MEMORANDUM

To: David E. Griffith, PE

From: Reneé Whittenberger, PE, RSP1 and Sela Jones, EIT

Date: January 30, 2025

Subject: Addendum to Report Recommendations

Overview

Upon providing a schematic plan of proposed countermeasures in the *TRU-SR 193-1.67 Roadway Segment Safety Improvement Study*, project team members met with stakeholders to gather feedback prior to the request of implementation funding. The following recommendations were provided in the report:

1. Install sidewalks and ADA compliant curb ramps where none presently exist.
2. Install high-visibility crosswalks, push buttons, and count-down pedestrian signals at each intersection in the study area.
3. Update traffic signals with reflective backplates, all-red time, and leading pedestrian intervals. Where capacity analyses deem appropriate, incorporate protected left turn phasing and lane assignment changes.
4. Install a median refuge island and pedestrian hybrid beacon (PHB) with a two-stage crossing at the right-in right-out entrance to Dunkin Donuts.
5. Install a rectangular rapid flashing beacon (RRFB) at the I-80 westbound slip lane.
6. Maintain functionality of existing streetlights and install additional lighting in accordance with the design standards outlined in the ODOT Transportation Engineering Manual (TEM).
7. Restrict existing access points to right-in right-out, where applicable.
8. Remove existing access points or reduce the width to limit exposure time for vulnerable road users, where applicable.
9. Replace the existing median between the I-80 overpass and the I-80 westbound ramp intersection, incorporating vertical elements such as trees and other vegetation to enhance traffic calming.

Receiving Feedback

On December 9, 2024, a virtual stakeholder meeting was held by the project team members. A variety of agencies were represented by meeting attendees, including Liberty Township, Trumbull County Engineer's Office, WRTA, Eastgate Regional Council of Governments, GPD Group, ODOT District 4, and Environmental Design Group.

Upon receiving input from members of the Township, the project team has created a revised plan of proposed countermeasures which is to be utilized for the request of implementation funding. These changes are clarified herein:

- Members of the Township expressed disinterest in providing sidewalk on the east side of SR 193 in proximity to the I-80 overpass, due to concern that the proposed infrastructure will encourage pedestrian activity near high-speed vehicles preparing to enter I-80. This includes the eastbound ramp south of the overpass and the slip lane which transitions into the westbound ramp north of the overpass. Presently,

the only amenity for pedestrians in this area is the *Belmont Avenue & Motor Inn Drive* WRTA bus stop. Stakeholders discussed their interest in moving this bus stop north of the westbound I-80 ramps in hopes of discouraging pedestrian traffic in the vicinity of high-speed vehicles preparing to enter I-80. This feedback has resulted in the removal of proposed sidewalk, crosswalks, and a rectangular rapid flashing beacon (RRFB) in this area. As a result, **the new sidewalk on the east side of SR 193 is now proposed to begin at Liberty Street and end at the entrance to the Baymont by Windham entrance.**

- Members of the Township expressed disinterest in removing access at the Speedway gas station across from the westbound I-80 ramps, due to the concern that incoming trucks will lose the ability to maneuver into the establishment. Also, the existing access point contains a median which facilitates right-in right-out movements. The project team agrees that this entrance can remain in its existing configuration. As a result, **access removal at the Speedway entrance is no longer proposed**.
- Members of ODOT District 4 expressed concern over the access management proposed for the restaurant property on the west side of SR 193 south of the I-80 overpass. Due to the multiple existing access points at the property, which increase exposure for crossing pedestrians, project team members recommended one shorter access point available at the north end of the lot. However, ODOT District 4 was concerned over the possibility of exiting patrons' ability to cross five lanes of traffic through the gap in the median in hopes of traveling northbound on SR 193 or entering the eastbound I-80 ramp. As a result, **the new access point of the restaurant property south of the I-80 overpass is now recommended for the south end of the lot, as this configuration utilizes the existing median to limit movements to right-in right-out only**.
- In the interest of maintenance and cost, **replacing the median** between the I-80 overpass and the I-80 westbound ramp intersection **was not preferred. The existing median will remain.**

Capacity Analysis

The three signalized intersections with Belmont Avenue – Liberty Street, I-80 westbound Ramp, and Churchill Road have been analyzed to determine the level of service and delay with the proposed improvements.

There is very little projected growth in the corridor. The annual growth rate is at 0.15%, which equates to approximately 4% between the existing and the 2047 design year . There is essentially no change between the existing and 2027 opening year. From a capacity standpoint there would be no difference between the Existing and 2027, therefore, the evaluations are the same. There is also very little difference between the Existing and 2047 and the results are very similar.

Capacity analysis was conducted with AM and PM traffic for:

- The Existing Condition with existing signal timings,
- The 2047 No-Build Condition with optimized signal timings, and
- The 2047 Build condition with optimized signal timings.

The Build Condition was updated based on Left Turn Phase Operation Guidelines, ODOT Traffic Engineering Manual Table 497-10. Considering the critical left turn crashes on the northbound and southbound approaches of

each intersection, design speeds, numbers of left/right/through lanes, and traffic volumes yielded recommendations for Protected Only, Protected-Permissive, or Permissive phasing. The southbound approach of SR 193 to the IR 80 Westbound ramps shows a Protected Only recommendation, while all other recommendations are either Protected-Permissive, or Permissive. Whereas the existing configurations are not Permissive, the proposed conditions will remain Protected-Permissive or Protected Only (in the case of the IR 80 WB ramps). A SWISS analysis on the existing support poles at the IR 80 WB ramps intersection shows the addition of two 3-spot heads and reduction of the 5-spot head to accommodate the Protected Only phasing is acceptable.

At Liberty Street, the eastbound lane use was changed from the existing shared left/through lane and right turn only lane to a left turn only lane and a shared through/right lane.

Existing Condition - The Existing Condition generally operates with LOS D or better at all three studied intersections. There are a few movements that operate at LOS E, but most of these have just crossed the theoretical threshold between LOS D and LOS E. Overall, the existing condition satisfies the capacity analysis goals of LOS D or better for the overall intersection and LOS E or better for the individual movements.

No-Build Condition - The No-Build Condition shows a very slight improvement to the Existing Condition. While there was a 4% increase in traffic volumes in the corridor, the signal timing optimization was able to capture a little improvement to offset the additional traffic. Overall, the results between the Existing and No-Build are very similar and all study intersections will achieve the operational goals of LOS D or better for the overall intersection and LOS E or better for the individual movements.

Build Condition - The analysis for the Build Condition shows an increase in delay at the study intersections, with the exception of Liberty Street. Generally, the addition of protected only left turn movements for the northbound and southbound approaches has increased the green time needed for these left turns and reduced the green time available for the remaining movements at the intersection. However, the increases in delay are expected to be just a few seconds per movement and the intersections in the Build Condition will still meet the operational goals of LOS D or better for the overall intersection and no movements worse than LOS E. At the Liberty Street intersection, the change in lane use for the eastbound approach had a benefit to the overall intersection. Even with the protected only left turn movements, the overall intersection delay was reduced. This improvement was achieved through a better distribution of traffic volumes on the eastbound approach. In the existing condition there are 320 left turning and nearly 100 through vehicles sharing a single lane with 240 right turning vehicles in the second lane. In the Build Condition, these volumes are changed so that there are 320 left turning vehicles in the left lane and 100 through/240 right turning vehicles in the second lane. This change creates a more balanced lane use for the approach. In addition, eastbound left turning vehicles in the Existing Condition that need to yield to oncoming traffic cause all eastbound through vehicles to stop and wait which adds additional delay.

Overall, the Build Condition will satisfy the operational requirements for the study intersections in the corridor. The addition of northbound and southbound protected only left turns will not have a significant impact on the operation of the intersections. In addition, it is recommended that the lane use for the eastbound approach at the Liberty Street intersection be converted to a left turn only lane and a shared through/right lane.

Note that existing and proposed signal timings include all red time. Leading Pedestrian Intervals can be executed when actuated by the pedestrian push buttons and will only add an additional three seconds of delay when used.

Attached to this document are the capacity analyses output and summary tables.

Conclusions

The project team believes that the recommended countermeasures will enhance roadway safety for all road users. These improvements are estimated to cost approximately $929,930. A breakdown of this cost opinion, as well as figures depicting the recommended improvements, are to be attached to this addendum.

APPENDICES

Proposed Safety Improvements

Traffic Engineering Manual Table 497-10 Recommendations

SWISS Analysis for IR 80 Signal Supports

Cost Estimates

- North Walk with Mid-Block Crossing Perni Lane to Hampton Inn
- South Walk E Liberty to I-80 EB On-ramp

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS
- PHASE 2 DESIGN PLANS
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- DESIGN PLAN NOTES

BELMONT AVE (SR 193)

E LIBERTY ST

I-80 EB

I-80 EB ON RAMP

PROPOSED ACCESS REMOVAL & REDESIGN

SIGNAL IMPROVEMENTS SUCH AS REFLECTIVE BACKPLATES, ALL-RED TIME, PROTECTED LEFT TURNS, LEADING PEDESTRIAN INTERVALS, AND EVALUATION OF LANE ASSIGNMENTS; NEW PEDESTRIAN PUSH BUTTONS AND SIGNAL HEADS TO BE INSTALLED ON NEW PEDESTALS

CONSIDER SIGNAGE AND/OR LANDSCAPING TO ENCOURAGE USE OF PEDESTRIAN INFRASTRUCTURE AT LIBERTY STREET INTERSECTION

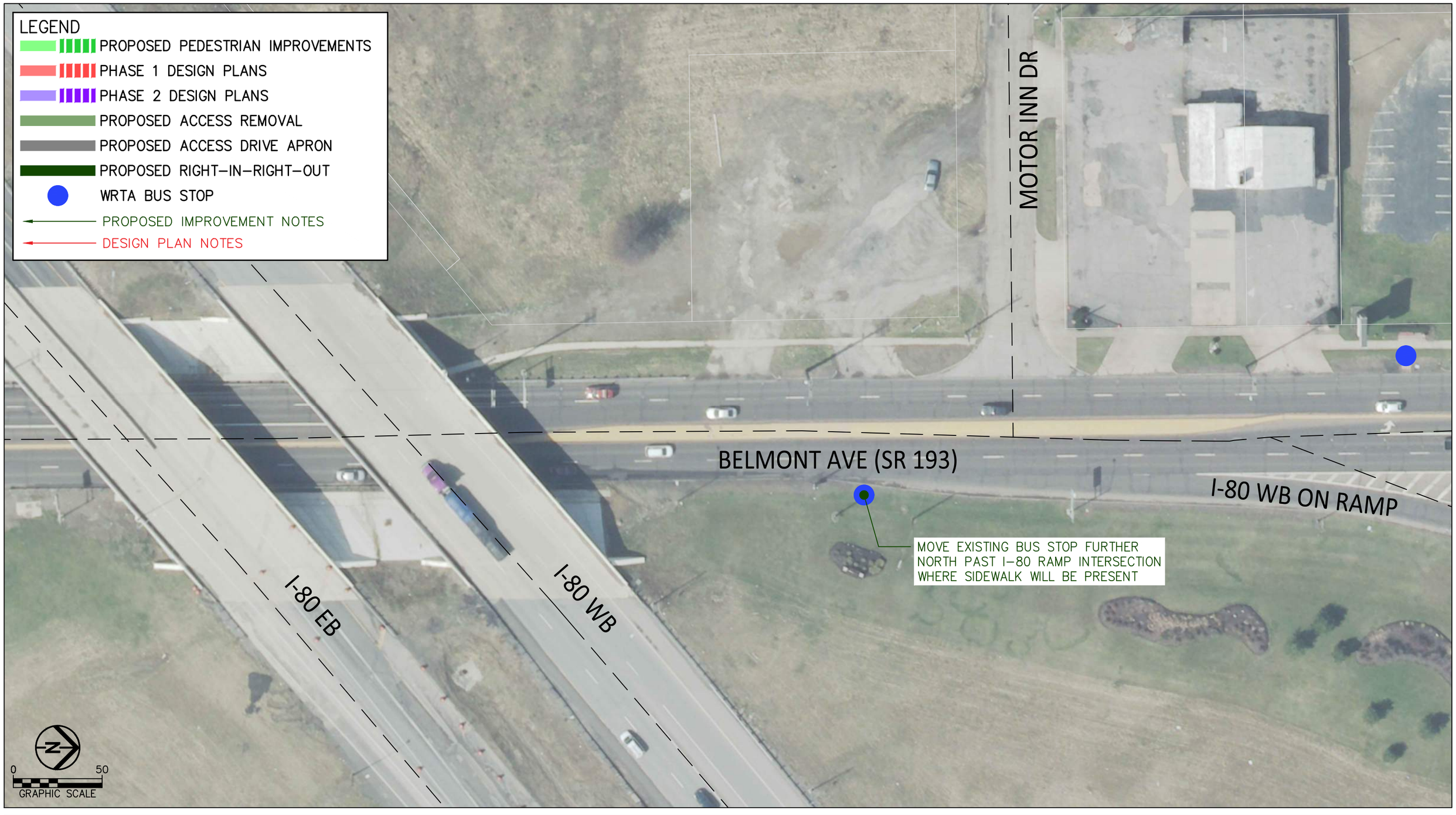
0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193\80WB RAMPS TO SR306\CADD\ZPLAN 21-00314-010 ADDENDUM.DWG - 1/29/2025 8:09:46 AM



Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\DOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CAD\DZPLAN 21-00314-010 ADDENDUM.DWG - 1/29/2025 8:09:57 AM

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS
- PHASE 2 DESIGN PLANS
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- DESIGN PLAN NOTES

SIGNAL IMPROVEMENTS SUCH AS ALL-RED TIME, PROTECTED LEFT TURNS, AND LEADING PEDESTRIAN INTERVALS
NEW PEDESTRIAN PUSH BUTTONS AND SIGNAL HEADS TO BE INSTALLED ON NEW PEDESTALS

BELMONT AVE (SR 193)

PROPOSED RELOCATED BUS STOP

I-80 WB ON RAMP

I-80 WB OFF RAMP

PERNI LN

N

0 50
GRAPHIC SCALE

E:\ODOT\21-0031-4-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80 WB RAMPS TO SR306\CADD\ZPLAN 21-0031-4-010 ADDENDUM.DWG - 1/29/2025 8:10:06 AM

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS
- PHASE 2 DESIGN PLANS
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- DESIGN PLAN NOTES

PROPOSED ACCESS REMOVAL & REDESIGN

PROPOSED TRAFFIC CALMING MEDIAN

BELMONT AVE (SR 193)

PROPOSED TWO-STAGE CROSSING WITH PEDESTRIAN HYBRID BEACON

PROPOSED ACCESS REMOVAL

PERNI LN

0 50

GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\ZPLAN 21-00314-010 ADDENDUM.DWG - 1/29/2025 8:10:16 AM

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS
- PHASE 2 DESIGN PLANS
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- DESIGN PLAN NOTES

CHURCHILL RD (SR 304)

NEW 5 FOOT WIDE SIDEWALK AND IMPROVED LIGHTING TO BE CONSTRUCTED ALONG THE WEST SIDE OF SR 193 BEGINNING AT SR 304 TO THE GIANT EAGLE NORTHERN ENTRANCE VIA PID 116846 (PHASE 2); FY 2026

SIGNAL IMPROVEMENTS SUCH AS REFLECTIVE BACKPLATES, ALL-RED TIME, PROTECTED LEFT TURNS, AND LEADING PEDESTRIAN INTERVALS NEW PEDESTRIAN PUSH BUTTONS AND SIGNAL HEADS TO BE INSTALLED ON NEW PEDESTALS

BELMONT AVE (SR 193)

PROPOSED RIGHT-IN RIGHT-OUT

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\ZPLAN 21-00314-010 ADDENDUM.DWG - 1/29/2025 8:10:26 AM

INTERSECTION	APPROACH	AM PEAK 110s Cycle Length			PM PEAK 120s Cycle Length		
		LOS	DELAY	QUEUE	LOS	DELAY	QUEUE
EXISTING CONDITION (EXISTING TIMINGS)							
SR 193 & SR 304 (Churchill Rd) (Signalized)	EB Left	B	19.8	23'	C	28.2	43'
	EB Through/Right	C	29.4	152'	D	42.0	195'
	Eastbound	**C**	**27.4**	--	**D**	**38.5**	--
	WB Left	D	36.3	227'	D	37.1	196'
	WB Through/Right	C	20.9	68'	C	25.3	89'
	Westbound	**C**	**29.1**	--	**C**	**30.9**	--
	NB Left	C	32.2	65'	D	47.7	159'
	NB Through	C	33.7	134'	D	38.0	168'
	NB Right	D	35.3	158'	D	42.1	220'
	Northbound	**C**	**34.1**	--	**D**	**41.0**	--
	SB Left	C	24.2	62'	E	65.7	247'
	SB Through	C	24.8	129'	C	28.2	191'
	SB Right	A	9.2	0'	B	13.4	13'
	Southbound	**C**	**23.6**	--	**D**	**36.0**	--
	Intersection Total	**C**	**28.9**	--	**D**	**37.0**	--
NO-BUILD CONDITION (OPTIMIZED TIMINGS)							
SR 193 & SR 304 (Churchill Rd) (Signalized)	EB Left	C	21.6	26'	C	34.1	49'
	EB Through/Right	C	31.1	172'	D	48.2	248'
	Eastbound	**C**	**29.2**	--	**D**	**44.6**	--
	WB Left	D	38.5	256'	E	55.5	293'
	WB Through/Right	C	20.4	77'	C	28.8	112'
	Westbound	**C**	**30.1**	--	**D**	**41.4**	--
	NB Left	B	16.7	25'	B	18.4	68'
	NB Through	C	22.1	69'	C	27.5	159'
	NB Right	B	12.9	56'	C	25.9	179'
	Northbound	**B**	**18.6**	--	**C**	**25.4**	--
	SB Left	C	29.1	71'	D	35.8	145'
	SB Through	C	26.4	140'	C	29.3	201'
	SB Right	B	10.3	1'	B	15.1	13'
	Southbound	**C**	**25.9**	--	**C**	**29.4**	--
	Intersection Total	**C**	**25.2**	--	**C**	**32.3**	--
BUILD CONDITION (NB/SB PROTECTED ONLY LEFT, OPTIMIZED TIMINGS)							
SR 193 & SR 304 (Churchill Rd) (Signalized)	EB Left	C	22.0	25'	C	27.1	44'
	EB Through/Right	C	32.5	164'	D	39.0	195'
	Eastbound	**C**	**30.3**	--	**D**	**36.0**	--
	WB Left	D	36.8	234'	D	43.1	228'
	WB Through/Right	C	21.5	69'	C	27.8	120'
	Westbound	**C**	**29.7**	--	**D**	**35.1**	--
	NB Left	D	43.8	73'	E	67.1	180'
	NB Through	C	25.8	123'	B	19.2	107'
	NB Right	C	29.8	166'	B	18.9	131'
	Northbound	**C**	**28.8**	--	**C**	**27.3**	--
	SB Left	D	50.7	111'	D	50.7	184'
	SB Through	C	26.1	133'	C	29.3	201'
	SB Right	A	8.7	3'	B	15.4	14'

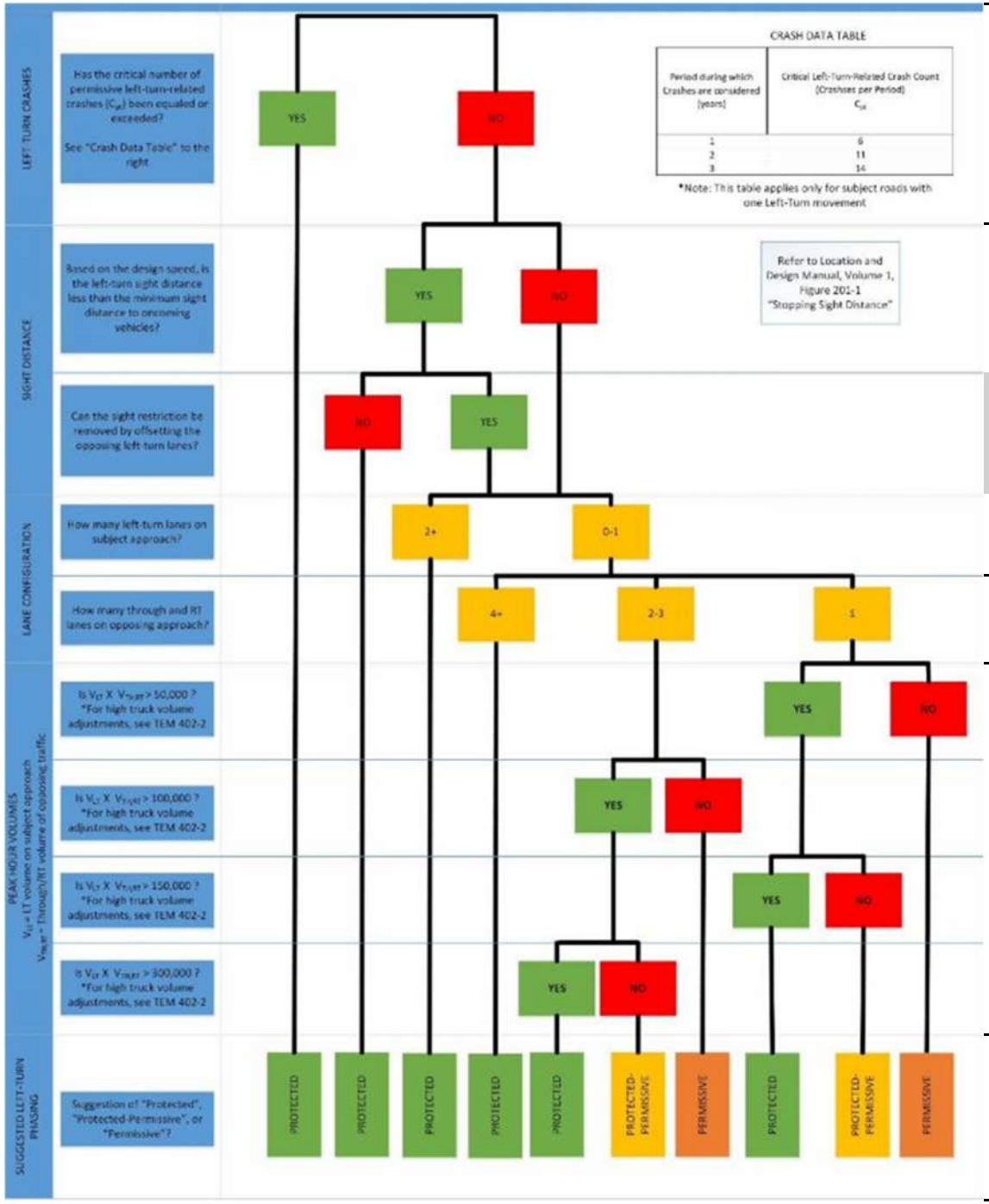
	Southbound	**C**	**29.9**	--	**C**	**33.3**	--
	Intersection Total	**C**	**29.6**	--	**C**	**31.9**	--
INTERSECTION	**APPROACH**	**AM PEAK 110s Cycle Length**			**PM PEAK 120s Cycle Length**		
		LOS	**DELAY**	**QUEUE**	**LOS**	**DELAY**	**QUEUE**
EXISTING CONDITION (EXISTING TIMINGS)							
SR 193 & WB I-80 Ramps (Signalized)	EB Left	D	36.1	53’	D	45.9	50’
	EB Through/Right	C	29.7	94’	C	30.7	64’
	Eastbound	**C**	**32.0**	--	**D**	**36.2**	--
	WB Left/TH/Right	D	44.1	152’	E	67.6	235’
	Westbound	**D**	**44.1**	--	**E**	**67.6**	--
	NB Left	B	18.8	44’	B	17.7	38’
	NB Through	B	16.5	136’	B	18.7	230’
	NB Right	A	0.4	0’	A	0.8	0’
	Northbound	**B**	**13.8**	--	**B**	**15.4**	--
	SB Left	B	11.9	82’	B	17.3	108’
	SB Through/Right	A	7.3	68’	A	6.0	65’
	Southbound	**A**	**8.8**	--	**A**	**9.4**	--
	Intersection Total	**B**	**15.8**	--	**B**	**18.1**	--
NO-BUILD CONDITION (OPTIMIZED TIMINGS)							
SR 193 & WB I-80 Ramps (Signalized)	EB Left	C	33.5	50’	D	41.2	48’
	EB Through/Right	C	27.9	90’	C	28.8	68’
	Eastbound	**C**	**29.9**	--	**C**	**33.2**	--
	WB Left/TH/Right	D	37.4	130’	D	41.8	159’
	Westbound	**D**	**37.4**	--	**D**	**41.8**	--
	NB Left	B	10.3	21’	B	12.5	16’
	NB Through	B	14.9	120’	B	17.5	257’
	NB Right	A	0.5	0’	A	2.5	12’
	Northbound	**B**	**11.8**	--	**B**	**14.5**	--
	SB Left	B	11.5	96’	B	12.4	81’
	SB Through/Right	B	14.3	154’	B	11.3	147’
	Southbound	**B**	**13.3**	--	**B**	**11.6**	--
	Intersection Total	**B**	**16.4**	--	**B**	**16.5**	--
BUILD CONDITION (NB/SB PROTECTED ONLY LEFT, OPTIMIZED TIMINGS)							
SR 193 & WB I-80 Ramps (Signalized)	EB Left	C	34.7	52’	D	40.0	48’
	EB Through/Right	C	28.8	94’	C	31.6	68’
	Eastbound	**C**	**30.9**	--	**C**	**34.7**	--
	WB Left/TH/Right	D	39.2	120’	D	43.5	163’
	Westbound	**D**	**39.2**	--	**D**	**43.5**	--
	NB Left	E	55.3	86’	D	47.1	72’
	NB Through	B	18.7	125’	B	19.4	206’
	NB Right	A	0.4	0’	A	0.5	4’
	Northbound	**B**	**18.9**	--	**B**	**17.7**	--
	SB Left	D	46.8	215’	D	35.7	104’
	SB Through/Right	A	8.2	78’	A	9.5	117’
	Southbound	**C**	**20.7**	--	**B**	**17.4**	--
	Intersection Total	**C**	**22.6**	--	**C**	**20.5**	--

INTERSECTION	APPROACH	AM PEAK 110s Cycle Length			PM PEAK 120s Cycle Length		
		LOS	DELAY	QUEUE	LOS	DELAY	QUEUE
EXISTING CONDITION (EXISTING TIMINGS)							
SR 193 & Liberty Street (Signalized)	EB Left/Through	D	41.2	290’	E	61.4	392’
	EB Right	A	7.0	43’	A	8.8	57’
	Eastbound	**C**	**28.7**	--	**D**	**41.5**	--
	WB Left	B	18.4	20’	C	23.8	57’
	WB Through/Right	B	15.0	42’	C	22.5	74’
	Westbound	**B**	**16.1**	--	**C**	**23.1**	--
	NB Left	D	41.2	71’	D	39.4	109’
	NB Through/Right	E	55.1	243’	D	51.4	397’
	Northbound	**D**	**53.4**	--	**D**	**49.9**	--
	SB Left	B	13.6	15’	C	32.0	54’
	SB Through/Right	B	17.8	110’	C	19.2	123’
	Southbound	**B**	**17.5**	--	**C**	**20.7**	--
	Intersection Total	**C**	**31.0**	--	**D**	**38.0**	--
NO-BUILD CONDITION (OPTIMIZED TIMINGS)							
SR 193 & Liberty Street (Signalized)	EB Left/Through	D	44.0	336’	E	64.5	410’
	EB Right	A	6.7	54’	A	8.6	57’
	Eastbound	**C**	**30.5**	--	**D**	**43.3**	--
	WB Left	B	18.8	24’	C	26.9	63’
	WB Through/Right	B	14.7	48’	C	25.2	77’
	Westbound	**B**	**16.0**	--	**C**	**25.9**	--
	NB Left	B	18.8	44’	C	23.9	78’
	NB Through/Right	A	8.4	51’	C	30.1	300’
	Northbound	**A**	**9.7**	--	**C**	**29.3**	--
	SB Left	B	19.6	17’	C	24.1	54’
	SB Through/Right	C	31.3	208’	C	30.9	245’
	Southbound	**C**	**30.6**	--	**C**	**30.1**	--
	Intersection Total	**C**	**23.5**	--	**C**	**32.6**	--
BUILD CONDITION (NB/SB PROTECTED ONLY LEFT, EB LEFT AND TH/RT, OPTIMIZED TIMINGS)							
SR 193 & Liberty Street (Signalized)	EB Left	C	28.7	186’	D	36.5	209’
	EB Through/Right	C	24.6	170’	C	30.2	214’
	Eastbound	**C**	**26.8**	--	**C**	**33.2**	--
	WB Left	C	23.9	28’	C	34.7	81’
	WB Through/Right	C	20.9	58’	C	27.9	90’
	Westbound	**C**	**21.9**	--	**C**	**30.8**	--
	NB Left	B	16.1	78’	D	53.1	138’
	NB Through/Right	B	15.8	132’	C	23.7	242’
	Northbound	**B**	**19.5**	--	**C**	**27.4**	--
	SB Left	D	47.5	44’	E	62.0	95’
	SB Through/Right	C	26.5	188’	B	16.6	124’
	Southbound	**C**	**27.6**	--	**C**	**22.1**	--
	Intersection Total	**C**	**24.6**	--	**C**	**27.7**	--

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 AM] EXISTING CONDITIONS - [NORTH]BOUND (SR 193 at Liberty St)



DATA:

# of years:	3
C_{PT}:	1
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	80	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	530		

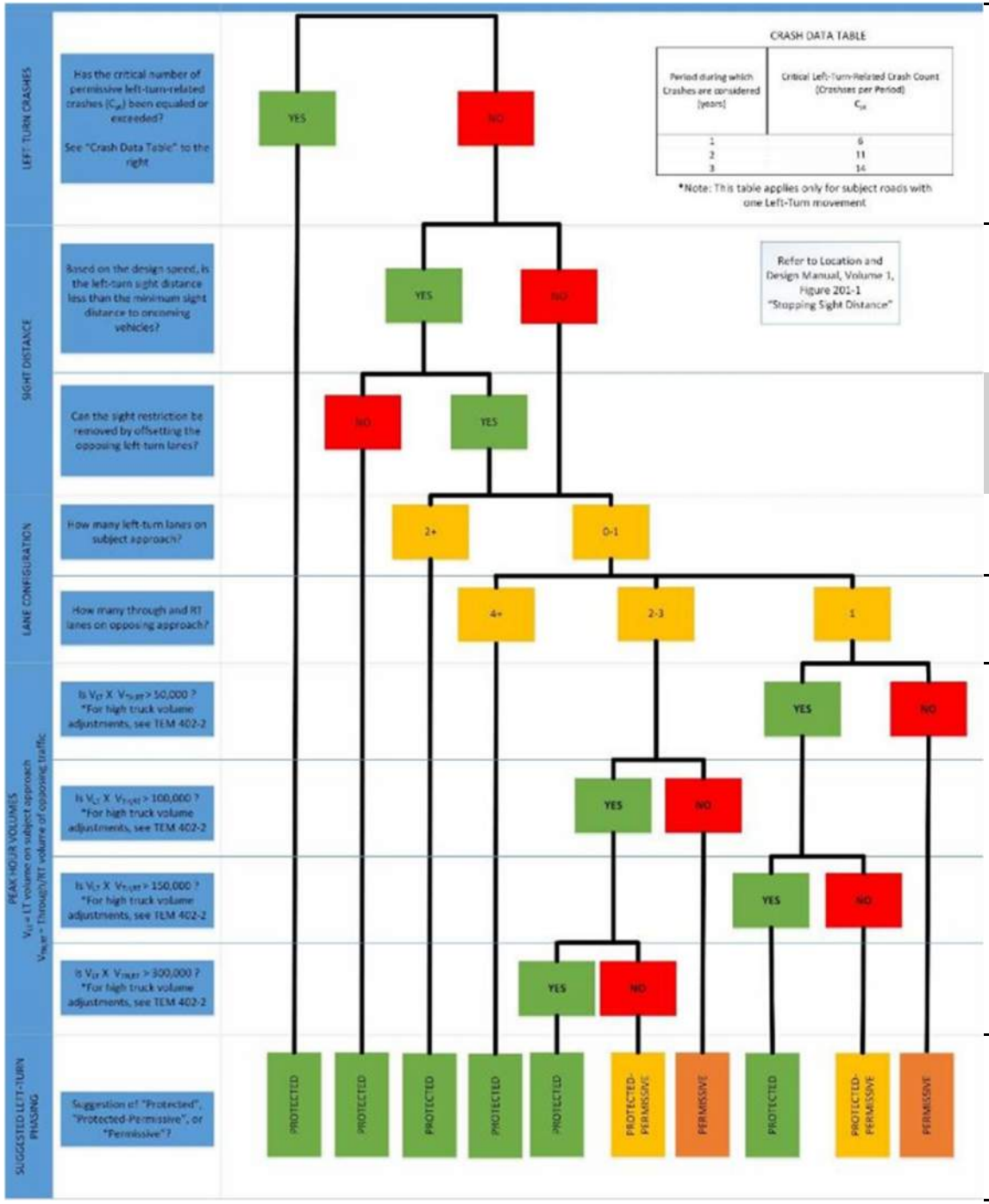
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 PM] EXISTING CONDITIONS - [NORTH]BOUND (SR 193 at Liberty St)



DATA:

# of years:	3
C_{PT}:	1
RESULT:	No

DATA:

*Design Speed:	45	
SSD:	360	Left-turn Sight Distance: 500
RESULT:	NO	

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	140
$V_{TH,RT}$:	650

Is V_{LT} x $V_{TH,RT}$ > 100,000? NO

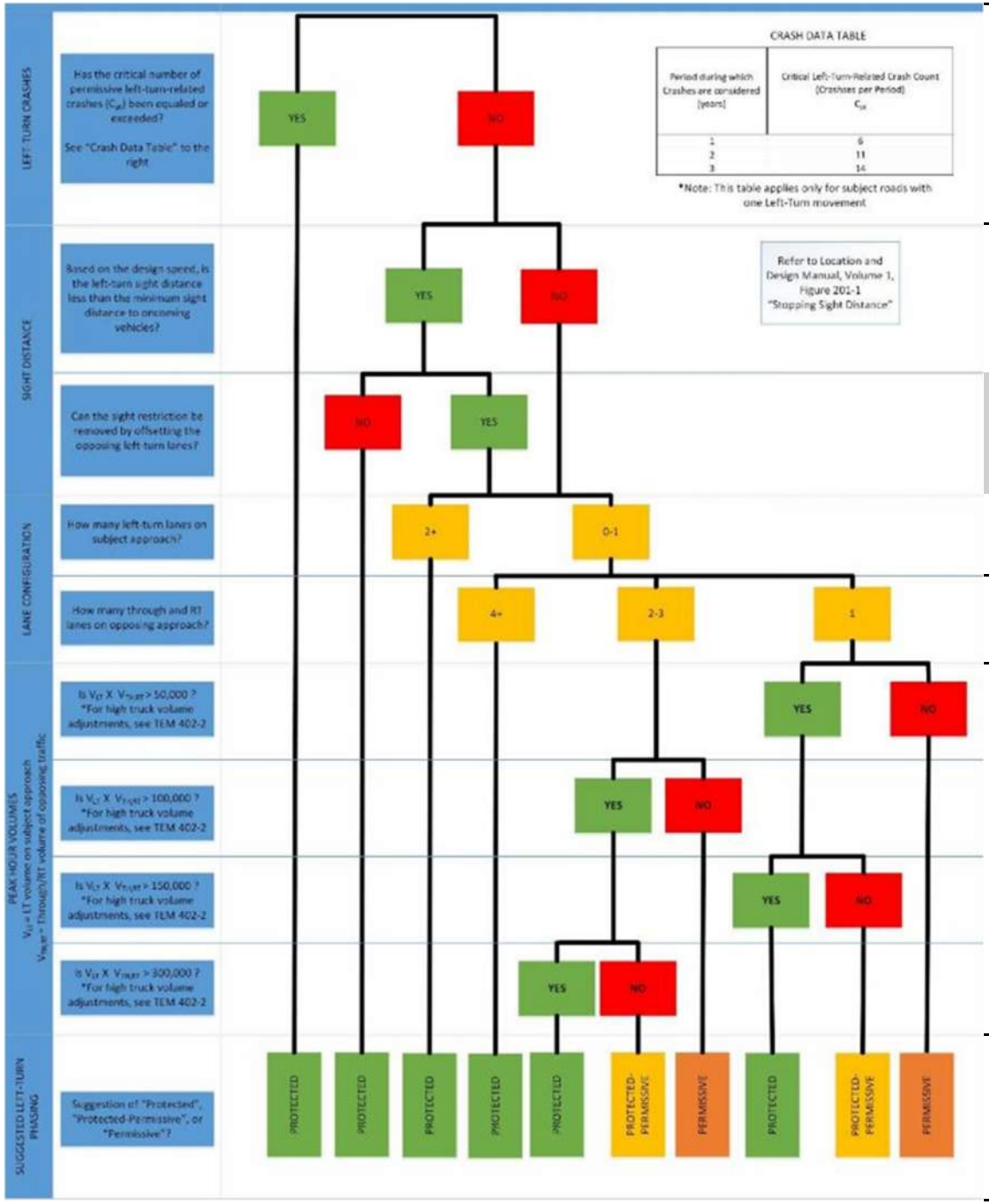
Suggested LT phasing: **PERMISSIVE**

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 AM] EXISTING CONDITIONS - [SOUTH]BOUND (SR 193 at Liberty St)



DATA:

# of years:	3
C_{PT}:	2
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1

# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	30	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	560		

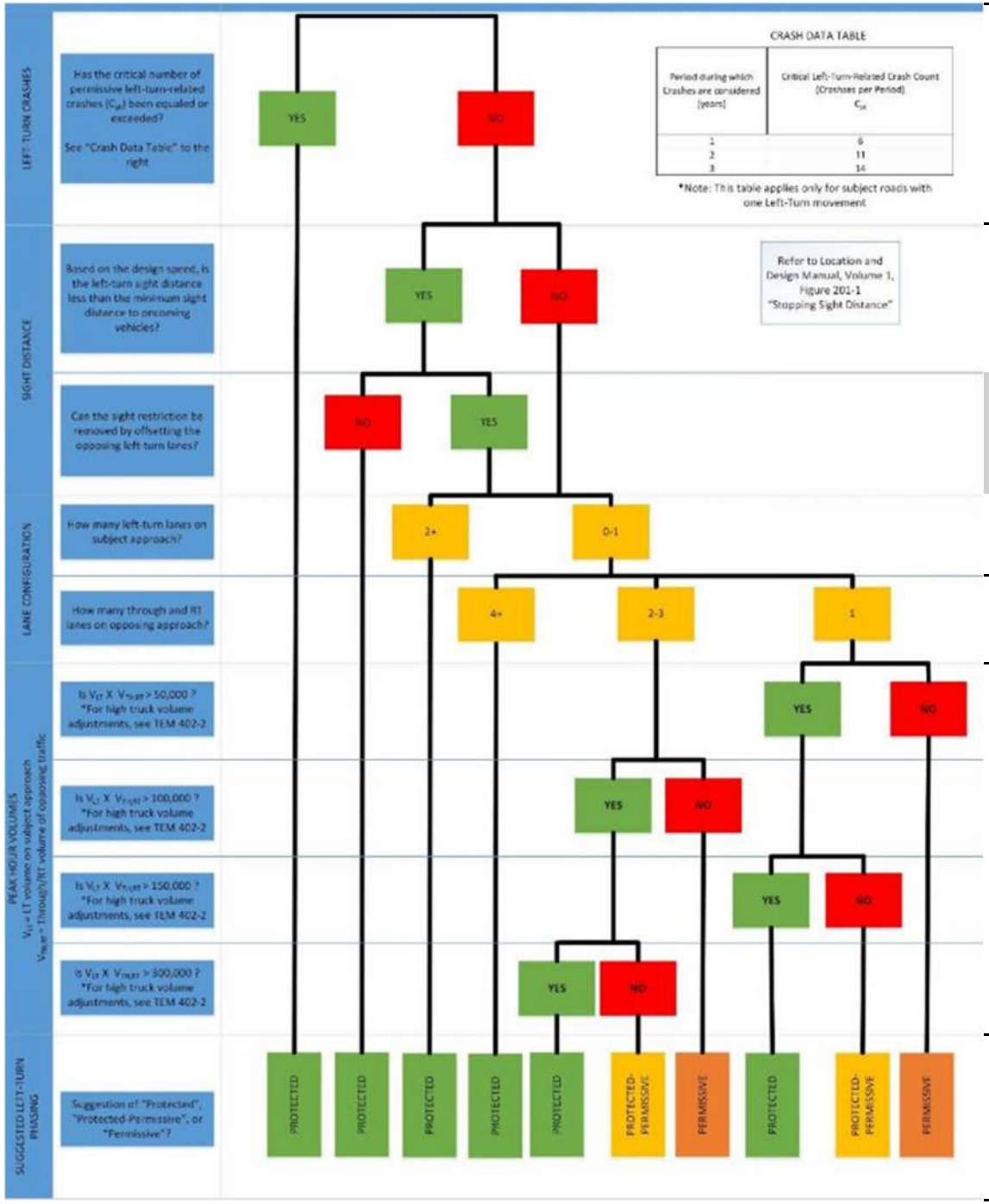
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 PM] EXISTING CONDITIONS - [SOUTH]BOUND (SR 193 at Liberty St)



DATA:

# of years:	3
C_{PT}:	2
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	40	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	980		

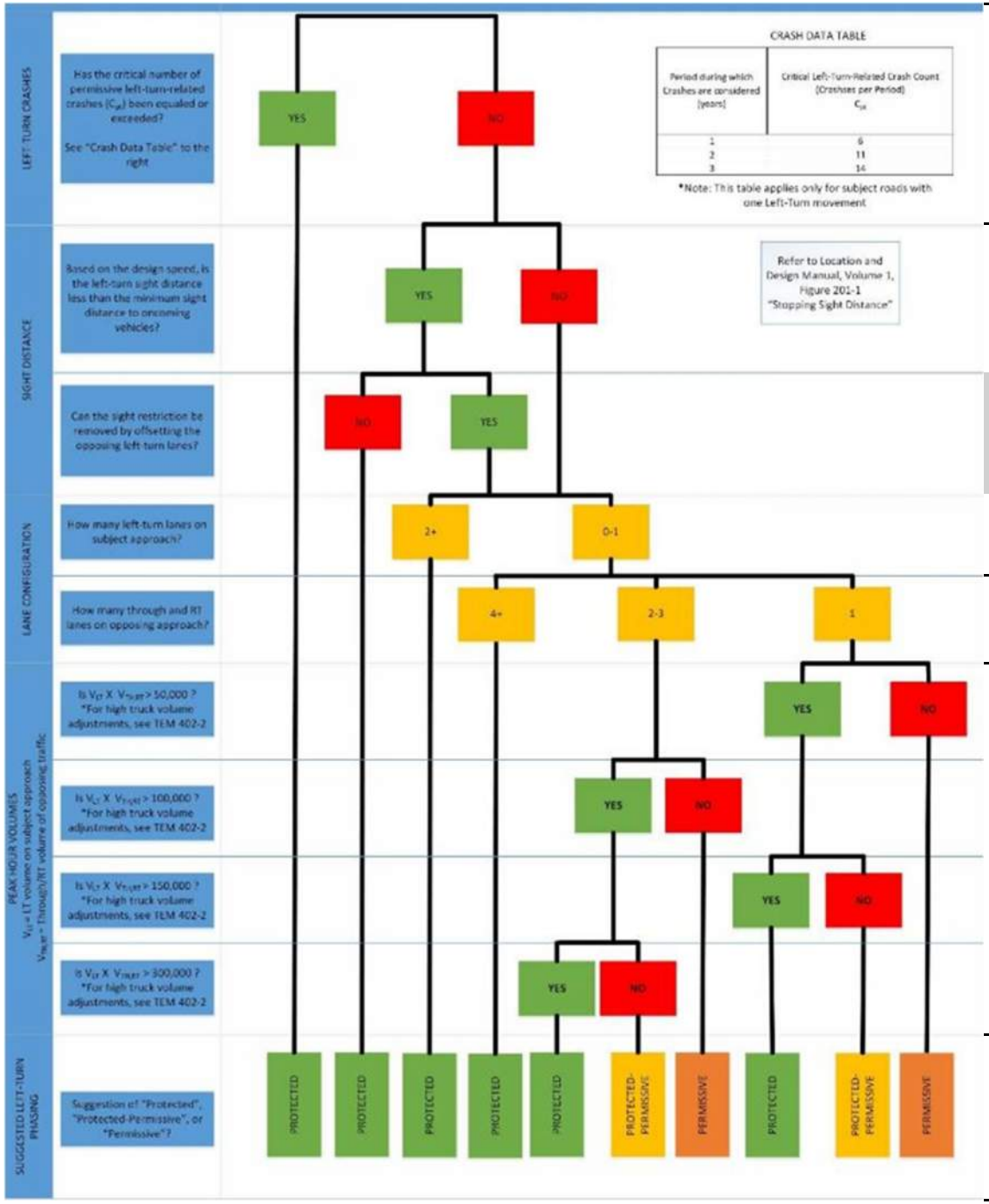
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 AM] EXISTING CONDITIONS - [NORTH]BOUND (SR 193 at IR 80 WB RAMPS)



DATA:

# of years:	3
C_{PT}:	2
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	80	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	480		

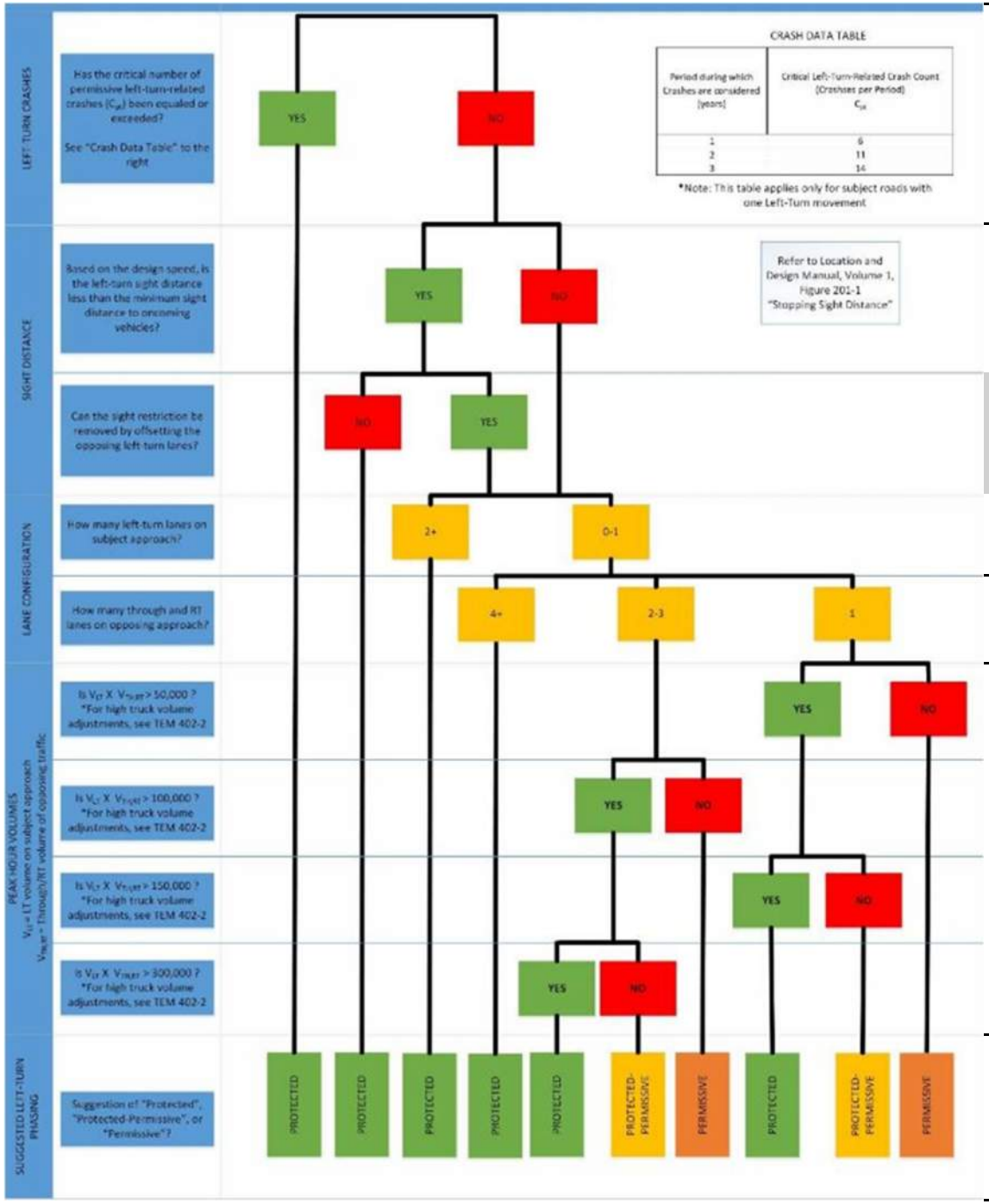
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 PM] EXISTING CONDITIONS - [NORTH]BOUND (SR 193 at IR 80 WB RAMPS)



DATA:

# of years:	3
C_{PT}:	2
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	60	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	590		

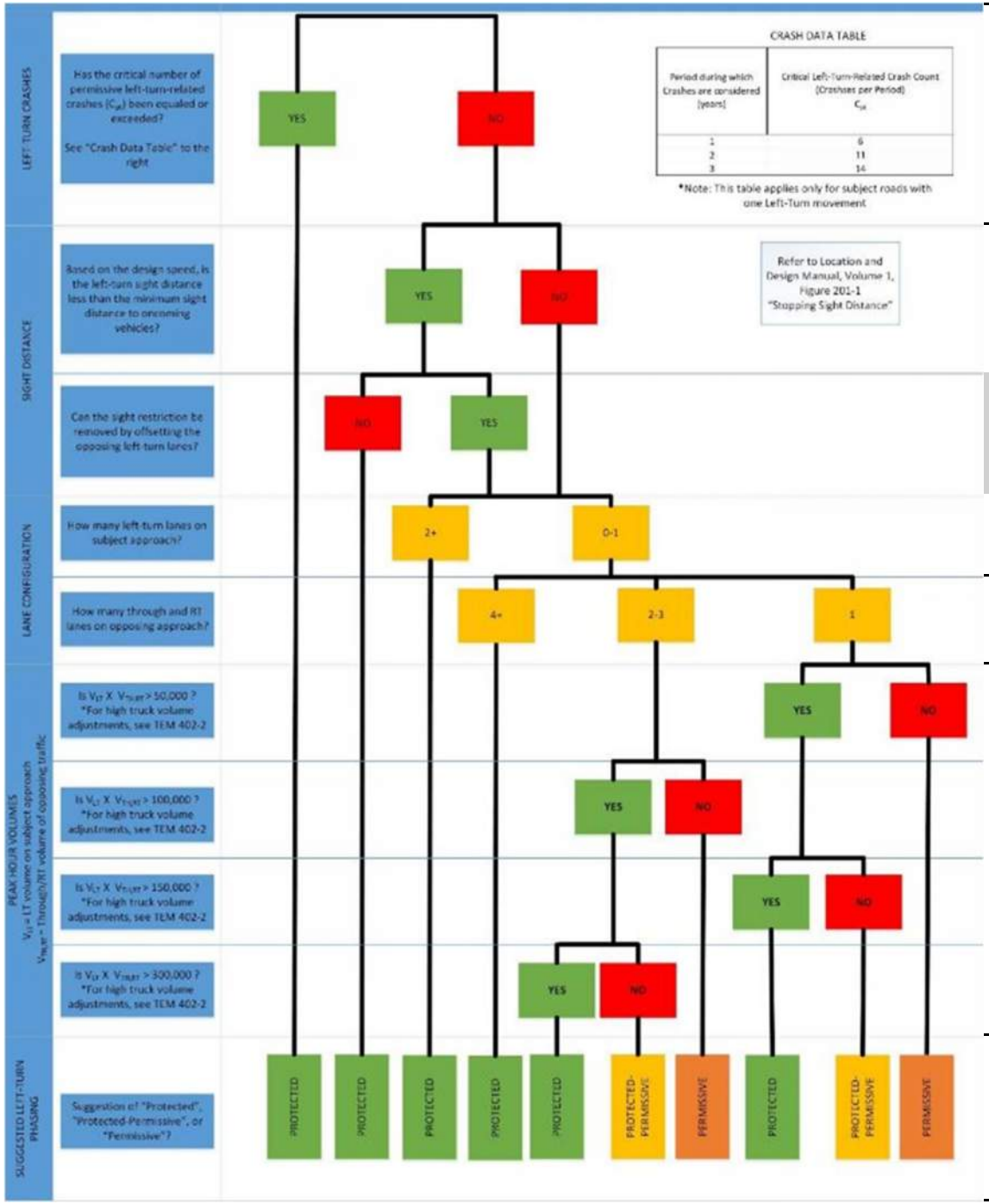
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 AM] EXISTING CONDITIONS - [SOUTH]BOUND (SR 193 at IR 80 WB RAMPS)



DATA:

# of years:	3
C_{PT}:	4
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	290	Is V_{LT} x $V_{TH,RT}$ > 100,000?	YES
$V_{TH,RT}$:	560	Is V_{LT} x $V_{TH,RT}$ > 300,000?	NO

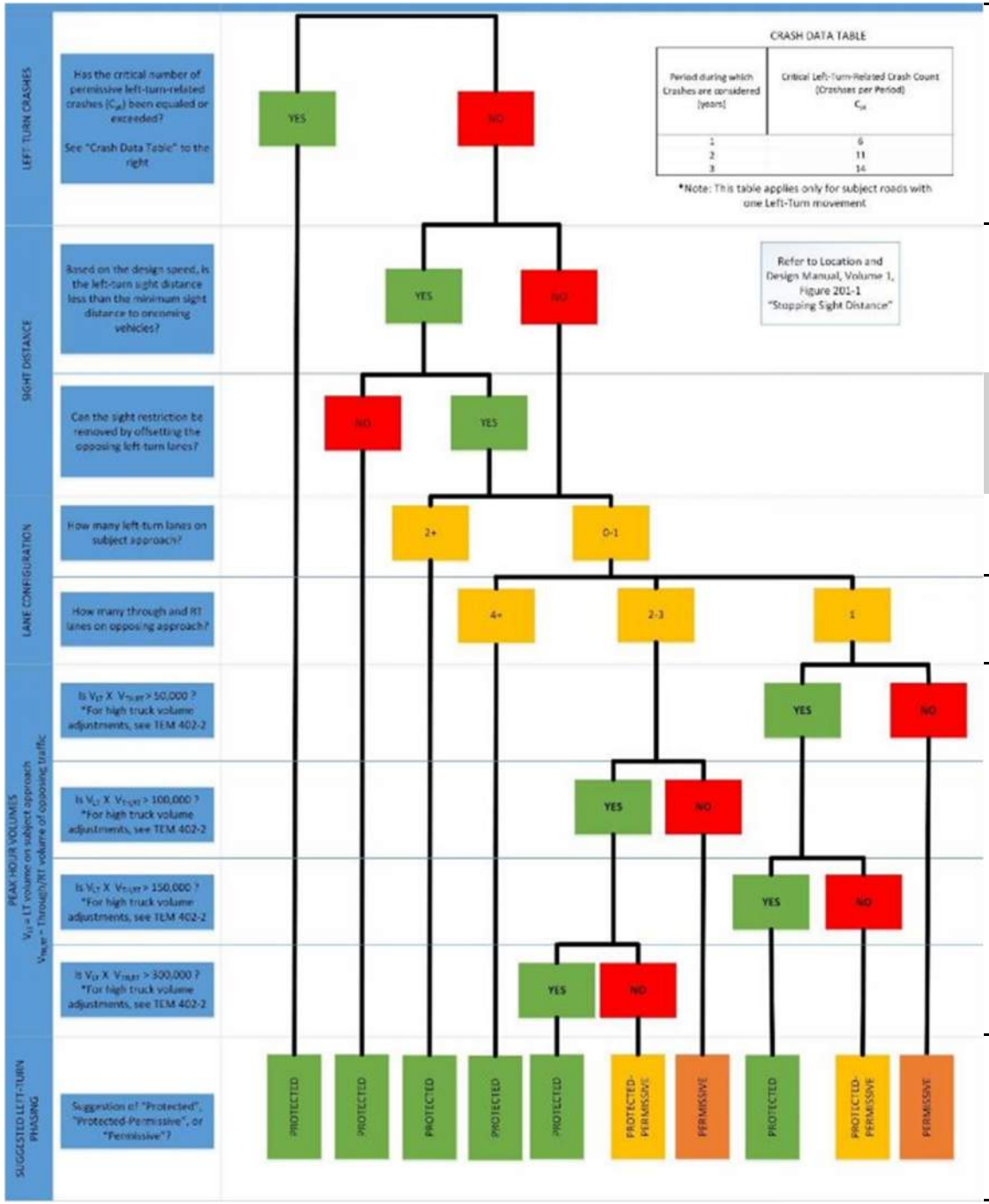
Suggested LT phasing:	PROTECTED-PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 PM] EXISTING CONDITIONS - [SOUTH]BOUND (SR 193 at IR 80 WB RAMPS)



DATA:

# of years:	3
C_{PT}:	4
RESULT:	No

DATA:

*Design Speed:	45
SSD:	360
RESULT:	NO

Left-turn Sight Distance: 500

# of LT lanes? 0-1

# of oppos. THRU and RT lanes? 2-3

DATA:

V_{LT}:	340
$V_{TH,RT}$:	880

Is V_{LT} x $V_{TH,RT}$ > 100,000? YES

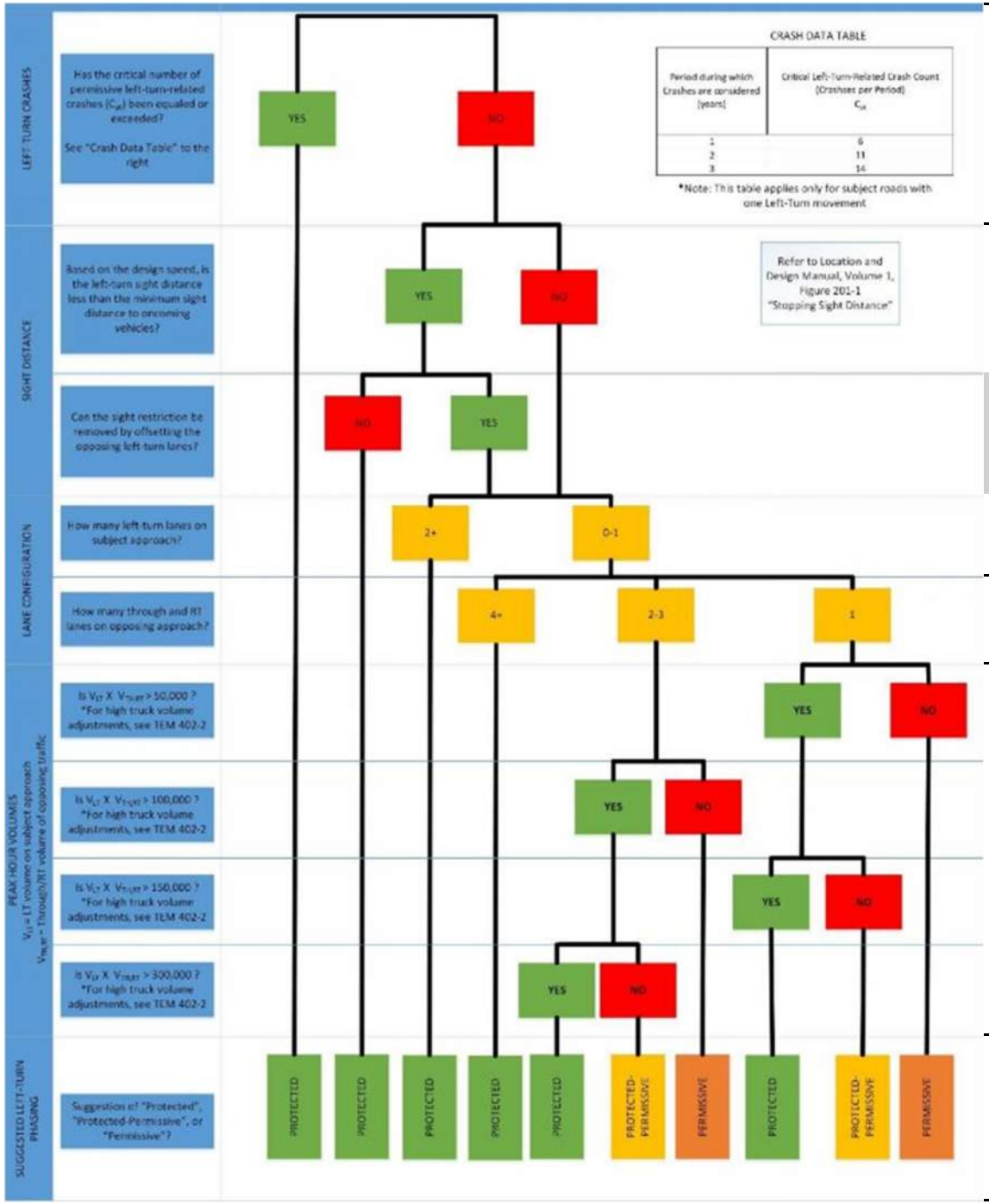
Is V_{LT} x $V_{TH,RT}$ > 300,000? NO

Suggested LT phasing: **PROTECTED-PERMISSIVE**

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

[2028 PM] OPENING YEAR CONDITIONS - [SOUTH]BOUND (SR 193 at IR 80 WB RAMPS)



DATA:

# of years:	3
C_{PT}:	4
RESULT:	No

DATA:

*Design Speed:	45
SSD:	360
RESULT:	NO

Left-turn Sight Distance: 500

# of LT lanes? 0-1

# of oppos. THRU and RT lanes? 2-3

DATA:

V_{LT}:	340
$V_{TH,RT}$:	900

Is V_{LT} x $V_{TH,RT}$ > 100,000? YES

Is V_{LT} x $V_{TH,RT}$ > 300,000? YES

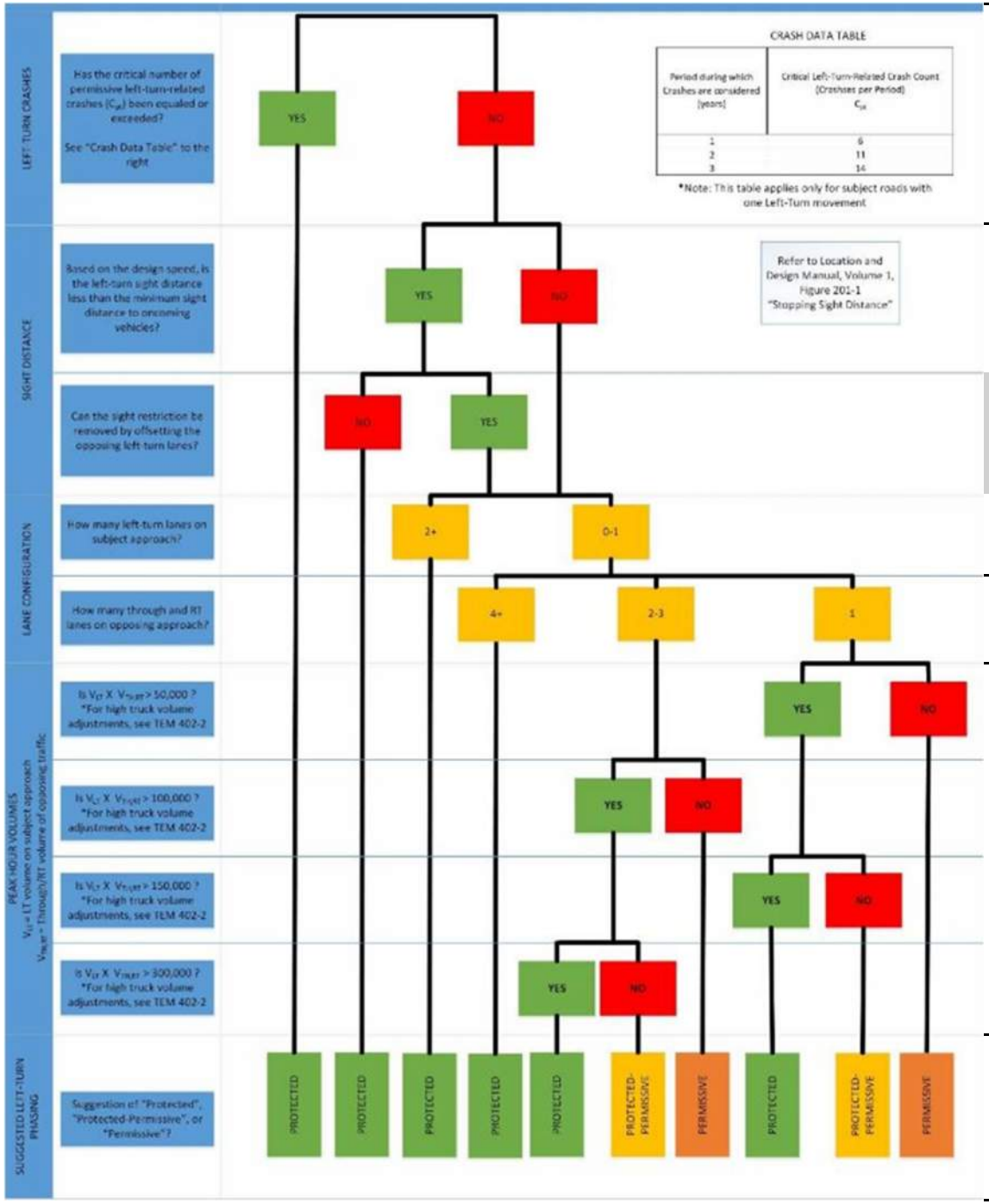
Suggested LT phasing: PROTECTED

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 AM] EXISTING CONDITIONS - [NORTH]BOUND (SR 193 at SR 304)



DATA:

# of years:	3
C_{PT}:	4
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	60	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	330		

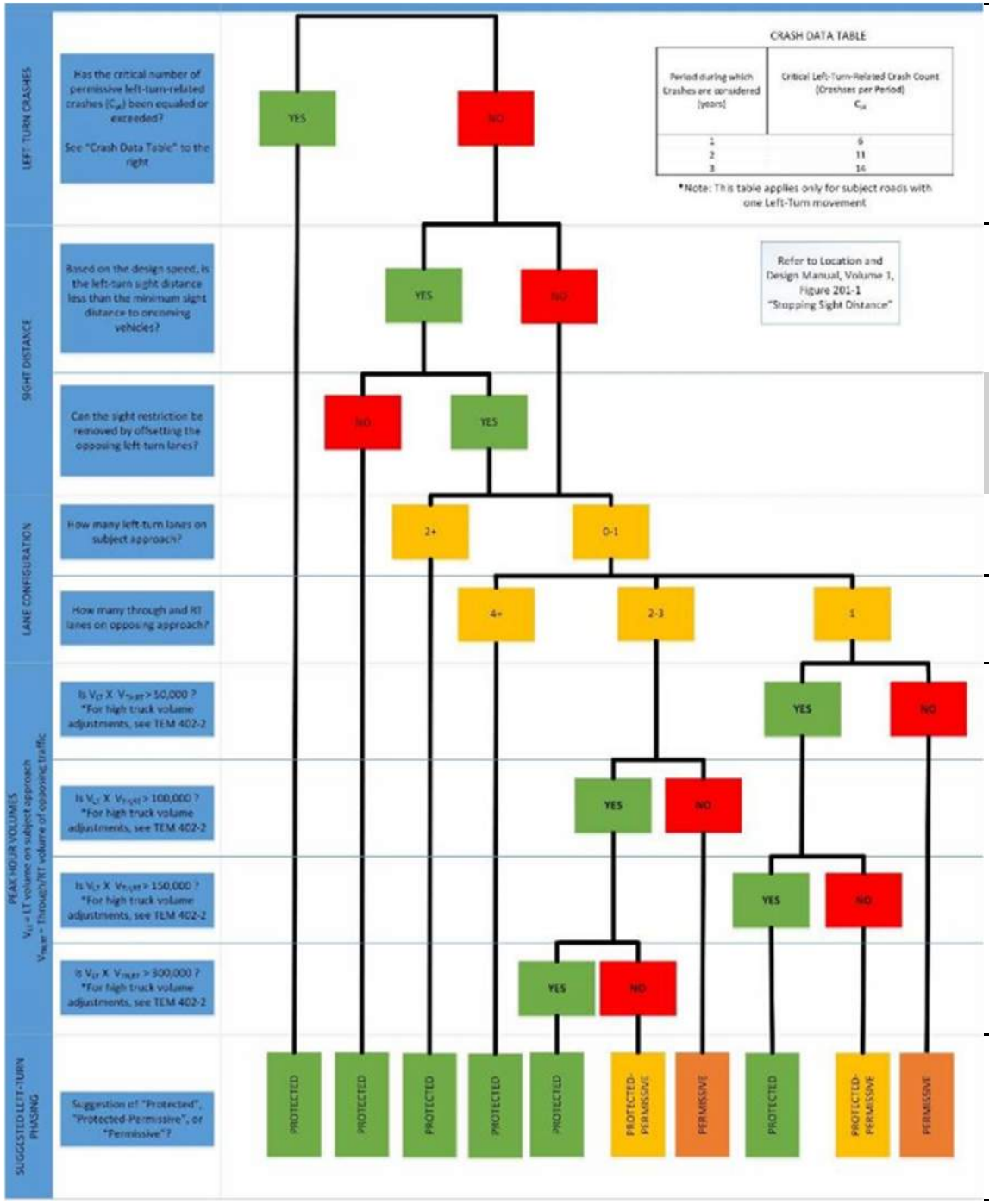
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 PM] EXISTING CONDITIONS - [NORTH]BOUND (SR 193 at SR 304)



DATA:

# of years:	3
C_{PT}:	4
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	160	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	610		

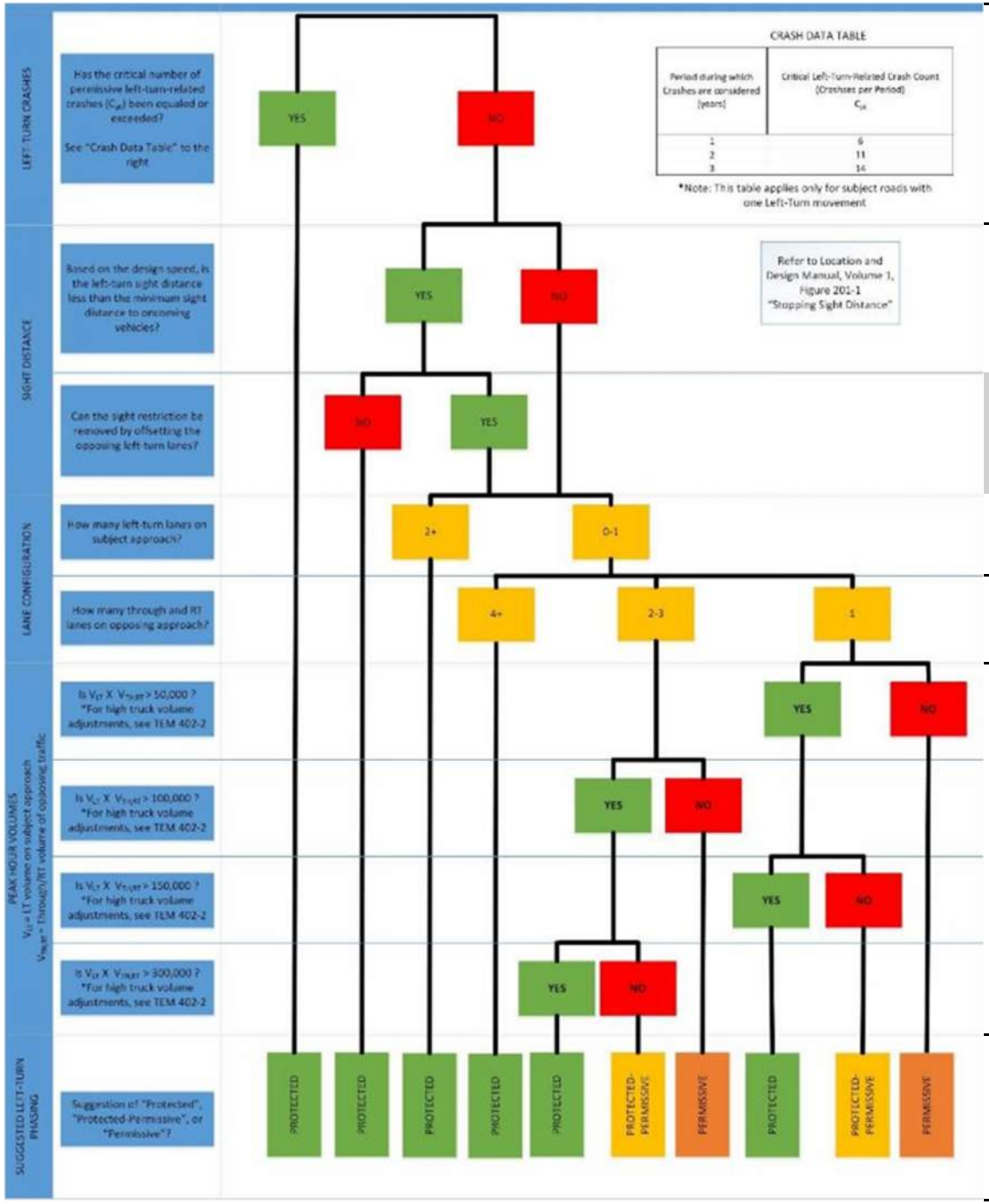
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 AM] EXISTING CONDITIONS - [SOUTH]BOUND (SR 193 at SR 304)



DATA:

# of years:	3
C_{PT}:	2
RESULT:	No

DATA:

*Design Speed:	45		
SSD:	360	Left-turn Sight Distance:	500
RESULT:	NO		

# of LT lanes?	0-1
# of oppos. THRU and RT lanes?	2-3

DATA:

V_{LT}:	100	Is V_{LT} x $V_{TH,RT}$ > 100,000?	NO
$V_{TH,RT}$:	580		

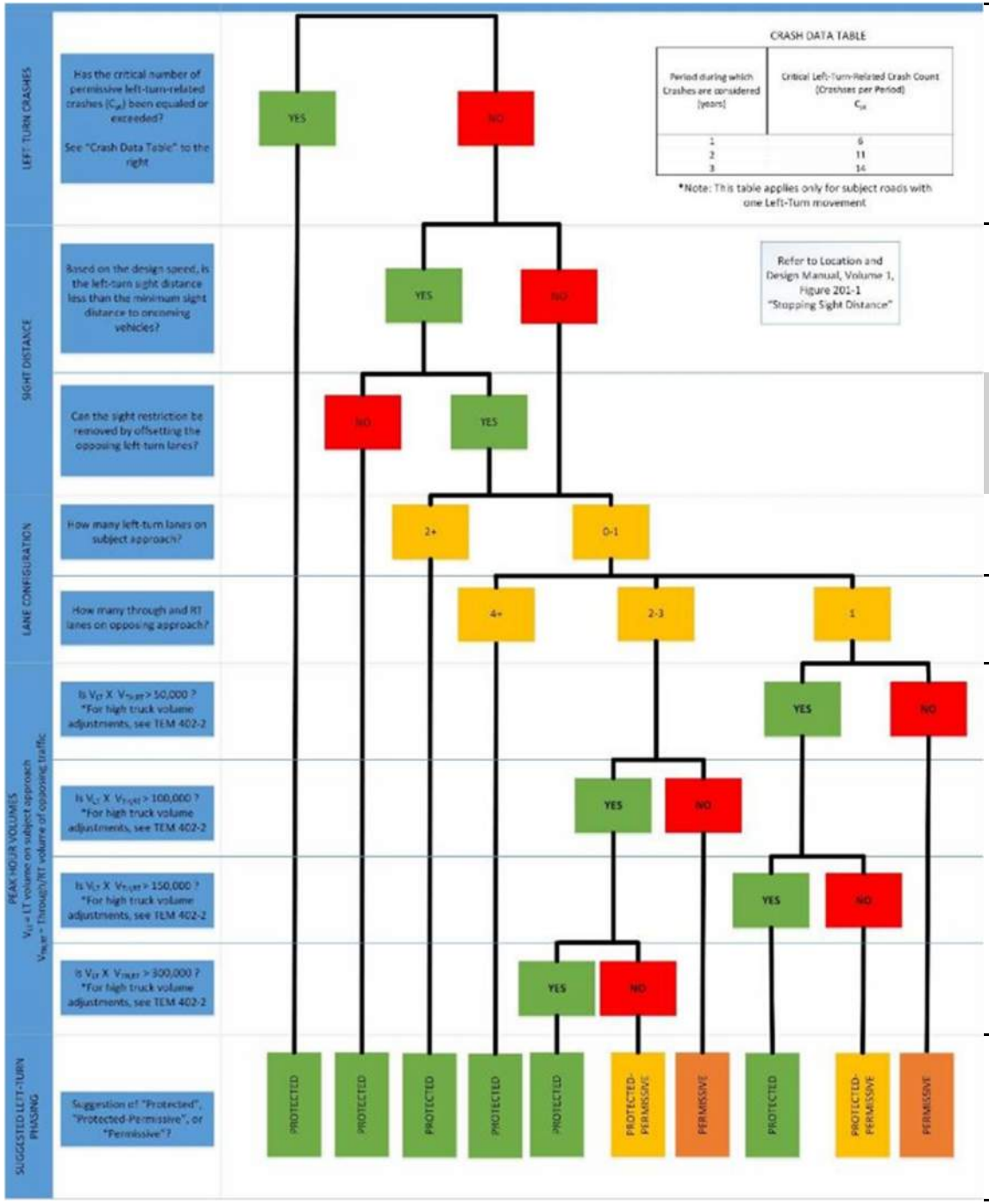
Suggested LT phasing:	PERMISSIVE

*Design Speed : Posted speed limit +5 mph

LEFT TURN PHASE OPERATION GUIDELINES *(ODOT TEM Table 497-10)*

Use existing DHV volumes

[2021 PM] EXISTING CONDITIONS - [SOUTH]BOUND (SR 193 at SR 304)



DATA:

# of years:	3
C_{PT}:	2
RESULT:	No

DATA:

*Design Speed:	45
SSD:	360
RESULT:	NO

Left-turn Sight Distance: 500

# of LT lanes? 0-1

# of oppos. THRU and RT lanes? 2-3

DATA:

V_{LT}:	200
$V_{TH,RT}$:	790

Is V_{LT} x $V_{TH,RT}$ > 100,000? YES

Is V_{LT} x $V_{TH,RT}$ > 300,000? NO

Suggested LT phasing: **PROTECTED-PERMISSIVE**

*Design Speed : Posted speed limit +5 mph

S W I S S Version 1.1.3

Span Wire Signal Support Design

PROJECT DETAIL

Project Date: 01/14/2025

Last Revision Date: 01/15/2025

Author:

Filename: TRU-193-1.67_Prot SBLT.xml

Comments:

S W I S S Version 1.1.3

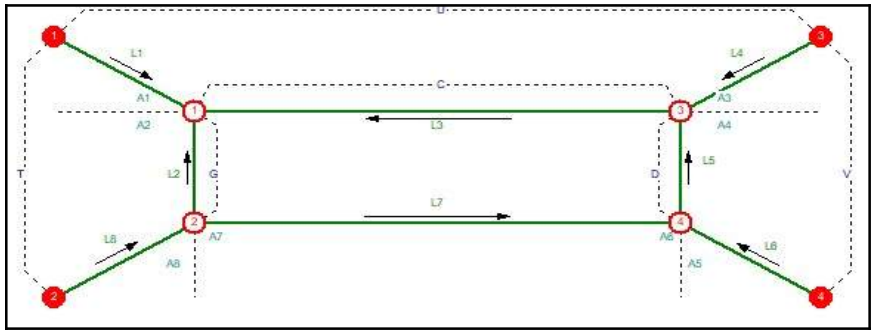
Span Wire Signal Support Design

INPUT VALUES

Sequence #: 1

Configuration Type: Box

Problem Identification: Box



Angles (Degrees)

[A 1]	[A 2]	[A 3]	[A 4]	[A 5]	[A 6]	[A 7]	[A 8]
45.00	90.00	45.00	90.00	45.00	90.00	90.00	45.00

Span Lengths (ft)

[L 1]	[L 2]	[L 3]	[L 4]	[L 5]	[L 6]	[L 7]	[L 8]
0.01	110.00	100.00	0.01	120.00	0.01	99.00	0.01

Elevation Differences (ft)

[C]	[D]	[G]
0.00	0.00	0.00

Base Elevations (ft)

[Pavement]	[Pole 1]	[Pole 2]	[Pole 3]	[Pole 4]
0.00	0.00	0.00	0.00	0.00

Signals and Signs

{Distance (ft) / Weight (lbs)}

Span 1	No signals or signs attached at this span.
Span 2	(52.00/49.30), (64.00/49.30)
Span 3	(34.00/49.30), (50.00/73.00)
Span 4	No signals or signs attached at this span.
Span 5	(41.00/49.30), (53.00/49.30)
Span 6	No signals or signs attached at this span.
Span 7	(17.00/49.30), (29.00/49.30), (41.00/49.30)
Span 8	No signals or signs attached at this span.

Wire Weights (lbs)

(Assumed)

0.01	**Span 1**
165.00	**Span 2**
150.00	**Span 3**
0.01	**Span 4**
180.00	**Span 5**
0.01	**Span 6**
148.50	**Span 7**
0.01	**Span 8**

Design Data

Min. SAG (ft):	4.68	**Max. SAG (ft):**	7.80	**Minimum Clearance (ft):**	22.00	**Wire Weight (lbs/ft):**	1.50		
Sum of Loads (lbs):	467.40	**Sum of Areas (ft):**	39.30	**Wind Pressure (psf):**	28.40	**Pole Strength (ksi):**	50.82	**Box Warp Enabled:**	No

S W I S S Version 1.1.3

Span Wire Signal Support Design

RESULT OF FINAL CALCULATION [MAX SAG]

Sequence #: 1 **Configuration Type:** Box **Problem Identification:** Box

Span Results

	[SPAN 1]	[SPAN 2]	[SPAN 3]	[SPAN 4]	[SPAN 5]	[SPAN 6]	[SPAN 7]	[SPAN 8]
Tension Relations:	1.41421	1.00000	1.00000	1.41421	1.00000	1.41421	1.00000	1.41421
Elevation Differences (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reaction at the end of the span (lbs)	262.75	-134.49	-128.26	272.66	-128.62	267.56	-117.57	307.94
Distance from end to low point (ft)	0.00	56.79	50.00	0.00	67.00	0.00	58.00	0.00
SAG below end of span (ft)	0.00	6.96	6.74	0.00	7.80	0.00	6.38	0.00

Pole Results

	[POLE 1]	[POLE 2]	[POLE 3]	[POLE 4]
Stringing Tension (lbs):	952.39	952.39	952.39	952.39
Attachment Height above pole base (ft)	29.80	29.80	29.80	29.80
Attachment Elevation (ft)	29.80	29.80	29.80	29.80
Base Moment (ft/lbs)	80821.60	80822.88	80821.88	80821.73

Other information

Calculated Design Factor : 2.85

System is in balance

Distance between Highest and Lowest Point (ft) : 7.80

Max. Wire Load (lbs): 2850.44

Height of each signal or sign attachment point above the lowest (ft)

Span 1 No signals or signs attached at this span.
Span 2 (0.84), (0.97)
Span 3 (1.81), (1.06)
Span 4 No signals or signs attached at this span.
Span 5 (0.54), (0.00)
Span 6 No signals or signs attached at this span.
Span 7 (3.60), (1.91), (1.42)
Span 8 No signals or signs attached at this span.

S W I S S Version 1.1.3

Span Wire Signal Support Design

RESULT OF FINAL CALCULATION [MIN SAG]

Sequence #: 1 **Configuration Type:** Box **Problem Identification:** Box

Span Results

	[SPAN 1]	[SPAN 2]	[SPAN 3]	[SPAN 4]	[SPAN 5]	[SPAN 6]	[SPAN 7]	[SPAN 8]
Tension Relations:	1.41421	1.00000	1.00000	1.41421	1.00000	1.41421	1.00000	1.41421
Elevation Differences (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reaction at the end of the span (lbs)	262.75	-134.49	-128.26	272.66	-128.62	267.56	-117.57	307.94
Distance from end to low point (ft)	0.00	56.79	50.00	0.00	67.00	0.00	58.00	0.00
SAG below end of span (ft)	0.00	4.18	4.04	0.00	4.68	0.00	3.83	0.00

Pole Results

	[POLE 1]	[POLE 2]	[POLE 3]	[POLE 4]
Stringing Tension (lbs):	1587.32	1587.32	1587.32	1587.32
Attachment Height above pole base (ft)	26.68	26.68	26.68	26.68
Attachment Elevation (ft)	26.68	26.68	26.68	26.68
Base Moment (ft/lbs)	120600.	120601.	120600.	120600.

Other information

Calculated Design Factor : 2.85

System is in balance

Distance between Highest and Lowest Point (ft) : 4.68

Max. Wire Load (lbs): 4604.58

Height of each signal or sign attachment point above the lowest (ft)

Span 1 No signals or signs attached at this span.
Span 2 (0.50), (0.58)
Span 3 (1.09), (0.63)
Span 4 No signals or signs attached at this span.
Span 5 (0.32), (0.00)
Span 6 No signals or signs attached at this span.
Span 7 (2.16), (1.15), (0.85)
Span 8 No signals or signs attached at this span.

Estimate TRU-S193

Estimated Cost:$392,468.68

Contingency: 18.50%

Estimated Total: $465,075.39

North Walk w Mid-Block Crossing Cost Estimate
Perni Lane to Hampton Inn

Base Date: 01/29/25

Spec Year: 23

Unit System: E

Work Type: CURB, GUTTER AND SIDEWALK WORK

Highway Type:

Urban/Rural Type: URBAN CLASS

Season: SPRING

County: TRUMBULL

Latitude of Midpoint: 410939

Longitude of Midpoint: -803954

District: 04

Federal Project Number: TBD

State Project Number: TBD

Estimate Type: Preliminary Safety Study Cost Estimate

Prepared by M. Philips, PE on 01/29/25
Checked by D. Griffith, PE

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 0010: Roadway					
0001	202E23000 PAVEMENT REMOVED	56.000	SY	$32.66047	$1,828.99
0002	202E32000 CURB REMOVED	88.000	FT	$25.02389	$2,202.10
0003	203E10000 EXCAVATION	44.000	CY	$42.13174	$1,853.80
0004	204E10000 SUBGRADE COMPACTION	67.000	SY	$5.54746	$371.68
0005	608E10000 4" CONCRETE WALK	3,270.000	SF	$8.49933	$27,792.81
0006	608E52000 CURB RAMP	300.000	SF	$30.67226	$9,201.68
				Total for Group 0010:	$43,251.06
Group 0020: Erosion Control					
0007	659E00100 SOIL ANALYSIS TEST	2.000	EACH	$108.63653	$217.27
0008	659E00300 TOPSOIL	32.000	CY	$85.96357	$2,750.83
0009	659E10000 SEEDING AND MULCHING	289.000	SY	$5.50144	$1,589.92
0010	659E20000 COMMERCIAL FERTILIZER	0.040	TON	$916.76119	$36.67
0011	659E31000 LIME	0.060	ACRE	$110.16948	$6.61
0012	659E35000 WATER	2.000	MGAL	$1.71458	$3.43
0013	832E30000 EROSION CONTROL	2,600.000	EACH	$1.00000	$2,600.00
				Total for Group 0020:	$7,204.73
Group 0050: Pavement					
0014	253E01000 PAVEMENT REPAIR	14.000	SY	$268.29940	$3,756.19
0015	304E20000	4.000	CY	$101.87639	$407.51

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
	AGGREGATE BASE				
0016	452E10010 6" NON-REINFORCED CONCRETE PAVEMENT, CLASS QC 1P	39.000	SY	$118.41673	$4,618.25
0017	609E26000 CURB, TYPE 6	64.000	FT	$50.24314	$3,215.56

Total for Group 0050:$11,997.51

Group 0060: Water Work

0018	638E98100 WATER WORK, MISC.:	1.000	LS	$5,000.00000	$5,000.00

Total for Group 0060:$5,000.00

Group 0080: Lighting

0019	625E98200 LIGHTING, MISC.:	1.000	LS	$15,000.00000	$15,000.00

Total for Group 0080:$15,000.00

Group 0120: Traffic Control

0020	630E95000 SIGNING, MISC.:	1.000	LS	$25,000.00000	$25,000.00
0021	642E50040 PAVEMENT MARKING, MISC.:	1.000	LS	$5,000.00000	$5,000.00

Total for Group 0120:$30,000.00

Group 0130: Traffic Signals

0022	632E90400 SIGNALIZATION, MISC.:	1.000	EACH	$120,000.00000	$120,000.00

Total for Group 0130:$120,000.00

Group 0240: Incidentals

0023	614E11000 MAINTAINING TRAFFIC	1.000	LS	$10,000.00000	$10,000.00
0024	619E16010 FIELD OFFICE, TYPE B	6.000	MNTH	$1,669.23077	$10,015.38
0025	623E10000 CONSTRUCTION LAYOUT STAKES AND SURVEYING	1.000	LS	$10,000.00000	$10,000.00

Line #	Item Number	Quantity	Units	Unit Price	Extension
	Description				
	Supplemental Description				
0026	624E10000	1.000	LS	$13,000.00000	$13,000.00
	MOBILIZATION				
	ASSUME 5%				
0027	990E10020	1.000	LS	$26,000.00000	$26,000.00
	ESTIMATED COST OF ENGINEERING, SUPERINTENDENCE AND CONTINGEN CIES				
	ASSUME 10%				
0028	990E30000	1.000	LS	$91,000.00000	$91,000.00
	AGREED LUMP SUM				
	35% CONTINGENCY				

Total for Group 0240:$160,015.38

Estimate TRU-S193

Estimated Cost:$392,281.86

Contingency: 18.50%

Estimated Total: $464,854.00

South Walk Cost Estimate
E. Liberty to I080 EB On-Ramp

Base Date: 01/28/25

Spec Year: 23

Unit System: E

Work Type: CURB, GUTTER AND SIDEWALK WORK

Highway Type:

Urban/Rural Type: URBAN CLASS

Season: SPRING

County: TRUMBULL

Latitude of Midpoint: 410919

Longitude of Midpoint: -803954

District: 04

Federal Project Number: TBD

State Project Number: TBD

Estimate Type: Preliminary Safety Study Cost Estimate

Prepared by M. Philips, PE on 01/29/25
Checked by D. Griffith, PE

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 0010: Roadway					
0001	202E23000 PAVEMENT REMOVED	101.000	SY	$27.94726	$2,822.67
0002	202E32000 CURB REMOVED	110.000	FT	$24.06672	$2,647.34
0003	202E35100 PIPE REMOVED, 24" AND UNDER	10.000	FT	$66.68180	$666.82
0004	202E58100 CATCH BASIN REMOVED	1.000	EACH	$1,131.42763	$1,131.43
0005	203E10000 EXCAVATION	19.000	CY	$48.83606	$927.89
0006	204E10000 SUBGRADE COMPACTION	44.000	SY	$6.05771	$266.54
0007	608E10000 4" CONCRETE WALK	1,320.000	SF	$10.18748	$13,447.47
0008	608E52000 CURB RAMP	180.000	SF	$34.09416	$6,136.95
				Total for Group 0010:	$28,047.11
Group 0020: Erosion Control					
0009	659E00100 SOIL ANALYSIS TEST	2.000	EACH	$108.63653	$217.27
0010	659E00300 TOPSOIL	14.000	CY	$106.85931	$1,496.03
0011	659E10000 SEEDING AND MULCHING	122.000	SY	$7.96575	$971.82
0012	659E20000 COMMERCIAL FERTILIZER	0.020	TON	$983.61362	$19.67
0013	659E31000 LIME	0.030	ACRE	$126.44055	$3.79
0014	659E35000 WATER	1.000	MGAL	$2.10978	$2.11
0015	832E30000 EROSION CONTROL	2,600.000	EACH	$1.00000	$2,600.00

Line #	Item Number	Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
					Total for Group 0020:	$5,310.69
Group 0040: Drainage						
0016	605E14020	6" BASE PIPE UNDERDRAINS WITH GEOTEXTILE FABRIC	75.000	FT	$20.00000	$1,500.00
0017	611E04400	12" CONDUIT, TYPE B	10.000	FT	$158.96408	$1,589.64
0018	611E98150	CATCH BASIN, NO. 3	1.000	EACH	$5,764.07443	$5,764.07
					Total for Group 0040:	$8,853.71
Group 0050: Pavement						
0019	253E01000	PAVEMENT REPAIR	44.000	SY	$202.96933	$8,930.65
0020	452E12010	8" NON-REINFORCED CONCRETE PAVEMENT, CLASS QC 1P	16.000	SY	$150.00000	$2,400.00
0021	609E26000	CURB, TYPE 6	200.000	FT	$43.62162	$8,724.32
					Total for Group 0050:	$20,054.97
Group 0060: Water Work						
0022	638E98100	WATER WORK, MISC.:	1.000	LS	$5,000.00000	$5,000.00
					Total for Group 0060:	$5,000.00
Group 0080: Lighting						
0023	625E98200	LIGHTING, MISC.:	1.000	LS	$10,000.00000	$10,000.00
					Total for Group 0080:	$10,000.00
Group 0120: Traffic Control						
0024	630E95000	SIGNING, MISC.:	1.000	LS	$5,000.00000	$5,000.00
0025	642E50040	PAVEMENT MARKING, MISC.:	1.000	LS	$5,000.00000	$5,000.00
					Total for Group 0120:	$10,000.00

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 0130: Traffic Signals					
0026	632E90300 SIGNALIZATION, MISC.: *E. LIBERTY STREET SIGNAL COMPLETE*	1.000	LS	$150,000.00000	$150,000.00
				Total for Group 0130:	$150,000.00
Group 0240: Incidentals					
0027	614E11000 MAINTAINING TRAFFIC	1.000	LS	$10,000.00000	$10,000.00
0028	619E16010 FIELD OFFICE, TYPE B	6.000	MNTH	$1,669.23077	$10,015.38
0029	623E10000 CONSTRUCTION LAYOUT STAKES AND SURVEYING	1.000	LS	$5,000.00000	$5,000.00
0030	624E10000 MOBILIZATION *ASSUME 5%*	1.000	LS	$13,000.00000	$13,000.00
0031	990E10020 ESTIMATED COST OF ENGINEERING, SUPERINTENDENCE AND CONTINGEN CIES *ASSUME 10%*	1.000	LS	$26,000.00000	$26,000.00
0032	990E30000 AGREED LUMP SUM *35% CONTINGENCY*	1.000	LS	$91,000.00000	$91,000.00
				Total for Group 0240:	$155,015.38

TRU-SR193-1.67 Roadway Segment Safety Improvement Study

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

Safety Study DRAFT
Prepared for: ODOT District 4
December 2024

OHIO DEPARTMENT OF TRANSPORTATION

TABLE OF CONTENTS

LIST OF TABLES

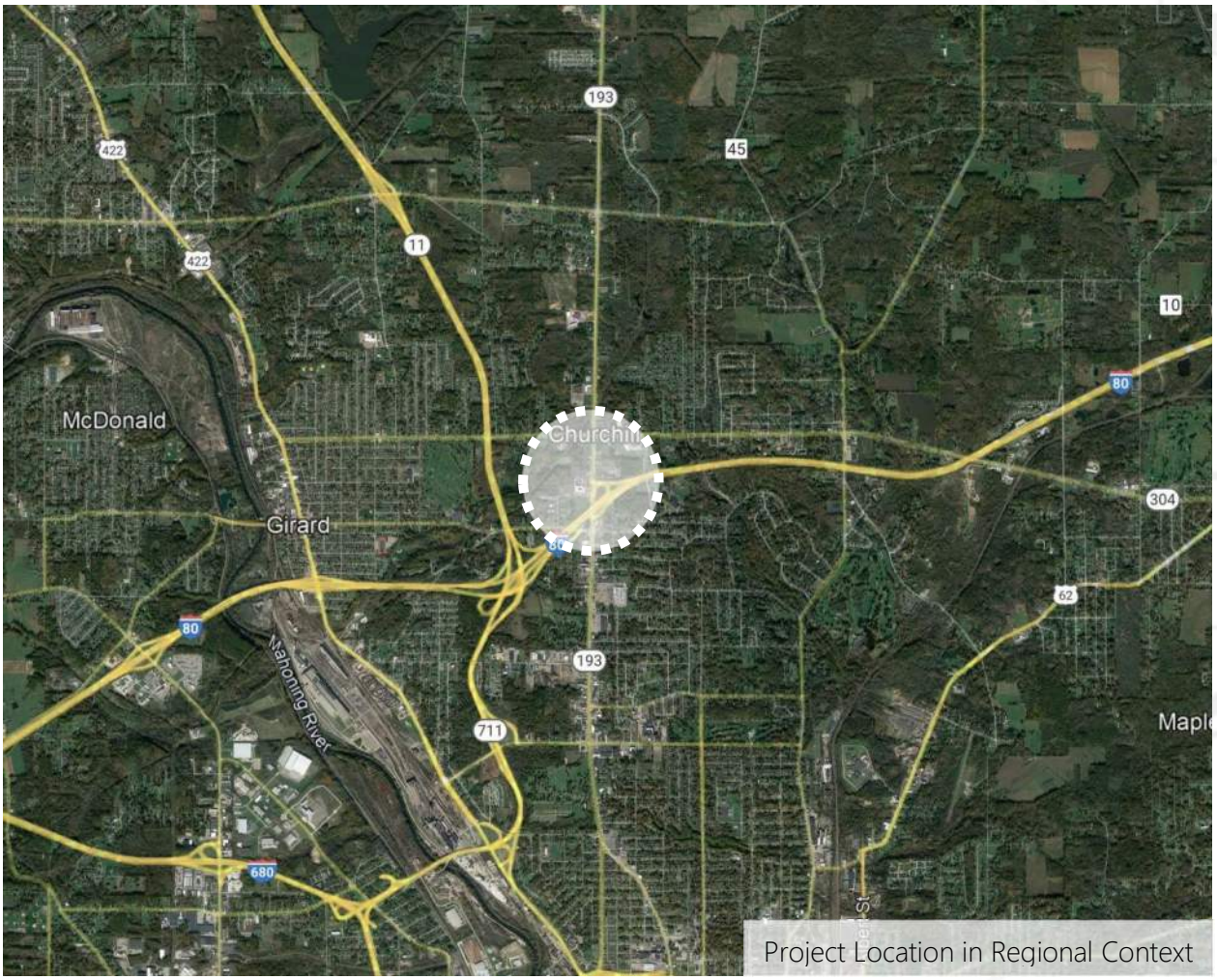
LIST OF FIGURES

I. TITLE PAGE

Ohio Department of Transportation District 4
Liberty Township, Trumbull County
Segment: Belmont Avenue (State Route 193) between Liberty Street and Churchill Road (State Route 304)
Study Completion Date: December 2024
Consultant: Environmental Design Group

Project Location

LOCATION MAP



Project Location in Regional Context

II. EXECUTIVE SUMMARY

A. Project Background

The study area encompasses the 0.6-mile roadway segment of Belmont Avenue (SR 193) between Liberty Street and Churchill Road (SR 304). Segments within these study limits are identified as #266, #1906, and #1908 on the 2020 ODOT Highway Safety Improvement Program (HSIP) Suburban Non-Freeway Priority List. The intersection of Belmont Avenue with Churchill Road is listed as #165 on the ODOT HSIP Suburban Intersection Priority List. The intent of this medium-level study is to determine the best countermeasures to proactively improve the crash frequency and severity at this location, with particular emphasis on pedestrian safety improvements. This report documents the safety-based study of the segment in terms of existing conditions, crash data and patterns, probable causes of crashes, potential safety countermeasures, and recommendations for safety improvement.

B. Overview of Possible Causes

The crash patterns throughout the study area point to several issues along Belmont Avenue and its intersections that negatively impact the crash frequency. The following probable causes have been identified and discussed herein:

1. The existing multilane roadway configuration hosts numerous conflict points, encourages higher speeds, attracts higher traffic volumes, and creates a complex environment for all road users,
2. The high frequency of access points on Belmont Avenue further increases the number of conflict points, increasing the likelihood of crashes for all road users,
3. Insufficient lighting along Belmont Avenue can cause drivers to experience reduced visibility, slower reaction time, and impaired depth perception, which creates an increased risk for pedestrians and cyclists and increases the likelihood of rear-end and run-off-road crashes,
4. Current infrastructure, such as bus stops or nearby amenities, attract foot- and bike-traffic, yet existing conditions are not safe for pedestrians or cyclists and further limit the maneuverability of pedestrians who experience limited mobility or other disabilities.
5. The three signalized intersections host challenges such as potentially long dilemma zones, poor visibility, and unsafe pedestrian crossings, leading to a history of high crash frequencies.

C. Recommended Countermeasures

The following recommendations are provided for the owner and maintaining authority over the subject corridor to reduce the crash frequency and severity.

1. Install sidewalks and ADA compliant curb ramps where none presently exist.

2. Install high-visibility crosswalks, push buttons, and count-down pedestrian signals at each intersection in the study area.
3. Update traffic signals with reflective backplates, all-red time, and leading pedestrian intervals. Where capacity analyses deem appropriate, incorporate protected left turn phasing and lane assignment changes.
4. Install a median refuge island and pedestrian hybrid beacon (PHB) with a two-stage crossing at the right-in right-out entrance to Dunkin Donuts.
5. Install a rectangular rapid flashing beacon (RRFB) at the I-80 westbound slip lane.
6. Maintain functionality of existing streetlights and install additional lighting in accordance with the design standards outlined in the ODOT Transportation Engineering Manual (TEM).
7. Restrict existing access points to right-in right-out, where applicable.
8. Remove existing access points or reduce their width to limit exposure time for vulnerable road users, where applicable.
9. Replace the existing median between the I-80 overpass and the I-80 westbound ramp intersection, incorporating vertical elements such as trees and other vegetation to enhance traffic calming.

III. EXISTING CONDITIONS

A. Background

The 0.6-mile roadway segment of Belmont Avenue (SR 193) between Liberty Street and Churchill Road (SR 304) is a north-south minor arterial located in Liberty Township, approximately 0.75 miles east of Girard and 1.5 miles north of the Trumbull County southern line. This segment contains three signalized intersections and several unsignalized access drives. The corridor includes exit and entrance ramps to Interstate 80 (I-80) in both east and west directions. The roadway is five lanes wide with two northbound lanes, two southbound lanes, and a center turn lane. The posted speed limit is 40 mph.

The corridor hosts an array of land uses including restaurants, drive throughs, financial institutions, gas stations, hotels, storage, retail, and an event center.

B. Conditions Diagram

Environmental Design Group staff traveled to the intersection for a field review of existing conditions on July 20, 2023. The investigation followed the GORE (Geometry, Operations, Roadway Users/Human Factors, and Environment) Model as described in the ODOT Regional Road Safety Audit Implementation Guide. The time envelope was 1:00pm – 4:30pm and weather conditions were dry, sunny, and 61 degrees. The field-gathered information is supplemented with other sources of information from ODOT and Google Earth imaging. The observations and current conditions are described below as visually articulated in Figure 1 – Figure 5. The

existing traffic control is depicted in Figure 6 – Figure 10. Full sheets of the existing conditions and traffic control are provided in Appendix A.

Figure 1. Existing site conditions, from Liberty Street to I-80.

Figure 2. Existing site conditions, from I-80 to the I-80 westbound entrance ramp.

Figure 3. Existing site conditions, from the I-80 westbound entrance ramp to Perni Lane.

Figure 4. Existing site conditions, from Perni Lane to the cemetery.

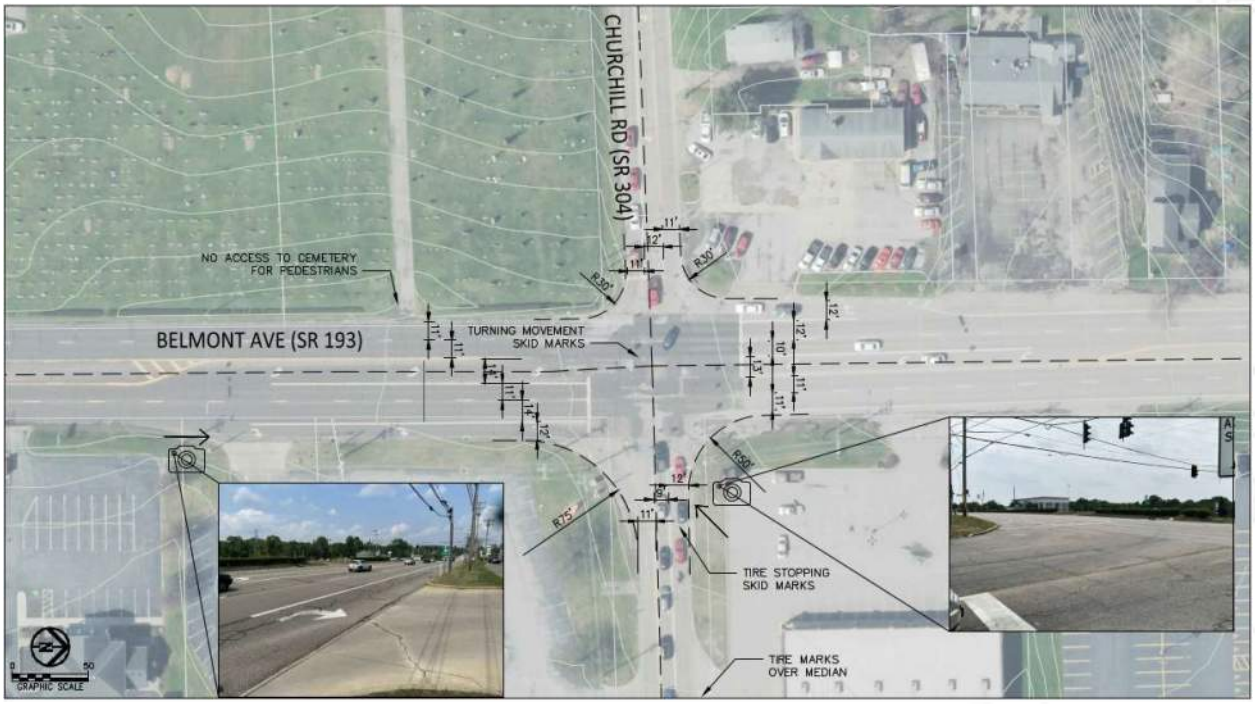


Figure 5. Existing site conditions, from the cemetery to Churchill Road.

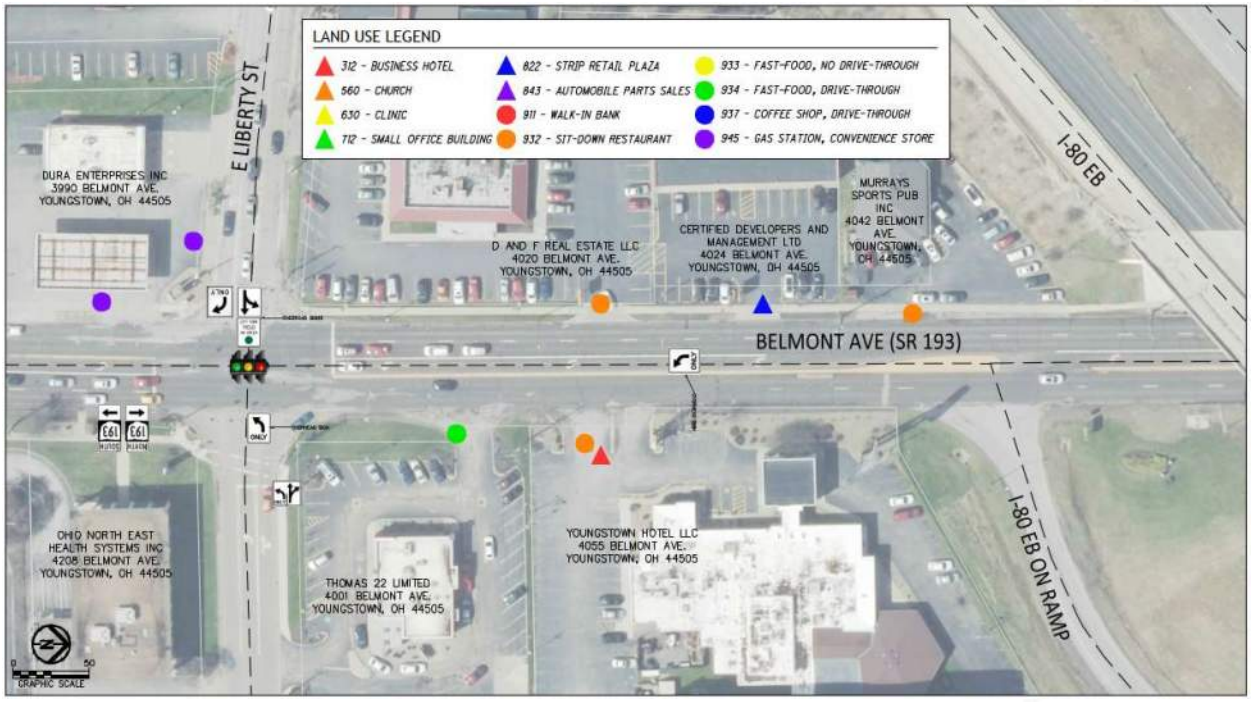


Figure 6. Traffic control and land use, from Liberty Street to I-80.

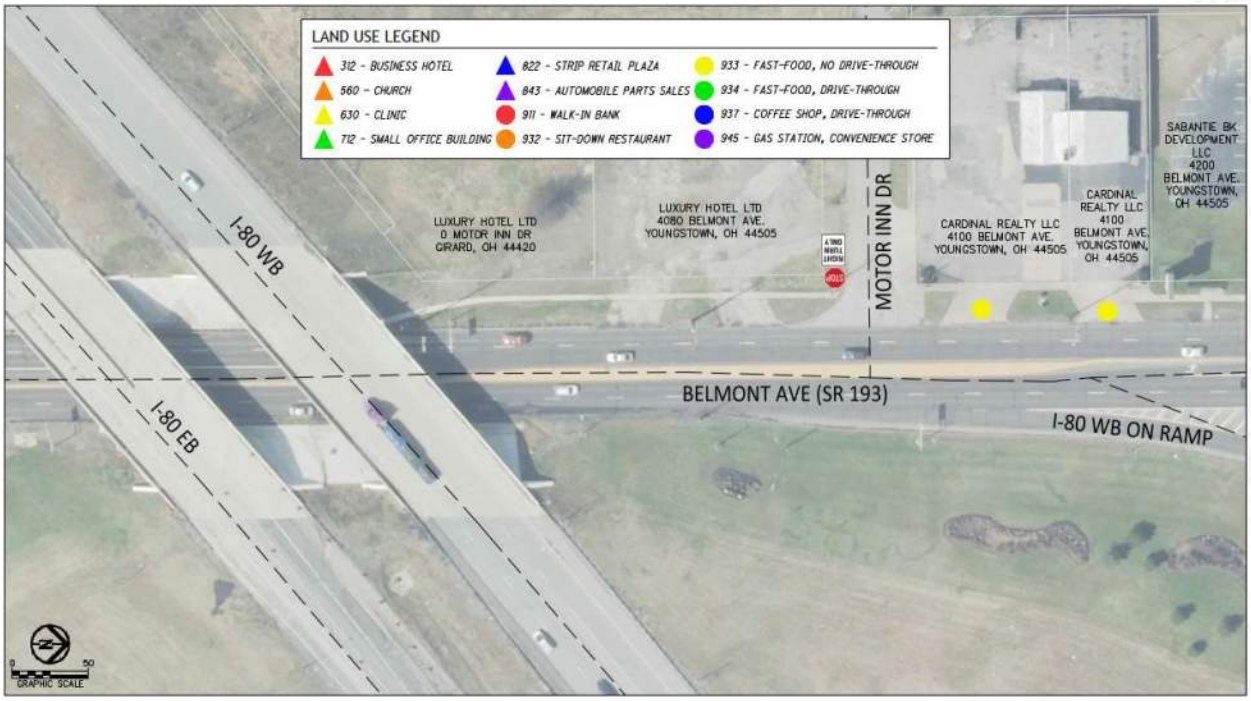


Figure 7. Traffic control and land use, from I-80 to the I-80 westbound entrance ramp.

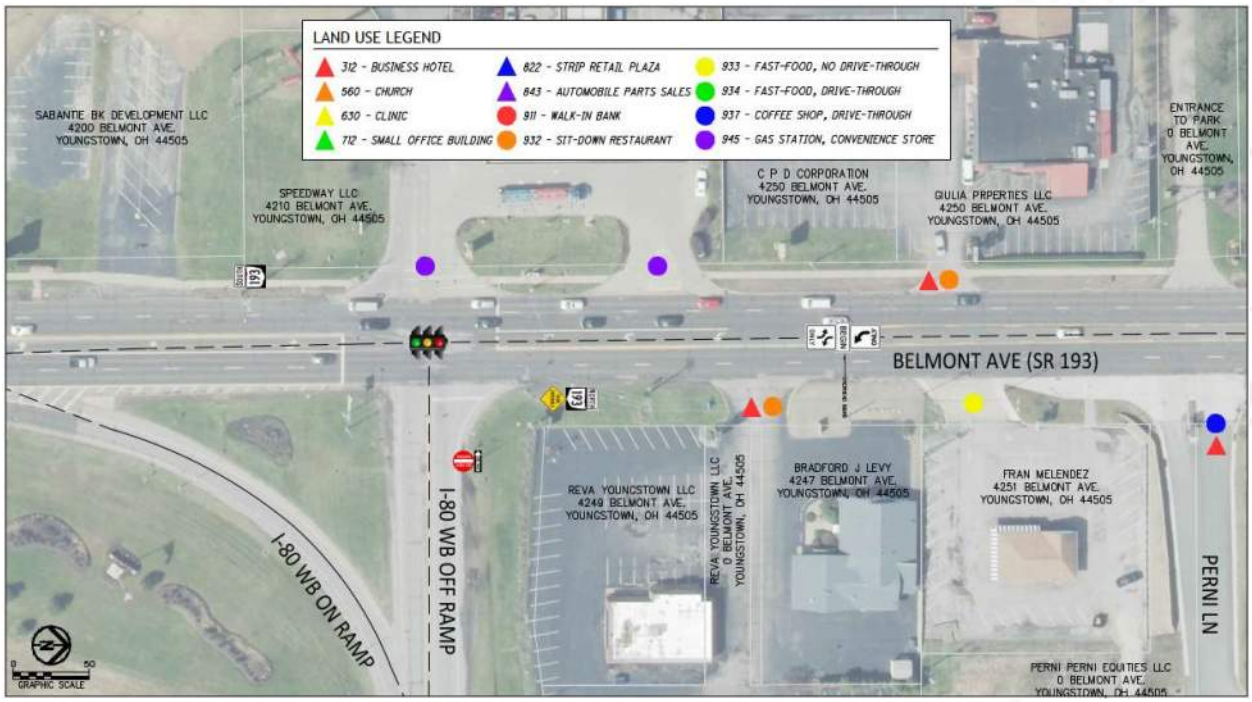


Figure 8. Traffic control and land use, from the I-80 westbound entrance ramp to Perni Lane.

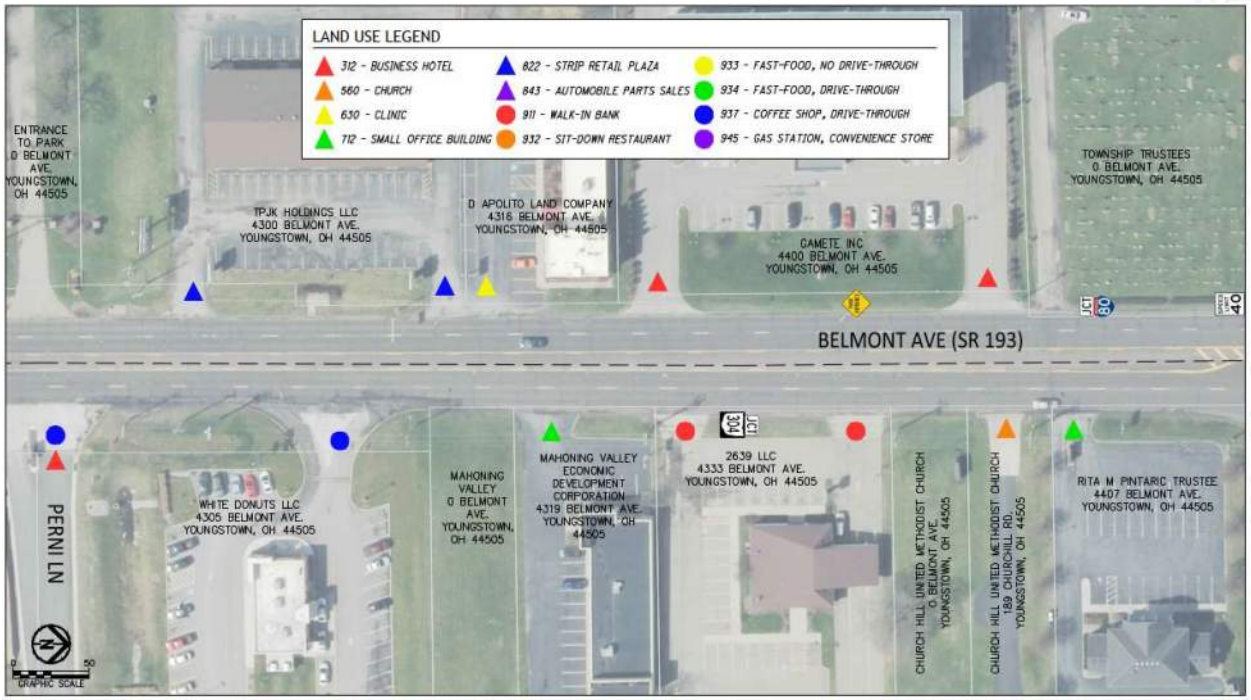


Figure 9. Traffic control and land use, from Perni Lane to the cemetery.

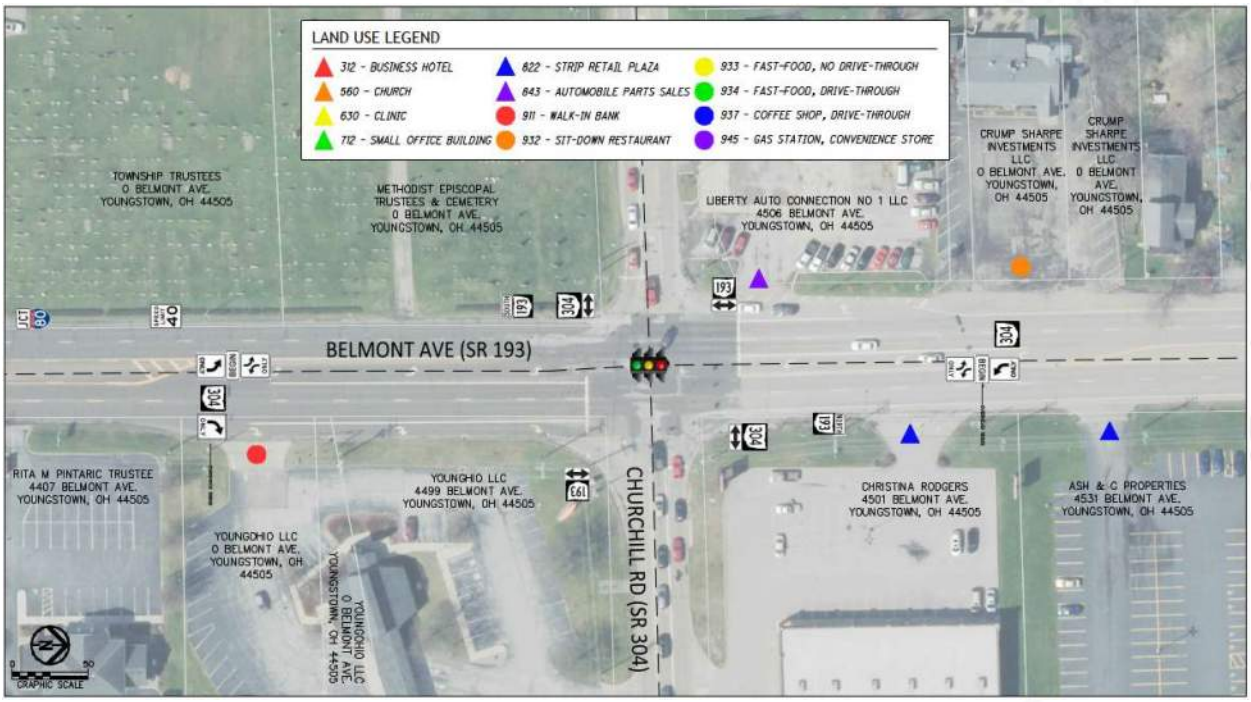


Figure 10. Traffic control and land use, from the cemetery to Churchill Road.

C. Physical Condition

See the following for site visit GORE model findings on the physical conditions along with detailed discussion.

1. Geometry
   Roadway elements such as curves, gradient, sight distance, clear zones.

   ### The Intersection of Belmont Avenue and Liberty Street

   The intersection is urban, with businesses on each quadrant and along each approach. Belmont Avenue, traveling north/south, is skewed approximately 0 degrees. Liberty Street, traveling east/west, is skewed approximately 2 degrees. Approximately 440 feet west of the intersection, Liberty Street intersects the I-80 eastbound exit ramp.

   Lane widths of Belmont Avenue vary from 10-12 feet wide, and lane widths of Liberty Street vary from approximately 12-14 feet wide. The curb radii range from 35 feet to 50 feet. Sidewalk exists on both sides of Belmont Avenue, but the east side does not continue north of the intersection. Sidewalk also exists on the north side of Liberty Street east of the intersection. The sidewalk is approximately 5 feet wide.

   There are several items in the clear zone, including utility poles and business signs. There is also an overgrown shrub in the southeast quadrant that obstructs the sight of northbound drivers and makes pedestrian crossings at the westbound approach of the intersection difficult and unsafe.

   ### Liberty Street to I-80 Westbound Ramp

   The segment of Belmont Avenue between the Liberty Street intersection and the I-80 westbound ramp intersection is approximately 0.3 miles long. The segment is skewed approximately 0 degrees. This urban section has multiple access drives, an intersection at Motor Inn Drive, and access to the I-80 eastbound on-ramp.

   Lane widths of Belmont Avenue vary from approximately 10-12 feet wide. There are no shoulders. There is a concrete median that spans the length of the segment, breaking only at the I-80 eastbound on-ramp to allow southbound traffic to turn left onto the ramp. Sidewalk exists on the west side of Belmont Avenue, varying from approximately 4-7 feet wide. Some portions of the sidewalk need repair, have a non-regulatory cross slope towards the street, or are jagged, which is shown below in Figure 11. A small portion of sidewalk exists on the east side under the I-80 overpass.

Motor Inn Drive intersects Belmont Avenue north of the overpass and south of the I-80 westbound ramps. Lane widths of Motor Inn Drive are approximately 13 feet wide. Curb radii at the intersection are approximately 40 feet. Because of the concrete median, Motor Inn Drive only provides access to southbound Belmont Avenue traffic. Motor Inn Drive provides access to Chipotle and the access road that later intersects Belmont Avenue at the I-80 westbound ramp intersection. Drivers on Motor Inn Drive wanting to travel northbound utilize the access road that will bring them to the signalized intersection with the westbound ramps.

There are several items in the clear zone, including utility poles and business signs. There are fewer businesses located near and north of the I-80 overpass, resulting in open clear zones in these areas.

The Intersection of Belmont Avenue and I-80 Westbound Ramp

This signalized intersection is urban with businesses located on the northeast, northwest, and southwest quadrants. Belmont Avenue travels north/south and is intersected by the I-80 westbound ramps to the east and an access road to the west. The entrance and exit ramps are separated by short reflective yellow bollards. These bollards are pictured below in Figure 12. The access drive to the west of the intersection leads to a Speedway gas station, Starbucks, Chipotle, and an event center. This access drive also intersects Motor Inn Drive as previously mentioned.

Lane widths of Belmont Avenue vary from approximately 10-11 feet wide. Lane widths of the I-80 westbound ramps vary from approximately 15-16 feet wide. Lane widths of the access road vary from approximately 12-15 feet wide. The curb radii range from approximately 15-55 feet. Sidewalk exists on the west side of Belmont Avenue and is approximately 5 feet wide. There is a crosswalk across the access drive, though it is faded.

I-80 Westbound Ramp to Churchill Road

The segment of Belmont Avenue between the I-80 westbound ramp intersection and the Churchill Road intersection is approximately 0.3 miles long. The segment is skewed approximately 0 degrees. This urban section has multiple access drives and an intersection with Perni Lane.

Lane widths of Belmont Avenue are approximately 11 feet wide. There are no shoulders. There is a concrete median north of the I-80 westbound ramp intersection that is approximately 220 feet long. After the median terminates, a center turn lane spans the rest of the segment. Sidewalk exists on the west side of Belmont Avenue but terminates at the park entrance across from Perni Lane. This sidewalk is approximately 5 feet wide.

Perni Lane intersects Belmont Avenue at an unsignalized intersection. Lane widths on Perni Lane are approximately 18 feet. Curb radii at the intersection vary from approximately 40-55 feet. Perni Lane provides access to Dunkin Donuts and a Comfort Suites hotel. Access to Dunkin Donuts from Belmont Avenue is limited to right-in and right-out only. To reach Dunkin Donuts from a southbound approach, or to continue southbound after leaving, Perni Lane must be used.

There are several items in the clear zone, including utility poles and business signs. There are businesses located along both sides of Belmont Avenue for the length of the portion.

Intersection of Belmont Avenue and Churchill Road

The intersection is urban, with businesses on each quadrant and along each approach. Belmont Avenue, traveling north/south, is skewed approximately 1 degree. Churchill Road, traveling east/west, is skewed approximately 1 degree.

Lane widths of Belmont Avenue vary from approximately 10-11 feet wide, and lane widths of Churchill Road vary from approximately 9-12 feet wide. The curb radii range from approximately 30-75 feet. There is no sidewalk present along any approach. There are several items in the clear zone, including utility poles and business signs.

Turning motions onto eastbound Churchill Road are tight, resulting in the stop bar for the westbound left-turn lane to be set back notably far. If a driver does not stop before the marking, they will likely be hit by either a southbound vehicle turning left or a northbound vehicle turning right.

The eastbound approach on Churchill Road is very steep, which may be difficult to maneuver in older vehicles without proper braking systems. Similarly, the westbound approach on Churchill Road slopes down to the intersection, which can make stopping at the left-turn lane stop bar more difficult. At the site visit, two sets of tire skid marks were seen at this approach. One tire skid mark on the westbound approach is shown in Figure 13. Another notable mark followed a left turn made from a westbound driver turning southbound onto Belmont Avenue, as the outside tire was the only tire to leave a mark, indicating high speeds and braking as the car made the turn. This tire skid mark is shown in Figure 14.

2. Operations
   How the road is utilized and how effective current operational practices are at preventing or mitigating crashes.

The Intersection of Belmont Avenue and Liberty Street

Each approach has a designated left-turn lane. During the visit, the traffic signals utilized protected/permissive left turn phases for northbound, eastbound, and westbound approaches. The southbound approach had a permissive left turn phase. Pedestrian signals exist at each quadrant, although there is no crosswalk between the northeast and northwest quadrants. To obtain a walk phase at this crossing, pedestrians must press the pushbutton. The three crosswalks were identifiable and had curb ramps that met the current specifications requiring a separate ramp for each direction of crossing.

One driver was witnessed running a red light traveling eastbound. There were two witnessed close calls between eastbound and westbound drivers obtaining their protected left-turn phase, when a driver on the opposite approach attempted to turn right on red.

Liberty Street to I-80 Westbound Ramp

A concrete median begins on Belmont Avenue on the north approach of the Liberty Street intersection. This median breaks at the I-80 eastbound on-ramp. A left turn lane on the southbound approach forms prior to the median break. The lane is long and provides drivers ample time to merge into the lane and wait for a gap in northbound traffic without creating a queue for southbound through traffic. The entrance ramp is located with clear sight of the Liberty Street intersection. Drivers turning left onto the ramp can see when the red light allows for a gap in northbound traffic. This design is believed to be the cause of the low number of crashes at this intersection.

The median also prevents left turn movements into and out of commercial access drives. Drivers can navigate to the nearest intersection—I-80 westbound ramps for northbound traffic, Liberty Street for southbound traffic—and make a U-turn to gain access to the other side of the street.

A right turn slip lane forms approximately 530 feet south of the intersection with the I-80 westbound ramps, acting as an additional I-80 westbound entrance ramp. This ramp later merges with the I-80 westbound access provided at the signalized intersection. This slip lane may influence drivers to increase their speed while still on Belmont Avenue, prior to entering the entrance ramp.

The Intersection of Belmont Avenue and I-80 Westbound Ramp

The center turn lane on Belmont Avenue transitions into left turn lanes for the northbound and southbound approaches. The traffic signal utilizes permissive left turn movements for all approaches. There are no pedestrian signals present at this intersection, though there is a faded crosswalk on the eastbound approach.

One pedestrian stated that he witnessed two crashes at this intersection in the past four months. He said that they both involved left turn movements. One run red light and one close call left turn were observed during the site visit.

I-80 Westbound Ramp to Churchill Road

This segment of Belmont Avenue experiences multiple changes in elevation, with crests located near both the Churchill Road intersection and the I-80 westbound ramp intersection. Near the middle of this span, a valley forms, encouraging drivers to pick up speed with the downhill.

Intersection of Belmont Avenue and Churchill Road

Each approach has one left turn lane, with northbound and southbound traffic having protected/permissive left turns and eastbound and westbound traffic having protected left turns only. Additionally, the northbound and southbound approaches have right turn lanes. There are no pedestrian signals, sidewalks, or crosswalks at this intersection. There are curb cuts at each corner, though there are no curb ramps or sidewalk present.

3. Roadway Users/Human Factors
   The various modes present along the roadway and the potential conflicts that may exist.

The Intersection of Belmont Avenue and Liberty Street

The intersection experiences all modes of highway traffic—passenger vehicles, motorcycles, trucks, transit, school buses, cyclists, and pedestrians. Most of the traffic witnessed at the site visit consisted of passenger vehicles. During the site visit, two pedestrians were observed at the intersection. One pedestrian was waiting for the WRTA bus at the northwest quadrant, and the other was trying to cross Belmont Avenue in front of Wendy's, where there is no crosswalk to accompany the pedestrian signals. These two pedestrians are pictured below in Figure 15. One cyclist was witnessed riding northbound on the west sidewalk. Another pedestrian was traveling northbound within the roadway and used the left turn lane to turn westbound onto Liberty Street. Upon turning onto Liberty Street,

where there is no sidewalk and a small shoulder, the cyclist was seen riding slowly, very close to the grass to protect himself from the traffic.

Liberty Street to I-80 Westbound Ramp

As previously stated, Belmont Avenue experiences passenger vehicles, motorcycles, trucks, transit, school buses, cyclists, and pedestrians. Two pedestrians were observed in this section. One pedestrian had gone shopping and was carrying bags with him. He walked northbound toward the bus stop and crossed Belmont Avenue under the I-80 overpass when he eventually found a gap in traffic, as depicted in Figure 16. Another pedestrian was waiting for the bus north of the overpass. He said that he frequently sees people walking in the area. He was waiting at one of the few bus stops in the study area that has pedestrian infrastructure, providing a trash can and a metal bench.

The Intersection of Belmont Avenue and I-80 Westbound Ramp

The intersection experiences passenger vehicles, motorcycles, trucks, transit, school buses, cyclists, and pedestrians. Most of the traffic witnessed at the site visit consisted of passenger vehicles. During the site visit, there were no pedestrians or cyclists present at the intersection.

I-80 Westbound Ramp to Churchill Road

The segment experiences passenger vehicles, motorcycles, trucks, transit, school buses, cyclists, and pedestrians. Most of the traffic witnessed at the site visit consisted of passenger vehicles. During the site visit, there was one pedestrian seen waiting at the bus stop in front of Dunkin Donuts.

As seen at other bus stops located on the east side of Belmont Avenue, there is no pedestrian infrastructure. There are large gaps in the sidewalk on the east side of Belmont Avenue, forcing WRTA patrons to walk through the grass with no shoulder between them and the northbound lanes. Here, there is also an area of rock landscaping that further increases the difficulty for pedestrians walking along the east side of Belmont Avenue. This area is shown below in Figure 17. There is one bus stop on the west side of this segment that has a metal bench and trash can for bus riders, though it is located north of the sidewalk's termination, so pedestrians must walk through the grass to reach it.

Due to the distance to the nearest pedestrian crosswalk, many pedestrians cross Belmont Avenue mid-block at various locations along the segment. During the site visit, there was one instance where three pedestrians got off the bus and crossed mid-block to the other side of Belmont Avenue,

waiting in the center turn lane or the concrete median for a gap to become available.

Intersection of Belmont Avenue and Churchill Road

The intersection experiences passenger vehicles, motorcycles, trucks, transit, school buses, cyclists, and pedestrians. Most of the traffic witnessed at the site visit consisted of passenger vehicles. During the site visit, there were no pedestrians or cyclists present at the intersection.

4. Environment

   Performance of a roadway under various environmental conditions such as differing weather patterns and lighting scenarios.

The Intersection of Belmont Avenue and Liberty Street

There are two streetlights provided at this intersection: one in the northeast quadrant and one in the northwest quadrant. Approaches at this intersection do not have large slopes, so it is less likely that rain or ice would have a greater impact on crash frequencies.

Due to the east/west configuration of Liberty Street, it is possible that the position of the sun at sunrise and sunset may influence crash frequencies, as this lighting scenario can be difficult for drivers to see under.

Liberty Street to I-80 Westbound Ramp

There are seven streetlights on this segment of Belmont Avenue, consistently providing lighting along the corridor during dark hours.

The Intersection of Belmont Avenue and I-80 Westbound Ramp

There is one streetlight located in the northwest quadrant and another located approximately 150 feet south of the intersection. The placement of these lights helps to illuminate approaching northbound and southbound traffic but may lead to visibility issues for drivers trying to navigate the intersection.

I-80 Westbound Ramp to Churchill Road

There are two streetlights on this segment of Belmont Avenue, which creates long stretches of insufficient lighting along the corridor during dark hours. This is especially dangerous when pedestrians cross midblock or walk along the edge of the roadway, which pedestrians must do to access local businesses or WRTA bus stops. A lack of lighting and heavy pedestrian presence is especially dangerous when the hilly geometry of Belmont Avenue is also considered. It was under these conditions that a fatal pedestrian crash occurred in 2019.

Intersection of Belmont Avenue and Churchill Road

There are streetlights in the southeast and southwest quadrants of the intersection. Another streetlight is located approximately 100 feet north of the intersection, improving visibility of the north approach during dark hours. The east and west approaches both have steep slopes, which may have a greater impact on crash frequency, notably during wet or icy conditions.

5. Field Observations

   Other gathered information not covered in the GORE model.

   No other field observations were noted.

See Figure 11 – Figure 17 for photos of the site, which are referenced in the above discussion.

Figure 11. Jagged and missing sidewalk on the west side of Belmont Avenue between Liberty Street and the I-80 westbound ramps

Figure 12. Reflective yellow bollards delineate traffic entering and exiting I-80 westbound ramps

Figure 13. Tire skid mark observed on the westbound approach of Churchill Road

Figure 14. A tire skid mark was produced from westbound traffic on Churchill Road turning left onto Belmont Avenue

Figure 15. At the Liberty Street intersection, one pedestrian waits for the WRTA bus and another crosses where no crosswalk is provided

Figure 16. A pedestrian crosses Belmont Avenue under the I-80 overpass

Figure 17. Rock landscaping on the east side of Belmont Avenue between the I-80 westbound ramps and Churchill Road

IV. CRASH DATA AND ANALYSIS

A. Available Traffic Data

ODOT District 4 obtained turning movement counts at the three signalized intersections and at the access points for Perni Lane and the I-80 eastbound ramp. The counts were taken on Tuesday, November 16, 2021 from 7:00 am to 7:00 pm. The morning peak for the corridor was 7:30 am – 8:30 am and the afternoon peak was 4:15 pm – 5:15 pm. The AM/PM peak hours matched at nearly all intersections except the intersections with Liberty Street (AM peak) and Perni Lane (PM peak). In both instances, the difference between the intersection peak and the overall corridor peak was less than 1%.

The mid-day peak on this corridor exceeds the AM peak at all counted locations, although the peak range varied at each location. The mid-day peak was not similar across all five locations. The range of 11:45 am – 12:45 pm may be considered the mid-day peak as it best covers the range. See Table 1 for a comparison of peak hour volumes with the selected Corridor peaks. See Figure 18 for a chart showing the peak hours at each counted location. See Figure 19 – Figure 28 for diagrams of turning movement counts for peak hours at each location.

Table 1. Peak hour volumes compared with selected peak.

	Actual Mid-day Peak Volume		Selected AM Peak Volume		Difference
SR304	7:30AM - 8:30AM	1665	7:30AM - 8:30AM	1665	0.0%
Perni Lane	7:30AM - 8:30AM	1316		1316	0.0%
WB I-80 Ramps	7:30AM - 8:30AM	1677		1677	0.0%
EB I-80 Ramp	7:30AM - 8:30AM	1292		1292	0.0%
Liberty Street	7:45AM - 8:45AM	1700		1691	0.5%
	Actual Mid-day Peak Volume		**Selected Mid-day Peak Volume**		**Difference**
SR304	12:30PM - 1:30PM	1905	11:45AM - 12:45PM	1842	3.4%
Perni Lane	11:30AM - 12:30PM	1476		1462	1.0%
WB I-80 Ramps	12:00PM - 1:00PM	1782		1705	4.5%
EB I-80 Ramp	12:00PM - 1:00PM	1530		1465	4.4%
Liberty Street	11:30AM - 12:30PM	1873		1868	0.3%
			Selected PM Peak Volume		**Difference**
SR304	4:15PM - 5:15PM	2333	4:15PM - 5:15PM	2333	0.0%
Perni Lane	4:30PM - 5:30PM	1772		1766	0.3%
WB I-80 Ramps	4:15PM - 5:15PM	2108		2108	0.0%
EB I-80 Ramp	4:15PM - 5:15PM	1694		1694	0.0%
Liberty Street	4:15PM - 5:15PM	2303		2303	0.0%

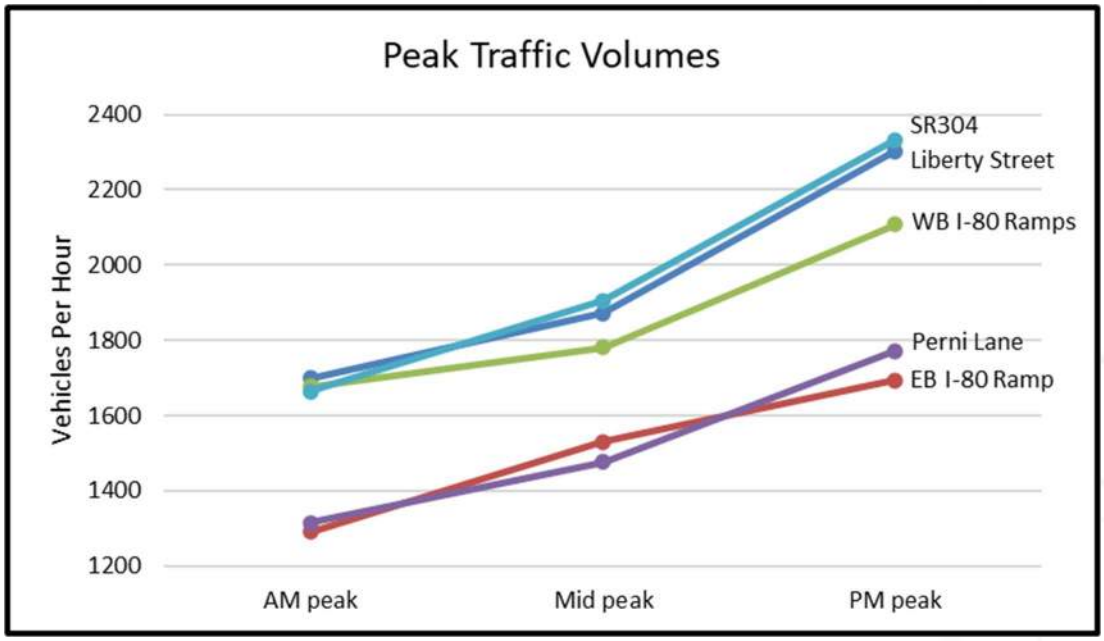


Figure 18 - Peak hour comparisons of traffic volume at counted locations.

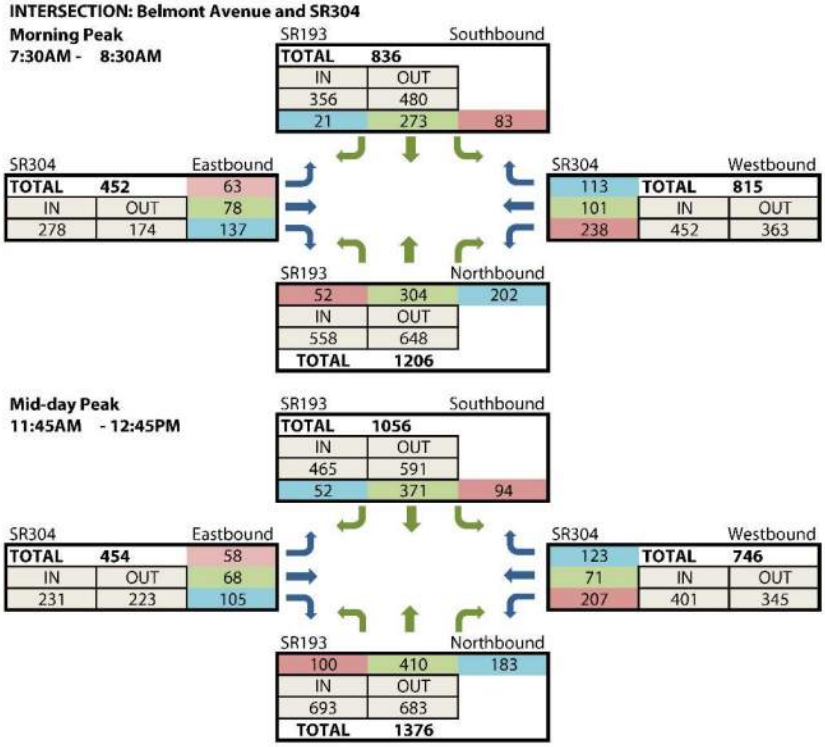


Figure 19 – Churchill Road (SR 304) Turning Movement Counts, AM Peak and Mid-day Peak

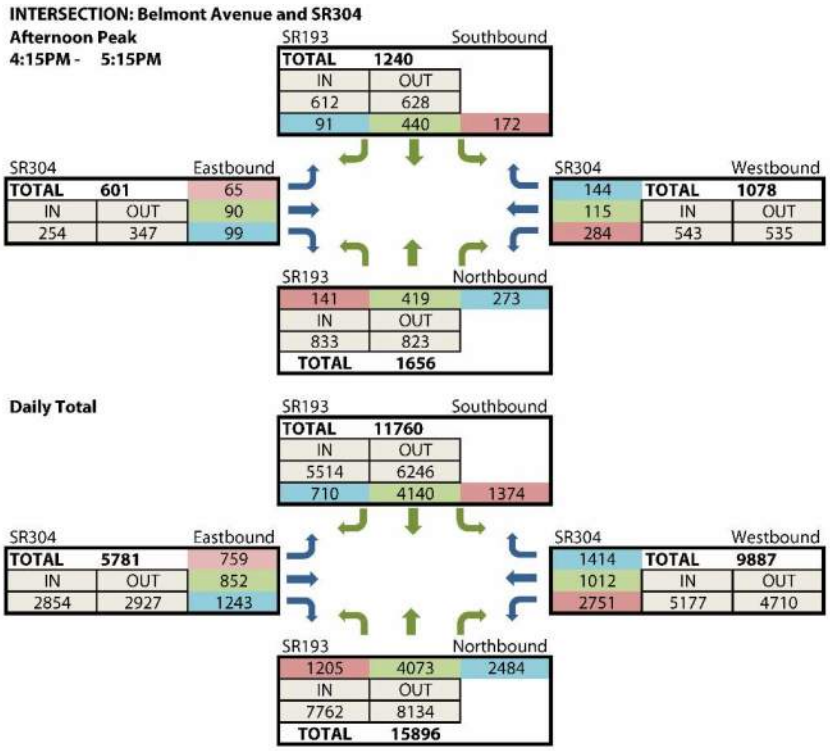


Figure 20 – Churchill Road (SR 304) Turning Movement Counts, PM Peak and Total

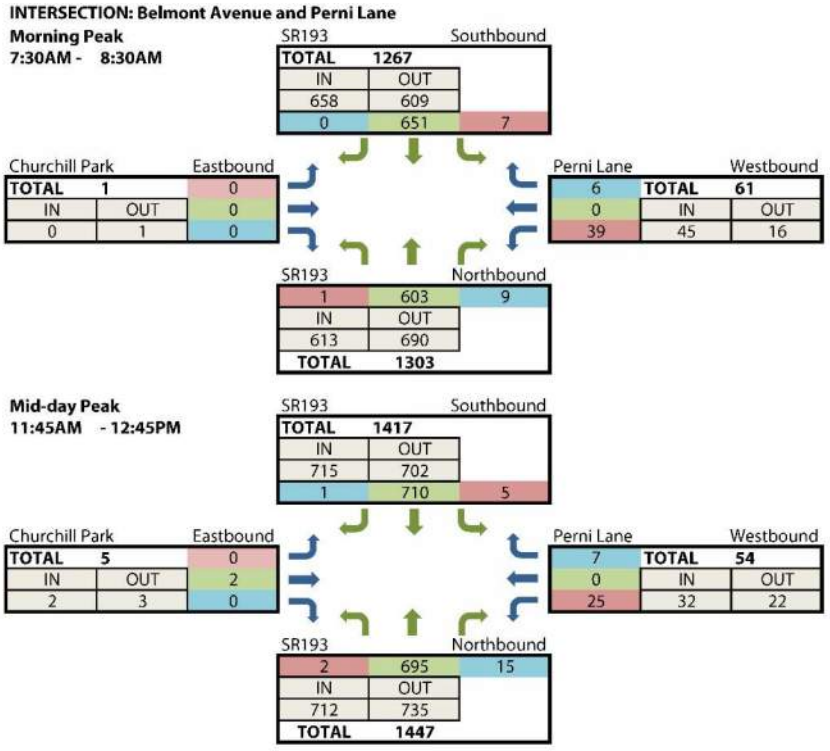


Figure 21 – Perni Lane Turning Movement Counts, AM Peak and Mid-day Peak

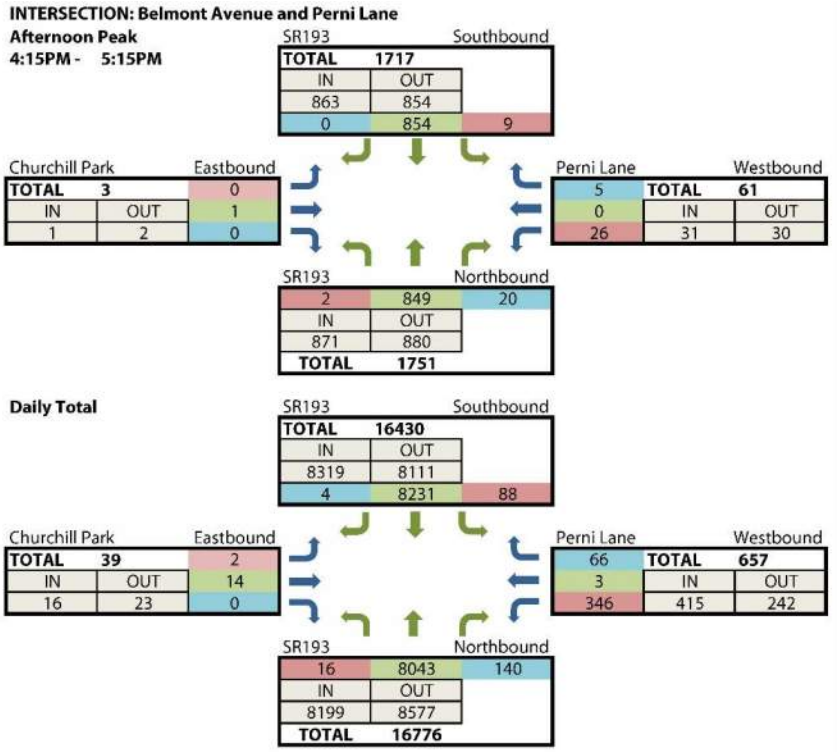


Figure 22 – Perni Lane Turning Movement Counts, PM Peak and Total

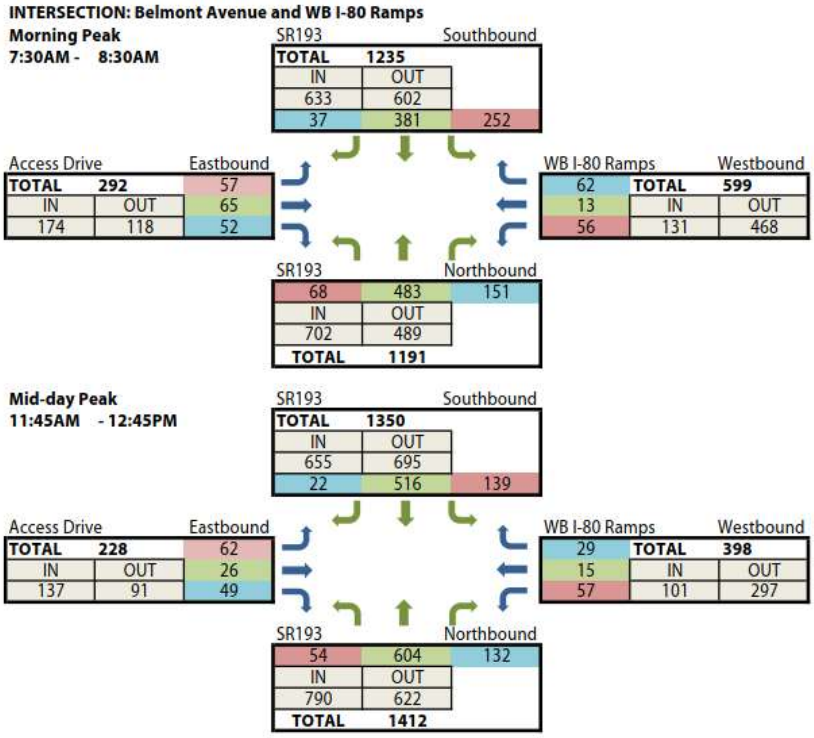


Figure 23 – I-80 Westbound Ramps Turning Movement Counts, AM Peak and Mid-day Peak

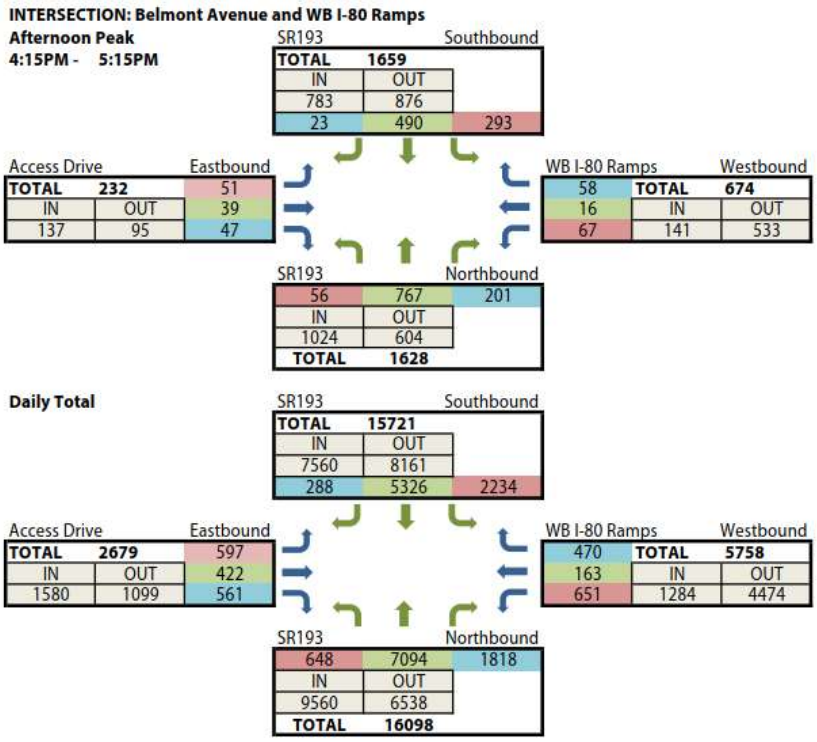


Figure 24 – I-80 Westbound Ramps Turning Movement Counts, PM Peak and Total

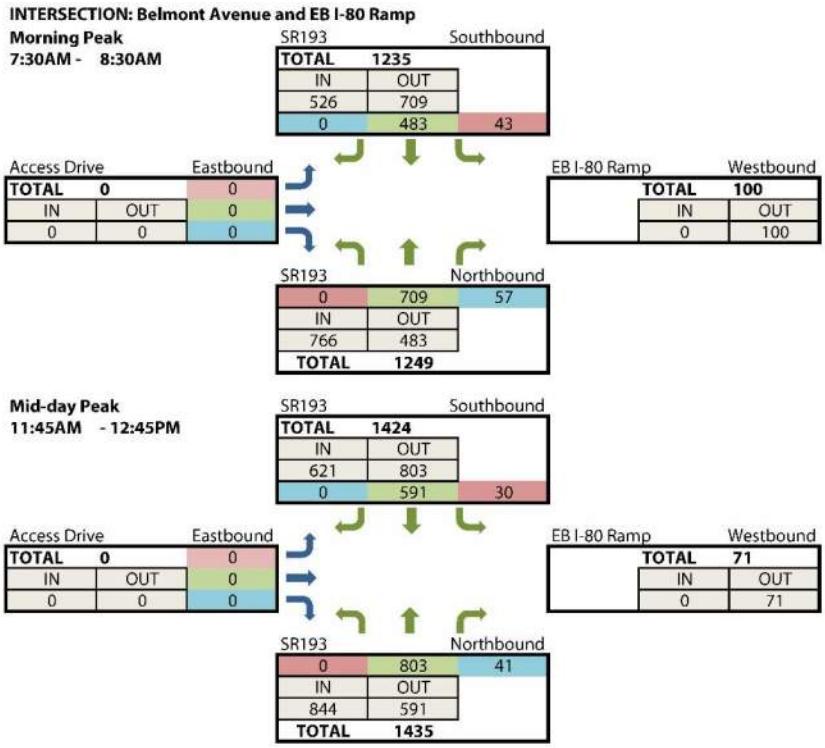


Figure 25 – I-80 Eastbound Ramp Turning Movement Counts, AM Peak and Mid-day Peak

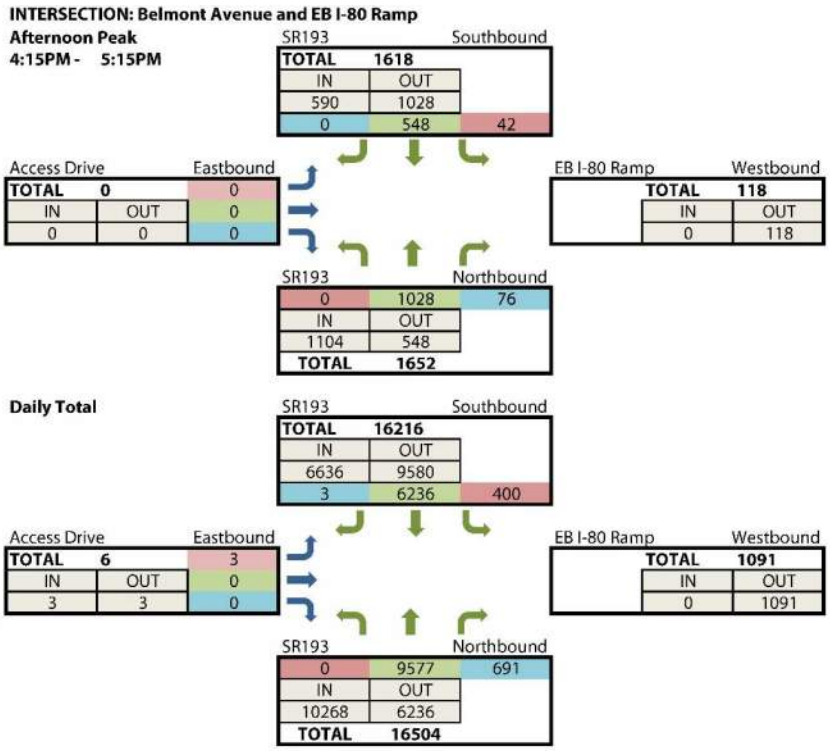


Figure 26 – I-80 Eastbound Ramp Turning Movement Counts, PM Peak and Total

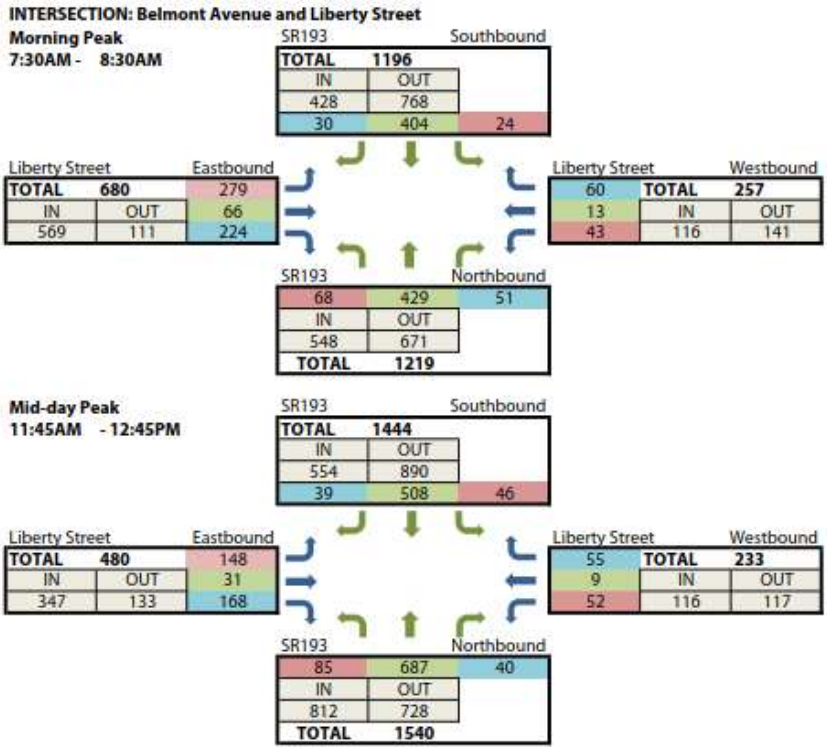


Figure 27 - Liberty Street Turning Movement Counts, AM Peak and Mid-day Peak

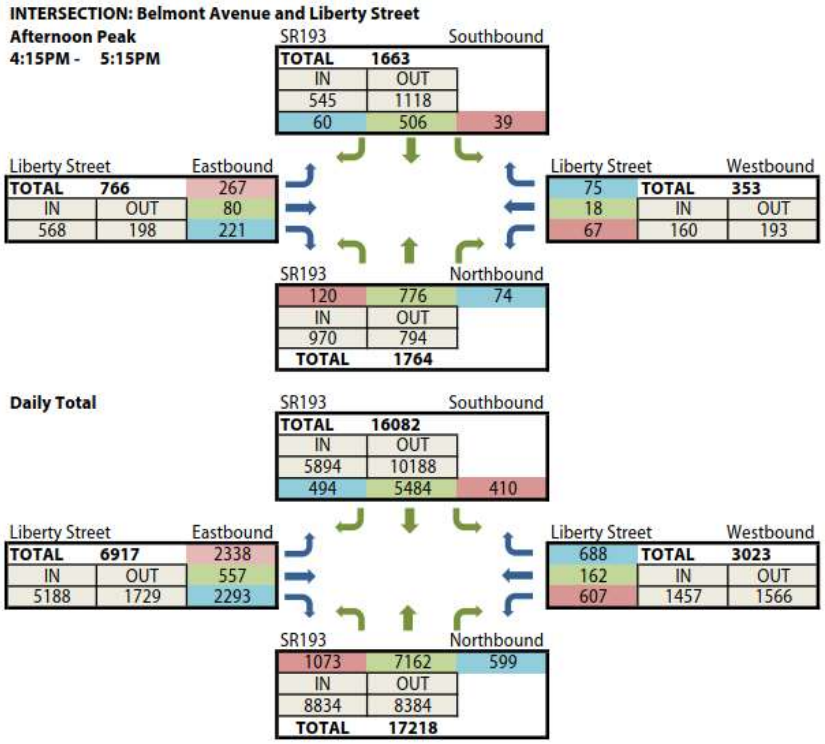


Figure 28 - Liberty Street Turning Movement Counts, PM Peak and Total

The average daily traffic based on the turning movement counts is shown at each intersection within the study limits in Figure 29.

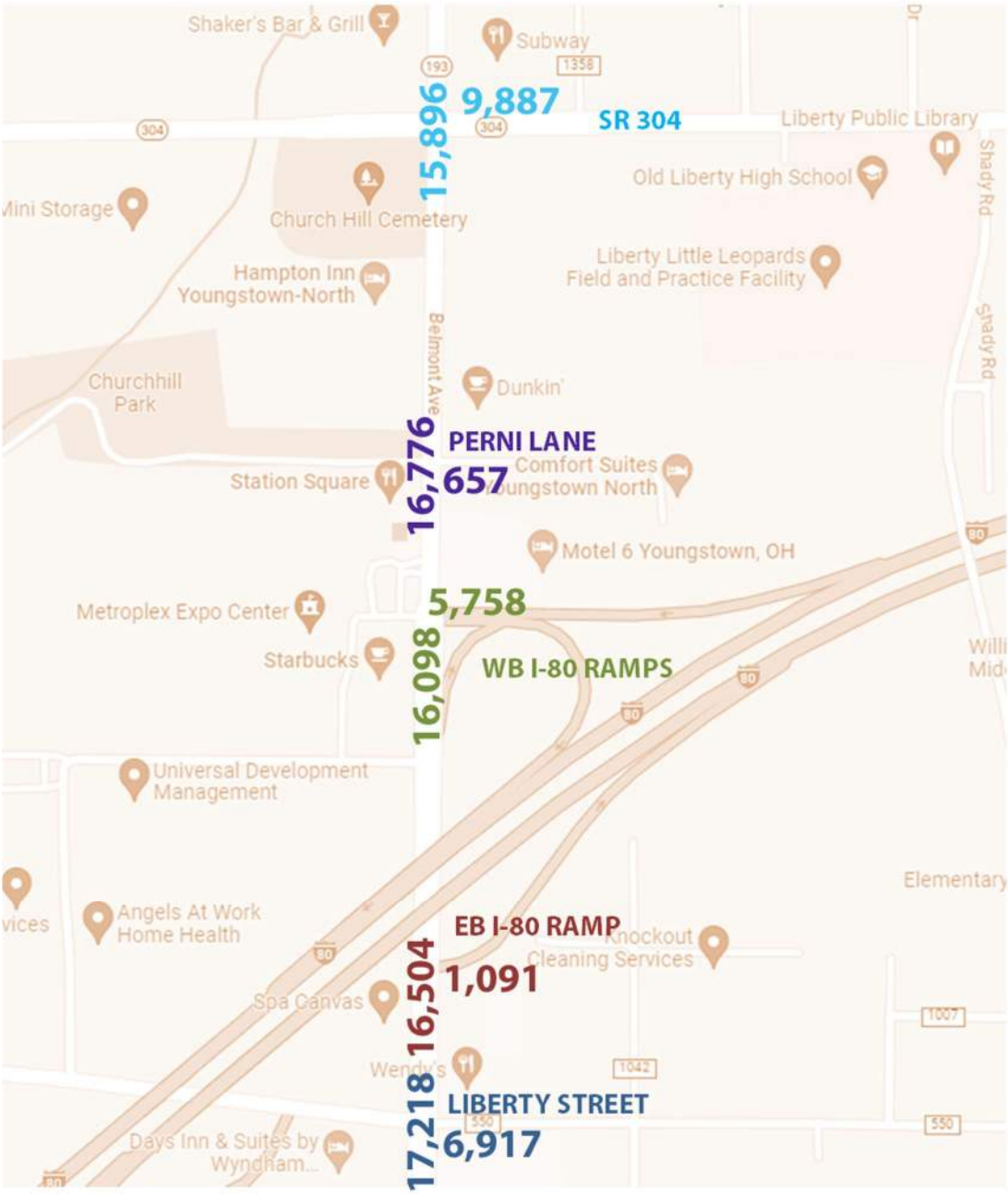


Figure 29 - ADT at intersections within the study limits

B. Crash Data Summaries

This corridor shows some variance in crash quantities per year over the five year study period of 2018 – 2022, with the highest of 49 crashes in 2021 and the lowest of 25 crashes in 2020. Notably, there was a pedestrian fatality in 2019, which will be discussed later in the section. To best understand the crash patterns and possibilities at this location, the crash history from the five year period of 2018 – 2022 will be studied and described in this report. Traffic crashes that have

been reported to the Ohio Department of Public Safety are obtained from the ODOT TIMS webpage.

Each crash from the data set is reviewed with particular attention to critical elements of the crash such as type of crashes, locations, contributing factors, driver actions and reactions, and severity of injuries. Some crashes are removed from the data set as they occurred outside study limits, are animal related, or contain other reasons rendering the crash non-applicable. Any necessary corrections are made to the crash data before further processing. The crash diagram shows all non-animal crashes within the vicinity of the intersection, even if some of those crashes are excluded from the analyzed data set based on applicability.

Once the refined collection of crash data is modified, the ODOT Crash Analysis Module (CAM) tool is used to organize the crash data into tables and charts. Information is tabulated in various categories based on significant crash characteristics such as the previously noted critical elements as well as date, time of day, weather conditions, road conditions, and other relevant aspects. The complete crash information tables are provided in Appendix B of this report.

During the period of 2018 – 2022, a total of 181 crashes were reported and deemed to be associated with the studied corridor. The most common type of crash reported during this period was the Rear End crash, which accounted for 63 crashes, or 35% of the identified 181 crashes. The second most common crash type was the Left Turn crash, with 39 crashes, or 22%. There were 31 Angle crashes and five Right Turn crashes, or 17% and 3% respectively. Combining the Angle, Right Turn, and Left Turn crashes due to similarity yields the General Angle crash type for 75 crashes, or 41%. There were 30 Sideswipe – Passing crashes, or 17%, and seven Backing crashes, or 4%. Head On crashes totaled two, or 1%, and there was one each Sideswipe – Meeting, Fixed Object, Pedestrian, and Parked Vehicle, or about 0.5% each.

In the five-year crash analysis period, the study area experienced one Fatal crash, two Severe Injury crashes, 19 Minor Injury crashes, 23 Injury Possible crashes, and 136 cases of property damage only. This data is available below in Table 2 and is visually articulated in Figure 30.

Table 2. Crash Type by Severity

Total Crashes	Injury Level					
Crash Type	(1) Fatal	(2) Serious Inju	(3) Minor Injury	(4) Injury Possi	(5) PDO/No Inj	Grand Total
Rear End	0	0	2	12	49	63
Left Turn	0	2	9	5	23	39
Angle	0	0	7	2	22	31
Sideswipe - Passing	0	0	1	1	28	30
Backing	0	0	0	0	7	7
Right Turn	0	0	0	1	4	5
Head On	0	0	0	2	0	2
Sideswipe - Meeting	0	0	0	0	1	1
Fixed Object	0	0	0	0	1	1
Pedestrian	1	0	0	0	0	1
Parked Vehicle	0	0	0	0	1	1
Grand Total	1	2	19	23	136	181

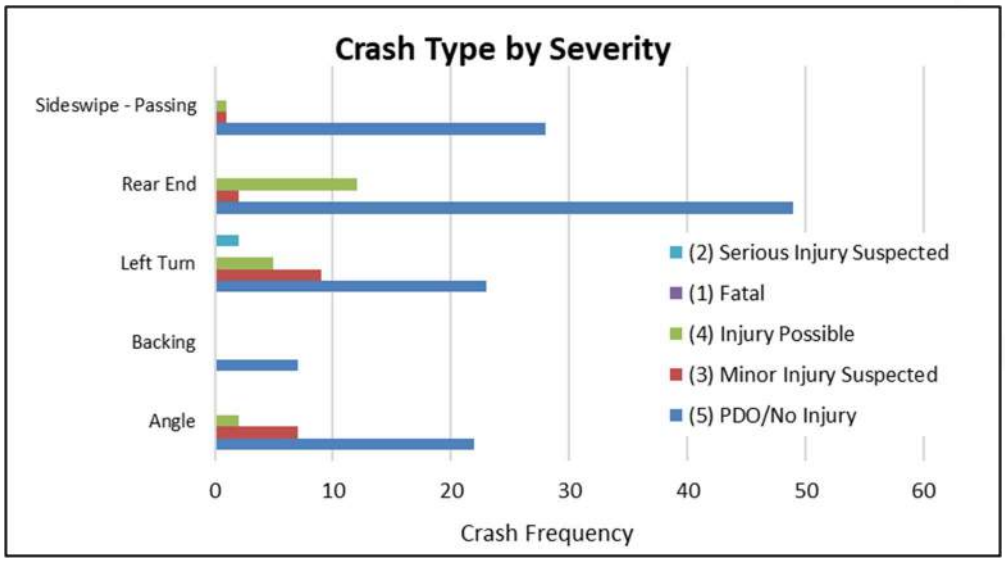


Figure 30. Crash Type by Severity

The most frequent contributing factor noted in the crash data was Following Too Closely / Assured Clear Distance Ahead, which was cited in 58, or 32%, of the identified crashes. The second most frequently cited contributing factor was Failure to Yield, with 55, or 30% of the 181 crashes. Other notable contributing factors were Improper Lane Change (17 crashes, 9%) and Improper Turn (13 crashes, 7%). Contributing factor data is provided in Table 3.

Table 3. Crashes by Contributing Factor

Unit 1 Contributing Factor	Crashes	%
Following Too Closely/ACDA	58	32.04%
Failure to Yield	55	30.39%
Improper Lane Change	17	9.39%
Improper Turn	13	7.18%
None	12	6.63%
Improper Backing	7	3.87%
Ran Red Light	5	2.76%
Improper Start From a Parked Position	4	2.21%
Other Improper Action	3	1.66%
Operating Defective Equipment	3	1.66%
Drove off Road	2	1.10%
Improper Crossing	1	0.55%
Not Discernible	1	0.55%
Grand Total	181	100.00%

The elevation of Belmont Avenue varies throughout the study limits, with great variation north of I-80. As a result of this variation, 40% of crashes occurred on a grade. See Figure 31.

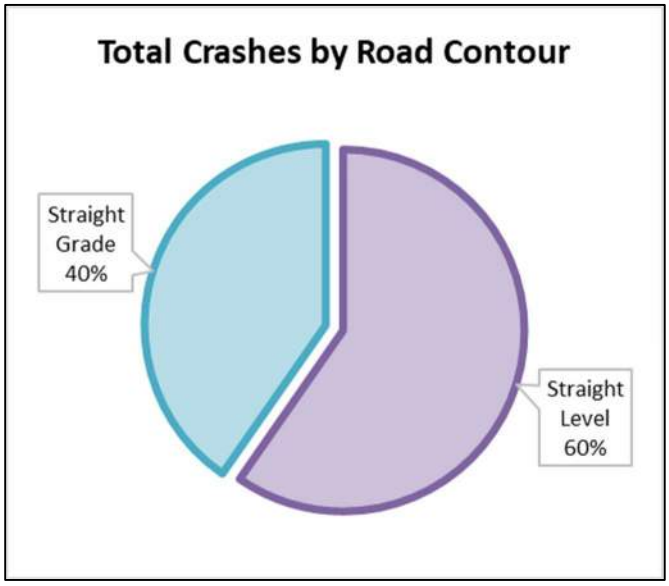


Figure 31. Crashes by Road Contour

Crash frequency is highest between 12 PM and 5 PM, with a peak at 3 PM. See Figure 32 for the distribution of crashes by hour of day. Recall from Table 1 that the peak traffic hours for AM, mid-day, and PM were 7:30-8:30, 11:45-12:45, and 4:15-5:15, respectively.

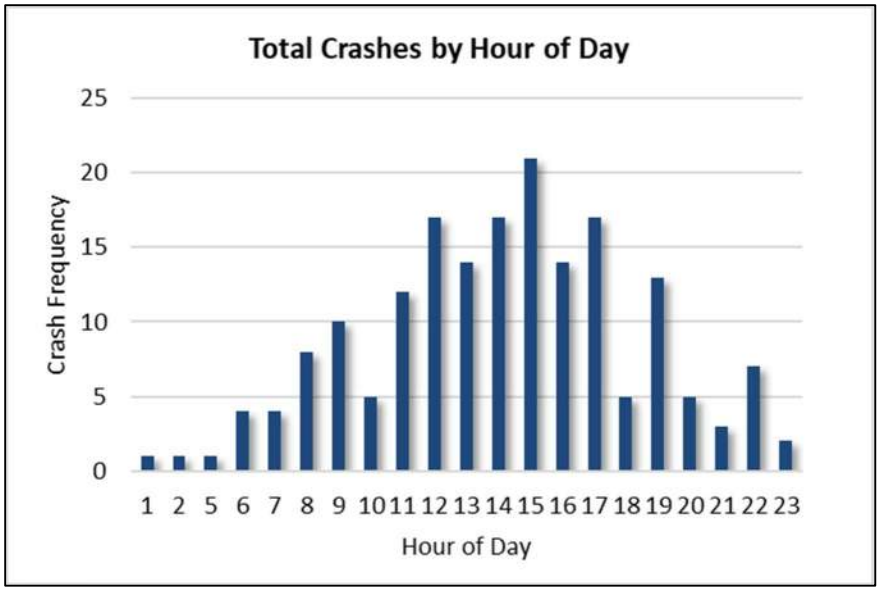


Figure 32. Crashes by Hour of Day

The months with the highest crash frequency were November with 24 crashes (13%), May and October with 18 crashes (10%), and June, August, and December each with 16 crashes (9%). See Table 4 for a summary of crashes by month.

Table 4. Crashes by Month

Month	Total Crashes
January	12
February	14
March	8
April	11
May	18
June	16
July	14
August	16
September	14
October	18
November	24
December	16
Grand Total	181

Most crashes (80%) occurred under dry roadway conditions. Wet road conditions contributed to 18% of all crashes. See the distribution of crashes by road condition in Figure 33.

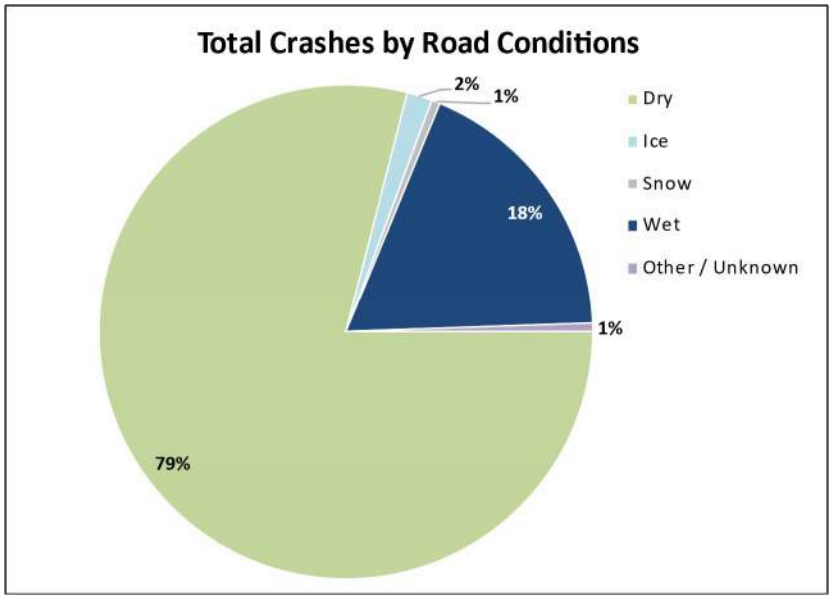


Figure 33. Crashes by Road Condition

See Table 5 for a depiction of crash frequency in 2020 – 2022 at each element within the corridor, as well as the proportion of these crashes that resulted in injury. Note that any crashes that occurred within the SLM ranges of both an intersection and a segment are counted in both elements.

Table 5. Crash frequency and injury proportion at each corridor element.

Element	SLM	Number of Crashes 2020-2022	Proportion with Injury
SR 304 and SR 193	1.97	39	33%
Perni Lane and SR 193	1.76	6	0%
SR 193 Corridor (north)	1.67-1.97	87	26%
WB I-80 Ramps and SR 193	1.67	20	25%
SR 193 Corridor (south)	1.35-1.67	28	29%
Liberty Street and SR 193	1.35	30	27%

C. Crash Graphs and Tables

Crash graphs and tables from the ODOT CAM tool are provided in Appendix B. The most relevant graphs pertaining to the crash analysis are discussed above.

D. Crash Diagram

Crash Diagrams displaying crashes from 2018 to 2021 can be found below in Figure 34 – Figure 40. Note that these diagrams do not include the most recent data from 2022 as otherwise reflected in earlier analysis discussions. These diagrams are also provided in Appendix C.

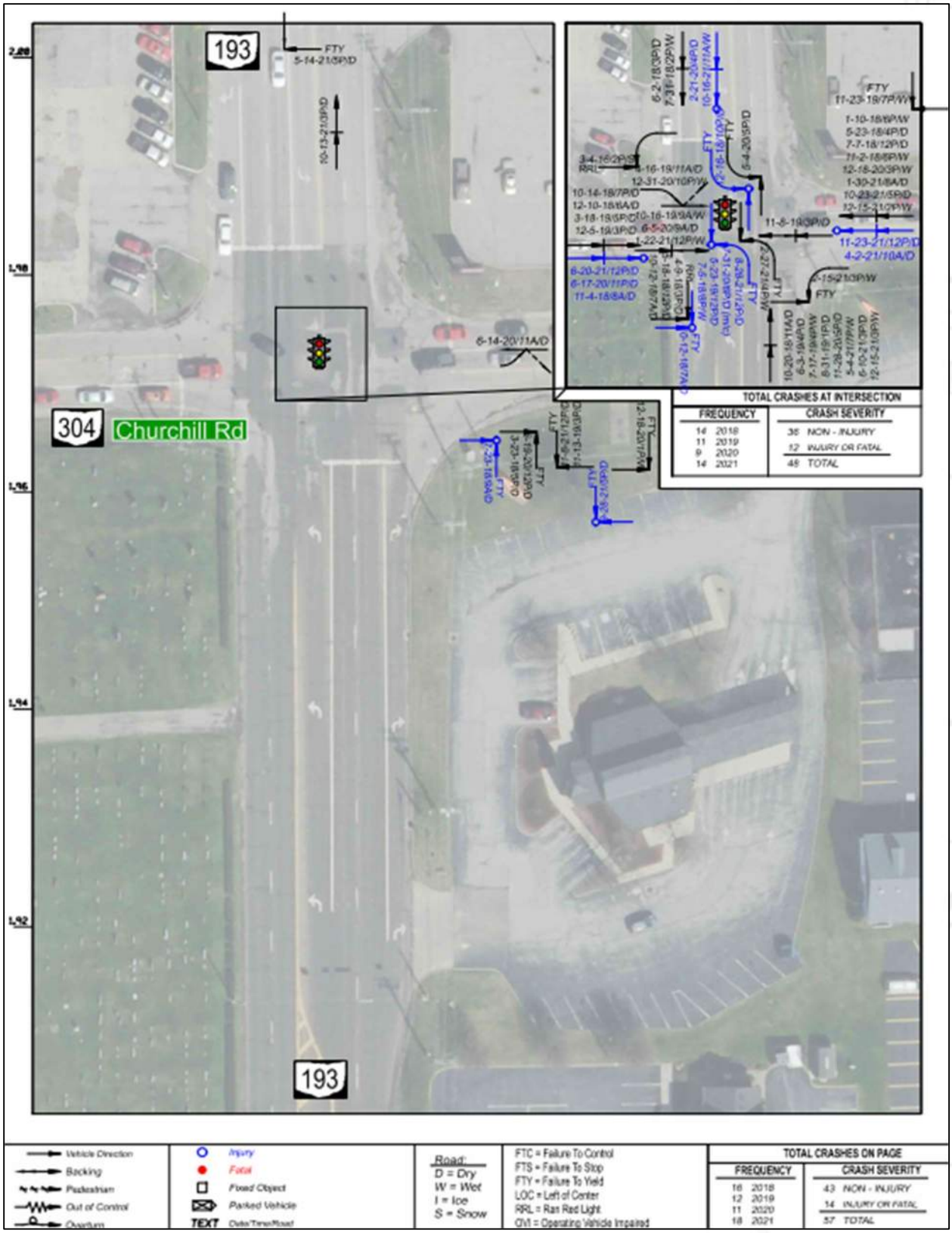


Figure 34. Crash Diagram: Churchill Road intersection to Church Hill Cemetery

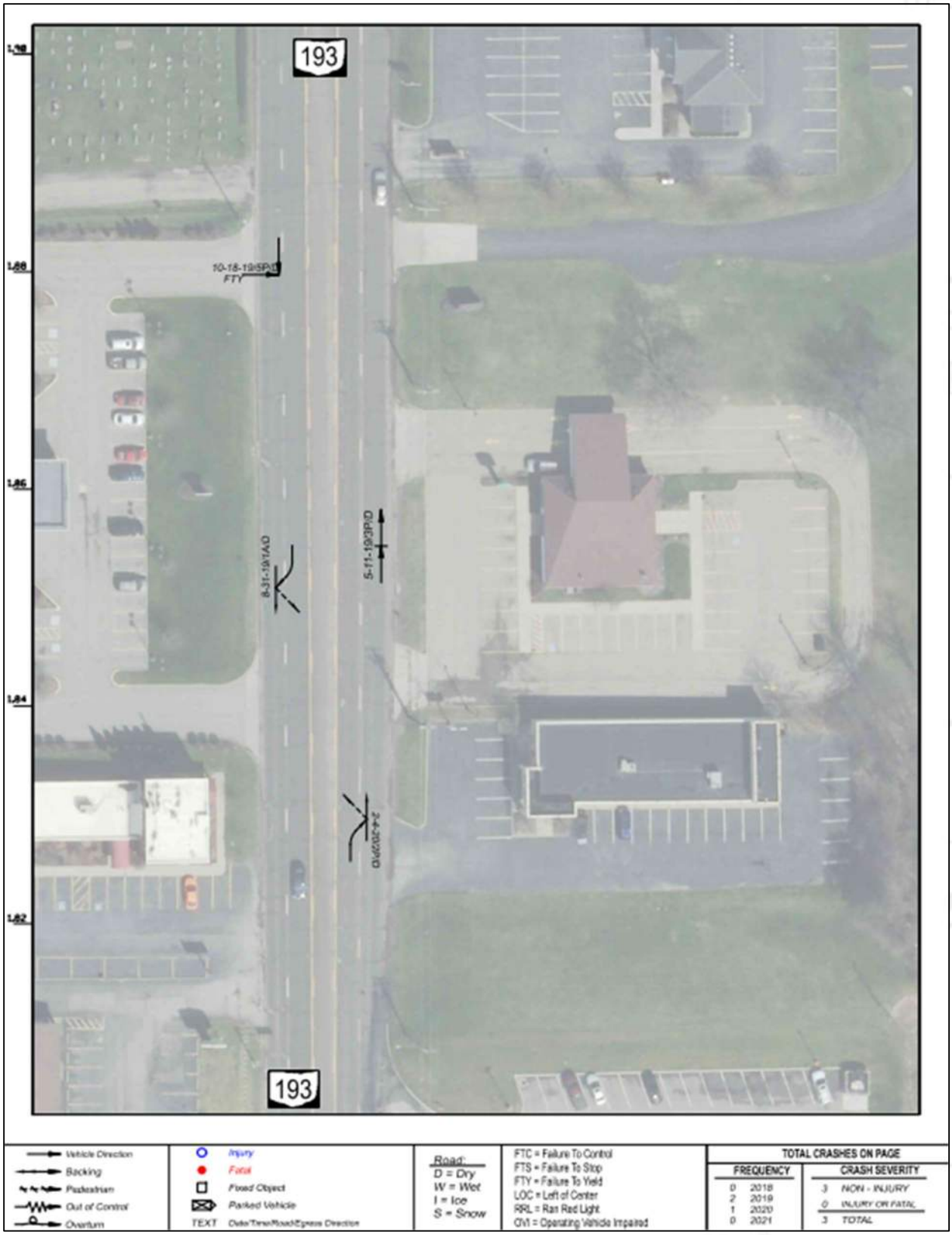


Figure 35. Crash Diagram: Church Hill Cemetery to Dunkin Donuts

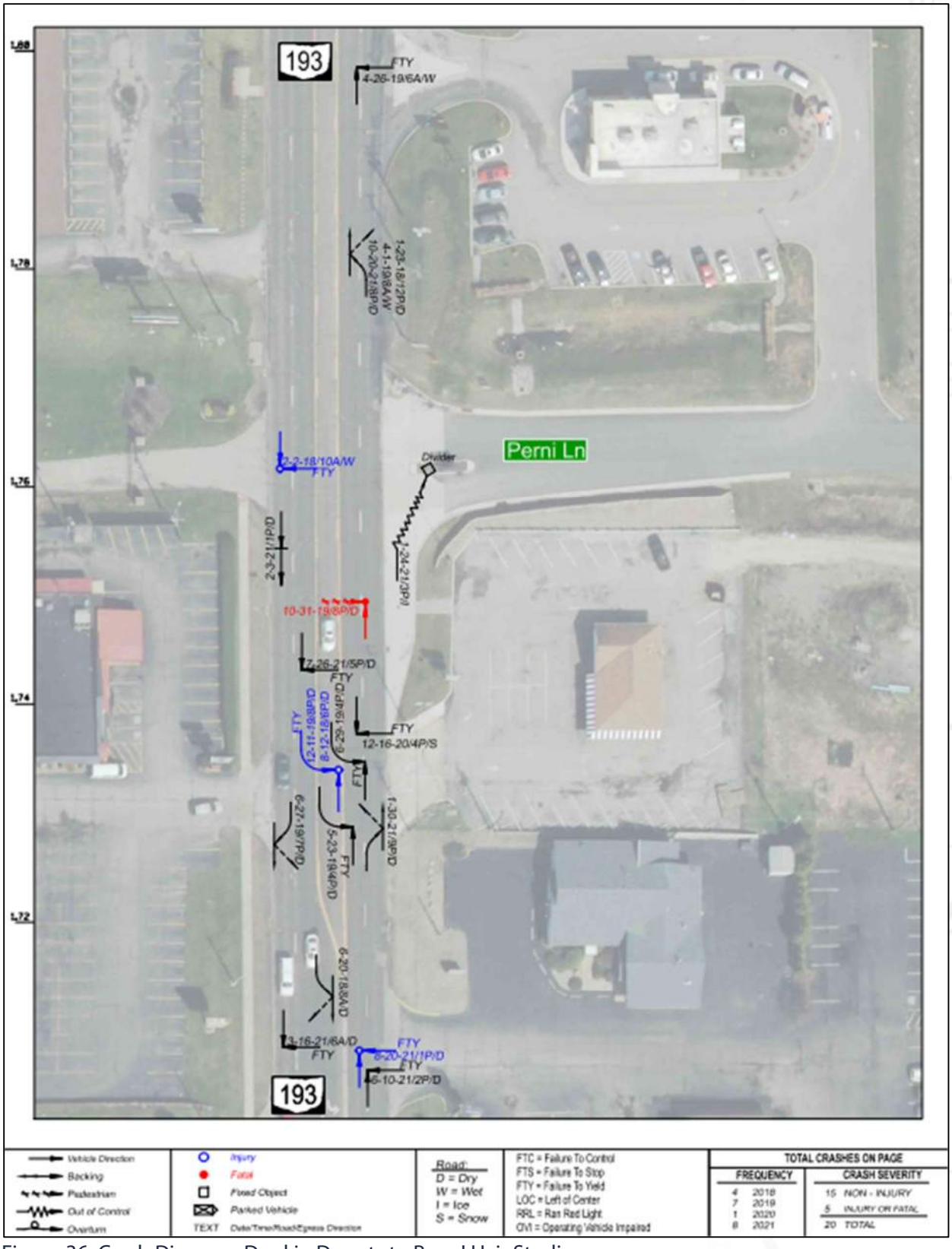


Figure 36. Crash Diagram: Dunkin Donuts to Bang! Hair Studio

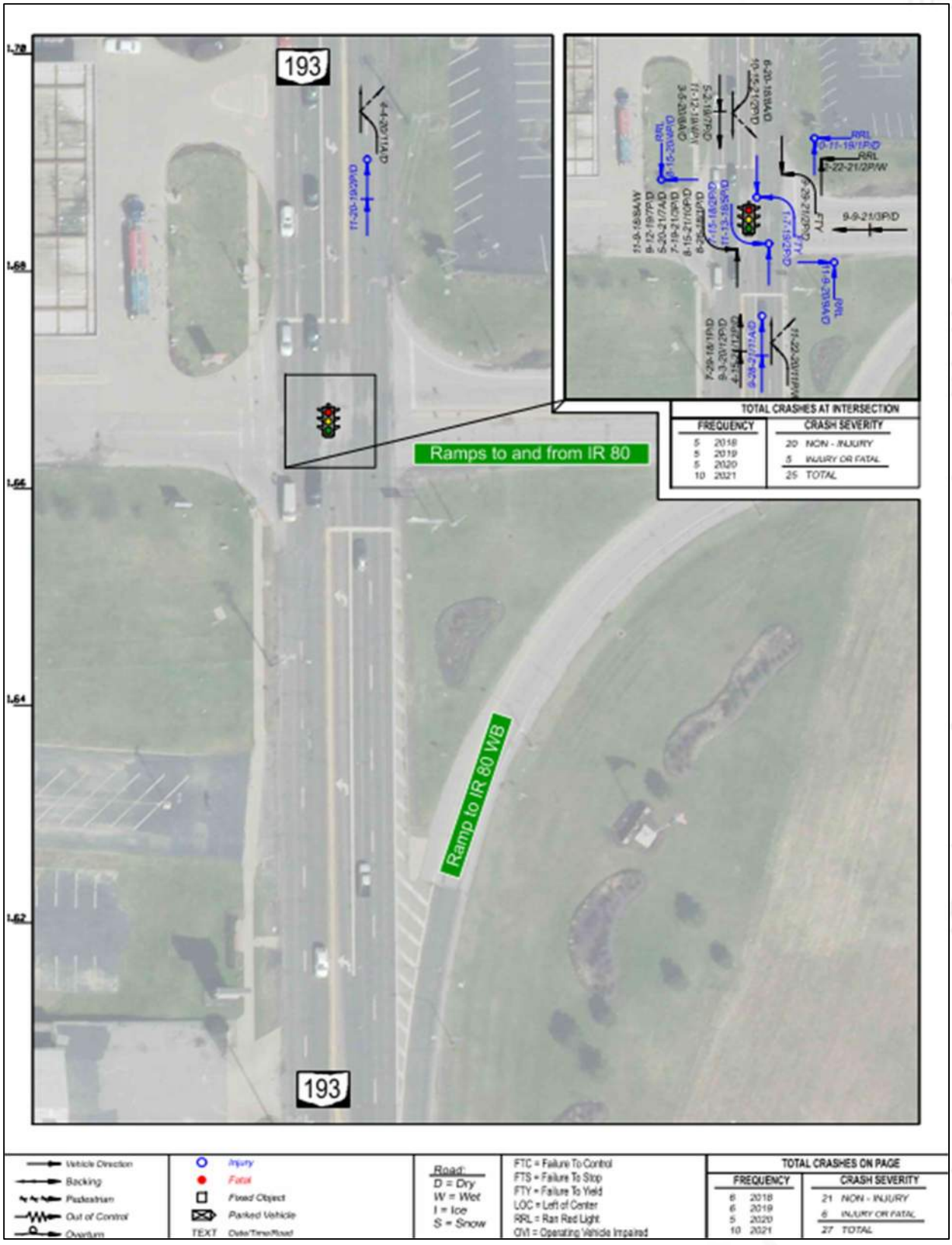


Figure 37. Crash Diagram: Bang! Hair Studio to I-80 Westbound Ramp

Figure 38. Crash Diagram: I-80 Westbound Ramp to I-80 overpass

Figure 39. Crash Diagram: I-80 overpass to Senor Jalapenos

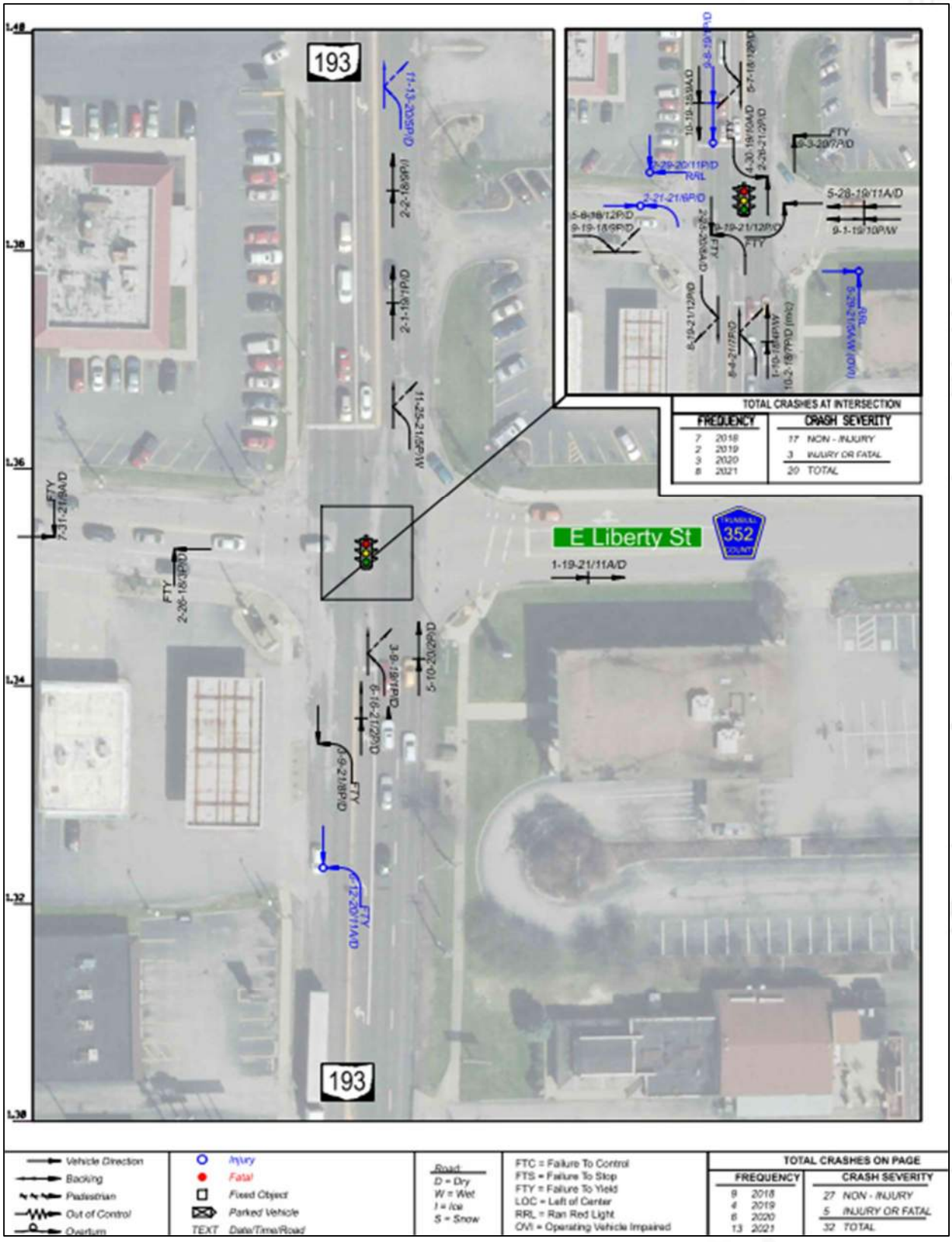


Figure 40. Crash Diagram: Senor Jalapenos to Liberty Street intersection

E. Crash Analyses

The traffic safety conditions of the study area are further evaluated by conducting a safety performance analysis based on the criteria and methodologies prescribed in the Highway Safety Manual (HSM). The HSM provides an analytical and statistical model for predicting frequency of crashes based on key features such as roadway type, roadway conditions, intersection geometry, and traffic data. The HSM model provides a way to quantitively evaluate the safety aspect of a particular segment of roadway and/or a particular intersection by comparing them to similar segments and intersections.

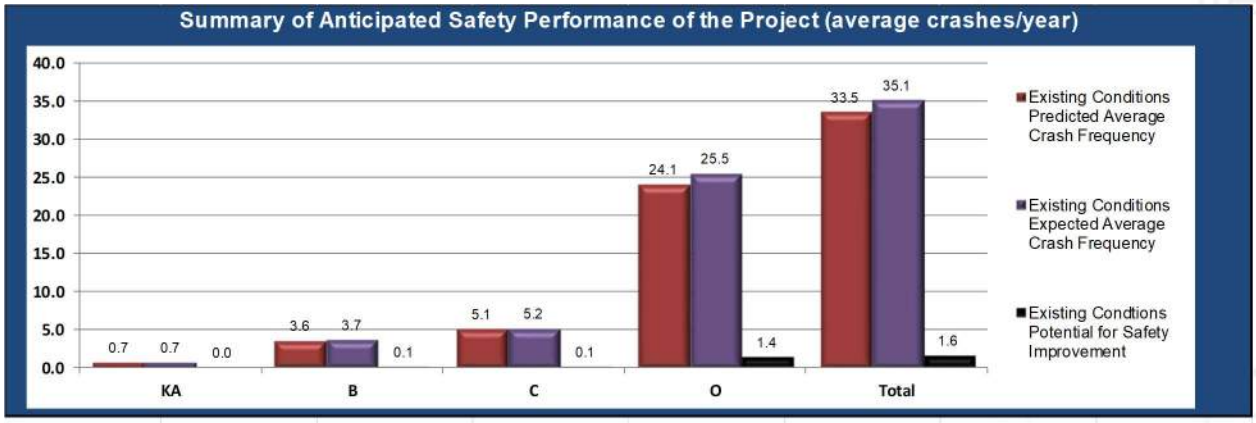
To facilitate the safety performance analysis, the ODOT Economic Crash Analysis Tool (ECAT) is used. This tool is a spreadsheet that can process the given crash data and, using the HSM crash predictive model, estimate the "predicted" and "expected" frequency of crashes along the subject corridor or at the subject intersection. These conditions are further described as follows:

Predicted Average Crash Frequency (crashes per year): Estimated average crash frequency for a site using the predictive HSM model adjusted for a given set of geometric conditions and traffic volumes. This reflects how the site is "predicted" to perform in comparison to peer sites.

Expected Average Crash Frequency (crashes per year): Estimated average crash frequency for a site with a given set of geometric conditions, traffic volume, and a known crash history. This reflects how the site is "expected" to perform in comparison to peer sites while taking actual historical crash performance into consideration.

If the Expected Average Crash Frequency is greater than the Predicted Average Crash Frequency, then the roadway segment or intersection being studied is indicated to be experiencing more crashes than anticipated for the given roadway conditions and traffic volumes. Thus, the segment or intersection is believed to have potential for safety improvements.

For the 0.6-mile segment of Belmont Avenue, the model provides an estimated Predicted Average Crash Frequency of 33.5 and an estimated Expected Average Crash Frequency of 35.1. These values denote that Belmont Avenue experiences a higher crash frequency than the HSM model predicts it should experience. Therefore, the calculated potential for safety improvements (predicted frequency minus expected frequency) is a positive value of 1.6. These values are displayed below in Figure 41. These values indicate that the study area has a positive potential for safety improvement, and this study proposes countermeasures to achieve it.



Project Summary Results (Without Animal Crashes)					
	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.6834	3.5895	5.1299	24.0739	33.4767
$N_{expected}$ - Existing Conditions	0.6913	3.6735	5.2476	25.4778	35.0902
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0079	0.0840	0.1177	1.4039	1.6135

Figure 41. ECAT summary of potential safety improvements

F. Probable Causes and Identification of Potential Countermeasures

The crash patterns throughout the study area point to several issues along Belmont Avenue and its intersections that negatively impact the crash frequency. The most likely and significant probable causes are:

1. Multilane Roadway Configuration

   Belmont Avenue is a high speed multilane roadway consisting of four travel lanes with periodic left turn lanes, center turn lanes, and concrete medians. Multilane roadways contain many conflict points. The Federal Highway Administration (FHWA) defines a conflict point as "any location where road users' paths coincide, categorized as either crossing, merging, diverging, or nonmotorized." With additional lanes comes additional conflict points, increasing the likelihood of crash types such as sideswipes, rear ends, or left turn angle crashes.

   Additionally, multilane roadways often encourage higher speeds. When drivers are presented with a wide roadway, they are likely to falsely perceive that it's safe to drive faster since there's more space available for recovery if an error were to occur. However, higher speeds reduce reaction times, increase crash severity, and create a less safe environment for road users of all modes.

   Multilane roadways also attract higher traffic volumes as drivers often perceive the presence of additional lanes to be an opportunity to support additional traffic. However, an increase in attracted traffic leads to vehicles driving in closer proximity, further worsening the chance of collisions.

Finally, multilane roadways present a complex environment for all road users. Drivers are presented with more visual information, such as signs and other vehicles, which can become overwhelming and lead to errors in decision making. Similarly, the complexity of multilane roadways affects pedestrians and cyclists since the presence of multiple lanes is more difficult to cross, both due to the physical distance of the crossing and the volume of traffic which must be avoided when crossing. If a pedestrian or cyclist makes an error, the stakes are much higher, as these vulnerable road users are much more susceptible to experiencing higher severity of crashes than their vehicular counterparts.

Traffic calming measures, such as road diets, lane narrowing, medians, and the use of vertical elements, are potential countermeasures that can address the various probable causes associated with multilane roadways.

2. Frequent Access Points

Like the previous contributing factor of multilane roadways, the presence of frequent access points along a roadway also increases the number of conflict points, decreasing safety for all road users. As vehicles enter and exit these establishments, they create additional crossing, merging, diverging, and nonmotorized conflict points that increase the likelihood of collisions.

There are numerous access points along both sides of Belmont Avenue, servicing restaurants, banks, hotels, and many other commercial businesses. The presence of these access points likely influences the crash frequency of the two highest contributing crash types: Rear End (32% of total crashes) and General Angle (43% of total crashes). Recall that General Angle crashes refer to the composition of left turn, right turn, and angle crashes.

Traffic on Belmont Avenue is likely traveling at or around the posted speed limit of 40 mph. When drivers reduce their speed to merge into the center turn lane or to turn into a driveway, the drivers behind them may not be anticipating slower speeds or stopped traffic, resulting in a rear end crash.

Similarly, the frequency of access points on Belmont Avenue likely contributes to the high percentage of general angle crashes. Left turns were the most frequent type of general angle crash with 24 crashes (21% of total crashes). When turning left to access these establishments, drivers must make their movements during an adequate gap in the opposing traffic, or "shoot the gap," which the crash data proves is not always successful.

The nonmotorized conflict points mentioned above refer to the additional crossings that pedestrians and cyclists must make at each additional access drive. These conflict points require additional attentiveness from nonmotorized users, worsening the experience of vulnerable road users as traveling safely becomes increasingly more difficult.

Potential countermeasures to address a high frequency of access points are to reduce or combine access points where possible, restrict access points to right-in right-out (RIRO), and to create a shared access road that joins multiple locations.

3. Insufficient Lighting

As discussed in the GORE model findings, lighting throughout the corridor is infrequent and inconsistent. During the study period of 2018 – 2022, 37 crashes (20.4% of total crashes) occurred in dark conditions. Of these, 35 were reported under "Dark - Lighted Roadway" conditions, indicating that sufficient lighting was present nearby. However, the available lighting is likely to be insufficient for drivers, particularly between the I-80 westbound ramps and Churchill Road. In this approximately 0.3-mile segment, there are four streetlights present. In contrast, there are also four streetlights present between the I-80 westbound ramps and the I-80 overpass – a segment of half the length. Therefore, insufficient lighting is likely to be a contributing factor of numerous crashes that occurred throughout the corridor, and especially between the I-80 westbound ramps and Churchill Road, despite the reported conditions in the crash data.

The poorly lit segment between the I-80 westbound ramps and Churchill Road also hosts many changes in slope with a peak elevation of 1076 near the right turn slip lane for I-80 westbound. The elevation drops to 1062 near Perni Lane and rises again to 1066 near Hampton Inn and Church Hill Cemetery. With insufficient lighting and a hilly terrain, visibility can be greatly affected during darker hours.

Additionally, the month of November was cited for having the highest frequency of crashes, with 24 crashes (13.3%) over the five year period. The beginning of November also hosts the end of daylight savings time where the sun begins to set an hour earlier. This increase in dark hours beginning in the late afternoon is likely to be a contributing factor to the month's high crash frequency.

A major consequence of insufficient lighting is reduced visibility. Without proper lighting, drivers have a limited ability to see the road, obstacles,

pedestrians, cyclists, and other vehicles clearly, increasing the likelihood of crashes in low-light conditions or at night.

This reduced visibility leads to an **increased risk for pedestrians and cyclists**. Reduced visibility can make it harder for drivers to notice pedestrians and cyclists, especially at crosswalks or intersections, heightening the risk of accidents involving vulnerable road users.

Insufficient lighting also leads to **slower reaction time** for drivers. Without adequate lighting, it takes longer for drivers to detect and react to hazards, leading to higher chances of collisions.

Similarly, insufficient lighting results in **impaired depth perception**. Poor lighting affects a driver's ability to perceive depth and speed accurately, which can result in misjudging distances and cause unsafe maneuvers.

By combining the harmful effects of insufficient lighting, drivers may struggle to accurately judge distances or follow the road's curvature. This can result in a **higher risk of rear-end and run-off-road crashes**.

Though there is lighting infrastructure presently available along Belmont Avenue, a recent site visit during dark hours revealed that some bulbs were burnt out. In addition to installing new lighting along the corridor, incorporating more frequent maintenance of the existing infrastructure can enhance roadway visibility in the future.

4. Lack of Pedestrian Infrastructure

   In the years 2018 – 2022, there was one pedestrian crash, which led to the loss of life. Prior to this study, there have been other pedestrian involved crashes. Despite this, a crash history showing evidence of pedestrian crashes is not necessary to establish that an area is unsafe for pedestrian travel. Instead, merely the presence of elements (geometry, lack of infrastructure, vehicular speeds, active transportation need and demand, etc.) that are known to cause pedestrian crashes is sufficient to identify a corridor unsafe for active modes of transportation. Pedestrians are far less resilient than vehicles when involved in a crash, which prompts further attention on pedestrian safety and infrastructure during roadway design. Therefore, despite the infrequency of pedestrian crashes in comparison to vehicular crashes, it is pertinent that pedestrian traffic in the study area be provided adequate infrastructure to prevent future pedestrian crashes, injuries, and fatalities.

Presently, there is minimal sidewalk along the east side of the 0.6-mile corridor, including a small stretch of sidewalk under the I-80 overpass. There is sidewalk on the west side of Belmont Avenue but only from Liberty Street to Perni Lane. As witnessed during the site visit, there is a heavy presence of pedestrian traffic throughout this studied segment of Belmont Avenue.

A major source of pedestrian traffic is likely to be the nearby WRTA bus stops. There are six WRTA stops located within the study limits: two at the Liberty Street intersection, two near the Motor Inn Drive intersection, and two near Hampton Inn. There is no sidewalk present at three of these six stops, meaning bus patrons must walk or bike through the grass to reach these stops or upon exiting the bus.

Notably, the northbound *Belmont Ave & Motor Inn Dr* WRTA stop is located on the east side of Belmont Avenue, just north of the I-80 overpass and south of the I-80 westbound slip lane. Bus riders at this stop are faced with choosing one of three undesirable and unsafe options when traveling to or departing from the bus, each depicted in Figure 42:

1. Walk north, traveling in the grass and crossing a slip-lane entrance ramp to the interstate which encourages vehicular acceleration (green)
2. Walk south through the grass. If wishing to cross Belmont Avenue, this route leads to the nearest marked crosswalk at Liberty Street (red)
3. Cross Belmont Avenue mid-block with no protection from vehicular traffic (blue)

Figure 42. Pedestrian Routes for WRTA Bus Riders

If a pedestrian needs to reach the west side of the road from this bus stop, they will likely choose between the red and blue routes, as the green route does not lead to any marked crosswalks. The red route requires pedestrians to walk approximately 0.2 miles to the south prior to crossing. If their destination is north of the bus stop, this results in a detour almost half a mile long. Since many pedestrians may not be willing to travel this extra distance, either due to the extra time it takes or their own limited mobility, they often choose the blue route instead. During the site visit, multiple pedestrians were seen crossing mid-block. Recall Figure 16 where a pedestrian was observed crossing Belmont Avenue under the dimly lit I-80 overpass.

As shown below in Figure 43, there are numerous destinations in the study area that generate pedestrian traffic in addition to the WRTA bus stops. These include hotels, restaurants, a park, banks, coffee shops, residential neighborhoods, schools, and places of work. Combined with the WRTA stops discussed above, there are many attractions for pedestrians that influence pedestrian traffic along the corridor. Figure 43 uses yellow arrows to identify locations where pedestrians are likely to cross Belmont Avenue to reach these destinations.

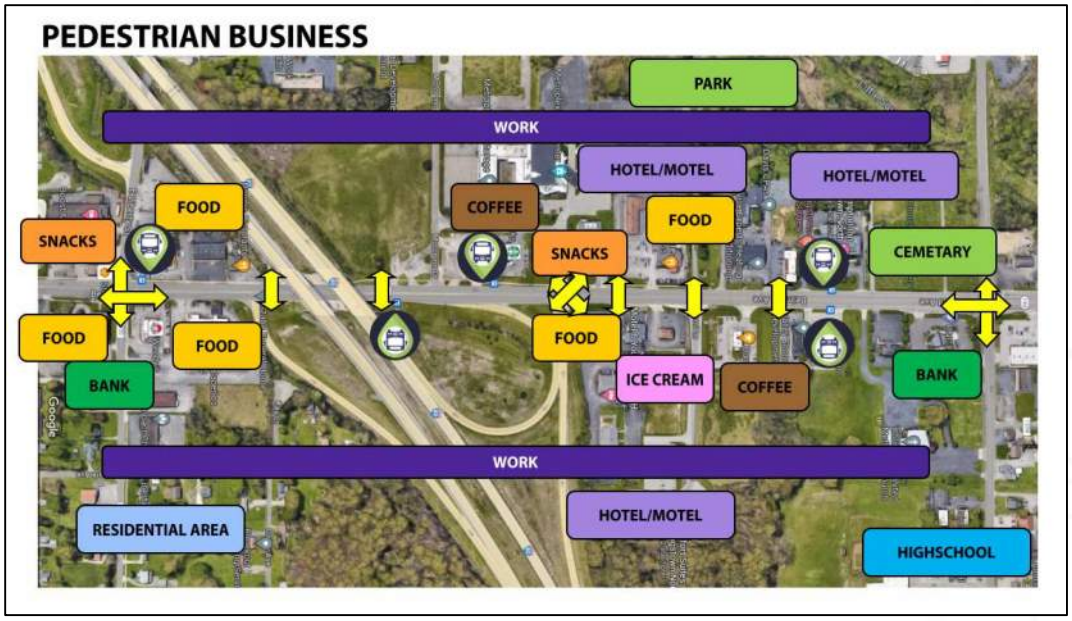


Figure 43. Pedestrian destinations in the study area

Despite the numerous theorized crossing locations indicated by the yellow arrows, there is only one marked pedestrian crossing on Belmont Avenue in the study area. This crossing is located on the northbound approach of the Liberty Street intersection. As discussed above, navigating to the only nearby marked crossing is very inconvenient, likely leading to pedestrians ignoring it altogether and crossing mid-block throughout the corridor. The National Association of City Transportation Officials (NACTO) states in their Urban Street Design Guide, "In general, if it takes a person more than 3 minutes to walk to a crosswalk, wait to cross the street, and then resume his or her journey, he or she may decide to cross along a more direct, but unsafe or unprotected, route." At the site visit, pedestrians were seen crossing Belmont Avenue at two of the mid-block locations indicated by the yellow arrows rather than navigating to the Liberty Street intersection. NACTO recommends locating pedestrian crossings as per current or projects pedestrian desire lines, i.e. the yellow arrow locations. NACTO also states to "balance their placement with that of the motorized traffic network, so as to not severely compromise either." Therefore, future improvements to pedestrian crossings should adequately serve the local pedestrian traffic but should be installed with limited negative effect to vehicular traffic.

Pedestrians may also be choosing to cross mid-block instead of at an intersection because it can feel safer. Crossing mid-block only requires a pedestrian to check two directions of traffic prior to crossing. One pedestrian at the site visit was witnessed crossing one direction at a time, pausing in the median before continuing to cross the opposite direction.

This shows that pedestrians may feel comfortable crossing mid-block by only having to check one direction at a time. At an intersection, a pedestrian must check each of four approach directions simultaneously, paying extra attention to turning vehicles, including unexpected right turns on a red light. This extra amount of required attentiveness is likely daunting to pedestrians and puts additional pressure on them to make fewer errors, or risk losing their life. Unless marked crossings with high driver visibility and user-friendly pedestrian signals are provided throughout the corridor, pedestrians are likely to continue to cross Belmont Avenue at unmarked mid-block locations.

Routes involving unprotected mid-block crossings and walking in the grass next to high speed traffic sound undesirable to the average pedestrian. Yet, these routes are entirely impossible for those in wheelchairs or with other forms of limited mobility to traverse. Many people who are elderly, disabled, or are otherwise limited in mobility are likely to also be unable to drive a car, or they may not even own a car. Without the ability to walk or drive along Belmont Avenue, these individuals are prevented from reaching certain destinations entirely. With the implementation of safety-focused countermeasures, Belmont Avenue can better meet the needs of many elderly and disabled individuals.

When combined with the insufficient lighting discussed above, a lack of pedestrian infrastructure throughout the study area creates an unsafe environment for pedestrians. Addressing these concerns can reduce the likelihood of pedestrian crashes.

Potential countermeasures to address this probable cause include installing sidewalks, ADA compliant curb ramps, high-visibility crosswalks, pedestrian hybrid beacons, rectangular rapid flashing beacons, and other types of pedestrian-centered infrastructure.

5. Challenging Signalized Intersections

There are three signalized intersections with Belmont Avenue in the study area: Liberty Street, I-80 Westbound Ramps, and Churchill Road. During the 2018-2022 study period, these three intersections hosted 44, 25, and 67 crashes, respectively. The most common crash type at Churchill Road intersection was rear end crashes. Angle crashes and left turn angle crashes tied for the second most common crash type. Rear end crashes were also the most common crash type at the Liberty Street intersection, though angle crashes and sideswipe – passing crashes tied for the second most common crash type. The most common crash type at the I-80 Westbound

Ramp intersection was left turn angle crashes, followed by rear end crashes.

The historical frequencies of rear end and angle crashes may be influenced by the existing signal timing. These crash types can arise from the presence of a long dilemma zone. The dilemma zone is the area on the approach to an intersection where, when experiencing a phase change from green to yellow, a driver may not be able to stop comfortably before the stop bar but also may not be through the intersection prior to the phase change to red. If the driver chooses to apply the brakes sharply, a rear end crash may result. If the driver chooses to continue through the intersection, they may strike a crossing vehicle, resulting in an angle crash.

The other common crash type, left turn crashes, commonly occurs when a driver fails to yield to another in the opposite direction. When drivers need to turn left, sight challenges such as hill crests, sun glare, or insufficient lighting can make it difficult to properly identify a sufficient gap in opposing traffic.

In addition to the pedestrian-focused improvements at these intersections, additional countermeasures such as reflective backplates, all-red time, protected left turns, and reduced access drives in close proximity can further reduce crashes at the three signalized intersections.

G. Evaluation of Countermeasures and Alternatives

The most effective countermeasure(s) to implement are those that address the crash problem and probable causes determined from crash data and field observations. ECAT is used to evaluate proposed countermeasure performance based on proposed predicted crash frequency. Many safety improvement countermeasures have been studied and assigned crash modification factors (CMFs) to estimate the change in the number of crashes after a countermeasure is implemented, indicating a decrease if the CMF is below 1.0, an increase if it is above 1.0, or no change if it is exactly 1.0. CMFs can be used in the ECAT analysis to compute the expected number of crashes after the implementation of a specific countermeasure.

Funded by the U.S. Department of Transportation Federal Highway Administration and managed by the University of North Carolina Highway Safety Research Center, the CMF Clearinghouse (accessible at www.CMFClearinghouse.org) serves as a centralized online repository for CMFs and related resources. It provides transportation professionals with an updated collection of CMFs, a platform for sharing new CMFs, and educational resources on CMF application and development. The Clearinghouse uses a star rating system to evaluate the quality

and reliability of CMFs based on study design, statistical methods, sample sizes, and significance, with scores up to 150 points translating to a star rating from 1 to 5, where 5 represents the highest quality (scores between 135 and 150).
In some cases, changing the geometry or operations of a segment or intersection changes the safety performance function (SPF) without the application of a specific CMF. In these cases, the proposed configuration is modeled in ECAT with or without additional safety improvement countermeasures and CMFs applied.

Multiple countermeasures can be applied in parallel, and this is often the final recommendation. In practice, applying several countermeasures at once has positive and multiplicative impacts, but somewhat diminishing returns. ECAT does not accurately model the outcome that is likely when more than three countermeasures are applied concurrently to an intersection or roadway segment. For a conservative prediction of proposed crash frequency, some countermeasures are omitted from the ECAT analysis although still included in the proposed configuration.

The potential countermeasures to address the aforementioned probable causes are described below.

1. Traffic Calming on a Multilane Roadway

   A common method of traffic calming is implementing a road diet. A road diet is the process of reducing the number of travel lanes within a road or decreasing lane widths. This reconfiguration provides extra space which can be reallocated for enhanced bicycle or pedestrian infrastructure, such as widened sidewalks or bike lanes. This extra space could also be reallocated for street parking. A road diet is a form of traffic calming, as smaller or fewer lanes can motivate drivers to operate at lower speeds, enhancing safety for all road users. However, due to the AADT of Belmont Avenue, this treatment may not be desirable.

   While a road diet may not be feasible for the study area, other measures of traffic calming can still be applicable. One method of traffic calming is the addition of medians. Medians – as low, narrow concrete barriers – presently exist in the study area from Liberty Street to approximately 220 feet north of the I-80 westbound ramp intersection. In addition to the existing medians, a wide median can be constructed to accommodate the two-stage pedestrian hybrid beacon (PHB) crossing, which will be discussed later in this report. The presence of medians makes drivers feel that they have less room to operate, creating discomfort and the desire to drive at a lower speed, therefore calming traffic. This lowering of speeds is especially important when approaching the location of a pedestrian

crosswalk, as this creates a safer environment for pedestrians and prepares drivers to slow, or stop, to comply with the PHB signal.

2. Access Management

One potential countermeasure to increase safety along Belmont Avenue is the removal or restriction of access points. This countermeasure can be applied to businesses or parcels which currently utilize multiple access drives or have access drives that are larger than necessitated. By having fewer access points, there will be fewer conflict points, possibly preventing future crashes. Limiting access points also increases safety for pedestrians walking along the sidewalk who must cross multiple driveways to reach their destination, increasing their exposure to possible crashes. Similarly, adjusting the width of existing access drives enhances safety for all road users as vehicles are better channelized into the access point and pedestrians have a shorter distance to cross, shortening their exposure time.

Similarly, access points can be restricted to right-in right-out on Belmont Avenue. This would prohibit left turns, likely preventing left turn crashes, and would reduce the number of conflict points. For example, Dunkin Donuts currently has right-in right-out (RIRO) access on Belmont Avenue, decreasing the likelihood of left turn crashes at this location. CMF 9821 *Install Right-In-Right-Out Operations at Stop-Controlled Intersections* can be utilized in the ECAT analysis at existing access points along Belmont Avenue. This CMF has a value of 0.55 and can be applied to stop-controlled three leg intersections, such as those at the existing commercial driveways and access points.

As discussed previously, medians presently exist in the study area from Liberty Street to approximately 220 feet north of the I-80 westbound ramp intersection. Some portions of these medians are relatively small in width and/or height, likely leading to increased driver comfort in driving over them. This can be inferred due to existing damage and tire marks visible on the medians. Therefore, at some locations where a median inherently restricts driveways to RIRO, additional access restrictions, such as signage and triangular medians in the access drive, can be installed to further defer drivers from making this dangerous choice.

There are locations throughout the study area where access points can be removed, restricted to RIRO, or decreased in width. These locations and their proposed treatments are also depicted in Figure 54 through Figure 58.

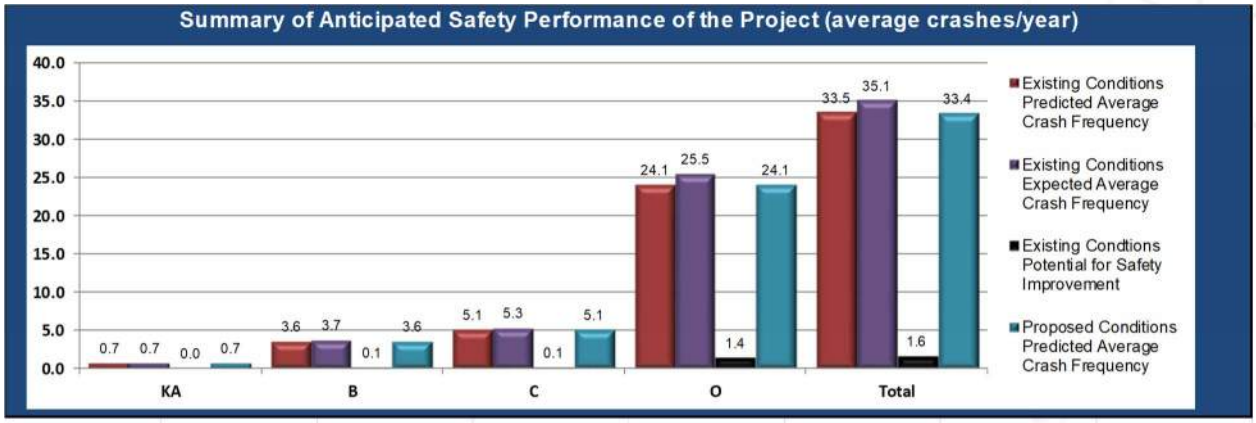
Another method of access management is to provide one shared access drive for multiple parcels or businesses. For example, an access road currently exists within the study limits, beginning at Motor Inn Drive and terminating at the I-80 westbound ramp intersection. This road provides access to Starbucks, Chipotle, Speedway, and the Metroplex Expo Center. If each of these businesses had their own access points on Belmont Avenue, the number of conflict points would greatly increase, likely increasing the frequency of both Rear End and General Angle crashes. Since the existing access road terminates at the I-80 westbound ramp intersection, traffic turning left to enter or exit these establishments can do so at one signalized intersection where northbound left turns have a protected signal phase and where slower speeds, stopped traffic, and turning movements are more likely to be anticipated by other drivers. With the current geometry of Belmont Avenue and the placement of adjacent buildings, the project team does not recommend construction of additional shared access drives, as there is not enough room to do so presently. This countermeasure would be more desirable if lane(s) were removed or restriped to decrease width, creating extra space which could be reallocated for a shared access drive.

3. Lighting Improvements

   To combat the insufficient lighting discussed on pages 46 and 47, more lighting can be installed along Belmont Avenue. This installation is recommended to take place between the I-80 westbound ramps and Churchill Road. Additional lighting along this roadway will enhance visibility for drivers during darker hours of the day. It will also help drivers anticipate what's ahead of them during hilly sections where motor vehicle headlights might provide sufficient visibility. Enhanced visibility creates a safer environment for road users of all modes and is likely to decrease crash frequency during times when the sun can no longer adequately illuminate the roadway. CMF 7783 *Install Lighting* can be utilized along segments of Belmont Avenue where there is currently insufficient lighting. This CMF has a value of 0.74 and applies to crashes on urban minor arterials that occur at night.

   When CMF 7783 is applied to the prioritized segment using the ECAT tool, the crash frequency is predicted to slightly decrease. The Proposed Conditions Predicted Average Crash Frequency is calculated to be 33.4 crashes per year. This is a 0.3% decrease from the Existing Conditions Predicted Average Crash Frequency and a 4.8% decrease from the Existing Conditions Expected Average Crash Frequency. One reason for this low reduction in crash frequency can be the attributes of the analyzed crash

data. Of the 35 crashes that were reported under "Dark – Lighted Roadway" conditions, 21 crashes occurred in the segment between the I-80 westbound ramps and Churchill Road. While this portion of roadway does contain streetlights, it is understood in this report that the available lighting is insufficient and limits driver visibility, reaction time, and depth perception. As a result, ECAT likely does not consider these crashes as those which would be affected by the addition of roadway lighting as defined in the CMF, limiting the potential for crash reduction. It is believed by the project team that the installation of lighting throughout the corridor, notably between the I-80 westbound ramps and Churchill Road, is likely to produce lower crash rates than the ECAT results suggest. See Figure 44 for these results.



Project Summary Results (Without Animal Crashes)					
	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.6849	3.5971	5.1370	24.1124	33.5314
$N_{expected}$ - Existing Conditions	0.6928	3.6809	5.2547	25.5137	35.1421
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0079	0.0838	0.1177	1.4013	1.6107
$N_{predicted}$ - Proposed Conditions	0.6806	3.5873	5.1234	24.0576	33.4489

Figure 44. ECAT Results using CMF 7783 *Install Lighting*

In addition to installing new lighting, maintaining existing lighting is greatly impactful on providing sufficient lighting for road users. Ensuring functionality of existing and new streetlights can enhance the safety of Belmont Avenue during non-daylight hours.

4. Install Pedestrian Infrastructure

New pedestrian infrastructure can be installed throughout the study area to decrease the likelihood of future pedestrian crashes and to create a safer transportation system for all road users. Pedestrian infrastructure such as sidewalks and crosswalks can be simple yet valuable assets in ensuring pedestrian safety. However, if a sidewalk network lacks connectivity, as it does on Belmont Avenue, pedestrians are placed in an

unsafe environment as they must navigate these gaps on foot through grass and other terrain with the looming threat of vehicles traveling just feet away. This becomes especially difficult for individuals with limited mobility, such as elderly pedestrians and pedestrians with disabilities. The existing sidewalk on Belmont Avenue provides a safe place for pedestrians to walk, offset from the adjacent vehicular traffic. However, when pedestrians need to cross Belmont Avenue, they must cross a five-lane road without any protection from vehicles moving at around 40 mph. Therefore, if new pedestrian infrastructure is to be installed, it must be incorporated into a well-connected and continuous network that spans throughout the entire study area and beyond.

The foremost priority in enhancing pedestrian infrastructure along Belmont Avenue is to install sidewalks where none presently exist. These sidewalks are to be installed in conjunction with curb ramps and high-visibility crosswalks at each intersection. When applying these improvements to the area with the ECAT tool, CMF 4123 *Install High-Visibility Crosswalk* can be utilized. The CMF value was found to be 0.6 and applies to pedestrian crashes at urban intersections.

Figure 45 below compares two styles of crosswalk markings. The left image shows two low-visibility crosswalks in the standard marking style. These markings do not grab drivers' attention, lessening the likelihood that drivers perceive the possible presence of a crossing pedestrian. Also, as cars drive over these markings, the paint fades quickly, lessening their effectiveness over time. In contrast, the right image shows four high-visibility crosswalks in the continental marking style. Not only does this style grab drivers' attention, but the markings can also be designed to align with tire paths, preventing the paint from being worn away as quickly as the standard design.

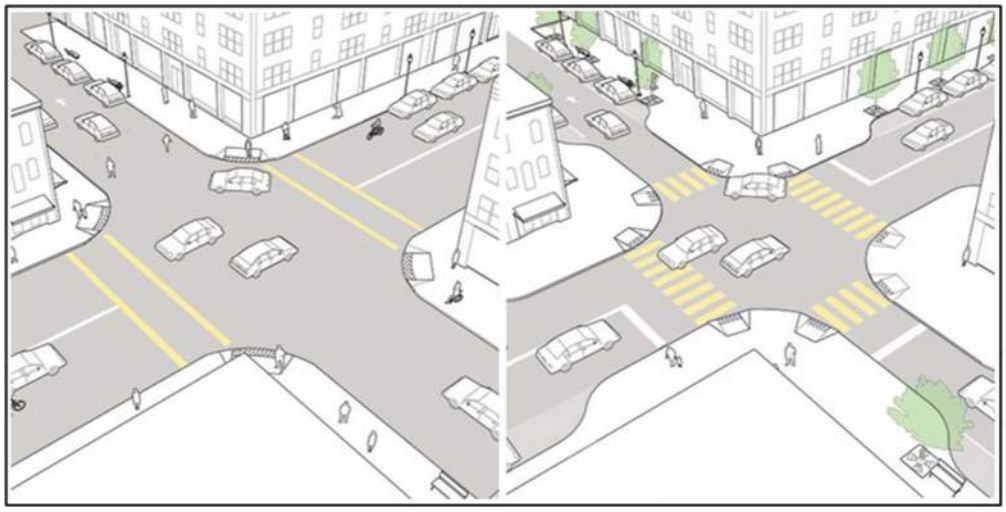


Figure 45. Comparison of traditional vs. high-visibility crosswalk markings

As mentioned in the GORE model discussion, the intersection at Liberty Street has pedestrian signals and push buttons but the intersections at Churchill Road and the I-80 westbound ramps do not. To further improve pedestrian safety when crossing Belmont Avenue, pedestrian signal heads with countdown timers and push buttons are recommended to be present at each intersection. This would require the installation of new signals and push buttons at Churchill Road and the I-80 westbound ramps, as well as the replacement of signal heads at Liberty Street. The predicted success of this countermeasure is quantified with CMF 5273 *Install Pedestrian Countdown Timer* which can be utilized in the ECAT analysis. This CMF has a value 0.45 and applies to pedestrian crashes at signalized intersections. Figure 46 depicts instructional signage to be utilized in conjunction with a pedestrian countdown timer.

Figure 46. Count-Down Pedestrian (R10-3e) Signage

Additional signage can be installed to further enhance driver awareness of pedestrians at intersections. Pedestrians commonly choose to cross mid-block on Belmont Avenue, likely due to the amount of attention required by pedestrians at a four-way intersection. Though pedestrians and vehicles traveling in the same direction receive signalization at the same time, left-turning vehicles may approach quickly and have limited visibility of pedestrians in the crosswalk. Vehicles turning right on red can present similar challenges for pedestrians. Altogether, this requires pedestrians to check all four approaches prior to entering the crosswalk, which can feel like a daunting task for vulnerable road users. Placing an R10-15 sign (depicted in Figure 47) next to a traffic signal can enhance driver awareness of nearby pedestrians, likely leading to safer crossings. If pedestrians can feel safer in the presence of turning vehicles at busy intersections, they may be more likely to avoid crossing at a mid-block location. Note that Figure 47 shows an R10-15L sign, since the sign is directed towards left-turning vehicles. An R10-15R sign, directed towards right-turning vehicles, is also available for installation.

Figure 47. Turning Vehicles Must Yield to Pedestrians (R10-15L) Signage

Drivers can also become more aware of pedestrians in crosswalks with the use of Leading Pedestrian Intervals (LPIs). An LPI gives pedestrians an advanced walk signal, typically about three to six seconds before motorists receive a green signal. This allows pedestrians to enter the roadway prior to vehicles, increasing their visibility and the likelihood that vehicles will yield to them.

Additional pedestrian treatments can be implemented along Belmont Avenue, but it is pertinent that these treatments be suitable for the characteristics of the adjacent roadway. ODOT's Multimodal Design Guide (MMDG) provides guidelines for the application of pedestrian treatments based on roadway speed, volume, and configuration. These guidelines are shown in Figure 48. This chart provides countermeasures that would be appropriate to apply at Belmont Avenue, including high-visibility

crosswalks, pedestrian refuge islands, and pedestrian hybrid beacons (PHBs), among others. Note that the MMDG does not recommend the rectangular rapid flashing beacon (RRFB) countermeasure for a roadway fitting the same characteristics as Belmont Avenue.

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	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 ❽ ❾	① ❸ 5 8 ❾	① ❸ 5 ❼ ❽ ❾	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 ❽ ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ ❽ ❾	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)**

Figure 48. Application of Pedestrian Crash Countermeasures by Roadway Speed, Volume, and Configuration

One countermeasure that the MMDG suggests for roadways with the same characteristics as Belmont Avenue is countermeasure 9: Pedestrian Hybrid Beacon (PHB). Similarly, the MMDG suggests the use of countermeasure 3: Advance Yield Here to (Stop Here For) Pedestrians sign and yield (stop) line. These countermeasures can be analyzed in ECAT using CMF 9021 ***Install Pedestrian Hybrid Beacon (PHB or HAWK) with Advanced Yield or Stop Markings and Signs.*** Installing a PHB on Belmont Avenue would decrease the likelihood of pedestrian crashes at mid-block crossings, as this type of signal directs vehicles to stop when a pedestrian needs to cross the road. CMF 9021 has a value of 0.432 and applies to pedestrian crashes in urban and suburban areas on minor arterial roadways.

Furthermore, the USDOT Federal Highway Administration states, "PHBs are used where it is difficult for pedestrians to cross a roadway, such as when gaps in traffic are not sufficient or speed limits exceed 35 miles per hour. They are very effective at locations where three or more lanes will be crossed or traffic volumes are above 9,000 annual average daily traffic." Since Belmont Avenue exceeds both requirements with a posted speed limit of 40 mph and an AADT of 16,000 - 17,000, the roadway is a good candidate for this treatment. Figure 49 provides the display sequence of a PHB once activated by a pedestrian. An example of an existing PHB is provided in Figure 50.

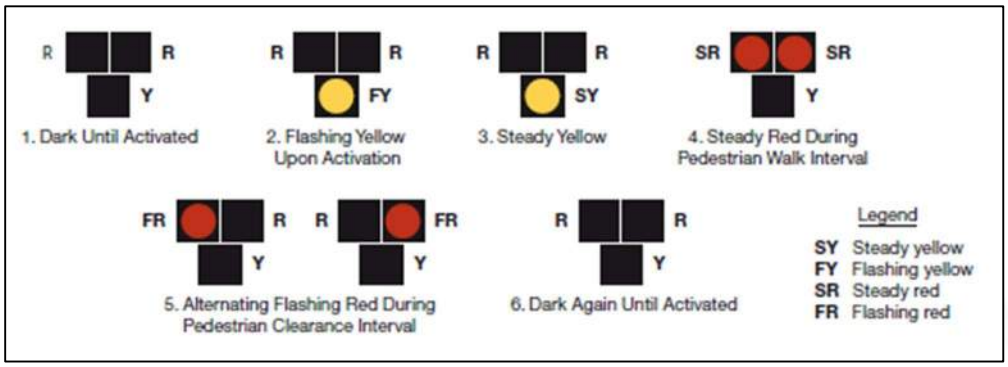


Figure 49. Signal head display sequence of a Pedestrian Hybrid Beacon (PHB)

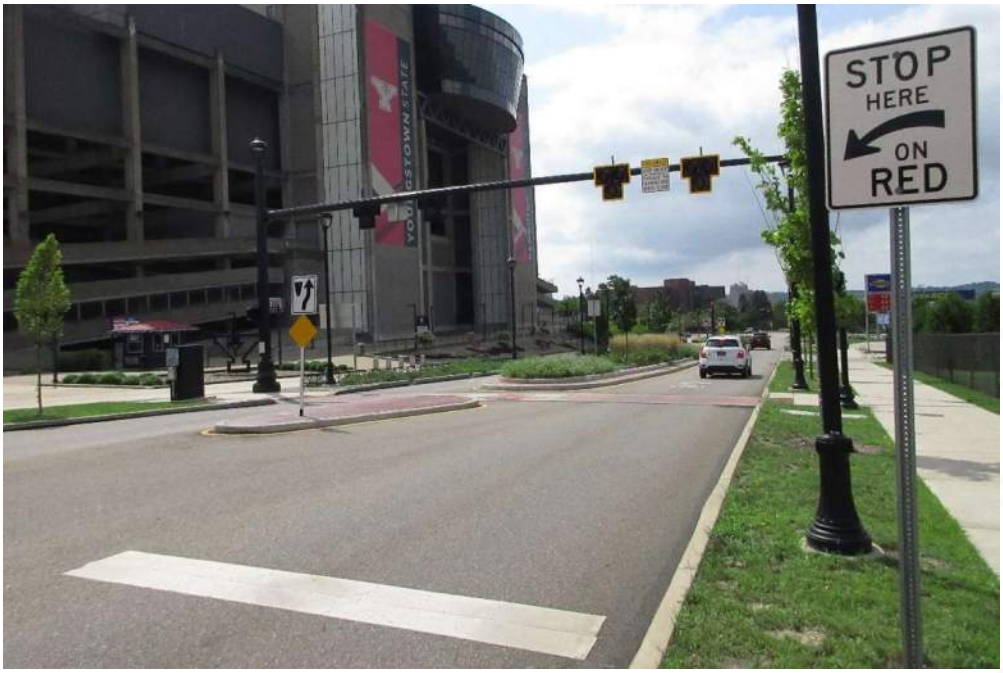


Figure 50. Example of a Pedestrian Hybrid Beacon in Youngstown, Ohio

The MMDG also suggests that roadways with the same characteristics as Belmont Avenue utilize countermeasure 6: pedestrian refuge island. A

pedestrian refuge island is a protected location between lanes of opposing traffic which allows pedestrians to pause before crossing the remaining distance. This countermeasure is useful when a pedestrian is unable to find a gap in both directions of traffic that provides enough time to safely cross all lanes of traffic. This is particularly helpful for older pedestrians or others with limited mobility who may need more time to cross the roadway.

Countermeasure 6 can be combined with countermeasure 9 (PHB) to create a signalized two-stage crossing, further enhancing pedestrian safety. Installing a two-stage PHB crossing would allow pedestrians to cross one direction of traffic at a time, provides a protected area to wait between crossings, and protects crossing pedestrians from vehicles with the use of a traffic signal. Also, by separating the crossings of each direction, traffic is less impacted as drivers must only wait for a pedestrian to cross half of the roadway, rather than the entire roadway. See Figure 51 for a visual representation of a pedestrian refuge island. The PHB shown in Figure 50 also contains a pedestrian refuge island, although it does not utilize a two-stage crossing.

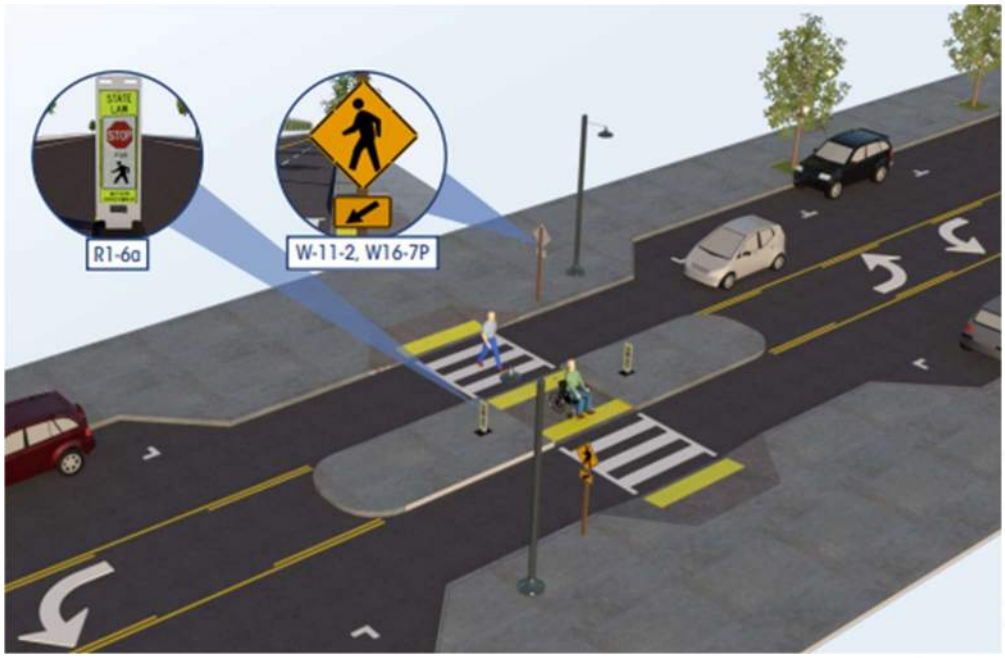


Figure 51. Visual representation of a Pedestrian Refuge Island

The project team suggests to implement a two-stage crossing that utilizes a pedestrian hybrid beacon at the Dunkin Donuts entrance on Belmont Avenue. This location is about mid-way between Churchill Road and the I-80 westbound ramps, providing an intermediate location for pedestrians to safely cross Belmont Avenue.

Another location where this treatment may be utilized is just north of the I-80 overpass at the northbound *Belmont Ave & Motor Inn Dr* WRTA stop. Placing a PHB at this location would allow bus patrons to immediately cross Belmont Avenue without having to walk south to Liberty Street or north to the I-80 westbound ramps. It may be undesirable to proceed north from this bus stop since pedestrians would have to cross the northbound slip lane that acts as an additional ramp to I-80 westbound. This crossing may be dangerous because vehicles are beginning to accelerate to meet the speeds of the interstate traffic. However, implementing a PHB at this bus stop may not be a viable treatment. Northbound traffic may experience visibility issues with the presence of the I-80 overpass. This bridge may limit drivers' ability to see the signal heads above the crosswalk, shortening driver reaction time and creating a dangerous environment for crossing pedestrians. Therefore, <u>further study is needed</u> for implementation of a PHB at this location.

If additional study proves that the I-80 overpass negatively affects visibility of northbound traffic, preventing the implementation of a PHB, an alternative solution should be evaluated. As discussed above, pedestrians would need to travel south to Liberty Street or north to the I-80 westbound ramps when utilizing the WRTA bus stop at *Belmont Ave & Motor Inn Dr*. If traveling north, pedestrians need to be able to safely cross a slip lane that encourages drivers to accelerate before joining I-80. Any other pedestrians traveling along the east side of Belmont Avenue would face this same challenge at the slip lane crossing. One possible treatment would be to add a RRFB at this crossing. This may be a desirable treatment as the AADT of the slip lane would fall under 9,000 and there's only one lane of traffic, adhering to similar roadway configurations that the MMDG suggests utilize RRFBs. Since this crossing involves an entrance ramp to the interstate, an Interchange Operations Study may be required prior to implementation.

The MMDG also suggests the use of countermeasure 5 – curb extensions – on roadways similar to Belmont Avenue. Curb extensions, also called curb bump outs, are a widened extension of curb at intersections. This leads to enhanced driver visibility of pedestrians who wait to cross the road, as they are placed closer to drivers' line of sight. Curb extensions also act as a traffic calming measure as they create tighter curb radii, slowing down turning traffic and improving safety for all road users. However, as discussed earlier, this treatment may not be desirable due to the present configuration and AADT of Belmont Avenue. As a result, the project team <u>does not recommend</u> the implementation of this countermeasure.

The recommended pedestrian infrastructure improvements can be seen in Figure 54 through Figure 58. These layouts depict the improvements recommended in the text above, as well as other proposed design plans which have been previously prepared by another consultant.

5. Implementing Signal Upgrades

   There are many factors listed above that lead to high crash frequencies at the three signalized intersections. Many of these can be addressed through improvements to the traffic signals. The following countermeasures should be considered for implementation at their respective intersection:

   - Belmont Avenue & Liberty Street

     Signal visibility can be improved through the installation of new LED signals and reflective signal backplates, as shown in Figure 52 below. This may improve awareness of and compliance with the signals, enhancing safety for all road users.

     Adding all-red time to the signal phasing may reduce the number of angle crashes, as this expansion of time allows the intersection to clear before more vehicles are permitted to enter. Similarly, evaluating the yellow time can present the opportunity to improve the dilemma zones of the intersection, possibly decreasing the number of rear end and angle crashes. Evaluating the applicability of protected left turns may also present the opportunity to reduce the frequency of left turn angle crashes at this intersection.

     Finally, crash frequency may be reduced if the eastbound approach was reconfigured. Presently, the eastbound approach utilizes a left/through-right (LT-R) configuration. This means that through traffic shares a lane with left-turning traffic. However, this causes the through traffic to align with westbound left-turning traffic. If capacity analyses show positive results with a left-through/right (L-TR) configuration, through vehicles can follow a straighter path to their receiving lane, possibly reducing angle or sideswipe crashes. Recall that angle and sideswipe – passing crashes tied for the second most common crash types at this intersection.

Figure 52. Reflective signal backplates increase signal visibility during dark hours

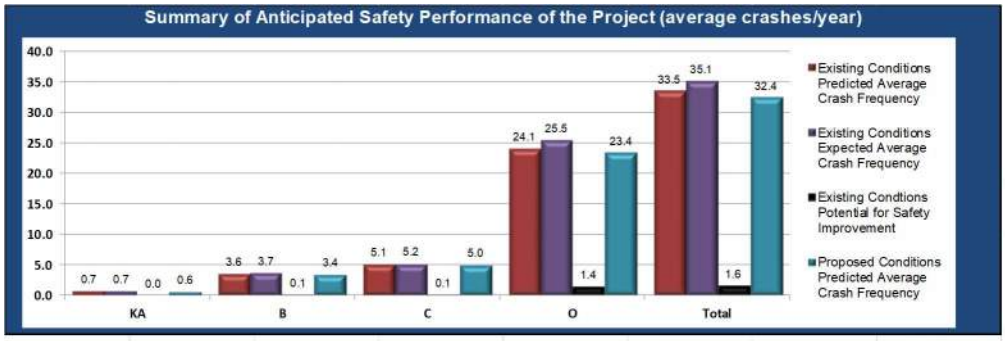
- Belmont Avenue & I-80 Westbound Ramps
  Unlike the intersection at Liberty Street, the signal heads at this intersection presently utilize reflective signal backplates. However, the same improvements to signal timing can be considered for this intersection. Adding all-red time to the signal phasing may reduce the number of angle crashes, as this expansion of time allows the intersection to clear before more vehicles are permitted to enter. Similarly, evaluating the yellow time can present the opportunity to improve the dilemma zones of the intersection, possibly decreasing the number of rear end and angle crashes. Evaluating the applicability of protected left turns may also present the opportunity to reduce the frequency of left turn angle crashes at this intersection. Recall that left turn angle crashes were the most common crash type at this intersection.

- Belmont Avenue & Churchill Road
  Though this intersection presently utilizes reflective signal backplates on its northbound and southbound approaches, signal head updates can be incorporated at the eastbound and westbound approaches, enhancing signal visibility for these drivers.

  Adding all-red time to the signal phasing may reduce the number of angle crashes, as this expansion of time allows the intersection

to clear before more vehicles are permitted to enter. Similarly, evaluating the yellow time can present the opportunity to improve the dilemma zones of the intersection, possibly decreasing the number of rear end and angle crashes. Evaluating the applicability of protected left turns may also present the opportunity to reduce the frequency of left turn angle crashes at this intersection.

Through implementation of each of the countermeasures recommended above, the crash frequency of the study area is predicted to decrease. By applying the CMF values discussed earlier, the Proposed Conditions Predicted Average Crash Frequency is calculated to be 32.4 crashes per year. This is a 3.3% decrease from the Existing Conditions Predicted Average Crash Frequency and a 7.7% decrease from the Existing Conditions Expected Average Crash Frequency. Note that the studied crash history has a low frequency in pedestrian crashes, lessening the effect of pedestrian-focused countermeasures on the Proposed Conditions Predicted Average Crash Frequency of the site. However, this does not negate the necessity of these countermeasures. One pedestrian has already lost their life on Belmont Avenue in recent years, and it is prudent that measures be taken to prevent future injuries and fatalities of other pedestrians in this same location. Additionally, as discussed previously, CMF 7783 *Install Lighting* is predicted to have a greater impact in the reduction of crash frequency, though it is not represented as so in the ECAT results. It is believed that the combination of proposed countermeasures will have a much greater impact in enhancing safety for all road users throughout the 0.6-mile corridor than as depicted by ECAT. See Figure 53 for a quantitative summary and visual depiction of the proposed condition ECAT results.



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.6834	3.5895	5.1299	24.0739	33.4767
$N_{expected}$ - Existing Conditions	0.6913	3.6735	5.2476	25.4778	35.0902
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0079	0.0840	0.1177	1.4039	1.6135
$N_{predicted}$ - Proposed Conditions	0.6358	3.4104	4.9664	23.3709	32.3835

Figure 53. ECAT Results for Proposed Conditions

Each of the countermeasures recommended above can be seen in the proposed layouts in Figure 54 through Figure 58. Lighting improvements for the corridor are

also recommended for implementation but are not shown on these maps. The figures are also available in Appendix D.

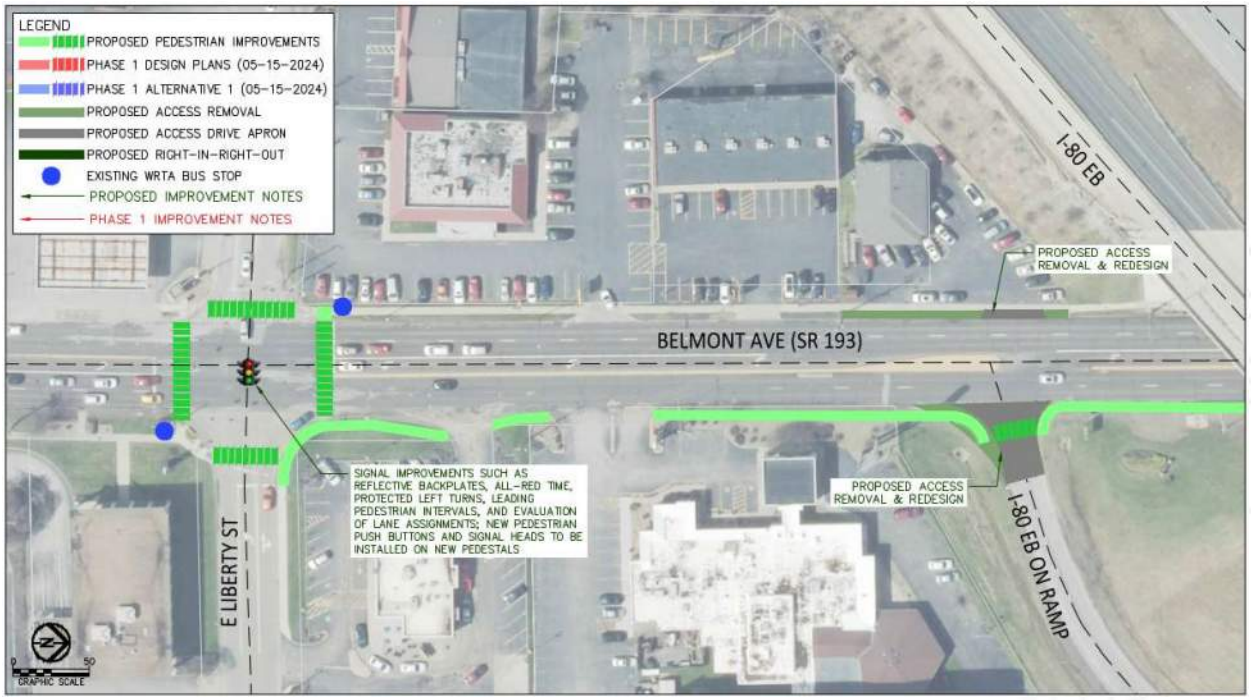


Figure 54. Proposed conditions, from Liberty Street to I-80

Figure 55. Proposed conditions, from I-80 to the I-80 westbound entrance ramp

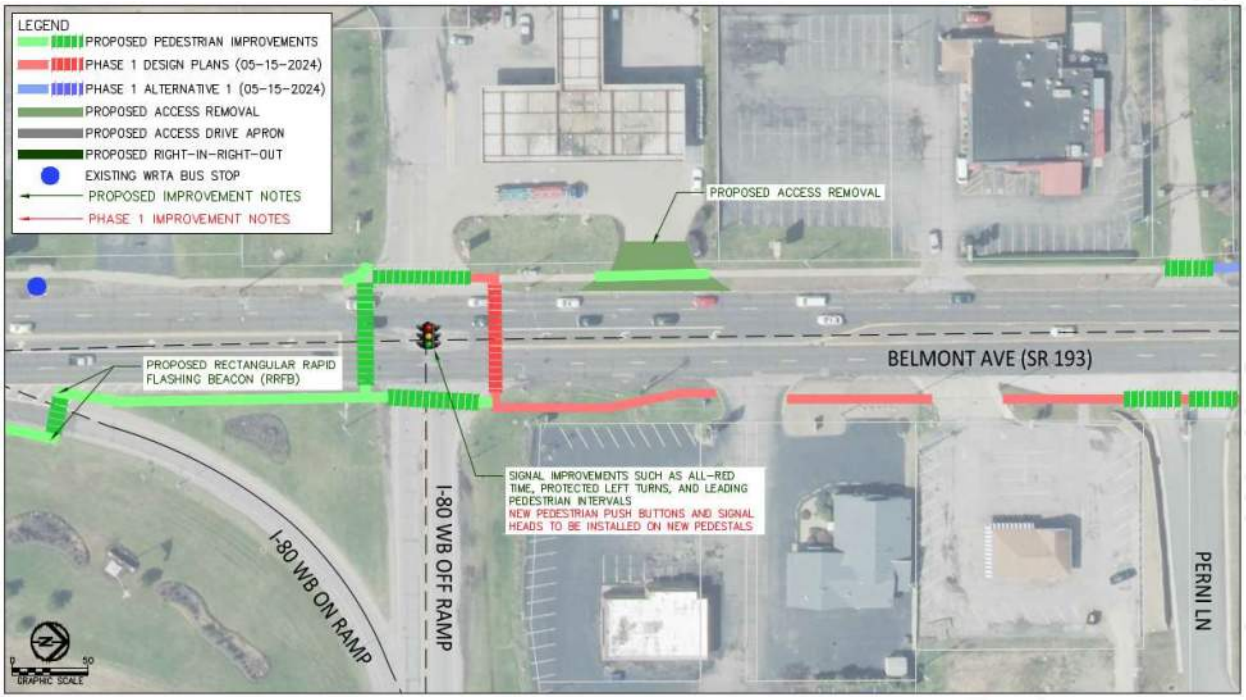


Figure 56. Proposed conditions, from the I-80 westbound entrance ramp to Perni Lane

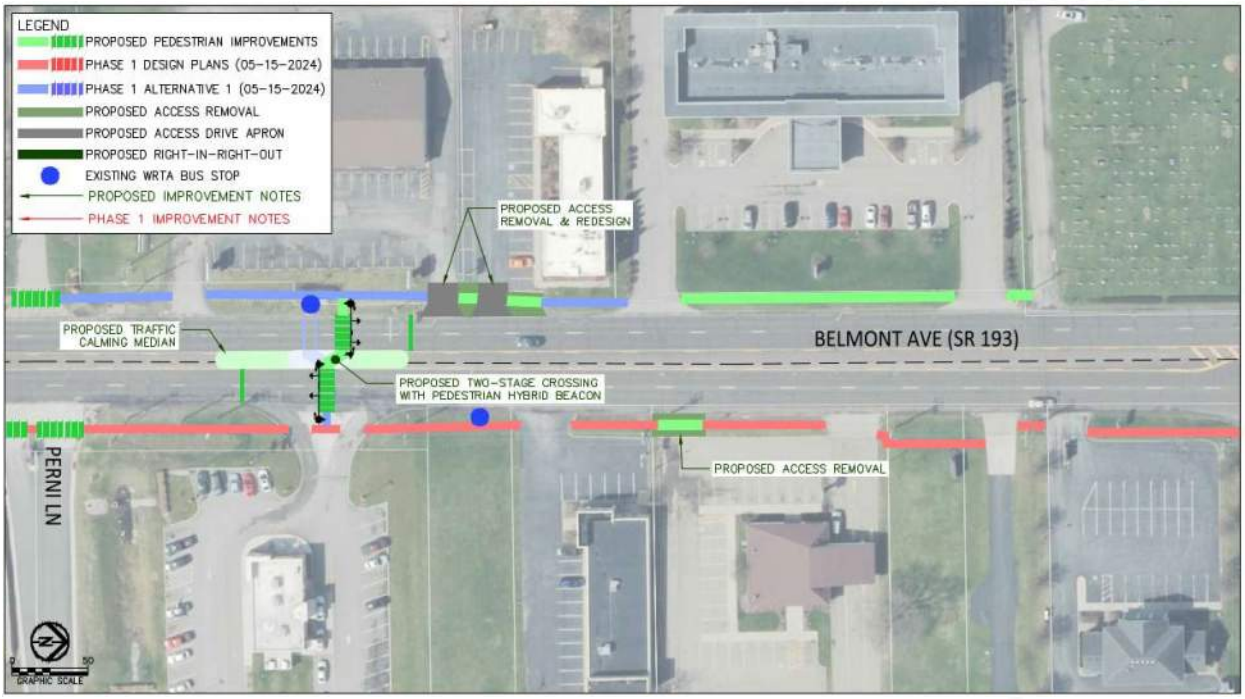


Figure 57. Proposed conditions, from Perni Lane to the cemetery

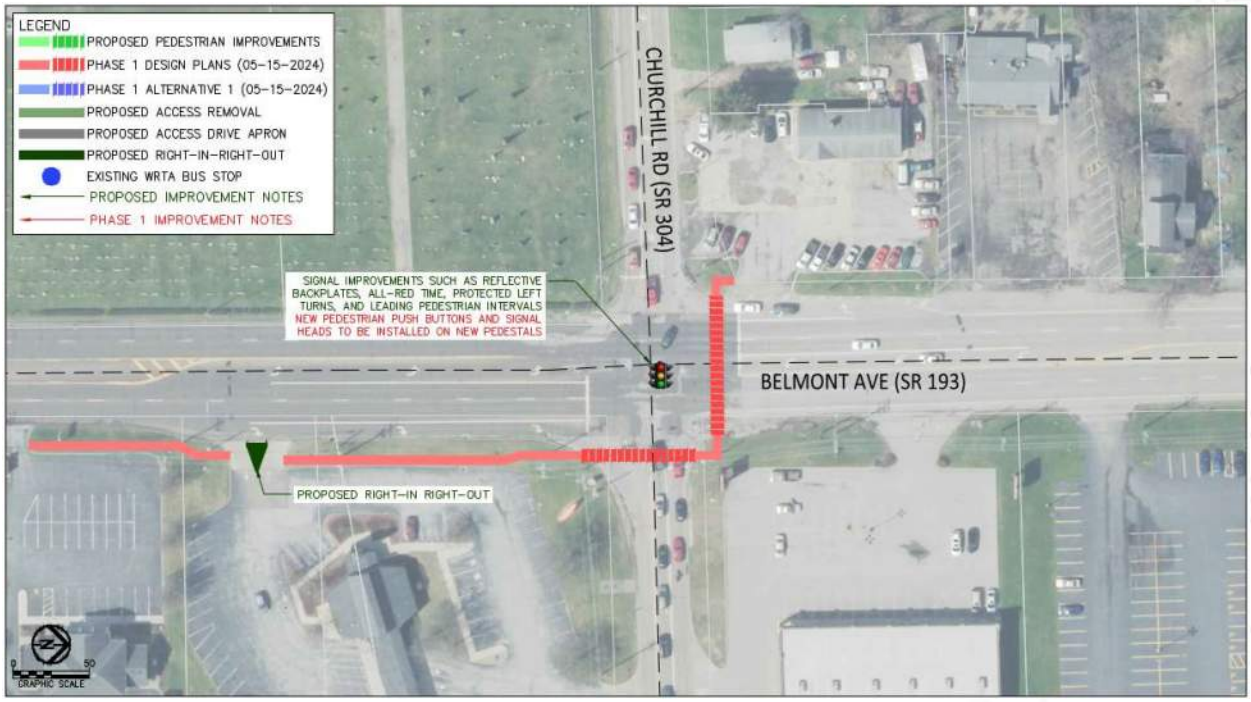


Figure 58. Proposed conditions, from the cemetery to Churchill Road

V. CAPACITY ANALYSES

A capacity analysis was performed for the signalized intersection of Belmont Avenue and the I-80 westbound ramps. This analysis utilized data for the 2016 existing AM and PM peak hours. In both the AM and PM peaks, certain approaches have a level of service (LOS) of D, with delays over 40 seconds. These included eastbound left turns and all westbound movements. However, in both the AM and PM peaks, an overall LOS of B was determined for the intersection. The full results of this analysis can be found in Appendix E.

VI. FINAL RECOMMENDATIONS

The following recommendations are provided for the owner and maintaining authority over the subject corridor to reduce the crash frequency and severity.

1. Install sidewalks and ADA compliant curb ramps where none presently exist.
2. Install high-visibility crosswalks, push buttons, and count-down pedestrian signals at each intersection in the study area.
3. Update traffic signals with reflective backplates, all-red time, and leading pedestrian intervals. Where capacity analyses deem appropriate, incorporate protected left turn phasing and lane assignment changes.
4. Install a median refuge island and pedestrian hybrid beacon (PHB) with a two-stage crossing at the right-in right-out entrance to Dunkin Donuts.

5. Install a rectangular rapid flashing beacon (RRFB) at the I-80 westbound slip lane.
6. Maintain functionality of existing streetlights and install additional lighting in accordance with the design standards outlined in the ODOT Transportation Engineering Manual (TEM).
7. Restrict existing access points to right-in right-out, where applicable.
8. Remove existing access points or reduce their width to limit exposure time for vulnerable road users, where applicable.
9. Replace the existing median between the I-80 overpass and the I-80 westbound ramp intersection, incorporating vertical elements such as trees and other vegetation to enhance traffic calming.

Implementing each of the countermeasures recommended above is estimated to cost approximately $800,000. A breakdown of this cost opinion is provided in Appendix F.

VII. CONCLUSIONS

Belmont Avenue hosts a variety of establishments and amenities, many of which commonly attract foot traffic. However, the existing design of the corridor is not conducive to safe nonmotorized travel. The countermeasures provided in this report have been recommended to address the identified probable causes of recent crash history and to meet the needs of vulnerable road users with the goal of enhancing safety for motorized and nonmotorized travelers alike.

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

APPENDIX A - EXISTING CONDITIONS & TRAFFIC CONTROL

E LIBERTY ST

BELMONT AVE (SR 193)

I-80 EB

I-80 EB ON RAMP

DAMAGED CURB

E/W PEDESTRIAN CROSSWALK ABSENT

SIDEWALK ENDS

OVERGROWN SHRUB

R35'

R40'

R45'

R50'

R85'

14'

12'

12'

5'

5'

5'

11'

11'

11'

11'

11'

11'

10'

10'

10'

12'

13'

12'

13'

0 50

GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
EXISTING CONDITIONS

E:\DOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\EXIST 21-00314-010 TRU SR193.DWG - 8/16/2024 2:34:12 PM

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
EXISTING CONDITIONS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\EXIST 21-00314-010 TRU SR193.DWG - 8/16/2024 2:34:19 PM

PEDESTRIAN INFRASTRUCTURE

JAGGED SIDEWALK

R40'

15' 12' 14'

R45'

5'

PEDESTRIAN SIGNALS ABSENT

SIDEWALK ENDS

11'

10'

BELMONT AVE (SR 193)

DAMAGED CONCRETE MEDIAN

ROCK LANDSCAPING PEDESTRIANS MUST CROSS

R15'

R55'

15'

16'

BOLLARDS CHANNELIZE RAMP TRAFFIC

I-80 WB OFF RAMP

R40'

18' 18'

PERNI LN

0 50

GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
EXISTING CONDITIONS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 180WB RAMPS TO SR304\CADD\EXIST 21-00314-010 TRU SR193.DWG - 8/16/2024 2:34:29 PM

PEDESTRIAN INFRASTRUCTURE

NO ACCESS TO CEMETERY FOR PEDESTRIANS

BELMONT AVE (SR 193)

11'

11'

11'

R55'

PERNI LN

MISLEADING ENTRANCE SIGN

18' 18'

N

0 50

GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
EXISTING CONDITIONS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\EXIST 21-00314-010 TRU SR193.DWG - 8/16/2024 2:34:39 PM

CHURCHILL RD (SR 304)

BELMONT AVE (SR 193)

NO ACCESS TO CEMETERY
FOR PEDESTRIANS

TURNING MOVEMENT
SKID MARKS

TIRE STOPPING
SKID MARKS

TIRE MARKS
OVER MEDIAN

11'
12'
11'
R30'
R30'
12'
12'
10'
13'
11'
11'
11'
11'
14'
12'
R50'
12'
9'
11'
R75'

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
EXISTING CONDITIONS

E:\ODOT\21-0031-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80 WB RAMPS TO SR304\CADD\EXIST 21-0031-010 TRU SR193.DWG - 8/16/2024 2:34:49 PM

LAND USE LEGEND

- 312 - BUSINESS HOTEL
- 560 - CHURCH
- 630 - CLINIC
- 712 - SMALL OFFICE BUILDING
- 822 - STRIP RETAIL PLAZA
- 843 - AUTOMOBILE PARTS SALES
- 911 - WALK-IN BANK
- 932 - SIT-DOWN RESTAURANT
- 933 - FAST-FOOD, NO DRIVE-THROUGH
- 934 - FAST-FOOD, DRIVE-THROUGH
- 937 - COFFEE SHOP, DRIVE-THROUGH
- 945 - GAS STATION, CONVENIENCE STORE

E LIBERTY ST

I-80 EB

DURA ENTERPRISES INC
3990 BELMONT AVE.
YOUNGSTOWN, OH 44505

D AND F REAL ESTATE LLC
4020 BELMONT AVE.
YOUNGSTOWN, OH 44505

CERTIFIED DEVELOPERS AND MANAGEMENT LTD
4024 BELMONT AVE.
YOUNGSTOWN, OH 44505

MURRAYS SPORTS PUB INC
4042 BELMONT AVE.
YOUNGSTOWN, OH 44505

ONLY

OVERHEAD SIGNS

LEFT TURN YIELD ON GREEN

BELMONT AVE (SR 193)

ONLY

OVERHEAD SIGN

193 SOUTH

193 NORTH

ONLY

OVERHEAD SIGN

ONLY

OHIO NORTH EAST HEALTH SYSTEMS INC
4208 BELMONT AVE.
YOUNGSTOWN, OH 44505

THOMAS 22 LIMITED
4001 BELMONT AVE.
YOUNGSTOWN, OH 44505

YOUNGSTOWN HOTEL LLC
4055 BELMONT AVE.
YOUNGSTOWN, OH 44505

I-80 EB ON RAMP

N

0 50

GRAPHIC SCALE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\2TRAFFIC CONTROL 21-00314-010 TRU SR193.DWG - 8/16/2024 2:35:01 PM

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
TRAFFIC CONTROL & LAND USE

LAND USE LEGEND

- 312 - BUSINESS HOTEL
- 560 - CHURCH
- 630 - CLINIC
- 712 - SMALL OFFICE BUILDING
- 822 - STRIP RETAIL PLAZA
- 843 - AUTOMOBILE PARTS SALES
- 911 - WALK-IN BANK
- 932 - SIT-DOWN RESTAURANT
- 933 - FAST-FOOD, NO DRIVE-THROUGH
- 934 - FAST-FOOD, DRIVE-THROUGH
- 937 - COFFEE SHOP, DRIVE-THROUGH
- 945 - GAS STATION, CONVENIENCE STORE

LUXURY HOTEL LTD
0 MOTOR INN DR
GIRARD, OH 44420

LUXURY HOTEL LTD
4080 BELMONT AVE.
YOUNGSTOWN, OH 44505

CARDINAL REALTY LLC
4100 BELMONT AVE.
YOUNGSTOWN, OH 44505

CARDINAL REALTY LLC
4100
BELMONT AVE.
YOUNGSTOWN,
OH 44505

SABANTIE BK
DEVELOPMENT
LLC
4200
BELMONT AVE.
YOUNGSTOWN,
OH 44505

RIGHT TURN ONLY

STOP

MOTOR INN DR

I-80 WB

I-80 EB

BELMONT AVE (SR 193)

I-80 WB ON RAMP

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
TRAFFIC CONTROL & LAND USE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\TRAFFIC CONTROL 21-00314-010 TRU SR193.DWG - 8/16/2024 2:35:09 PM

LAND USE LEGEND

- 312 - BUSINESS HOTEL
- 560 - CHURCH
- 630 - CLINIC
- 712 - SMALL OFFICE BUILDING
- 822 - STRIP RETAIL PLAZA
- 843 - AUTOMOBILE PARTS SALES
- 911 - WALK-IN BANK
- 932 - SIT-DOWN RESTAURANT
- 933 - FAST-FOOD, NO DRIVE-THROUGH
- 934 - FAST-FOOD, DRIVE-THROUGH
- 937 - COFFEE SHOP, DRIVE-THROUGH
- 945 - GAS STATION, CONVENIENCE STORE

SABANTIE BK DEVELOPMENT LLC
4200 BELMONT AVE.
YOUNGSTOWN, OH 44505

SPEEDWAY LLC
4210 BELMONT AVE.
YOUNGSTOWN, OH 44505

C P D CORPORATION
4250 BELMONT AVE.
YOUNGSTOWN, OH 44505

GIULIA PRPERTIES LLC
4250 BELMONT AVE.
YOUNGSTOWN, OH 44505

ENTRANCE
TO PARK
0 BELMONT
AVE.
YOUNGSTOWN,
OH 44505

SOUTH 193

BEGIN ONLY

ONLY

BELMONT AVE (SR 193)

OVERHEAD SIGNS

PARK ENTRANCE

NORTH 193

DO NOT ENTER

I-80 WB OFF RAMP

I-80 WB ON RAMP

REVA YOUNGSTOWN LLC
4249 BELMONT AVE.
YOUNGSTOWN, OH 44505

REVA YOUNGSTOWN LLC
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

BRADFORD J LEVY
4247 BELMONT AVE.
YOUNGSTOWN, OH 44505

FRAN MELENDEZ
4251 BELMONT AVE.
YOUNGSTOWN, OH 44505

PERNI LN

PERNI PERNI EQUITIES LLC
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

N

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
TRAFFIC CONTROL & LAND USE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\ZTRAFFIC CONTROL 21-00314-010 TRU SR193.DWG - 8/16/2024 2:35:17 PM

LAND USE LEGEND

- 312 - BUSINESS HOTEL
- 560 - CHURCH
- 630 - CLINIC
- 712 - SMALL OFFICE BUILDING
- 822 - STRIP RETAIL PLAZA
- 843 - AUTOMOBILE PARTS SALES
- 911 - WALK-IN BANK
- 932 - SIT-DOWN RESTAURANT
- 933 - FAST-FOOD, NO DRIVE-THROUGH
- 934 - FAST-FOOD, DRIVE-THROUGH
- 937 - COFFEE SHOP, DRIVE-THROUGH
- 945 - GAS STATION, CONVENIENCE STORE

ENTRANCE TO PARK
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

TPJK HOLDINGS LLC
4300 BELMONT AVE.
YOUNGSTOWN, OH 44505

D APOLITO LAND COMPANY
4316 BELMONT AVE.
YOUNGSTOWN, OH 44505

GAMETE INC
4400 BELMONT AVE.
YOUNGSTOWN, OH 44505

TOWNSHIP TRUSTEES
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

PARK ENTRANCE

JCT I-80

SPEED LIMIT 40

BELMONT AVE (SR 193)

PERNI LN

WHITE DONUTS LLC
4305 BELMONT AVE.
YOUNGSTOWN, OH 44505

MAHONING VALLEY
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

MAHONING VALLEY ECONOMIC DEVELOPMENT CORPORATION
4319 BELMONT AVE.
YOUNGSTOWN, OH 44505

JCT 304

2639 LLC
4333 BELMONT AVE.
YOUNGSTOWN, OH 44505

CHURCH HILL UNITED METHODIST CHURCH
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

CHURCH HILL UNITED METHODIST CHURCH
189 CHURCHILL RD.
YOUNGSTOWN, OH 44505

RITA M PINTARIC TRUSTEE
4407 BELMONT AVE.
YOUNGSTOWN, OH 44505

N

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
TRAFFIC CONTROL & LAND USE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\TRAFFIC CONTROL 21-00314-010 TRU SR193.DWG - 8/16/2024 2:35:22 PM

LAND USE LEGEND

312 - BUSINESS HOTEL	822 - STRIP RETAIL PLAZA	933 - FAST-FOOD, NO DRIVE-THROUGH
560 - CHURCH	843 - AUTOMOBILE PARTS SALES	934 - FAST-FOOD, DRIVE-THROUGH
630 - CLINIC	911 - WALK-IN BANK	937 - COFFEE SHOP, DRIVE-THROUGH
712 - SMALL OFFICE BUILDING	932 - SIT-DOWN RESTAURANT	945 - GAS STATION, CONVENIENCE STORE

TOWNSHIP TRUSTEES
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

METHODIST EPISCOPAL
TRUSTEES & CEMETERY
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

LIBERTY AUTO CONNECTION NO 1 LLC
4506 BELMONT AVE.
YOUNGSTOWN, OH 44505

CRUMP SHARPE
INVESTMENTS
LLC
0 BELMONT AVE.
YOUNGSTOWN,
OH 44505

CRUMP
SHARPE
INVESTMENTS
LLC
0 BELMONT
AVE.
YOUNGSTOWN,
OH 44505

JCT 80

SPEED LIMIT 40

SOUTH 193

304

193

BELMONT AVE (SR 193)

304

BEGIN

ONLY

ONLY

OVERHEAD SIGNS

304

ONLY

193 NORTH

304

OVERHEAD SIGNS

RITA M PINTARIC TRUSTEE
4407 BELMONT AVE.
YOUNGSTOWN, OH 44505

YOUNGOHIO LLC
0 BELMONT AVE.
YOUNGSTOWN, OH
44505

YOUNGHIO LLC
4499 BELMONT AVE.
YOUNGSTOWN, OH 44505

193

YOUNGOHIO LLC
0 BELMONT AVE.
YOUNGSTOWN, OH 44505

CHURCHILL RD (SR 304)

CHRISTINA RODGERS
4501 BELMONT AVE.
YOUNGSTOWN, OH 44505

ASH & G PROPERTIES
4531 BELMONT AVE.
YOUNGSTOWN, OH 44505

N

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
TRAFFIC CONTROL & LAND USE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 180WB RAMPS TO SR304\CADD\TRAFFIC CONTROL 21-00314-010 TRU SR193.DWG - 8/16/2024 2:35:27 PM

APPENDIX B - CAM TOOL TABLES

TRU-SR 193 Crash Data (2018 - 2022)

Crash Summary Sheet

Fatalities	1
Serious Injuries	4
Other Injuries	58

Crashes Per Year	36.20
Fatal and All Injury Crashes	45
Percent Injury	24.9%
Equivalent PDO Index Value	2.76

Crash Severity	Crashes	%
(1) Fatal	1	0.55%
(2) Serious Injury Suspected	2	1.10%
(3) Minor Injury Suspected	19	10.50%
(4) Injury Possible	23	12.71%
(5) PDO/No Injury	136	75.14%
Grand Total	181	100.00%

Year	Crashes	%
2018	32	17.68%
2019	34	18.78%
2020	25	13.81%
2021	49	27.07%
2022	41	22.65%
Grand Total	181	100.00%

Day of Week	Crashes	%
(1) Sunday	19	10.50%
(2) Monday	24	13.26%
(3) Tuesday	22	12.15%
(4) Wednesday	32	17.68%
(5) Thursday	26	14.36%
(6) Friday	34	18.78%
(7) Saturday	24	13.26%
Grand Total	181	100.00%

Crash Type	Crashes	%
Rear End	63	34.81%
Left Turn	39	21.55%
Angle	31	17.13%
Sideswipe - Passing	30	16.57%
Backing	7	3.87%
Right Turn	5	2.76%
Head On	2	1.10%
Sideswipe - Meeting	1	0.55%
Fixed Object	1	0.55%
Pedestrian	1	0.55%
Parked Vehicle	1	0.55%
Grand Total	181	100.00%

Hour of Day	Crashes	%
1	1	0.55%
2	1	0.55%
5	1	0.55%
6	4	2.21%
7	4	2.21%
8	8	4.42%
9	10	5.52%
10	5	2.76%
11	12	6.63%
12	17	9.39%
13	14	7.73%
14	17	9.39%
15	21	11.60%
16	14	7.73%
17	17	9.39%
18	5	2.76%
19	13	7.18%
20	5	2.76%
21	3	1.66%
22	7	3.87%
23	2	1.10%
Grand Total	181	100.00%

Month	Crashes	%
1	12	6.63%
2	14	7.73%
3	8	4.42%
4	11	6.08%
5	18	9.94%
6	16	8.84%
7	14	7.73%
8	16	8.84%
9	14	7.73%
10	18	9.94%
11	24	13.26%
12	16	8.84%
Grand Total	181	100.00%

TRU-SR 193 Crash Data (2018 - 2022)

Crash Summary Sheet

Weather Condition	Crashes	%
Clear	110	60.77%
Cloudy	49	27.07%
Rain	15	8.29%
Snow	6	3.31%
Unknown	1	0.55%
Grand Total	181	100.00%

Road Condition	Crashes	%
Dry	143	79.01%
Wet	33	18.23%
Ice	3	1.66%
Snow	1	0.55%
Other / Unknown	1	0.55%
Grand Total	181	100.00%

Light Condition	Crashes	%
Daylight	140	77.35%
Dark - Lighted Roadway	35	19.34%
Dawn/Dusk	4	2.21%
Dark - Roadway Not Lighted	2	1.10%
Grand Total	181	100.00%

Number of Units	Crashes	%
2	173	95.58%
3	6	3.31%
5	1	0.55%
1	1	0.55%
Grand Total	181	100.00%

ODOT Location	Crashes	%
Four-Way Intersection	101	55.80%
Not An Intersection	27	14.92%
Data Not Valid or Not Provided	25	13.81%
Driveway/Alley Access	24	13.26%
T-Intersection	1	0.55%
On Ramp	1	0.55%
5 Or More Point Intersection	1	0.55%
Off Ramp	1	0.55%
Grand Total	181	100.00%

Work Zone Related	Crashes	%
No	180	99.45%
Yes	1	0.55%
Grand Total	181	100.00%

Alcohol Related	Crashes	%
No	177	97.79%
Yes	4	2.21%
Grand Total	181	100.00%

Drug Related (Inc. Marijuana)	Crashes	%
No	180	99.45%
Yes	1	0.55%
Grand Total	181	100.00%

Contour	Crashes	%
Straight Grade	73	40.33%
Straight Level	108	59.67%
Grand Total	181	100.00%

Marijuana Related	Crashes	%
No	181	100.00%
Grand Total	181	100.00%

Roadway Departure	Crashes	%
No	172	95.03%
Yes	9	4.97%
Grand Total	181	100.00%

Older Driver (65+)	Crashes	%
No	133	73.48%
Yes	48	26.52%
Grand Total	181	100.00%

Intersection Related	Crashes	%
Yes	125	69.06%
No	56	30.94%
Grand Total	181	100.00%

Young Driver (15-25)	Crashes	%
No	117	64.64%
Yes	64	35.36%
Grand Total	181	100.00%

Speed Related	Crashes	%
No	177	97.79%
Yes	4	2.21%
Grand Total	181	100.00%

Motorcycle Involved	Crashes	%
No	176	97.24%
Yes	5	2.76%
Grand Total	181	100.00%

TRU-SR 193 Crash Data (2018 - 2022)

Crash Summary Sheet

Unit 1 Summary

Unit 1 Pre-Crash Action	Crashes	%
Straight Ahead	76	41.99%
Making Left Turn	53	29.28%
Changing Lanes	16	8.84%
Making Right Turn	12	6.63%
Backing	7	3.87%
Slowing or Stopped In Traffic	7	3.87%
Entering Traffic Lane	5	2.76%
Parked	1	0.55%
Walking, Running, Jogging, Playing	1	0.55%
Making U-Turn	1	0.55%
Driverless	1	0.55%
Other / Unknown	1	0.55%
Grand Total	181	100.00%

Unit 1 Contributing Factor	Crashes	%
Following Too Closely/ACDA	58	32.04%
Failure to Yield	55	30.39%
Improper Lane Change	17	9.39%
Improper Turn	13	7.18%
None	12	6.63%
Improper Backing	7	3.87%
Ran Red Light	5	2.76%
Improper Start From a Parked Position	4	2.21%
Other Improper Action	3	1.66%
Operating Defective Equipment	3	1.66%
Drove off Road	2	1.10%
Improper Crossing	1	0.55%
Not Discernible	1	0.55%
Grand Total	181	100.00%

Unit 1 Object Struck	Crashes	%
Nothing Struck	176	97.24%
Other / Unknown	2	1.10%
Utility Pole	1	0.55%
Median Concrete Barrier	1	0.55%
Fence	1	0.55%
Grand Total	181	100.00%

Unit 1 Traffic Control	Crashes	%
Signal	104	57.46%
No Control	73	40.33%
Yield Sign	2	1.10%
Stop Sign	1	0.55%
Flasher	1	0.55%
Grand Total	181	100.00%

Unit 1 Posted Speed	Crashes	%
0	5	2.76%
25	6	3.31%
35	21	11.60%
40	143	79.01%
45	4	2.21%
65	2	1.10%
Grand Total	181	100.00%

Unit 1 Direction From	Crashes	%
South	63	34.81%
North	55	30.39%
West	31	17.13%
East	28	15.47%
Unknown	3	1.66%
Northeast	1	0.55%
Grand Total	181	100.00%

Unit 1 Direction To	Crashes	%
North	52	28.73%
East	45	24.86%
South	41	22.65%
West	33	18.23%
Southeast	3	1.66%
Northwest	2	1.10%
Unknown	2	1.10%
Southwest	2	1.10%
Northeast	1	0.55%
Grand Total	181	100.00%

TRU-SR 193 Crash Data (2018 - 2022)

Crash Summary Sheet

Unit 1 Summary

Unit 1 Type	Crashes	%
Passenger Car	99	54.70%
Sport Utility Vehicle	40	22.10%
Pick up	18	9.94%
Cargo Van	7	3.87%
Passenger Van (minivan)	6	3.31%
Unknown or Hit/Skip	5	2.76%
Semi-Tractor	3	1.66%
Single Unit Truck	2	1.10%
Pedestrian/Skater	1	0.55%
Grand Total	181	100.00%

Unit 1 Special Function	Crashes	%
None	176	97.24%
Other / Unknown	3	1.66%
Taxi	1	0.55%
Police	1	0.55%
Grand Total	181	100.00%

TRU-SR 193 Crash Data (2018 - 2022)
Crash Summary Sheet

Unit 2 Summary

Unit 2 Pre-Crash Action	Crashes	%
Straight Ahead	95	52.49%
Slowing or Stopped In Traffic	66	36.46%
Making Left Turn	12	6.63%
Making Right Turn	3	1.66%
Driverless	2	1.10%
Changing Lanes	1	0.55%
	1	0.55%
Leaving Traffic Lane	1	0.55%
Grand Total	181	100.00%

Unit 2 Contributing Factor	Crashes	%
None	172	95.03%
Following Too Closely/ACDA	2	1.10%
Other Improper Action	2	1.10%
Failure to Yield	2	1.10%
Improper Lane Change	1	0.55%
Not Discernible	1	0.55%
	1	0.55%
Grand Total	181	100.00%

Unit 2 Direction From	Crashes	%
	2	1.10%
East	29	16.02%
North	50	27.62%
Northeast	1	0.55%
Northwest	1	0.55%
South	67	37.02%
Southwest	1	0.55%
West	30	16.57%
Grand Total	181	100.00%

Unit 2 Direction To	Crashes	%
	2	1.10%
East	32	17.68%
North	67	37.02%
South	51	28.18%
West	29	16.02%
Grand Total	181	100.00%

Unit 2 Type	Crashes	%
Passenger Car	92	50.83%
Sport Utility Vehicle	45	24.86%
Pick up	18	9.94%
Passenger Van (minivan)	9	4.97%
Motorcycle 2 Wheeled	5	2.76%
Cargo Van	3	1.66%
Unknown or Hit/Skip	2	1.10%
Bus (16+ Passengers)	2	1.10%
Semi-Tractor	2	1.10%
	1	0.55%
Van (9-15 Seats)	1	0.55%
Single Unit Truck	1	0.55%
Grand Total	181	100.00%

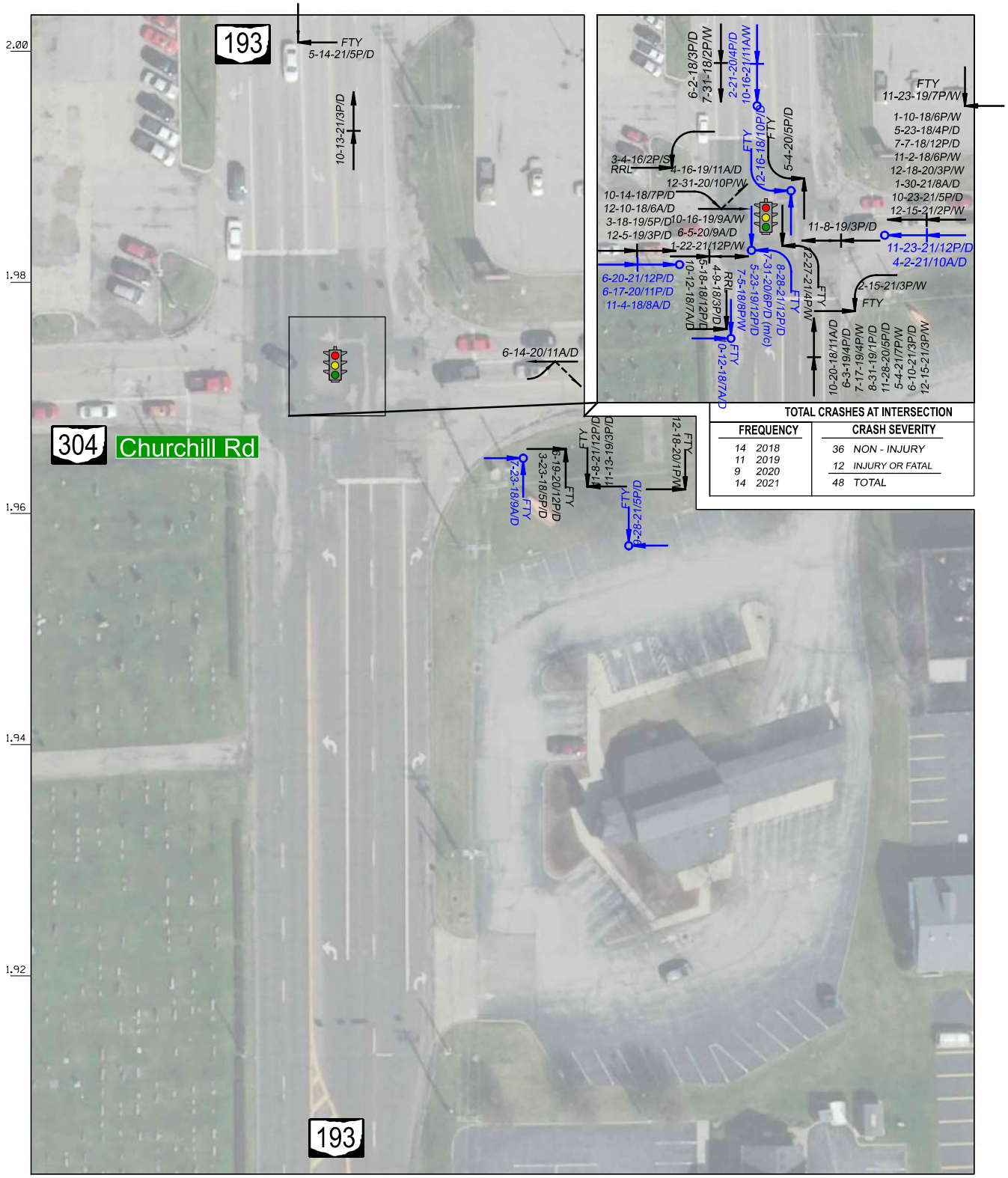
Unit 2 Special Function	Crashes	%
None	177	97.79%
School Transport	1	0.55%
Other / Unknown	1	0.55%
Bus – Other	1	0.55%
	1	0.55%
Grand Total	181	100.00%

APPENDIX C - CRASH DIAGRAMS

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

2018-2021



TOTAL CRASHES AT INTERSECTION

FREQUENCY		CRASH SEVERITY	
14	2018	36	NON - INJURY
11	2019	12	INJURY OR FATAL
9	2020	48	TOTAL
14	2021		

Vehicle Direction
Backing
Pedestrian
Out of Control
Overturn

Injury
Fatal
Fixed Object
Parked Vehicle
TEXT Date/Time/Road

Road:
D = Dry
W = Wet
I = Ice
S = Snow

FTC = Failure To Control
FTS = Failure To Stop
FTY = Failure To Yield
LOC = Left of Center
RRL = Ran Red Light
OVI = Operating Vehicle Impaired

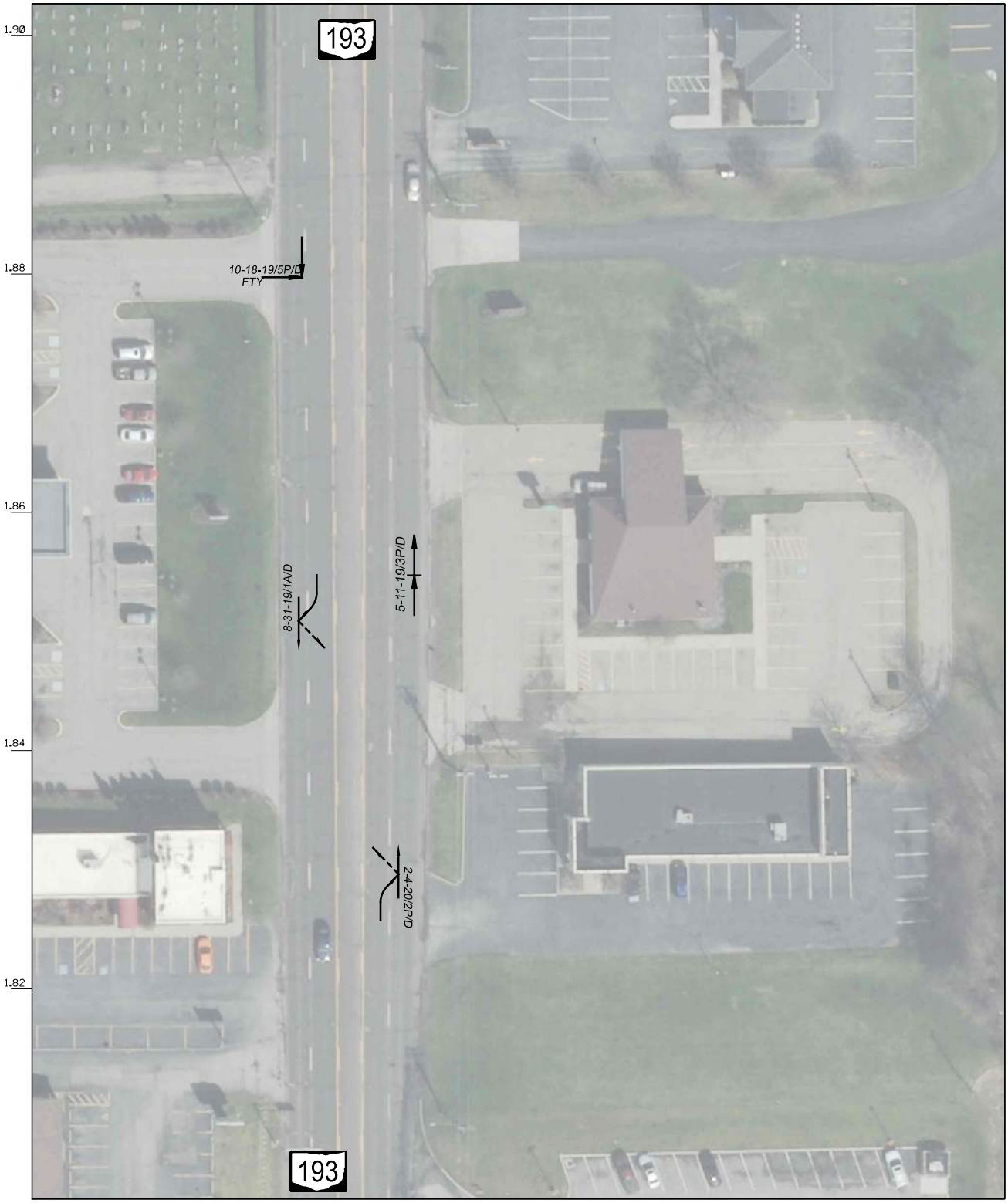
TOTAL CRASHES ON PAGE

FREQUENCY		CRASH SEVERITY	
16	2018	43	NON - INJURY
12	2019	14	INJURY OR FATAL
11	2020	57	TOTAL
18	2021		

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

2018-2021

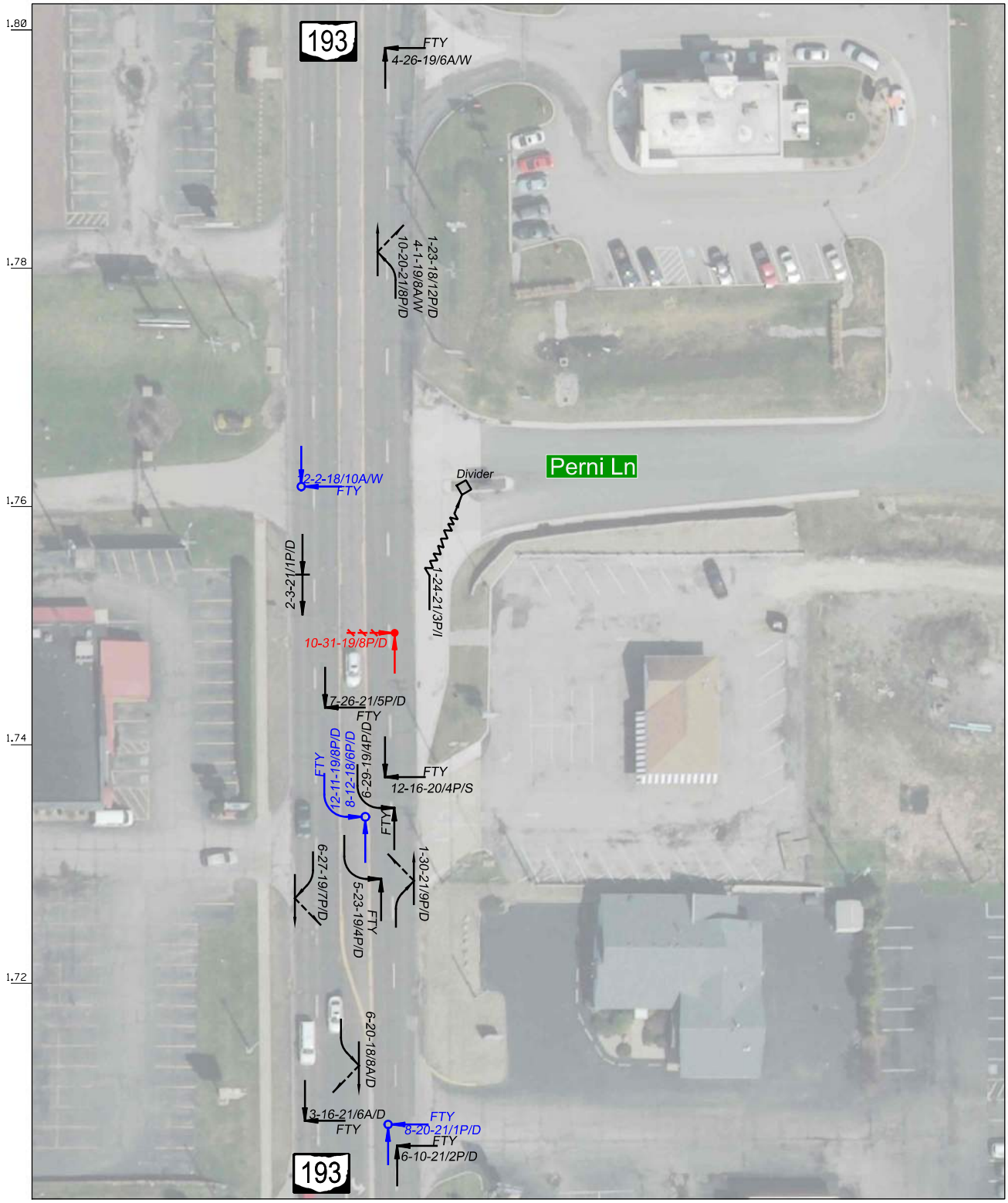


Vehicle Direction	Injury	Road:	FTC = Failure To Control	TOTAL CRASHES ON PAGE
Backing	Fatal	D = Dry	FTS = Failure To Stop	FREQUENCY / CRASH SEVERITY
Pedestrian	Fixed Object	W = Wet	FTY = Failure To Yield	0 2018 / 3 NON - INJURY
Out of Control	Parked Vehicle	I = Ice	LOC = Left of Center	2 2019 / 0 INJURY OR FATAL
Overturn	TEXT Date/Time/Road/Egress Direction	S = Snow	RRL = Ran Red Light	1 2020 / 3 TOTAL
			OVI = Operating Vehicle Impaired	0 2021

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

2018-2021

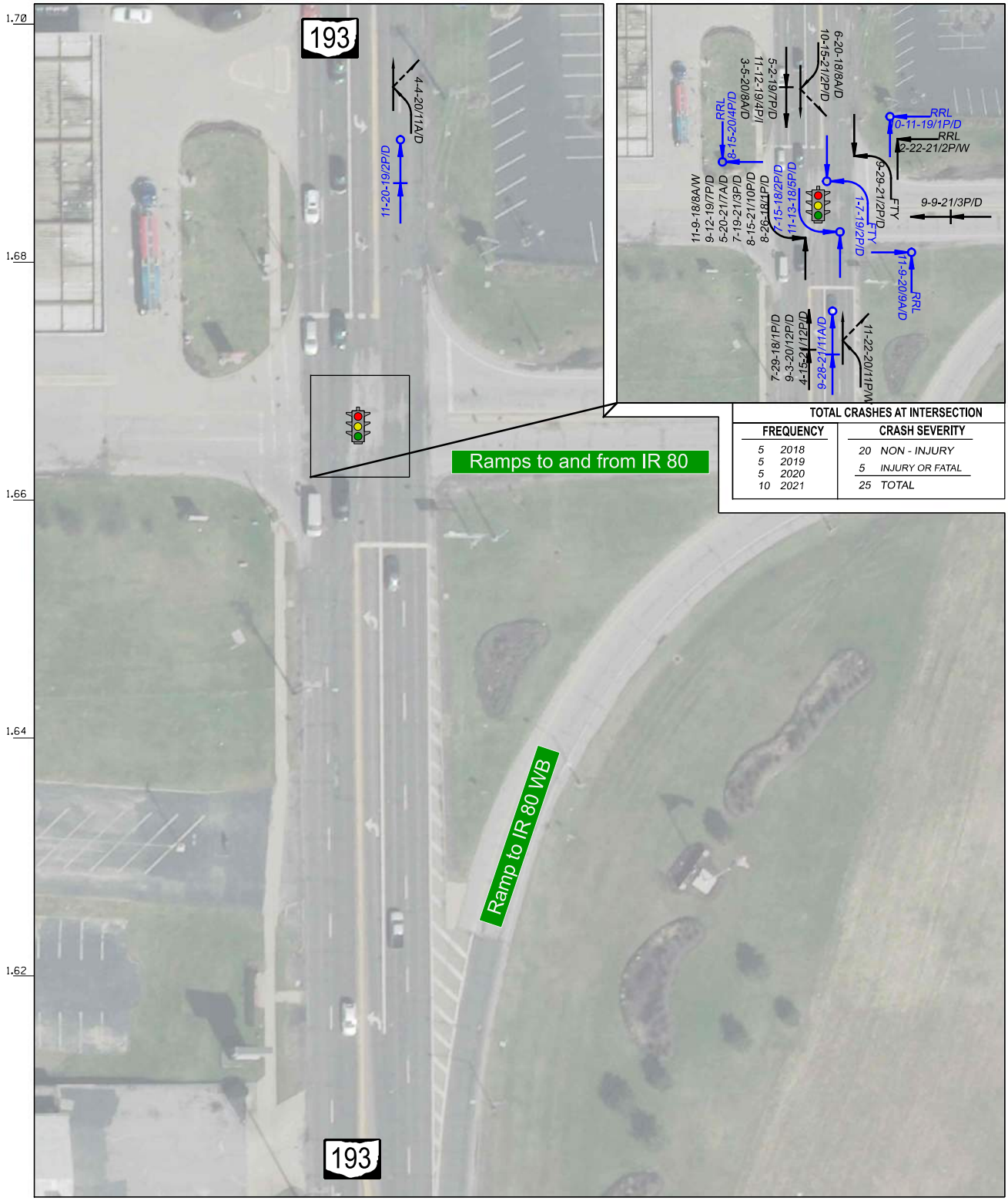


Vehicle Direction	Injury	Road:	FTC = Failure To Control	TOTAL CRASHES ON PAGE
Backing	Fatal	D = Dry	FTS = Failure To Stop	FREQUENCY / CRASH SEVERITY
Pedestrian	Fixed Object	W = Wet	FTY = Failure To Yield	4 2018 / 15 NON - INJURY
Out of Control	Parked Vehicle	I = Ice	LOC = Left of Center	7 2019 / 5 INJURY OR FATAL
Overturn	TEXT Date/Time/Road/Egress Direction	S = Snow	RRL = Ran Red Light	1 2020 / 20 TOTAL
			OVI = Operating Vehicle Impaired	8 2021

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

2018-2021



TOTAL CRASHES AT INTERSECTION

FREQUENCY		CRASH SEVERITY	
5	2018	20	NON - INJURY
5	2019	5	INJURY OR FATAL
5	2020	25	TOTAL
10	2021		

Vehicle Direction
Backing
Pedestrian
Out of Control
Overturn

Injury
Fatal
Fixed Object
Parked Vehicle
TEXT Date/Time/Road

Road:
D = Dry
W = Wet
I = Ice
S = Snow

FTC = Failure To Control
FTS = Failure To Stop
FTY = Failure To Yield
LOC = Left of Center
RRL = Ran Red Light
OVI = Operating Vehicle Impaired

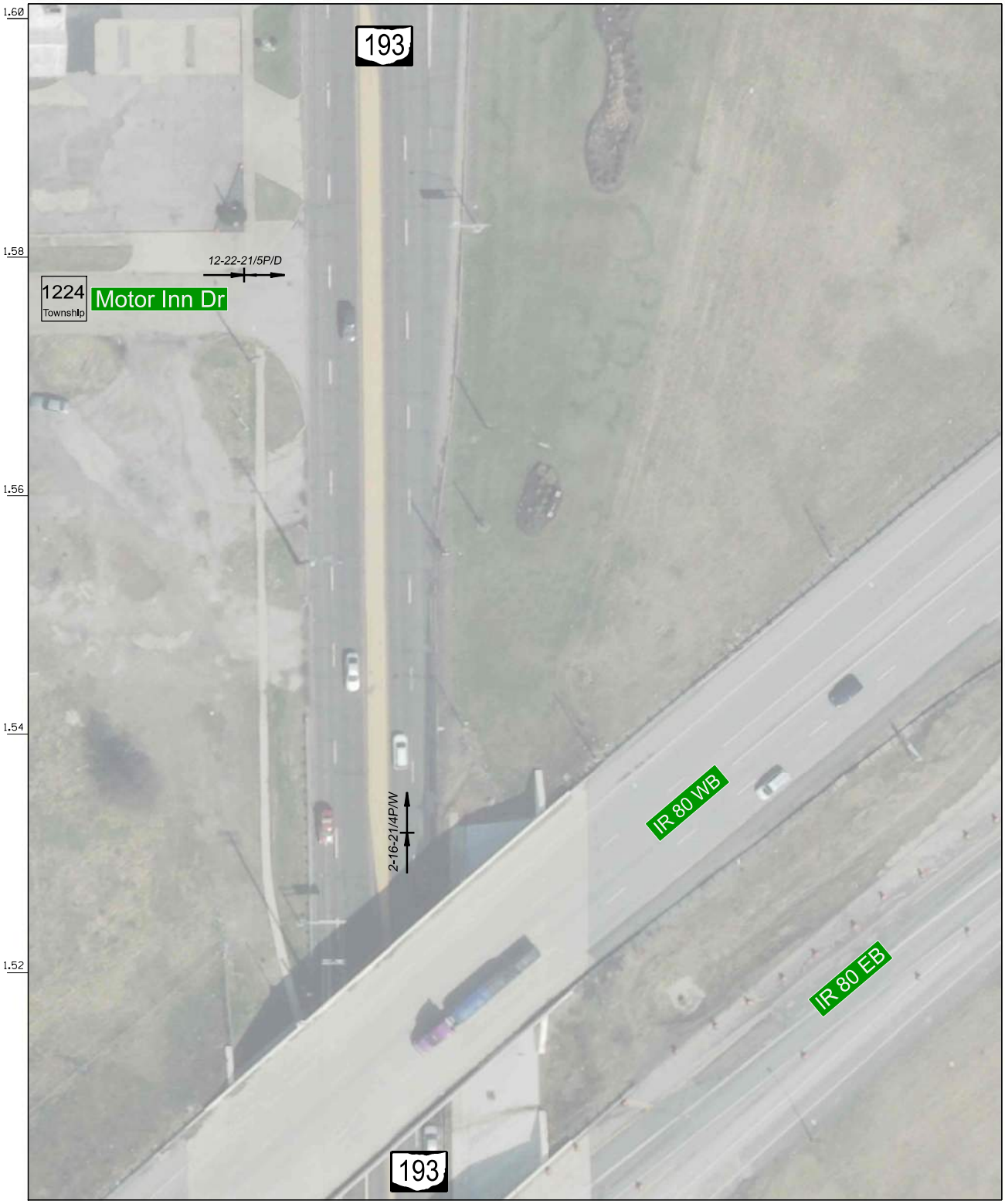
TOTAL CRASHES ON PAGE

FREQUENCY		CRASH SEVERITY	
6	2018	21	NON - INJURY
6	2019	6	INJURY OR FATAL
5	2020	27	TOTAL
10	2021		

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

2018-2021



Vehicle Direction Backing Pedestrian Out of Control Overturn	Injury Fatal Fixed Object Parked Vehicle TEXT Date/Time/Road/Egress Direction	Road: D = Dry W = Wet I = Ice S = Snow	FTC = Failure To Control FTS = Failure To Stop FTY = Failure To Yield LOC = Left of Center RRL = Ran Red Light OVI = Operating Vehicle Impaired	TOTAL CRASHES ON PAGE FREQUENCY 0 2018 0 2019 0 2020 1 2021	CRASH SEVERITY 1 NON - INJURY 0 INJURY OR FATAL 1 TOTAL

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

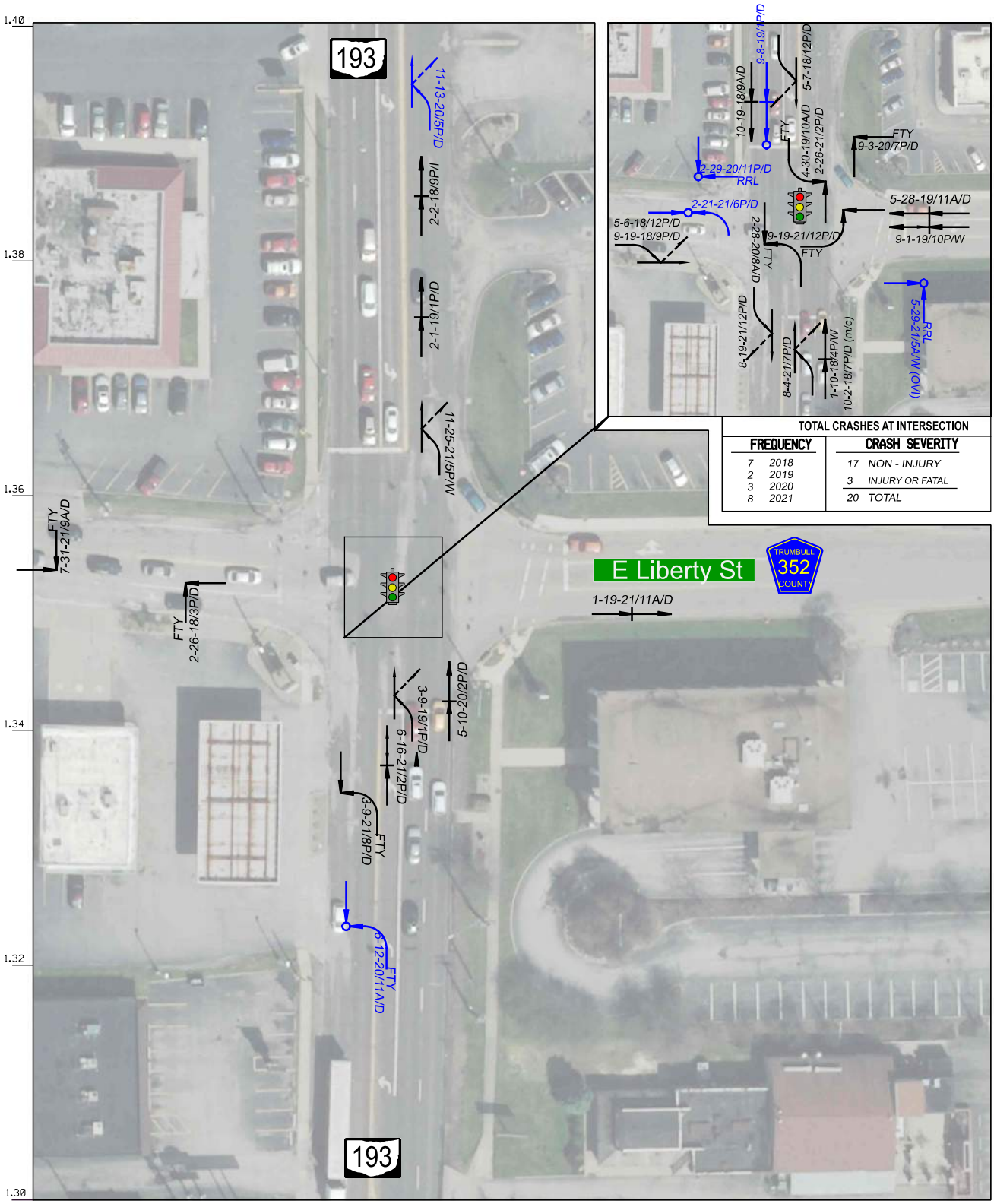
2018-2021

Vehicle Direction Backing Pedestrian Out of Control Overturn	Injury Fatal Fixed Object Parked Vehicle TEXT Date/Time/Road/Egress Direction	Road: D = Dry W = Wet I = Ice S = Snow	FTC = Failure To Control FTS = Failure To Stop FTY = Failure To Yield LOC = Left of Center RRL = Ran Red Light OVI = Operating Vehicle Impaired	TOTAL CRASHES ON PAGE FREQUENCY 0 2018 0 2019 0 2020 2 2021	CRASH SEVERITY 1 NON - INJURY 1 INJURY OR FATAL 2 TOTAL

COLLISION DIAGRAM

TRU SR 193 SLM 1.30 - 2.05

2018-2021



Vehicle Direction
Backing
Pedestrian
Out of Control
Overturn

Injury
Fatal
Fixed Object
Parked Vehicle
TEXT Date/Time/Road

Road:
D = Dry
W = Wet
I = Ice
S = Snow

FTC = Failure To Control
FTS = Failure To Stop
FTY = Failure To Yield
LOC = Left of Center
RRL = Ran Red Light
OVI = Operating Vehicle Impaired

TOTAL CRASHES ON PAGE

FREQUENCY		CRASH SEVERITY	
9	2018	27	NON - INJURY
4	2019	5	INJURY OR FATAL
6	2020	32	TOTAL
13	2021		

APPENDIX D – PROPOSED IMPROVEMENTS

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS (05-15-2024)
- PHASE 1 ALTERNATIVE 1 (05-15-2024)
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- EXISTING WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- PHASE 1 IMPROVEMENT NOTES

I-80 EB

PROPOSED ACCESS REMOVAL & REDESIGN

BELMONT AVE (SR 193)

SIGNAL IMPROVEMENTS SUCH AS REFLECTIVE BACKPLATES, ALL-RED TIME, PROTECTED LEFT TURNS, LEADING PEDESTRIAN INTERVALS, AND EVALUATION OF LANE ASSIGNMENTS; NEW PEDESTRIAN PUSH BUTTONS AND SIGNAL HEADS TO BE INSTALLED ON NEW PEDESTALS

PROPOSED ACCESS REMOVAL & REDESIGN

E LIBERTY ST

I-80 EB ON RAMP

N

0 50

GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR306\CADD\PLAN 21-00314-010 TRU SR193.DWG - 12/11/2024 12:46:32 PM

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS (05-15-2024)
- PHASE 1 ALTERNATIVE 1 (05-15-2024)
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- EXISTING WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- PHASE 1 IMPROVEMENT NOTES

MOTOR INN DR

PROPOSED TRAFFIC CALMING MEDIAN WITH TREES

BELMONT AVE (SR 193)

I-80 WB ON RAMP

PROPOSED RECTANGULAR RAPID FLASHING BEACON (RRFB)

PROPOSED REST AREA
BELMONT AVE & MOTOR INN DR
WRTA BUS STOP

I-80 EB

I-80 WB

0 50
GRAPHIC SCALE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR39\4CADD\2PLAN 21-00314-010 TRU SR193.DWG - 12/11/2024 12:46:39 PM

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION
LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS (05-15-2024)
- PHASE 1 ALTERNATIVE 1 (05-15-2024)
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- EXISTING WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- PHASE 1 IMPROVEMENT NOTES

PROPOSED ACCESS REMOVAL

BELMONT AVE (SR 193)

PROPOSED RECTANGULAR RAPID FLASHING BEACON (RRFB)

SIGNAL IMPROVEMENTS SUCH AS ALL-RED TIME, PROTECTED LEFT TURNS, AND LEADING PEDESTRIAN INTERVALS
NEW PEDESTRIAN PUSH BUTTONS AND SIGNAL HEADS TO BE INSTALLED ON NEW PEDESTALS

I-80 WB ON RAMP

I-80 WB OFF RAMP

PERNI LN

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\DOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 I80WB RAMPS TO SR304\CADD\ZPLAN 21-00314-010 TRU SR193.DWG - 12/11/2024 12:46:44 PM

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS (05-15-2024)
- PHASE 1 ALTERNATIVE 1 (05-15-2024)
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- EXISTING WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- PHASE 1 IMPROVEMENT NOTES

PROPOSED ACCESS REMOVAL & REDESIGN

PROPOSED TRAFFIC CALMING MEDIAN

BELMONT AVE (SR 193)

PROPOSED TWO-STAGE CROSSING WITH PEDESTRIAN HYBRID BEACON

PROPOSED ACCESS REMOVAL

PERNI LN

N

0 50

GRAPHIC SCALE

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193 180WB RAMPS TO SR304\CAD\ZPLAN 21-00314-010 TRU SR193.DWG - 12/11/2024 12:46:49 PM

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION

LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

LEGEND

- PROPOSED PEDESTRIAN IMPROVEMENTS
- PHASE 1 DESIGN PLANS (05-15-2024)
- PHASE 1 ALTERNATIVE 1 (05-15-2024)
- PROPOSED ACCESS REMOVAL
- PROPOSED ACCESS DRIVE APRON
- PROPOSED RIGHT-IN-RIGHT-OUT
- EXISTING WRTA BUS STOP
- PROPOSED IMPROVEMENT NOTES
- PHASE 1 IMPROVEMENT NOTES

CHURCHILL RD (SR 304)

SIGNAL IMPROVEMENTS SUCH AS REFLECTIVE BACKPLATES, ALL-RED TIME, PROTECTED LEFT TURNS, AND LEADING PEDESTRIAN INTERVALS
NEW PEDESTRIAN PUSH BUTTONS AND SIGNAL HEADS TO BE INSTALLED ON NEW PEDESTALS

BELMONT AVE (SR 193)

PROPOSED RIGHT-IN RIGHT-OUT

0 50
GRAPHIC SCALE

Environmental Design Group
AKRON / CLEVELAND / COLUMBUS
HQ 450 GRANT ST., AKRON, OH 44311
P 330.375.1390 / TF 800.835.1390
W ENVDESIGNGROUP.COM

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

TRU SR193 SAFETY STUDY
OHIO DEPARTMENT OF TRANSPORTATION
LIBERTY TOWNSHIP
PROPOSED IMPROVEMENTS

E:\ODOT\21-00314-010 OHIO STATEWIDE SAFETY STUDIES\PHASE 6 - TRU SR193\180\WB RAMPS TO SR304\CADD\ZPLAN 21-00314-010 TRU SR193.DWG - 12/11/2024 12:46:54 PM

APPENDIX E - CAPACTIY ANALYSIS

INTERSECTION	APPROACH	2016 Existing AM Peak 110s Cycle Length			2016 Existing PM Peak 120s Cycle Length		
		LOS	DELAY	QUEUE	LOS	DELAY	QUEUE
SR 193 & WB I-80 Ramps (Signalized)	EB Left	D	40.0	31’	D	43.4	19’
	EB Through/Right	C	25.9	65’	C	26.6	45’
	Eastbound	**C**	**29.6**	--	**C**	**30.2**	--
	WB Left/TH/Right	D	44.4	136’	D	48.5	172’
	Westbound	**D**	**44.4**	--	**D**	**48.5**	--
	NB Left	B	10.4	9’	B	13.1	13’
	NB Through/Right	A	7.8	110’	B	10.7	177’
	Northbound	**A**	**7.9**	--	**B**	**10.8**	--
	SB Left	B	15.3	78’	C	21.8	85’
	SB Through/Right	A	3.7	75’	A	4.8	56’
	Southbound	**A**	**9.6**	--	**B**	**10.0**	--
	Intersection Total	**B**	**13.2**	--	**B**	**14.2**	--

APPENDIX F - COST OPINION

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations

TRU 193 SAFETY STUDY
ODOT DISTRICT 4
COST OPINION
November 21, 2024

Environmental Design Group

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
Demolition & Site Preparation					
1	Clearing and Grubbing	1	LS	$3,000.00	$3,000.00
2	Pavement Removed	1483	SY	$25.00	$37,075.00
3	Removal of Ground Mounted Sign and Reerection	2	EACH	$70.00	$140.00
4	Mailbox Relocated	0	EACH	$2,000.00	$0.00
				Subtotal	**$40,215.00**
Earthwork & Erosion Control					
5	Excavation (sidewalk only)	206	CY	$50.00	$10,300.00
6	Excavation (trees within median)	489	CY	$50.00	$24,450.00
7	Proof Rolling	0	HOUR	$180.00	$0.00
8	Erosion Control	1	LS	$5,000.00	$5,000.00
				Subtotal	**$39,750.00**
Drainage					
9	8" Conduit, Type B	0	FT	$20.00	$0.00
10	Catch Basin, No. 3	0	EACH	$2,000.00	$0.00
				Subtotal	**$0.00**
Pavement					
11	Subgrade Compaction	845	SY	$5.00	$4,225.00
12	Aggregate Base	141	CY	$65.00	$9,165.00
13	Asphalt Concrete Surface Course, Type 1, (449), PG64-22	30	CY	$290.00	$8,700.00
14	Asphalt Concrete Intermediate Course, Type 2, (449)	42	CY	$260.00	$10,920.00
15	6" Concrete Drive Apron	134	SY	$65.00	$8,710.00
16	4" Concrete Walk, 6' wide	9504	SF	$6.00	$57,024.00
17	6" Concrete Median (within roadway)	489	SY	$100.00	$48,900.00
18	6" Concrete Median (RIRO Access Management)	16	SY	$100.00	$1,600.00
19	Curb Ramp	16	EACH	$1,300.00	$20,800.00
20	Curb Removed	42	FT	$18.00	$756.00
21	Curb, Type 6	800	FT	$25.00	$20,000.00
				Subtotal	**$190,800.00**
Traffic Control					
22	Crosswalk Line, Type 1 24"	518	L.F.	$30.00	$15,540.00
23	Solar Powered RRFB (ea. set of two double-sided posts)	1	EACH	$16,000.00	$16,000.00
24	Pedestrian Hybrid Beacon	1	EACH	$120,000.00	$120,000.00
25	Luminaire and Arm (added to existing electric pole)	3	EACH	$5,000.00	$15,000.00
26	Ground Rod	24	EACH	$370.00	$8,880.00
27	Signal Head Type D2 Countdown	24	EACH	$740.00	$17,760.00
28	Accessible Push Button	24	EACH	$450.00	$10,800.00
29	Signal Cable	384	FT	$3.00	$1,152.00
30	Pedestal Foundation	13	EACH	$1,400.00	$18,200.00
31	Pedestal 8' Transformer Base	13	EACH	$950.00	$12,350.00
				Subtotal	**$235,682.00**
Landscaping					
32	Seeding and Mulching, Class 1	1130	SY	$2.00	$2,260.00
33	Vegetation within Replaced Median	1	LS	$10,000.00	$10,000.00
				Subtotal	**$12,260.00**
Incidentals					
34	Maintaining Traffic	1	$	$15,561.21	$15,561.21
35	Construction Layout Stakes and Surveying	1	$	$7,780.61	$7,780.61
36	General Conditions	1	$	$10,374.14	$10,374.14
37	Bonds and Insurance	1	$	$15,561.21	$15,561.21
38	Mobilization/Demobilization	1	$	$12,967.68	$12,967.68
39	Design and Documents	1	$	$67,431.91	$67,431.91
				Subtotal	**$129,676.75**
				Total	**$648,383.75**
	Contingency (20%)				$129,676.75
Total Construction Cost					**$778,060.50**
	2025 Total Construction Cost (ODOT Inflation Factor 5.2%)				$818,519.65
	2026 Total Construction Cost (ODOT Inflation Factor 4.9%)				$858,627.11
	2027 Total Construction Cost (ODOT Inflation Factor 4.0%)				$892,972.19

Refer to January 30, 2025 Memorandum for the Addendum to Report Recommendations