



CREATION TO COMPLETION

FEASIBILITY STUDY

For

Gumwood Road & Redfield Street

**Milton Township,
Cass County, Michigan**

**Prepared by:
CESO, Inc.
8164 Executive Ct., Ste. B
Lansing, MI 48917**

June 2014

Engineering • Architecture • Survey • Construction Mgt • Environmental



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1 Introduction

In March 2014, the Cass County Road Commission and Milton Township engaged the services of CESO, Inc. to undertake a feasibility study for the Gumwood Road (east and west legs) and Redfield Street intersection located in Milton Township, Cass County, Michigan. Figure 1 illustrates the study location with respect to the surrounding area.

Gumwood Road is a north-south roadway that currently exists as a left-right offset “T” type intersection at Redfield Street with the east leg of the intersection located approximately 700 feet east of the west leg. The east leg intersects Redfield Street at a 45 degree angle and is stop sign controlled. The west leg intersects Redfield Street at a 90 degree angle and is stop sign controlled. The following aerial photograph shows the left-right offset “T” type intersection while Figure 2 shows more detailed aerial photographs of both the east and west legs of Gumwood Road.



Currently, northbound vehicles that traverse Gumwood Road must turn left from the east leg onto Redfield Street then make an immediate right turn onto the west leg in order to continue north. Southbound vehicles would turn left from the west leg onto Redfield Street then make an immediate right-turn onto the east leg in order to continue south making a similar type “jog” pattern movement. This “jog” pattern from the offset intersections creates increased delay, and potential for accidents.



In addition to the offset nature of the Gumwood Road and Redfield Street intersection, the east leg of Gumwood Road intersects Redfield Street at a 45 degree angle. According to the 2011 AASHTO Green Book, “intersecting roads should generally meet at or nearly at right angles. Roads intersecting at acute angles require extensive turning roadway areas and tend to limit visibility. Acute-angle intersections increase the exposure time of the vehicles crossing the main traffic flow and may increase the accident potential.” Intersection angles should be a minimum of sixty (60) degrees at a skewed intersection such that a driver stopped on the side road has the acute angle on his left side (vision not blocked by his own vehicle). Currently, the Gumwood Road east leg is skewed at a forty-five (45) degree angle on the drivers right side.

Sight distance is also a concern at the east leg of Gumwood Road with a northbound vehicle turning left onto Redfield Street. A northbound vehicle must have adequate sight distance to safely enter onto Redfield Street. According to the 2011 AASHTO Green Book, a vehicle turning from Gumwood Road onto Redfield Street should have an available intersection sight distance (ISD) of 665 feet based on a design speed of 60 mph. Currently, in order to achieve this sight distance, a vehicle must stop at the edge of the Redfield Street edge of pavement creating a dangerous situation. In addition, the sight distance on Gumwood Road west leg looking to the west is less than the required 665 feet. Redfield Street currently has a vertical crest curve to the west that limits sight distance.

The following sections of this study examine the current operation of the Gumwood Road & Redfield Street intersection and investigate potential alignment options and their feasibility.



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FIGURE 2 GUMWOOD ROAD & REDFIELD STREET INTERSECTION AERIAL PHOTOGRAPH

GUMWOOD ROAD & REDFIELD STREET STUDY

REDFIELD TOWNSHIP

CASSE COUNTY, MICHIGAN

FIGURE 2

DATE:	08/16/2014
JOB NO.:	750381-01
DESIGN:	REM
DRAWN:	REM
CHECKED:	MJG
PAGE	9



1.1 Study Procedure

The following studies and analyses were undertaken:

1. Traffic counts (manual) were conducted by Miovision at each of the key study intersections during the weekday A.M., Mid-Day, and P.M. peak hours on Thursday, April 3, 2014.
2. Capacity analysis to determine the capacity of the key study intersections under the Existing traffic scenario using Synchro V 8.0 software.
3. Develop alignment alternatives to improve traffic flow and safety at the Gumwood Road (east and west) & Redfield Street intersection.
4. Summarize advantage and disadvantages of each alignment alternative.
5. Capacity analysis to determine the capacity of each alignment option at the Gumwood Road & Redfield Street intersection using Synchro V 8.0 software.
6. Determine future parcels that potentially will develop into residential development within the next ten (10) years.
7. An analysis to determine the potential traffic generated under 2024 Background Traffic Scenario utilizing data provided in the Institute of Transportation Engineers' Trip Generation Manual, 9th Edition.
8. Determine directional distribution associated with the future residential development generated traffic volumes.
9. Add the traffic for the future Background development to the Existing Weekday Peak Hour Traffic Volumes to reflect the 2024 Background Weekday Peak Hour traffic volumes.
10. Capacity analysis to determine the capacity of the key study intersections under the 2024 Background Traffic Scenario using Synchro V 8.0 software.
11. Accident analysis at the existing Gumwood Road (east and west leg) and Redfield Street intersection.
12. Recommendations and Conclusions.
13. Cost analysis of the selected alignment option.



1.2 References

This report utilizes information provided by the following sources:

1. Analysis of Capacity and Level of Service according to the procedures of the Highway Capacity Manual, Fifth Edition, Updated 2010, Transportation Research Board.
2. The Institute of Transportation Engineers' Trip Generation Manual, 9th Edition and the Trip Generation Handbook.
3. The Michigan Manual of Uniform Traffic Control Devices (MMUTCD).
4. A Policy on Geometric Design of Highways and Streets, 6th Edition, 2011, AASHTO.
5. Roundabouts: An Informational Guide, U.S. Department of Transportation, Federal Highway Administration, Publication No. FHWA-RD-00-067



4. Alignment Alternatives

4.1 Alignment Options

Initially, eight (8) options were reviewed in a stakeholder workshop meeting with the Cass County Road Commission and Milton Township on March 25, 2014. The eight (8) options included the following:

- (1) Do nothing (Status Quo).
- (2) Gumwood Road (East Leg) perpendicular connection with Redfield Street.
- (3) Align Gumwood Road at Redfield Street.
- (4) Gumwood Road (East Leg) roundabout.
- (5) Single roundabout with Gumwood Road aligned.
- (6) Double roundabout (roundabout at Gumwood west leg and a roundabout at Gumwood east leg).
- (7) Various multiway stops with turn lanes.
- (8) New road alignment to connect perpendicular to Redfield Street.

Based on the above, options 1, 3, 5, and 6 were selected for further investigation.

4.2 Alignment Advantages and Disadvantages

The following is a summary of each selected option and their advantages and disadvantages associated with each.

Option #1: Gumwood Road & Redfield Street Intersection (Status Quo):

Figure 5 illustrates existing conditions (Option #1). Gumwood Road is currently constructed as an offset intersection with Redfield Street with the east leg of the intersection located approximately 700 feet east of the west leg. The east leg intersects Redfield Street at a 45 degree angle and is stop sign controlled. The west leg intersects Redfield Street at a 90 degree intersection and is stop sign controlled. Both legs of Gumwood Road are two (2) lane roadways with a speed limit of 55 mph (north leg) and 50 mph (south leg to State line). Table 3 provides a summary of some advantages and disadvantages with leaving the intersection as currently constructed (Option #1):



Table 3
Option #1: Advantages/Disadvantages ~ Gumwood Road
& Redfield Street Intersection (Status Quo):

ADVANTAGES	DISADVANTAGES
1. No cost associated with improvements and no right-of-way acquisition.	1. 45 degree skewed intersection with limited sight distance.
	2. Offset intersection creates a “jog” traffic pattern since the majority of vehicles travel Gumwood to Redfield to Gumwood.
	3. Higher risk for accidents based on 2 intersection conflict points.
	4. Inadequate corner sight distance on east leg looking to the east.
	5. High vehicle turning speed from Redfield Street to Gumwood Road east leg.
	6. Location could not be signalized should a traffic signal be warranted in the future.
	7. Increased crossing distance on Gumwood Road east leg should pedestrian crossing be implemented in the future.

14-070-016-023-50
GERBETH RICHARD & PATRICIA
48.57 ACRES

14-070-017-051-00
MACKIN STEPHEN JR & SHIRLEY
68.98 ACRES

14-070-017-056-00
KAMINSKI BARBARA
6.79 ACRES

14-070-020-002-60
CLOUSE TROY D & KIMBERLY A
5.40 ACRES

14-070-021-014-00
ROMANETZ PAUL E & MELINDA M
34.65 ACRES

14-070-021-013-00
GUMWOOD HOLDINGS
3.79 ACRES



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GUMWOOD ROAD & REDFIELD STREET
INTERSECTION (OPTION #1 STATUS QUD)

GUMWOOD ROAD & REDFIELD STREET STUDY

FIGURE 5

DATE

06.16.2014

JOB NO: 750081-01

DESIGN: R/M

DRAWN: R/M

CHECKED: MJC

DATE: 11/11/13

CASS COUNTY, MICHIGAN



Option #2: Gumwood Road & Redfield Street Intersection (Aligned):

Figure 6 illustrates aligning the west leg of Gumwood Road with the east leg of Gumwood Road providing a “four legged” aligned stop sign controlled intersection. Figure 6 illustrates that the alignment would require a property take from parcel 14-070-016-023-50 (Richard & Patricia Gerbeth). According to Figure 6, it is anticipated that a minimum 1.622 acres would be required for r/w and a remainder parcel of 4.095 acres would be left between the west edge of realigned Gumwood Road and the east side of the existing Gumwood road r/w. Based on a design speed of 60 mph, the curve to connect back into existing Gumwood Road to the north would need to be 1,273’ radius (with 0.080 superelevation). Table 4 provides a summary of some advantages and disadvantages with constructing the Option #2 aligned intersection:

**Table 4
Option #2: Advantages/Disadvantages ~ Gumwood Road
& Redfield Street Intersection (Aligned):**

ADVANTAGES	DISADVANTAGES
1. Aligned “four legged” stop controlled intersection.	1. Does not remove the 45 degree skewed intersection with limited sight distance. Consider a flashing beacon light.
2. Theoretical reduction in accidents by removing one intersection conflict point.	2. Cost for additional r/w.
3. Potential for traffic signal in the future.	3. Does not remove inadequate corner sight distance on east leg looking to the east.
4. Reduced maintenance costs.	4. Increased crossing distance on Gumwood Road east leg should pedestrian crossing be implemented in the future.
5. Removes the “jog” traffic pattern.	

R/W TAKE = 1.622 ACRES
EXCESS PARCEL =
4.095 ACRES

1.622 ACRES

14-070-017-051-00
MACKIN STEPHEN JR & SHIRLEY
68.98 ACRES

14-070-016-023-50
GERBETH RICHARD & PATRICIA
48.57 ACRES

4.095 ACRES

14-070-017-056-00
KAMINSKI BARBARA
6.79 ACRES

14-070-021-013-00
GUMWOOD HOLDINGS
3.79 ACRES

14-070-021-014-00
ROMANETZ PAULE & MELINDA M
34.65 ACRES

14-070-020-002-60
CLOUSE TROY D & KIMBERLY A
5.40 ACRES



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GUMWOOD ROAD & REDFIELD STREET INTERSECTION
(OPTION #2: ALIGNED)

GUMWOOD ROAD & REDFIELD STREET STUDY

FIGURE 6

DATE:
06.16.2014
JOB NO.: 740581-01
PERSON: R/W
DRAWN: R/W
CHECKED: M/J
SCALE: 1"=10'

CASS COUNTY, MICHIGAN

AS BUILT



Option #3: Gumwood Road & Redfield Street Intersection (Aligned with Single Roundabout):

Figure 7 illustrates aligning the west leg of Gumwood Road with the east leg of Gumwood Road and providing a single roundabout at its intersection with Redfield Street. Figure 7 illustrates that this option would require property takes from parcel 14-070-016-023-50 (Richard & Patricia Gerbeth), parcel 14-070-021-014-00 (Paul E. & Melinda M. Romanetz), parcel 14-070-020-002-60 (Troy D. & Kimberly A. Clouse), and parcel 14-070-021-013-00 Gumwood Holdings. According to Figure 7, it is anticipated that a minimum 2.603 acres would be required for r/w and a remainder parcel of 4.540 acres would be left between the west edge of realigned Gumwood Road and the east side of the existing Gumwood road r/w. Based on a design speed of 60 mph, the curve to connect back into existing Gumwood Road to the north would need to be 1,273' radius (with 0.080 superelevation). Table 5 provides is a summary of some advantages and disadvantages with constructing the Option #3 aligned with single roundabout:

**Table 5
Option #3: Advantages/Disadvantages ~ Gumwood Road
& Redfield Street Intersection (Aligned with Single Roundabout):**

ADVANTAGES	DISADVANTAGES
1. Theoretically improved safety performance over other types of intersections. Numerous studies have found that roundabouts reduce the frequency and severity of crashes.	1. Crashes may temporarily increase due to improper driver education.
2. Lower operational speeds. Allowing for time for drivers to react while reducing crash severity.	2. Cost for additional r/w.
3. One way operation.	3. Construction cost.
4. Fewer conflict points. 8 conflict points vs. 32 conflict points at a “four legged” intersection. Drivers only make right turn movements.	4. Intersection skew will continue to exist but will be significantly reduced.
5. More efficient traffic flow (up to 50% increase in traffic capacity).	5. Cannot provide explicit priority to specific users (i.e. emergency vehicles, pedestrians).
6. Reduced pollution and fuel usage: Less stops, shorter queues and no left-turn storage.	6. Illumination cost.
7. No signal equipment required should the need for a signal exist in the future.	7. Central island landscaping maintenance.



Table 5 (Continued)
**Option #3: Advantages/Disadvantages ~ Gumwood Road
& Redfield Street Intersection (Aligned with Single Roundabout):**

ADVANTAGES	DISADVANTAGES
8. Reduced long-term operational costs.	8. Longer pedestrian travel path.
9. Reduce the size of sight triangles needed for users to see one another.	
10. Reduced decision making at point of entry.	
11. Low speed conditions improve bicycle and pedestrian safety.	
12. Splitter islands provide refuge for pedestrians and permit them to cross one direction of traffic at a time.	
13. Community benefits: Traffic calming and enhanced aesthetics by landscaping.	
14. Traffic yields rather than stops, often resulting in the acceptance of smaller gaps.	

RAW TAKE = 2.603 ACRES
EXCESS PARCEL =
4.540 ACRES

14-070-017-051-00
MACKIN STEPHEN JR & SHIRLEY
68.98 ACRES

14-070-017-056-00
KAMINSKI BARBARA
6.79 ACRES

2.258 ACRES

14-070-016-023-50
GERBETH RICHARD & PATRICIA
48.57 ACRES

4.540 ACRES

PROP. TO PEDESTRIAN/BICYCLE PATH

0.0073 ACRES

14-070-020-002-60
CLOUSE TROY D & KIMBERLY A
5.40 ACRES

0.3241 ACRES

14-070-021-014-00
ROMANETZ PAUL E & MELINDA M
34.65 ACRES

0.0138 ACRES

14-070-021-013-00
GUMWOOD HOLDINGS
3.79 ACRES

PROP. TO PEDESTRIAN/BICYCLE PATH



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GUMWOOD ROAD & REDFIELD STREET INTERSECTION
(OPTION #3: ALIGNED WITH SINGLE ROUNDABOUT)

GUMWOOD ROAD & REDFIELD STREET STUDY

MALTON TOWNSHIP

CASS COUNTY, MICHIGAN

FIGURE 7
DATE: 05.16.2014
JOB NO.: 740.581_01
DESIGN: R/M
DRAWN: R/M
CHECKED: M/G
DATE: 7/01



Option #4: Gumwood Road & Redfield Street Intersection (Dual Roundabouts):

Figure 8 illustrates dual roundabouts (single roundabouts at the west and east Gumwood Road & Redfield Street intersections). Figure 8 illustrates that this option would require property take from parcel 14-070-016-023-50 (Richard & Patricia Gerbeth), parcel 14-070-021-014-00 (Paul E. & Melinda M. Romanetz), parcel 14-070-021-013-00 Gumwood Holdings, parcel 14-070-017-056-00 (Barbara Kaminski), and parcel 14-070-020-002-60 (Troy D. & Kimberly A. Clouse). According to Figure 8, it is anticipated that a minimum 0.4089 acres would be required for r/w. Table 6 provides a summary of some advantages and disadvantages with constructing the Option #4 dual roundabouts:

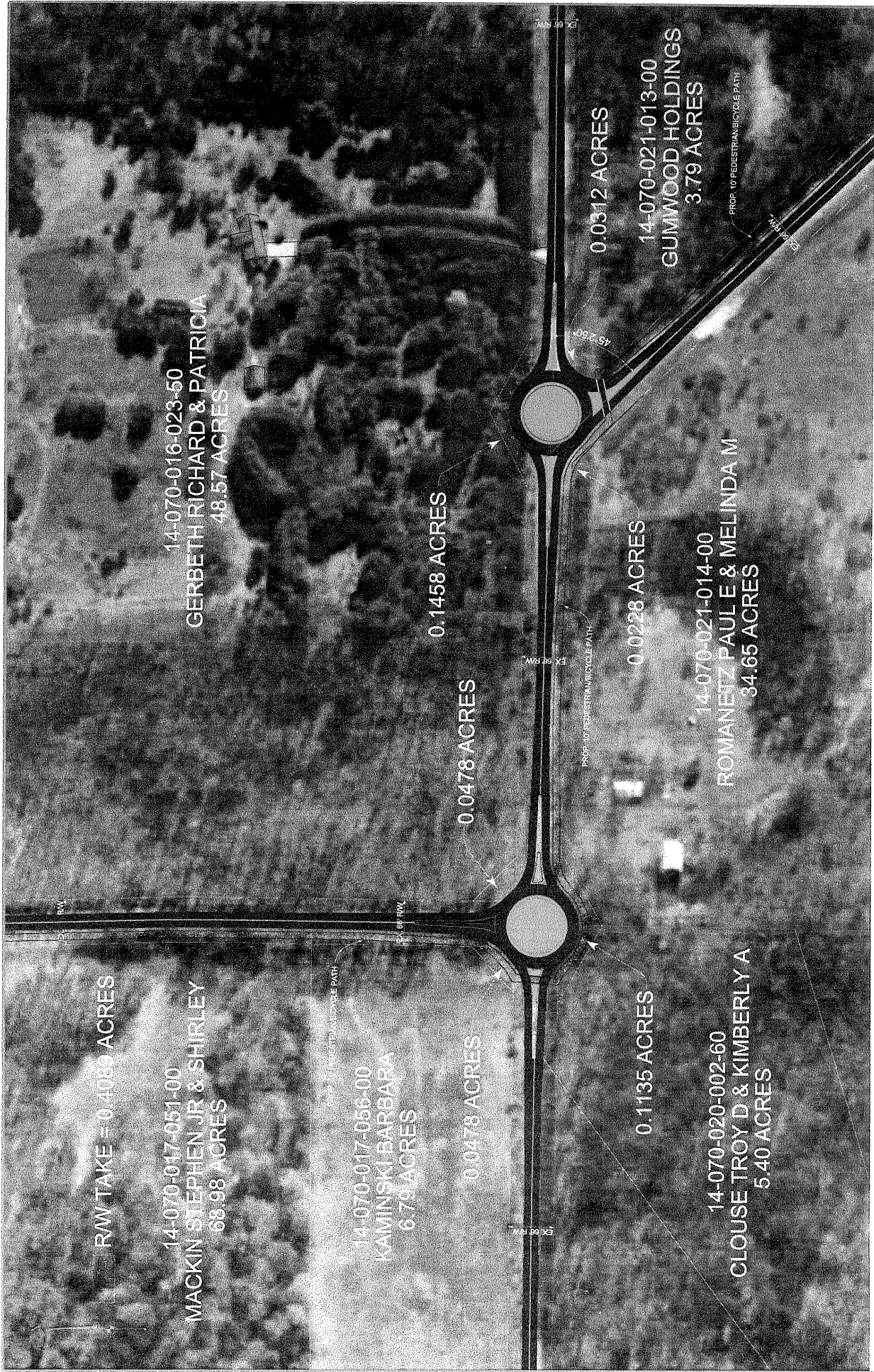
**Table 6
Option #4: Advantages/Disadvantages ~ Gumwood Road
& Redfield Street Intersection (Dual Roundabouts):**

ADVANTAGES	DISADVANTAGES
1. Removes skewed intersection conflict concerns by creating a continuous movement.	1. Crashes may temporarily increase due to improper driver education.
2. Lower r/w costs than other 2 options.	2. Construction cost.
3. Theoretically improved safety performance over other types of intersections. Numerous studies have found that roundabouts reduce the frequency and severity of crashes.	3. Although a safer situation, will not remove the “jog” situation with vehicles traveling from Gumwood Road (E/W leg) to Redfield to Gumwood Road (E/W leg).
4. Lower operational speeds. Allowing for time for drivers to react while reducing crash severity.	4. Cannot provide explicit priority to specific users (i.e. emergency vehicles, pedestrians).
5. One way operation.	5. Illumination cost.
6. Fewer conflict points. 8 conflict points vs. 32 conflict points at a “four legged” intersection. Drivers only make right turn movements.	6. Central islands landscaping maintenance.
7. More efficient traffic flow (up to 50% increase in traffic capacity).	7. Pedestrians may experience increased delay and reduced safety in securing acceptable gaps to cross.
8. Reduced pollution and fuel usage: Less stops, shorter queues and no left-turn storage.	8. Longer pedestrian travel path.



Table 6 (Continued)
**Option #4: Advantages/Disadvantages ~ Gumwood Road
& Redfield Street Intersection (Dual Roundabouts):**

ADVANTAGES	DISADVANTAGES
9. No signal equipment required should need for a signal exist in the future.	9. R/W required from five (5) property owners.
10. Community benefits: Traffic calming and enhanced aesthetics by landscaping.	
11. Reduced long-term operational costs.	
12. Reduce the size of sight triangles needed for users to see one another.	
13. Reduced decision making at point of entry.	
14. Low speed conditions improve bicycle and pedestrian safety.	
15. Low speed conditions improve bicycle and pedestrian safety.	
16. Splitter islands provide refuge for pedestrians and permit them to cross one direction of traffic at a time.	
17. Community benefits: Traffic calming and enhanced aesthetics by landscaping.	
18. Traffic yields rather than stops, often resulting in the acceptance of smaller gaps.	



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GUMWOOD ROAD & REDFIELD STREET INTERSECTION
 (OPTION #4: DUAL ROUNDABOUTS)
 GUMWOOD ROAD & REDFIELD STREET STUDY

CASS COUNTY, MICHIGAN

FIGURE 8
 DATE: 06.18.2014
 JOB NO.: 750581 01
 DESIGN: R/M
 DRAWN: R/M
 CHECKED: MJC
 PAGE: 2/3



5. Alignment Alternative Analysis

Each of the four (4) selected options was analyzed to review the capacity associated with each option. The Existing Weekday Peak Hour Traffic Volumes illustrated on Figure 4 were reassigned to reflect Options 2, 3, and 4 alignment. Option #1 is status quo or do nothing resulting in Figure 4 volumes. Figures 9, 10, and 11 represent the Reassigned Existing Weekday Peak Hour Traffic Volumes.

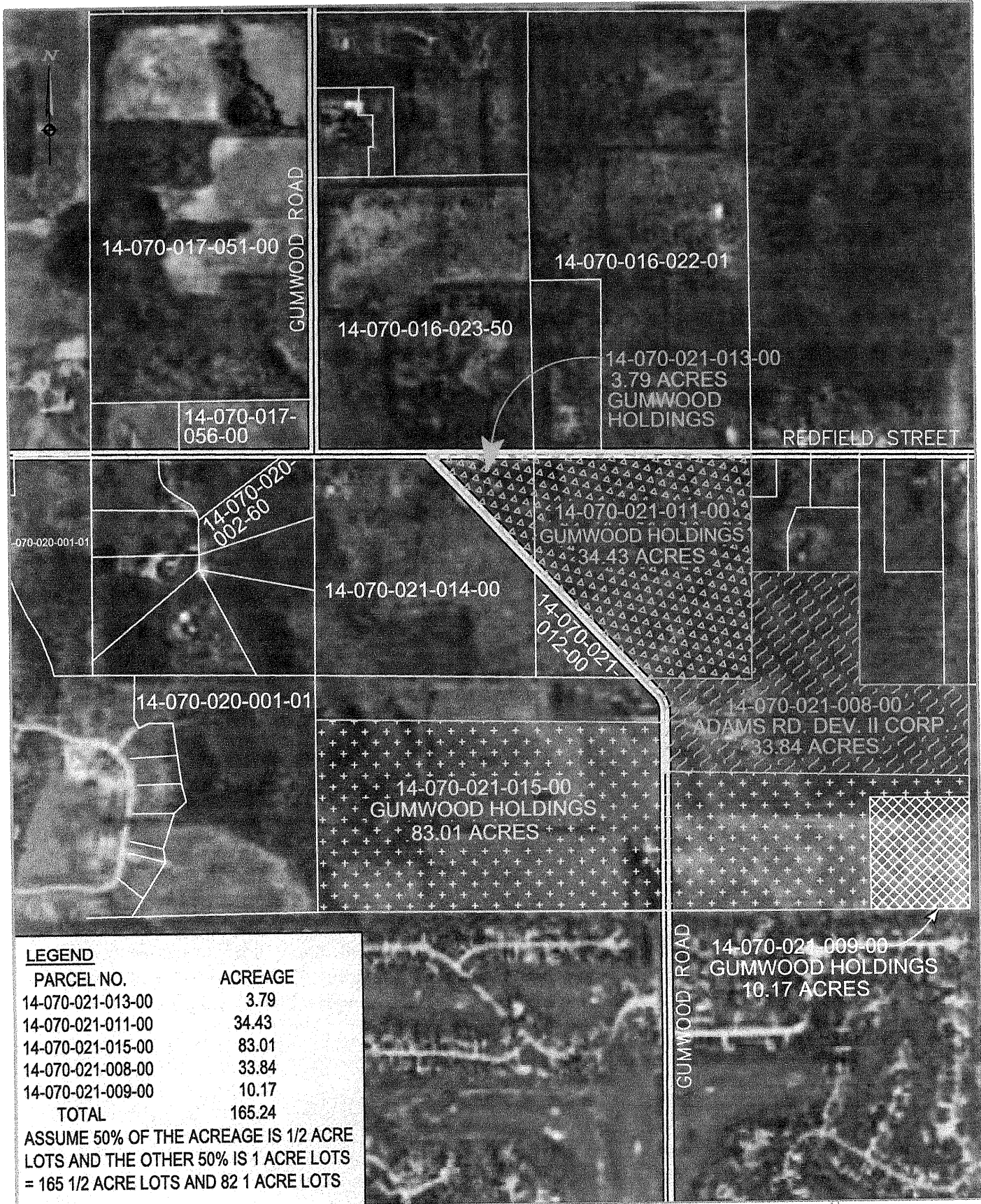
Using the Reassigned Existing Weekday Peak Hour Traffic Volumes shown on Figures 9, 10, and 11, capacity calculations were run for each scenario. Table 7 summarizes the results from the analysis.

Table 7
Summary of Existing Capacity Analysis (Reassigned Volumes)

INTERSECITON	CONTROL	APPROACH	LEVEL OF SERVICE (LOS) WEEKDAY PEAK HOUR		
			AM PEAK HOUR	PM PEAK HOUR	PM PEAK HOUR
Option #1: Gumwood Road & Redfield Street Intersection (Status Quo)					
Redfield Street & Gumwood Road (East Leg)	Stop Sign	NBLR	B (12.1)	B (10.6)	C (17.6)
		WBL	A (8.0)	A (7.7)	A (8.1)
		WBT	A (0.0)	A (0.0)	A (0.0)
Redfield Street & Gumwood Road (West Leg)	Stop Sign	EBL	A (7.6)	A (7.6)	A (8.2)
		EBT	A (0.0)	A (0.0)	A (0.0)
		SBLR	B (12.7)	B (11.1)	C (17.9)
Option #2: Gumwood Road & Redfield Street Intersection (Aligned)					
Redfield Street & Gumwood Road	Stop Sign	NBLTR	A (9.5)	A (8.3)	B (12.5)
		EBLTR	A (9.1)	A (8.2)	B (11.7)
		WBLTR	A (9.2)	A (8.1)	B (10.7)
		SBLTR	A (8.8)	A (8.1)	B (11.2)
Option #3: Gumwood Road & Redfield Street Intersection (Aligned with Single Roundabout)					
Redfield Street & Gumwood Road	Roundabout	EB	A (5.6)	A (4.7)	A (6.7)
		WB	A (5.0)	A (4.2)	A (6.4)
		SB	A (6.0)	A (4.7)	A (6.5)
		NB	A (4.7)	A (4.6)	A (7.4)
Option #4: Gumwood Road & Redfield Street Intersection (Dual Roundabouts)					
Redfield Street & Gumwood Road (East Leg)	Roundabout	EB	A (6.5)	A (5.2)	A (6.9)
		WB	A (4.9)	A (4.2)	A (6.2)
		NB	A (4.7)	A (4.6)	A (7.1)
Redfield Street & Gumwood Road (West Leg)	Roundabout	EB	A (5.6)	A (5.0)	A (6.6)
		WB	A (5.0)	A (4.6)	A (7.3)
		SB	A (6.0)	A (4.9)	A (6.3)

A – Level of Service (8.5) – Delay (seconds/vehicle)

The Reassigned Existing Capacity Analysis Summary sheets are contained in Appendix C of the report.



LEGEND

PARCEL NO.	ACREAGE
14-070-021-013-00	3.79
14-070-021-011-00	34.43
14-070-021-015-00	83.01
14-070-021-008-00	33.84
14-070-021-009-00	10.17
TOTAL	165.24

ASSUME 50% OF THE ACREAGE IS 1/2 ACRE LOTS AND THE OTHER 50% IS 1 ACRE LOTS = 165 1/2 ACRE LOTS AND 82 1 ACRE LOTS



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BACKGROUND DEVELOPMENT

GUMWOOD ROAD & REDFIELD STREET STUDY

MILTON TOWNSHIP CASS COUNTY, MICHIGAN

FIGURE 12	
DATE:	06.16.2014
JOB NO.:	750381-01
DESIGN:	REM
DRAWN:	REM
CHECKED:	MJG
PAGE	29



7 Accident Analysis

The most recent accident data for the study area covers the period between January 1, 2009 and December 31, 2013. This data was provided by the Cass County Road Commission and is contained in Appendix “F” of the report. A summary of reported collisions is provided in Table 12.

Table 12
Reported Accident Summary
Gumwood Road (East and West) & Redfield Street

Roadway	Property Damage/Injury /Fatal			Head-On/Rear End/Sideswipe/Angle & Left-Turn/Other					Alcohol Involved		Total
	P	I	F	H	R	S	A/L	O	Y	N	
Year: 2009											
Gumwood Road (East) & Redfield Street	1	0	0	0	1	0	0	0	0	1	1
Gumwood Road (West) & Redfield Street	0	0	0	0	0	0	0	0	0	0	0
Year 2010											
Gumwood Road (East) & Redfield Street	3	2	0	0	4	0	1	0	0	3	5
Gumwood Road (West) & Redfield Street	2	0	0	0	0	0	1	1	0	2	2
Year 2011											
Gumwood Road (East) & Redfield Street	2	0	0	1	0	0	0	1	0	2	2
Gumwood Road (West) & Redfield Street	2	0	0	0	2	0	0	0	0	2	2
Year 2012											
Gumwood Road (East) & Redfield Street	2	0	0	0	1	0	0	1	0	2	2
Gumwood Road (West) & Redfield Street	1	0	0	0	0	0	0	1	0	1	1
Year 2013											
Gumwood Road (East) & Redfield Street	2	0	0	0	0	0	0	2	0	2	2
Gumwood Road (West) & Redfield Street	0	0	0	0	0	0	0	0	0	0	0
TOTAL	15	2	0	1	8	0	2	6	0	15	15



Based on the above table, there were a reported 15 accidents at the study location from January 1, 2009 through December 31, 2013. Of the 15 reported accidents, 10 (or 67%) of those accidents, or more than half, were rear end/angle accidents with the majority of those occurring on the Gumwood Road east leg. This location currently has an intersection skew of 45 degrees that limits sight distance to the east.



8. Findings and Recommendations

8.1 Findings

Based on the analysis, the following is a summary of findings for the Gumwood Road & Redfield Street left-right offset “T” intersection:

- A high volume left-right and right-left movement currently occurs at the Gumwood Road & Redfield Street intersection.
- The Gumwood Road east leg currently intersects Redfield Street at a forty-five (45) degree angle. Intersection angles should be a minimum of sixty (60) degrees at a skewed intersection such that a driver stopped on the side road has the acute angle on his left side (vision not blocked by his own vehicle).
- Both the east and west legs of Gumwood Road currently have intersection sight distance constraints.
- The east leg of Gumwood Road is offset 700 feet to the east of the west leg of Gumwood Road.
- Existing traffic counts revealed the following weekday peak hours:
 - AM Peak: 7:00 – 8:00 am
 - MID-DAY Peak: 11:45 – 12:45 pm
 - PM Peak: 4:45 – 5:45 pm.
- The northbound left-right movement at the Redfield Street & Gumwood Road (East Leg) currently operates at a LOS B/B/C during the weekday AM, MID-DAY, and PM peak hours.
- The southbound left-right movement at the Redfield Street & Gumwood Road (West Leg) currently operates at a LOS B/B/C during the weekday AM, MID-DAY, and PM peak hours.
- Eight (8) initial options were reviewed in a stakeholder workshop meeting with Cass County and Milton Township on March 25, 2014. The eight (8) options included the following:
 - (1) Do nothing (Status Quo).
 - (2) Gumwood Road (East Leg) perpendicular connection with Redfield Street.
 - (3) Align Gumwood Road at Redfield Street.
 - (4) Gumwood Road (East Leg) roundabout.
 - (5) Single roundabout with Gumwood Road aligned.
 - (6) Dual roundabouts (roundabout at Gumwood west leg and a roundabout at Gumwood east leg).
 - (7) Various multiway stops with turn lanes.
 - (8) New road alignment to connect perpendicular to Redfield Street.
- Based on the eight (8) initial options, options 1, 3, 5, and 6 were selected for further investigation.
- Advantages and disadvantages were reviewed for each of the four (4) narrowed down options. The following are a few of the key advantages and disadvantages of each option:



(1) Option #1 Gumwood Road & Redfield Street Intersection (Status Quo or Do Nothing).

Key Advantages:

- No cost associated with improvements and no right-of-way acquisition

Key Disadvantages:

- 45 degree skewed intersection.
- High risk for accidents based on number of conflict points.
- Inadequate corner sight distance.
- Offset intersection creates a “jog” traffic pattern since most vehicles make the left-right or right-left movement from Gumwood Road to Redfield Street.

(2) Option #2 Gumwood Road & Redfield Street Intersection (Aligned)

Key Advantages:

- Aligned “four legged” intersection.
- Removes the “jog” traffic pattern outlined in Option #1 above.

Key Disadvantages:

- Does not remove the 45 degree intersection skew.
- Does not remove inadequate corner sight distance.
- Cost for additional right-of-way.

(3) Option #3 Gumwood Road & Redfield Street Intersection (Aligned with Single Roundabout)

Key Advantages:

- Theoretically improved safety performance.
- Lower operational speeds.
- One way operation.
- More efficient traffic flow (up to 50% increase in traffic capacity).

Key Disadvantages:

- Construction cost.
- Cost for additional right-of-way.

(4) Option #4 Gumwood Road & Redfield Street Intersection (Dual Roundabouts)

Key Advantages:

- Same as Option #3 except right-of-way costs would be lower.

Key Disadvantages:

- Same as Option #3 except will not remove the “jog” traffic pattern from Gumwood to Redfield Street to Gumwood.

Additional information on each option is included in section 4 of the report.

- Existing traffic volumes were reassigned to reflect each selection study option. Capacity calculations show that Option #3 (single roundabout) and Option #4 (dual roundabouts) improve the Gumwood Road level of service from a B/B/C to a level of service A/A/A during the weekday AM, MID-DAY, and PM peak hours.
- Approximately 165 plus acres of residential development is anticipated to develop over the next ten (10) years generating an additional 2,352 trips per day.



- 2024 Background traffic volumes were calculated by adding the future residential development to the existing traffic volumes. Capacity calculations again show that Option #3 (single roundabout) and Option #4 (dual roundabouts) improve the Gumwood Road level of service from a B/B/C to a level of service A/A/A during the weekday AM, MID-DAY, and PM peak hours.
- Accident data was obtained from the Cass County Road Commission from 2009 through 2013. The accident data shows that 15 accidents occurred at the study location. Of the 15 reported accidents, 10 (or 67%) of those accidents, or more than half, were rear end/angle accidents with the majority of those occurring on the Gumwood Road east leg

8.2 Recommendations

Eight (8) options were initially selected for review and ultimately narrowed down to four (4) study options. The analysis reviewed each narrowed down option and summarized advantages and disadvantages associated with each. In addition, capacity analysis was performed for each of the four (4) options (existing and 10 year) along with a review of accident data.

Based on the analysis, CESO narrowed down the four (4) study options to two (2) options for consideration:

- (1) Option #3: Gumwood Road & Redfield Street Intersection (Aligned with Single Roundabout).
- (2) Option #4: Gumwood Road & Redfield Street Intersection (Dual Roundabouts).

CESO recommends **Option #3: Gumwood Road & Redfield Street Intersection (Aligned with Single Roundabout)** over Option #4 (Option #4 will not remove the current “jog” pattern that currently exists). Option #3 would improve safety as roundabouts reduce the frequency and severity of accidents while improving the capacity of the intersection by up to fifty (50) percent. A single roundabout will reduce the number of conflict points from 22 to 8. Additionally, the sight distance issue from the skewed angle will improve by curving the north and south legs of Gumwood Road in a more perpendicular orientation to the roundabout. The curves will also reduce the speed. The lower travel speed will improve the sight distance situation. The high volume left-right and right-left Gumwood to Redfield to Gumwood “jog” movement would be eliminated. Roundabouts are appropriate where there are high proportions of left-turn traffic. Currently, the southbound and northbound left-turn volumes at Gumwood & Redfield exceed the through volume on Redfield Street.



9. Cost Analysis

Cost Estimates were prepared for Option 2, 3, and 4 and are attached in Appendix G of the report. A summary of the cost estimates is as follows:

Option #1: No Cost

Option #2: \$563,279.17

Option #3: \$879,132.04

Option #4: \$541,959.55



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**ENGINEER'S OPINION OF CONSTRUCTION COSTS
OPTION #2: ALIGNED (6-5-14)**

PROJECT: GUMWOOD ROAD & REDFIELD STREET ROADWAY IMPROVEMENTS - OPTION #2

ROADWAY

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
1	LUMP	CLEARING AND GRUBBING	\$ 18,000.00	\$18,000.00
45	EACH	TREE REMOVED, 12 SIZE	\$ 125.00	\$5,625.00
40	EACH	TREE REMOVED, 18" SIZE	\$ 185.00	\$7,400.00
10	EACH	TREE REMOVED, 24" SIZE	\$ 215.00	\$2,150.00
2,780	SQ YD	PAVEMENT REMOVED	\$ 6.50	\$18,070.00
850	CU YD	EXCAVATION	\$ 6.95	\$5,907.50
4,100	CU YD	EMBANKMENT	\$ 8.81	\$36,121.00
3,200	SQ YD	SUBGRADE COMPACTION	\$ 2.18	\$6,976.00
8	HOUR	PROOF ROLLING	\$ 175.00	\$1,400.00
2	EACH	MONUMENT ASSEMBLY	\$ 608.08	\$1,216.16
10,500	SQ FT	ASPHALT BIKE PATH INCLUDING BASE	\$ 2.50	\$26,250.00
4	EACH	CURB RAMP	\$ 500.00	\$2,000.00
			SUBTOTAL=	\$131,115.66

EROSION CONTROL

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
225	CU YD	TOPSOIL	\$10.16	\$2,286.00
18,000	SQ YD	SEEDING AND MULCHING	\$0.49	\$8,820.00
200	SQ YD	REPAIR SEEDING AND MULCHING	\$0.41	\$82.00
.55	TON	COMMERCIAL FERTILIZER	\$458.59	\$252.22
.75	ACRE	LIME	\$64.35	\$48.26
10	M. GAL	WATER	\$4.16	\$41.60
25	SQ YD	SODDING STAKED	\$8.47	\$211.75
1	LUMP	EROSION CONTROL	\$12,000.00	\$12,000.00
			SUBTOTAL=	\$23,741.84

DRAINAGE

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
125	FT	6" CONDUIT FOR UNDERDRAIN OUTLETS	\$10.84	\$1,355.00
145	FT	12" CONDUIT, TYPE B	\$46.55	\$6,749.75
155	FT	18" CONDUIT, TYPE B	\$58.02	\$8,993.10
55	FT	24" CONDUIT, TYPE C	\$55.34	\$3,043.70
6,200	FT	6" SHALLOW PIPE UNDERDRAINS	\$5.63	\$34,906.00
			SUBTOTAL=	\$55,047.55

PAVEMENT

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
825	SQ YD	PAVEMENT PLANING, ASPHALT CONCRETE	\$1.20	\$990.00
96	FT	FULL DEPTH PAVEMENT SAWING	\$2.06	\$197.76
195	GALLON	TACK COAT	\$1.57	\$306.15
2,640	TONS	12" CIP SUBBASE	\$25.00	\$66,000.00
1,320	TONS	6" AGGREGATE BASE	\$40.00	\$52,800.00
1,320	TONS	6" HMA PAVEMENT	\$65.00	\$85,800.00
			SUBTOTAL=	\$206,093.91



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**ENGINEER'S OPINION OF CONSTRUCTION COSTS
OPTION #2: ALIGNED (6-5-14)**

PROJECT: GUMWOOD ROAD & REDFIELD STREET ROADWAY IMPROVEMENTS - OPTION #2

MAINTENANCE OF TRAFFIC

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
1	LUMP	DETOUR SIGNING	\$7,500.00	\$7,500.00
1	LUMP	MAINTAINING TRAFFIC	\$10,000.00	\$10,000.00
5	MONTH	FIELD OFFICE, TYPE A	\$967.14	\$4,835.70
1	LUMP	CONSTRUCTION LAYOUT STAKES	\$9,500.00	\$9,500.00
1	LUMP	MOBILIZATION	\$20,000.00	\$20,000.00
			SUBTOTAL=	\$51,835.70

TRAFFIC CONTROL

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
52	FT	GROUND MOUNTED SUPPORT, NO. 2 POST	\$7.55	\$619.10
112	SQ FT	SIGN, FLAT SHEET	\$20.00	\$2,200.00
5	MILE	EDGE LINE	\$1,781.82	\$890.91
25	MILE	CENTER LINE	\$4,000.00	\$1,000.00
108	LF	STOP BAR	\$2.00	\$216.00
55	FT	CROSSWALK	\$6.03	\$331.76
			SUBTOTAL=	\$5,257.77

RIGHT OF WAY

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
5.717	ACRES	RIGHT OF WAY TAKE	\$7,500.00	\$42,877.50
			SUBTOTAL=	\$42,877.50

ROADWAY SUBTOTAL	\$131,115.66
EROSION CONTROL SUBTOTAL	\$23,741.84
DRAINAGE SUBTOTAL	\$55,047.55
PAVEMENT SUBTOTAL	\$206,093.91
MAINTENANCE OF TRAFFIC SUBTOTAL	\$51,835.70
TRAFFIC CONTROL SUBTOTAL	\$5,257.77
RIGHT OF WAY COST	\$42,877.50
SUBTOTAL	\$515,969.93
10% CONTINGENCY	\$47,309.24

OPTION #2 TOTAL

\$563,279.17



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**ENGINEER'S OPINION OF CONSTRUCTION COSTS
OPTION #3: SINGLE ALIGNED ROUNDABOUT (6-5-14)**

PROJECT: GUMWOOD ROAD & REDFIELD STREET ROADWAY IMPROVEMENTS - OPTION #3

ROADWAY

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
1	LUMP	CLEARING AND GRUBBING	\$ 18,000.00	\$18,000.00
45	EACH	TREE REMOVED, 12" SIZE	\$ 125.00	\$5,625.00
40	EACH	TREE REMOVED, 18" SIZE	\$ 185.00	\$7,400.00
10	EACH	TREE REMOVED, 24" SIZE	\$ 215.00	\$2,150.00
7,467	SQ YD	PAVEMENT REMOVED	\$ 6.50	\$48,535.50
1,000	CU YD	EXCAVATION	\$ 6.95	\$6,950.00
4,500	CU YD	EMBANKMENT	\$ 8.81	\$39,645.00
8,800	SQ YD	SUBGRADE COMPACTION	\$ 2.18	\$19,184.00
16	HOUR	PROOF ROLLING	\$ 175.00	\$2,800.00
2	EACH	MONUMENT ASSEMBLY	\$ 608.08	\$1,216.16
12,500	SQ FT	ASPHALT BIKE PATH INCLUDING BASE	\$ 2.50	\$31,250.00
4	EACH	CURB RAMP	\$ 500.00	\$2,000.00
			SUBTOTAL=	\$184,755.66

EROSION CONTROL

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
350	CU YD	TOPSOIL	\$10.16	\$3,556.00
24,000	SQ YD	SEEDING AND MULCHING	\$0.49	\$11,760.00
200	SQ YD	REPAIR SEEDING AND MULCHING	\$0.41	\$82.00
.65	TON	COMMERCIAL FERTILIZER	\$458.59	\$298.08
.85	ACRE	LIME	\$64.35	\$54.70
15	M. GAL	WATER	\$4.16	\$62.40
35	SQ YD	SODDING STAKED	\$8.47	\$296.45
1	LUMP	EROSION CONTROL	\$12,000.00	\$12,000.00
			SUBTOTAL=	\$28,109.63

DRAINAGE

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
125	FT	6" CONDUIT FOR UNDERDRAIN OUTLETS	\$10.84	\$1,355.00
145	FT	12" CONDUIT, TYPE B	\$46.55	\$6,749.75
155	FT	18" CONDUIT, TYPE B	\$58.02	\$8,993.10
55	FT	24" CONDUIT, TYPE C	\$55.34	\$3,043.70
6,200	FT	6" SHALLOW PIPE UNDERDRAINS	\$5.63	\$34,906.00
			SUBTOTAL=	\$55,047.55

PAVEMENT

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
750	SQ YD	PAVEMENT PLANING, ASPHALT CONCRETE	\$1.20	\$900.00
102	FT	FULL DEPTH PAVEMENT SAWING	\$2.06	\$210.12
425	GALLON	TACK COAT	\$1.57	\$667.25
5,400	TONS	12" CIP SUBBASE	\$25.00	\$135,000.00
2,700	TONS	6" AGGREGATE BASE	\$40.00	\$108,000.00
2,700	TONS	6" HMA PAVEMENT	\$65.00	\$175,500.00
			SUBTOTAL=	\$420,277.37



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**ENGINEER'S OPINION OF CONSTRUCTION COSTS
OPTION #4: DOUBLE ROUNDABOUT (6-5-14)**

PROJECT: GUMWOOD ROAD & REDFIELD STREET ROADWAY IMPROVEMENTS - OPTION #4

ROADWAY

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
1	LUMP	CLEARING AND GRUBBING	\$ 7,500.00	\$7,500.00
6	EACH	TREE REMOVED, 18" SIZE	\$ 185.00	\$1,110.00
5,067	SQ YD	PAVEMENT REMOVED	\$ 6.50	\$32,935.50
50	CU YD	EXCAVATION	\$ 6.95	\$347.50
100	CU YD	EMBANKMENT	\$ 8.81	\$881.00
5,067	SQ YD	SUBGRADE COMPACTION	\$ 2.18	\$11,046.06
10	HOUR	PROOF ROLLING	\$ 175.00	\$1,750.00
2	EACH	MONUMENT ASSEMBLY	\$ 608.08	\$1,216.16
19,000	SQ FT	ASPHALT BIKE PATH INCLUDING BASE	\$ 2.50	\$47,500.00
4	EACH	CURB RAMP	\$ 500.00	\$2,000.00
			SUBTOTAL=	\$106,286.22

EROSION CONTROL

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
250	CU YD	TOPSOIL	\$10.16	\$2,540.00
4,200	SQ YD	SEEDING AND MULCHING	\$0.49	\$2,058.00
150	SQ YD	REPAIR SEEDING AND MULCHING	\$0.41	\$61.50
.5	TON	COMMERCIAL FERTILIZER	\$458.59	\$229.30
.75	ACRE	LIME	\$64.35	\$48.26
10	M. GAL	WATER	\$4.16	\$41.60
50	SQ YD	SODDING STAKED	\$8.47	\$423.50
1	LUMP	EROSION CONTROL	\$8,000.00	\$8,000.00
			SUBTOTAL=	\$13,402.16

DRAINAGE

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
125	FT	6" CONDUIT FOR UNDERDRAIN OUTLETS	\$10.84	\$1,355.00
100	FT	12" CONDUIT, TYPE B	\$46.55	\$4,655.00
100	FT	18" CONDUIT, TYPE B	\$58.02	\$5,802.00
35	FT	24" CONDUIT, TYPE C	\$55.34	\$1,936.90
3,800	FT	6" SHALLOW PIPE UNDERDRAINS	\$5.63	\$21,394.00
			SUBTOTAL=	\$35,142.90

PAVEMENT

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
1,000	SQ YD	PAVEMENT PLANING, ASPHALT CONCRETE	\$1.20	\$1,200.00
102	FT	FULL DEPTH PAVEMENT SAWING	\$2.06	\$210.12
200	GALLON	TACK COAT	\$1.57	\$314.00
3,520	TONS	12" CIP SUBBASE	\$25.00	\$88,000.00
1,760	TONS	6" AGGREGATE BASE	\$40.00	\$70,400.00
1,760	TONS	6" HMA PAVEMENT	\$65.00	\$114,400.00
			SUBTOTAL=	\$274,524.12

MAINTENANCE OF TRAFFIC

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
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**ENGINEER'S OPINION OF CONSTRUCTION COSTS
OPTION #4: DOUBLE ROUNDABOUT (6-5-14)**

PROJECT: GUMWOOD ROAD & REDFIELD STREET ROADWAY IMPROVEMENTS - OPTION #4

1	LUMP	DETOUR SIGNING	\$7,500.00	\$7,500.00
1	LUMP	MAINTAINING TRAFFIC	\$10,000.00	\$10,000.00
5	MONTH	FIELD OFFICE, TYPE A	\$967.14	\$4,835.70
1	LUMP	CONSTRUCTION LAYOUT STAKES	\$12,000.00	\$12,000.00
1	LUMP	MOBILIZATION	\$20,000.00	\$20,000.00
			SUBTOTAL=	\$54,335.70

TRAFFIC CONTROL

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
180	FT	GROUND MOUNTED SUPPORT, NO. 2 POST	\$7.55	\$1,359.00
92	SQ FT	SIGN, FLAT SHEET	\$20.00	\$1,840.00
.72	MILE	EDGE LINE	\$1,781.82	\$1,282.91
.36	MILE	CENTER LINE	\$4,000.00	\$1,440.00
48	FT	CROSSWALK	\$6.03	\$289.54
			SUBTOTAL=	\$6,211.45

RIGHT OF WAY

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	COST
0.4089	ACRES	RIGHT OF WAY TAKE	\$7,500.00	\$3,066.75
			SUBTOTAL=	\$3,066.75

ROADWAY SUBTOTAL	\$106,286.22
EROSION CONTROL SUBTOTAL	\$13,402.16
DRAINAGE SUBTOTAL	\$35,142.90
PAVEMENT SUBTOTAL	\$274,524.12
MAINTENANCE OF TRAFFIC SUBTOTAL	\$54,335.70
TRAFFIC CONTROL SUBTOTAL	\$6,211.45
RIGHT OF WAY COST	\$3,066.75
SUBTOTAL	\$492,969.29
10% CONTINGENCY	\$48,990.25

OPTION #4 TOTAL **\$541,959.55**