

ABBREVIATED ENGINEERING REPORT

ROAD CONSTRUCTION ROUNDABOUT

SR 56 Roundabout at Boatman

Scott County
Des. No. 1800210

December 22, 2020

Prepared for: INDOT Seymour District
 185 Agrico Lane
 Seymour, IN 47274

Project Manager: Mr. William Fortson

Prepared by:



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I. Purpose of Report

The purpose of this report is to document the engineering assessment phase of project development, including all coordination that has been completed in preparation for this road project. This purpose of this report is limited in that the Seymour District has determined that a roundabout is the most cost-effective solution to reduce vehicle crashes at the project location. This report is being prepared to analyze the roundabout placement impacts in relation to utility relocation costs, environmental impacts, project costs and right-of-way acquisition cost. This document outlines the proposal and is intended to serve as a guide for subsequent survey, design, environmental, right of way and other project activities leading to construction. The preferred alternative identified in this document is considered predecisional, pending the outcome of environmental studies.

II. Project Location

This project is located at the intersection of SR 56 and Boatman Road, approximately 1.36 miles west of I-65 in Scott County, Indiana. The project is located in the INDOT Seymour District.

III. Project Purpose and Need

Purpose

The purpose of this project is to improve the safety and reduce the frequency and severity of crashes that occur at the intersection of State Road 56 and Boatman Road. Thirty-four crashes have occurred at this intersection during the time frame of January 1, 2012 to March 13, 2017. Sixteen of the thirty-four crashes have been right angle collisions, which represents about 45% of the crashes. Two incapacitating injury crashes and a fatal crash have been recorded within the last three years.

Given the types of accidents and their severity, it was decided that a roundabout was the best alternative, a SIDRA analysis was completed for the intersection of State Road 56 and Boatman Road. A SIDRA analysis determines at what Level of Service (LOS) the proposed roundabout will function. Using the design year and peak hour traffic counts, the SIDRA analysis shows a single lane roundabout functioning at a LOS A in the design year.

Need

The need for this project is the high crash rates and the severity of crashes occurring at the intersection of State Route 56 and Boatman Road. A ROADHAT analysis completed at this location had an Index of Crash Frequency (ICF) score

of 3.15 and an Index of Crash Cost (ICC) score of 1.89. An ICF score of 2 or higher is considered a high crash location and warrants a discussion with INDOT Traffic Safety personnel. An ICC score of 1.89 means the severity of the crashes at the location of State Road 56 and Boatman Road is higher than nominal value, by nearly 2 standard deviations. The ROADHAT analysis can be found in Appendix I.

Crash narratives indicate that drivers are unaware that the intersection is a two way stop, rather than a four way stop, when approaching from the northbound and southbound directions (Boatman Road). Supplemental signs, speed bumps, nor the two-way flashing beacon has effectively reduced the crash rate at the intersection of State Route 56 and Boatman Road.

The geometry of the intersection and posted speed limit plays a role in the crash rate. The Indiana Design Manual, section 46-1.02, states the desirable skew of an intersection is less than a 20-degree skew. The current intersection has a 28-degree skew, which reduces the driver's line of sight.

The intersection is also located in a reverse curve segment. With a posted speed limit of 50-55 mph on State Route 56, the intersection sight distance required for a passenger car to turn from Boatman Road onto State Route 56 is 530ft for a right turn and 730ft for a left turn (Indiana Design Manual Figures 46-10G and 46-10H). The existing reverse curves reduce the intersection sight distance.

A traffic signal was considered but eliminated as an effective alternate as it would not address the number and severity of right-angle crashes that this intersection's crash history shows but may increase rear-end accidents as the signal introduces a stop situation between curves that may surprise motorists unfamiliar with the area.

The preferred alternative of placing a roundabout at the intersection of SR 56 and Boatman Rd would improve the geometry of the intersection by having the approach legs intersecting at 90 degrees which improve sight lines. Slower vehicle speeds entering the roundabout alternative would also improve the safety by reducing the severity of crashes. A well-lit roundabout also improves intersection sight lines and reduces crash rate.

IV. Existing Facility

The classification of State Route 56 is Minor/Principal Arterial and is not part of the US National Highway System (NHS). The roadway is on the National Truck Network. The posted speed limit at the project location changes from 50 to 55 mph.

Boatman Road is classified as a Major Collector and is not part of the US National Highway System (NHS). There is not a posted speed limit for Boatman Road, therefore, the existing speed limit set by state law is 55 mph.

Roadway

State Route 56 has a pavement width of 26 ft through the project limits. State Route 56 currently consists of two 12-ft wide travel lanes with a 1ft paved and 1ft usable shoulders. The existing right-of-way along State Route 56 varies from 60 to 70 ft wide. State Route 56 and Boatman Rd is a two-way stop-controlled intersection, providing free flow traffic for SR 56 and a stop condition for Boatman Rd. A flashing beacon is also present at the intersection of SR 56 and Boatman Rd.

Boatman has a pavement width of 20 ft through the project limits. Boatman Rd currently consists of two 10ft wide travel lanes with unmarked 1 ft usable earth shoulders. The existing right-of-way along Boatman Road varies from 36-40ft.

Drainage

The terrain is level. The existing drainage through the project is primarily through sheet flow away from the road into adjoining open channel ditches. There is a 24-inch corrugated metal pipe (CMP) culvert approximately 550ft west of SR 56 and Boatman Rd intersection. This 24-inch culvert runs underneath SR 56, north/south. There is also a 12-inch CMP culvert approximately 350ft south of the SR 56 and Boatman Rd intersection. This 12-inch culvert runs underneath Boatman Rd, east/west. A third 12-inch CMP culvert is located in the northside open channel ditch at the intersection of SR 56 and Boatman Rd. This 12-inch culvert runs underneath Boatman Rd, east/west, albeit is still located close enough to SR 56 to most likely be inside state right-of-way.

The proposed drainage though the project will be primarily sheet flow to adjoining roadside ditches. Per INDOT's request, First Group will attempt to avoid the 24-inch CMP located west of the Boatman Rd and SR 56 intersection. First Group will inspect and perform hydraulic analysis on all three of the CMP culverts (both 12-inch and 24-inch). Proposed treatment of the three CMP culverts may consist of replacing, lining and or pipe extensions.

Land Use

The land use in the project area is a mix of residential, commercial and agricultural. There is an Indiana Farm Bureau Insurance Office and Farm Credit Mid-America Bank in the northeast quadrant of State 56 and Boatman Rd. There is a residential housing development in the northwest quadrant of the intersection. The southwest quadrant of the State Route 56 and Boatman Road intersection has parcels own by Elevation Church. The southeast quadrant of the State 56 and Boatman Road intersection has parcels that are used for

agricultural activities. The southside of State Route 56 has less conflicts for the placement of the roundabout due to the open fields with minimum obstructions.

Roadway Information			
Geometric Criteria – Boatman Road			
Design Speed	Exist: 55 mph (Not Posted) Prop: 35 mph	Functional Class	Major Collector
Design Criteria	4R (Non Freeway)	Rural/Urban	Rural
Terrain	Level	Access Control	None
Approach Cross Section			
IDM Figure Reference	IDM 53-4		
Travel Lane Count	2	Travel Lane Width	Existing: 10 ft Proposed: 12 ft
Shoulder Width (Usable) Curb & Gutter	Existing: 1ft Proposed: 2ft	Shoulder Width (paved)	Existing: 0 ft Proposed: *2 ft
Mainline Pavement	HMA	Shoulder Pavement	Existing: HMA Proposed: HMA

* Level 1 Design Exception

Roadway Information			
Geometric Criteria – SR 56			
Design Speed	Exist: 50-55 mph Prop: 45 mph	Functional Class	Minor Principal Arterial
Design Criteria	4R (Non Freeway)	Rural/Urban	Rural
Terrain	Level	Access Control	None
Approach Cross Section			
IDM Figure Reference	IDM 55-3F (Suburban)		
Travel Lane Count	2	Travel Lane Width	Existing: 12 ft Proposed: 12 ft
Shoulder Width (Usable) Curb and Gutter	Existing: 1 ft Proposed: *2ft Concrete Gutter only	Shoulder Width (paved)	Existing: 1 ft Proposed: *4 ft.
Mainline Pavement	HMA	Shoulder Pavement	Existing: HMA Proposed: HMA

* Level 1 Design Exception

V. Field Check

A Field Check was held on July 11, 2019 at the project site. The minutes for that meeting are attached to this report.

VI. Traffic Data and Capacity Analysis

Traffic Data

INDOT provided traffic turn count data from 3/6/2017 and data from GIS provided Site Count in June 2018 used:

- 2018 AADT – 9,820 VPD
- 2018 DHV – 870 VPH
- 2038 Design Year AADT – 14,377 VPD
- 2038 DHV – 1,290 VPH
- Commercial Vehicles – 5.2%
- Growth Rate = 2.2% (Linear)

See Appendix A for Traffic Data and Turning Counts.

Capacity Analysis

The computer program SIDRA was used to analyze the intersection for a single lane roundabout with four approaching roadways. The intersection level of service (LOS) is used to grade the level of delay at an intersection with the following conditions:

Level of Service	Control Delay (seconds/vehicle)	
	UNSIGNALIZED	SIGNALIZED
A	Less than or equal to 10	Less than or equal to 10
B	Between 10.1 and 15	Between 10.1 and 20
C	Between 15.1 and 25	Between 20.1 and 35
D	Between 25.1 and 35	Between 35.1 and 55
E	Between 35.1 and 50	Between 55.1 and 80
F	Greater than 50	Greater than 80

A LOS lower than a D is undesirable while a LOS of F is considered failure and warrants improvements to the capacity of the intersection.

The proposed roundabout at the intersection of State Route 56 and Boatman Rd, will operate at a Level of Service A for Design Year 2038.

The following is a Capacity Analysis summary for the roundabout. See Appendix A for SIDRA results.

Roadway Approach	Level of Service Peak Year 2038
SR 56 – East Approach	Level of Service B
SR 56 – West Approach	Level of Service A
Boatman Rd – North Approach	Level of Service A
Boatman Rd – South Approach	Level of Service A

VII. Crash Data and Analysis

Crash data for this project uses the timeframe of January 1, 2012 to March 13, 2017. During that time, thirty-four crashes have occurred at this intersection. Sixteen of the thirty-four crashes have been right angle collisions, which represents about 45% of the crashes. Two incapacitating injury crashes and a fatal crash have been recorded within the last three years. The crash analysis table/chart for State Route 56 and Boatman Road can be found in the Appendix B. A summary of the severity of the collisions is shown below:

Crash Summary

21 Property Damage

5 crashes with non-incapacitating injuries

7 crashes with incapacitating injuries

1 fatal crash

11 right angle collision

According to the Traffic Engineering Handbook, 6th Edition, potential factors in Right-Angle Crashes include restricted sight distance, excessive speed, inadequate roadway lighting, inadequate advance warning signs, large traffic volumes, and inadequate traffic control devices. Countermeasures to address these crashes include removal of the sight obstruction, provide all-way stop or signal, install or improve warning signs, reduce speed limit with enforcement, install rumble strips, install or improve lighting, install or improve warning signs, or reroute traffic. Left & right turn crashes can be caused by large turn volumes, restricted sight distance, and excessive speed. Possible countermeasures include adding turn lanes, prohibiting left turns, rerouting left turn traffic, providing a traffic signal with a turn phase, removing sight obstructions, reducing the speed limit and improving enforcement. Rear end crashes can be caused by large turning volumes, slippery pavement, or inadequate roadway lighting. Potential countermeasures include prohibiting left turns, provide turn lanes, increasing the corner radius for right turns, reducing the speed limit with enforcement, overlaying the pavement or use an ultra-thin bonded wearing course, provide adequate drainage, groove the pavement, provide "Slippery When Wet" signs, and improve the lighting. Run-off-the-road and sideswipe crashes can be caused by excessive speed, slippery pavement, inadequate roadway lighting, poor visibility or lack of warning signs, narrow pavement, poor pavement markings, inadequate shoulder, or inadequate pavement maintenance. Potential countermeasures include reducing the speed limit with enforcement, overlaying the pavement, provide adequate drainage, groove pavement, provide "Slippery When Wet" signs, improve lighting, widen lanes and/or shoulders, install guardrail, improve pavement markings, upgrade the shoulder slope, and repair the roadway surface.

Federal Highway Administration (FHWA) provides a worksheet table named "Crash Reduction Factors Table", which estimates the crash reduction that might be achieved if a specific countermeasure is implemented at an intersection. A review of the FHWA Crash Reduction Factors Table shows that the best possible countermeasure for reducing crashes, including right-angle crashes, is a geometric change of the intersection to a roundabout. The Crash Reduction Factor for a roundabout is 82, versus 74 for installing a traffic signal. The intersection currently has a two-way beacon and advance warning signs, which has not reduced the crash rates. The FHWA Crash Reduction Factors Tables can be found in the Appendix H.

VIII. Alternatives and Recommendations

Three alternative options would convert the intersection into a single lane roundabout with 4 legs. All 4 approach legs would have horizontal curves introduced preceding the splitter islands to slow traffic and provide smooth transitions into and out of the roundabout.

All of the alternatives will include intersection lighting. Due to the intersection location being a rural suburban, high speed setting, the introduction of a roundabout at this location should be made highly visible with intersection lighting for the safety of motorist. Advance signing and lower speed limits would be needed on all 4 approaches. Traffic on SR 56 would no longer be free-flowing at 55 mph, as this alternative would require traffic on SR 56 to slow through the intersection and yield to traffic from other approaches in the roundabout. It is recommended that INDOT consider lowering the speed limit along SR 56 in advance of the roundabout. It is also recommended that Scott County Highway Department consider posting a lower speed limit along Boatman in advance of the roundabout. Lowering the speed limit in advance of the roundabout will result in shorter approach legs which reduces the construction costs.

All of the alternatives will include drainage culvert work. Three existing drainage culverts location within the project limits will require either pipe lining, pipe extension or full replacement.

All of the alternatives will include the closing of Mount Road. The pavement connecting Mount Road and SR 56 will be removed and an earth berm will be constructed to prevent vehicle passage. A truck turn around will be constructed approximately 300 ft from the intersection of Mount Road and SR 56. The closing of Mount Road will require R.O.W., which is included with the R.O.W. acquisition cost.

What differentiates the three alternatives is the placement of the circulating roadway within the project limits. The placement of the roundabout will impact utility relocation costs, private property and construction cost.

Preferred Alternative One

Alternative one places the center of the circulating roadway approximately 65ft southeast of the existing intersection. This location would require facility relocations of electric, water, telephone and a high-pressure gas main. Permanent right-of-way acquisition would be 3.5 acres from a total of 12 parcels. There would be no relocations and 1 total parcel take. The estimated cost of right-of-way acquisition is \$108,825.

The maintenance of traffic includes \$112,000 for traffic control and \$328,500 for temporary pavement.

There are no reimbursable utilities within the project limits. The relocation costs will be zero dollars.

The construction cost is estimated at \$2,084,000.

The total cost for the preferred option is \$2,633,325.

See Appendix C for Preferred Alternative Option 1 Design.

Alternative Two

Alternative two places the center of the circulating roadway approximately 125ft south of the existing intersection. This location would require facility relocations of electric, water, telephone and a high-pressure gas main.

Permanent right-of-way acquisition would be 3.7 acres from a total of 12 parcels. While there are no relocations, the Elevation Church parcel adjacent to SR 56 would require relocation of a digital billboard sign and impact the Church's future expansion plans. This option also includes 1 total parcel take. The estimated cost of right-of-way acquisition is \$167,050.

The maintenance of traffic includes \$112,000 for traffic control and \$292,000 for temporary pavement.

There are no reimbursable utilities within the project limits. The utility relocation costs will be zero dollars.

The construction cost is estimated at \$2,134,000.

The total cost for the Alternate Two option is \$2,705,050.

See Appendix C for Alternative Option 2 Design

Alternative Three

Alternative three places the center of the circulating roadway at the center of the existing intersection. This location would require facility relocations of electric, water, telephone and a high-pressure gas main.

Permanent right-of-way acquisition would be 3.5 acres from a total of 12 parcels. This option would require a relocation of one residential parcel at a cost of

\$200,000. This option also includes 2 total parcels take. The estimated cost of right-of-way acquisition is \$336,475.

The maintenance of traffic includes \$112,000 for traffic control and \$365,000 for temporary pavement.

There are no reimbursable utilities within the project limits. The relocation costs will be zero dollars.

The construction cost is estimated at \$2,070,000.

The total cost for the Alternate Three option is \$2,883,475.

See Appendix C for Alternative Option 3 Design.

IX. Maintenance of Traffic During Construction

Possible Detour routes around the intersection of SR 56 and Boatman Road are limited. The nearest parallel state route is SR 256 to the north and would create a detour of approximately 21 miles. The Seymour District of INDOT also recommended against a detour route. Using temporary pavement will to allow SR 56 to remain open to traffic will be costly. The estimated cost of the temporary pavement is between \$300,000 – \$365,000, which includes borrow, subgrade treatment and compacted aggregate.

Appendix C provides a proposed Typical Cross Section along with a Maintenance of Traffic (MOT) Plan that uses temporary pavement lanes and shoulders to provide a safe construction zone while staying within the scope of the project.

X. Cost Estimate

Below is a breakdown of every alternative cost. Appendix D shows the preliminary construction cost estimate.

Preferred Alternative Location 1	
Construction	\$2,084,000.00
Right of Way Engineering and Acquisition	\$108,825.00
Maintenance of Traffic including Temp Pavement	\$440,500.00
Total Project Cost	\$2,633,325.00

Alternative Location 2	
Construction	\$2,134,000.00
Right of Way Engineering and Acquisition	\$167,050.00
Maintenance of Traffic including Temp Pavement	\$404,000.00
Total Project Cost	\$2,705,050.00

Alternative Location 3	
Construction	\$2,070,000.00
Right of Way Engineering and Acquisition	\$336,475.00
Maintenance of Traffic including Temp Pavement	\$477,000.00
Total Project Cost	\$2,883,475.00

XI. Environmental Impacts

A preliminary Red Flag investigation was completed in order to identify any potential environmental concerns within the project limits. Based on the investigation, there should be minimal effects. Midwest Natural Gas Corporation owns two (2) high-pressure 6-inch natural gas pipe lines within the project area. Early Utility Coordination and Subsurface Utility Engineering performed during survey will lessen the possibility of significant utility reimbursement expenses. This project will acquire about 3.5 acres of right-of-way. That amount of right-of-way acquisition means that this project appears to meet the requirements of a Level 2 Categorical Exclusion (CE-2). A Rule 5 approval from IDEM will be required as the project will result in more than one acre of ground disturbance. While there are no water resources within or adjacent to the project, a waters investigation by need to be and the findings documented in a Wetland Delineation/Waters of the U.S. Determination Report. The Indiana bat and northern long-eared bat are within range of this project, but suitable habitat does not appear to be present in the project area. A review of the National Register of Historic Places (NRHP) and the Indiana Register of Historic Sites and Structures did not identify any properties listed or likely eligible for inclusion in the NRHP within the project area. The Preliminary Red Flag Investigation can be view in Appendix E.

XII. Survey Requirements

The survey limits extend approximately 700ft west and 1100 east of the State 56 and Boatman Road intersection, along State Route 56. The survey limits extend 400ft north and 425 ft south of the State 56 and Boatman Road intersection, along Boatman Road. The survey limits extend 450ft west of the intersection of State 56 and Mount Road, along Mount Road.

XIII. Right-of-Way Impact

The southside of State Route 56 is preferred for locating the roundabout due to the open fields with minimum obstructions and no residential or commercial relocations. The land use in the project area is a mix of residential, commercial and agricultural.

The preferred location for the roundabout will require approximately 3.5 acres of permanent right-of-way and 12 parcels. There are three agricultural parcels totaling 1.6 acres. There are three residential parcels totaling 0.3 acres. There are six business parcels totaling 1.6 acres. See "Option 1" exhibit for Right-of-Way Impacts details in Appendix C.

The Alternative 2 will require approximately 3.7 acres of permanent right-of-way. There are two agricultural parcels totaling 2.5 acres. There are three residential parcels totaling 0.12 acres. There are seven business parcels totaling 1.1 acres. See "Option 2" exhibit for Right-of-Way Impacts details in Appendix C.

Alternative 3 will require approximately 3.5 acres of permanent right-of-way, but will require 1 relocation. There are three agricultural parcels totaling 1.2 acres. There are three residential parcels totaling 0.73 acres. There are seven business parcels totaling 1.6 acres. See "Option 3" exhibit for Right-of-Way Impacts details in Appendix C.

	Residential		Business		Agricultural		Relocation		Total
	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres
Alternative 1	0.30	3	1.6	6	1.6	3			3.5
Alternative 2	0.12	3	1.1	7	2.5	2			3.7
Alternative 3	0.73	3	1.6	7	1.2	3	.45	1	3.5

XIV. Railroad Impact

Railroads are not located within the project footprint, therefore no impacts.

XV. Utility Impact

A completed topographical survey and the One Call Utility Locates listed the following facilities within the project area:

Frontier (Telephone), Insight Communications (Cable TV), Jackson County R.E.M.C. (Electric), Midwest Natural Gas Corporation/Ohio Valley (Gas), City of Scottsburg (Water, Electric and Sewer) and Stucker Fork Water Utility (Water).

The proposed design will try to avoid and if necessary, use minor relocations to minimize impacts to each utility. Midwest Natural Gas Corporation has a high-pressure main within the project limits. The cost to relocate a high-pressure gas main is expensive, though a meeting with a representative from Midwest Natural Gas Corporation stated that there is not a gas easement. The extent of reimbursable utilities will not be known until the early stages of utility coordination.

XVI. Coordination and Meetings

Scope of Services Meeting Minutes – December 6, 2018

Field Inspection Meeting Minutes – July 11, 2019

See Appendix F for meeting minutes.

XVII. Report Concurrence Block



This document was prepared by:

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Project Manager, Seymour District

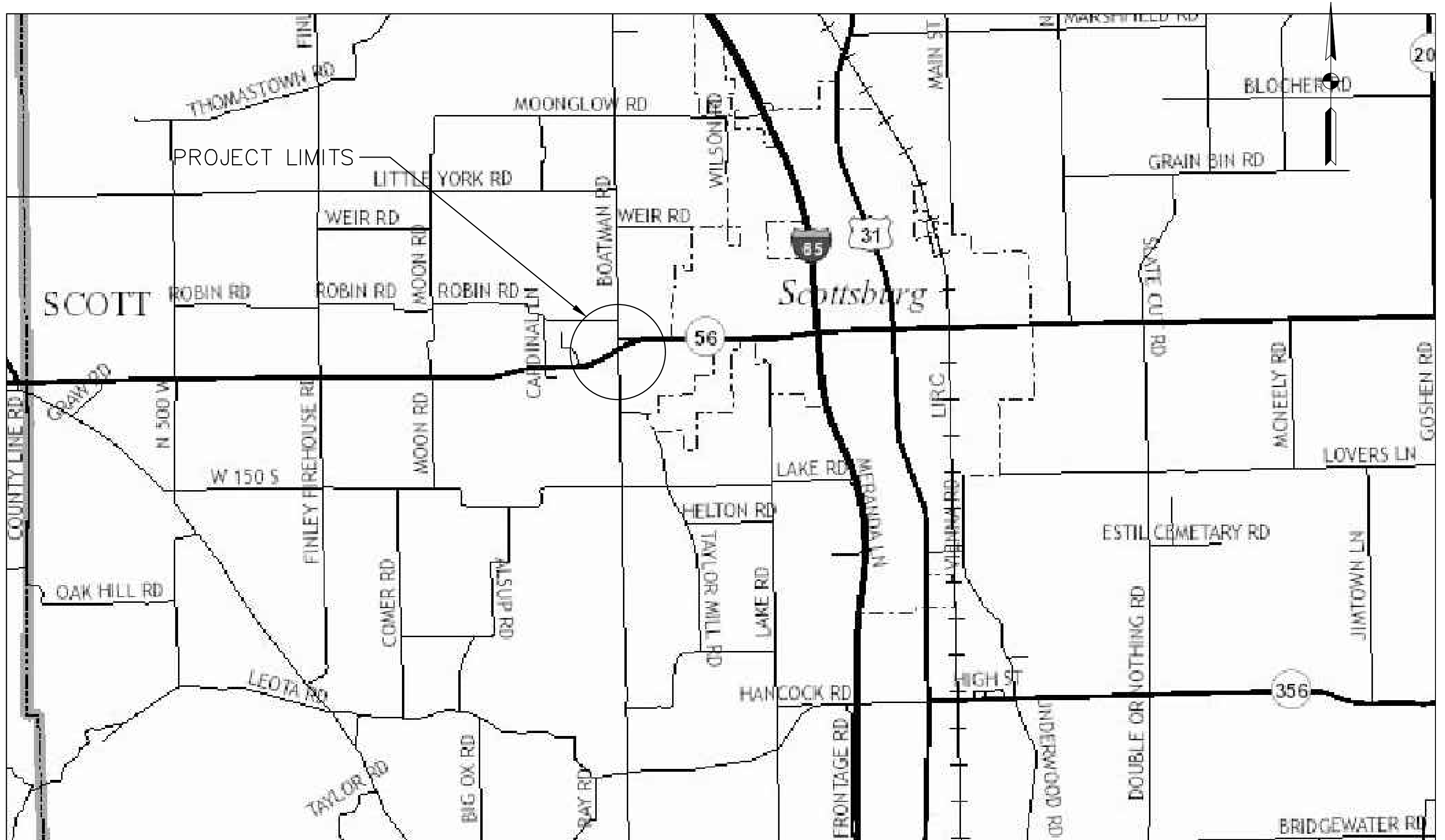
Reviewed by:
SAM Review

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Systems Asset Manager, Seymour District

APPENDIX A

PROJECT MAP LOCATION





Indiana DOT
100 N. Senate Ave.

Indianapolis, Indiana, United States 46204
317 750 4056 KLee@indot.in.gov

Count Name: SD SR56 @ Boatman Rd (72)
Site Code:
Start Date: 03/06/2017
Page No: 1

Turning Movement Data

Start Time	Boatman Rd. Southbound					SR56 Westbound					Boatman Rd. Northbound					SR56 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
11:00 AM	2	3	8	0	13	0	28	5	0	33	8	4	2	0	14	0	35	1	0	36	96
11:15 AM	2	0	10	0	12	0	37	7	0	44	4	0	0	0	4	0	55	1	0	56	116
11:30 AM	1	2	11	0	14	0	43	6	0	49	7	2	2	0	11	1	42	0	0	43	117
11:45 AM	3	2	15	0	20	0	43	14	0	57	6	0	1	0	7	4	46	3	0	53	137
Hourly Total	8	7	44	0	59	0	151	32	0	183	25	6	5	0	36	5	178	5	0	188	466
12:00 PM	4	2	6	0	12	0	41	15	0	56	22	6	2	0	30	1	46	6	0	53	151
12:15 PM	3	1	7	0	11	0	48	11	0	59	13	5	1	0	19	0	41	3	0	44	133
12:30 PM	2	1	3	0	6	0	53	11	0	64	10	1	0	0	11	1	33	2	0	36	117
12:45 PM	3	0	6	0	9	1	42	9	0	52	4	0	0	0	4	0	62	2	0	64	129
Hourly Total	12	4	22	0	38	1	184	46	0	231	49	12	3	0	64	2	182	13	0	197	530
1:00 PM	3	4	13	0	20	0	46	6	0	52	9	1	0	0	10	0	51	6	0	57	139
1:15 PM	0	1	3	0	4	1	40	14	0	55	13	4	0	0	17	1	53	2	0	56	132
1:30 PM	2	2	10	0	14	0	46	9	0	55	11	0	1	0	12	1	36	1	0	38	119
1:45 PM	3	1	7	0	11	2	36	6	0	44	8	3	0	0	11	0	39	3	0	42	108
Hourly Total	8	8	33	0	49	3	168	35	0	206	41	8	1	0	50	2	179	12	0	193	498
2:00 PM	2	2	8	0	12	1	37	5	0	43	14	3	1	0	18	0	53	1	0	54	127
2:15 PM	3	2	5	0	10	0	39	11	0	50	7	1	0	0	8	0	49	1	0	50	118
2:30 PM	2	2	11	0	15	0	45	6	0	51	4	3	0	0	7	1	37	2	0	40	113
2:45 PM	5	3	7	0	15	0	39	18	0	57	8	2	0	0	10	0	48	1	0	49	131
Hourly Total	12	9	31	0	52	1	160	40	0	201	33	9	1	0	43	1	187	5	0	193	489
3:00 PM	4	4	7	0	15	1	70	11	0	82	5	4	0	0	9	0	28	3	0	31	137
3:15 PM	5	5	6	0	16	1	74	13	0	88	16	4	2	0	22	4	53	1	0	58	184
3:30 PM	13	3	8	0	24	0	68	19	0	87	7	3	2	0	12	1	48	6	0	55	178
3:45 PM	9	4	12	0	25	0	77	10	0	87	14	4	2	0	20	1	57	1	0	59	191
Hourly Total	31	16	33	0	80	2	289	53	0	344	42	15	6	0	63	6	186	11	0	203	690
4:00 PM	7	1	11	0	19	1	101	13	0	115	9	2	0	0	11	0	51	2	0	53	198
4:15 PM	4	11	7	0	22	0	88	14	0	102	14	4	1	0	19	0	65	2	0	67	210
4:30 PM	16	6	5	0	27	1	90	17	0	108	17	4	1	0	22	1	54	2	0	57	214
4:45 PM	6	2	13	0	21	0	90	15	0	105	8	3	1	0	12	1	51	1	0	53	191
Hourly Total	33	20	36	0	89	2	369	59	0	430	48	13	3	0	64	2	221	7	0	230	813
5:00 PM	10	3	5	0	18	0	81	15	0	96	12	7	0	0	19	1	57	7	0	65	198
5:15 PM	6	11	7	0	24	0	72	13	0	85	11	3	2	0	16	2	59	2	0	63	188
5:30 PM	4	8	10	0	22	0	92	15	0	107	21	6	1	0	28	1	62	2	0	65	222
5:45 PM	5	3	9	0	17	0	93	9	0	102	9	5	1	0	15	1	44	2	0	47	181
Hourly Total	25	25	31	0	81	0	338	52	0	390	53	21	4	0	78	5	222	13	0	240	789
6:00 PM	4	4	11	0	19	0	87	10	0	97	10	1	4	0	15	1	38	6	0	45	176
6:15 PM	6	2	11	0	19	1	68	12	0	81	10	2	1	0	13	2	56	2	0	60	173
6:30 PM	3	2	6	0	11	0	44	10	0	54	6	4	0	0	10	0	36	3	0	39	114

6:45 PM	2	2	4	0	8	0	56	11	0	67	8	2	1	0	11	2	29	1	0	32	118
Hourly Total	15	10	32	0	57	1	255	43	0	299	34	9	6	0	49	5	159	12	0	176	581
7:00 PM	0	0	7	0	7	0	43	6	0	49	10	2	1	0	13	2	37	0	0	39	108
7:15 PM	4	0	2	0	6	0	37	5	0	42	5	0	0	0	5	0	23	0	0	23	76
7:30 PM	2	0	4	0	6	0	35	5	0	40	7	1	0	0	8	2	17	2	0	21	75
7:45 PM	1	0	3	0	4	0	33	6	0	39	5	0	0	0	5	1	15	4	0	20	68
Hourly Total	7	0	16	0	23	0	148	22	0	170	27	3	1	0	31	5	92	6	0	103	327
8:00 PM	2	1	2	0	5	0	26	8	0	34	3	3	0	0	6	0	30	0	0	30	75
8:15 PM	2	1	3	0	6	0	23	4	0	27	6	4	0	0	10	1	30	2	0	33	76
8:30 PM	1	3	3	0	7	0	33	7	0	40	7	1	1	0	9	0	43	0	0	43	99
8:45 PM	1	0	1	0	2	0	11	4	0	15	8	0	1	0	9	0	34	2	0	36	62
Hourly Total	6	5	9	0	20	0	93	23	0	116	24	8	2	0	34	1	137	4	0	142	312
9:00 PM	0	1	3	0	4	0	15	6	0	21	1	0	1	0	2	0	26	0	0	26	53
9:15 PM	2	0	2	0	4	0	10	3	0	13	4	1	0	0	5	0	23	0	0	23	45
9:30 PM	1	0	2	0	3	0	18	3	0	21	2	1	0	0	3	0	16	1	0	17	44
9:45 PM	0	0	1	0	1	0	20	3	0	23	4	1	0	0	5	0	12	0	0	12	41
Hourly Total	3	1	8	0	12	0	63	15	0	78	11	3	1	0	15	0	77	1	0	78	183
10:00 PM	0	2	0	0	2	0	22	7	0	29	2	0	0	0	2	0	15	0	0	15	48
10:15 PM	1	1	1	0	3	0	15	6	0	21	2	0	0	0	2	0	6	0	0	6	32
10:30 PM	1	2	1	0	4	0	10	2	0	12	1	0	0	0	1	0	4	0	0	4	21
10:45 PM	1	0	1	0	2	0	8	0	0	8	2	0	0	0	2	0	3	1	0	4	16
Hourly Total	3	5	3	0	11	0	55	15	0	70	7	0	0	0	7	0	28	1	0	29	117
11:00 PM	0	0	0	0	0	0	10	2	0	12	0	1	0	0	1	0	2	0	0	2	15
11:15 PM	2	0	1	0	3	0	3	5	0	8	4	1	0	0	5	0	9	0	0	9	25
11:30 PM	0	1	1	0	2	0	6	4	0	10	1	0	0	0	1	1	4	0	0	5	18
11:45 PM	0	1	0	0	1	0	7	0	0	7	2	0	0	0	2	0	5	0	0	5	15
Hourly Total	2	2	2	0	6	0	26	11	0	37	7	2	0	0	9	1	20	0	0	21	73
12:00 AM	0	0	1	0	1	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	4
12:15 AM	0	0	0	0	0	0	3	2	0	5	0	0	0	0	0	0	3	0	0	3	8
12:30 AM	0	0	1	0	1	0	2	1	0	3	1	0	0	0	1	0	4	0	0	4	9
12:45 AM	0	0	0	0	0	0	3	1	0	4	0	0	0	0	0	0	3	0	0	3	7
Hourly Total	0	0	2	0	2	0	10	4	0	14	1	0	0	0	1	0	11	0	0	11	28
1:00 AM	1	0	1	0	2	0	2	1	0	3	0	0	0	0	0	0	1	0	0	1	6
1:15 AM	0	1	2	0	3	0	4	0	0	4	0	0	0	0	0	1	1	0	0	2	9
1:30 AM	1	0	1	0	2	0	3	0	0	3	1	1	0	0	2	0	2	0	0	2	9
1:45 AM	0	0	0	0	0	0	3	1	0	4	1	1	0	0	2	0	0	0	0	0	6
Hourly Total	2	1	4	0	7	0	12	2	0	14	2	2	0	0	4	1	4	0	0	5	30
2:00 AM	0	1	0	0	1	0	3	2	0	5	0	0	0	0	0	0	1	0	0	1	7
2:15 AM	0	0	1	0	1	0	4	0	0	4	0	1	0	0	1	0	6	0	0	6	12
2:30 AM	0	0	0	0	0	0	3	0	0	3	0	1	0	0	1	0	4	0	0	4	8
2:45 AM	0	0	0	0	0	0	1	1	0	2	2	0	0	0	2	0	4	0	0	4	8
Hourly Total	0	1	1	0	2	0	11	3	0	14	2	2	0	0	4	0	15	0	0	15	35
3:00 AM	0	0	1	0	1	0	1	1	0	2	0	0	0	0	0	1	3	0	0	4	7
3:15 AM	0	0	0	0	0	0	2	0	0	2	3	0	0	0	3	0	8	0	0	8	13
3:30 AM	0	0	0	0	0	0	4	1	0	5	2	2	0	0	4	0	8	0	0	8	17
3:45 AM	0	1	0	0	1	0	0	1	0	1	1	1	0	0	2	0	15	0	0	15	19
Hourly Total	0	1	1	0	2	0	7	3	0	10	6	3	0	0	9	1	34	0	0	35	56
4:00 AM	1	1	1	0	3	0	10	1	0	11	1	0	0	0	1	0	7	0	0	7	22
4:15 AM	2	1	1	0	4	0	2	1	0	3	0	0	0	0	0	0	12	0	0	12	19
4:30 AM	0	1	3	0	4	0	6	0	0	6	3	0	0	0	3	0	11	0	0	11	24
4:45 AM	1	0	3	0	4	0	4	0	0	4	2	1	0	0	3	0	23	1	0	24	35
Hourly Total	4	3	8	0	15	0	22	2	0	24	6	1	0	0	7	0	53	1	0	54	100

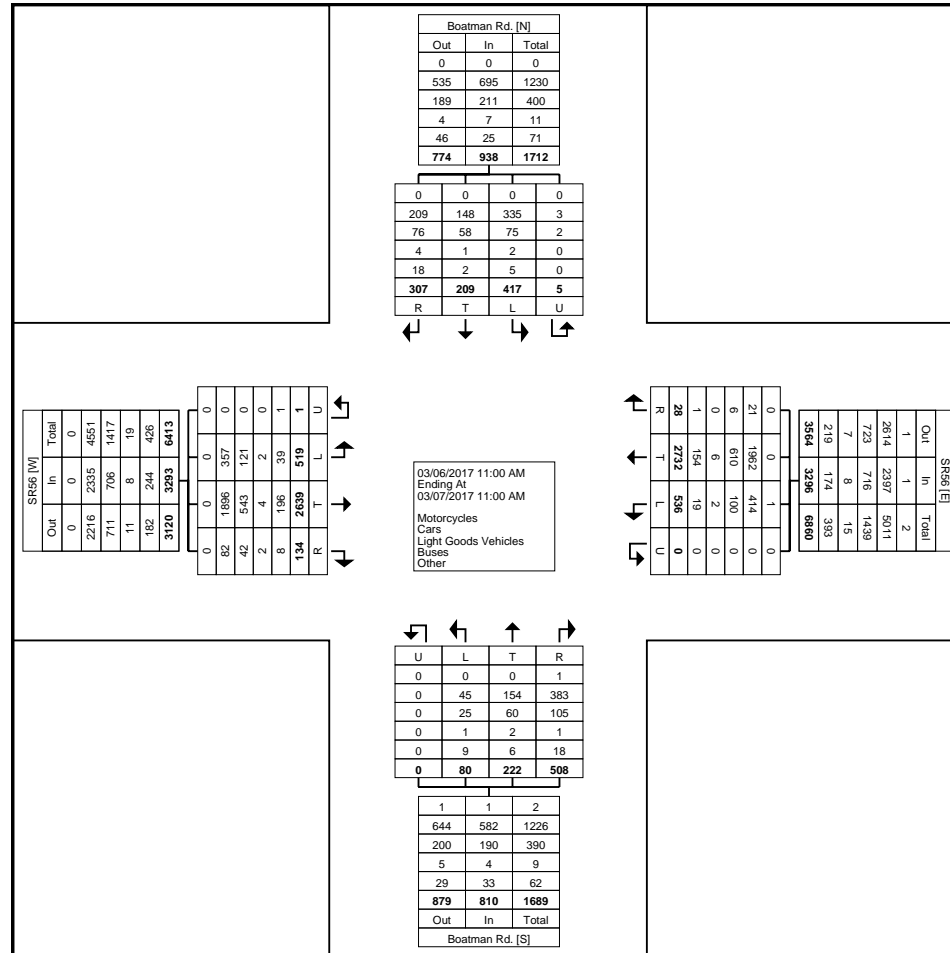
5:00 AM	1	1	8	0	10	0	7	0	0	7	3	0	0	0	3	0	20	0	0	20	40
5:15 AM	0	0	1	0	1	0	7	0	0	7	3	1	0	0	4	0	27	0	0	27	39
5:30 AM	2	0	3	0	5	0	17	1	0	18	1	1	0	0	2	2	33	2	0	37	62
5:45 AM	2	0	4	0	6	0	9	3	0	12	3	1	0	0	4	1	49	4	0	54	76
Hourly Total	5	1	16	0	22	0	40	4	0	44	10	3	0	0	13	3	129	6	0	138	217
6:00 AM	1	1	4	0	6	0	29	6	0	35	7	1	1	0	9	2	55	3	0	60	110
6:15 AM	1	3	5	0	9	0	20	4	0	24	9	2	2	0	13	0	52	2	0	54	100
6:30 AM	0	0	9	0	9	0	14	6	0	20	12	1	0	0	13	1	58	3	0	62	104
6:45 AM	3	3	7	0	13	0	16	7	0	23	7	2	0	0	9	2	54	4	0	60	105
Hourly Total	5	7	25	0	37	0	79	23	0	102	35	6	3	0	44	5	219	12	0	236	419
7:00 AM	3	2	8	0	13	0	23	8	0	31	6	1	1	0	8	2	49	2	0	53	105
7:15 AM	5	0	14	0	19	0	28	5	0	33	15	1	0	0	16	2	74	5	0	81	149
7:30 AM	5	8	20	0	33	0	15	5	0	20	6	9	1	0	16	1	87	12	0	100	169
7:45 AM	3	6	11	0	20	0	14	3	0	17	14	3	2	0	19	0	74	14	0	88	144
Hourly Total	16	16	53	0	85	0	80	21	0	101	41	14	4	0	59	5	284	33	0	322	567
8:00 AM	4	6	3	1	14	6	39	7	0	52	1	6	6	0	13	8	18	31	0	57	136
8:15 AM	4	8	0	0	12	2	25	5	0	32	0	5	1	0	6	2	0	49	0	51	101
8:30 AM	5	4	0	0	9	0	13	4	0	17	0	4	0	0	4	7	0	54	0	61	91
8:45 AM	4	6	1	1	12	2	24	3	0	29	0	10	2	0	12	6	0	37	0	43	96
Hourly Total	17	24	4	2	47	10	101	19	0	130	1	25	9	0	35	23	18	171	0	212	424
9:00 AM	5	5	0	0	10	1	25	2	0	28	0	6	0	0	6	4	0	45	0	49	93
9:15 AM	6	5	0	1	12	2	25	1	0	28	0	8	1	0	9	10	0	25	0	35	84
9:30 AM	10	4	0	0	14	0	8	2	0	10	0	3	3	0	6	6	1	27	0	34	64
9:45 AM	14	5	0	0	19	0	2	1	0	3	0	6	4	0	10	10	1	38	0	49	81
Hourly Total	35	19	0	1	55	3	60	6	0	69	0	23	8	0	31	30	2	135	0	167	322
10:00 AM	20	4	0	0	24	2	1	0	0	3	1	10	10	0	21	12	1	26	1	40	88
10:15 AM	12	5	2	0	19	1	2	2	0	5	2	6	8	0	16	2	0	20	0	22	62
10:30 AM	15	7	1	2	25	1	2	0	0	3	0	10	3	0	13	8	1	12	0	21	62
10:45 AM	11	8	0	0	19	1	6	1	0	8	0	8	2	0	10	9	0	13	0	22	59
Hourly Total	58	24	3	2	87	5	11	3	0	19	3	34	23	0	60	31	2	71	1	105	271
Grand Total	307	209	417	5	938	28	2732	536	0	3296	508	222	80	0	810	134	2639	519	1	3293	8337
Approach %	32.7	22.3	44.5	0.5	-	0.8	82.9	16.3	0.0	-	62.7	27.4	9.9	0.0	-	4.1	80.1	15.8	0.0	-	-
Total %	3.7	2.5	5.0	0.1	11.3	0.3	32.8	6.4	0.0	39.5	6.1	2.7	1.0	0.0	9.7	1.6	31.7	6.2	0.0	39.5	-
Motorcycles	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	2
% Motorcycles	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-	0.0	0.2	0.0	0.0	-	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Cars	209	148	335	3	695	21	1962	414	0	2397	383	154	45	0	582	82	1896	357	0	2335	6009
% Cars	68.1	70.8	80.3	60.0	74.1	75.0	71.8	77.2	-	72.7	75.4	69.4	56.3	-	71.9	61.2	71.8	68.8	0.0	70.9	72.1
Light Goods Vehicles	76	58	75	2	211	6	610	100	0	716	105	60	25	0	190	42	543	121	0	706	1823
% Light Goods Vehicles	24.8	27.8	18.0	40.0	22.5	21.4	22.3	18.7	-	21.7	20.7	27.0	31.3	-	23.5	31.3	20.6	23.3	0.0	21.4	21.9
Buses	4	1	2	0	7	0	6	2	0	8	1	2	1	0	4	2	4	2	0	8	27
% Buses	1.3	0.5	0.5	0.0	0.7	0.0	0.2	0.4	-	0.2	0.2	0.9	1.3	-	0.5	1.5	0.2	0.4	0.0	0.2	0.3
Single-Unit Trucks	12	2	5	0	19	1	62	13	0	76	14	6	6	0	26	5	78	19	0	102	223
% Single-Unit Trucks	3.9	1.0	1.2	0.0	2.0	3.6	2.3	2.4	-	2.3	2.8	2.7	7.5	-	3.2	3.7	3.0	3.7	0.0	3.1	2.7
Articulated Trucks	6	0	0	0	6	0	92	6	0	98	4	0	3	0	7	3	118	20	1	142	253
% Articulated Trucks	2.0	0.0	0.0	0.0	0.6	0.0	3.4	1.1	-	3.0	0.8	0.0	3.8	-	0.9	2.2	4.5	3.9	100.0	4.3	3.0



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Count Name: SD SR56 @ Boatman Rd (72)
Site Code:
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Turning Movement Data Plot



Indiana DOT
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Count Name: SD SR56 @ Boatman Rd (72)
Site Code:
Start Date: 03/06/2017
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Turning Movement Peak Hour Data (11:00 AM)

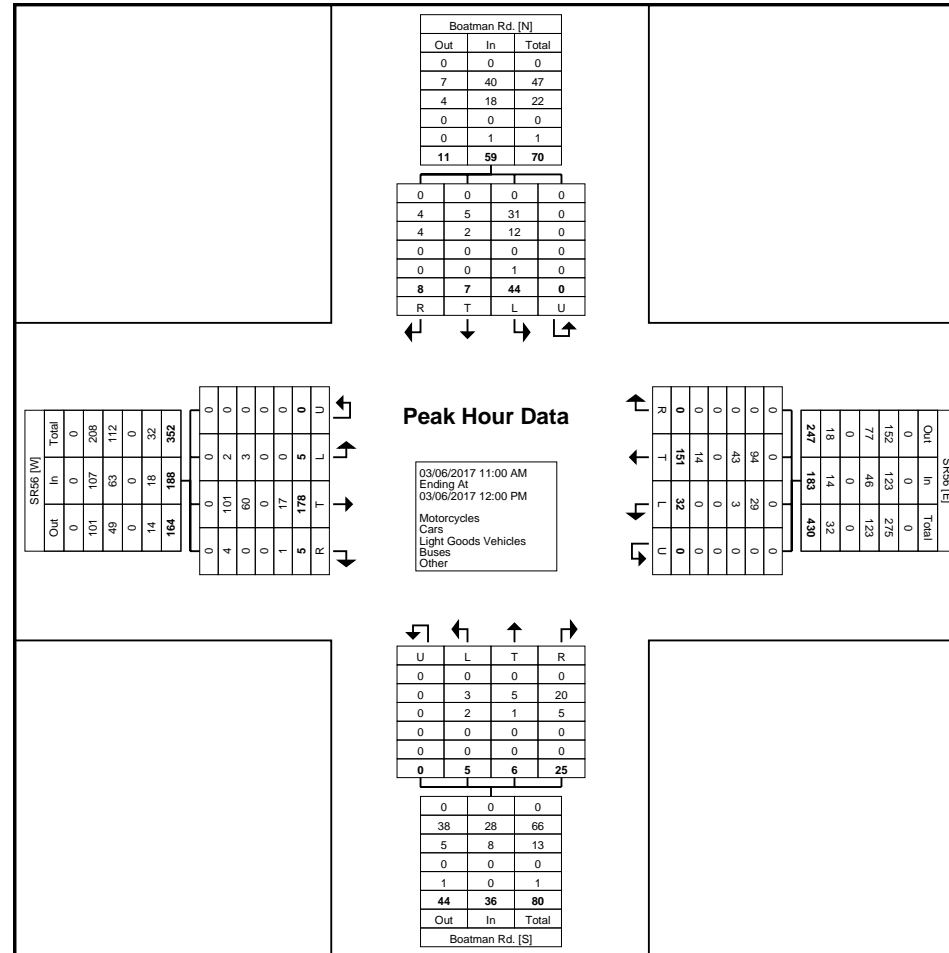
Start Time	Boatman Rd. Southbound					SR56 Westbound					Boatman Rd. Northbound					SR56 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
11:00 AM	2	3	8	0	13	0	28	5	0	33	8	4	2	0	14	0	35	1	0	36	96
11:15 AM	2	0	10	0	12	0	37	7	0	44	4	0	0	0	4	0	55	1	0	56	116
11:30 AM	1	2	11	0	14	0	43	6	0	49	7	2	2	0	11	1	42	0	0	43	117
11:45 AM	3	2	15	0	20	0	43	14	0	57	6	0	1	0	7	4	46	3	0	53	137
Total	8	7	44	0	59	0	151	32	0	183	25	6	5	0	36	5	178	5	0	188	466
Approach %	13.6	11.9	74.6	0.0	-	0.0	82.5	17.5	0.0	-	69.4	16.7	13.9	0.0	-	2.7	94.7	2.7	0.0	-	-
Total %	1.7	1.5	9.4	0.0	12.7	0.0	32.4	6.9	0.0	39.3	5.4	1.3	1.1	0.0	7.7	1.1	38.2	1.1	0.0	40.3	-
PHF	0.667	0.583	0.733	0.000	0.738	0.000	0.878	0.571	0.000	0.803	0.781	0.375	0.625	0.000	0.643	0.313	0.809	0.417	0.000	0.839	0.850
Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Motorcycles	0.0	0.0	0.0	-	0.0	-	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0
Cars	4	5	31	0	40	0	94	29	0	123	20	5	3	0	28	4	101	2	0	107	298
% Cars	50.0	71.4	70.5	-	67.8	-	62.3	90.6	-	67.2	80.0	83.3	60.0	-	77.8	80.0	56.7	40.0	-	56.9	63.9
Light Goods Vehicles	4	2	12	0	18	0	43	3	0	46	5	1	2	0	8	0	60	3	0	63	135
% Light Goods Vehicles	50.0	28.6	27.3	-	30.5	-	28.5	9.4	-	25.1	20.0	16.7	40.0	-	22.2	0.0	33.7	60.0	-	33.5	29.0
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0.0	0.0	0.0	-	0.0	-	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0
Single-Unit Trucks	0	0	1	0	1	0	6	0	0	6	0	0	0	0	0	1	7	0	0	8	15
% Single-Unit Trucks	0.0	0.0	2.3	-	1.7	-	4.0	0.0	-	3.3	0.0	0.0	0.0	-	0.0	20.0	3.9	0.0	-	4.3	3.2
Articulated Trucks	0	0	0	0	0	0	8	0	0	8	0	0	0	0	0	0	10	0	0	10	18
% Articulated Trucks	0.0	0.0	0.0	-	0.0	-	5.3	0.0	-	4.4	0.0	0.0	0.0	-	0.0	0.0	5.6	0.0	-	5.3	3.9



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Count Name: SD SR56 @ Boatman Rd (72)
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Turning Movement Peak Hour Data Plot (11:00 AM)



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Count Name: SD SR56 @ Boatman Rd (72)
Site Code:
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Turning Movement Peak Hour Data (3:45 PM)

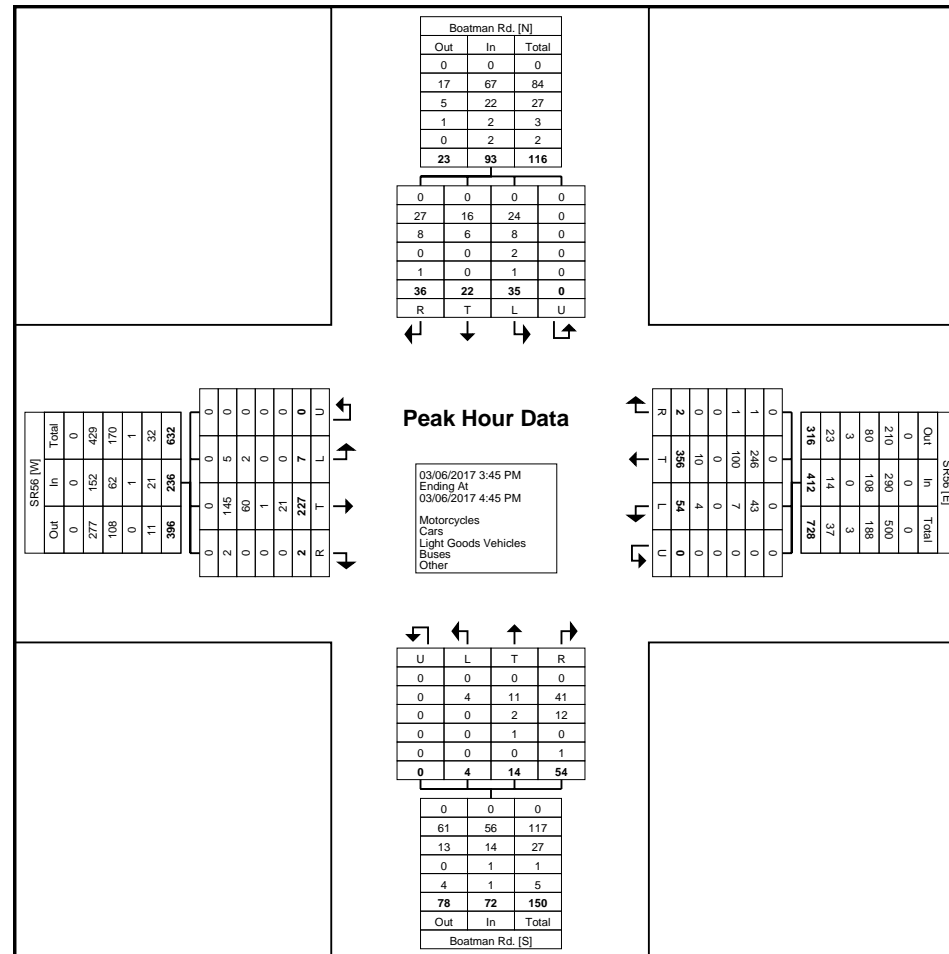
Start Time	Boatman Rd. Southbound					SR56 Westbound					Boatman Rd. Northbound					SR56 Eastbound					Int. Total	
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total		
3:45 PM	9	4	12	0	25	0	77	10	0	87	14	4	2	0	20	1	57	1	0	59	191	
4:00 PM	7	1	11	0	19	1	101	13	0	115	9	2	0	0	11	0	51	2	0	53	198	
4:15 PM	4	11	7	0	22	0	88	14	0	102	14	4	1	0	19	0	65	2	0	67	210	
4:30 PM	16	6	5	0	27	1	90	17	0	108	17	4	1	0	22	1	54	2	0	57	214	
Total	36	22	35	0	93	2	356	54	0	412	54	14	4	0	72	2	227	7	0	236	813	
Approach %	38.7	23.7	37.6	0.0	-	0.5	86.4	13.1	0.0	-	75.0	19.4	5.6	0.0	-	0.8	96.2	3.0	0.0	-	-	
Total %	4.4	2.7	4.3	0.0	11.4	0.2	43.8	6.6	0.0	50.7	6.6	1.7	0.5	0.0	8.9	0.2	27.9	0.9	0.0	29.0	-	
PHF	0.563	0.500	0.729	0.000	0.861	0.500	0.881	0.794	0.000	0.896	0.794	0.875	0.500	0.000	0.818	0.500	0.873	0.875	0.000	0.881	0.950	
Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Motorcycles	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	
Cars	27	16	24	0	67	1	246	43	0	290	41	11	4	0	56	2	145	5	0	152	565	
% Cars	75.0	72.7	68.6	-	72.0	50.0	69.1	79.6	-	70.4	75.9	78.6	100.0	-	77.8	100.0	63.9	71.4	-	64.4	69.5	
Light Goods Vehicles	8	6	8	0	22	1	100	7	0	108	12	2	0	0	14	0	60	2	0	62	206	
% Light Goods Vehicles	22.2	27.3	22.9	-	23.7	50.0	28.1	13.0	-	26.2	22.2	14.3	0.0	-	19.4	0.0	26.4	28.6	-	26.3	25.3	
Buses	0	0	2	0	2	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	4	
% Buses	0.0	0.0	5.7	-	2.2	0.0	0.0	0.0	-	0.0	0.0	7.1	0.0	-	1.4	0.0	0.4	0.0	-	0.4	0.5	
Single-Unit Trucks	1	0	1	0	2	0	7	3	0	10	1	0	0	0	1	0	11	0	0	11	24	
% Single-Unit Trucks	2.8	0.0	2.9	-	2.2	0.0	2.0	5.6	-	2.4	1.9	0.0	0.0	-	1.4	0.0	4.8	0.0	-	4.7	3.0	
Articulated Trucks	0	0	0	0	0	0	3	1	0	4	0	0	0	0	0	0	10	0	0	10	14	
% Articulated Trucks	0.0	0.0	0.0	-	0.0	0.0	0.8	1.9	-	1.0	0.0	0.0	0.0	-	0.0	0.0	4.4	0.0	-	4.2	1.7	



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Site Code:
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Turning Movement Peak Hour Data Plot (3:45 PM)



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Site Code:
Start Date: 03/06/2017
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Turning Movement Peak Hour Data (7:15 AM)

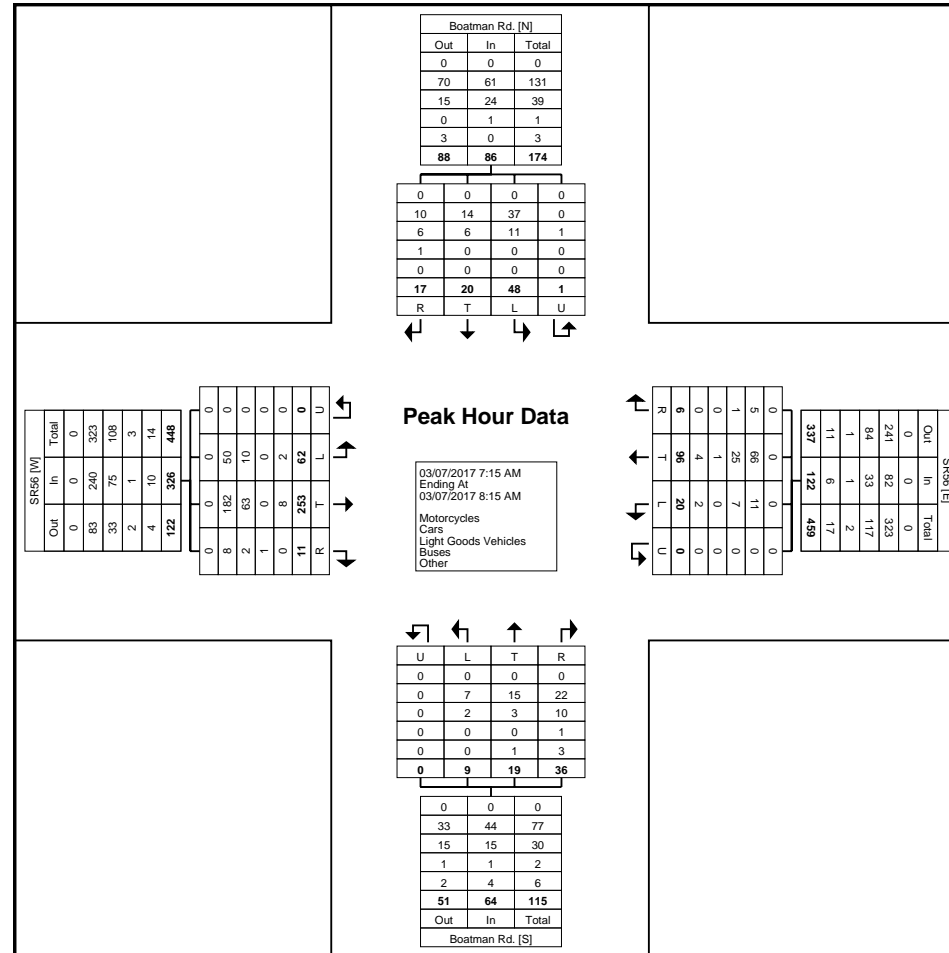
Start Time	Boatman Rd. Southbound					SR56 Westbound					Boatman Rd. Northbound					SR56 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
7:15 AM	5	0	14	0	19	0	28	5	0	33	15	1	0	0	16	2	74	5	0	81	149
7:30 AM	5	8	20	0	33	0	15	5	0	20	6	9	1	0	16	1	87	12	0	100	169
7:45 AM	3	6	11	0	20	0	14	3	0	17	14	3	2	0	19	0	74	14	0	88	144
8:00 AM	4	6	3	1	14	6	39	7	0	52	1	6	6	0	13	8	18	31	0	57	136
Total	17	20	48	1	86	6	96	20	0	122	36	19	9	0	64	11	253	62	0	326	598
Approach %	19.8	23.3	55.8	1.2	-	4.9	78.7	16.4	0.0	-	56.3	29.7	14.1	0.0	-	3.4	77.6	19.0	0.0	-	-
Total %	2.8	3.3	8.0	0.2	14.4	1.0	16.1	3.3	0.0	20.4	6.0	3.2	1.5	0.0	10.7	1.8	42.3	10.4	0.0	54.5	-
PHF	0.850	0.625	0.600	0.250	0.652	0.250	0.615	0.714	0.000	0.587	0.600	0.528	0.375	0.000	0.842	0.344	0.727	0.500	0.000	0.815	0.885
Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Motorcycles	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0
Cars	10	14	37	0	61	5	66	11	0	82	22	15	7	0	44	8	182	50	0	240	427
% Cars	58.8	70.0	77.1	0.0	70.9	83.3	68.8	55.0	-	67.2	61.1	78.9	77.8	-	68.8	72.7	71.9	80.6	-	73.6	71.4
Light Goods Vehicles	6	6	11	1	24	1	25	7	0	33	10	3	2	0	15	2	63	10	0	75	147
% Light Goods Vehicles	35.3	30.0	22.9	100.0	27.9	16.7	26.0	35.0	-	27.0	27.8	15.8	22.2	-	23.4	18.2	24.9	16.1	-	23.0	24.6
Buses	1	0	0	0	1	0	1	0	0	1	1	0	0	0	1	1	0	0	0	1	4
% Buses	5.9	0.0	0.0	0.0	1.2	0.0	1.0	0.0	-	0.8	2.8	0.0	0.0	-	1.6	9.1	0.0	0.0	-	0.3	0.7
Single-Unit Trucks	0	0	0	0	0	0	2	2	0	4	0	1	0	0	1	0	4	2	0	6	11
% Single-Unit Trucks	0.0	0.0	0.0	0.0	0.0	0.0	2.1	10.0	-	3.3	0.0	5.3	0.0	-	1.6	0.0	1.6	3.2	-	1.8	1.8
Articulated Trucks	0	0	0	0	0	0	2	0	0	2	3	0	0	0	3	0	4	0	0	4	9
% Articulated Trucks	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	-	1.6	8.3	0.0	0.0	-	4.7	0.0	1.6	0.0	-	1.2	1.5



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Turning Movement Peak Hour Data Plot (7:15 AM)



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Appendix A 2 - 2018 Traffic Counts

SR 56 Traffic Count Information

Location Info		Count Data Info	
Location ID	720252	Start Date	6/19/2018
Type	I-SECTION	End Date	6/20/2018
Functional Class	3	Start Time	9:00 AM
Located On	SR 56 4.10 MI E OF WASHINGTON C/L	End Time	9:00 AM
Between	AND	Direction	
Direction	2-WAY	Notes	indot
Community	-	Count Source	0000GC105295
MPO_ID		File Name	
HPMS ID		Weather	
Agency	Indiana Department of Transportation	Study	
		Owner	gena
Interval: 60 mins			
Time	Hourly Count		
00:00 - 01:00	77		
01:00 - 02:00	43		
02:00 - 03:00	42		
03:00 - 04:00	48		
04:00 - 05:00	132		
05:00 - 06:00	290		
06:00 - 07:00	459		
07:00 - 08:00	609		
08:00 - 09:00	458		
09:00 - 10:00	640		
10:00 - 11:00	576		
11:00 - 12:00	685		
12:00 - 13:00	764		
13:00 - 14:00	669		
14:00 - 15:00	599		
15:00 - 16:00	793		
16:00 - 17:00	870		
17:00 - 18:00	817		
18:00 - 19:00	655		
19:00 - 20:00	535		
20:00 - 21:00	514		
21:00 - 22:00	417		
22:00 - 23:00	279		
23:00 - 24:00	148		
TOTAL	11119		

<=DHV

Appendix A 2 - 2018 Traffic Counts

SR 56 Traffic Count Projection Calculations

Growth Rate Calculation		
2018	-8%	FROM INDOT GIS TRAFFIC COUNT DATABASE
2017	1%	
2016	0%	
2015	15%	
2014	1%	
2013	-1%	
2012	0%	
2011	1%	
2001	4%	
1997	9%	
	2.2%	

Calculated AADT Growth		
YR	2.2%	DELTA
2018	9820	217
2019	10037	217
2020	10254	217
2021	10471	217
2022	10688	217
2023	10905	217
2024	11122	217
2025	11339	217
2026	11556	217
2027	11773	217
2028	11990	217
2029	12207	217
2030	12424	217
2031	12641	217
2032	12858	217
2033	13075	217
2034	13292	217
2035	13509	217
2036	13726	217
2037	13943	217
2038	14160	217
2039	14377	217

DHV Growth		
YR	2.2%	DELTA
2018	870	20
2019	890	20
2020	910	20
2021	930	20
2022	950	20
2023	970	20
2024	990	20
2025	1010	20
2026	1030	20
2027	1050	20
2028	1070	20
2029	1090	20
2030	1110	20
2031	1130	20
2032	1150	20
2033	1170	20
2034	1190	20
2035	1210	20
2036	1230	20
2037	1250	20
2038	1270	20
2039	1290	20

Truck % from 2017 Count for SR 56 at Boatman Intersection

Articulated = 1.7%
 SU Trucks = 3.0%
 Buses = 0.5%
 Truck % DHV= 5.2%

MOVEMENT SUMMARY

Site: SR 56 and Boatman Rd - 1 lane

Roundabout at SR 56 and Boatman Rd
SR 56 is 2 lane and Boatman Rd is 1 lane

Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph	
South: RoadName												
3	L	6	0.0	0.151	6.6	LOS A	0.5	13.6	0.48	0.87	19.9	
8	T	21	0.0	0.151	6.6	LOS A	0.5	13.6	0.48	0.43	21.0	
18	R	82	2.0	0.151	6.6	LOS A	0.5	13.6	0.48	0.51	20.8	
Approach		110	1.5	0.151	6.6	LOS A	0.5	13.6	0.48	0.52	20.8	
East: RoadName												
1	L	82	6.0	0.591	11.1	LOS B	4.4	111.0	0.26	0.86	18.6	
6	T	542	2.0	0.591	11.1	LOS B	4.4	111.0	0.26	0.11	19.6	
16	R	3	0.0	0.591	11.1	LOS B	4.4	111.0	0.26	0.24	19.3	
Approach		627	2.5	0.591	11.1	LOS B	4.4	111.0	0.26	0.21	19.4	
North: RoadName												
7	L	53	3.0	0.244	9.4	LOS A	0.9	22.2	0.59	0.89	19.1	
4	T	33	0.0	0.244	9.4	LOS A	0.9	22.2	0.59	0.59	19.8	
14	R	55	3.0	0.244	9.4	LOS A	0.9	22.2	0.59	0.65	19.7	
Approach		142	2.3	0.244	9.4	LOS A	0.9	22.2	0.59	0.72	19.5	
West: RoadName												
5	L	11	0.0	0.397	8.6	LOS A	1.8	48.0	0.40	0.98	19.4	
2	T	345	5.0	0.397	8.6	LOS A	1.8	48.0	0.40	0.29	20.4	
12	R	3	0.0	0.397	8.6	LOS A	1.8	48.0	0.40	0.41	20.3	
Approach		359	4.8	0.397	8.6	LOS A	1.8	48.0	0.40	0.31	20.4	
All Vehicles		1237	3.1	0.591	9.8	LOS A	4.4	111.0	0.35	0.32	19.8	

Level of Service (LOS) Method: Delay & v/c (HCM 2010).

Roundabout LOS Method: Same as Sign Control.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 2010.

HCM Delay Model used. Geometric Delay not included.

Processed: Friday, March 24, 2017 3:16:20 PM
 SIDRA INTERSECTION 5.1.12.2089
 Project: T:\Damon\Scott County - 72\SR 56 and Boatman Rd_CR 200 W (Scottsburg)\SIDRA Analysis at SR 56 and Boatman Rd.sip
 8001443, INDIANA DEPARTMENT OF TRANSPORT, ENTERPRISE

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APPENDIX B

Crash Analysis for SR 56 and Boatman Rd, Scottsburg, Scott County
 Date: 1/1/2012 - 3/13/2017

1.) SEVERITY	2012	2013	2014	2015	2016	2017	TOTALS	
Property Damage	4	2	5	3	7	0	21	62%
Non-Incapacitating Injury	3	1	0	1	0	0	5	15%
Incapacitating Injury	2	1	0	2	1	1	7	21%
Fatality	0	0	1	0	0	0	1	3%
Unknown	0	0	0	0	0	0	0	0%

TOTALS	9	4	6	6	8	1	34	100%

2.) COLLISION DIAGRAM	2012	2013	2014	2015	2016	2017	TOTALS	
Rear End Collision (#1)	2	1	2	1	2	0	8	24%
Head-On Collision (#2)	0	0	0	0	0	0	0	0%
Same Direction Sideswipe (#3)	0	0	0	0	0	0	0	0%
Opposite Direction Sideswipe (#4)	0	1	0	0	0	0	1	3%
Off Road Collision (#5)	1	0	1	1	1	0	4	12%
Right Angle Collision (#6).....	3	1	2	2	2	1	11	32%
Lt. Turn Collision (#7-13).....	1	1	0	1	2	0	5	15%
Rt. Turn Collision (#14-18).....	0	0	1	0	0	0	1	3%
Animal/Object in Roadway	2	0	0	0	1	0	3	9%
Backing Crash	0	0	0	0	0	0	0	0%
Rear to Rear	0	0	0	0	0	0	0	0%
Left/Right Turn	0	0	0	0	0	0	0	0%
Non-Collision	0	0	0	0	0	0	0	0%
Other	0	0	0	1	0	0	1	3%
Unknown.....	0	0	0	0	0	0	0	0%

TOTALS	9	4	6	6	8	1	34	100%

3.) SURFACE CONDITION	2012	2013	2014	2015	2016	2017	TOTALS	
Dry (#1).....	9	4	4	5	7	1	30	88%
Wet (#2).....	0	0	0	1	1	0	2	6%
Snow/Ice/Slush (#3,4,5).....	0	0	1	0	0	0	1	3%

Loose Material	0	0	0	0	0	0	0	0%
Muddy	0	0	0	0	0	0	0	0%
Water (Standing or Moving)	0	0	1	0	0	0	1	3%
Other.....	0	0	0	0	0	0	0	0%
Unknown.....	0	0	0	0	0	0	0	0%

TOTALS	9	4	6	6	8	1	34	100%

4.) **CONTRIBUTING**

CIRCUMSTANCE	2012	2013	2014	2015	2016	2017	TOTALS	
Unsafe Speed	0	0	0	0	0	0	0	0%
Disregard Signal	0	0	0	0	0	0	0	0%
Failure to Yield R/W	4	1	2	3	4	1	15	44%
Brake Failure or Defective	0	0	0	0	0	0	0	0%
Following Too Closely	2	1	1	1	2	0	7	21%
Animal/Object in Roadway	2	0	0	0	1	0	3	9%
Crossed Centerline	0	1	0	0	0	0	1	3%
Improper Lane Change	0	0	0	0	0	0	0	0%
Distracted	0	1	1	2	0	0	4	12%
Driver Illness or Fatigue	0	0	0	0	0	0	0	0%
Illegal Drugs or Alcohol	0	0	0	0	0	0	0	0%
Avoiding Collision With Vehicle	1	0	0	0	0	0	1	3%
Road/Weather Condition	0	0	2	0	1	0	3	9%

TOTALS	9	4	6	6	8	1	34	100%

5.) **MONTH**

	2012	2013	2014	2015	2016	2017	TOTALS	
January (01).....	0	1	1	0	1	0	3	9%
February (02)	0	0	0	1	1	1	3	9%
March (03)	0	0	0	0	0	0	0	0%
April (04).....	3	0	0	0	0	0	3	9%
May (05).....	1	0	1	0	0	0	2	6%
June (06).....	2	1	0	1	1	0	5	15%
July (07).....	1	1	0	2	1	0	5	15%
August (08).....	0	0	1	1	1	0	3	9%

September (09).....	0	0	0	0	1	0	1	3%
October (10).....	0	0	0	1	2	0	3	9%
November (11).....	1	1	2	0	0	0	4	12%
December (12).....	1	0	1	0	0	0	2	6%
Unknown.....	0	0	0	0	0	0	0	0%

TOTALS	9	4	6	6	8	1	34	100%

6.) **DAY OF**

WEEK	2012	2013	2014	2015	2016	2017	TOTALS	
Sunday.....	1	0	0	0	3	1	5	15%
Monday.....	1	2	0	1	1	0	5	15%
Tuesday.....	0	0	0	1	1	0	2	6%
Wednesday.....	0	1	3	0	0	0	4	12%
Thursday.....	3	0	0	2	1	0	6	18%
Friday.....	4	0	1	1	1	0	7	21%
Saturday.....	0	1	2	1	1	0	5	15%
Unknown.....	0	0	0	0	0	0	0	0%

TOTALS	9	4	6	6	8	1	34	100%

7.) **HOUR OF**

DAY	2012	2013	2014	2015	2016	2017	TOTALS	
6-7AM (0600).....	0	0	0	0	0	0	0	0%
7-8AM (0700).....	1	0	0	1	1	0	3	9%
8-9AM (0800).....	0	0	0	0	1	0	1	3%
9-10AM (0900).....	4	0	0	0	1	0	5	15%
10-11AM (1000).....	0	0	0	0	1	0	1	3%
11A-12N (1100).....	0	1	0	1	1	0	3	9%
12N-1P (1200).....	0	0	2	1	1	0	4	12%
1-2PM (1300).....	1	0	0	0	0	0	1	3%
2-3PM (1400).....	0	0	0	0	1	0	1	3%
3-4PM (1500).....	1	1	0	1	0	0	3	9%
4-5PM (1600).....	0	0	1	0	0	0	1	3%
5-6PM (1700).....	0	1	0	0	0	0	1	3%

Daylight Sub-Totals	7	3	3	4	7	0	24	71%
6-7PM (1800).....	0	0	1	1	0	1	3	9%
7-8PM (1900).....	1	1	0	0	0	0	2	6%
8-9PM (2000).....	0	0	0	0	0	0	0	0%
9-10PM (2100).....	0	0	0	0	1	0	1	3%
10-11PM (2200).....	1	0	0	0	0	0	1	3%
11P-12M (2300).....	0	0	1	0	0	0	1	3%
12M-1A (2400).....	0	0	0	0	0	0	0	0%
1-2AM (0100).....	0	0	0	0	0	0	0	0%
2-3AM (0200).....	0	0	0	0	0	0	0	0%
3-4AM (0300).....	0	0	0	1	0	0	1	3%
4-5AM (0400).....	0	0	0	0	0	0	0	0%
5-6AM (0500).....	0	0	1	0	0	0	1	3%
Unknown.....	0	0	0	0	0	0	0	0%

Nighttime Sub-Totals	2	1	3	2	1	1	10	29%

GRAND TOTALS	9	4	6	6	8	1	34	100%

8.) ROAD CHARACTER	2012	2013	2014	2015	2016	2017	TOTALS	
Straight/Level (#1).....	2	2	2	1	4	1	12	35%
Straight/Grade (#2).....	1	0	2	2	0	0	5	15%
Straight/Hillcrest (#3)	1	0	0	0	0	0	1	3%
Curve/Level (#4).....	4	1	1	2	2	0	10	29%
Curve/Grade (#5).....	1	1	1	1	2	0	6	18%
Curve/Hillcrest (#6).....	0	0	0	0	0	0	0	0%
Unknown.....	0	0	0	0	0	0	0	0%

TOTALS	9	4	6	6	8	1	34	100%

9.) DIRECTIONAL ANALYSIS / COLLISION INVOLVED	2012	2013	2014	2015	2016	2017	TOTALS	
WB Off Road	1	0	1	0	0	0	2	6%

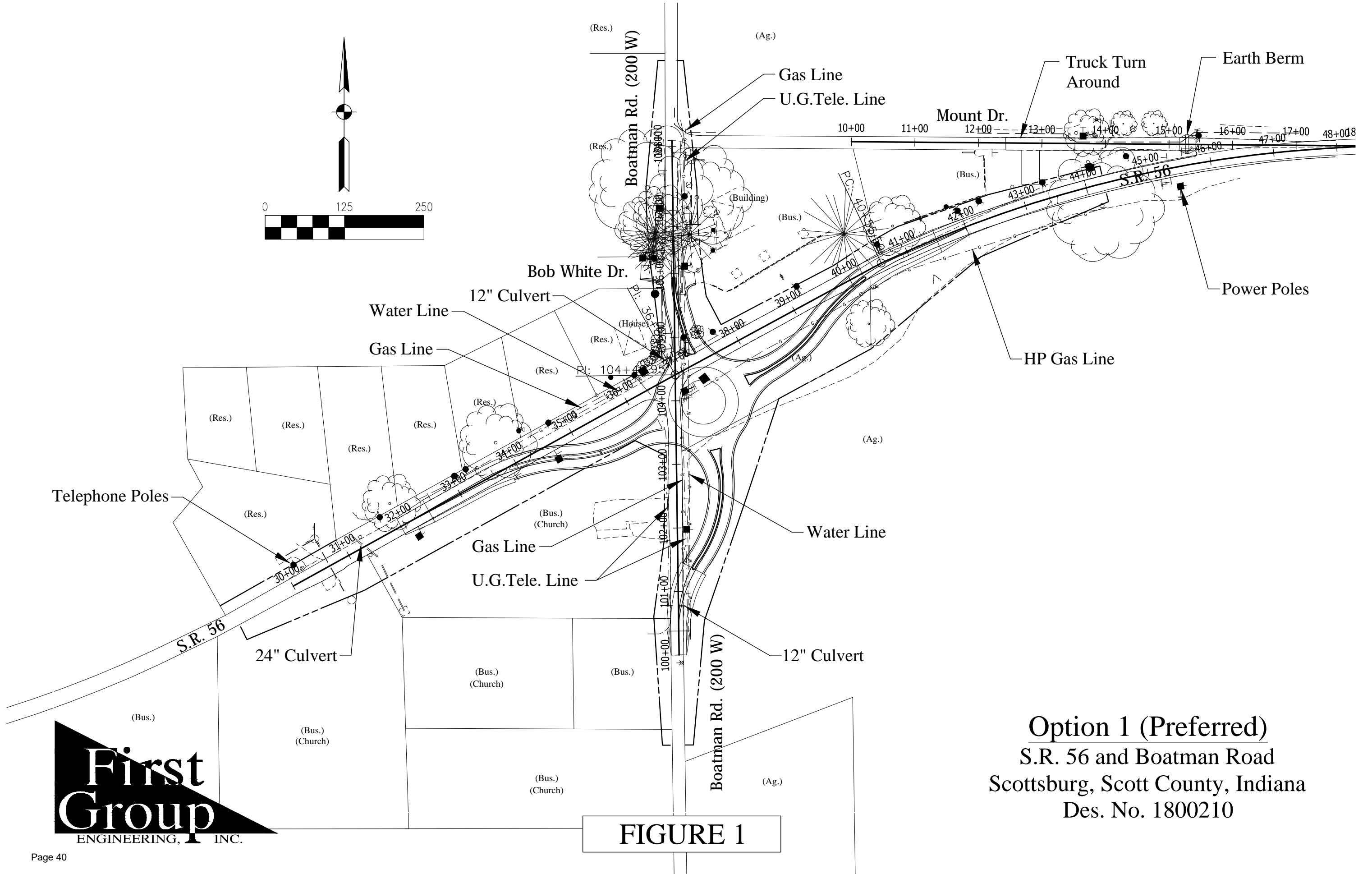
SBlt w/ Deer	1	0	0	0	0	0	1	3%
EB Off Road	0	0	0	2	1	0	3	9%
SB w/ WB	2	0	1	0	0	0	3	9%
SB w/ EB	0	0	1	1	0	0	2	6%
EB w/ SBlt	1	0	0	0	0	0	1	3%
WBlt w/ EB	0	1	0	0	0	0	1	3%
NB w/ NB	1	0	0	0	0	0	1	3%
EB w/ EBrt	0	0	1	0	0	0	1	3%
EB w/ NB	1	0	0	0	0	0	1	3%
WB w/ NB	0	1	0	2	1	1	5	15%
SBlt w/ WB	0	0	0	0	3	0	3	9%
WB w/ WB.....	0	0	0	1	1	0	2	6%
EBlt w/ SB	0	1	0	0	0	0	1	3%
WB w/ WBlt	0	0	0	0	1	0	1	3%
EB w/ Deer	1	0	0	0	1	0	2	6%
WB w/ WBrt	0	0	1	0	0	0	1	3%
EB w/ EB	1	1	1	0	0	0	3	9%

TOTALS	9	4	6	6	8	1	34	100%

10.) REFERENCED LOCATIONS	2012	2013	2014	2015	2016	2017	TOTALS	
At Intersection	8	4	5	4	6	1	28	82%
Zero to Hundred Feet East	0	0	0	0	0	0	0	0%
Zero to Hundred Feet North	0	0	0	0	0	0	0	0%
Zero to Hundred Feet South	0	0	0	0	0	0	0	0%
Zero to Hundred Feet West	0	0	0	0	0	0	0	0%
Hundred to Thousand Feet East	1	0	1	1	1	0	4	12%
Hundred to Thousand Feet North	0	0	0	0	0	0	0	0%
Hundred to Thousand Feet South	0	0	0	0	0	0	0	0%
Hundred to Thousand Feet West	0	0	0	1	1	0	2	6%

TOTALS	9	4	6	6	8	1	34	100%

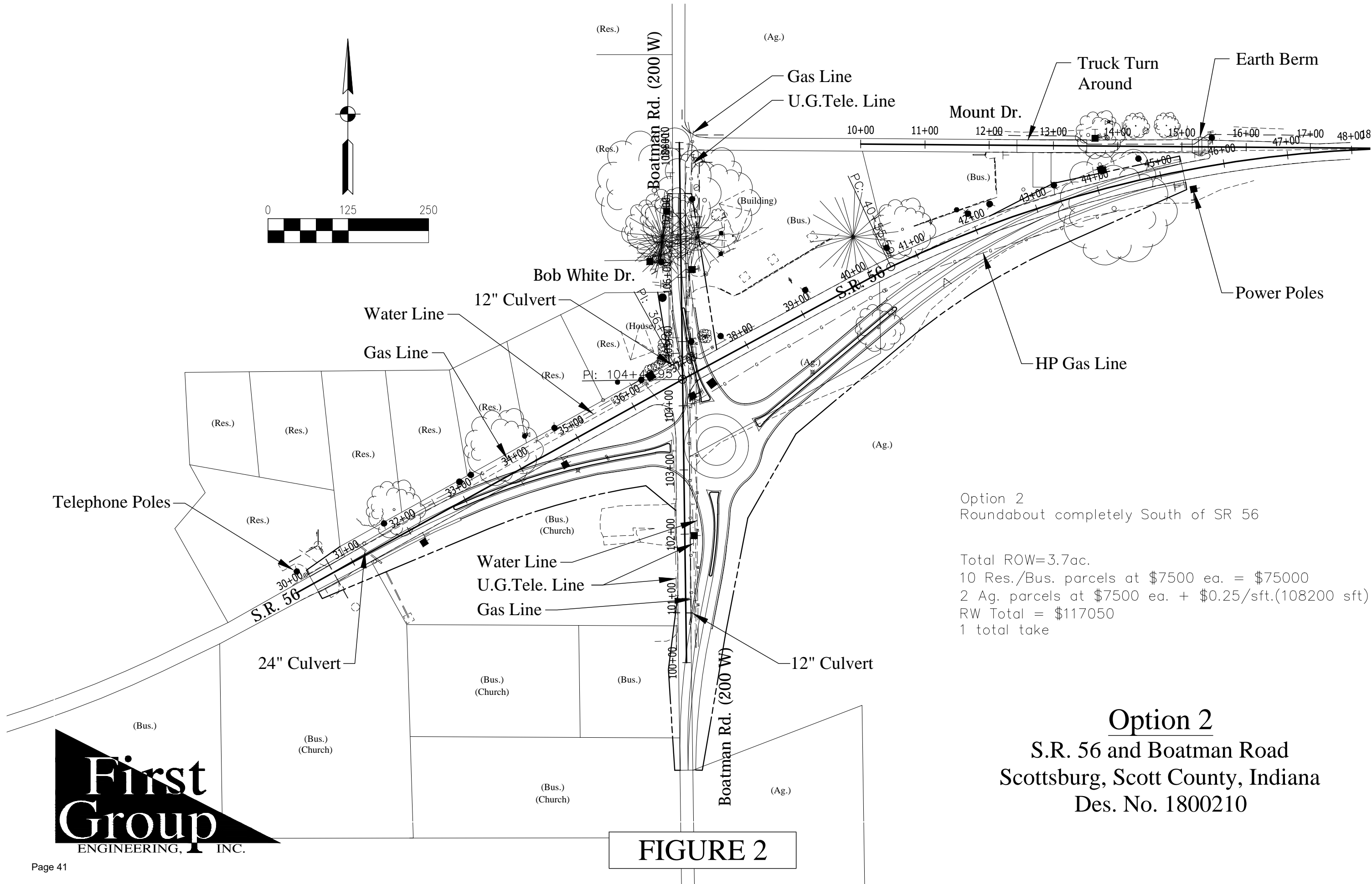
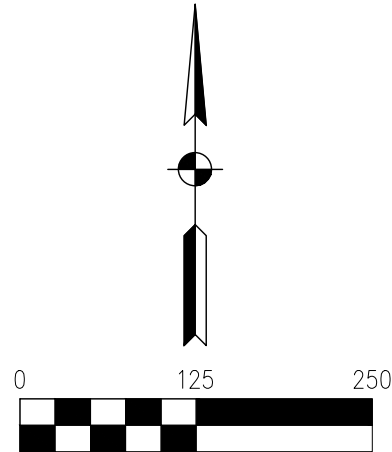
APPENDIX C



Option 1 (Preferred)
 S.R. 56 and Boatman Road
 Scottsburg, Scott County, Indiana
 Des. No. 1800210

FIGURE 1





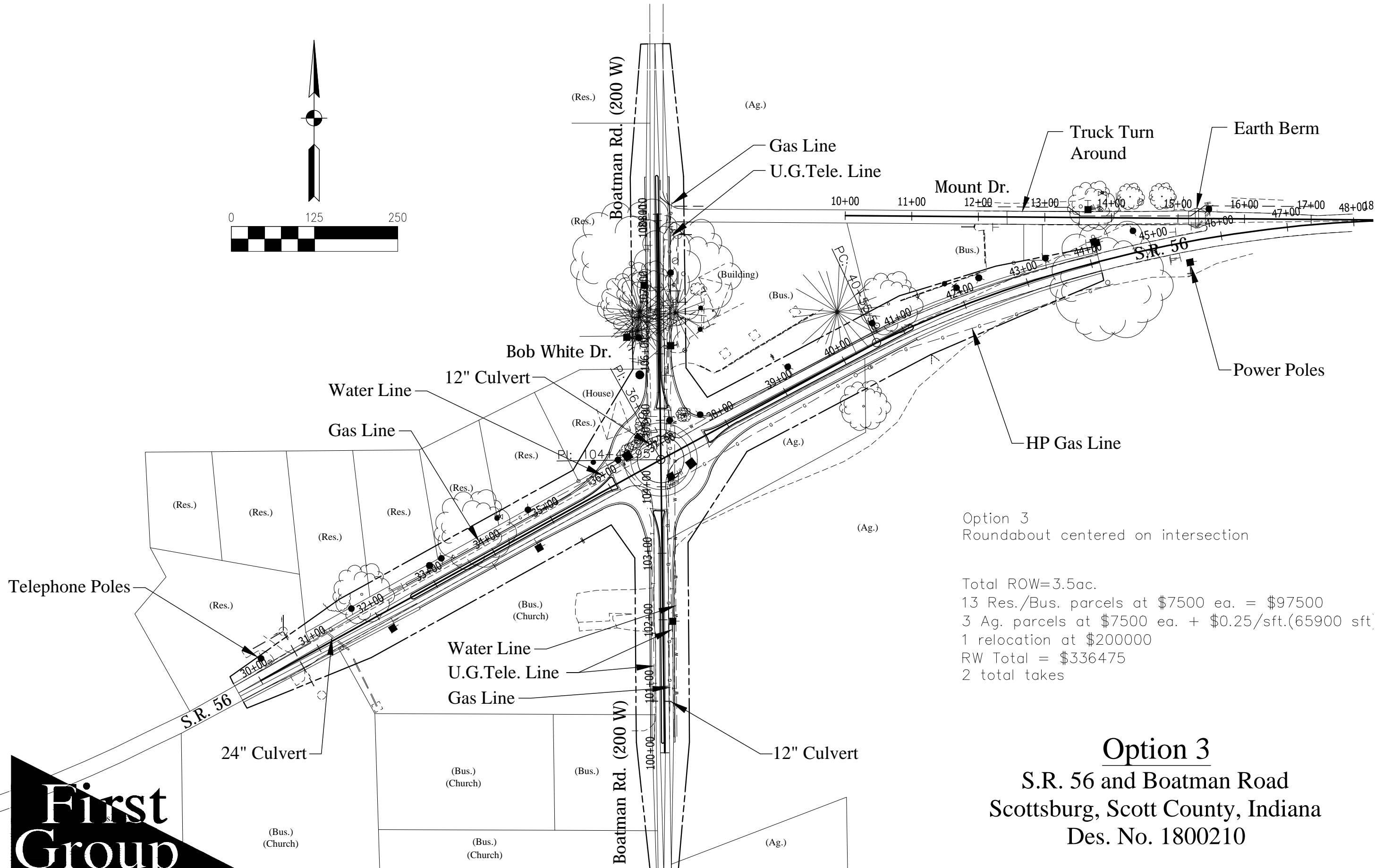
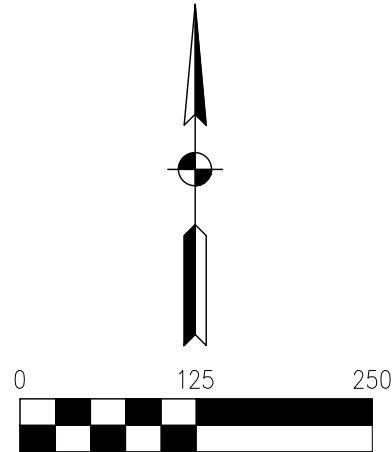
Option 2
Roundabout completely South of SR 56

Total ROW=3.7ac.
10 Res./Bus. parcels at \$7500 ea. = \$75000
2 Ag. parcels at \$7500 ea. + \$0.25/sft.(108200 sft)
RW Total = \$117050
1 total take

Option 2
S.R. 56 and Boatman Road
Scottsburg, Scott County, Indiana
Des. No. 1800210

FIGURE 2



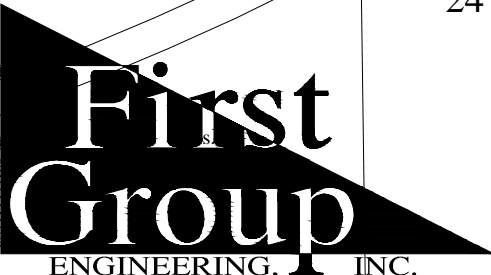


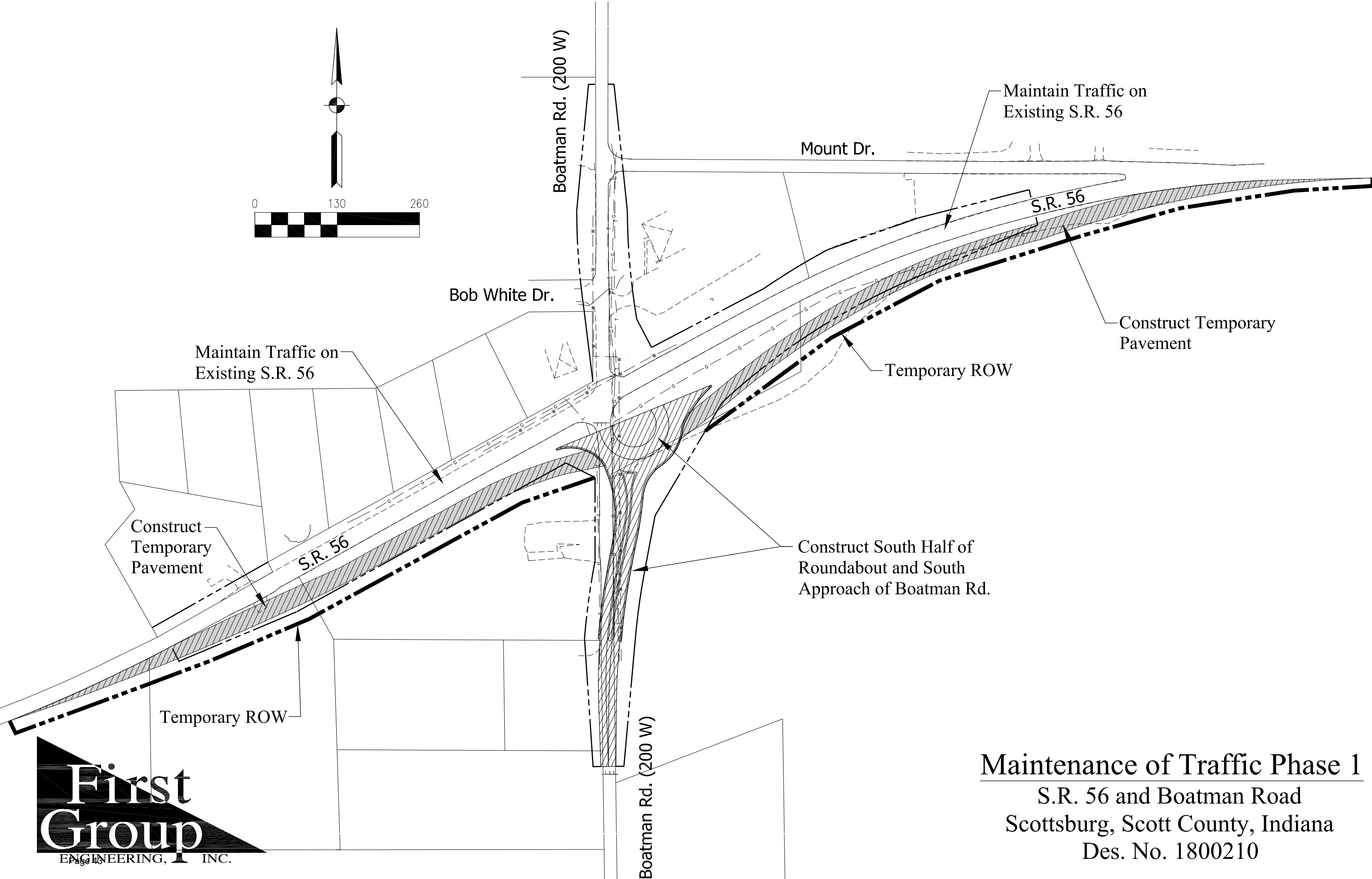
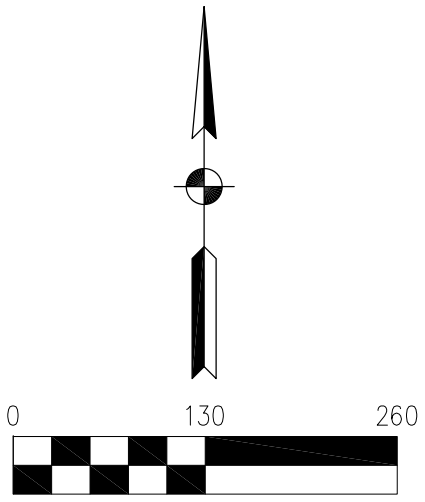
Option 3
Roundabout centered on intersection

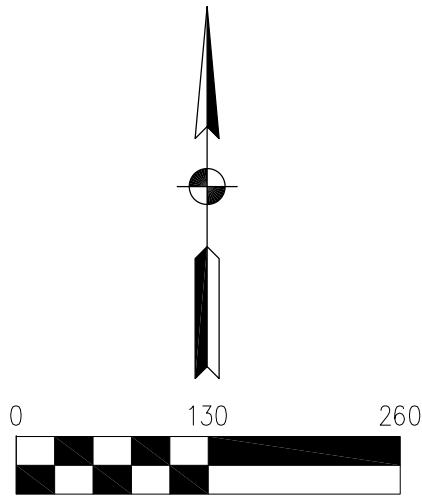
Total ROW=3.5ac.
 13 Res./Bus. parcels at \$7500 ea. = \$97500
 3 Ag. parcels at \$7500 ea. + \$0.25/sft.(65900 sft)
 1 relocation at \$200000
 RW Total = \$336475
 2 total takes

Option 3
 S.R. 56 and Boatman Road
 Scottsburg, Scott County, Indiana
 Des. No. 1800210

FIGURE 3







Construct North Half of Roundabout, West and East Approaches of S.R. 56 and North Approach of Boatman Rd.

Bob White Dr.

Boatman Rd. (200 W)

Mount Dr.

S.R. 56

Run Traffic on Temporary Pavement and South Half of Roundabout

Temporary ROW

Varies 2' - 24'

11'

Westbound Lane

11'

Eastbound Lane

Existing Pavement

Section A-A

HMA for Temporary Pavement

Temporary ROW

11'

Westbound Lane

11'

Eastbound Lane

Proposed Construction

Section B-B

HMA for Temporary Pavement

Run Traffic on Temporary Pavement and South Half of Roundabout

Boatman Rd. (200 W)

APPENDIX D

SR 56 IN SCOTTSBURG - QUANTITIES AND PAY ITEM LIST
HMA PREFERRED ALTERNATE - PRELIMINARY ESTIMATE
11-Sep-19

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
105-06845	CONSTRUCTION ENGINEERING	LS	1.00	\$ 47,000.00	\$ 47,000.00
110-01001	MOBILIZATION AND DEMOBILIZATION	LS	1.00	\$ 125,000.00	\$ 125,000.00
201-52370	CLEARING RIGHT OF WAY	LS	1.00	\$ 63,000.00	\$ 63,000.00
202-93995	SIGNAL POLE FOUNDATION, REMOVE	EACH	2.00	\$ 700.00	\$ 1,400.00
202-93999	SIGNAL POLE, REMOVE	EACH	2.00	\$ 450.00	\$ 900.00
202-95579	SERVICE POINT, REMOVE	EACH	1.00	\$ 25.00	\$ 25.00
202-96151	TRANSPORTATION OF SALVAGEABLE ITEMS	LS	1.00	\$ 4,500.00	\$ 4,500.00
203-02000	EXCAVATION, COMMON	CYS	4750.00	\$ 20.00	\$ 95,000.00
203-02070	BORROW	CYS	1500.00	\$ 25.00	\$ 37,500.00
205-12108	STORM WATER MANAGEMENT BUDGET	DOL	20000.00	\$ 1.00	\$ 20,000.00
205-12109	SWQCP PREPARATION AND IMPLEMENTATION, LEVEL 1	LS	1.00	\$ 20,000.00	\$ 20,000.00
207-08264	SUBGRADE TREATMENT, TYPE II	SYS	55.00	\$ 9.00	\$ 495.00
207-09935	SUBGRADE TREATMENT, TYPE IC	SYS	12600.00	\$ 25.00	\$ 315,000.00
211-09264	STRUCTURE BACKFILL, TYPE 1	CYS	250.00	\$ 30.00	\$ 7,500.00
401-07347	QC/QA-HMA, 3, 70, SURFACE, 12.5 mm	TON	825.00	\$ 81.00	\$ 66,825.00
401-07398	QC/QA-HMA, 3, 70, INTERMEDIATE, 19.0 mm	TON	1370.00	\$ 72.00	\$ 98,640.00
401-07424	QC/QA-HMA, 3, 64, BASE, 19.0 mm	TON	3300.00	\$ 69.00	\$ 227,700.00
401-10258	JOINT ADHESIVE, SURFACE	LFT	2000.00	\$ 0.20	\$ 400.00
401-10259	JOINT ADHESIVE, INTERMEDIATE	LFT	2000.00	\$ 0.25	\$ 500.00
401-11785	LIQUID ASPHALT SEALANT	LFT	2000.00	\$ 0.10	\$ 200.00
401-12137	QC/QA-HMA, 4, 76, INTERMEDIATE, OG, 19.0 mm	TON	1240.00	\$ 80.00	\$ 99,200.00
406-05520	ASPHALT FOR TACK COAT	TON	7.50	\$ 475.00	\$ 3,562.50
415-11527	BASE SEAL	TON	2.50	\$ 500.00	\$ 1,250.00
605-06140	CURB AND GUTTER, CONCRETE	LFT	3000.00	\$ 25.00	\$ 75,000.00
605-06255	CENTER CURB, D CONCRETE	SYS	560.00	\$ 125.00	\$ 70,000.00
610-07488	HMA FOR APPROACHES, TYPE C	TON	150.00	\$ 90.00	\$ 13,500.00
610-09108	PCCP FOR APPROACHES, 9 IN.	SYS	55.00	\$ 60.00	\$ 3,300.00
616-02320	GEOTEXTILES	SYS	300.00	\$ 5.00	\$ 1,500.00
616-06405	RIPRAP, REVETMENT	TON	200.00	\$ 60.00	\$ 12,000.00
628-09402	FIELD OFFICE, B	MOS	12.00	\$ 2,200.00	\$ 26,400.00
715-05048	PIPE, TYPE 4, CIRCULAR, 6 IN.	LFT	5000.00	\$ 4.00	\$ 20,000.00
715-05053	PIPE, UNDERDRAIN, OUTLET 6 IN.	LFT	250.00	\$ 10.00	\$ 2,500.00
715-05123	PIPE, TYPE 1, CIRCULAR, 24 IN.	LFT	115.00	\$ 70.00	\$ 8,050.00
715-05149	PIPE, TYPE 2, CIRCULAR, 12 IN.	LFT	715.00	\$ 50.00	\$ 35,750.00
715-05169	PIPE, TYPE 3, CIRCULAR, 15 IN.	LFT	60.00	\$ 60.00	\$ 3,600.00
715-46000	PIPE END SECTION, DIAMETER 12 IN.	EACH	14.00	\$ 575.00	\$ 8,050.00
715-46005	PIPE END SECTION, DIAMETER 15 IN.	EACH	2.00	\$ 600.00	\$ 1,200.00
715-46020	PIPE END SECTION, DIAMETER 24 IN.	EACH	4.00	\$ 800.00	\$ 3,200.00
718-06529	OUTLET PROTECTOR, 2	EACH	4.00	\$ 500.00	\$ 2,000.00
718-06532	VIDEO INSPECTION FOR UNDERDRAINS	LFT	3000.00	\$ 1.00	\$ 3,000.00
718-52610	AGGREGATE FOR UNDERDRAINS	CYS	420.00	\$ 35.00	\$ 14,700.00
718-99153	GEOTEXTILES FOR UNDERDRAIN	SYS	5000.00	\$ 1.00	\$ 5,000.00
720-98174	INLET, B15	EACH	26.00	\$ 2,500.00	\$ 65,000.00
801-06775	MAINTAINING TRAFFIC	LS	1.00	\$ 112,000.00	\$ 112,000.00
802-	SIGNING (LUMP SUM)	LS	1.00	\$ 5,000.00	\$ 5,000.00
805-01300	TRAFFIC SIGNAL EQUIPMENT, REMOVE	EACH	3.00	\$ 1,410.00	\$ 4,230.00
807-	LIGHTING (LUMP SUM)	LS	1.00	\$ 180,000.00	\$ 180,000.00
	CONTINGENCY (15%)	LS	1.00	\$ 285,000.00	\$ 285,000.00
				TOTAL	\$ 2,195,577.50
				TOTAL	\$ 2,196,000.00
				MOT	\$ 112,000.00
				Total (excluding MOT)	\$ 2,084,000.00

SR 56 IN SCOTTSBURG - QUANTITIES AND PAY ITEM LIST
HMA ALTERNATE 2 - PRELIMINARY ESTIMATE
11-Sep-19

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
105-06845	CONSTRUCTION ENGINEERING	LS	1.00	\$ 48,000.00	\$ 48,000.00
110-01001	MOBILIZATION AND DEMOBILIZATION	LS	1.00	\$ 128,000.00	\$ 128,000.00
201-52370	CLEARING RIGHT OF WAY	LS	1.00	\$ 64,000.00	\$ 64,000.00
202-93995	SIGNAL POLE FOUNDATION, REMOVE	EACH	2.00	\$ 700.00	\$ 1,400.00
202-93999	SIGNAL POLE, REMOVE	EACH	2.00	\$ 450.00	\$ 900.00
202-95579	SERVICE POINT, REMOVE	EACH	1.00	\$ 25.00	\$ 25.00
202-96151	TRANSPORTATION OF SALVAGEABLE ITEMS	LS	1.00	\$ 4,500.00	\$ 4,500.00
203-02000	EXCAVATION, COMMON	CYS	4750.00	\$ 20.00	\$ 95,000.00
203-02070	BORROW	CYS	3000.00	\$ 25.00	\$ 75,000.00
205-12108	STORM WATER MANAGEMENT BUDGET	DOL	20000.00	\$ 1.00	\$ 20,000.00
205-12109	SWQCP PREPARATION AND IMPLEMENTATION, LEVEL 1	LS	1.00	\$ 20,000.00	\$ 20,000.00
207-08264	SUBGRADE TREATMENT, TYPE II	SYS	55.00	\$ 9.00	\$ 495.00
207-09935	SUBGRADE TREATMENT, TYPE IC	SYS	12600.00	\$ 25.00	\$ 315,000.00
211-09264	STRUCTURE BACKFILL, TYPE 1	CYS	250.00	\$ 30.00	\$ 7,500.00
401-07347	QC/QA-HMA, 3, 70, SURFACE, 12.5 mm	TON	825.00	\$ 81.00	\$ 66,825.00
401-07398	QC/QA-HMA, 3, 70, INTERMEDIATE, 19.0 mm	TON	1370.00	\$ 72.00	\$ 98,640.00
401-07424	QC/QA-HMA, 3, 64, BASE, 19.0 mm	TON	3300.00	\$ 69.00	\$ 227,700.00
401-10258	JOINT ADHESIVE, SURFACE	LFT	2000.00	\$ 0.20	\$ 400.00
401-10259	JOINT ADHESIVE, INTERMEDIATE	LFT	2000.00	\$ 0.25	\$ 500.00
401-11785	LIQUID ASPHALT SEALANT	LFT	2000.00	\$ 0.10	\$ 200.00
401-12137	QC/QA-HMA, 4, 76, INTERMEDIATE, OG, 19.0 mm	TON	1240.00	\$ 80.00	\$ 99,200.00
406-05520	ASPHALT FOR TACK COAT	TON	7.50	\$ 475.00	\$ 3,562.50
415-11527	BASE SEAL	TON	2.50	\$ 500.00	\$ 1,250.00
605-06140	CURB AND GUTTER, CONCRETE	LFT	3000.00	\$ 25.00	\$ 75,000.00
605-06255	CENTER CURB, D CONCRETE	SYS	560.00	\$ 125.00	\$ 70,000.00
610-07488	HMA FOR APPROACHES, TYPE C	TON	150.00	\$ 90.00	\$ 13,500.00
610-09108	PCCP FOR APPROACHES, 9 IN.	SYS	55.00	\$ 60.00	\$ 3,300.00
616-02320	GEOTEXTILES	SYS	300.00	\$ 5.00	\$ 1,500.00
616-06405	RIPRAP, REVETMENT	TON	200.00	\$ 60.00	\$ 12,000.00
628-09402	FIELD OFFICE, B	MOS	12.00	\$ 2,200.00	\$ 26,400.00
715-05048	PIPE, TYPE 4, CIRCULAR, 6 IN.	LFT	5000.00	\$ 4.00	\$ 20,000.00
715-05053	PIPE, UNDERDRAIN, OUTLET 6 IN.	LFT	250.00	\$ 10.00	\$ 2,500.00
715-05123	PIPE, TYPE 1, CIRCULAR, 24 IN.	LFT	115.00	\$ 70.00	\$ 8,050.00
715-05149	PIPE, TYPE 2, CIRCULAR, 12 IN.	LFT	715.00	\$ 50.00	\$ 35,750.00
715-05169	PIPE, TYPE 3, CIRCULAR, 15 IN.	LFT	60.00	\$ 60.00	\$ 3,600.00
715-46000	PIPE END SECTION, DIAMETER 12 IN.	EACH	14.00	\$ 575.00	\$ 8,050.00
715-46005	PIPE END SECTION, DIAMETER 15 IN.	EACH	2.00	\$ 600.00	\$ 1,200.00
715-46020	PIPE END SECTION, DIAMETER 24 IN.	EACH	4.00	\$ 800.00	\$ 3,200.00
718-06529	OUTLET PROTECTOR, 2	EACH	4.00	\$ 500.00	\$ 2,000.00
718-06532	VIDEO INSPECTION FOR UNDERDRAINS	LFT	3000.00	\$ 1.00	\$ 3,000.00
718-52610	AGGREGATE FOR UNDERDRAINS	CYS	420.00	\$ 35.00	\$ 14,700.00
718-99153	GEOTEXTILES FOR UNDERDRAIN	SYS	5000.00	\$ 1.00	\$ 5,000.00
720-98174	INLET, B15	EACH	26.00	\$ 2,500.00	\$ 65,000.00
801-06775	MAINTAINING TRAFFIC	LS	1.00	\$ 112,000.00	\$ 112,000.00
802-	SIGNING (LUMP SUM)	LS	1.00	\$ 5,000.00	\$ 5,000.00
805-01300	TRAFFIC SIGNAL EQUIPMENT, REMOVE	EACH	3.00	\$ 1,410.00	\$ 4,230.00
807-	LIGHTING (LUMP SUM)	LS	1.00	\$ 180,000.00	\$ 180,000.00
	CONTINGENCY (15%)	LS	1.00	\$ 292,500.00	\$ 292,500.00
				TOTAL	\$ 2,245,577.50
				TOTAL	\$ 2,246,000.00
				MOT	\$ 112,000.00
				Total (excluding MOT)	\$ 2,134,000.00

SR 56 IN SCOTTSBURG - QUANTITIES AND PAY ITEM LIST
HMA ALTERNATE 3 - PRELIMINARY ESTIMATE
11-Sep-19

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
105-06845	CONSTRUCTION ENGINEERING	LS	1.00	\$ 47,000.00	\$ 47,000.00
110-01001	MOBILIZATION AND DEMOBILIZATION	LS	1.00	\$ 124,000.00	\$ 124,000.00
201-52370	CLEARING RIGHT OF WAY	LS	1.00	\$ 62,000.00	\$ 62,000.00
202-93995	SIGNAL POLE FOUNDATION, REMOVE	EACH	2.00	\$ 700.00	\$ 1,400.00
202-93999	SIGNAL POLE, REMOVE	EACH	2.00	\$ 450.00	\$ 900.00
202-95579	SERVICE POINT, REMOVE	EACH	1.00	\$ 25.00	\$ 25.00
202-96151	TRANSPORTATION OF SALVAGEABLE ITEMS	LS	1.00	\$ 4,500.00	\$ 4,500.00
203-02000	EXCAVATION, COMMON	CYS	4750.00	\$ 20.00	\$ 95,000.00
203-02070	BORROW	CYS	1000.00	\$ 25.00	\$ 25,000.00
205-12108	STORM WATER MANAGEMENT BUDGET	DOL	20000.00	\$ 1.00	\$ 20,000.00
205-12109	SWQCP PREPARATION AND IMPLEMENTATION, LEVEL 1	LS	1.00	\$ 20,000.00	\$ 20,000.00
207-08264	SUBGRADE TREATMENT, TYPE II	SYS	55.00	\$ 9.00	\$ 495.00
207-09935	SUBGRADE TREATMENT, TYPE IC	SYS	12600.00	\$ 25.00	\$ 315,000.00
211-09264	STRUCTURE BACKFILL, TYPE 1	CYS	250.00	\$ 30.00	\$ 7,500.00
401-07347	QC/QA-HMA, 3, 70, SURFACE, 12.5 mm	TON	825.00	\$ 81.00	\$ 66,825.00
401-07398	QC/QA-HMA, 3, 70, INTERMEDIATE, 19.0 mm	TON	1370.00	\$ 72.00	\$ 98,640.00
401-07424	QC/QA-HMA, 3, 64, BASE, 19.0 mm	TON	3300.00	\$ 69.00	\$ 227,700.00
401-10258	JOINT ADHESIVE, SURFACE	LFT	2000.00	\$ 0.20	\$ 400.00
401-10259	JOINT ADHESIVE, INTERMEDIATE	LFT	2000.00	\$ 0.25	\$ 500.00
401-11785	LIQUID ASPHALT SEALANT	LFT	2000.00	\$ 0.10	\$ 200.00
401-12137	QC/QA-HMA, 4, 76, INTERMEDIATE, OG, 19.0 mm	TON	1240.00	\$ 80.00	\$ 99,200.00
406-05520	ASPHALT FOR TACK COAT	TON	7.50	\$ 475.00	\$ 3,562.50
415-11527	BASE SEAL	TON	2.50	\$ 500.00	\$ 1,250.00
605-06140	CURB AND GUTTER, CONCRETE	LFT	3000.00	\$ 25.00	\$ 75,000.00
605-06255	CENTER CURB, D CONCRETE	SYS	560.00	\$ 125.00	\$ 70,000.00
610-07488	HMA FOR APPROACHES, TYPE C	TON	150.00	\$ 90.00	\$ 13,500.00
610-09108	PCCP FOR APPROACHES, 9 IN.	SYS	55.00	\$ 60.00	\$ 3,300.00
616-02320	GEOTEXTILES	SYS	300.00	\$ 5.00	\$ 1,500.00
616-06405	RIPRAP, REVETMENT	TON	200.00	\$ 60.00	\$ 12,000.00
628-09402	FIELD OFFICE, B	MOS	12.00	\$ 2,200.00	\$ 26,400.00
715-05048	PIPE, TYPE 4, CIRCULAR, 6 IN.	LFT	5000.00	\$ 4.00	\$ 20,000.00
715-05053	PIPE, UNDERDRAIN, OUTLET 6 IN.	LFT	250.00	\$ 10.00	\$ 2,500.00
715-05123	PIPE, TYPE 1, CIRCULAR, 24 IN.	LFT	115.00	\$ 70.00	\$ 8,050.00
715-05149	PIPE, TYPE 2, CIRCULAR, 12 IN.	LFT	715.00	\$ 50.00	\$ 35,750.00
715-05169	PIPE, TYPE 3, CIRCULAR, 15 IN.	LFT	60.00	\$ 60.00	\$ 3,600.00
715-46000	PIPE END SECTION, DIAMETER 12 IN.	EACH	14.00	\$ 575.00	\$ 8,050.00
715-46005	PIPE END SECTION, DIAMETER 15 IN.	EACH	2.00	\$ 600.00	\$ 1,200.00
715-46020	PIPE END SECTION, DIAMETER 24 IN.	EACH	4.00	\$ 800.00	\$ 3,200.00
718-06529	OUTLET PROTECTOR, 2	EACH	4.00	\$ 500.00	\$ 2,000.00
718-06532	VIDEO INSPECTION FOR UNDERDRAINS	LFT	3000.00	\$ 1.00	\$ 3,000.00
718-52610	AGGREGATE FOR UNDERDRAINS	CYS	420.00	\$ 35.00	\$ 14,700.00
718-99153	GEOTEXTILES FOR UNDERDRAIN	SYS	5000.00	\$ 1.00	\$ 5,000.00
720-98174	INLET, B15	EACH	26.00	\$ 2,500.00	\$ 65,000.00
801-06775	MAINTAINING TRAFFIC	LS	1.00	\$ 112,000.00	\$ 112,000.00
802-	SIGNING (LUMP SUM)	LS	1.00	\$ 5,000.00	\$ 5,000.00
805-01300	TRAFFIC SIGNAL EQUIPMENT, REMOVE	EACH	3.00	\$ 1,410.00	\$ 4,230.00
807-	LIGHTING (LUMP SUM)	LS	1.00	\$ 180,000.00	\$ 180,000.00
	CONTINGENCY (15%)	LS	1.00	\$ 285,000.00	\$ 285,000.00
				TOTAL	\$ 2,181,077.50
				TOTAL	\$ 2,182,000.00
				MOT	\$ 112,000.00
				Total (excluding MOT)	\$ 2,070,000.00

APPENDIX E



State Road (56) Intersection Improvement Project
SR 56 and Boatman Road (CR 200 W)
Scott County, Indiana
Loch Group # 218-0056

Project Scope

The proposed project involves the construction of a roundabout at the SR 56 and Boatman Road intersection in order to improve safety for travelers at this intersection. Additional right-of-way is anticipated, but an estimated quantity was not available at the time this Preliminary Red Flag Investigation was completed. It is anticipated the amount of right-of-way required will exceed 0.5-acre.

Preliminary Red Flag Investigation

A preliminary Red Flag Investigation was completed for the project area by Lochmueller Group. The project was screened using 46 Geographic Information System (GIS) layers in order to identify any potential environmental concerns located within the immediate vicinity of the project.

Ecological Resources: No water resources are mapped within or adjacent to the project area. However, a waters investigation may be needed and the findings documented in a *Wetland Delineation / Waters of the U.S. Determination Report*. The project area is not located within the Potential Karst Features Region as identified in the Karst Memorandum of Understanding (MOU). The project area is not located in the St. Joseph's Sole Source Aquifer.

The project is within the range of the federally endangered Indiana bat and federally threatened northern long-eared bat. Suitable habitat does not appear to be present within or adjacent to the project area. The proposed project is anticipated to qualify for the *Range-wide Programmatic Informal Consultation for the Indiana bat and Northern Long-eared Bat (NLEB)*. Given the scope of the project, it is anticipated the resulting finding of this coordination will be "No Effect" or "Not Likely to Adversely Affect".

Cultural Resources: There are no properties listed in the National Register of Historic Places (NRHP) adjacent to the project. On October 15, 2018, Lochmueller Group reviewed the information presented on the Indiana State Historic Architectural and Archaeological Research Database (SHAARD) GIS and the Indiana Historic Buildings, Bridges, and Cemeteries Map (IHBBCM) for the proposed project location. The project area does not appear to be within or adjacent to an NRHP eligible or listed bridge, or historic district, and no cemeteries appear to be within or adjacent to the project limits. One property rated Contributing is located north of SR 56 on the west side of Boatman Road. Contributing resources are not typically considered individually eligible for inclusion in the NRHP.

A virtual review was conducted via Google Streetview imagery to assess soil disturbance in regard to the potential for intact archaeological resources. A portion of the project area appears to be within undisturbed soils. Therefore, an archaeological field review is recommended.

Hazardous Materials: N/A

Infrastructure: Two (2) pipelines, owned by Midwest Natural Gas Corporation, are within, or adjacent to, the likely project area. While not mapped on the searched GIS layers, Elevation Church is located near the project area and owns undeveloped property in the southwest quadrant of the subject intersection that will likely be affected by the project.

Mining/Mineral Exploration: N/A

Urbanized Area Boundary (UAB): A portion of the project area is located within a UAB, however, a Rule 13 Permit from IDEM has not been issued.

Summary of Environmental Requirements (LOI Write-Up)

NEPA Documentation: This project appears to meet the requirements of a Level 2 Categorical Exclusion (CE-2) due to the anticipated amount of right-of-way, which is expected to exceed one half acre. The likely acquisition of more than one half acre of new right-of-way will prompt public involvement requirements, requiring at a minimum the advertisement of an opportunity for the public to request a hearing. Approval of the CE-2 is anticipated within 8-10 months due to the public involvement requirements.

A preliminary Red Flag Investigation was completed for the project area by Lochmueller Group. The project was screened using 46 Geographic Information System (GIS) layers in order to identify any potential environmental concerns located within the immediate vicinity of the project. The results of this preliminary review identified the following areas of concern.

- *Elevation Church* - This resource is located near the subject intersection, but according to Scott County GIS data, also owns undeveloped property in the southwest quadrant of the project. The undeveloped church property will likely be affected by the project. Coordination will occur with a representative of the church during the environmental process to identify any issues.
- *Pipeline* – Two (2) 6-inch natural gas pipelines, owned by Midwest Natural Gas Corporation, traverse the likely project area. During the development of the project, appropriate coordination with this utility will be required to determine any conflicts.

The National Register of Historic Places (NRHP) and the Indiana Register of Historic Sites and Structures (State Register) were reviewed using the State Historic Architectural and Archaeological Research Database (SHAARD) and the Indiana Historic Buildings, Bridges, and Cemeteries (IHBBC) Map. The results of this virtual review did not identify any properties listed or likely eligible (rated as Notable or Outstanding) for inclusion in the NRHP within the project area. Although, one property rated as Contributing is located north of the intersection. Contributing resources are not typically considered individually eligible for inclusion in the NRHP. As proposed, the project is likely to qualify as a Category B project under the Minor Projects Programmatic Agreement (MPPA) providing no archaeological resources are identified that are considered eligible for the NRHP. The application of the MPPA means formal Section 106 consultation will not be required.

Permits: Rule 5 approval from IDEM will be required as the project is expected to result in more than one acre of ground disturbance. Other permits, such as a Section 404 Permit and Section 401 Water Quality Certification may be required if the results of surveys identify Waters of the U.S. within the project area.



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Preliminary RFI Map

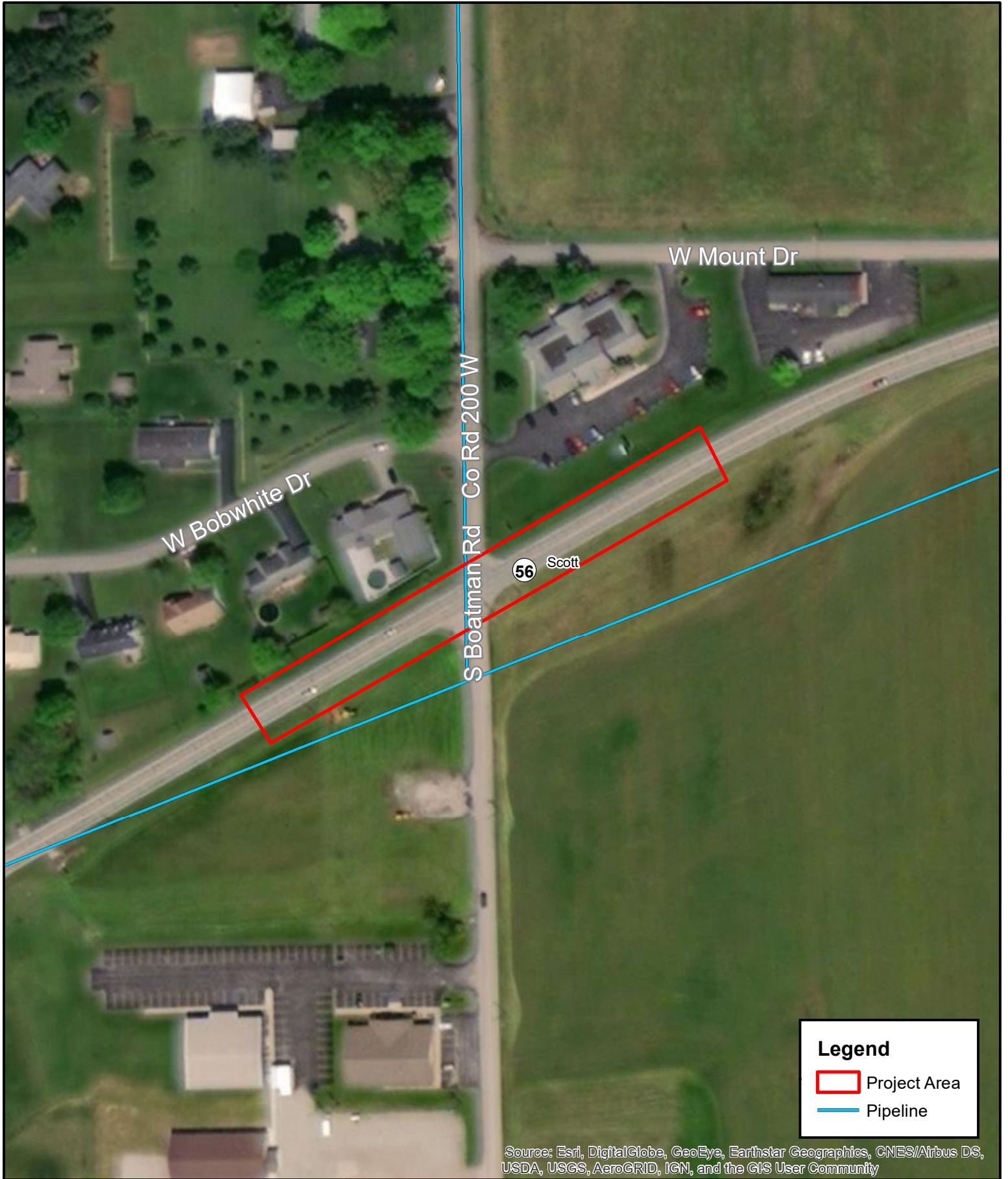
Des. No. 1800210



County: Scott
 Township: Vienna
 State: Indiana

Intersection Improvement Project
 SR 56 and Boatman Road
 Created: 10/18/2018, SBeaupre

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Legend

- Project Area
- Pipeline

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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Preliminary RFI Map
 Des. No. 1800210



County: Scott
 Township: Vienna
 State: Indiana

Intersection Improvement Project
 SR 56 and Boatman Road
 Created: 10/15/2018, SBeaupre

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APPENDIX F



**SR 56 at Boatman Road Roundabout
Des. No. 1800210
Scope of Services Meeting Summary
Seymour District
10 AM on December 6, 2018**

In attendance:

William Fortson – INDOT Project Manager – wfortson@indot.in.gov
Travis Mankin – Project Manager – tmankin@indot.in.gov
Jeremeih Shawn – Traffic Planning Engineer - jeshaw@indot.in.gov
Damon Brown – Acting Traffic Engineer - DaBrown@indot.in.gov
Greg Carleton - Consultant Services Manager - gcarleton@indot.in.gov
David Vorndran (via phone) – Senior Contract Engineer – dvondran@indot.in.gov

Shawn Strange, Consultant Project Manager, First Group Engineering, sstrange@firstgroupengineering.com
Jeff Brechbill, First Group Engineering, jbrechbill@firstgroupengineering.com

The following notes were transcribed from the project kick-off meeting:

- Project is scheduled for January, 2023 Letting
- Projected Construction Budget is \$1.884 million
- Scope of Work is to fix accident problem at intersection. The current intersection is in a reverse curve segment, and is at a skew with a 25 degree angle. 45% of the crashes are right angle crashes, and crash narratives have indicated a trend that drivers are not aware of the intersection. Crash narratives also indicate that drivers are unaware that the intersection is a two way stop rather than a four way stop when approaching from the northbound and southbound directions. A fatal crash and two incapacitating injury crashes have been recorded within the last three years, and the index of crash frequency rates at 3.21.
- There are no plans to add travel lanes to this section of SR 56.
- The accident rate has not been effectively reduced by the flasher at this location nor by speed bumps added by the county on the north approach or supplemental signs.
- According to FHWA Toolbox of Countermeasures and Crash Reduction Factors found at https://safety.fhwa.dot.gov/tools/crf/resources/fhwas08011/page2.cfm#linktarget_6 the best alternative is reconstructing the intersection is a roundabout. ROADHAT analysis also determined that a roundabout was the most cost-effective alternative to reduce accidents at this location.
- A SIDRA analysis was completed using projected traffic volumes, and it shows that a single lane roundabout will function at a LOS of B in the design year during the peak hour. This indicates that the roundabout will only need a single circulating lane.
- Given the ROADHAT, SIDRA, traffic data collection, and accident analysis already performed, Greg Carleton recommended First Group start by compiling the data in an abbreviated Engineer's Report that evaluates the best location for the circulating roadway with respect to utility impacts, private property impacts, and construction cost.
- First Group pointed out that there are potential reimbursable gas mains that may be expensive to relocate and therefore will need to be more accurately located to ensure the roundabout location does not incur significant utility reimbursement expenses as high-

pressure gas mains can cost hundreds of thousands of dollars to relocate. A limited SUE will be performed at the same time the survey is picked up during the engineering assessment phase of this contract.

- INDOT recognized that due to the high concentration of utilities at the intersection, we should look at adding a Subsurface Utility Engineering Subconsultant to do a SUE analysis for the abbreviated Engineer's Report. First Group also added that in order to determine if utilities are in an easement and therefore reimbursable, early coordination requesting any easement documentation will be necessary.
- INDOT will furnish First Group with 2017 traffic counts.
- INDOT wanted to close off Mount Road to SR 56 as the intersection angle is severely substandard and it would be safer to force that turning traffic to the roundabout to access SR 56.
- INDOT requested two coordination meetings prior to the project's public hearing. They would like one with first responders and the school and another with property owners/public. These would not be advertised and would be more informal than a typical public hearing. Public flyers, door hangers, and coordination with county officials will be necessary to include in the design phase of the contract.
- INDOT would like us to include a review of the horizontal curve to the east in the survey to ensure superelevation requirements are met at the end of the project.
- INDOT would like the drives/approaches near the roundabout evaluated for intersection sight distance. INDOT would like Bob White drive access possibly controlled via a turn lane/by-pass lane and/or splitter island prohibiting left turns out of the development if the roundabout is placed near this intersection. Other options may need to be reviewed during the EA phase on this contract as well.
- INDOT would like lighting at the roundabout and chicanes and RPM's approaching the chicanes if approved by the IDM.
- INDOT would like to use a posted speed limit of 45 mph for SR 56 as the existing speed limit changes from 50 to 55 about 250' west of Boatman. This may require stepping down the speed from the west.
- INDOT would like RPM's in advance of the roundabout on SR 56.
- INDOT would like an independent construction cost estimate be provided as part of the EA to verify the programmed construction cost is accurate.
- INDOT would like to try to avoid the pipe structure located about 550' west of the Boatman Road intersection. The structure does appear to have scour problems and may be undersized and need rip rap. The structure is less than 48" so it will be in the district maintenance logs and not in the INDOT BIAS System. INDOT could provide inspection reports but would replace as part of a maintenance contract if needed. First Group will check the hydraulic capacity of the existing structure and determine during design if the structure should be replaced.
- MOT – INDOT recommends against closing SR 56 for a temporary detour. There are no good alternate routes.
- The house at Boatman and mount may need to checked in the EA stage of the contract to ensure no Section 106 is required. INDOT can provide that review if requested by First Group.
- The church in the SW quadrant of the intersection did buy the land near the road recently for potential expansion. There are no known plans at this time for site improvements. Early coordination with locals my flesh out any potential site work. INDOT permits will

check for any pending drive work at this location. The county will know if anything is planned in the near future for this site.

- INDOT would like a preliminary and a final field check during the design of this project.
- The fee proposal will be due in late January and will be a PDF document emailed to Dave Vorndran and William Fortson.
- Fee to include SUE, Survey, and Engineering Assessment. Other services to be added via Supplemental Agreement.
- After visiting the site, it was determined that Ohio Valley Gas owned the high-pressure gas mains near the intersection of Boatman and SR 56. Their headquarters was located on the west site of Scottsburg where First Group met Kelly Shafer, a representative of Ohio Valley Gas who stated that the company had no easements for the gas mains located along SR 56 but may have one on Boatman Road and; therefore, were may not be reimbursable, but they would need to verify this. He also stated that the valve lids can be removed to see the top of the gate valves which are 6” higher than the lines indicating the depth at that location. After visiting the site, popping the top off the gate valve, it was discovered the valve was half full of water. Given limited probing in the water it was determined that the gas mains were most likely around 40” to 48” deep.

The following represent our understanding of the responsibilities for this project:

Services Provided by INDOT:

- Pavement Cores
- Pavement History
- Pavement Design
- R/W Services (except for R/W Engineering)
- Accidents
- Traffic Data & Traffic Projections
- Small Culvert Inspections
- Railroad Coordination

Services by FGE:

- Engineering Assessment
- Early Utility Coordination
- Survey
- SUE
- Geotechnical Investigation & Recommendations
- No Public Involvement as part of Engineering Assessment
- Coordination with Police, Fire, School during the design phase of the contract
- Utility Coordination
- R/W Engineering & Staking
- Title Search
- Categorical Exclusion
- Permits (Rule 5)
- Hydraulics – small structures
- Roadway Design / Maintenance of Traffic
- Public Hearing/Public Involvement

- Monthly Project Reports to William Fortson
- Signing Plans
- Lighting Plans

Summary of Meeting provided by: Shawn H. Strange



Looking West at Intersection from East



Looking South at Intersection from North



Looking North at Intersection from South



Looking East at Intersection from West



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Field Inspection Agenda
 State Route 56 and Boatman Roundabout
 Des 1800210
 Fiscal Year of Letting: 2023

1. Design

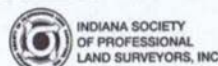
- Roundabout Location – Preferred Alternate (Need state’s approval of Option 1 – Circulating Roadway Southeast of existing intersection). This alternate limits impacts to properties on the north and west sides of the intersection.
- Speed Reduction – Our Preferred design for the SR 56 approaches use a design speed of 45 mph which is less than the 50-mph posted speed limit. The Boatman Road approaches use a design speed of 35 mph even though the roadway does not have a posted speed; therefore, its 55 mph. Will INDOT require a design exception? We’re trying to discourage speeding, so our thought is that the limiting geometry will give enough visual queues to the approaching driver that they will immediately start to slow down enough to yield at the circulating roadway.
- Project tie-in limits are further back than originally anticipated due to high speed approach design requiring quite a bit of length for the splitter islands to encourage deceleration. A 55-mph design speed for the approaches will actually extend the splitter island another 90 ft each direction along SR 56. If a 55-mph design speed were used for full deceleration on Boatman Road, it would extend the north-south approaches another 300 ft. Given the tighter property lines and other impacts such as potential Section 106 issues with the historic house located just northwest of the intersection of Mount Dr. and Boatman Rd., we decided on utilizing a lower design speed for the Boatman Road approaches to limit construction impacts.
- Closure of Mount Drive at SR 56. At this time, this intersection is outside the limits of this roundabout project and thus not included in this project at this time. The roadway is used as a short cut to northbound Boatman Road and sees high speed traffic coming off of westbound SR 56. This intersection is at such a poor skew that almost all traffic from Boatman utilize the main intersection at SR 56 to turn east (instead of this short cut). At this time, this project will not impact this intersection and will not be included with this project unless INDOT decides to expand the scope of the project to close this intersection due to safety concerns.

2. Drainage

- The proposed design utilizes curb and gutter to create visual queues to slow down as the lane looks narrower at the splitter island. Since there is no need for sidewalk, our proposed design will utilize curb turnouts to side ditches behind the curb to drain the project location. Pipes will be used to mover water from the east to the west and eventually the stream that

STREETS – HIGHWAYS – TRAFFIC – STRUCTURES – WATER – SEWER – SURVEYING – RIGHT-OF-WAY SERVICES

ACTIVE MEMBERSHIPS:





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crosses under SR 56 approximately 500 ft west of Boatman Road. The proposed outfall for the project is also a good location for an engineered stormwater control structure or sediment basin.

3. Property Impacts

- High Speed Characteristics of Boatman Rd were minimized and to a lesser extent on SR 56 to mitigate impacts to the surrounding properties including:
 - One potential Historic 106 Property
 - Church Property Access
 - Minimize Impacts to Properties on County Road

4. Utilities

- Midwest Natural Gas Corporation (Gas) – High Pressure Gas is most likely non-reimbursable and will require relocation
- Frontier (Telephone) is most likely non-reimbursable and will require relocation
- Insight Communications (Cable TV) is most likely non-reimbursable and will require relocation
- Jackson County R.E.M.C. (Electric) is most likely non-reimbursable and will require relocation
- City of Scottsburg (Water, Electric and Sewer) is most likely non-reimbursable and will require relocation
- Stucker Fork Water Utility (Water) is most likely non-reimbursable and will require relocation

5. Existing Drainage

- 24 inch CMP 550ft west of intersection – The proposed design will require that this structure either be replaced or extended. After field inspection, the existing structure is in good enough condition to be extended.
- 12-inch CMP 350ft south of intersection. Given the condition of this structure, the proposed design will require that this structure be replaced.
- 12-inch CMP northside ditch at intersection. Given the condition of this structure, the proposed design will require that this structure be replaced.

6. ROW Acquisition

12 parcels – 3 Residential, 3 Agricultural and 6 Business (including Church)

Contributing House (Historic)

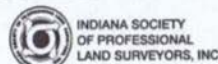
Elevation Church Parcels (2)

Relocating Church LCD Billboard (Damages)

One Additional Parcel will be needed if the Mount Drive approach to SR 56 is closed off as a cul-de-sac or simple turn-around will require one additional parcel (from the property needing access)

STREETS – HIGHWAYS – TRAFFIC – STRUCTURES – WATER – SEWER – SURVEYING – RIGHT-OF-WAY SERVICES

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7. Construction MOT

Allowed to close Boatman Road? At this time we are proposing to maintain traffic only on SR 56 and close access to Boatman Road during construction to expedite the completion of the project. Alternate routes will be local. Temporary Pavement will be used to maintain traffic for SR 56 during construction.

8. Project Information

- a. Construction Budget - \$ 1.8 million
- b. Construction Year – FY 2023
- c. Stage 1 Plans Due 12/6/19

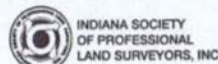
The following notes were transcribed from the meeting:

- The preferred alternative will require acquiring right-of-way from 12 parcels. The closing of Mount Drive will require right-of-way acquisition from one more parcel if added. The cul-de-sac design required for closing Mount Drive will have to avoid a large tree and the primary driveway used to access the residence.
- Elevation Church has plans to build a structure. Discussed coordinating with architect to limit conflicts with new structure and proposed road design. Proposed road design will limit placement of access to Elevation Church’s parcels.
- The 50-55 mph posted speed limit on SR 56 dictates the use of high-speed approaches for the roundabout. The high-speed approaches require a splitter island approximately 350 ft long.
- There is a contributing house located on Boatman Rd., north leg. Contributing resources typically do not affect the environmental document.
- Boatman Road does not have a posted speed limit. Being that Boatman Road is county road located outside urban district, the maximum speed limit is 55 mph. The 55mph speed limit would require high-speed approaches for the north and south legs of Boatman Road. Shorting Boatman’s Road approach legs will reduce the proposed right-of-way. The question was about using a design exception for Boatman Road or reducing the design speed limit. Ask Damon Brown and Jeremeih Shawn about design speed limit for Boatman Rd.
- State Route 56 will use temporary pavement to maintain traffic during construction. Mount Drive could be used as a detour route for north leg of Boatman Rd.
- First Group met with Midwest Natural Gas. Midwest Natural Gas does not believe a gas easement is owned within the project limits.
- William Fortson requested design year traffic counts for First Group Engineering.
- First Group will submit the Engineering Report based on current design assumptions and will revise based on input from INDOT.

Summary provided by: Tim Suber

STREETS – HIGHWAYS – TRAFFIC – STRUCTURES – WATER – SEWER – SURVEYING – RIGHT-OF-WAY SERVICES

ACTIVE MEMBERSHIPS:



APPENDIX G

Design Speed (mph)	Intersection Sight Distance For Passenger Car	
	Calculated (ft)	Design (ft)
15	143.3	145
20	191.1	195
25	238.9	240
30	286.7	290
35	334.4	335
40	382.2	385
45	430.0	430
50	477.8	480
55	525.5	530
60	573.3	575
65	621.1	625
70	668.9	670

Note: Intersection sight distance shown is for a stopped passenger car to turn right onto or cross a two-lane highway with no median and grades of 3% or flatter. For other conditions, the time gap should be adjusted and the required sight distance recalculated.

**INTERSECTION SIGHT DISTANCE FOR PASSENGER CAR
TO TURN RIGHT FROM A STOP OR TO MAKE A CROSSING MANEUVER**

Figure 46-10H

V_{major} (mph)	Passenger Car				Single-Unit Truck		Combination Truck	
	Local Road		Collector or Arterial		t_g (s)	ISD (ft)	t_g (s)	ISD (ft)
	t_g (s)	ISD (ft)	t_g (s)	ISD (ft)				
15	7.5	170	7.5	170	9.5	210	11.5	260
20	7.5	220	7.5	220	9.5	280	11.5	340
25	7.5	280	7.5	280	9.5	350	11.5	430
30	7.5	330	7.5	330	9.5	420	11.5	510
35	7.5	390	7.5	390	9.5	490	11.5	600
40	7.5	440	7.5	440	9.5	560	11.5	680
45	7.5	500	7.5	500	9.5	630	11.5	760
50	7.5	550	8.5	630	10.5	780	12.5	920
55	7.5	610	9.0	730	11.0	890	13.0	1060
60	7.5	670	9.5	840	11.5	1020	13.5	1190
65	7.5	720	10.0	960	12.0	1150	14.0	1340
70	7.5	780	10.0	1030	12.0	1240	14.0	1440

V_{major} = Design speed of major road

t_g = Time gap for minor road vehicle to enter major road

ISD = Intersection sight distance (length of leg of sight triangle along major road)

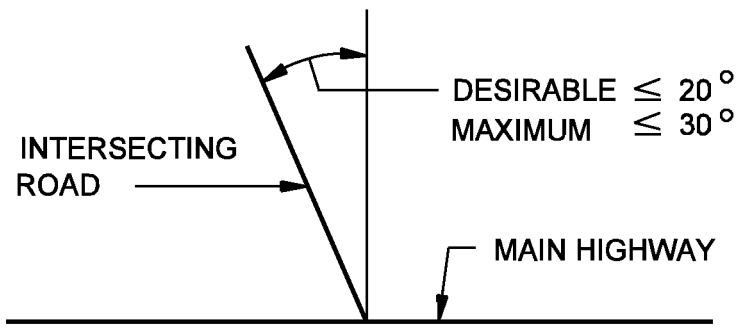
ISD is shown for a stopped vehicle to turn left onto a two-lane highway with approach grades of 3% or flatter. For other conditions, the time gap should be adjusted and the required ISD recalculated using the formula $ISD = 1.47 V_{major} t_g$.

For a left turn onto a two-way highway with more than two lanes, add 0.5 s for a passenger car, or 0.7 s for a truck for each additional lane from the left in excess of one, to be crossed by a turning vehicle.

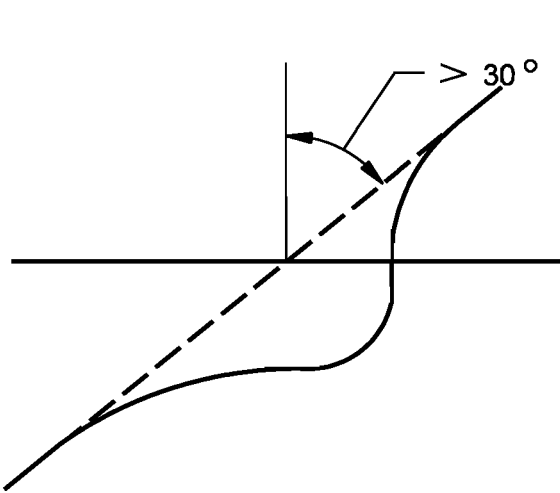
For the minor-road approach, if its grade is an upgrade that is steeper than 3%, add 0.2 s for each percent grade for a left turn. The adjustment for the minor-road approach grade is required only if the rear wheels of the design vehicle would be on an upgrade steeper than 3%.

INTERSECTION SIGHT DISTANCE FOR STOP-CONTROLLED INTERSECTION

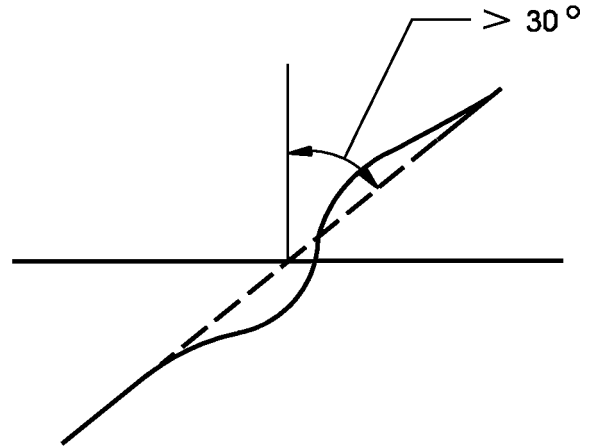
Figure 46-10G



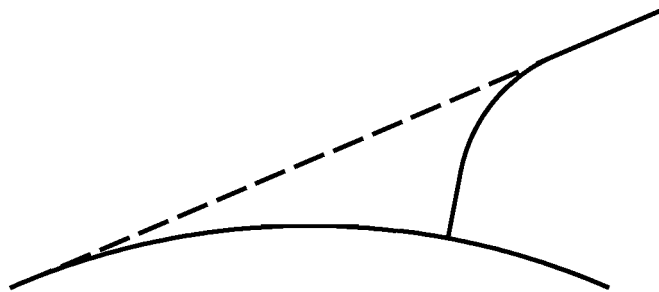
-A-



-B-



-C-



-D-

TREATMENTS FOR SKEWED INTERSECTIONS

Figure 46-1A

APPENDIX H

Safety



Desktop Reference for Crash Reduction Factors

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Tables for Intersection Crash Reduction Factors

Table 1. Signalization Countermeasures

Countermeasures	Crash Type	Crash Severity	Area Type	Config	Control	Major Daily Traffic Volume (veh/day)	Minor Daily Traffic Volume (veh/day)	Ref	Obs	Effectiveness			Study Type
										Crash Reduction Factor/Function	Std Error	Range Low/High	
Signal Operations Countermeasures													
Add all-red clearance interval	All	All			Signal			15	15				Cross-section
	Right-angle	All			Signal			15	30				Cross-section
Add all-red clearance interval (from 0 to 1 second)	Right-angle	All	Urban		Signal			47	6	0	44	-32	67
Add exclusive pedestrian phasing	Ped	All			Signal			28	34			7	60
Convert exclusive leading protected to exclusive lagging protected	All	All			Signal			25	-15		19		Simple Before-After
	Left-turn	All			Signal			25	-49		54		Simple Before-After
Convert protected left-turn phase to protected/permissive	All	All			Signal			25	-20		17		Comparison Group Before After
	All	Fatal/Injury			Signal			25	-10		25		Comparison Group Before After
	Left-turn	All			Signal			25	-65		71		Comparison Group Before After
	Rear-end	All			Signal			25	4		22		Comparison Group Before After
Convert protected/permissive left-turn phase to permissive/protected	All	All			Signal			29	13		19		Simple Before-After
	Left-turn	All			Signal			29	33		22		Simple Before-After
Improve signal timing [to intervals specified by the ITE <i>Determining Vehicle Change Intervals: A Proposed Recommended Practice</i> (1985)]	All	All		4-leg	Signal			49	8		9		Experimental Design (Case-Control Study)
	All	All		4-leg	Signal			39	20	18			Experimental Design (Case-Control Study)
	All	Fatal/Injury		4-leg	Signal			49	12		9		Experimental Design (Case-Control Study)
	Head-on	Fatal/Injury			Signal			15	75				Simple Before-After
	Left-turn	All			Signal			15	75				
	Left-turn	Fatal/Injury			Signal			15	55				Simple Before-After
	Left-turn	PDO			Signal			15	63				Simple Before-After
	Multi-vehicle	All	All		Signal			21	40	5			Comparison Group Before After
	Multi-vehicle	Fatal/Injury	All		Signal			21	40	9			Comparison Group Before After
	ROR	Fatal/Injury			Signal			15	62				Simple Before-After
	ROR	PDO			Signal			15	28				Simple Before-After
	Older-driver	All		4-leg	Signal			39	20	42			Experimental Design (Case Control Study)
	Rear-end	All		4-leg	Signal			49	-12		16		Experimental Design (Case Control Study)
	Rear-end	Fatal/Injury		4-leg	Signal			49	-8		17		Experimental Design (Case Control Study)
	Rear-end	PDO			Signal			15	17				Simple Before-After

	Right-angle	All		4-leg	Signal			49	4		18			Experimental Design (Case Control Study)
	Right-angle	Fatal/Injury			Signal			15	30					Simple Before-After
	Right-angle	Fatal/Injury		4-leg	Signal			49	-6		22			Experimental Design (Case Control Study)
	Right-angle	PDO			Signal			15	46					Simple Before-After
	Ped	Fatal/Injury			Signal			49	37					Comparison Group Before After
Increase yellow change interval	All	All			Signal			15	15					Cross-section
	Right-angle	All			Signal			15	30					Cross-section
Install emergency vehicle pre-emption systems	Emerg vehicle	All						51	70					
Install pedestrian countdown signal heads	Ped	Fatal/Injury	Urban (San Francisco)		Signal			32	25					
Install pedestrian signal	All	All			Signal			15	20					
	All	All						15	25					
	All	All						15	15					
	Ped	All			Signal			15	53					
	Ped	All			Signal			5	0					
	Ped	All						15	55					
	Ped	All						15	50					
Modify signal phasing (implement a leading pedestrian interval)	Ped	All			Signal			28	5					
Provide actuated signals	Left-turn	All			Signal			15	80					Cross-section
	Right-angle	All			Signal			15	10					Cross-section
Provide Advanced Dilemma Zone Detection for rural high speed approaches	All	Fatal/Injury	Rural	4-leg (1 app)	Signal			61	5	39				Simple Before-After
Provide protected left turn phase	All	All			Signal	<5,000/lane (Total)		15	30					Simple Before-After
	All	All			Signal	<5,000/lane (Total)		15	36					Simple Before-After
	All	All			Signal			15	15					Simple Before-After
	All	All			Signal			15	25					Cross-section
	All	All			Signal			15	30					Simple Before-After
	All	All			Signal			15	27					
	Left-turn	All			Signal	<5,000/lane (Total)		15	41					Simple Before-After
	Left-turn	All			Signal	>5,000/lane (Total)		15	46					Simple Before-After
	Left-turn	All			Signal			15	35					Simple Before-After
	Left-turn	All			Signal			15	70					Cross-section
	Left-turn	All			Signal			15	48					
	Left-turn	Fatal/Injury	Urban		Signal			31	30	16	2			EB Before-After
	Right-angle	Fatal/Injury	Urban		Signal			31	30	19	2			EB Before-After
	Overturn	All			Signal	<5,000/lane (Total)		15	27					Simple Before-After
	Overturn	All			Signal	>5,000/lane (Total)		15	35					Simple Before-After
	Overturn	All			Signal			15	31					
	Ped	All			Signal			28	5					
	Rear-end	All			Signal	<5,000/lane (Total)		15	27					Simple Before-After
	Rear-end	All			Signal	>5,000/lane (Total)		15	35					Simple Before-After
	Rear-end	All			Signal			15	31					
	Right-angle	All			Signal	<5,000/lane (Total)		15	54					Simple Before-After
	Right-angle	All			Signal	>5,000/lane (Total)		15	56					Simple Before-After
	Right-angle	All			Signal			15	80					Simple Before-After
	Right-angle	All			Signal			15	63					
Provide protected/permissive left-turn phase (leading flashing green) (Request MUTCD Experimentation)	Left-turn	Fatal/Injury	Urban		Signal			31	15	16	4			EB Before-After
	Right-angle	Fatal/Injury	Urban		Signal			31	15	12	4			EB Before-After
Provide protected left-turn phase (leading green arrow)	Left-turn	Fatal/Injury	Urban		Signal			31	20	17	2			EB Before-After
	Right-angle	Fatal/Injury	Urban		Signal			31	20	25	2			EB Before-After
Provide signal coordination	All	All	All		Signal			1	15					
	All	All			Signal			28	16					
	All	All	Arizona		Signal			3	7					
	Right-angle	All			Signal			28	32		25	38		
Provide split phases	All	All			Signal			28	25					
Remove flash mode (late night/early morning)	All	All			Signal			28	29					
	Right-angle	All			Signal			47	17	75	19	29	100	Simple Before-After
	Right-angle	All			Signal			28	80					
Replace existing WALK/DON'T WALK signals with pedestrian countdown signal heads	Ped	All	Urban (San		Signal			32	25					

	Overturn	All		No signal	<5,000/lane (Total)	15	22					Simple Before-After	
	Overturn	All		No signal	>5,000/lane (Total)	15	20					Simple Before-After	
	Rear-end	All		No signal	<5,000/lane (Total)	15	22					Simple Before-After	
	Rear-end	All		No signal	>5,000/lane (Total)	15	20					Simple Before-After	
	Rear-end	Fatal/Injury	Urban	3-leg	Stop	11,750-42,000	900-4,000	34	-50		51	EB Before-After	
	Rear-end	Fatal/Injury	Urban	4-leg	Stop	12,650-22,400	2,400-3,625	34	-38		39	EB Before-After	
	Right-angle	All		No signal	<5,000/lane (Total)	15	74					Simple Before-After	
	Right-angle	All		No signal	>5,000/lane (Total)	15	43					Simple Before-After	
	Right-angle	All		No signal		15	58						
	Right-angle	All		No signal		15	60					Simple Before-After	
	Right-angle	All		No signal		15	42					Simple Before-After	
	Right-angle	All		No signal		15	65					Cross-section	
	Right-angle	All		No signal		15	65					Simple Before-After	
	Right-angle	All		No signal		28	68						
	Right-angle	All		No signal		47	8	74		66	56	100	Simple Before-After
	Right-angle	Fatal/Injury	Urban	3-leg	Stop	11,750-42,000	900-4,000	34	34		45		EB Before-After
	Right-angle	Fatal/Injury	Urban	4-leg	Stop	12,650-22,400	2,400-3,625	34	67		20		EB Before-After
	All	PDO		No signal		43	447	-15					Simple Before-After
Install signals (temporary)	Head-on	PDO		No signal		15	83						Simple Before-After
	Left-turn	PDO		No signal		15	11						Simple Before-After
	Right-angle	Fatal/Injury		No signal		15	39						Simple Before-After
	Right-angle	PDO		No signal		15	73						Simple Before-After
	Sideswipe	Fatal/Injury		No signal		15	50						Simple Before-After
Install signals (to have one over each approach lane)	Right-angle	All	All			35	46						Simple Before-After
Remove unwarranted signals	All	All		Signal		15	75						
	All	All		Signal		15	100						Simple Before-After
	All	All		Signal		15	50						Cross-section
	All	All		Signal		15	75						Simple Before-After
	All	All		Signal		28	52			50	53		
	All	All	Urban	Signal		21	199	24					EB Before-After
	All	Fatal/Injury	Urban	Signal		21	199	53					EB Before-After
	All	PDO	Urban	Signal		21	199	24					EB Before-After
	Day	All	Urban	Signal		21	199	22					EB Before-After
	Fixed object	All	Urban	Signal		21	199	31					EB Before-After
	Night	All	Urban	Signal		21	199	30					EB Before-After
	Rea-end	All		Signal		15	95			90	100		
	Rear-end	All		Signal		15	100						Simple Before-After
	Rear-end	All		Signal		15	90						Cross-section
	Rear-end	All	Urban	Signal		21	199	29					EB Before-After
	Right-angle	All	Urban	Signal		21	199	24					EB Before-After
Replace signal lenses with optical lenses	All	All		Signal		28	17			15	18		
	All	All		Signal		15	15						
	All	All		Signal		15	15						Cross-section
	Head-on	All		Signal		15	20						Cross-section
	Left-turn	All		Signal		15	10						Cross-section
	Rear-end	All		Signal		15	10						Cross-section
	Right-angle	All		Signal		15	10						Cross-section
COMBINATION SIGNAL AND OTHER COUNTERMEASURES													
Install left-turn lane and add turn phase	All	All		Signal		28	58			46	69		
Install signals and add channelization	Head-on	PDO		No signal		15	27						Simple Before-After
	Left-turn	PDO		No signal		15	24						Simple Before-After
	ROR	Fatal/Injury		No signal		15	35						Simple Before-After
	Right-angle	Fatal/Injury		No signal		15	67						Simple Before-After
	Right-angle	PDO		No		15	63						Simple

	Sideswipe	Fatal/Injury			signal														Before-After Simple Before-After
					No signal			15	54										
LEFT-TURN COUNTERMEASURES																			
Add indirect left-turn treatments to minimize conflicts																			
All	All				Stop	>34,000		59	18		8								Cross-section
All	All				Stop	>34,000 4 lanes		59	-24		35								Cross-section
All	All				Stop	>34,000 6 lanes		59	26		8								Cross-section
All	All				Stop	>34,000 8 lanes		59	24		63								Cross-section
All	Fatal/Injury				Stop	>34,000		59	27		12								Cross-section
All	PDO				Stop	>34,000		59	6		11								Cross-section
Create directional median openings to allow left-turns and u-turns																			
All	All				Signal			51	51										
Install left-turn lane																			
All	All	All						1	25										
All	All	Rural	3-leg	Signal	4,200-26,000	1,300-11,400	22	199	15										Expert Panel
All	All	Rural	3-leg	Stop	1,100-32,400	25-11,800	22	44		6									EB Before-After
All	All	Rural	4-leg (app)	Signal	4,200-26,000	1,300-11,400	22	199	18										Expert Panel
All	All	Rural	4-leg (1 app)	Stop	1,100-32,400	25-11,800	22	28		3									EB Before-After
All	All	Rural	4-leg (2 app)	Stop	1,100-32,400	25-11,800	22	48		3									EB Before-After
All	All				No signal			15	34										
All	All				No signal			15	35										Simple Before-After
All	All				No signal			15	35										Cross-section
All	All				No signal			15	25										Simple Before-After
All	All				No signal			15	40										Simple Before-After
All	All				No signal			28	33		25	41							
All	All	Urban	3-leg	Signal	4,600-55,100	100-26,000	22	199	7										Expert Panel
All	All	Urban	3-leg	Stop	1,520-40,600	80-8,000	22	33		12									EB Before-After
All	All	Urban	4-leg (1 app)	Signal	4,600-55,100	100-26,000	22	10		10									EB Before-After
All	All	Urban	4-leg (1 app)	Stop	1,520-40,600	80-8,000	22	27		3									EB Before-After
All	All	Urban	4-leg (2 app)	Signal	4,600-55,100	100-26,000	22	19		13									EB Before-After
All	All	Urban	4-leg (2 app)	Stop	1,520-40,600	80-8,000	22	47		4									EB Before-After
All	Fatal/Injury	Rural	3-leg	Stop	1,100-32,400	25-11,800	22	55		8									EB Before-After
All	Fatal/Injury	Rural	4-leg (1 app)	Stop	1,100-32,400	25-11,800	22	35		3									EB Before-After
All	Fatal/Injury	Rural	4-leg (2 app)	Stop	1,100-32,400	25-11,800	22	58		4									EB Before-After
All	Fatal/Injury	Urban	4-leg (1 app)	Signal	4,600-55,100	100-26,000	22	9		1									EB Before-After
All	Fatal/Injury	Urban	4-leg (1 app)	Stop	1,520-40,600	80-8,000	22	29		4									EB Before-After
All	Fatal/Injury	Urban	4-leg (2 app)	Signal	4,600-55,100	100-26,000	22	17		2									EB Before-After
All	Fatal/Injury	Urban	4-leg (2 app)	Stop	1,520-40,600	80-8,000	22	50		6									Comparison Group
All	Fatal/Injury	All	All	All				58	30										
Left-turn	All	Rural	3-leg	Stop	1,100-32,400	25-11,800	21	35	62										Comparison Group Before After
Left-turn	All	Rural	4-leg (1 app)	Stop	1,100-32,400	25-11,800	21	23	37										EB Before-After
Left-turn	All	Rural	4-leg (2 app)	Stop	1,100-32,400	25-11,800	21	23	60										EB Before-After
Left-turn	All				No signal			15	55										
Left-turn	All				No signal			15	55										Simple Before-After
Left-turn	All				No signal			28	68		50	86							
Left-turn	All				Signal	>5,000/lane (Total)		15	24										Simple Before-After
Left-turn	All	Urban	4-leg (1 app)	Signal	4,600-55,100	100-26,000	21	35	13										Yorked Comparison Before-After
Left-turn	All	Urban	4-leg (1 app)	Stop	1,520-40,600	80-8,000	21	7	26										EB Before-After
Left-turn	All	Urban	4-leg (2 app)	Signal	4,600-55,100	100-26,000	21	35	24										Yorked Comparison Before-After
Left-turn	All	Urban	4-leg (2 app)	Stop	1,520-40,600	80-8,000	21	7	45										EB Before-After
Night	All				Signal	>5,000/lane (Total)		15	28										Simple Before-After
Overturn	All				Signal	>5,000/lane (Total)		15	28										Simple Before-After
Install left-turn lane (double)																			
Heads-on	Fatal/Injury							15	75										Simple Before-After
Left-turn	Fatal/Injury							15	47										Simple Before-After

	Left-turn	PDO					15	71					Simple Before-After
	ROR	Fatal/Injury					15	8					Simple Before-After
	ROR	PDO					15	13					Simple Before-After
	Rear-end	Fatal/Injury					15	29					Simple Before-After
	Rear-end	PDO					15	32					Simple Before-After
	Right-angle	Fatal/Injury					15	20					Simple Before-After
	Right-angle	PDO					15	8					Simple Before-After
	Sideswipe	Fatal/Injury					15	50					Simple Before-After
Install left-turn lane (painted separation)	All	All				<5,000/lane (Total)	15	50					Simple Before-After
	All	Fatal/Injury	Rural	3-leg		5,000-15,000	13	22		14			Meta-analysis
	All	Fatal/Injury	Rural	4-leg		5,000-15,000	13	-28		27			Meta-analysis
	All	PDO	Rural	3-leg		5,000-15,000	13	20		19			Meta-analysis
	All	PDO	Rural	4-leg		5,000-15,000	13	26		12			Meta-analysis
	Left-turn	All				<5,000/lane (Total)	15	57					Simple Before-After
	Left-turn	All				>5,000/lane (Total)	15	35					Simple Before-After
	Overturn	All				<5,000/lane (Total)	15	54					Simple Before-After
	Overturn	All				>5,000/lane (Total)	15	39					Simple Before-After
	Rear-end	All				<5,000/lane (Total)	15	54					Simple Before-After
	Rear-end	All				>5,000/lane (Total)	15	39					Simple Before-After
	Right-angle	All				<5,000/lane (Total)	15	62					Simple Before-After
	Right-angle	All				>5,000/lane (Total)	15	49					Simple Before-After
Install left-turn lane (physical channelization)	All	All	All		No signal		1	35					
	All	All	All		Signal		1	25					
	All	All	Rural	3-leg	No signal		28	44					
	All	All	Rural	4-leg (1 app)	No signal		28	28					
	All	All		4-leg (2 app)	No signal		28	42					
	All	All				<5,000/lane (Total)	15	51					Simple Before-After
	All	All				>5,000/lane (Total)	15	19					Simple Before-After
	All	All	Urban	3-leg	No signal		28	33					
	All	All	Urban	4-leg (1 app)	No signal		28	27					
	All	Fatal/Injury	Rural	3-leg		5,000-15,000	13	27		13			Meta-analysis
	All	Fatal/Injury	Rural	4-leg		5,000-15,000	13	4		12			Meta-analysis
	All	PDO	Rural	3-leg		5,000-15,000	13	-20		23			Meta-analysis
	All	PDO	Rural	4-leg		5,000-15,000	13	16		22			Meta-analysis
	Left-turn	All				<5,000/lane (Total)	15	24					Simple Before-After
	Left-turn	All				>5,000/lane (Total)	15	24					Simple Before-After
	Left-turn	Fatal/Injury					15	50					Simple Before-After
	ROR	PDO					15	50					Simple Before-After
	Overturn	All				<5,000/lane (Total)	15	50					Simple Before-After
	Overturn	All				>5,000/lane (Total)	15	28					Simple Before-After
	Rear-end	All				<5,000/lane (Total)	15	50					Simple Before-After
	Rear-end	All				>5,000/lane (Total)	15	28					Simple Before-After
	Rear-end	Fatal/Injury					15	11					Simple Before-After
	Rear-end	PDO					15	56					Simple Before-After
	Right-angle	All				<5,000/lane (Total)	15	68					Simple Before-After
	Right-angle	All				>5,000/lane (Total)	15	55					Simple Before-After
	Right-angle	Fatal/Injury					15	58					Simple Before-After
	Right-angle	PDO					15	54					Simple Before-After
Install left-turn lane (signal has left-turn phase)	All	All			Signal		28	31		25	36		
	All	All			Signal		51	35					
	Left-turn	All			Signal		28	44		43	45		
	Older-driver head on	All		4-leg	Signal		39	13	73				

	Younger-driver head on	All		4-leg	Signal			39	13	63							
Install left-turn lane (signal has no turn phase)	All	All			Signal			28		23			21	25			
	Left-turn	All			Signal			28		50			46	54			
Install left-turn lane (with channelization and existing left-turn phase)	All	All			Signal			15		35							
	All	All			Signal			15		35							Simple Before-After
	All	All			Signal			15		35							Cross-section
Install left-turn lane (with channelization and no left-turn phase)	All	All						15		15							
	All	All						15		15							Simple Before-After
	All	All						15		15							Cross-section
Install left-turn lane (within existing curbs)	All	All			Signal			28		26							
	Left-turn	All			Signal			28		66							
Install left-turn refuge within flush median	All	All				<5,000/lane (Total)		15		24							Simple Before-After
	All	All				>5,000/lane (Total)		15		44							Simple Before-After
	Head-on	All				>5,000/lane (Total)		15		52							Simple Before-After
	Left-turn	All				>5,000/lane (Total)		15		77							Simple Before-After
	Overturn	All				<5,000/lane (Total)		15		44							Simple Before-After
	Overturn	All				>5,000/lane (Total)		15		40							Simple Before-After
	Rear-end	All				<5,000/lane (Total)		15		44							Simple Before-After
	Rear-end	All				>5,000/lane (Total)		15		40							Simple Before-After
	Sideswipe	All				>5,000/lane (Total)		15		52							Simple Before-After
Remove left-turn lane	All	All	Rural	3-leg	Signal			6		-18							
	All	All	Rural	4-leg (1 app)	Signal			6		-22							
	All	All	Rural	4-leg (2 app)	Signal			6		-49							
	All	All	Urban	3-leg	Signal			6		-8							
	All	All	Urban	3-leg	Stop			6		-49							
	All	All	Urban	4-leg (1 app)	Signal			6		-11							
	All	All	Urban	4-leg (1 app)	Stop			6		-37							
	All	All	Urban	4-leg (2 app)	Signal			6		-23							
	All	All	Urban	4-leg (2 app)	Stop			6		-88							
	All	Fatal/Injury	Rural	3-leg	Signal			6		-16							
	All	Fatal/Injury	Rural	4-leg (1 app)	Signal			6		-21							
	All	Fatal/Injury	Rural	4-leg (2 app)	Signal			6		-45							
	All	Fatal/Injury	Urban	3-leg	Signal			6		-6							
	All	Fatal/Injury	Urban	3-leg	Stop			6		-53							
	All	Fatal/Injury	Urban	4-leg (1 app)	Signal			6		-10							
	All	Fatal/Injury	Urban	4-leg (1 app)	Stop			6		-41							
	All	Fatal/Injury	Urban	4-leg (2 app)	Signal			6		-21							
	All	Fatal/Injury	Urban	4-leg (2 app)	Stop			6		-98							
RIGHT-TURN COUNTERMEASURES																	
Increase length of right-turn lane	All	Fatal/Injury	All	All	All			58		15							
Install right-turn lane	All	All	All	4-leg (1 app)	Signal	4,200-55,100	100-26,000	22		4			2				EB Before-After
	All	All	All	4-leg (1 app)	Stop	1,100-40,600	25-11,800	22		14			5				EB Before-After
	All	All	All	4-leg (2 app)	Signal	4,200-55,100	100-26,000	22		8			3				EB Before-After
	All	All	All	4-leg (2 app)	Stop	1,100-40,600	25-11,800	22		26			7				EB Before-After
	All	All	All	All	All			58		35							
	All	All	All					1		25							
	All	All	Rural	4-leg (1 app)	Signal			28		14							
	All	All	Rural	4-leg (1 app)	No signal			28		21			14	27			
	All	All	All	All	No signal			28		27			24	30			
	All	All	All					15		25							
	All	All	All					15		25							Cross-section
	All	All	All					15		25							Simple Before-After
	All	All	All					15		25							Simple Before-After
	All	Fatal/Injury	All	4-leg (1 app)	Signal	4,200-55,100	100-26,000	22		9			3				EB Before-After
	All	Fatal/Injury	All	4-leg (1 app)	Stop	1,100-40,600	25-11,800	22		23			7				EB Before-After
	All	Fatal/Injury	All	All	No signal			58		35							
	All	Fatal/Injury	All	All	Signal			58		35							
	All	Fatal/Injury	All	All				51		40							

	All	Fatal/Injury/Rural	All	All			58	35					
	All	Fatal/Injury/Urban	All	All			58	30					
	Rear-end	All					15	65					Simple Before-After
	Right-angle	All					15	50					Simple Before-After
	Right-turn	All					15	53					
	Right-turn	All					15	56					Simple Before-After
	Right-turn	All					15	50					Cross-section
	Sideswipe	All					15	20					Simple Before-After
Install right-turn lane (painted separation)	All	Fatal/Injury/All	All	All			58	30					
Install right-turn lane (physical channelization)	All	Fatal/Injury/All	All	All			58	35					

Table 2. Geometric Countermeasures

Countermeasures	Crash Type	Crash Severity	Area Type	Config	Control	Major		Minor		Ref	Obs	Effectiveness			Study Type		
						Daily Traffic Volume (veh/day)		Daily Traffic Volume (veh/day)				Crash Reduction Factor/Function	Std Error	Range Low High			
OTHER GEOMETRIC COUNTERMEASURES																	
Convert four-leg to two T-intersections	All	All		4-leg	No signal					28	57						
	All	Fatal/Injury	Urban	4-leg		<70%*	>30%*	13	33			6		Meta-analysis			
	All	Fatal/Injury	Urban	4-leg		>85%*	<15%*	13	-35			15		Meta-analysis			
	All	Fatal/Injury	Urban	4-leg		70-85%*	15-30%*	13	25			5		Meta-analysis			
	All	PDO	Urban	4-leg		<70%*	>30%*	13	10			5		Meta-analysis			
	All	PDO	Urban	4-leg		>85%*	<15%*	13	-15			6		Meta-analysis			
	All	PDO	Urban	4-leg		70-85%*	15-30%*	13	0			5		Meta-analysis			
Convert intersection to roundabout	All	All	All		All					50	55	35		3	EB Before-After		
	All	All	All		Signal					50	9	48		5	EB Before-After		
	All	All	All		Signal					21	23	40			EB Before-After		
	All	All	All		Stop (2-way)					50	36	44		4	EB Before-After		
	All	All	All		Stop (4-way)					50	10	-3		15	EB Before-After		
	All	All	Rural	1-lane	Stop (2-way)					50	9	72		4	EB Before-After		
	All	All	Rural		Stop	7,185-17,220				44		58		7	EB Before-After		
	All	All		3-leg						15		50			Simple Before-After		
	All	All		4-leg						15		75			Simple Before-After		
	All	Fatal/Injury								55	181	65			Simple Before-After		
	All	PDO								55	181	42			Simple Before-After		
	Ped	All								55	181	89			Simple Before-After		
	All	All	Urban		Stop	13,272-30,418				44		5		10	EB Before-After		
	All	All	Urban		Signal	5,322-31,525				44		35		9	EB Before-After		
	All	All	Urban		Signal					50	5	1		12	EB Before-After		
	All	All	Urban		Signal					21	4	35			EB Before-After		
	All	All	Urban		Stop (2-way)					50	27	31		6	EB Before-After		
	All	All	Urban	1-lane	Stop (2-way)					50	16	56		6	EB Before-After		
	All	All	Urban	2-lane	Signal					50	4	67		4	EB Before-After		
	All	All	Urban	2-lane	Stop (2-way)					50	11	18		8	EB Before-After		
	All	All	Urban		Stop	4,600-17,825				44		72		6	EB Before-After		
	All	Fatal/Injury	All		All					50	55	76		3	EB Before-After		
	All	Fatal/Injury	All		Signal					50	9	78		6	EB Before-After		
	All	Fatal/Injury	All		Stop (2-way)					50	36	82		3	EB Before-After		
	All	Fatal/Injury	All		Stop (4-way)					50	10	-28		41	EB Before-After		
	All	Fatal/Injury	All		All					21	23	80			EB Before-After		
	All	Fatal/Injury	Rural	1-lane	Stop (2-way)					50	9	87		3	EB Before-After		
	All	Fatal/Injury	Rural		Stop	7,185-17,220				44		82		9	EB Before-After		
	All	Fatal/Injury			No signal					11	62	44			34	52	EB and Meta-analysis
	All	Fatal/Injury			Signal					11	34	32			19	43	EB and Meta-analysis
	All	Fatal/Injury								11	96	39			31	45	EB and Meta-analysis
	All	Fatal/Injury	Urban		Signal					50	5	60		12		EB Before-After	
	All	Fatal/Injury	Urban		Stop (2-way)					50	27	74		6		EB Before-After	
All	Fatal/Injury	Urban	1-lane	Stop (2-way)					50	16	78		7		EB Before-After		
All	Fatal/Injury	Urban	2-lane	Stop (2-way)					50	11	72		9		EB Before-After		
All	Fatal/Injury	Urban		Signal	5,322-31,525				44		74		14		EB Before-After		
All	Fatal/Injury	Urban		Stop	4,600-17,825				44		88		8		EB Before-After		
Ped	Fatal/Injury			No signal					11		27						
Ped	Fatal/Injury			Signal					11		-28						
Improve intersection alignment (reduce skew)	All	All	Rural	3-leg	Stop					6		100(1-EXP(0.0048* intersection angle - 90°)); angle in degrees					
	All	All	Rural	4-leg	Stop					6		100(1-EXP(0.0054* intersection angle - 90°)); angle in degrees					
Improve sight distance in 1 quadrant	All	All	Rural	4-leg	Stop/Yield (2-way)					23		5				Expert Panel	
Improve sight distance in 2 quadrants	All	All	Rural	4-leg	Stop/Yield (2-way)					23		9					

Improve sight distance in 3 quadrants	All	All	Rural	4-leg	Stop/Yield (2-way)		23	13					
Improve sight distance in 4 quadrants	All	All	Rural	4-leg	Signal		23	0					
	All	All	Rural	4-leg	Stop/Yield (2-way)		23	17					
Improve sight distance to intersection	All	Fatal					51	56					
	All	Injury					51	37					
Increase median width by 3 ft	Multiple-vehicle	All	Rural	4-leg	Stop		24	4	1				Cross-section
	Multiple-vehicle	All	Urban	3-leg	Stop		24	-3	1				Cross-section
	Multiple-vehicle	All	Urban	4-leg	Signal		24	-3	1				Cross-section
	Multiple-vehicle	All	Urban	4-leg	Stop		24	-6	1				Cross-section
	Multiple-vehicle	Fatal/Injury	Rural	4-leg	Stop		24	4	1				Cross-section
	Multiple-vehicle	Fatal/Injury	Urban	4-leg	Signal		24	-3	1				Cross-section
	Multiple-vehicle	Fatal/Injury	Urban	4-leg	Stop		24	-5	1				Cross-section
Increase pedestrian storage area at corner	All	Fatal/Injury					5	-12		126			Meta-analysis
Install median	All	All	Rural		Stop		6	27					
Install median islands (painted) on major road approaches	All	Fatal/Injury	All	All	All		58	15					
Install median islands (physical) on major road approaches	All	Fatal/Injury	All	All	All		58	25					
Install raised median	All	All			No signal		28	25					
	All	All					28	25					
	Ped	All			No signal		28	69					
Install raised median (marked crosswalk)	Ped	All					60	46					
Install raised median (unmarked crosswalk)	Ped	All					60	39					
Install refuge islands	Peds	All					28	56					
Install splitter islands on minor road approaches	All	Fatal/Injury	All	3-leg	All		58	45					
	All	Fatal/Injury	All	4-leg	All		58	40					
	All	Fatal/Injury	All	All	All		58	40					
	All	Fatal/Injury	Rural	All	All		58	35					
	All	Fatal/Injury	Urban	All	All		58	40					
Install turn and bypass lanes	All	All	Rural		Stop		48	5	10				Simple Before-After
	Head-on	PDO		3-leg			15	13					Simple Before-After
	Left-turn	Injury		3-leg			15	36					Simple Before-After
	Left-turn	PDO		3-leg			15	28					Simple Before-After
	ROR	PDO		3-leg			15	40					Simple Before-After
	Rear-end	Injury		3-leg			15	18					Simple Before-After
	Rear-end	PDO		3-leg			15	21					Simple Before-After
	Right-angle	Injury		3-leg			15	24					Simple Before-After
	Right-angle	PDO		3-leg			15	53					Simple Before-After
	Sideswipe	PDO		3-leg			15	30					Simple Before-After
Vary median width	All	All	Rural		Stop		6	100(1-EXP(-0.012(Wm-16))); Wm=median width (ft)					
	All	All	Urban	3-leg	Stop		6	100(1-EXP(0.0082(Wm-16))) for Wm>16 1.0 for Wm<=16; Wm=median width (ft)					
	All	All	Urban	4-leg	Stop		6	100(1-EXP(0.0173(Wm-16))) for Wm>16 1.0 for Wm<=16; Wm=median width (ft)					
	All	Fatal/Injury	Urban	3-leg	Stop		6	100(1-EXP(0.0076(Wm-16))) for Wm>16 1.0 for Wm<=16; Wm=median width (ft)					
	All	Fatal/Injury	Urban	4-leg	Stop		6	100(1-EXP(0.016(Wm-16))) for Wm>16 1.0 for Wm<=16; Wm=median width (ft)					
Vary shoulder width	All	All	Rural	3-leg and 4-leg	Stop		6	100(1-EXP(-0.03(Ws-8))); Ws=outside shoulder width (ft)					
	All	All	Urban		Stop		6	100(1-EXP(-0.02(Ws-1.5))); Ws=outside shoulder width (ft)					

* Percentage of Total Daily Traffic Volume

Table 3. Signs/Markings/Operational Countermeasures

Countermeasures	Crash Type	Crash Severity	Area Type	Config	Control	Major Daily Traffic Volume (veh/day)	Minor	Ref	Obs	Effectiveness			Study Type	
										Crash Reduction Factor/Function	Std Error	Range Low High		
SIGNS														
Install double stop signs	All	All			No signal			28	11					
	Right-angle	All			No signal			47	10	55	52	-38	100	Simple Before-After
	Right-angle	All			No signal			28	36					
Install flashing beacons as advance warning	All	All		3-leg				15	70					Simple Before-After
	All	All		4-leg				15	39					Simple Before-After

	All	All			Signal			28	27			25	28	
	All	All						15	25					
	All	All						15	25					Cross-section
	All	All						15	27					Simple Before-After
	All	All						15	25					Simple Before-After
	Left-turn	Fatal/Injury						15	67					Simple Before-After
	Left-turn	PDO						15	79					Simple Before-After
	Rear-end	All			4-leg	Signal		39	36					
	Right-angle	All			4-leg	Signal		39	62					
	Right-angle	Fatal/Injury						15	73					Simple Before-After
	Right-angle	Fatal/Injury						15	73					Simple Before-After
	Right-angle	PDO						15	62					Simple Before-After
Install larger stop signs	All	All			Stop	>5,000/lane (Total)		15	19					Simple Before-After
Install pedestrian signing	All	All						15	4					
	Ped	All						15	15					
Install advance warning signs (positive guidance)	All	All	All					1	35					
	All	All			Signal			28	22			3	40	
	All	All	Urban					15	30					Cross-section
	All	All	Rural					15	40					
	Right-angle	All			Signal			47	11	35		20	100	Simple Before-After
	Right-angle	All			Signal			28	35					
Provide overhead lane-use signs	Rear-end	All						51	10					
	Sideswipe	All						51	20					
PAVEMENT MARKINGS/MODIFICATIONS														
Add centerline and move STOP bar to extended curb lines	All	All			No signal			28	29					
	Right-angle	All			No signal			28	24					
Add centerline and move STOP bar to extended curb lines, double stop signs	All	All			No signal			28	9					
	Right-angle	All			No signal			28	0					
Add centerline and STOP bar, replace 24-inch with 30-inch stop signs	Right-angle	All			No signal			47	67			11	27	100
	Right-angle	All			No signal			28	67					
Improve pavement friction (groove)	All	All						28	25					
	Wet	All						28	59			42	75	
Improve/install pedestrian crossing	All	All						15	25					
	Ped	All						15	25					
Install pedestrian crossing	Ped	All						15	25					
	Ped	All						15	25					
	Ped	Fatal/Injury	Rural					38	60					EB Before-After
Install pedestrian crossing (raised)	All	All						5	30			67		Meta-analysis
	All	Fatal/Injury						5	36			54		Meta-analysis
	Ped	All						28	8					
Install raised intersection	All	Fatal/Injury			4-leg			13	-5					Meta-analysis
	All	PDO			4-leg			13	-13					Meta-analysis
Install raised pavement markers	All	All						28	10			6	13	
	Wet	All						28	25			20	30	
	Wet/Night	All						28	33			20	16	
Install STOP bars (pedestrian crosswalk)	All	All			Signal			28	18			10	25	
Install STOP bars (STOP bar on minor road approaches, with short segments of centerline)	All	All						28	19			10	27	
	Right-angle	All						28	47					
Install transverse pavement markings	All	All						15	18					Simple Before-After
	Speed-related	Fatal/Injury			Stop			18	57			8		Simple Before-After
	Speed-related	Serious injury			Stop			18	74			13		Simple Before-After
	Speed-related	Slight injury			Stop			18	52			11		Simple Before-After
	Speed-related and day	All			Stop			18	66			8		Simple Before-After
	Speed-related and dry	All			Stop			18	45			15		Simple Before-After
	Speed-related	All			Stop			18	48			14		Simple Before-After
	Speed-related and wet	All			Stop			18	68			11		Simple Before-After
Install transverse rumble strips on approaches	All	All	Rural		No signal			28	35					
	All	All			Stop			15	28					Simple Before-After
	All	All						28	23			2	44	

	Rear-end	All					15	90							Simple Before-After
Mark pavement with supplementary warning messages	All	All			No signal		28	6							
	Right-angle	All			No signal		28	30							
	Right-angle	All	Urban		Stop		47	5	30		66	-20	100		Simple Before-After
Provide bicycle box (advance stop bar to leave dedicated space for cyclists)	Bicycle	All			Signal		51	36							
Provide bike lanes	Bicycle	All					51	36							
Resurface pavement	All	All					28	33				7	59		
	Wet	All					28	47				42	75		
REGULATORY															
Convert STOP control to Yield control	All	All	All		Stop		21	141	-137						Comparison Group Before After
	All	All	Urban	4-leg	Stop		33		-127		70				Comparison Group Before After
Convert to all-way STOP control (from 2-way control)	All	All	All		Stop		21	360	47						Before-After with Likelihood Functions
	All	All			No signal		28	64			53	74			
	All	All			Stop		15	53							
	All	Fatal/Injury	Urban		Stop		30	71			6				Simple Before-After
	Left-turn	All	Urban		Stop		30	20			52				Simple Before-After
	Left-turn	All			Stop		15	20							Cross-section
	Ped	All					15	39							
	Ped	All	Urban		Stop		30	39			8				Before-After
	Rear-end	All	Urban		Stop		30	13			13				Simple Before-After
	Rear-end	All			Stop		15	13							Cross-section
	Right-angle	All	Urban		Stop		30	72			3				Simple Before-After
	Right-angle	All			No signal		28	84							
	Right-angle	All			Stop		15	72							Cross-section
	Right-angle	All	Urban		Stop		47	10	80		41	49	100		Simple Before-After
Convert two-way to one-way roadway	All	All					15	26							
	All	All					15	26							Cross-section
Convert Yield control to STOP control	All	All			No signal		28	29							
	Right-angle	All			No signal		28	9							
Install no left-turn and no u-turn signs	All	All	Urban			19,435-42,000 (Total)	7	62		6					Simple Before-After
	Left-turn (or u-turn)	All	Urban			19,435-42,000 (Total)	7	59		5					Simple Before-After
Permit right-turn-on-red	All	All			Signal		5	-7		1					Simple Before-After
	All	All			Signal		10	-5		1					Simple Before-After
	Ped	All	New Orleans		Signal		5	-81		88					Before-After
	Ped	All	New York		Signal		5	-43		24					Before-After
	Ped	All	Ohio		Signal		5	-57		31					Before-After
	Ped	All	Wisconsin		Signal		5	-108		51					Before-After
	Right-turn	Fatal/Injury			Signal		13	-60		5					Meta-analysis
Right-turn	PDO			Signal		13	-10		1					Meta-analysis	
Prohibit left-turns	All	All					15	-45							
	All	All					15	45							Cross-section
	Left-turn	All					15	90							Cross-section
	Ped	All					15	10							
	Rear-end	All					15	30							Cross-section
Prohibit right-turn-on-red	All	All			Signal		28	23			20	25			
	ROR	All			Signal		15	30							Cross-section
	Rear-end	All			Signal		15	20							Cross-section
	All	All	Urban/suburban		Signal		62	100(1-(0.984)^n); n=number of signalized intersection approaches where RTOR is prohibited							Expert Panel
	Right-angle	All			Signal		15	30							Cross-section
Sideswipe	All			Signal		15	20							Cross-section	
Prohibit turns	All turns	All	All				1	45			40	90			
Restrict parking near intersections (to offstreet)	All	All					28	49			8	90			
	Ped	All					15	30							
Vary speed	All	All	Rural				6	100(1-EXP(0.019(V-55))); V=majorroad speed limit (or design speed) (mph)							
	All	All	Urban				6	100(1-EXP(0.005(V-40))); V=majorroad speed limit (or design speed) (mph)							
LIGHTING															
Improve lighting at intersection	Ped	Fatal					5	78			87				
	Ped	Injury					5	42			18				

Install lighting	All	All			Signal			51	30				
	All	Fatal/Injury			Signal			51	17				
	Night	All			Signal			51	50				
	All	All			No signal			28	47				
OPERATIONAL													
Convert STOP control (2-way) to signal control	All	All			Stop			15	28				Cross-section
	All	Injury			Stop			15	43				Cross-section
	Right-angle	All			Stop			15	74				Cross-section
Convert STOP control (2-way) to signal control and install left-turn lane	All	All			Stop			15	36				Cross-section
	All	Injury			Stop			15	53				Cross-section
	Rear-end	All			Stop			15	8				Cross-section
	Right-angle	All			Stop			15	74				Cross-section
Increase enforcement to reduce speed	Ped	All						28	70				
Install angled median crosswalk	All	All						28	12				
Install beacon (flashing) at intersection	All	All	All					1	30			7	50
	All	All	All					1	30				
	All	All			Signal			28	34			30	38
	All	All						15	30				
	All	All						15	30				Cross-section
	All	All						15	4				Simple Before-After
	All	All						15	30				Simple Before-After
Install cameras to detect red-light running	All	All			Signal	17,000-78,000		37	46	-12		5	EB Before-After
	All	All	Urban (Scottsdale)		Signal			56	11				EB Before-After
	All	Fatal/Injury	All	All	Signal			58	5				
	All	Fatal/Injury			Signal	17,000-78,000		37	46	-14		9	EB Before-After
	Left-turn	All	Urban (Scottsdale)		Signal			56	14	45		6	EB Before-After
	Rear-end	All			Signal	52,625-109,067	12,562-33,679	45		-15		3	EB Before-After
	Rear-end	All			Signal	17,000-78,000		37	13	-57		1	EB Before-After
	Rear-end	All	Urban (Scottsdale)		Signal			56		-41		11	EB Before-After
	Rear-end	Fatal/Injury			Signal	52,625-109,067	12,562-33,679	45		-24		12	EB Before-After
	Right-angle	All			Signal	52,625-109,067	12,562-33,679	45		25		3	EB Before-After
	Right-angle	All	Urban (Scottsdale)		Signal			56	14	20			EB Before-After
	Right-angle	Fatal/Injury			Signal	52,625-109,067	12,562-33,679	45		16		6	EB Before-After
Install far-side bus stops	Ped	All						28	1				
Install flashing red/yellow signal (MUTCD: intersection control beacon)	All	All			No signal	<5,000/lane (Total)		15	25				Simple Before-After
	All	All			No signal	>5,000/lane (Total)		15	26				Simple Before-After
	All	All			No signal			15	26				
	All	Fatal/Injury			No signal			15	50				Simple Before-After
	Head-on	All			No signal			15	50				Simple Before-After
	Right-angle	All			No signal	<5,000/lane (Total)		15	35				Simple Before-After
	Right-angle	All			No signal	>5,000/lane (Total)		15	36				Simple Before-After
	Right-angle	All			No signal			15	36				
Install pedestrian crossing (signed and marked with curb ramps and extensions)	All	All			No signal			28	37			25	48
Install pedestrian overpass/underpass	Ped	All			No signal			28	13				
Install stop signs at alternate intersections in residential areas	All	All	Urban		Stop			53	50			45	55
	All	Fatal/Injury	Urban		Stop			53	67			61	72
Vary frequency of driveways within 250 ft of intersection	All	All	Rural		Signal			6				100(1-EXP(0.046(Nd-3))); Nd=number of driveways on the major road within 250ft of the intersection	
	All	All	Rural		Stop			6				100(1-EXP(0.056(Nd-3))); Nd=number of driveways on the major road within 250ft of the intersection	
Vary lane width	All	All	Urban		Signal			6				100(1-EXP(-0.053(WI-12))); WI=lane width (ft)	
	All	All	Urban		Stop			6				100(1-EXP(-0.057(WI-12))); WI=lane width (ft)	
Vary sight distance	All	All	Rural		Signal			6	0				
Vary through lanes	All	All	Rural		Signal			6				100(1-EXP(0.007(Nln-2))); Nln=number of through lanes on the road	
	All	All	Rural		Stop			6				100(1-EXP(-0.093(Nln-2))); Nln=number of through lanes on the road	
Vary truck presence	All	All	Rural	4-leg	Signal			6				100(1-EXP(0.026(Pt-9))); Pt=percent truck during the peak hour (average for all intersection movements)	
	All	Fatal/Injury	Rural	3-leg	Stop			6				100(1-EXP(-0.0253(Pt-9))); Pt=percent truck during the peak hour (average for all intersection movements)	
	All	Fatal/Injury	Rural	4-leg	Stop			6				100(1-EXP(-0.0520(Pt-9))); Pt=percent truck during the peak hour (average for all intersection movements)	

	All	Fatal/Injury	Rural	4-leg	Signal			6	100(1-EXP(0.0323(Pt-9))); Pt=percent truck during the peak hour (average for all intersection movements)	
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Federal Highway Administration | 1200 New Jersey Avenue, SE | Washington, DC 20590 | 202-366-4000

APPENDIX I

DES #: 1800210

ORIGIN DES #: 1800210

DESIRED FISCAL YEAR OF LETTING: 2023

APPLICATION DATE: 01/16/2018

APPLICANT TITLE:

APPLICANT NAME: Lowther, Hillary

Route Information

ROUTE TYPE: State Road
ROUTE: 56
LENGTH: .1
START RP: 116 + 4
END RP: 116 + 14
LOCATION: At Boatman Road (CR 200W) west of Scottsburg

Project Information

CITY:
COUNTY NAME: Scott
DISTRICT: Seymour
WORK CATEGORY: Intersection Improvement Project
WORK TYPE: Intersection Improvement, Roundabout
ASSET GROUP: Safety
SCORE: 80

Project Costs

Des #	CN Costs	RW Costs	PE Costs	Other Costs	Total Costs
1800210 (*Origin Des)	\$1,884,000.00	\$0.00	\$250,000.00	\$0.00	\$2,134,000.00

Cost are from latest stage: CN = CN, RW = RW1+RW2, PE =PE1+PE2, Other= UT1+UT2+RR1+RR2+CE+RQP+WZP

INITIAL STATEMENT OF ESSENTIAL PROJECT NEED(PROBLEM): The current intersection is in a reverse curve segment, and is at a skew with a 25 degree angle. 45% of the crashes are right angle crashes, and crash narratives have indicated a trend that drivers are not aware of the intersection. Crash narratives also indicate that drivers are unaware that the intersection is a two way stop rather than a four way stop when approaching from the Northbound and Southbound directions. A fatal crash and two incapacitating injury crashes have been recorded within the last three years, and the index of crash frequency rates at 3.21.

INITIAL STATEMENT OF ESSENTIAL PROJECT PURPOSE: The intent of this project is to improve the safety of the intersection and reduce the frequency and severity of crashes that occur by reconstructing the intersection as a roundabout.

PRIOR PLANNING, ENGINEERING OR OTHER STUDY OR ACTIVITY PROMPTING AND SUPPORTING THE PROJECT:

ANTICIPATED ENVIRONMENTAL STUDY: Categorical Exclusion

ADDITIONAL ENGINEERING NEEDED TO ESTABLISH DEFINITE PROJECT IMPROVEMENTS: No

ANTICIPATED NUMBER OF MONTHS TO COMPLETE:

ADDITIONAL COMMENTS:

Attachments

Name	Document Type	Description
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SR 56 and Boatman Rd

Stage 2 Question 2:

Crash Data from 2013-2016

$$\begin{aligned}
 PD_{\text{Equivalent}} &= 58h + 6y + z \\
 &= 58(1+6) + 6(5) + (21) \\
 &= 457
 \end{aligned}$$

$$\begin{aligned}
 \text{Annual } PD_{\text{equiv.}} &= PD_{\text{equiv.}} / 5 \\
 &= 457 / 5 = 91 \text{ crashes per year}
 \end{aligned}$$

$$CR = \text{Annual } PD_{\text{equiv.}} \times CRF_{\text{composite}}$$

Alternative	Expected # of $PD_{\text{equiv.}}$ Crashes Reduced Per Year (CR)
Conventional - with signal and left-turn lanes	$CR = 91 \times 0.31 = 28$
Roundabout	$CR = 91 \times 0.57 = 52$
Offset T	$CR = 91 \times$

Mainline left-turn lanes would overlap

*INOT Roundabout pamphlet says the service life of a roundabout is 25 years compared to 10 years of a signal equipment. I used 15 years for a signal project since the added pavement lanes would be closer to 20 year service life.

$$A = P \left[\frac{i(1+i)^n}{(1+i)^n - 1} \right]$$

Conventional	$A = 750,000 \left[\frac{0.05(1+0.05)^{15}}{(1+0.05)^{15} - 1} \right] = \$72,000$
Roundabout	$A = 1,500,000 \left[\frac{0.05(1+0.05)^{25}}{(1+0.05)^{25} - 1} \right] = \$106,000$
Offset T	$A = 1,200,000 [\dots]$

$$CE_{\text{safety}} = A / CR$$

Conventional	$CE_{\text{safety}} = \$72,000 / 28 = \$2,571 \text{ per } PD_{\text{equiv.}} \text{ crash reduced}$
Roundabout	$CE_{\text{safety}} = \$106,000 / 52 = \$2,038 \text{ per } PD_{\text{equiv.}} \text{ crash reduced}$
Offset T	$CE_{\text{safety}} =$

Index of Crash Frequency and Cost - Form F1		Page 1/2
Location	SR 56 and Boatman Rd	
Scottsburg, Scott County		
GIS		
Post		
Analyst	Damon Brown	
Date		
INPUT		
Road Facility Type	Unsignalized Urban State-Local Intersection	
Major Road AADT (veh/day)	10589	
T-intersection Indicator (1 if present, 0 otherwise)	0	
Major Collector Indicator for Crossing Local Road (1 if present, 0 otherwise)	1	
First Year with Crash Data (yyyy)	2014	
Last Year with Crash Data (yyyy)	2016	
Number of Crashes (crash/period)		
Fatal and Incapacitating Injury Crashes	3	
Non-Incapacitating and Possible Injury Crashes	2	
Property Damage Only Crashes	14	
Route or Road Type	Unsignalized Urban State-Local Intersection	
Average Crash Costs (\$)		
Fatal and Incapacitating Injury Crashes	279300	
Non-Incapacitating and Possible Injury Crashes	31400	
Property Damage Only Crashes	6500	
Crash Cost Year (yyyy)	2017	
OUTPUT		
Expected Crash Frequency (crash/year)		
Fatal and Incapacitating Injury Crashes	0.029	
Non-Incapacitating and Possible Injury Crashes	0.19	
Property Damage Only Crashes	0.75	
All Crashes	0.97	
Index of Crash Frequency	3.15	
Index of Crash Cost	1.89	

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Location	SR 56 and Boatman Rd	
Scottsburg, Scott County		
GIS		
Post		

Analyst	Damon Brown
Date	
Comments: 	