FINAL REPORT
NOVEMBER 2022

FRA-62-3.26

Abbreviated Safety Study
Intersection of US-62 at SR-665
Pleasant Townships | Franklin County
Crash Data (2016-2020)

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1.0 Purpose and Need

The study intersection of US-62 at SR-665 is in Pleasant Township in Franklin County. The intersection has repeatedly appeared on the Highway Safety Improvement Program (HSIP) priority list for rural intersections most recently ranking 43rd in 2018 and 73rd in 2020.

The purpose of this study is to analyze the existing safety performance of the intersection and to identify potential countermeasures to reduce crashes and to improve overall safety.

2.0 Existing Conditions

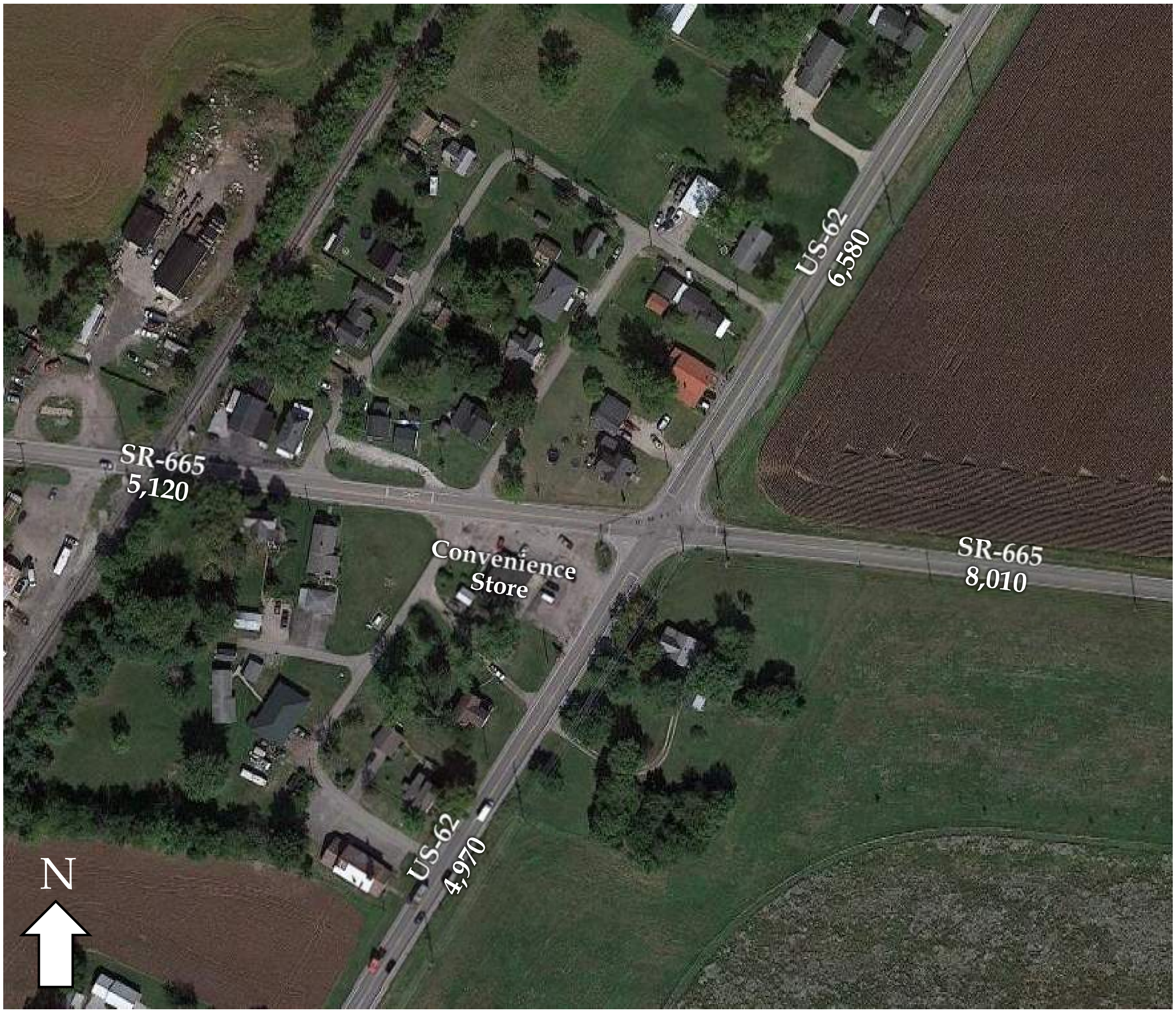
The US-62 at SR-665 intersection is signalized with a diagonal span wire. Signal heads have 12" lenses and are painted black with no backplates. No turn lanes are present at the intersection. No pedestrian facilities such as sidewalks, crosswalks, or pedestrian heads and push buttons are present at the intersection. Grades at the intersection are relatively flat. SR-665 intersects US-62 at approximately a 65 degree angle. A luminaire is present on the southwest corner, however, it is aligned to illuminate the convenience store parking lot. Radar detection is present at the intersection.

Signal Ahead warning signs are present on the northbound and southbound approaches of US-62. Longitudinal pavement markings are in good condition on both roadways. Stop bars on SR-665 are worn but visible. Pavement is generally in good condition. In a few areas, the shoulder pavement is cracked. Based on ODOT's Transportation Information Management Systems (TIMS), the PCR is between 75 and 84 on US-62 which is within the good range and between 51-66 on US-665 which is within the fair to poor range.

US-62 is a two lane principal arterial with a speed limit of 55 mph. Lanes are approximately 12 feet wide with four foot wide paved shoulder. SR-665 is a two lane roadway with a speed limit of 55 mph. The west leg is classified as a minor arterial and the east leg is classified as a principal arterial. Lanes are approximately 11 feet wide with gravel shoulders varying between one and two feet. An at grade railroad crossing is present on SR-665 approximately 500 feet west of the US-62 intersection.

The area surrounding the study intersection is primarily rural in nature. Farm fields are present on northeast and southeast quadrants. A few houses are in the northwest quadrant and the southwest quadrant has a convenience store. **Figure 1** shows the study intersection with AADT's calculated from the count data.

Figure 1: Study Area



A field review was conducted on July 20, 2022. Below is a summary of observations:

- The *Signal Ahead* warning signs on the southbound (860′) and northbound (1,100′) approaches are placed significantly farther from the intersection than the 325 feet suggested in the Ohio Manual of Uniform Traffic Control (OMUTCD) for 55 mph roads.
- The shoulders showed some cracking and breakage (see **Photo 1).**

Photo 1: Broken Pavement on Shoulder

- Access to the convenience store is permitted along the entire property along SR-665. This did not appear to cause significant safety issues at the intersection, however, if traffic along SR-665 increases, vehicles entering and exiting the convenience store could have safety impacts.
- Some signs were worn and difficult to read (see **Photo 2**)

Photo 2: Worn Signs

- Queuing often extended to 10 or more vehicles, particularly on the westbound and southbound approaches (see **Photo 3)**. These approaches had a higher percentage of vehicles turning left that impacted queuing. In some cases, a left turning vehicle may have to wait the entire phase before finding a gap.

Photo 3: Westbound Queuing

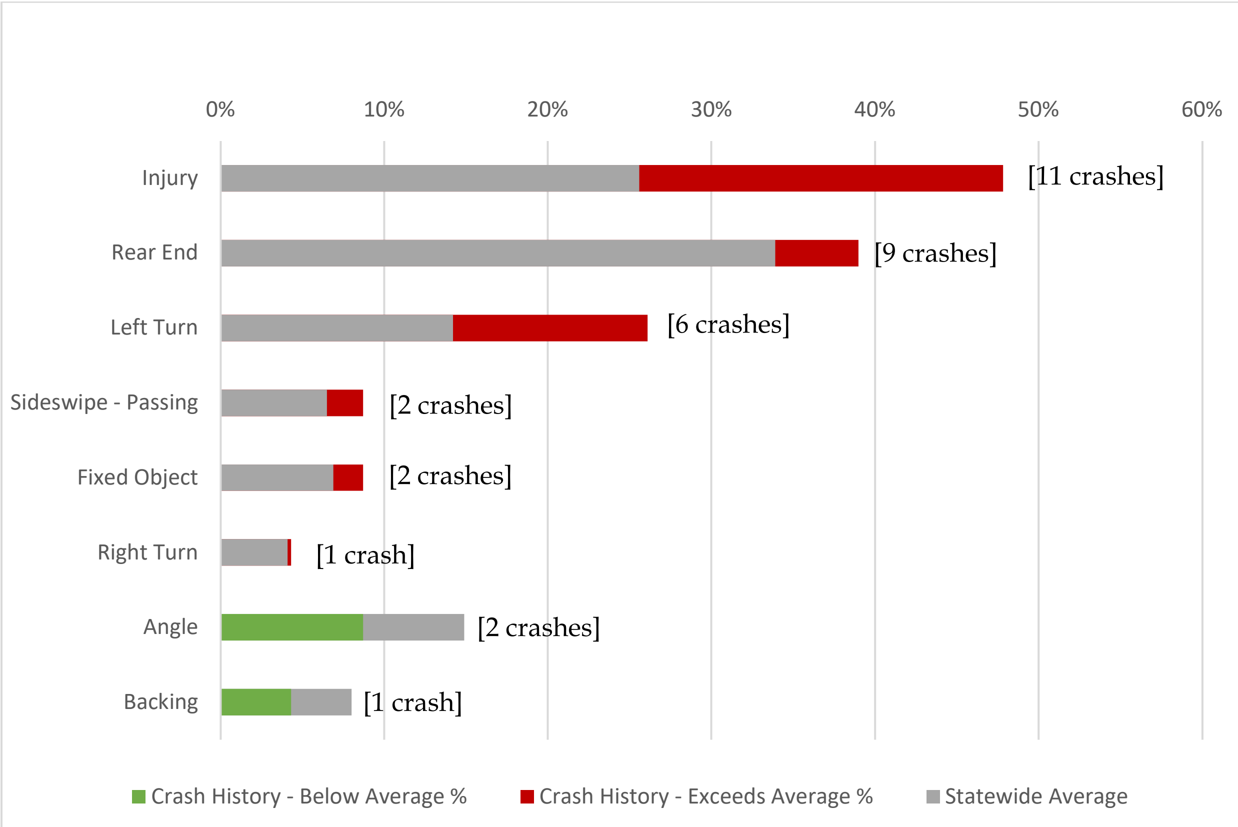
- Speeding did not appear to be prevalent.
- A few instances were witnessed where a westbound right turning vehicle barely missed striking an eastbound left turning vehicle as both were proceeding through a yellow signal. This is likely exacerbated by the lack of left turn lanes.

Turning movement counts were collected at the study intersection on June 28, 2022, from 7 AM – 7 PM. Using the count data, the peak hours were determined to be 7:15-8:15 AM and 4:30-5:30 PM for the intersection. Daily heavy vehicle traffic accounts for about 2% of the traffic on southbound US-62 and 3% on all other traffic. Count data is provided in **Appendix A**.

3.0 Crash Data

Crash data between 2016 and 2020 was obtained using ODOT's TIMS website. A total of 23 crashes occurred within the study area with one involving serious injuries, four involving minor injuries, and six involving possible injuries. **Graph 1** shows the frequency per crash type for the intersection compared to the statewide average for four-legged signalized rural intersections. Crash frequencies higher than the statewide average are in red, and those lower than the statewide average are in green.

Graph 1: Percentage of Crashes by Type Versus Statewide Averages



The graph shows that injury, rear end, left turn, fixed object, and sideswipe-passing crashes happen more frequently at the intersection than is typical. **Table 1** shows notable crash statistics and **Appendix B** contains the full crash data from the CAM tool. A crash diagram is provided in **Figure 2**.

Table 1: Crash Statistics

Unit 1 Contributing Factor	Crashes	%
Following Too Closely/ACDA	9	39.1%
Failure to Yield	7	30.4%
Failure to Control	2	8.7%
Ran Red Light	2	8.7%
Other Improper Action	1	4.3%
Improper Backing	1	4.3%
Improper Lane Change	1	4.3%

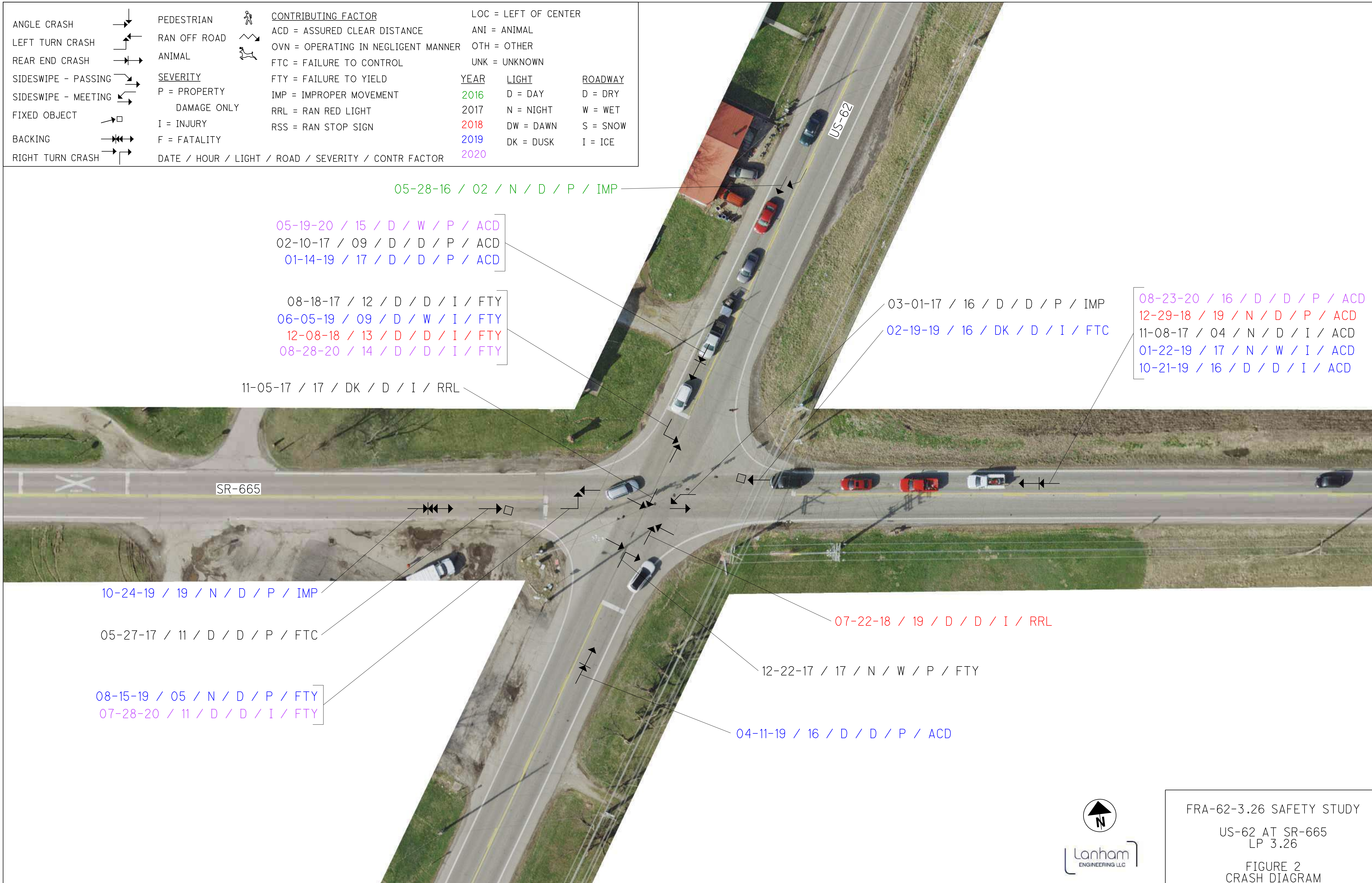
Light Condition	Crashes	%
Daylight	14	60.9%
Dark - Lighted Roadway	4	17.4%
Dawn/Dusk	2	8.7%
Dark - Roadway Not Lighted	2	8.7%
Dark - Unknown Roadway Lighting	1	4.3%

Road Condition	Crashes	%
Dry	19	82.6%
Wet	4	17.4%

Hour of Day	Crashes	%
2	1	4.3%
4	1	4.3%
5	1	4.3%
9	2	8.7%
11	2	8.7%
12	1	4.3%
13	1	4.3%
14	1	4.3%
15	1	4.3%
16	5	21.7%
17	4	17.4%
19	3	13.0%

Estimated Speed	Crashes	%
0-10	9	39.1%
11-20	2	8.7%
21-30	6	26.1%
31-40	2	8.7%
41-50	3	13.0%
51-60	1	4.3%

Crashes were most common between 4 PM and 6 PM. This indicates that congestion may be a contributing factor. Following too closely was the most frequent contributing factor also suggesting that congestion is an issue. Failure to yield was a common contributing factor indicating vehicles may be accepting a smaller gap to turn left. Approximately 40% of the crashes occurred either at dawn, dusk or dark, indicating that lighting may be insufficient at the intersection. Pavement friction is likely not a significant contributing factor since almost 85% of the crashes occurred on dry pavement. Speeding does not appear to be an issue; estimated speeds listed on the crash reports were at or below the speed limit.


ANGLE CRASH
LEFT TURN CRASH
REAR END CRASH
SIDESWIPE - PASSING
SIDESWIPE - MEETING
FIXED OBJECT
BACKING
RIGHT TURN CRASH
PEDESTRIAN
RAN OFF ROAD
ANIMAL
SEVERITY
P = PROPERTY DAMAGE ONLY
I = INJURY
F = FATALITY
DATE / HOUR / LIGHT / ROAD / SEVERITY / CONTR FACTOR
CONTRIBUTING FACTOR
ACD = ASSURED CLEAR DISTANCE
OVN = OPERATING IN NEGLIGENT MANNER
FTC = FAILURE TO CONTROL
FTY = FAILURE TO YIELD
IMP = IMPROPER MOVEMENT
RRL = RAN RED LIGHT
RSS = RAN STOP SIGN
LOC = LEFT OF CENTER
ANI = ANIMAL
OTH = OTHER
UNK = UNKNOWN
YEAR
2016
2017
2018
2019
2020
LIGHT
D = DAY
N = NIGHT
DW = DAWN
DK = DUSK
ROADWAY
D = DRY
W = WET
S = SNOW
I = ICE
US-62
SR-665
05-28-16 / 02 / N / D / P / IMP
05-19-20 / 15 / D / W / P / ACD
02-10-17 / 09 / D / D / P / ACD
01-14-19 / 17 / D / D / P / ACD
08-18-17 / 12 / D / D / I / FTY
06-05-19 / 09 / D / W / I / FTY
12-08-18 / 13 / D / D / I / FTY
08-28-20 / 14 / D / D / I / FTY
11-05-17 / 17 / DK / D / I / RRL
03-01-17 / 16 / D / D / P / IMP
02-19-19 / 16 / DK / D / I / FTC
08-23-20 / 16 / D / D / P / ACD
12-29-18 / 19 / N / D / P / ACD
11-08-17 / 04 / N / D / I / ACD
01-22-19 / 17 / N / W / I / ACD
10-21-19 / 16 / D / D / I / ACD
10-24-19 / 19 / N / D / P / IMP
05-27-17 / 11 / D / D / P / FTC
08-15-19 / 05 / N / D / P / FTY
07-28-20 / 11 / D / D / I / FTY
07-22-18 / 19 / D / D / I / RRL
12-22-17 / 17 / N / W / P / FTY
04-11-19 / 16 / D / D / P / ACD
N
Lanham ENGINEERING LLC
FRA-62-3.26 SAFETY STUDY
US-62 AT SR-665
LP 3.26
FIGURE 2
CRASH DIAGRAM

4.0 Existing Transportation Analysis

Capacity Analysis

Capacity analysis for the existing conditions was performed in *HCS Version 2022* for the signalized intersection. Growth rates of 2.4% for eastbound SR-665, 1.5% for westbound SR-665, and 1.1% for both directions on US-62 were determined using ODOT's SHIFT tool. A design hour factor of 1.18 for eastbound traffic and 1.23 for all other traffic was applied to the AM and PM peak hours to determine the peak design hours. **Figure 3** shows the count, opening, and design year volumes. **Table 2** below shows the level of service (LOS) thresholds for roundabout and signalized intersections as published in the *Highway Capacity Manual*.

Figure 3: Volumes (AM/PM)

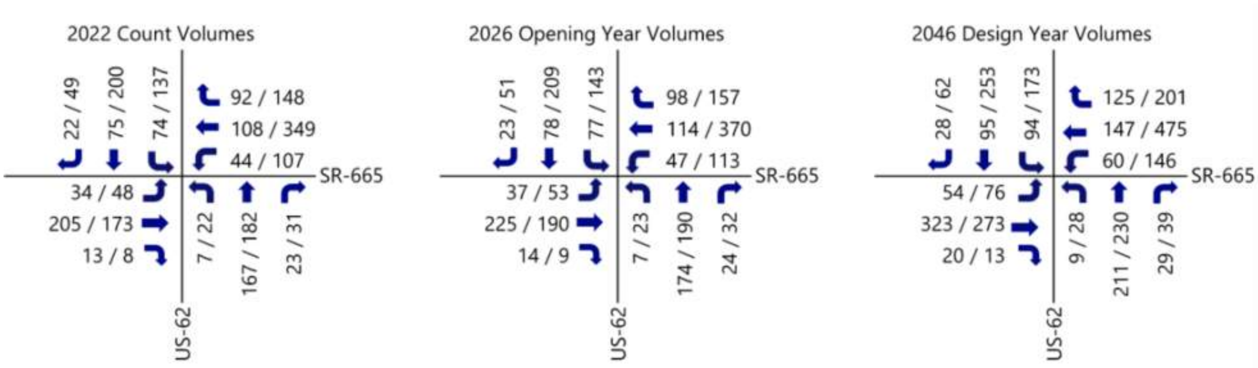


Table 2: LOS Criteria

Level of Service	Roundabout	Signalized Intersection
	Delay (Seconds)	Delay (Seconds)
A	≤ 10	≤ 10
B	> 10-15	> 10 – 20
C	> 15-25	> 20 - 35
D	> 25-35	> 35 - 55
E	> 35-50	> 55 - 80
F	> 50 or V/C ration > 1.00	> 80 or V/C ratio > 1.00

Table 3 shows the results of the existing capacity analysis for 2022 using the AM and PM peak design hours and timings provided by ODOT. The intersection functions well during both the AM and PM peaks under the existing conditions, with no movements falling below a LOS B. Full capacity analysis printouts are in **Appendix C**.

Table 3: 2022 Existing Conditions Results

Movement	AM Peak				PM Peak			
	LOS	Delay (sec)	V/C	95th% Queue (feet)	LOS	Delay (sec)	V/C	95th% Queue (feet)
EBLTR	B	10.6	0.34	45	B	10.2	0.30	40
WBLTR	B	10.6	0.34	43	B	13.6	0.74	130
NBLTR	B	10.4	0.27	38	B	11.2	0.31	48
SBLTR	B	10.2	0.24	28	B	12.5	0.52	78
Overall	B	10.5			B	12.4		

Table 4 shows the 2026 and 2046 No Build capacity analysis results for the AM and PM peak design hours. The intersection functions well in the opening year, but by the design year PM Peak, the westbound approach is over capacity and overall capacity has deteriorated significantly. Queuing in the southbound and westbound directions also become significantly higher by the design year PM Peak.

Table 4: 2026 and 2046 No Build Results

Peak	Movement	2025				2045			
		LOS	Delay (sec)	V/C	95th% Queue (feet)	LOS	Delay (sec)	V/C	95th% Queue (feet)
AM Peak	EBLTR	B	11.3	0.44	63	B	10.1	0.37	65
	WBTR	B	11.3	0.45	60	B	15.9	0.84	233
	NBTR	B	10.8	0.34	50	B	16.0	0.43	98
	SBLTR	B	10.5	0.31	38	B	19.2	0.75	180
	Overall	B	11.0			B	15.8		
PM Peak	EBLTR	B	12.7	0.64	103	B	11.9	0.54	113
	WBTR	B	12.5	0.58	83	F	49.6	1.00	535
	NBTR	B	11.2	0.42	63	B	19.1	0.50	130
	SBTR	B	10.9	0.38	48	D	44.7	0.92	328
	Overall	B	12.0			D	36.9		

Clearance and Change Intervals

Clearance and change intervals were calculated according to ODOT's TEM and compared to the existing to ensure that current standards are met. **Table 5** below shows the existing and calculated timings:

Table 5: Clearance and Change Intervals

Movement	Existing Change Interval (sec)	Calculated Change Interval (sec)	Existing Clearance Interval (sec)	Calculated Clearance Interval (sec)
EBLTR	5.6	5.7	1.0	1.0
WBLTR	5.6	5.7	1.0	1.0
NBLTR	5.6	5.5	1.0	1.0
SBLTR	5.6	5.5	1.0	1.0

The table shows that the clearance and change intervals are near the calculated values indicating they are sufficient. Clearance and change calculations are included in **Appendix D**.

5.0 Probable Causes

The crash patterns within the corridor are described below:

- **Rear End Crashes:** Rear end crashes were the most frequent crash type at the intersection with three on the southbound approach, one on the northbound approach, and five on the westbound approach. This type of crash is typically due to congestion, inattentive drivers, and signal visibility issues. Over half of the crashes occurred between 4pm and 6pm which tend to be higher travel times, indicating the congestion is a contributing factor. The southbound and westbound approaches have the highest volume of left turning vehicles indicating the lack of left turn lanes may also be a contributing factor. The lack of backplates may impair signal visibility, particularly for SR-665 due to sun glare.
- **Left Turn Crashes:** Six left turn crashes occurred within the intersection, four involved a southbound left turning vehicle, and two involved an eastbound left turning vehicle. All but one of these crashes resulted in injury, likely due to the highs speeds on both roads. All left turn crashes were due to the left turning vehicle failing to yield to through traffic. Left turn crashes are typically due to drivers accepting smaller gaps due to congestion and poor sight distance. During the field visit, it was observed vehicles, particularly southbound, often could not complete the left turn until the yellow indication appeared.
- **Angle Crash:** Two angle crashes occurred at the intersection, both involving red signal violations. Both crashes involved injuries. These crashes are typically due to driver inattention, poor signal visibility, and inadequate signal timing. The lack of backplates may be hindering signal visibility, contributing to these crashes.

6.0 Countermeasures

Rear end, left turn, and angle crashes are the most prominent and serious crashes at the intersection, so countermeasures should focus on mitigating these crash types. The following section suggests potential improvements that may reduce the potential for the most common crash types.

Short Term

- Place dual “Signal Ahead” (W3-3) signs on the eastbound and westbound approaches at the distance recommended by the OMUTCD.
- Replace worn signs and pavement markings to enhance visibility at the signal.

Long Term

- Add left turn lanes to all approaches and reconstruct signal to a box span configuration with backplates. The addition of left turn lanes should reduce queuing and improve visibility to for vehicles turning left. Additionally, removing left turning vehicles from the through movement should reduce rear end crashes since through vehicles will not have to stop unexpectedly for a preceding left turning vehicle.
- Construct a single lane roundabout. Roundabouts eliminate left turn crashes, which are prevalent at this intersection. Roundabouts have also been shown to significantly decrease injury crashes, particularly at rural intersections.

Turn Lane Lengths

Turn lane lengths were calculated using methods outlined in section 400 of ODOT’s Location and Design Manual. **Table 6** shows the calculated turn lane lengths and full calculations are included in **Appendix D**:

Table 6: Turn Lane Lengths

Intersection	Turn Lane	Calculated Length (ft)
SR-665 and US-62	Westbound Left	360
	Eastbound Left	345
	Northbound Left	345
	Southbound Left	385

The calculated length for the eastbound left turn lane cannot be accommodated due to the proximity of the railroad tracks. To avoid interfering with the tracks, a length of 110 feet is recommended.

Capacity analysis for adding left lanes is shown in **Table 7**.

Table 7: 2046 Left Turn Lane Capacity Results

Movement	AM Peak				PM Peak			
	LOS	Delay (sec)	V/C	95th% Queue (feet)	LOS	Delay (sec)	V/C	95th% Queue (feet)
EBL	B	14.8	0.15	15	C	31.9	0.48	50
EBTR	B	12.3	0.62	85	B	10.9	0.34	85
WBL	B	16.1	0.19	20	B	14.8	0.28	58
WBTR	B	11.8	0.55	65	B	19.0	0.92	255
NBL	B	11.0	0.12	3	C	22.3	0.09	15
NBTR	B	11.2	0.46	60	B	17.6	0.47	110
SBL	B	14.4	0.24	28	C	24.7	0.52	93
SBTR	B	10.1	0.23	25	B	18.2	0.54	128
Overall	B	12.2			B	18.2		

Capacity of the added left turn lanes improves compared to the No Build, particularly in the PM Peak. Queuing is also reduced compared to the No Build.

The capacity analysis for the roundabout countermeasure is shown in **Table 8**.

Table 8: 2046 Roundabout Countermeasures Capacity Results

Movement	AM Peak				PM Peak			
	LOS	Delay (sec)	V/C	95th% Queue (feet)	LOS	Delay (sec)	V/C	95th% Queue (feet)
EBLTR	A	8.1	0.42	53	B	12.6	0.51	73
WBLTR	A	7.9	0.38	45	D	30.1	0.89	313
NBLTR	A	9.0	0.35	40	A	10.0	0.40	50
SBLTR	A	5.5	0.22	23	C	22.9	0.74	165
Overall	A	7.8			C	22.1		

The roundabout capacity is improved compared to the No Build. Queuing also decreases compared to the No Build scenario. Full capacity results for both long term countermeasures are in **Appendix E**.

7.0 Safety Benefits

The Highway Safety Manual (HSM) is used to determine how an intersection is performing compared to similar intersections and to assess the safety benefit of countermeasures. ODOT's Economic Crash Analysis Tool (ECAT) was used to evaluate the existing signalized intersection and the proposed countermeasures.

Crash modification factors (CMF) are used in ECAT to calculate the reduction in crashes for each countermeasure. For example, a CMF of 0.85 reduces crashes by 15%. Not all countermeasures have been studied adequately enough to provide a CMF value. The CMF values used for each scenario are listed below. To avoid overestimating the value of the combined countermeasures, ODOT recommends that no more than four CMF values should be used per intersection for each scenario.

<u>Short Term</u>

- Place "Signal Ahead" (W3-3) signs on the eastbound and westbound approaches at the distance recommended by the OMUTCD. No CMF was applied for this countermeasure, however, it is expected to improve driver awareness of the signal thus reducing rear end crashes.
- Replace worn signs and pavement markings to enhance visibility. No CMF was applied for this countermeasure, however, it is expected to improve visibility which should reduce rear end crashes.

<u>Long Term</u>

- Add left turn lanes to all approaches and reconstruct signal to a box span configuration with backplates. The CMFs applied for this countermeasure are as follows:
    - The addition of left turn lanes has a CMF of 0.45 for all crash types based on Table 10-13 of the HSM.
    - Converting a single span wire to a box span has a CMF of 0.97 for all crash types based on the study *Safety Evaluation of Box Span Signal Configuration* by Yassin et al and published in 2017.
    - The addition of backplates is expected to reduce crashes by 7% for all crash types based on the study *Evaluating the Safety Impacts of Improving Signal Visibility at Urban Signalized Intersections* by Sayed et al and dated 2007.
- Construct a single lane roundabout. This countermeasure is expected to reduce crashes by 78% for fatal and injury crashes and by 48% for property damage only crashes. This is based on Table 14-3 of the HSM for all settings.

Table 9 shows how the existing study area ($N_{expected\_existing}$) compares to similar areas ($N_{predicted\_existing}$) and the proposed conditions ($N_{predicted\_proposed}$). According to the table, the intersection is functioning better than its peers by 3.3 crashes per year. Full HSM results and details of the CMF studies from the CMF Clearinghouse website are included in **Appendix F**.

Table 9: HSM Results Summary

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.2742	1.1657	1.4742	8.8080	11.7221
$N_{expected}$ - Existing Conditions	0.2578	1.0965	1.3863	5.6546	8.3952
$N_{potential\ for\ improvement}$ - Existing Conditions	**-0.0164**	**-0.0692**	**-0.0879**	**-3.1534**	**-3.3269**
$N_{expected}$ - Proposed Conditions, Left Turn Lanes	0.1052	0.4474	0.5656	2.3073	3.4255
$N_{predicted}$ - Proposed Conditions, Roundabout	0.0603	0.2565	0.3243	4.5802	5.2213

The short term countermeasures could not be analyzed due to the lack of available CMFs, however, they are expected to decrease safety with minimal cost. Based on the ECAT calculations, the addition of left turn lanes and improving signal visibility are expected to reduce the number of total crashes per year compared to the existing conditions by 5.0 crashes per year and injury crashes by 1.6 crashes per year. The construction of a roundabout is expected to reduce the number of total crashes per year by 6.5 compared to the existing conditions and injury crashes by 2.2 crashes per year.

8.0 Conclusions and Recommendations

A benefit cost analysis was prepared using the ECAT to compare the estimated cost of the addition of left turn lanes countermeasures and the roundabout countermeasure to their respective safety benefit. Benefit cost ratios greater than 1.00 indicate a positive return on the investment.

The results of the benefit cost analysis are shown in **Table 10**. Full calculations and detailed cost estimates are in **Appendix G**.

Table 10: Benefit Cost Analysis

	Left Turn Lanes	Roundabout
Expected Annual Crash Adjustment	-4.970	-6.501
Net Present Value of Project	$2,346,800	$3,759,000
Net Present Value of Safety Benefit	$2,166,485	$3,035,865
Benefit Cost Ratio	0.92	0.81

The benefit-cost ratio for both long term countermeasures is unfavorable since they are below the threshold value of 1.0. The addition of left turn lanes does provide a benefit-cost ratio closer to one indicating that it would be the more cost-effective option.

Based on the findings of the study, it is recommended that the short term and long term countermeasures listed below are implemented.

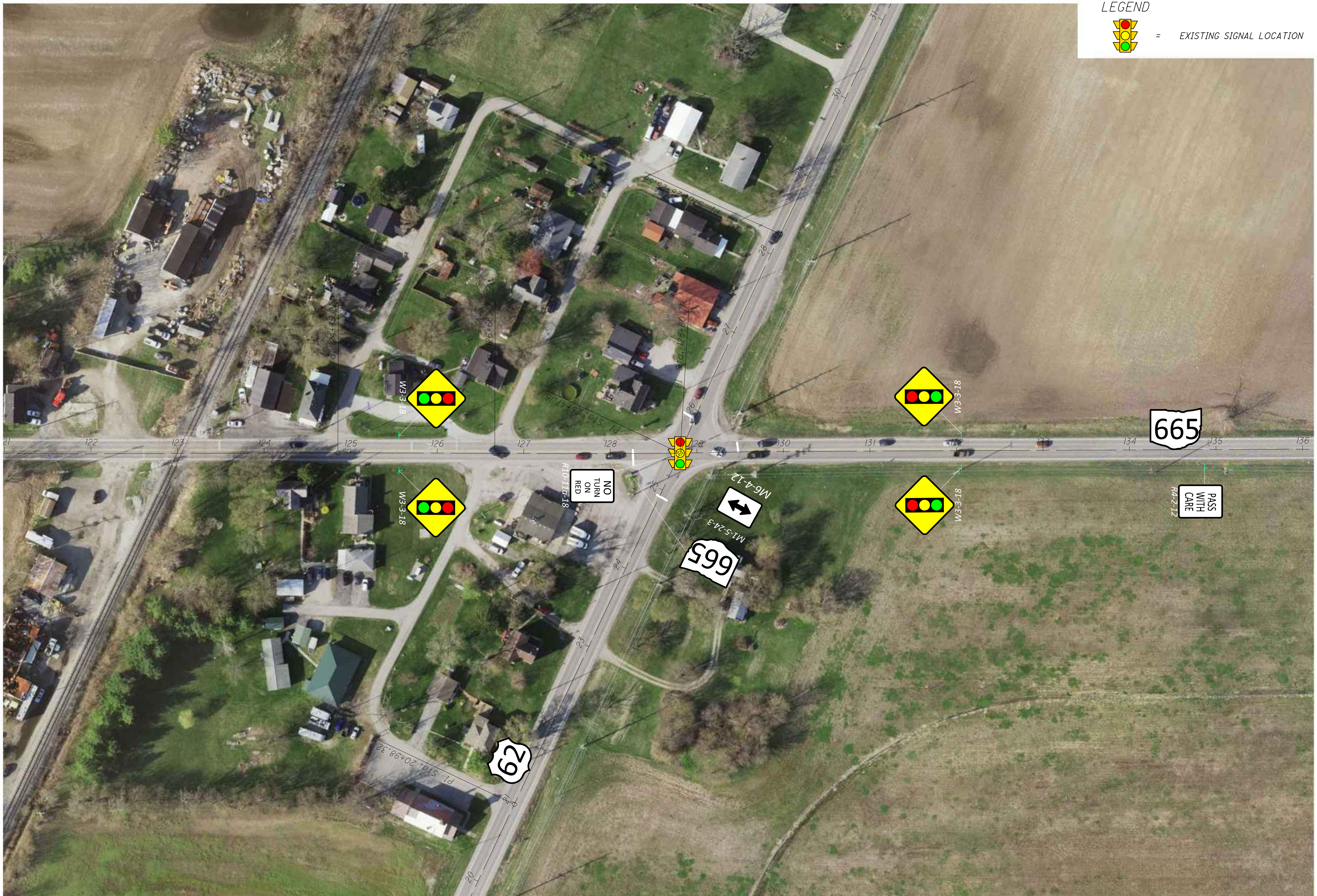
<u>Short Term</u>

- Place dual "Signal Ahead" (W3-3) signs on the eastbound and westbound approaches at the distance recommended by the OMUTCD.
- Replace worn signs and pavement markings.

<u>Long Term</u>

- Add left turn lanes to all approaches and reconstruct signal to a box span configuration with backplates.

The short term countermeasures are shown in **Figure 4. Figure 5** shows the addition of left turn lanes countermeasures and **Figure 6** shows the roundabout countermeasure.



HORIZONTAL SCALE IN FEET

0 25 50 100

CALCULATED TGW

CHECKED

SHORT TERM COUNTERMEASURES SIGNAGE AND STRIPING ALTERNATIVE

US 62/SRR 665

NOTE:
- ALL PR LANES ARE 12' WIDE
- PROPOSED SHOULDERS ARE 4' WIDE
- SHIFT TAPER BASED ON 55 MPH FOR 6'-0" SYMMETRIC WIDENING FOR SR 665
- SHIFT TAPER BASED ON 55 MPH FOR 12'-0" ASYMMETRIC WIDENING FOR US 62
- TURNING RADII BASED ON SU-30

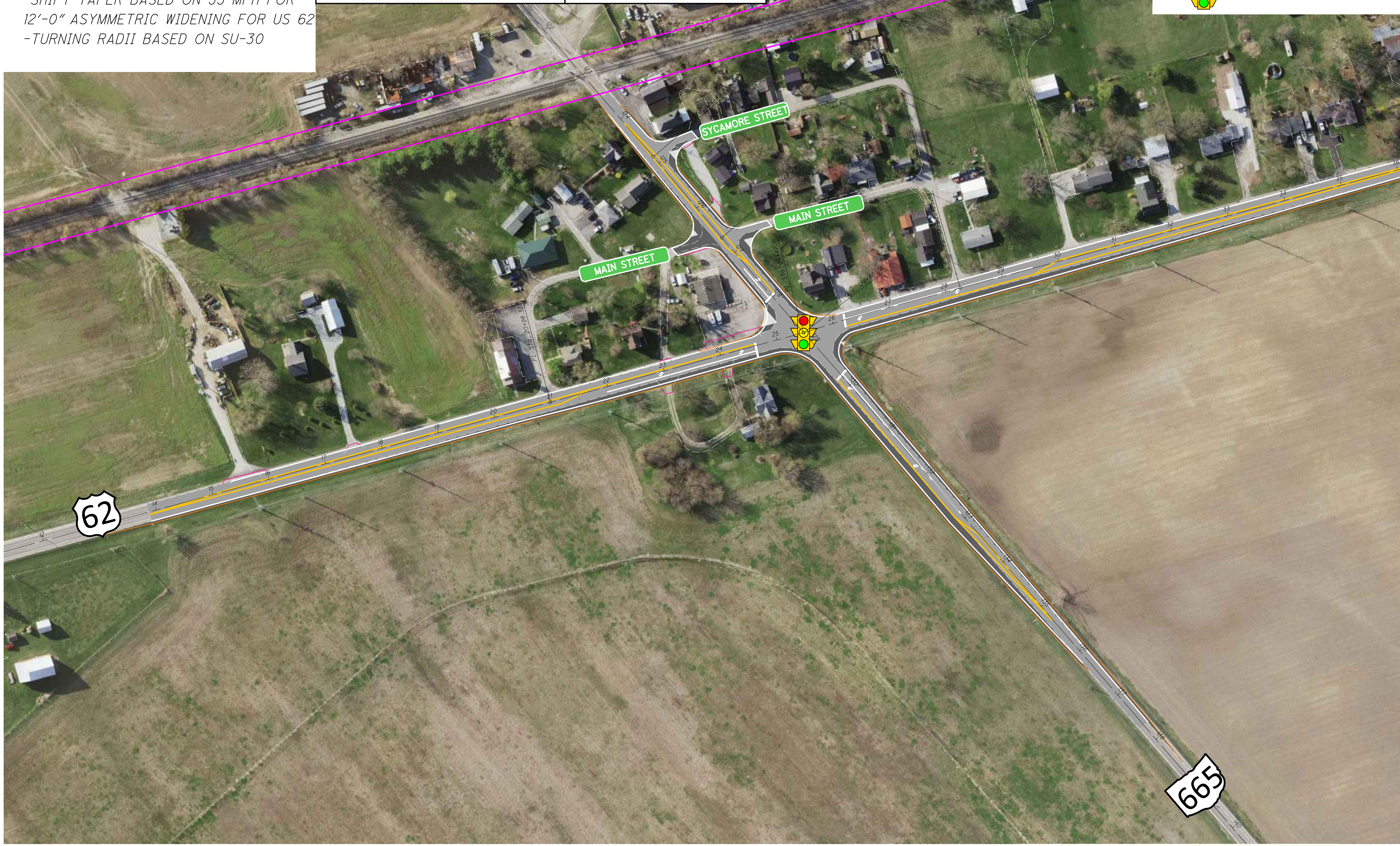
Proposed Turn Lane Location	Length (feet)
SR-665 EB Left	113'
SR-665 WB Left	360'
US-62 NB Left	345'
US-62 SB Left	385'

LEGEND

= OVERLAY

= FULL DEPTH PAVEMENT

= PROPOSED SIGNAL REPLACEMENT



0 40 80 160
HORIZONTAL SCALE IN FEET

CALCULATED TGW
CHECKED —

LONG TERM COUNTERMEASURES TURN LANE ALTERNATIVE

US 62 / SR 665 SAFTEY STUDY

J:\20220417\Dgn\US62\US62 Turn Lane Option - Update.dgn Design 8/11/2022 7:48:55 PM bmiller

NOTE:
-ALL PR LANES ARE 12' WIDE

HORIZONTAL SCALE IN FEET
0 30 60 120

CALCULATED TGW
CHECKED —

LONG TERM COUNTERMEASURES
ROUNDABOUT ALTERNATIVE

US 62/ SR 665
SAFETY STUDY

J:\20220417\Dgn\US62\US62 ROUNDABOUT.dgn Design 8/11/2022 6:08:05 PM twilson