Intersection Control Evaluation

Balcerzak Drive at Pohl Road

in Mankato, Blue Earth County, Minnesota

Mankato/North Mankato Area Planning Organization

SRF Consulting Group, Inc. | Engineers Planners Designers

October 2016

SRF No. 016 09243

Intersection Control Evaluation

Balcerzak Drive at Pohl Road

Proposed Letting Date: TBD

Report Certification:

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Scott C. Poska — 47068

Print Name — Reg. No.

Signature — 10-31-16

Date

Approved:

City of Mankato — 12-13-16

City Engineer — Date

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Introduction

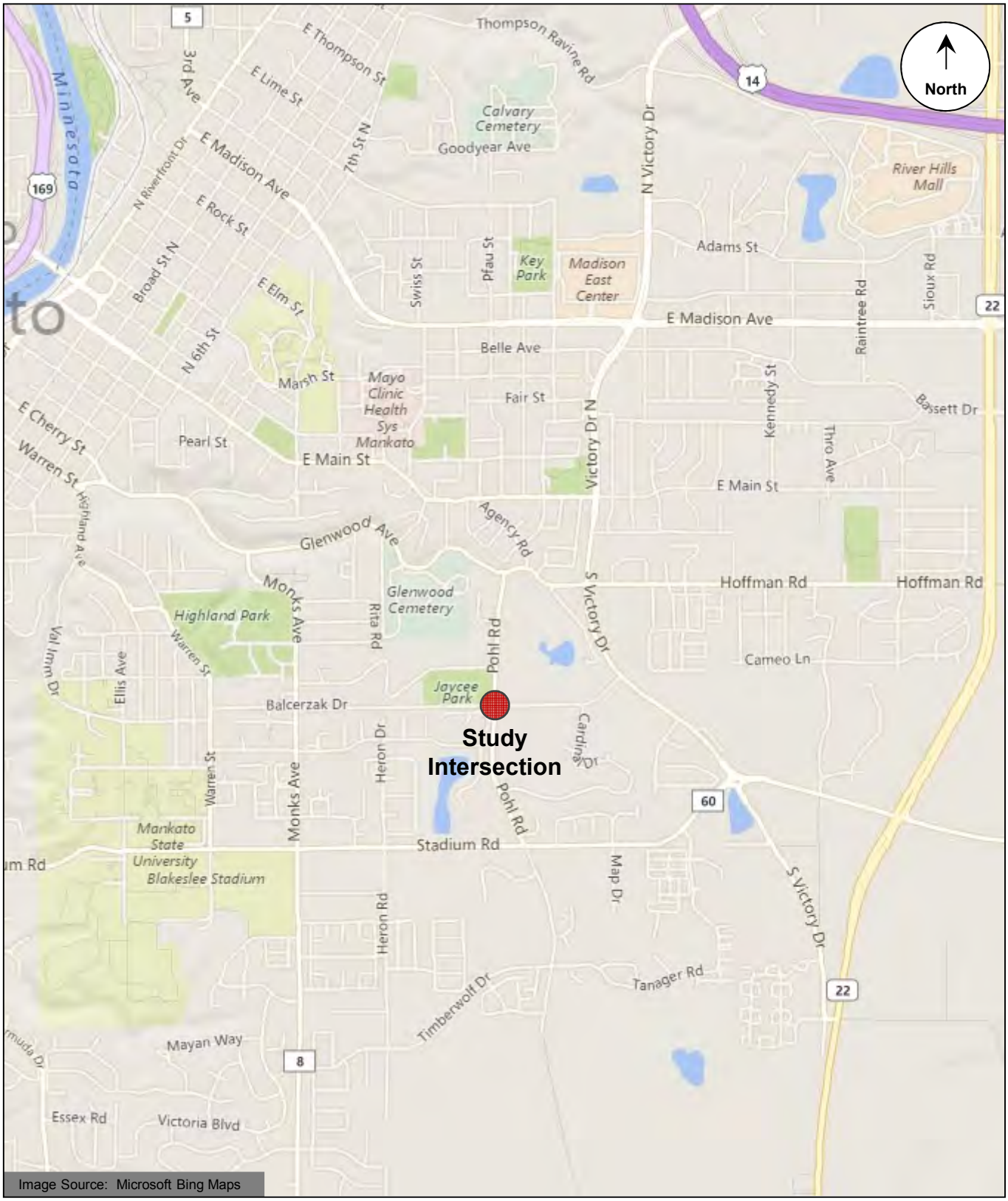
This report contains the intersection control evaluation results for the Balcerzak Drive at Pohl Road intersection in Mankato, Blue Earth County, Minnesota (see Figure 1). The purpose of the evaluation was to analyze the intersection control alternatives for the intersection to identify the long-term preferred intersection control. The following intersection control alternatives were considered applicable and are analyzed within this report:

- All-Way Stop Control
- Roundabout Control
- Traffic Signal Control

A mini-roundabout variation was also explored. According to *Mini-Roundabouts Technical Summary* (Federal Highway Administration, 2010), mini-roundabouts are best suited/most efficient in lower speed environments (30 mph or less), and are generally recommended for intersections in which the total entering daily traffic volume is no more that approximately 15,000 vehicles. The intersection currently has 14,900 entering vehicles and is forecasted to reach 19,300 by 2036, and Balcerzak Drive has a posted speed of 40 mph. Large vehicles are typically required to over-run the fully traversable central island, and high volumes of large vehicles will significantly reduce the capacity of a mini-roundabout, and may lead to rapid wear of the roadway markings. Based on these factors, the mini-roundabout option was not analyzed further at the study intersection.

A detailed warrants analysis, operational analysis, safety analysis, and planning-level cost analysis were performed to determine the preferred intersection control alternative. In addition to these analyses, other factors considered for this evaluation that were applicable to determining the long-term preferred intersection control included:

- Right-of-Way Considerations
- Transportation System Considerations
- Pedestrian and Bicycle Considerations
- Local Acceptance



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Study Intersection

Intersection Control Evaluation
Balcerzak Drive at Pohl Road

Figure 1

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Existing Intersection Characteristics

Existing Conditions

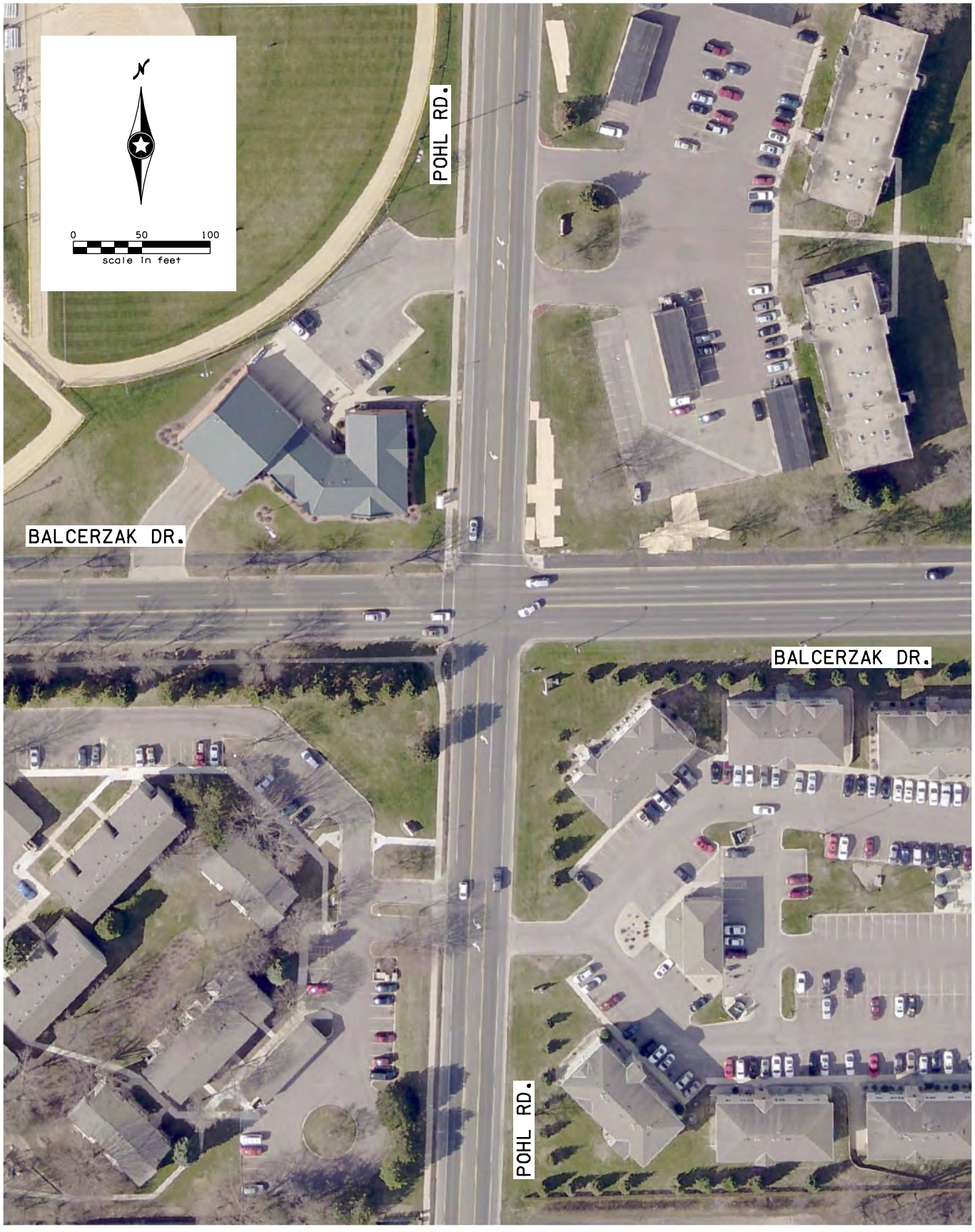
The study intersection is located in the City of Mankato, Blue Earth County, as shown in Figure 1. Balcerzak Drive is a four-lane undivided city street with a speed limit of 40 mph and is functionally classified as a Minor Arterial. Pohl Road was recently restriped from a four-lane to a three-lane undivided roadway. Pohl Road is a city street with a speed limit of 30 mph and is functionally classified as a Major Collector. The intersection of Balcerzak Drive and Pohl Road is currently all-way stop controlled. There are trails/sidewalks on the north side of Balcerzak Drive, the south side of Balcerzak Drive to the west of Pohl Road, and the west side of Pohl Road. Pohl Road also has shoulders that can be utilized as bike lanes. There are marked pedestrian crossings on the north and west legs (matching the sidewalk locations). The adjacent area has primarily residential land uses. Minnesota State University is located approximately one mile to the west. The existing lane configurations for the Balcerzak Drive and Pohl Road intersection are listed in Table 1 below and are shown in Figure 2.

Table 1. Existing Conditions

Leg	Configuration
Eastbound Balcerzak Drive	One shared thru/left-turn lane and one shared thru/right-turn lane
Westbound Balcerzak Drive	One shared thru/left-turn lane and one shared thru/right-turn lane
Northbound Pohl Road	One left-turn lane and one shared thru/right-turn lane
Southbound Pohl Road	One left-turn lane and one shared thru/right-turn lane

Crash History

Crash data was obtained from the Minnesota Crash Mapping Analysis Tool (MnCMAT) database for a five-year period from 2011 to 2015. There were twenty-two recorded crashes at the study intersection during the analysis period. Detailed crash data is provided in the Appendix. This results in a crash rate of 0.81 crashes per million entering vehicles, which exceeds the statewide average of 0.35 for all-way stop controlled intersections and the critical crash rate of 0.56 (0.95 level of confidence) for this intersection. However, Pohl Road was recently restriped and converted from a four-lane road to a three-lane road, and the majority of the crashes occurred under the previous conditions, and are not relevant to consider with the current intersection configuration.



H:\Projects\09000\9243\CAD_BIM\Graphics\9243 Figure 2 - Existing Conditions.dgn

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Existing Conditions

Intersection Control Evaluation

Balcerzak Drive at Pohl Road

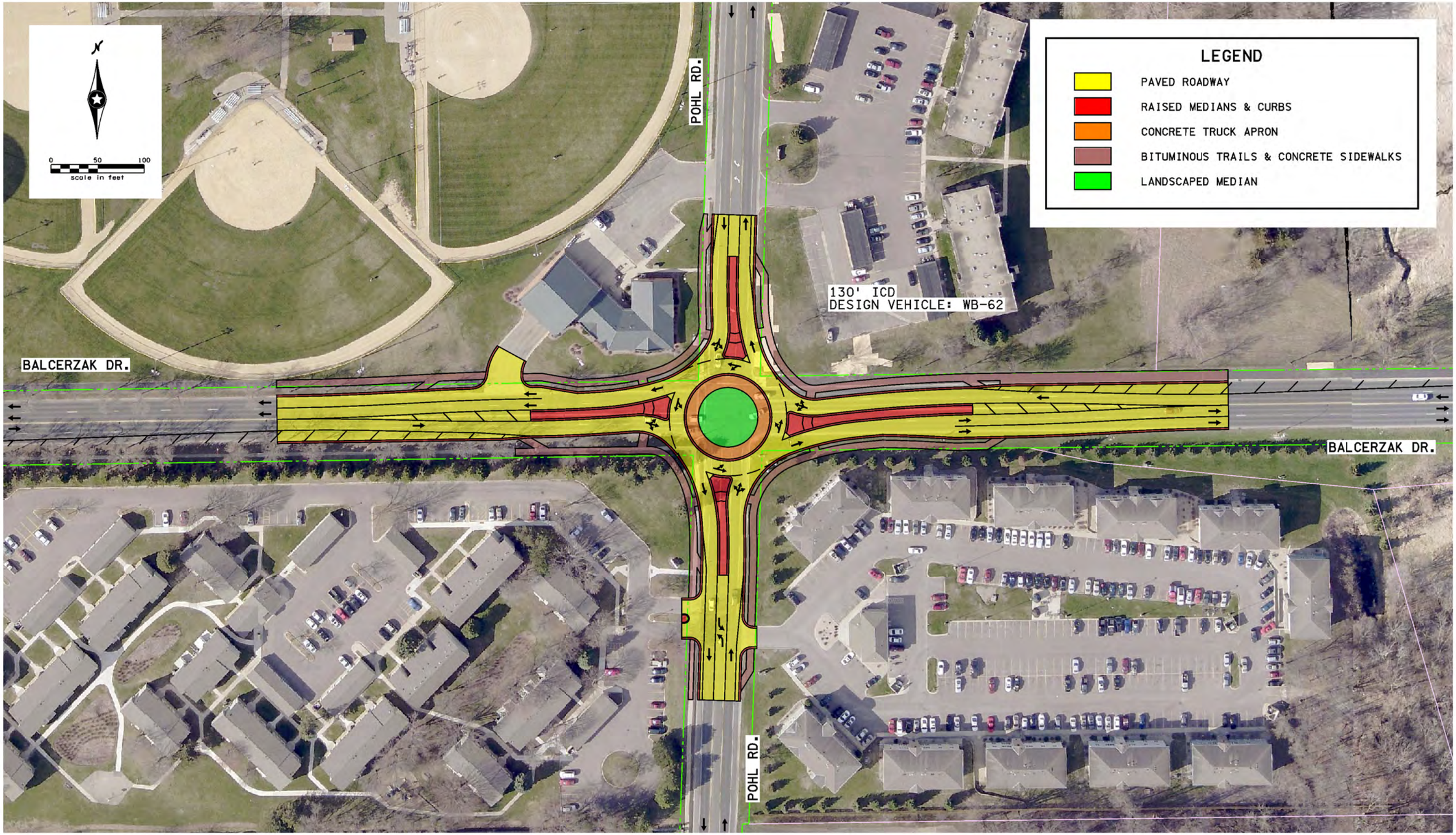
Figure 2

Future Conditions

Based on discussions with city staff in the summer of 2016, no short-term improvements to Balcerzak Drive, Pohl Road, or the study intersection are planned. For the alternatives analysis, the existing lane configurations under all-way stop control (listed in Table 1 and shown in Figure 2) were assumed to be the same for the traffic signal control alternative. All-way stop control and traffic signal control were also analyzed with the variation of Balcerzak Drive changed to a three-lane roadway (one left-turn lane and one shared thru/right-turn lane on each approach, matching the configuration on Pohl Road). This is commonly referred to as a "road diet." The lane configurations for the roundabout control alternative are listed in Table 2 below and are shown in Figure 3. In the roundabout concept design shown, Balcerzak Drive is a four-lane roadway to match existing conditions, though the roundabout alternative could accommodate either a four-lane or three-lane section on Balcerzak Drive.

Table 2. Proposed Lane Configurations for Roundabout Control Alternative

Leg	Configuration
Eastbound Balcerzak Drive	One shared lane (all movements)
Westbound Balcerzak Drive	One shared lane (all movements)
Northbound Pohl Road	One shared lane (all movements)
Southbound Pohl Road	One shared lane (all movements)



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Roundabout Control Alternative

Intersection Control Evaluation

Balcerzak Drive at Pohl Road

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Figure 3

Traffic Volumes

Hourly traffic volumes including the existing a.m. and p.m. peak hour were collected in late April 2016 by SRF prior to the conclusions of the spring term at nearby Minnesota State University and are shown in Figure 4. Pedestrian and bicycle volumes were also collected. Growth rates from the MAPO 2045 Transportation Plan (0.9% for the north leg, 1.6% for the east leg, 1.6% for the south leg, and 1.5% for the west leg) were used to determine Forecasted Year 2036 peak hour turning movement volumes, which are shown in Figure 5.

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Existing Year 2016 Volumes

Figure 4

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Forecasted Year 2036 Volumes

Figure 5

Intersection Control Evaluation
Balcerzak Drive at Pohl Road

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Analysis of Alternatives

The analysis of the all-way stop control, traffic signal control, and roundabout control alternatives included a warrants analysis, operational analysis, planning-level crash analysis, and a planning-level cost analysis. Existing Year 2016 and Forecasted Year 2036 volumes with proposed lane configurations discussed previously were used for the analysis.

Warrants Analysis

A warrants analysis was performed for the traffic signal control alternative as outlined in the February 2015 *Minnesota Manual on Uniform Traffic Control Devices* (MN MUTCD). The signal warrants analysis was based on the assumptions shown in Table 3.

Table 3. Warrants Analysis Assumptions

Leg	Geometry	Speed
Eastbound Mainline (Balcerzak Drive)	2 or more approach lanes	40 mph
Westbound Mainline (Balcerzak Drive)	2 or more approach lanes	40 mph
Northbound Minor Street (Pohl Road)	1 approach lane	30 mph
Southbound Minor Street (Pohl Road)	1 approach lane	30 mph

Because of the shared northbound and southbound thru/right-turn lanes, minor approach right turns were included in the analysis. Because of the low northbound and southbound left-turn volumes compared to the thru and right-turn volumes, the minor approaches were considered as one lane approaches. Table 4 provides a summary of the results of the warrants analysis. The detailed warrants analysis can be found in the Appendix.

Table 4. Warrants Analysis Results

MN MUTCD Warrant	Hours Required	Year 2016 Volumes		Forecasted Year 2036 Volumes	
		Hours Met	Warrant Met	Hours Met	Warrant Met
Warrant 1A: Minimum Vehicular Volume	8	5	No	10	Yes
Warrant 1B: Interruption of Continuous Traffic	8	0	No	3	No
Warrant 1C: Combination of Warrants	8	3	No	8	Yes
Warrant 2: Four-Hour Volume	4	3	No	9	Yes
Warrant 3B: Peak-Hour Volume	1	0	No	3	Yes
Multi-way Stop Applications Condition C	8	14	Yes	15	Yes

Warrants 4-9 were investigated but were determined to be not applicable. Results of the warrants analysis indicate that Existing Year 2016 volumes do not satisfy any MN MUTCD traffic signal warrants, while Forecasted Year 2036 volumes satisfy the MN MUTCD warrant requirements for traffic signal Warrants 1 (Conditions A and C), 2, and 3B. The intersection meets multi-way stop warrants in 2016 and 2036.

Operational Analysis

An initial planning-level analysis was performed for the roundabout control alternative based on Highway Capacity Manual methods found in *NCHRP Report 672 Roundabouts: An Informational Guide, Second Edition* (Transportation Research Board, 2010). The analysis involved testing the theoretical capacity of a single-lane roundabout against the Forecasted Year 2036 entering and circulating volumes. As shown in Chart 1, the Forecasted Year 2036 volumes do not exceed the theoretical capacity of a single-lane roundabout. Therefore, a single lane roundabout was selected for further analysis.

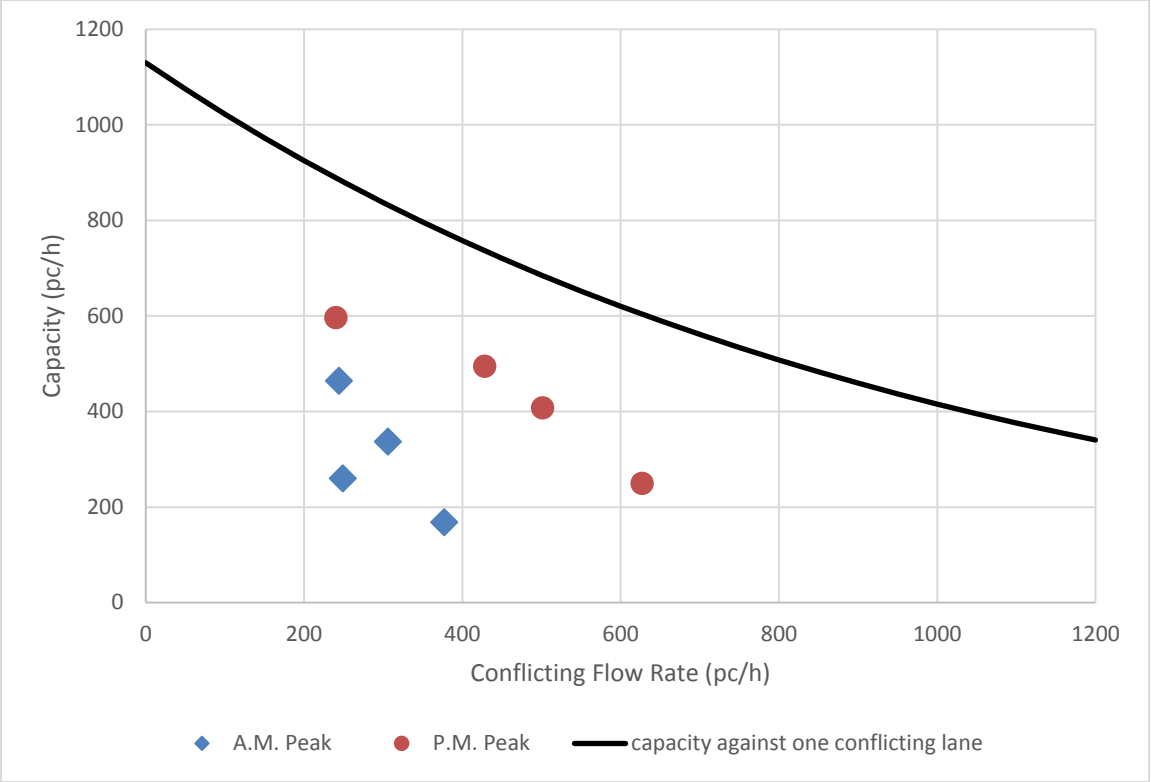


Chart 1. Single-Lane Roundabout Entry Lane Capacity (Forecasted Year 2036 volumes)

Operational analysis of the roundabout control alternative was performed using RODEL and Highway Capacity Software (HCS). RODEL is a software program that is based on existing roundabout operational research and uses an empirical formula method to determine roundabout delay based on geometric features and traffic flows. RODEL is the current MnDOT accepted analysis tool for evaluating roundabouts. HCS is based on methodologies found in the 2010 Highway Capacity Manual (HCM) which is considered a conservative approach to determining the capacity of a roundabout. It is important to note that RODEL and HCS only report "stop" or "control" delay. Therefore, in order to determine the total delay, "geometric" delay, or delay due to vehicle deceleration and acceleration through an intersection, must be added to the "stop" or "control" delay.

The detailed operational analysis of all-way stop control and traffic signal control was performed using methods outlined in the 2010 HCM using Synchro/SimTraffic. Synchro/SimTraffic is capable of calculating various measures of effectiveness such as control delay, queuing, and total travel time impacts. SimTraffic results are reported for the analysis.

The operational analysis identified a Level of Service (LOS), which indicates how well an intersection is operating based on average delay per vehicle. Intersections are given a ranking from LOS A to LOS F. LOS A indicates the best traffic operation and LOS F indicates an intersection where demand exceeds capacity. LOS A through LOS D are generally considered acceptable. RODEL results for a Confidence Level (CL) of 50% and 85% were determined. 50% CL results are typically used for roundabout analysis while the 85% CL results indicate

the sensitivity of the roundabout design. When a substantial degradation in LOS is expected from 50% CL to 85% CL, designers should exercise caution in the design of the roundabout to ensure adequate capacity is provided.

Tables 5 and 6 provide a summary of the operational analysis for Existing Year 2016 and Forecasted Year 2036 conditions, respectively. Detailed operational analysis results can be found in the Appendix (report sheets with an * after the alternative name denote the three-lane Balcerzak variation).

Table 5. Existing Year 2016 Operational Analysis Results

Alternative	Analysis Tool		A.M. Peak		P.M. Peak	
			Delay (1) (sec/veh)	LOS	Delay (1) (sec/veh)	LOS
All-Way Stop Control (Existing)	Synchro/SimTraffic		5/6	A/A	6/7	A/A
All-Way Stop Control (Balcerzak three-lane)	Synchro/SimTraffic		5/6	A/A	8/10	A/B
Traffic Signal Control (Balcerzak four-lane)	Synchro/SimTraffic		7/7	A/A	8/11	A/B
Traffic Signal Control (Balcerzak three-lane)	Synchro/SimTraffic		7/8	A/A	11/13	B/B
Roundabout Control	HCS 2010		7/8	A/A	10/11	B/B
	RODEL	50% CL	4/5	A/A	5/5	A/A
		85% CL	6/7	A/A	8/8	A/A

(1) Control/stop delay is reported. Overall results are followed by the worst approach results.

Table 6. Forecasted Year 2036 Operational Analysis Results

Alternative	Analysis Tool		A.M. Peak		P.M. Peak	
			Delay (1) (sec/veh)	LOS	Delay (1) (sec/veh)	LOS
All-Way Stop Control (No Build)	Synchro/SimTraffic		11/20	B/C	13/16	B/C
All-Way Stop Control (Balcerzak three-lane)	Synchro/SimTraffic		13/25	B/D	70/>100	F/F
Traffic Signal Control (Balcerzak four-lane)	Synchro/SimTraffic		10/13	A/B	12/17	B/B
Traffic Signal Control (Balcerzak three-lane)	Synchro/SimTraffic		9/11	A/B	15/20	B/B
Roundabout Control	HCS 2010		9/11	A/B	16/18	C/C
	RODEL	50% CL	5/6	A/A	7/8	A/A
		85% CL	7/9	A/A	12/14	B/B

(1) Control/stop delay is reported. Overall results are followed by the worst approach results.

Results of the operational analysis indicate that under the existing all-way stop control, the intersection operates with an acceptable level of service, and would continue to do so under Forecasted Year 2036 conditions. However, with a three-lane Balcerzak Drive, all-way stop control would have an unacceptable level of service during the p.m. peak under Forecasted Year 2036 volumes. The traffic signal control and roundabout control alternatives would operate with acceptable levels of service under forecasted conditions. The p.m. peak hour factor is 0.93, which indicates this peak hour volume is sustained over the entire peak hour. There is no significant difference in operations for traffic signal control with Balcerzak Drive being a four-lane or three-lane roadway.

Safety Analysis

A crash analysis was performed to determine the projected crashes per year for Year 2016 and Forecasted Year 2036 conditions for the study intersection. Crash rates from the MnDOT Green Sheets (2011 to 2015 data) were used for the crash analysis of the alternatives. According to *NCHRP Report 672 Roundabouts: An Informational Guide, Second Edition* (Transportation Research Board, 2010), the conversion of an all-way stop controlled intersection to a roundabout has an insignificant impact on safety. Therefore, the crash rate for all-way stop control was used for the roundabout control alternative. A summary of the crash analysis is shown in Table 7.

Table 7. Crash Analysis Results

Alternative	Intersection AADT (2016)	Intersection AADT (2036)	Crash Rate	Projected Crashes/Year (2016)	Projected Crashes/Year (2036)
All-Way Stop Control	14,900	19,300	0.35	2	3
Traffic Signal Control			0.52	3	4
Roundabout Control			0.35	2	3

Based on the results of the crash analysis, the roundabout control alternative is anticipated to have slightly less crashes than the traffic signal control alternative.

Studies have determined that the installation of a roundabout can improve overall safety of an intersection when compared to other forms of intersection control. Roundabouts typically have fewer conflict points than conventional intersections and the geometry of a roundabout induces lower speeds for vehicles approaching and traversing an intersection. With lower speeds, the severity of the crashes is decreased. A roundabout virtually eliminates right-angle and left-turn head-on crashes. Studies have shown the frequency of injury crashes is reduced more than property damage only crashes.

At a roundabout, drivers must be aware of traffic traveling around the circle when merging on or off the roundabout. Conversely, drivers at a traditional intersection must be aware of vehicles at all approaches and the movements they are making. This issue is most prevalent at stop-controlled intersections where there is not a traffic signal to control vehicle movements.

Planning-Level Cost Analysis

Capital Costs

The intersection is currently all-way stop controlled, therefore with a "no build" alternative there would be no cost to continue with this type of intersection control. The "road diet" variation with Balcerzak Drive as a three-lane roadway would involve removing and installing new pavement markings within the existing roadway curb lines. This type of restriping project would need to be performed along a large portion of Balcerzak Drive, outside the focus are of this project. Therefore no additional costs for conversion of the Balcerzak Drive pavement markings to a three-lane roadway were assumed. It is likely this restriping project would be undertaken as part of a mill and overlay project. The traffic signal control alternative can utilize the existing geometric conditions, therefore the cost for this alternative would only be the cost of installing a traffic signal system, along with ADA improvements. The roundabout control alternative would require substantial reconstruction at and leading up to the intersection, which results in a much higher cost than the traffic signal control alternative.

Operation and Maintenance Costs

Traffic signals typically have higher operation and maintenance costs than roundabouts because of the electricity required to operate the signal and routine maintenance required to keep the signal in operation. Operation and maintenance costs associated with a roundabout can vary depending on the amount of illumination required or landscaping alternatives used for the center island. All-way stop control operation and maintenance costs are only the ongoing costs of maintaining the stop signs and pavement markings.

A cost analysis summary is shown in Table 8. Detailed cost analysis results can be found in the Appendix.

Table 8. Cost Analysis Summary

Alternative	Capital Costs (1)	Operation/Maintenance Costs (annual)
All-Way Stop Control	$0	< $200
Traffic Signal Control	$300,000	$4,000-$6,000
Roundabout Control	$1,390,000	$500-$1,000

(1) Does not include engineering or right-of-way costs.

Alternatives Assessment

Right-of-Way Considerations

The roadway geometry for the all-way stop control and traffic signal control alternatives, including the "road diet" variation, would use existing conditions and therefore no additional right-of-way would be required. Construction of a roundabout at the study intersection would require additional right-of-way in all four quadrants of the intersection. The fire station property in the northwest quadrant would be impacted the most with the trail potentially coming within approximately ten feet of the building.

Transportation System Considerations

There is an existing traffic signal approximately one-third of a mile east of the study intersection at the Balcerzak Drive and Victory Drive intersection, and an existing traffic signal half of a mile to the west of study intersection at the Balcerzak Drive and Monks Avenue intersection. The traffic signal control alternative would provide the opportunity for coordination with the Victory Drive signal. The traffic signal control alternative would extend the intersection control continuity along Balcerzak Drive. The roundabout control alternative could be considered a traffic calming measure for the surrounding residential area.

Pedestrian and Bicycle Considerations

Currently, there are trails/sidewalks on the north side of Balcerzak Drive, the south side of Balcerzak Drive to the west of Pohl Road, and the west side of Pohl Road. Pohl Road also has shoulders that are used as bike lanes. Jaycee Park in the northwest quadrant contributes to high pedestrian activity. Pedestrian accommodations can be provided regardless of selected intersection control.

The design of a roundabout allows pedestrians to cross one direction of traffic at a time with a refuge space in the middle of each leg of the roundabout, and these short crossing distances and reduced travel speeds of traffic improve pedestrian safety. Their route is slightly longer since they are kept to the outside of the inscribed circle. The roundabout concept design shown includes slip ramps to transition bicyclists between on-street bike lanes and multi-use trails around the perimeter of the roundabout.

The design of signalized intersections can create a safe environment for pedestrian crossings with the use of pedestrian signal phasing. This phasing allows pedestrians to safely cross an intersection while vehicular movements are served. Although signalized intersections can provide indications showing pedestrian right-of-way, potential conflicts can come from red-light running through vehicles and permissive turning traffic.

The all-way stop alternative would provide a safety benefit for pedestrians by having all vehicular movements stop; however, there are safety concerns for pedestrians where all road users expect other road users to stop. Most vehicle-pedestrian collisions at all-way stop controlled intersections are a result of either vehicles not stopping when pedestrians assume they are, or pedestrians not paying attention to vehicles approaching the intersection.

Local Acceptance

Drivers are familiar with traveling through all-way stop controlled and signalized intersections since there are many intersections in the area under these types of traffic control. Drivers are also familiar with traveling through roundabout controlled intersections since there are many existing roundabouts throughout the Mankato area including one nearby at Stadium Road and Victory Drive.

Conclusions and Recommendations

The following conclusions are provided for this intersection control evaluation for the Balcerzak Drive at Pohl Road intersection in Mankato, Blue Earth County, Minnesota:

- *Warrants Analysis*
  Results of the warrants analysis indicate that Existing Year 2016 volumes do not satisfy any MN MUTCD traffic signal warrants, while Forecasted Year 2036 volumes satisfy the MN MUTCD warrant requirements for traffic signal Warrants 1 (Conditions A and C), 2, and 3B. The intersection meets multi-way stop warrants in 2016 and 2036.

- *Operational Analysis*
  Results of the operational analysis indicate that under the existing all-way stop control, the intersection operates with an acceptable level of service, and would continue to do so under Forecasted Year 2036 conditions. However, with a three-lane Balcerzak Drive, all-way stop control would have an unacceptable level of service during the p.m. peak under Forecasted Year 2036 volumes. The traffic signal control and roundabout control alternatives would operate with acceptable levels of service under forecasted conditions. There is no significant difference in operations for traffic signal control with Balcerzak Drive being a four-lane or three-lane roadway.

- *Safety Analysis*
  Based on the results of the crash analysis, the roundabout control alternative is anticipated to have slightly less crashes than the traffic signal control alternative. Roundabouts typically have fewer conflict points than conventional intersections and the geometry of a roundabout induces lower speeds for vehicles approaching and traversing an intersection. With lower speeds, the severity of the crashes is decreased.

- *Planning-Level Cost Analysis*
  There would be no cost to continue with the existing all-way stop control. The traffic signal control alternative can utilize the existing geometric conditions, therefore the cost for this alternative would only be the cost of installing a traffic signal system, along with ADA improvements, which would be approximately $300,000. The roundabout control alternative would require substantial reconstruction at and leading up to the intersection, which results in a much higher cost estimate of approximately $1,390,000. Traffic signals typically have higher operation and maintenance costs because of the electricity required to operate the signal and routine maintenance required to keep the signal in operation. Operation and maintenance costs associated with a roundabout can vary depending on the amount of illumination required or landscaping alternatives used for the center island. Stop control operation and maintenance costs are only the ongoing costs of maintaining the stop signs and pavement markings.

- *Right-of-Way Considerations*
  The roadway geometry for the all-way stop control and traffic signal control alternatives, including the "road diet" variation, would use existing conditions and therefore no

additional right-of-way would be required. Construction of a roundabout at the study intersection would require additional right-of-way in all four quadrants of the intersection. The fire station property in the northwest quadrant would be impacted the most with the trail potentially coming within approximately ten feet of the building.

- *Transportation System Considerations*
  The traffic signal control alternative would extend the intersection control continuity along Balcerzak Drive, and would provide the opportunity for coordination with the Victory Drive signal. The roundabout control alternative could be considered a traffic calming measure for the surrounding residential area.

- *Pedestrian Considerations*
  The design of signalized intersections can take pedestrian crossings and safety into consideration with the use of pedestrian signal phasing. The design of a roundabout allows pedestrians to cross one direction of traffic at a time on each leg of the roundabout. Their route is slightly longer since they are kept to the outside of the inscribed circle. All-way stop control provides a safety benefit for pedestrians by having all vehicular movements stop; however, most vehicle-pedestrian collisions at all-way stop controlled intersections are a result of either vehicles not stopping when pedestrians assume they are, or pedestrians not paying attention to vehicles approaching the intersection.

- *Local Acceptance*
  Drivers are familiar with traveling through signalized intersections since there are many intersections in the area under this type of traffic control. Drivers are also familiar with traveling through roundabout controlled intersections since there are many existing roundabouts throughout the Mankato area.

A decision matrix was developed to help evaluate the key factors and is provided on the following page. Based on the results of this Intersection Control Evaluation, we recommend the Balcerzak Drive at Pohl Road intersection remain under all-way stop control and monitor crashes for one to two years. If the crash problem persists, then we recommend converting Balcerzak Drive to a three-lane roadway to improve safety in the near-term. However, this configuration would have unacceptable operations by Forecasted Year 2036. The traffic signal control and roundabout control alternatives are both viable long-term options for the intersection in either a four-lane or three-lane Balcerzak Drive roadway configuration, with a roundabout fitting seamlessly into the three-lane configuration. The traffic signal control and roundabout control alternatives have comparable operations in both existing and Forecasted Year 2036. Compared to a traffic signal, a roundabout would have more consistent off-peak operations throughout the day when traffic volumes are lower. A roundabout would have more capital and right-of-way costs, but would have lower annual operation and maintenance costs. Therefore, the roundabout control alternative is recommended.

Alternatives Decision Matrix: Balcerzak Drive at Pohl Road

Balcerzak Drive Four-Lane Roadway

Factor		All-Way Stop Control	Traffic Signal Control	Roundabout Control	Recommended Alternative(s) Based on Factor
Warrants Analysis	2016	• AWSC warrant met	• Existing Year 2016 volumes do not meet traffic signal control warrants	N/A	All-Way Stop Control Roundabout Control
	2036	• AWSC warrant met	• Forecasted Year 2036 volumes meet traffic signal control warrants	N/A	All-Way Stop Control Traffic Signal Control Roundabout Control
Operational Analysis	2016	• Acceptable LOS	• Acceptable LOS	• Acceptable LOS • Consistent off-peak operations	All-Way Stop Control Traffic Signal Control Roundabout Control
	2036	• Acceptable LOS with four-lane Balcerzak Drive	• Acceptable LOS	• Acceptable LOS	
Safety Analysis	Pro(s):	• Least number of crashes expected • Lower vehicle speeds through intersection	• Signal indications show vehicle right-of-way	• Least number of crashes expected • Lower vehicle speeds through intersection	All-Way Stop Control Roundabout Control
	Con(s):	• Drivers decide right-of-way	• Slightly more crashes expected than all-way stop or roundabout	• Drivers select acceptable gaps	
Cost Analysis	Pro(s):	• No cost • Low operation/maintenance costs	• Lower capital costs ($300,000) than roundabout control	• Lower operation/maintenance costs than traffic signal control	All-Way Stop Control
	Con(s):	none	• Higher capital costs than all-way stop • Higher operation/maintenance costs than roundabout control	• Higher capital costs ($1,390,000) than all-way stop or traffic signal control • Requires substantial roadway reconstruction	
Right-of-Way	Pro(s):	N/A (existing control)	• No ROW impacts	none	All-Way Stop Control Traffic Signal Control
	Con(s):		none	• Requires additional ROW in all four quadrants	
Transportation System Considerations	Pro(s):	N/A (existing control)	• Provides control continuity along Balcerzak Drive	• Traffic calming through residential area	All-Way Stop Control Traffic Signal Control Roundabout Control
	Con(s):		none	none	
Pedestrian and Bicycle Considerations	Pro(s):	• All vehicular movements stop	• Pedestrian pushbuttons and signal phasing	• Pedestrian Refuge islands • Bike slip ramps • Lower vehicle speeds thru intersection	Traffic Signal Control Roundabout Control
	Con(s):	• Expecting vehicles to yield to pedestrians can lead to a false sense of security	• Pedestrian signal phasing can lead to a false sense of security	• Longer pedestrian route • No pedestrian phase	
Local Acceptance	Pro(s):	N/A (existing control)	• Familiar to drivers	• Familiar to drivers	All-Way Stop Control Traffic Signal Control Roundabout Control
	Con(s):		none	none	

Balcerzak Drive Three-Lane Roadway

Operational Analysis	2016	• Acceptable LOS	• Acceptable LOS	• Acceptable LOS	Traffic Signal Control Roundabout Control
	2036	• Unacceptable p.m. peak LOS with Balcerzak three-lane variation	• Acceptable LOS	• Acceptable LOS	
Safety Analysis	Pro(s):	• Vehicular safety benefits with only one opposing thru lane	• Vehicular safety benefits with only one opposing thru lane	• Vehicular safety benefits with no thru lane drop before roundabout	All-Way Stop Control Traffic Signal Control Roundabout Control
	Con(s):	• None	• None	• None	

Appendix

- 2011-2015 Crash History
- Existing Year 2016 Warrants Analysis
- Forecasted Year 2036 Warrants Analysis
- Existing Year 2016 Detailed Operational Analysis
- Forecasted Year 2036 Detailed Operational Analysis
- Detailed Cost Analysis

2011-2015 Crash History

Crash Detail Report

Balcerzak Drive and Pohl Road

Report Version 1.0 March 2010

Crash ID: 110430113 **Date:** 02/12/2011 **Time:** 1148
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: WET
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: CLOUDY

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	N	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	SPORT UNTILITY VEHICLE	
Age:	23	50	
Gender:	F	F	
Cond:	NORMAL	NORMAL	
Cont Fact 1	DISREGARD TRAFFIC DEVICE	NO IMPROPER DRIVING	
Cont Fact 2	FAIL TO YIELD ROW	NO IMPROPER DRIVING	

Crash ID: 110600140 **Date:** 01/25/2011 **Time:** 0855
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	SE	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	22	20	
Gender:	F	M	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 113400128 **Date:** 12/06/2011 **Time:** 1454
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: CLEAR

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	N	W	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	3+AXLE SINGLE UNIT	PICKUP TRUCK	
Age:	39	18	
Gender:	M	F	
Cond:	NORMAL	NORMAL	
Cont Fact 1	NO IMPROPER DRIVING	FAIL TO YIELD ROW	
Cont Fact 2	NO IMPROPER DRIVING	VISION OBSCURED - SUN OR HEA	

Crash ID: 120520226 **Date:** 12/12/2011 **Time:** 1730
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.776

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: SUNSET
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit:
Diagram: REAR END
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	W	W	
Veh Act:	STOPPED TRAFFIC	SLOWING TRAFFIC	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	81	20	
Gender:	F	M	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 120540155 **Date:** 01/09/2012 **Time:** 1434
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: SIDESWIPE PASSING
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	E	
Veh Act:	CHANGING LANES	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	25	20	
Gender:	M	M	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 121140043 **Date:** 03/20/2012 **Time:** 1355
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: WET
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: SIDESWIPE OPPOSING
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	W	S	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	VAN OR MINIVAN	
Age:	20	52	
Gender:	M	M	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 121290067 **Date:** 04/04/2012 **Time:** 1720
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: NOT CODED
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	W	S	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PICKUP TRUCK	
Age:	21	22	
Gender:	F	F	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 121750130 **Date:** 06/23/2012 **Time:** 1934
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	N	E	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	900	67	
Gender:	UNK	F	
Cond:	UNKNOWN	NORMAL	
Cont Fact 1	DISREGARD TRAFFIC DEVICE	NO IMPROPER DRIVING	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 122640009 **Date:** 09/19/2012 **Time:** 1823
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: INTERSECTION-RELATED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: LEFT TURN INTO TRAFFIC
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	S	E	
Veh Act:	LEFT TURN	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	64	19	
Gender:	M	M	
Cond:	NORMAL	NORMAL	
Cont Fact 1	IMPROPER LANE	NO IMPROPER DRIVING	
Cont Fact 2	IMPROPER TURN	NOT SPECIFIED	

Crash ID: 132250126 **Date:** 08/13/2013 **Time:** 1433
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	N	
Veh Act:	START TRAFFIC	START TRAFFIC	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	21	59	
Gender:	F	F	
Cond:	NORMAL	NORMAL	
Cont Fact 1	FAIL TO YIELD ROW	NO IMPROPER DRIVING	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 133150095 **Date:** 11/11/2013 **Time:** 0903
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/SIGN POLE
Surf Cond: ICE/PACKED SNOW
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RAN OFF ROAD - RIGHT SIDE
Officer:
Reliability: CONFIDENT
# of Vehicles: 1.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	S		
Veh Act:	STRAIGHT AHEAD		
Veh Type:	VAN OR MINIVAN		
Age:	56		
Gender:	F		
Cond:	NORMAL		
Cont Fact 1	NO IMPROPER DRIVING		
Cont Fact 2	NOT SPECIFIED		

Crash ID: 133160186 **Date:** 11/12/2013 **Time:** 1627
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: SIDESWIPE PASSING
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	N	W	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	34	82	
Gender:	M	M	
Cond:	NORMAL	NORMAL	
Cont Fact 1	NO IMPROPER DRIVING	VISION OBSCURED - SUN OR HEA	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 140660056 **Date:** 01/28/2014 **Time:** 1015
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 3.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	W	N	EAST
Veh Act:	STOPPED TRAFFIC	STRAIGHT AHEAD	STRAIGHT AHEAD
Veh Type:	PASSENGER CAR	PASSENGER CAR	PASSENGER CAR
Age:	80	17	902
Gender:	M	M	NULL
Cond:	NOT SPECIFIED	NOT SPECIFIED	NOT SPECIFIED
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	NOT SPECIFIED
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	NOT SPECIFIED

Crash ID: 140700101 **Date:** 02/09/2014 **Time:** 1830
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DARK - STREET LIGHTS ON
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	S	E	
Veh Act:	START TRAFFIC	STRAIGHT AHEAD	
Veh Type:	SPORT UNTILITY VEHICLE	SPORT UNTILITY VEHICLE	
Age:	64	41	
Gender:	M	M	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 140910119 **Date:** 02/22/2014 **Time:** 1220
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: POSSIBLE INJURY
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: SLUSH
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: SIDESWIPE PASSING
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	E	
Veh Act:	STRAIGHT AHEAD	SLOWING TRAFFIC	
Veh Type:	SPORT UNTILITY VEHICLE	VAN OR MINIVAN	
Age:	20	902	
Gender:	F	NULL	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 140910177 **Date:** 02/28/2014 **Time:** 2115
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: ICE/PACKED SNOW
Light Cond: DARK - STREET LIGHTS ON
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: SIDESWIPE OPPOSING
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	W	N	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	36	20	
Gender:	M	M	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 142170153 **Date:** 08/05/2014 **Time:** 1336
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLEAR
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: REAR END
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	E	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PICKUP TRUCK	
Age:	32	50	
Gender:	F	M	
Cond:	UNDER THE INFLUENCE	NORMAL	
Cont Fact 1	FOLLOWING TOO CLOSELY	NO IMPROPER DRIVING	
Cont Fact 2	CHEMICAL IMPAIRMENT	NOT SPECIFIED	

Crash ID: 142810021 **Date:** 10/07/2014 **Time:** 1211
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: SIDESWIPE OPPOSING
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	W	
Veh Act:	LEFT TURN	STRAIGHT AHEAD	
Veh Type:	FARM EQUIPMENT	PASSENGER CAR	
Age:	20	18	
Gender:	M	F	
Cond:	NORMAL	NORMAL	
Cont Fact 1	NO IMPROPER DRIVING	DISTRACTION	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 143460053 **Date:** 11/07/2014 **Time:** 0938
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.782

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: DRY
Light Cond: DAYLIGHT
Weather 1: CLOUDY
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	S	E	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	57	19	
Gender:	M	F	
Cond:	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 1	NOT SPECIFIED	NOT SPECIFIED	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 152070097 **Date:** 07/26/2015 **Time:** 0327
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: POSSIBLE INJURY
Road Type: 2 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: WET
Light Cond: DARK - STREET LIGHTS ON
Weather 1: RAIN
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	EAST	S	
Veh Act:	STRAIGHT AHEAD	STRAIGHT AHEAD	
Veh Type:	PASSENGER CAR	PASSENGER CAR	
Age:	32	17	
Gender:	F	M	
Cond:	NORMAL	NORMAL	
Cont Fact 1	FAIL TO YIELD ROW	NO IMPROPER DRIVING	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 152480105 **Date:** 09/04/2015 **Time:** 1940
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200140 000+00.783

Severity: POSSIBLE INJURY
Road Type: 4_6 LANES UNDIV 2_WAY
Road Char: STRAIGHT AND LEVEL
Crash Type: COLL W/PERDESTRIAN
Surf Cond: WET
Light Cond: DARK - STREET LIGHTS ON
Weather 1: RAIN
Weather 2: NOT SPECIFIED

First Event: ON ROADWAY
To Junction: 4-LEGGED INTERSECTION
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 40
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 1.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	N	S	
Veh Act:	LEFT TURN	PEDESTRIAN IN CROSSWALK	
Veh Type:	PASSENGER CAR	SKATER	
Age:		19	
Gender:	NULL	M	
Cond:	UNKNOWN	NORMAL	
Cont Fact 1	UNKNOWN	NO IMPROPER DRIVING	
Cont Fact 2	NOT SPECIFIED	NOT SPECIFIED	

Crash ID: 160280014 **Date:** 12/28/2015 **Time:** 1946
County: BLUE EARTH **City:** MANKATO

Sys: 05-MSAS
Route: 24200113 001+00.770

Severity: PROPERTY DAMAGE
Road Type: NOT SPECIFIED
Road Char: NOT SPECIFIED
Crash Type: COLL W/MV IN TRANSPORT
Surf Cond: SNOW
Light Cond: DARK - STREET LIGHTS ON
Weather 1: SNOW
Weather 2: NOT SPECIFIED

First Event: NOT SPECIFIED
To Junction: NOT SPECIFIED
Traffic Device: STOP SIGN 4-WAY
Speed Limit: 30
Diagram: RIGHT ANGLE
Officer:
Reliability: CONFIDENT
# of Vehicles: 2.00

	Unit 1	Unit 2	Unit 3
Trav Dir:	N		
Veh Act:	STRAIGHT AHEAD		
Veh Type:	SPORT UNTILITY VEHICLE		
Age:	30		
Gender:	M		
Cond:	NOT SPECIFIED		
Cont Fact 1	NOT SPECIFIED		
Cont Fact 2	NOT SPECIFIED		

Selection Filter:

WORK AREA: Statewide - FILTER: CRASH_YEAR('2011','2012','2013','2014','2015'), TRAFFIC_CONTROL_DEVICE_CODE('03') - SPATIAL FILTER APPLIED

Analyst:

Luke James

Notes:

Existing Year 2016 Warrants Analysis

SRF Consulting Group, Inc.

WARRANTS ANALYSIS

Existing Year 2016

Balcerzak Drive at Pohl Road
Intersection Control Evaluation Studies
MAPO

Background Information

		Speed (mph)	Lanes	Approach	
Location :	MAPO	40	2 or more	Major Approach 1:	Eastbound Balcerzak Drive
Date:	9/28/2016	40	2 or more	Major Approach 3:	Westbound Balcerzak Drive
Analysis Prepared By:	Luke James	30	1	Minor Approach 2:	Northbound Pohl Road
Population Less than 10,000:	No	30	1	Minor Approach 4:	Southbound Pohl Road
Seventy Percent Factor Used:	No				

Warrants Analysis: Warrants 1A, 1B and 1C

Hour	Major Approach 1	Major Approach 3	Total 1 + 3	Warrant Met 600	Warrant Met 900	Minor Approach 2	Minor Approach 4	Largest Minor App.	Warrant Met 150	Warrant Met 75	Met Same Hours Condition A	Met Same Hours Condition B	Combination A	Combination B	MWSA (C) 300	MWSA (C) 200
6 - 7 AM	92	57	149			140	46	140		X						
7 - 8 AM	187	213	400			313	118	313	X	X					X	X
8 - 9 AM	155	229	384			217	130	217	X	X					X	X
9 - 10 AM	137	178	315			150	73	150	X	X					X	X
10 - 11 AM	173	211	384			164	92	164	X	X					X	X
11 - 12 AM	217	244	461			189	121	189	X	X					X	X
12 - 1 PM	261	311	572			215	135	215	X	X			X		X	X
1 - 2 PM	245	295	540			212	123	212	X	X			X		X	X
2 - 3 PM	313	303	616	X		253	150	253	X	X	X		X		X	X
3 - 4 PM	340	399	739	X		256	158	256	X	X	X		X	X	X	X
4 - 5 PM	390	399	789	X		336	183	336	X	X	X		X	X	X	X
5 - 6 PM	330	487	817	X		263	201	263	X	X	X		X	X	X	X
6 - 7 PM	261	410	671	X		217	142	217	X	X	X		X		X	X
7 - 8 PM	231	354	585			193	153	193	X	X			X		X	X
8 - 9 PM	215	351	566			135	125	135		X			X		X	X
9 - 10 PM	174	284	458			104	91	104		X					X	
10 - 11 PM	95	195	290			76	64	76		X						
											5	0	9	3	14	

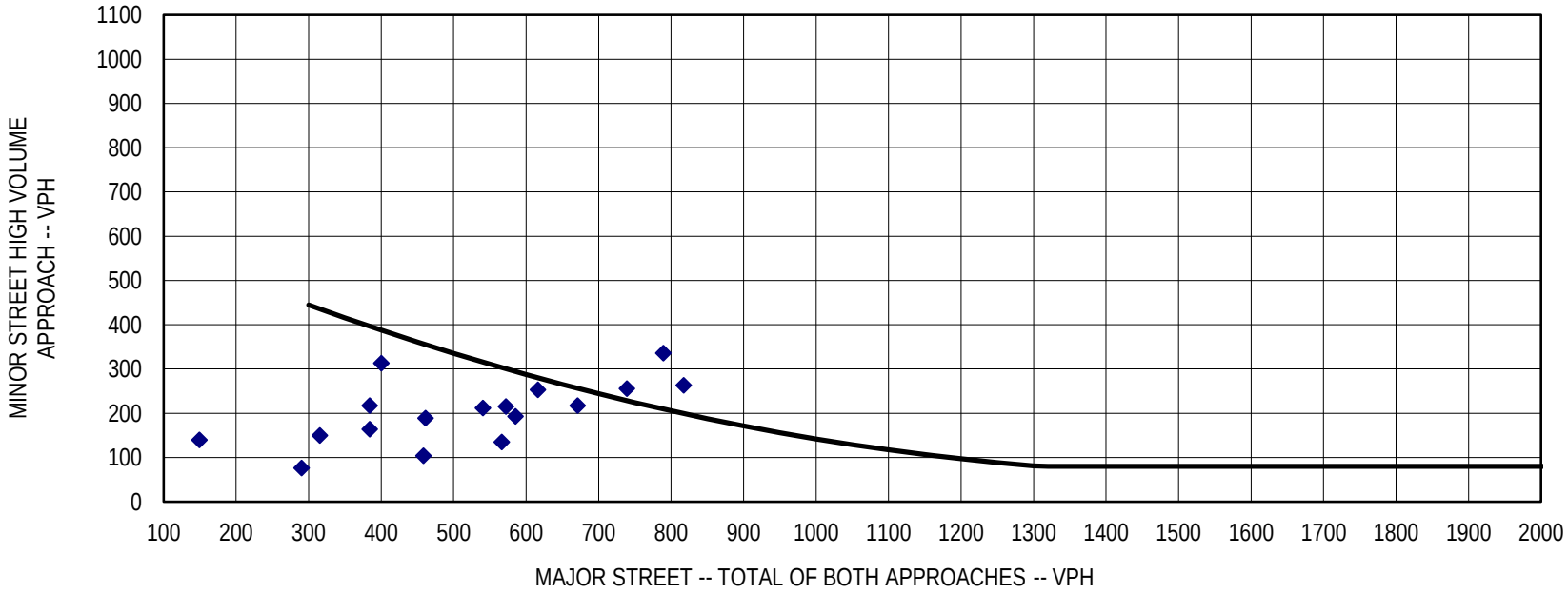
Warrant Summary

Warrant and Description		Hours Met	Hours Required	Met/Not Met
Warrant 1A:	Minimum Vehicular Volume	5	8	Not Met
Warrant 1B:	Interruption of Continuous Traffic	0	8	Not Met
Warrant 1C:	Combination of Warrants	3	8	Not Met
Warrant 2:	Four-Hour Vehicular Volume	3	4	Not Met
Warrant 3B:	Peak Hour	0	1	Not Met
MWSA (C):	Multiway Stop Applications Condition C	14	8	Met - Multiway Stop Applications

Balcerzak Drive at Pohl Road
Intersection Control Evaluation Studies
MAPO

Warrants Analysis: Warrant 2

WARRANT 2 - FOUR-HOUR VEHICULAR VOLUME



Number of Hours Satisfying Requirements:	3

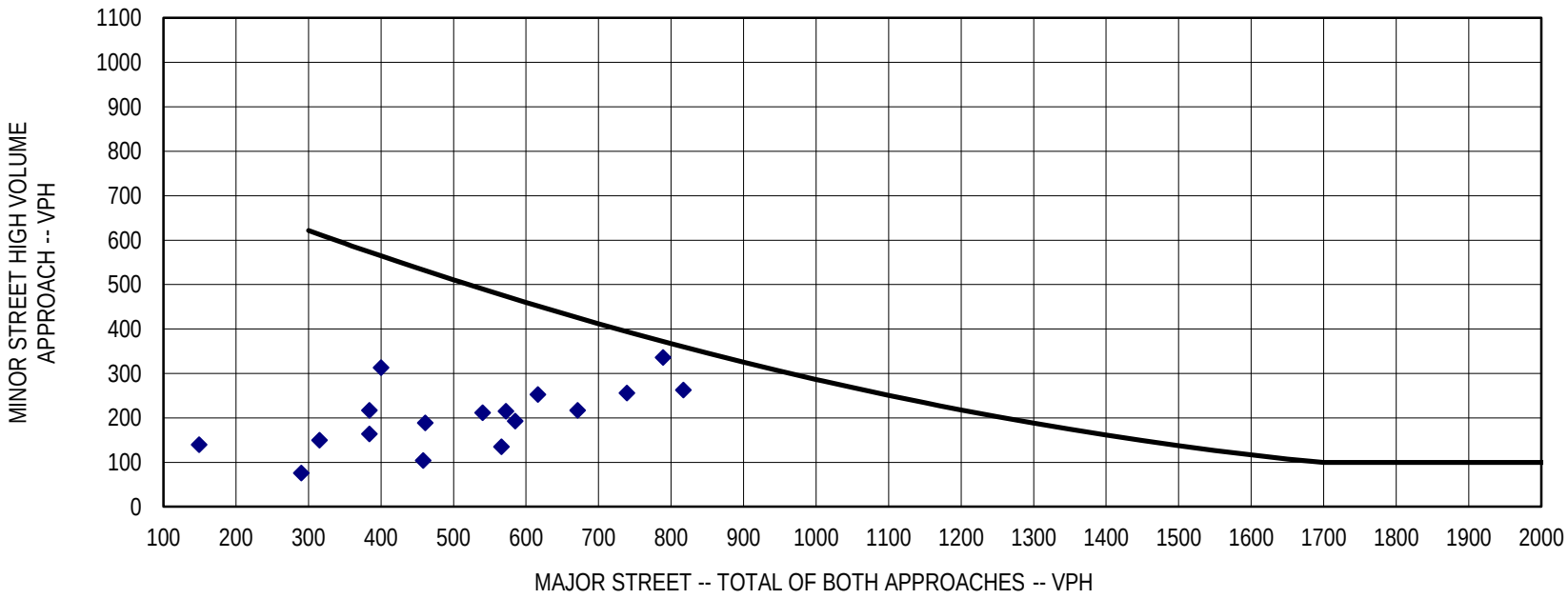
Notes: 1. 115 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 80 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

WARRANTS ANALYSIS

Existing Year 2016

Balcerzak Drive at Pohl Road
Intersection Control Evaluation Studies
MAPO

Warrants Analysis: Warrant 3



Number of Hours Satisfying Requirements:	0

Notes: 1. 150 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

Forecasted Year 2036 Warrants Analysis

SRF Consulting Group, Inc.

WARRANTS ANALYSIS

Forecasted Year 2036

Balcerzak Drive at Pohl Road
Intersection Control Evaluation Studies
MAPO

Background Information

Location :	MAPO	Speed (mph)	Lanes	Approach	
Date:	9/28/2016	40	2 or more	Major Approach 1:	Eastbound Balcerzak Drive
Analysis Prepared By:	Luke James	40	2 or more	Major Approach 3:	Westbound Balcerzak Drive
Population Less than 10,000:	No	30	1	Minor Approach 2:	Northbound Pohl Road
Seventy Percent Factor Used:	No	30	1	Minor Approach 4:	Southbound Pohl Road

Warrants Analysis: Warrants 1A, 1B and 1C

Hour	Major Approach 1	Major Approach 3	Total 1 + 3	Warrant Met 600	Warrant Met 900	Minor Approach 2	Minor Approach 4	Largest Minor App.	Warrant Met 150	Warrant Met 75	Met Same Hours Condition A	Met Same Hours Condition B	Combination A	Combination B	MWSA (C) 300	MWSA (C) 200
6 - 7 AM	119	75	194			184	54	184	X	X						X
7 - 8 AM	242	281	523			413	139	413	X	X			X		X	X
8 - 9 AM	201	302	503			286	153	286	X	X			X		X	X
9 - 10 AM	177	235	412			197	86	197	X	X					X	X
10 - 11 AM	224	279	503			216	109	216	X	X			X		X	X
11 - 12 AM	282	322	604	X		249	142	249	X	X	X		X		X	X
12 - 1 PM	339	410	749	X		284	159	284	X	X	X		X	X	X	X
1 - 2 PM	319	389	708	X		279	145	279	X	X	X		X		X	X
2 - 3 PM	407	400	807	X		333	176	333	X	X	X		X	X	X	X
3 - 4 PM	442	526	968	X	X	337	186	337	X	X	X	X	X	X	X	X
4 - 5 PM	507	527	1034	X	X	444	215	444	X	X	X	X	X	X	X	X
5 - 6 PM	429	643	1072	X	X	347	237	347	X	X	X	X	X	X	X	X
6 - 7 PM	339	541	880	X		286	167	286	X	X	X		X	X	X	X
7 - 8 PM	300	467	767	X		254	180	254	X	X	X		X	X	X	X
8 - 9 PM	280	463	743	X		178	148	178	X	X	X		X	X	X	X
9 - 10 PM	226	375	601	X		137	107	137		X			X		X	X
10 - 11 PM	123	257	380			100	76	100		X					X	
											10	3	14	8	15	

Warrant Summary

Warrant and Description		Hours Met	Hours Required	Met/Not Met
Warrant 1A:	Minimum Vehicular Volume	10	8	Met - Warrant 1A Satisfied
Warrant 1B:	Interruption of Continuous Traffic	3	8	Not Met
Warrant 1C:	Combination of Warrants	8	8	Met - Warrant 1C Satisfied
Warrant 2:	Four-Hour Vehicular Volume	9	4	Met - Warrant 2 Satisfied
Warrant 3B:	Peak Hour	3	1	Met - Warrant 3B Satisfied
MWSA (C):	Multiway Stop Applications Condition C	15	8	Met - Multiway Stop Applications

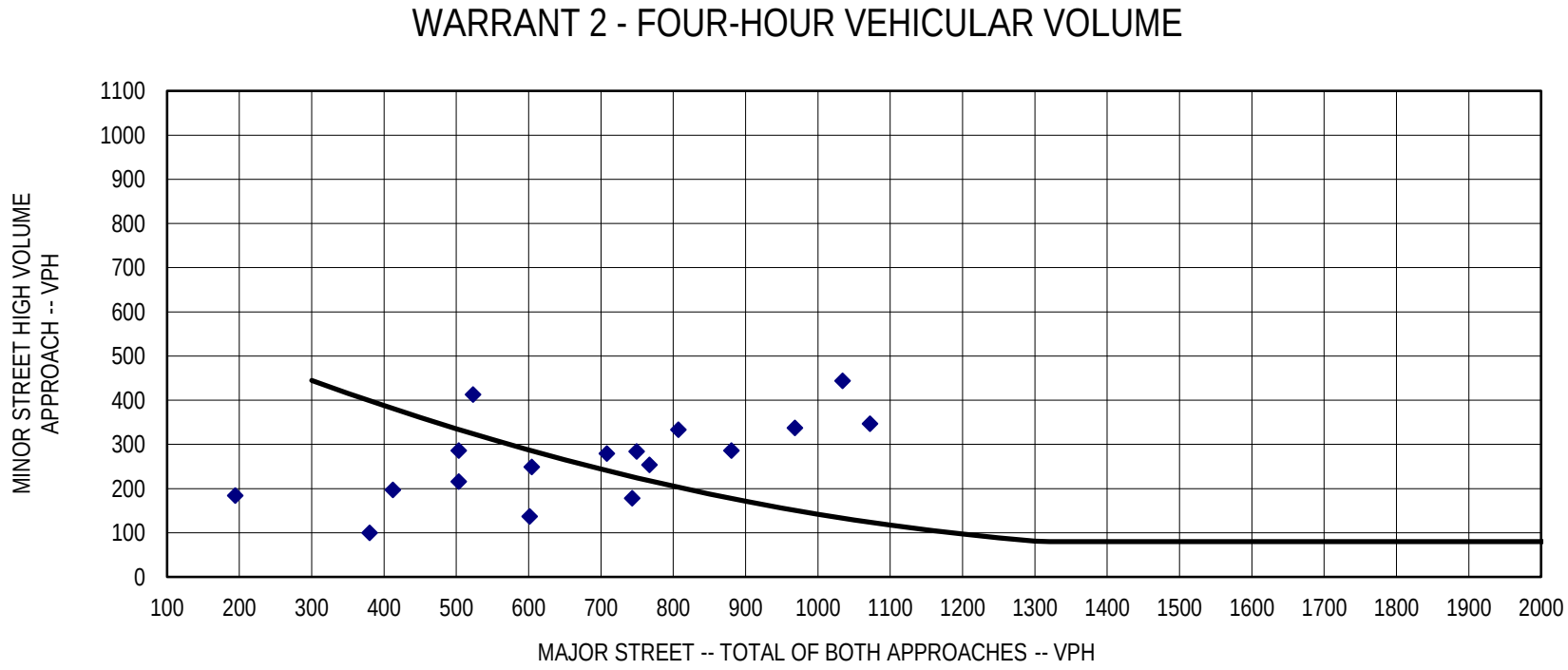
SRF Consulting Group, Inc.

WARRANTS ANALYSIS

Forecasted Year 2036

Balcerzak Drive at Pohl Road
Intersection Control Evaluation Studies
MAPO

Warrants Analysis: Warrant 2



Number of Hours Satisfying Requirements:	9

Notes: 1. 115 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 80 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

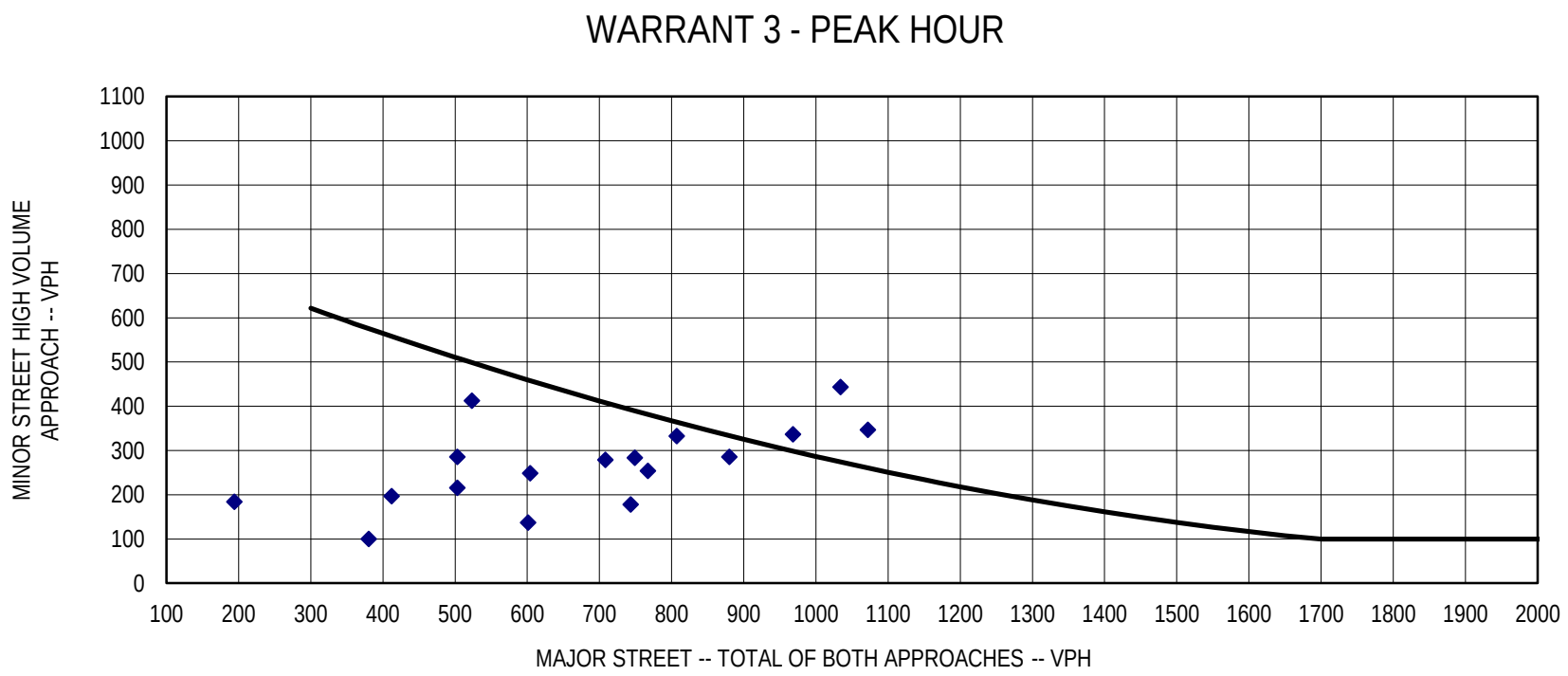
SRF Consulting Group, Inc.

WARRANTS ANALYSIS

Forecasted Year 2036

Balcerzak Drive at Pohl Road
Intersection Control Evaluation Studies
MAPO

Warrants Analysis: Warrant 3



Number of Hours Satisfying Requirements:	3

Notes: 1. 150 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

Existing Year 2016 Detailed Operational Analysis

All-Way Stop Control (Existing)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.1
Denied Del/Veh (s)	0.1	0.1	0.6	0.4	0.4
Total Delay (hr)	0.5	0.6	0.9	0.3	2.3
Total Del/Veh (s)	8.9	9.0	8.9	7.0	8.6
Stop Delay (hr)	0.2	0.3	0.5	0.2	1.2
Stop Del/Veh (s)	3.9	4.0	5.6	3.9	4.5
Total Stops	203	253	349	142	947
Stop/Veh	1.00	0.99	0.99	1.00	0.99

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	73	56	96	63	82	182	31	85
Average Queue (ft)	41	24	45	22	23	67	7	40
95th Queue (ft)	63	48	75	51	63	128	28	66
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)						3		0
Queuing Penalty (veh)						1		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.1	0.2	0.6	0.7	0.3
Total Delay (hr)	1.2	1.6	0.7	0.5	4.1
Total Del/Veh (s)	11.6	12.6	8.8	9.1	10.9
Stop Delay (hr)	0.6	0.9	0.5	0.3	2.3
Stop Del/Veh (s)	5.7	6.9	6.0	5.8	6.2
Total Stops	379	445	303	210	1337
Stop/Veh	0.99	1.00	0.99	1.00	1.00

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	112	87	155	97	44	133	51	102
Average Queue (ft)	58	38	76	36	19	65	20	52
95th Queue (ft)	94	68	125	69	46	107	48	84
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)						1		0
Queuing Penalty (veh)						0		0

Existing Year 2016 Detailed Operational Analysis

All-Way Stop Control (Balcerzak Three-Lane)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.1	0.0	0.2
Denied Del/Veh (s)	0.5	1.6	0.7	0.4	0.9
Total Delay (hr)	0.6	0.6	0.9	0.3	2.3
Total Del/Veh (s)	10.2	8.8	8.9	7.1	8.9
Stop Delay (hr)	0.3	0.3	0.5	0.2	1.2
Stop Del/Veh (s)	4.6	3.9	5.6	4.1	4.7
Total Stops	204	256	343	133	936
Stop/Veh	1.00	1.00	0.99	0.99	0.99

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	33	92	69	89	49	157	31	82
Average Queue (ft)	12	47	34	43	23	69	8	42
95th Queue (ft)	36	77	57	73	48	119	30	69
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)						3		0
Queuing Penalty (veh)						1		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.2	0.0	0.0	0.4
Denied Del/Veh (s)	0.5	1.8	0.6	0.7	1.0
Total Delay (hr)	1.8	1.4	0.9	0.6	4.8
Total Del/Veh (s)	17.0	11.6	11.0	10.1	12.8
Stop Delay (hr)	1.1	0.8	0.7	0.4	3.0
Stop Del/Veh (s)	10.4	6.1	8.2	6.8	7.9
Total Stops	377	445	301	214	1337
Stop/Veh	0.99	0.99	0.99	1.00	0.99

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	37	201	91	126	66	177	56	122
Average Queue (ft)	16	89	48	64	20	73	21	56
95th Queue (ft)	41	158	76	105	53	130	49	98
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)		1				3		1
Queuing Penalty (veh)		0				1		0

Existing Year 2016 Detailed Operational Analysis

Traffic Signal Control (Balcerzak Four-Lane)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.1
Denied Del/Veh (s)	0.1	0.1	0.7	0.4	0.4
Total Delay (hr)	0.4	0.8	1.0	0.3	2.6
Total Del/Veh (s)	8.0	11.3	10.5	9.0	10.0
Stop Delay (hr)	0.3	0.5	0.7	0.2	1.7
Stop Del/Veh (s)	4.8	7.3	7.1	6.6	6.6
Total Stops	86	141	219	79	525
Stop/Veh	0.44	0.55	0.62	0.59	0.56

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	92	50	148	68	83	187	31	108
Average Queue (ft)	42	13	61	13	24	83	7	43
95th Queue (ft)	79	39	110	43	61	147	27	83
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)					0	4		0
Queuing Penalty (veh)					0	2		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.1
Denied Del/Veh (s)	0.1	0.2	0.6	0.7	0.3
Total Delay (hr)	0.9	1.7	1.0	0.8	4.5
Total Del/Veh (s)	8.9	13.8	12.0	14.5	12.1
Stop Delay (hr)	0.5	1.1	0.8	0.7	3.0
Stop Del/Veh (s)	5.1	8.8	9.1	11.3	8.2
Total Stops	159	269	196	142	766
Stop/Veh	0.43	0.61	0.65	0.67	0.58

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	126	79	186	145	59	167	53	151
Average Queue (ft)	65	26	97	30	19	79	21	69
95th Queue (ft)	107	63	152	85	50	138	50	123
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)					0	4		2
Queuing Penalty (veh)					0	1		1

Existing Year 2016 Detailed Operational Analysis

Traffic Signal Control (Balcerzak Three-Lane)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.1	0.0	0.2
Denied Del/Veh (s)	0.5	1.6	0.7	0.4	0.8
Total Delay (hr)	0.5	0.8	1.0	0.4	2.7
Total Del/Veh (s)	9.5	11.2	10.5	9.3	10.3
Stop Delay (hr)	0.3	0.5	0.7	0.3	1.8
Stop Del/Veh (s)	5.6	7.7	7.2	6.9	7.0
Total Stops	97	138	214	79	528
Stop/Veh	0.48	0.55	0.61	0.56	0.56

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	41	114	88	118	70	195	40	102
Average Queue (ft)	9	49	40	47	21	84	9	43
95th Queue (ft)	32	93	77	90	56	147	33	84
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)						4		0
Queuing Penalty (veh)						2		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.2	0.0	0.0	0.4
Denied Del/Veh (s)	0.5	1.8	0.6	0.7	1.0
Total Delay (hr)	2.0	1.4	1.3	0.9	5.5
Total Del/Veh (s)	18.4	11.1	15.3	16.1	14.9
Stop Delay (hr)	1.3	0.9	1.0	0.8	3.9
Stop Del/Veh (s)	12.0	7.2	12.1	13.0	10.6
Total Stops	242	239	212	145	838
Stop/Veh	0.63	0.54	0.71	0.69	0.63

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	50	221	120	161	72	189	79	145
Average Queue (ft)	13	119	58	65	23	92	23	69
95th Queue (ft)	40	195	100	125	58	159	58	123
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)		1		0	0	6	0	3
Queuing Penalty (veh)		0		0	0	2	0	1

Existing Year 2016 Detailed Operational Analysis

Roundabout Control (HCS)

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Luke James*	Intersection	*Balcerzak Drive at Pohl Road*
Agency or Co.	*SRF Consulting Group, Inc.*	E/W Street Name	*Balcerzak Drive*
Date Performed	*8/5/2016*	N/S Street Name	*Pohl Road*
Time Period	*A.M. Peak*	Analysis Year	*2016*
Peak Hour Factor	*1.00*	Project ID	*9243*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Lane Assignment			*LTR*				*LTR*				*LTR*				*LTR*	
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h	*15*	*165*	*20*	*0*	*90*	*160*	*5*	*0*	*35*	*175*	*135*	*0*	*10*	*100*	*30*	*0*
Heavy Veh. Adj. (f_{HV}), %	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*	

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*204*			*229*			*193*			*291*		
Exiting Flow (V_{ex}), pc/h	*316*			*229*			*199*			*214*		
Entry Flow (V_e), pc/h		*204*			*260*			*352*			*143*	
Entry Volume veh/h		*200*			*255*			*345*			*140*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*921*			*898*			*931*			*845*	
Capacity (*c*), veh/h		*903*			*881*			*913*			*828*	
v/c Ratio (X)		*0.22*			*0.29*			*0.38*			*0.17*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*6.2*			*7.2*			*8.2*			*6.1*	
Lane LOS		*A*			*A*			*A*			*A*	
Lane 95% Queue		*0.8*			*1.2*			*1.8*			*0.6*	
Approach Delay, s/veh	*6.22*			*7.19*			*8.21*			*6.08*		
Approach LOS, s/veh	*A*			*A*			*A*			*A*		
Intersection Delay, s/veh	*7.19*											
Intersection LOS	*A*											

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Luke James*	Intersection	*Balcerzak Drive at Pohl Road*
Agency or Co.	*SRF Consulting Group, Inc.*	E/W Street Name	*Balcerzak Drive*
Date Performed	*8/5/2016*	N/S Street Name	*Pohl Road*
Time Period	*P.M. Peak*	Analysis Year	*2016*
Peak Hour Factor	*1.00*	Project ID	*9243*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Lane Assignment			*LTR*				*LTR*				*LTR*				*LTR*	
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h	*20*	*330*	*25*	*0*	*170*	*270*	*5*	*0*	*30*	*130*	*145*	*0*	*30*	*140*	*40*	*0*
Heavy Veh. Adj. (f_{HV}), %	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*	

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*347*			*184*			*388*			*479*		
Exiting Flow (V_{ex}), pc/h	*515*			*347*			*158*			*342*		
Entry Flow (V_e), pc/h		*383*			*454*			*311*			*214*	
Entry Volume veh/h		*375*			*445*			*305*			*210*	

Capacity and v/c Ratios

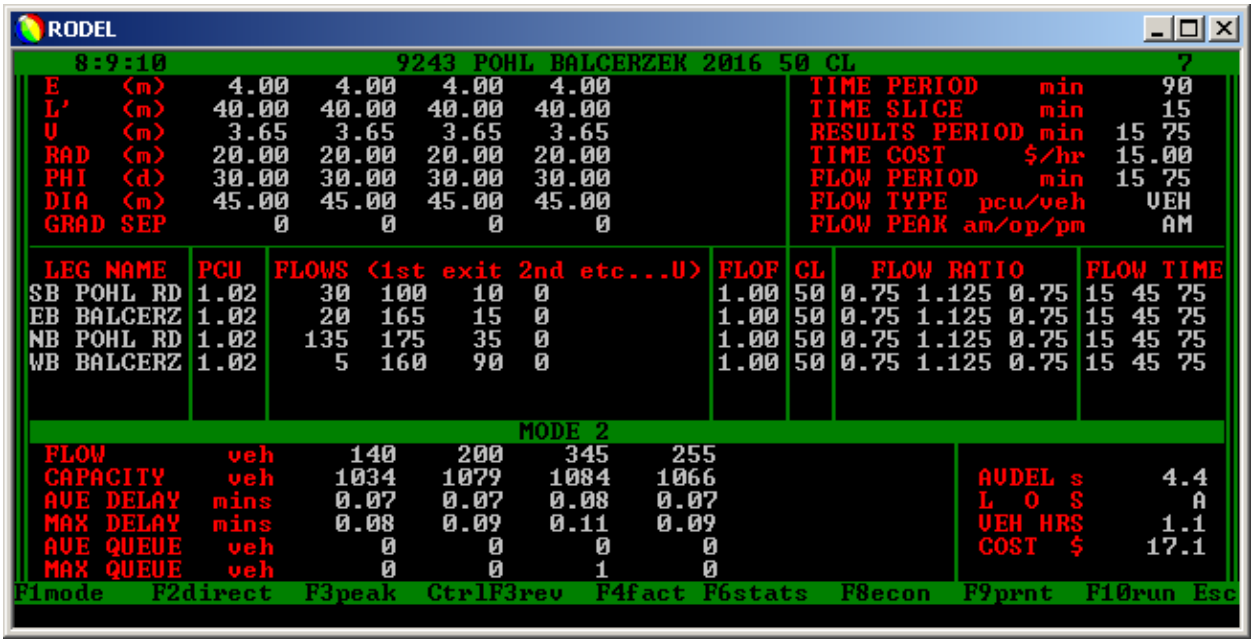
	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*799*			*940*			*767*			*700*	
Capacity (*c*), veh/h		*783*			*922*			*752*			*686*	
v/c Ratio (X)		*0.48*			*0.48*			*0.41*			*0.31*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*11.2*			*9.9*			*10.0*			*9.1*	
Lane LOS		*B*			*A*			*B*			*A*	
Lane 95% Queue		*2.6*			*2.7*			*2.0*			*1.3*	
Approach Delay, s/veh	*11.16*			*9.91*			*10.04*			*9.07*		
Approach LOS, s/veh	*B*			*A*			*B*			*A*		
Intersection Delay, s/veh	*10.16*											
Intersection LOS	*B*											

Existing Year 2016 Detailed Operational Analysis

Roundabout Control (RODEL)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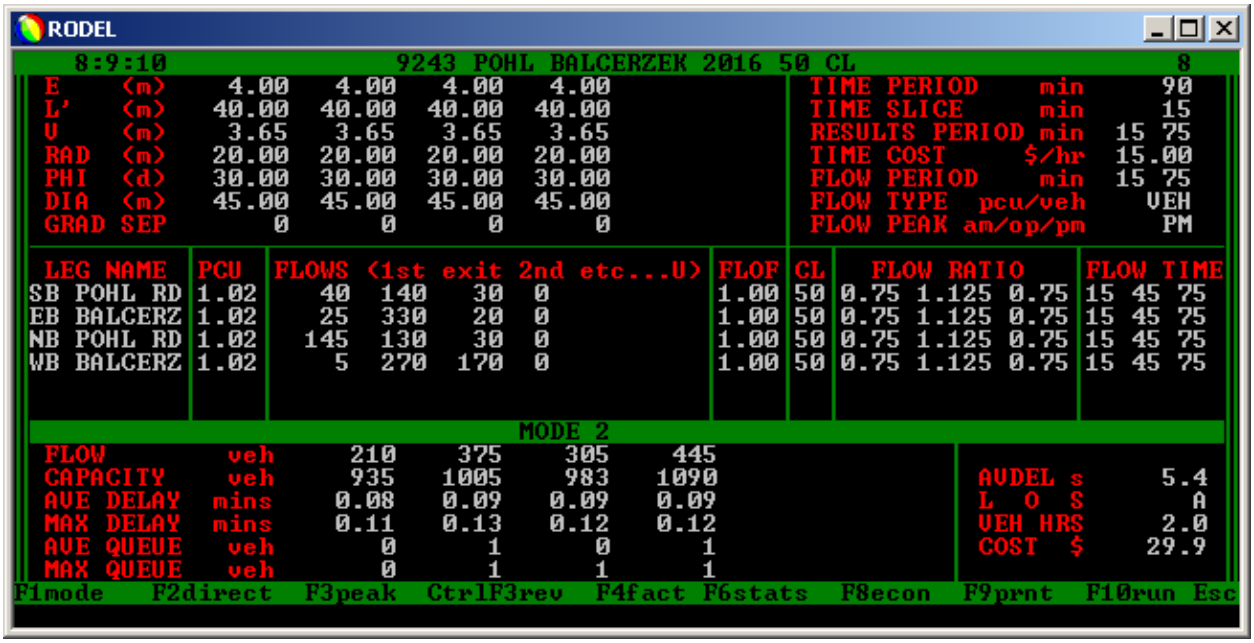
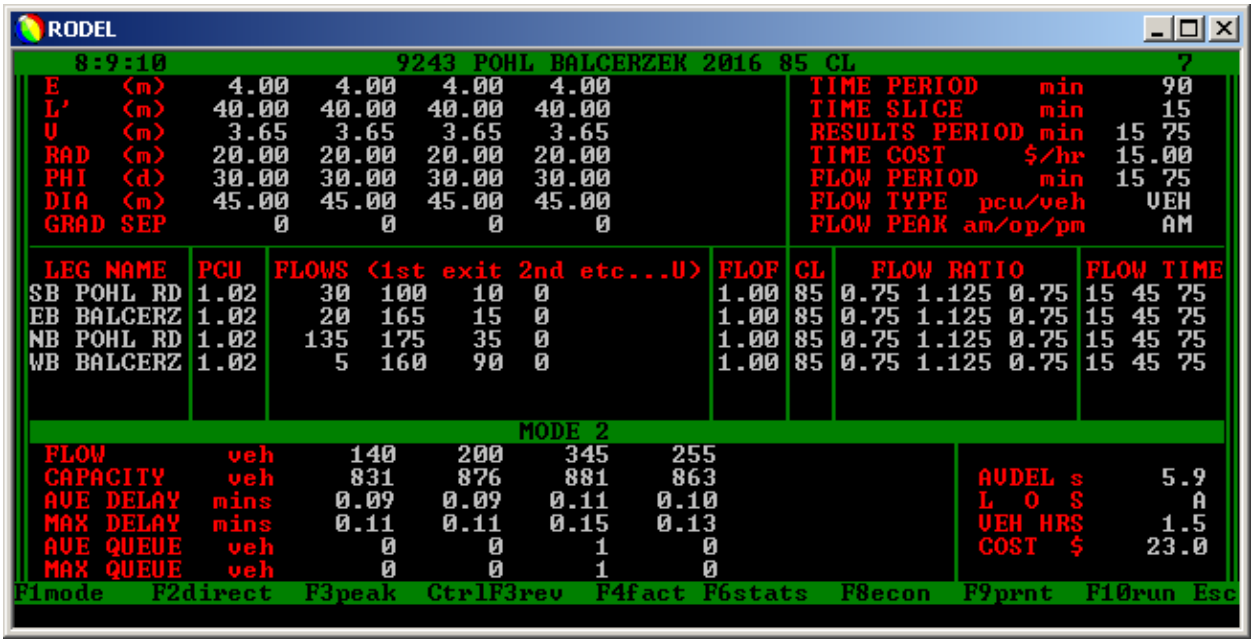
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm AM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 30 100 10 0 1.00 50 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 20 165 15 0 1.00 50 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 135 175 35 0 1.00 50 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 5 160 90 0 1.00 50 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 140 200 345 255
CAPACITY veh 1034 1079 1084 1066
AVE DELAY mins 0.07 0.07 0.08 0.07
MAX DELAY mins 0.08 0.09 0.11 0.09
AVE QUEUE veh 0 0 0 0
MAX QUEUE veh 0 0 1 0
AVDEL s 4.4
L O S A
VEH HRS 1.1
COST $ 17.1
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc


RODEL
8:9:10 9243 POHL BALCERZEK 2016 50 CL 8
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm PM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 40 140 30 0 1.00 50 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 25 330 20 0 1.00 50 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 145 130 30 0 1.00 50 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 5 270 170 0 1.00 50 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 210 375 305 445
CAPACITY veh 935 1005 983 1090
AVE DELAY mins 0.08 0.09 0.09 0.09
MAX DELAY mins 0.11 0.13 0.12 0.12
AVE QUEUE veh 0 1 0 1
MAX QUEUE veh 0 1 1 1
AVDEL s 5.4
L O S A
VEH HRS 2.0
COST $ 29.9
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc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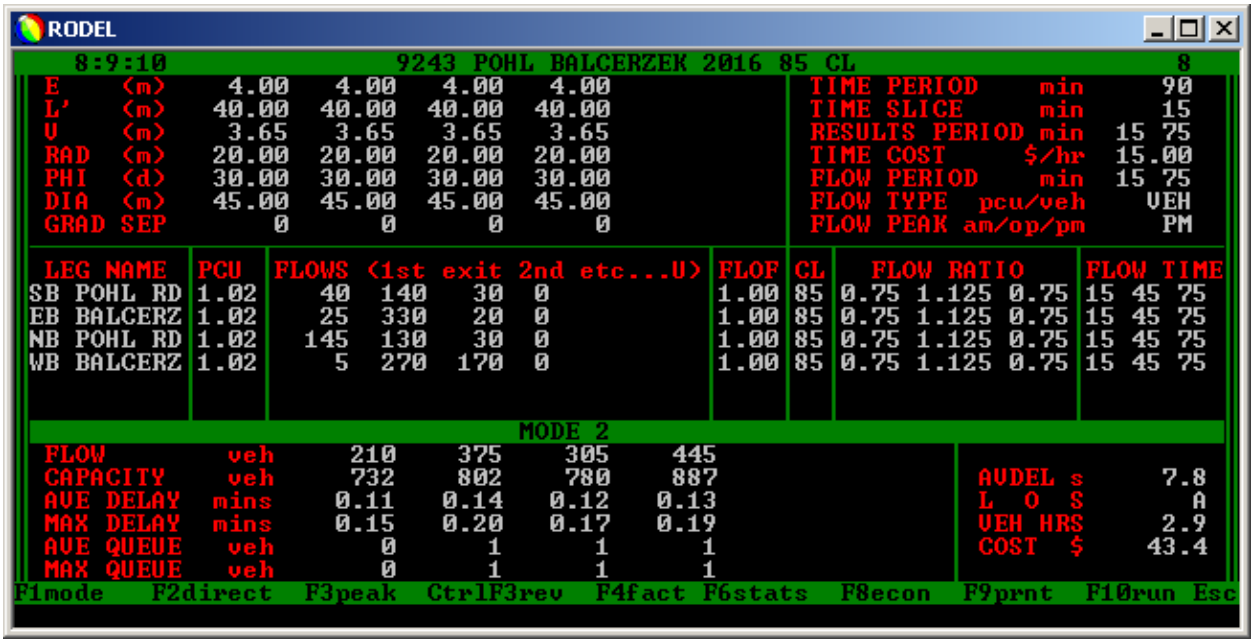
8:9:10 9243 POHL BALCERZEK 2016 85 CL 7
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm AM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 30 100 10 0 1.00 85 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 20 165 15 0 1.00 85 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 135 175 35 0 1.00 85 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 5 160 90 0 1.00 85 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 140 200 345 255
CAPACITY veh 831 876 881 863
AVE DELAY mins 0.09 0.09 0.11 0.10
MAX DELAY mins 0.11 0.11 0.15 0.13
AVE QUEUE veh 0 0 1 0
MAX QUEUE veh 0 0 1 0
AVDEL s 5.9
L O S A
VEH HRS 1.5
COST $ 23.0
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc


RODEL
8:9:10 9243 POHL BALCERZEK 2016 85 CL 8
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm PM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 40 140 30 0 1.00 85 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 25 330 20 0 1.00 85 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 145 130 30 0 1.00 85 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 5 270 170 0 1.00 85 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 210 375 305 445
CAPACITY veh 732 802 780 887
AVE DELAY mins 0.11 0.14 0.12 0.13
MAX DELAY mins 0.15 0.20 0.17 0.19
AVE QUEUE veh 0 1 1 1
MAX QUEUE veh 0 1 1 1
AVDEL s 7.8
L O S A
VEH HRS 2.9
COST $ 43.4
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc

Forecasted Year 2036 Detailed Operational Analysis

All-Way Stop Control (No Build)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.1
Denied Del/Veh (s)	0.1	0.2	0.7	0.4	0.4
Total Delay (hr)	0.8	1.1	3.0	0.4	5.3
Total Del/Veh (s)	10.4	12.4	22.7	8.6	15.4
Stop Delay (hr)	0.4	0.6	2.6	0.3	3.9
Stop Del/Veh (s)	5.1	7.1	19.9	5.4	11.3
Total Stops	264	326	472	168	1230
Stop/Veh	1.00	1.00	1.01	0.99	1.00

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	88	62	151	110	200	494	31	101
Average Queue (ft)	47	30	62	29	43	133	7	47
95th Queue (ft)	74	55	117	67	139	372	29	77
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)					0	19		0
Queuing Penalty (veh)					0	11		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.2
Denied Del/Veh (s)	0.1	0.2	0.7	0.7	0.4
Total Delay (hr)	2.3	3.8	1.8	0.9	8.7
Total Del/Veh (s)	16.9	22.1	15.5	12.4	17.8
Stop Delay (hr)	1.5	2.7	1.4	0.6	6.3
Stop Del/Veh (s)	10.7	16.1	12.6	9.2	12.8
Total Stops	495	627	406	248	1776
Stop/Veh	1.00	1.02	0.99	1.00	1.01

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	164	136	273	236	90	211	52	144
Average Queue (ft)	83	53	131	82	29	101	24	64
95th Queue (ft)	134	96	234	185	72	181	50	112
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)					0	12	0	2
Queuing Penalty (veh)					0	5	0	1

Forecasted Year 2036 Detailed Operational Analysis

All-Way Stop Control (Balcerzak Three-Lane)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.1	0.0	0.3
Denied Del/Veh (s)	0.5	1.6	0.8	0.4	0.9
Total Delay (hr)	1.0	1.0	3.5	0.4	5.9
Total Del/Veh (s)	13.3	10.6	27.4	8.7	17.3
Stop Delay (hr)	0.5	0.5	3.2	0.3	4.5
Stop Del/Veh (s)	7.4	5.4	25.1	5.5	13.4
Total Stops	257	321	469	168	1215
Stop/Veh	1.00	0.99	1.01	0.99	1.00

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	42	157	82	112	173	531	33	102
Average Queue (ft)	15	60	38	52	49	149	9	48
95th Queue (ft)	40	112	63	87	152	421	33	80
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)						0		
Queuing Penalty (veh)						0		
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)		0			0	22		0
Queuing Penalty (veh)		0			0	12		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	6.8	0.3	0.1	0.0	7.2
Denied Del/Veh (s)	50.1	1.8	0.7	0.7	14.9
Total Delay (hr)	26.6	3.1	4.0	1.0	34.7
Total Del/Veh (s)	196.5	18.9	34.6	13.9	71.4
Stop Delay (hr)	27.3	2.1	3.8	0.7	33.9
Stop Del/Veh (s)	201.1	12.9	32.7	10.6	69.7
Total Stops	335	589	416	250	1590
Stop/Veh	0.69	0.99	1.00	0.99	0.91

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	600	948	168	213	199	386	52	142
Average Queue (ft)	179	692	69	99	49	161	22	67
95th Queue (ft)	618	1151	123	171	152	337	49	111
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)		32						
Queuing Penalty (veh)		0						
Storage Bay Dist (ft)	500		200		100		100	
Storage Blk Time (%)		65	0	1		39		2
Queuing Penalty (veh)		16	1	3		16		1

Forecasted Year 2036 Detailed Operational Analysis

Traffic Signal Control (Balcerzak Four-Lane)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.1
Denied Del/Veh (s)	0.1	0.2	0.8	0.4	0.4
Total Delay (hr)	0.7	1.3	2.3	0.5	4.8
Total Del/Veh (s)	9.9	14.2	17.7	10.7	14.2
Stop Delay (hr)	0.4	0.9	1.6	0.4	3.3
Stop Del/Veh (s)	6.2	9.6	12.6	8.1	9.8
Total Stops	125	198	329	91	743
Stop/Veh	0.48	0.61	0.70	0.57	0.61

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	114	61	166	114	162	392	46	124
Average Queue (ft)	54	21	78	23	35	137	8	50
95th Queue (ft)	96	52	139	75	109	322	33	99
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)						0		
Queuing Penalty (veh)						0		
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)					0	13		1
Queuing Penalty (veh)					0	7		0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.2
Denied Del/Veh (s)	0.1	0.2	0.6	0.7	0.4
Total Delay (hr)	1.5	3.9	1.7	1.1	8.2
Total Del/Veh (s)	11.0	23.3	15.1	15.5	16.8
Stop Delay (hr)	0.9	2.8	1.3	0.8	5.9
Stop Del/Veh (s)	6.7	16.8	11.3	12.3	12.0
Total Stops	231	458	275	164	1128
Stop/Veh	0.47	0.76	0.68	0.67	0.64

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	TR	L	TR
Maximum Queue (ft)	156	124	283	249	112	234	77	183
Average Queue (ft)	87	41	162	89	25	112	25	78
95th Queue (ft)	137	89	263	210	64	192	59	141
Link Distance (ft)	966	966	966	966		960		960
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)					100		100	
Storage Blk Time (%)					0	10		4
Queuing Penalty (veh)					0	4		1

Forecasted Year 2036 Detailed Operational Analysis

Traffic Signal Control (Balcerzak Three-Lane)

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.1	0.0	0.3
Denied Del/Veh (s)	0.6	1.6	0.7	0.4	0.9
Total Delay (hr)	0.9	1.4	1.6	0.5	4.4
Total Del/Veh (s)	12.7	15.3	12.5	10.2	13.0
Stop Delay (hr)	0.6	1.0	1.1	0.4	3.0
Stop Del/Veh (s)	8.0	11.1	8.2	7.7	8.9
Total Stops	141	201	287	95	724
Stop/Veh	0.54	0.61	0.62	0.57	0.59

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	55	164	137	149	160	262	49	121
Average Queue (ft)	15	67	54	63	30	116	9	51
95th Queue (ft)	42	128	105	120	90	210	35	98
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)		0		0	0	9	0	1
Queuing Penalty (veh)		0		0	0	5	0	0

2: Pohl Road & Balcerzak Drive Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.3	0.1	0.0	0.5
Denied Del/Veh (s)	0.6	1.8	0.7	0.7	1.0
Total Delay (hr)	3.2	2.4	2.9	1.6	10.0
Total Del/Veh (s)	22.8	14.7	24.8	23.1	20.6
Stop Delay (hr)	2.1	1.6	2.3	1.3	7.4
Stop Del/Veh (s)	14.9	10.0	20.0	19.5	15.1
Total Stops	334	343	332	179	1188
Stop/Veh	0.67	0.58	0.80	0.72	0.68

Intersection: 2: Pohl Road & Balcerzak Drive

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	59	316	183	203	199	300	90	171
Average Queue (ft)	17	167	85	91	39	151	31	89
95th Queue (ft)	47	266	145	163	114	254	72	150
Link Distance (ft)		966		966		966		966
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		200		100		100	
Storage Blk Time (%)		4	0	0	0	24	0	7
Queuing Penalty (veh)		1	2	1	0	10	0	2

Forecasted Year 2036 Detailed Operational Analysis

Roundabout Control (HCS)

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Luke James*	Intersection	*Balcerzak Drive at Pohl Road*
Agency or Co.	*SRF Consulting Group, Inc.*	E/W Street Name	*Balcerzak Drive*
Date Performed	*8/5/2016*	N/S Street Name	*Pohl Road*
Time Period	*A.M. Peak*	Analysis Year	*2036*
Peak Hour Factor	*1.00*	Project ID	*9243*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Lane Assignment			*LTR*				*LTR*				*LTR*				*LTR*	
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h	*20*	*210*	*25*	*0*	*115*	*210*	*5*	*0*	*45*	*235*	*175*	*0*	*10*	*120*	*35*	*0*
Heavy Veh. Adj. (f_{HV}), %	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*	

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*249*			*306*			*244*			*377*		
Exiting Flow (V_{ex}), pc/h	*403*			*296*			*265*			*265*		
Entry Flow (V_e), pc/h		*260*			*337*			*464*			*168*	
Entry Volume veh/h		*255*			*330*			*455*			*165*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*880*			*832*			*885*			*775*	
Capacity (*c*), veh/h		*863*			*816*			*867*			*760*	
v/c Ratio (X)		*0.30*			*0.40*			*0.52*			*0.22*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*7.4*			*9.4*			*11.3*			*7.1*	
Lane LOS		*A*			*A*			*B*			*A*	
Lane 95% Queue		*1.2*			*2.0*			*3.1*			*0.8*	
Approach Delay, s/veh	*7.39*			*9.40*			*11.26*			*7.13*		
Approach LOS, s/veh	*A*			*A*			*B*			*A*		
Intersection Delay, s/veh	*9.37*											
Intersection LOS	*A*											

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Luke James*	Intersection	*Balcerzak Drive at Pohl Road*
Agency or Co.	*SRF Consulting Group, Inc.*	E/W Street Name	*Balcerzak Drive*
Date Performed	*8/5/2016*	N/S Street Name	*Pohl Road*
Time Period	*P.M. Peak*	Analysis Year	*2036*
Peak Hour Factor	*1.00*	Project ID	*9243*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Lane Assignment			*LTR*				*LTR*				*LTR*				*LTR*	
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h	*25*	*430*	*30*	*0*	*220*	*355*	*10*	*0*	*40*	*170*	*190*	*0*	*35*	*165*	*45*	*0*
Heavy Veh. Adj. (f_{HV}), %	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*		*3.1858*	*3.1858*	

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*428*			*240*			*501*			*627*		
Exiting Flow (V_{ex}), pc/h	*668*			*449*			*209*			*423*		
Entry Flow (V_e), pc/h		*495*			*597*			*408*			*250*	
Entry Volume veh/h		*485*			*585*			*400*			*245*	

Capacity and v/c Ratios

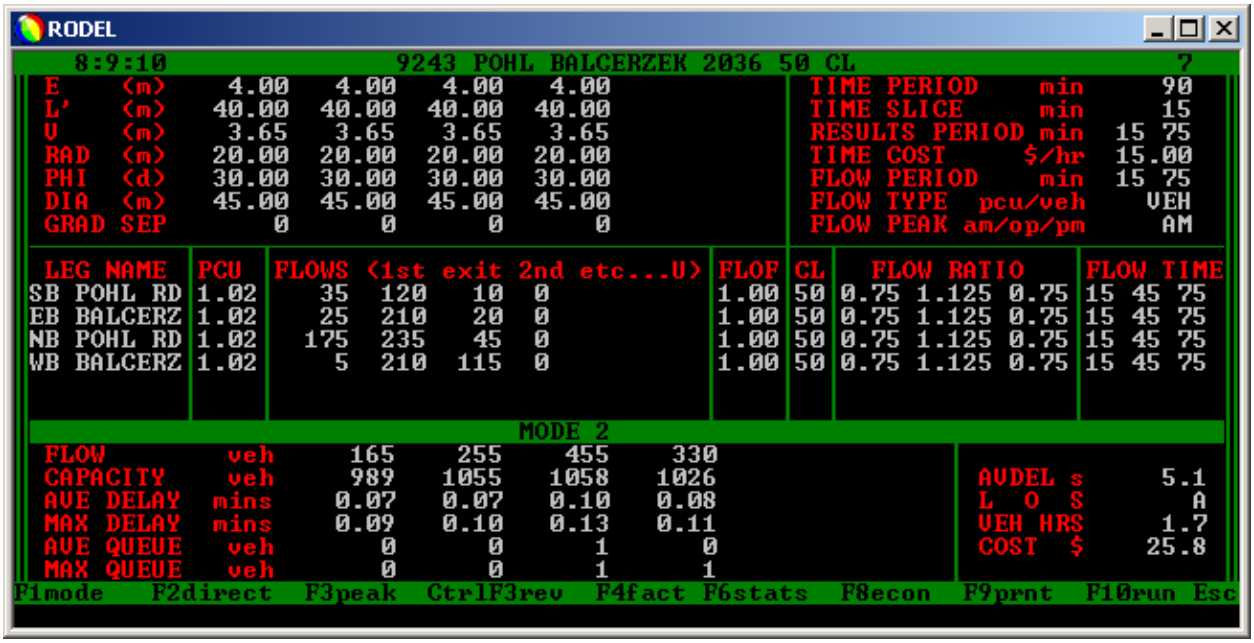
	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*736*			*889*			*686*			*603*	
Capacity (*c*), veh/h		*722*			*872*			*672*			*592*	
v/c Ratio (X)		*0.67*			*0.67*			*0.60*			*0.41*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*17.9*			*15.5*			*15.9*			*12.4*	
Lane LOS		*C*			*C*			*C*			*B*	
Lane 95% Queue		*5.2*			*5.3*			*4.0*			*2.0*	
Approach Delay, s/veh	*17.95*			*15.48*			*15.90*			*12.38*		
Approach LOS, s/veh	*C*			*C*			*C*			*B*		
Intersection Delay, s/veh	*15.83*											
Intersection LOS	*C*											

Forecasted Year 2036 Detailed Operational Analysis

Roundabout Control (RODEL)


RODEL
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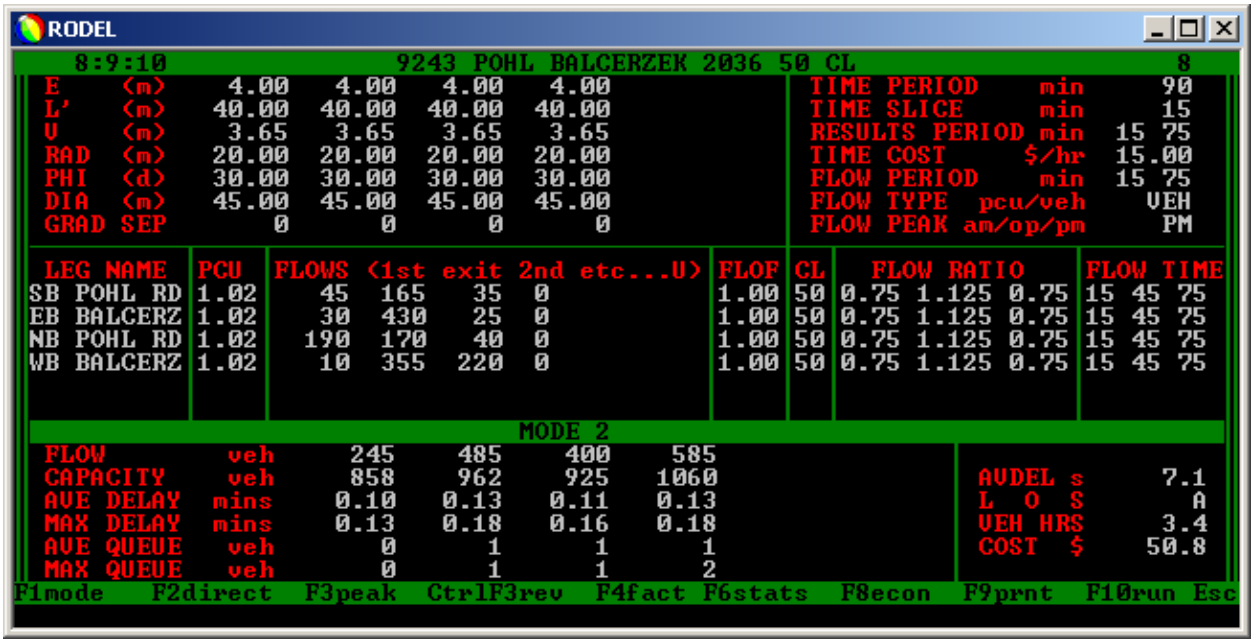
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm AM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 35 120 10 0 1.00 50 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 25 210 20 0 1.00 50 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 175 235 45 0 1.00 50 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 5 210 115 0 1.00 50 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 165 255 455 330
CAPACITY veh 989 1055 1058 1026
AVE DELAY mins 0.07 0.07 0.10 0.08
MAX DELAY mins 0.09 0.10 0.13 0.11
AVE QUEUE veh 0 0 1 0
MAX QUEUE veh 0 0 1 1
AVDEL s 5.1
L O S A
VEH HRS 1.7
COST $ 25.8
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc


RODEL
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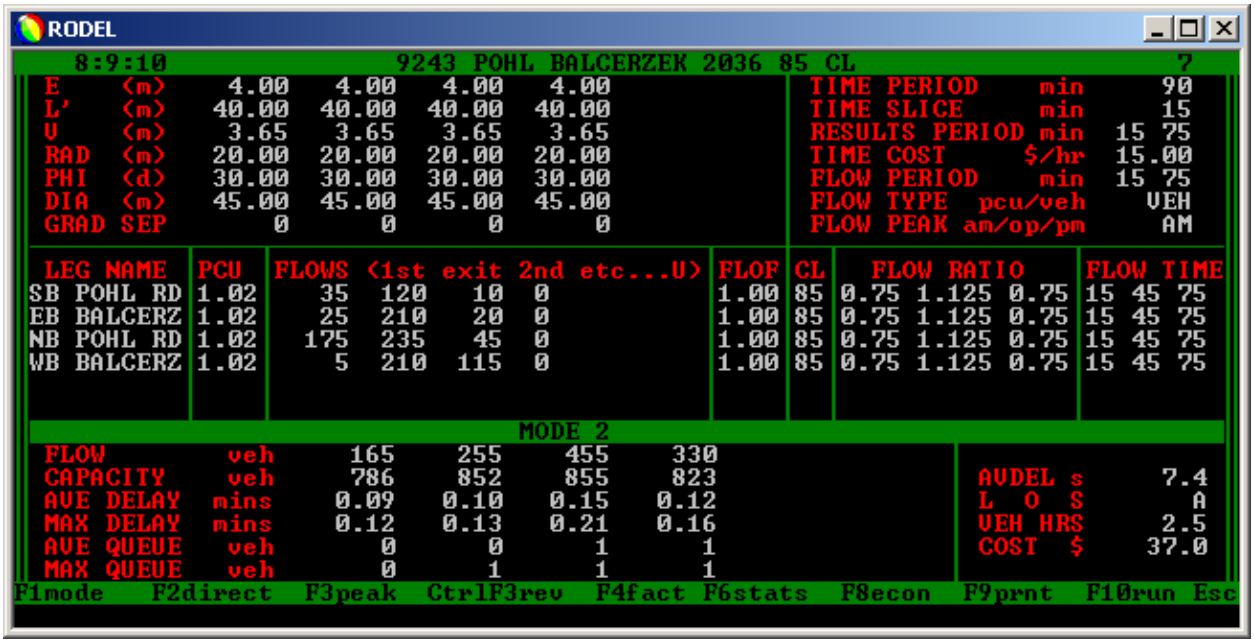
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm PM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 45 165 35 0 1.00 50 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 30 430 25 0 1.00 50 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 190 170 40 0 1.00 50 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 10 355 220 0 1.00 50 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 245 485 400 585
CAPACITY veh 858 962 925 1060
AVE DELAY mins 0.10 0.13 0.11 0.13
MAX DELAY mins 0.13 0.18 0.16 0.18
AVE QUEUE veh 0 1 1 1
MAX QUEUE veh 0 1 1 2
AVDEL s 7.1
L O S A
VEH HRS 3.4
COST $ 50.8
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc


RODEL
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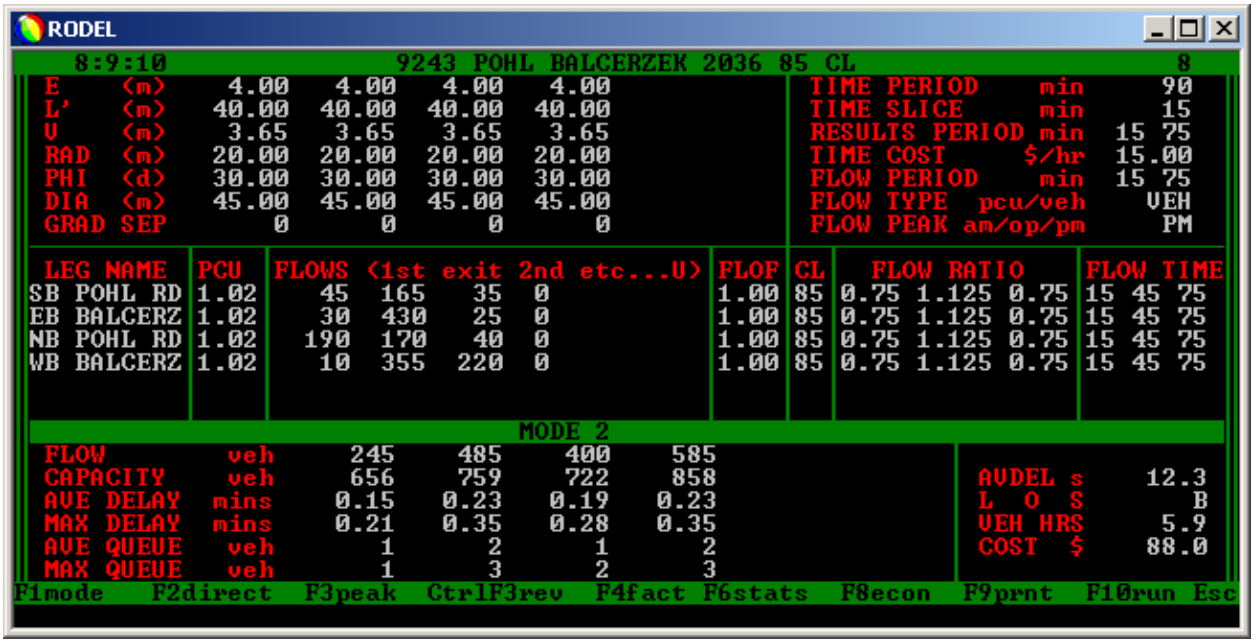
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm AM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 35 120 10 0 1.00 85 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 25 210 20 0 1.00 85 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 175 235 45 0 1.00 85 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 5 210 115 0 1.00 85 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 165 255 455 330
CAPACITY veh 786 852 855 823
AVE DELAY mins 0.09 0.10 0.15 0.12
MAX DELAY mins 0.12 0.13 0.21 0.16
AVE QUEUE veh 0 0 1 1
MAX QUEUE veh 0 1 1 1
AVDEL s 7.4
L O S A
VEH HRS 2.5
COST $ 37.0
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc


RODEL
8:9:10 9243 POHL BALCERZEK 2036 85 CL 8
E (m) 4.00 4.00 4.00 4.00
L' (m) 40.00 40.00 40.00 40.00
V (m) 3.65 3.65 3.65 3.65
RAD (m) 20.00 20.00 20.00 20.00
PHI (d) 30.00 30.00 30.00 30.00
DIA (m) 45.00 45.00 45.00 45.00
GRAD SEP 0 0 0 0
TIME PERIOD min 90
TIME SLICE min 15
RESULTS PERIOD min 15 75
TIME COST $/hr 15.00
FLOW PERIOD min 15 75
FLOW TYPE pcu/veh VEH
FLOW PEAK am/op/pm PM
LEG NAME PCU FLOWS (1st exit 2nd etc...U) FLOF CL FLOW RATIO FLOW TIME
SB POHL RD 1.02 45 165 35 0 1.00 85 0.75 1.125 0.75 15 45 75
EB BALCERZ 1.02 30 430 25 0 1.00 85 0.75 1.125 0.75 15 45 75
NB POHL RD 1.02 190 170 40 0 1.00 85 0.75 1.125 0.75 15 45 75
WB BALCERZ 1.02 10 355 220 0 1.00 85 0.75 1.125 0.75 15 45 75
MODE 2
FLOW veh 245 485 400 585
CAPACITY veh 656 759 722 858
AVE DELAY mins 0.15 0.23 0.19 0.23
MAX DELAY mins 0.21 0.35 0.28 0.35
AVE QUEUE veh 1 2 1 2
MAX QUEUE veh 1 3 2 3
AVDEL s 12.3
L O S B
VEH HRS 5.9
COST $ 88.0
F1mode F2direct F3peak CtrlF3rev F4fact F6stats F8econ F9prnt F10run Esc

Detailed Cost Analysis

SRF Consulting Group, Inc. | Engineers Planners Designers

Concept Cost Estimate (based upon 2016 bid price information)

Prepared By: SRF Consulting Group, Inc., Date 10/2016

						Balcerzak Drive at Pohl Road	
	ITEM DESCRIPTION		UNIT	UNIT PRICE	EST. QUANTITY	EST. AMOUNT
PAVING AND GRADING COSTS						
GrP 1	Excavation - common & subgrade		cu. yd.	$7.00	6,600	$46,200
GrP 2	Granular Subgrade (CV)		cu. yd.	$14.00	4,000	$56,000
GrP 3	County Road Pavement	(1)	sq. yd.	$32.00	7,960	$254,720
GrP 4	Concrete Median	(1)	sq. yd.	$40.00	590	$23,600
GrP 5	Walk / Trail	(1)	sq. yd.	$25.00	2,130	$53,250
GrP 6	ADA Pedestrian Curb Ramp		each	$800.00	22	$17,600
GrP 7	Concrete Curb and Gutter		lin. ft.	$12.00	4,690	$56,280
GrP 8	Removals - Pavement		sq. yd.	$2.50	10,410	$26,025
	SUBTOTAL PAVING AND GRADING COSTS:					**$533,675**
DRAINAGE, UTILITIES AND EROSION CONTROL						
Dr 1	Local Utilities - Sanitary Sewers		lin. ft.			
Dr 2	Local Utilities - Watermains		lin. ft.			
Dr 3	Water Quality Ponds		l.s.			
Dr 5	Drainage - urban (10-30%)		30%			$160,000
Dr 6	Turf Establishment & Erosion Control		10%			$53,000
Dr 7	Landscaping					
	SUBTOTAL DRAINAGE, UTILITIES AND EROSION CONTROL					**$213,000**
SIGNAL AND LIGHTING COSTS						
SGL 1	Signals (permanent)		each	$200,000		
SGL 2	At Grade Intersection Lighting (permanent - non signa		each	$10,000	12	$120,000
	SUBTOTAL SIGNAL AND LIGHTING COSTS:					**$120,000**
SIGNING & STRIPING COSTS						
SGN 1	Mainline Signing (C&D)		mile	$20,000	0.3	$6,000
SGN 2	Mainline Striping		mile	$10,000	0.3	$3,000
	SUBTOTAL SIGNING & STRIPING COSTS:					**$9,000**
	SUBTOTAL CONSTRUCTION COSTS:					**$875,675**
MISCELLANEOUS COSTS						
M 1	Mobilization		6%			$53,000
M 2	Non Quantified Minor Items (10% to 30%)		20%			$175,000
M 3	Temporary Pavement & Drainage		2%			$18,000
M 4	Traffic Control		4%			$35,000
	SUBTOTAL MISCELLANEOUS COSTS:					**$281,000**
	ESTIMATED TOTAL CONSTRUCTION COSTS without Contingency:					**$1,156,675**
1	Contingency or "risk" (10% to 30%)		20%			$231,000
	ESTIMATED TOTAL CONSTRUCTION COSTS PLUS CONTINGENCY:					**$1,387,675**

	OTHER PROJECT COSTS:				
	R/W ACQUISITIONS	Lump Sum			
	DESIGN ENG. & CONSTRUCTION ADMIN.	Lump Sum			
	SUBTOTAL OTHER PROJECT COSTS				
	TOTAL PROJECT COST (based upon 2016 bid price information)				**$1,387,675**

	INFLATION COST (CURRENT YR. TO YR. OF OPE	Years	3%		
	TOTAL PROJECT COST (OPENING YEAR DOLLARS)				**$1,387,675**

NOTE: (1) Includes aggregate base class 5.

MAJOR ITEMS NOT INCLUDED:
- Local utilities (sanitary sewer or watermain)
- Water quality ponds or other BMPs
- R/W acquisitions
- Engineering design fees
- Inflation