VALUE ENGINEERING STUDY

OF

FEGENBUSH LANE AND BEULAH CHURCH ROAD INTERSECTION

ITEM NUMBER: 5-73.00/fd041550 C056

Jefferson County, Kentucky

February 12-16, 2007

Prepared by:

VE GROUP, L.L.C.

In Association With:

KENTUCKY TRANSPORTATION CABINET

VALUE ENGINEERING STUDY
TEAM LEADER

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C.V.S. Registration No. 840603 (LIFE)

DATE

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I. EXECUTIVE SUMMARY

INTRODUCTION

This Value Engineering report summarizes the results of the Value Engineering Study performed by VE Group for the Kentucky Transportation Cabinet. The study was performed during the week of February 12-16, 2007.

The subject of the study is improvements to the Outer Loop at the intersection of Fegenbush Lane and Beulah Church Road in Jefferson County in metropolitan Louisville.

PROJECT DESCRIPTION

The project provides improvements to the following two at-grade intersections:

- Outer Loop, Fegenbush Lane, and S Watterson Trace
- Fegenbush Lane and Beulah Church Road

The project, with an overall length of 0.93 miles, includes pavement widening and resurfacing to provide additional travel and turning lanes as well as storm water drainage improvements. Additional right-of-way acquisition is required to accommodate the pavement widening.

METHODOLOGY

The Value Engineering Team followed the basic Value Engineering procedure for conducting this type of analysis.

This process included the following phases:

1. Investigation
2. Speculation
3. Evaluation
4. Development
5. Presentation
6. Report Preparation

Evaluation criteria identified as a basis for the comparison of alternatives included the following:

- Traffic Control
- Construction Time
- Service Life
- Maintenance of Traffic
- Construction Cost
- Utility Impacts
- R/W Requirements

I. EXECUTIVE SUMMARY

RESULTS – AREAS OF FOCUS

The following areas of focus were analyzed by the Value Engineering team and from these areas the following Value Engineering alternatives were developed and are recommended for Implementation:

Recommendation Number1: Fegenbush Lane/S. Watterson Trace/Outer Loop Intersection

The Value Engineering Team recommends that Value Engineering Alternative be implemented. This alternative provides a free flowing Roundabout in lieu of a signalized intersection.

If this recommendation can be implemented, there is a possible savings of ***$1,327,418.***

Recommendation Number 2: Fegenbush Lane/Beulah Church Road Intersection

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative provides a free flowing Roundabout in lieu of a signalized intersection.

If this recommendation can be implemented, there is a possible savings of ***$1,645,603.***

Recommendation Number 3: Pavement Design

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative minimizes the thickness of the aggregate base and maximizes the depth of the asphalt concrete to obtain the required pavement structural support for the design year traffic.

If this recommendation can be implemented, there is a possible savings of ***$131,968.***

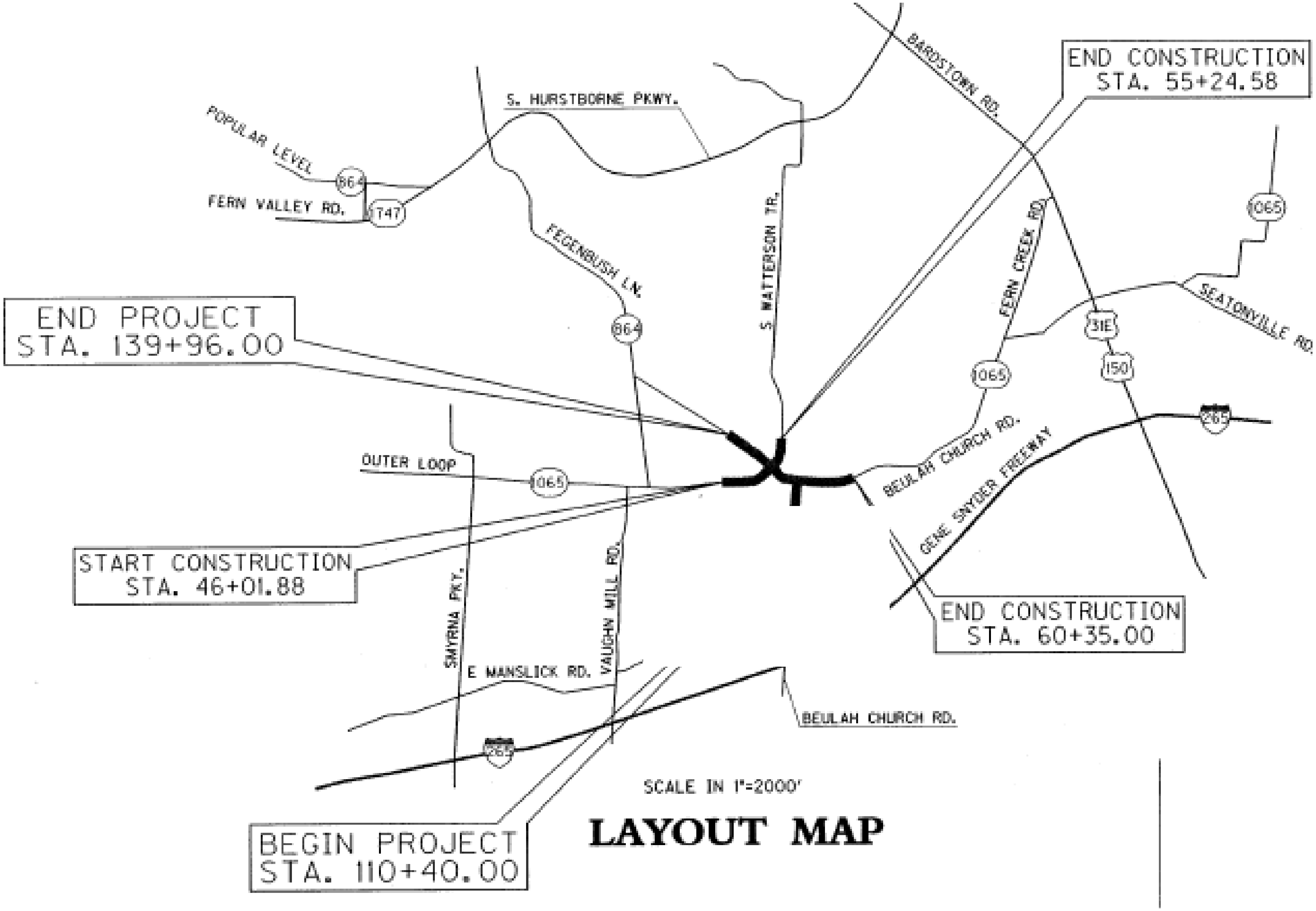
Recommendation Number 4: Drainage System

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative has open channel swales with 8 ft. paved shoulders as the typical section instead of curbs and gutters with a closed drainage system. High-density polyethylene pipes are proposed as an acceptable alternate for all storm drains.

If this recommendation can be implemented, there is a possible savings of ***$179,556.***

As Proposed			Value Engineering Alternatives	
Construction	**Right-of-Way**	**Total**	**# Recommendations**	**Possible Savings**
$ 3,500,000.00	**$ 4,600,000.00**	**$ 8,100,000.00**	**4**	**$ 3,284,545.00**

II. LOCATION OF PROJECT



III. TEAM MEMBERS AND PROJECT DESCRIPTION

TEAM MEMBERS

NAME	AFFILIATION	EXPERTISE	PHONE
Jerry Love, P.E., C.V.S., PhD	VE Group	Team Leader	850/627-3900
Tom Hartley, P.E., C.V.S.	VE Group	Traffic	850/627-3900
Bill Keating, P.E.	VE Group	Construction	850/627-3900
Joel Pate	VE Group	Roadway	850/627-3900
Mike Bezold, P.E.	KYTC – Dist. 6	Roadway	859-341-2700
Joe Tucker	KYTC-Headquarters	Pavement Design	502-564-3280

PROJECT DESCRIPTION

The project includes pavement widening and improvements at the following two signalized intersections:

- Beulah Church Road (KY 864) and Fegenbush Lane (KY 864)
- Outer Loop (KY 1063), Fegenbush Lane (KY864), and S. Watterson Trace

The project has an overall length of 0.93 miles with an estimated construction cost of $3.6 million and R/W acquisition costs of $4.6 million. The project, located in Jefferson County, within the Louisville Metropolitan Area, has a designated design speed of 35 mph and a design year ADT of 18,900.

IV. INVESTIGATION PHASE

VALUE ENGINEERING STUDY BRIEFING

FERGENBUSH LANE AND BEULAH CHURCH ROAD INTERSECTION **February 12-16, 2007**		
NAME	**AFFILIATION**	**PHONE**
Jerry Love	VE Group	850-627-3900
Thomas Hartley	VE Group	850-627-3900
Bill Keating	VE Group	850-627-3900
Joel Pate	VE Group	850-627-3900
Mike Bezold	KYTC-Dist. 6	859-341-2700
Kelly Meyer	Quest Engineers	502-584-4118
Kert Ballard	Quest Engineers	502-584-4118
John Callihan	KYTC-Dist. 5	502-367-6411
Tala Quino	KYTC-Dist. 5	502-367-6411
Joe Tucker	KYTC- Design	502-564-3280
Mary Murray	FHWA	502-223-6745
Robert Semones	KYTC-Headquarters	502-564-9900

STUDY RESOURCES

FERGENBUSH LANE AND BEULAH CHURCH ROAD INTERSECTION **February 12-16, 2007**		
NAME	**AFFILIATION**	**PHONE**
Brent A. Sweger	KYTC – Planning	564-9900-3297

IV. INVESTIGATION PHASE

FUNCTIONAL ANALYSIS WORKSHEET

FERGENBUSH LANE AND BEULAH CHURCH ROAD INTERSECTION

February 12-16, 2007

ITEM	FUNCT. VERB	FUNCT. NOUN	* TYPE	COST (000)	WORTH	VALUE INDEX
Fegenbush Lane /Outerloop Intersection	Accom.	Traffic	B	$1,000	$300	3.33
Fegenbush Lane /Beulah Church Intersection	Accom.	Traffic	B	$2,000	$500	4.00
Pavement Design	Support	Traffic	B	$1,700	$1,500	1.13
Drainage System	Convey	Water	B	$660	$500	1.32
Maintenance of Traffic	Maintain	Traffic	B	$250	$225	1.11

***B – Basic S - Secondary**

** Note: This worksheet is a tool of the Value Engineering process and is only used for determining the areas that the Value Engineering team should focus on for possible alternatives. The column for COST indicates the approximate amount of the cost as shown in the cost estimate. The column for WORTH is an estimated cost for the lowest possible alternative that would provide the FUNCTION shown. Many times the lowest cost alternatives are not considered implementable but are used only to establish a worth for a function. A value index greater than 1.00 indicates the Value Engineering team intends to focus on this area of the project.

IV. INVESTIGATION PHASE

The following areas have a value index greater than 1.00 on the proceeding Functional Analysis Worksheet and therefore have been identified by the Value Engineering Team as areas of focus and investigation for the Value Engineering process:

A. FEGENBUSH LANE/ SOUTH WATTERSON TRACE/ OUTER LOOP INTERSECTION

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

C. PAVEMENT DESIGN

D. DRAINAGE SYSTEM

E. MAINTENANCE OF TRAFFIC

V. SPECULATION PHASE

Ideas generated, utilizing the brainstorming method, for performing the functions of previously identified areas of focus.

A. FEGENBUSH LANE/SOUTH WATTERSON TRACE/ OUTER LOOP INTERSECTION

- Roundabout
- Urban Interchange
- Cul-de-sac S. Watterson Trace
- Add additional turning lanes

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

- Roundabout
- Urban Interchange
- Add additional turning lanes

C. PAVEMENT DESIGN

- Portland Cement Concrete Pavement
- Minimum Aggregate Base with Maximum Asphalt Concrete
- Alternate Types of Asphalt Concrete

D. DRAINAGE SYSTEM

- Open Channel Swales in Certain Areas and Reduce Curb and Gutter
- Permit use of High Density Polyethylene Storm Drain Pipes
- Provide 8 ft. shoulders in lieu of curbs and gutters

E. MAINTENANCE OF TRAFFIC

- Utilize Detours and Temporary Pavement to Reduce Traffic in Construction Areas
- Temporarily Close Lower Volume Intersection Approaches

VI. EVALUATION PHASE

A. ALTERNATIVES

The following alternatives were formulated during the "eliminate and combine" portion of the Evaluation Phase.

A. FEGENBUSH LANE/SOUTH WATTERSON TRACE/OUTER LOOP INTERSECTION

Value Engineering Alternative: ***Roundabout.***

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

Value Engineering Alternative: ***Roundabout.***

C. PAVEMENT DESIGN

Value Engineering Alternative Number 1: ***Portland Cement Concrete Pavement.***

Value Engineering Alternative Number 2: ***Minimum Aggregate Base with Maximum Asphalt Concrete.***

D. DRAINAGE SYSTEM

Value Engineering Alternative: ***Open Channel Swale with 8 ft. Shoulders as Typical Section, Reduce Curb and Gutter, and Designate High Density Polyethylene Pipe as an Acceptable Alternate for Storm Drains.***

E. MAINTENANCE OF TRAFFIC

Value Engineering Alternative: ***Utilize Detours and Temporary Pavement to Reduce Traffic in Construction Areas.***

VI. EVALUATION PHASE

B. ADVANTAGES AND DISADVANTAGES

The following Advantages and Disadvantages were developed for the Value Engineering Alternatives previously generated during the speculation phase. It also includes the Advantages and Disadvantages for the "As Proposed".

A. FEGENBUSH LANE/SOUTH WATTERSON TRACE/ OUTER LOOP INTERSECTION

"As Proposed": At-grade Signalized Intersection.

Advantages

- Acceptable to public.
- Smaller footprint.

Disadvantages

- High construction cost.
- High maintenance cost.
- Increase in traffic conflicts.
- Increases traffic delays.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative: Roundabout.

Advantages

- Reduces traffic delays.
- Requires less pavement area.
- Requires less R/W.
- Lower maintenance costs.
- Enhances aesthetics.
- Flexibility to convert to future higher capacity signalized intersection.

Disadvantages

- Public not as familiar with roundabout operation.
- May be more difficult to maintain traffic during construction.

Conclusion

Carry forward for further evaluation.

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

"As Proposed": At-grade signalized intersection.

Advantages

- Acceptable to public.

Disadvantages

- High construction cost.
- High maintenance cost.
- Larger footprint.
- Increase in traffic conflicts.
- Increases traffic delays.
- Reduces property access.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative: ***Roundabout.***

Advantages

- Reduces traffic delays.
- Requires less pavement area.
- Lower maintenance cost.
- Enhances aesthetics.
- Flexibility to convert to future higher capacity signalized intersection.

Disadvantages

- May be more difficult to maintain traffic during construction.
- Has larger footprint.
- Public not as familiar with roundabout operation.

Conclusion

Carry forward for further evaluation.

C. PAVEMENT DESIGN

"As Proposed”: Asphalt Concrete with Maximum Aggregate Design.

Advantages

- Simplifies MOT.
- Matches existing approach pavements.
- More adaptable to future pavement overlays.

Disadvantages

- Higher maintenance cost.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative Number 1: Portland Cement Concrete Pavement.

Advantages

- Lower maintenance cost.
- Reduces potential for rutting with stop and go intersection traffic.
- Requires less excavation.

Disadvantages

- Doesn’t match existing approach pavements.
- Higher construction cost.
- More difficult to maintain traffic during construction.

Conclusion

Drop from further evaluation because of higher construction cost and more difficult MOT.

C. PAVEMENT DESIGN *(continued)*

Value Engineering Alternative Number 2: Minimum Aggregate with Maximum Asphalt Concrete.

Advantages

- Requires less pavement material.
- Simplifies MOT.
- Less excavation required.
- Matches existing pavements.
- Reduces lane drop off during construction.
- Higher salvage value.
- Lower construction cost.

Disadvantages

- None apparent.

Conclusion

Carry forward for further evaluation.

B. ADVANTAGES AND DISADVANTAGES *(continued)*

D. DRAINAGE SYSTEM

“As Proposed”: Curb and Gutter With Closed Drainage System.

Advantages

- Minimizes R/W.
- Aesthetically pleasing.
- Controls access to abutting property.

Disadvantages

- Higher construction cost.
- Eliminates safety areas for disabled vehicles.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative: ***Open Channel Swales With 8 ft. shoulders as Typical Section, Reduce Curb and Gutter, and Designate High Density Polyethylene Pipe as an Acceptable Alternate for Storm*** Drains.

Advantages

- Lower construction cost.
- Provides areas for disabled vehicles.
- Matches swales on approach roadways.
- Provides additional pavement width for MOT.

Disadvantages

- May require additional grading.
- Eliminates sidewalks.

Conclusion

Carry forward for further evaluation.

E. MAINTENANCE OF TRAFFIC

“As Proposed”: Maintain one lane of traffic in each direction at all times.

Advantages

- Provides access to abutting property during construction.

Disadvantages

- Higher construction cost.
- Longer construction time.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative:* *Utilize Detours and Temporary Pavement To Reduce Traffic in Construction Areas.

Advantages

- Reduces construction phases.
- May reduce construction time.
- May reduces construction cost.

Disadvantages

- Temporary increase in traffic on local streets.
- May impede access to abutting businesses.

Conclusion

Drop from further evaluation since this alternative is not more cost effective than the as proposed MOT. Comments regarding the proposed MOT plan are included as a design comment.

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/SOUTH WATTERSON TRACE/ OUTER LOOP INTERSECTION

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE

B. FEGENBUSH LANE/BEULAH CHURCH LANE INTERSECTION

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE

C. PAVEMENT DESIGN

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE

D. DRAINAGE SYSTEM

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

1. "As Proposed"

This intersection and approaches include improvements that are a part of the Congestion Mitigation Project designed to improve the operational characteristics of the roadway system within the project limits.

The following photographs depict the conditions at the existing intersection and the intersection approaches that are 2-lane typical rural sections with open drainage swales.

**EXISTING INTERSECTION –
FEGENBUSH LANE/OUTER LOOP/SOUTH WATTERSON TRACE**

SOUTH WATTERSON TRACE APPROACH

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

1. "As Proposed" *(continued)*

FEGENBUSH LANE SOUTH APPROACH

FEGENBUSH LANE NORTH APPROACH

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

1. “As Proposed” *(continued)*

OUTER LOOP APPROACH

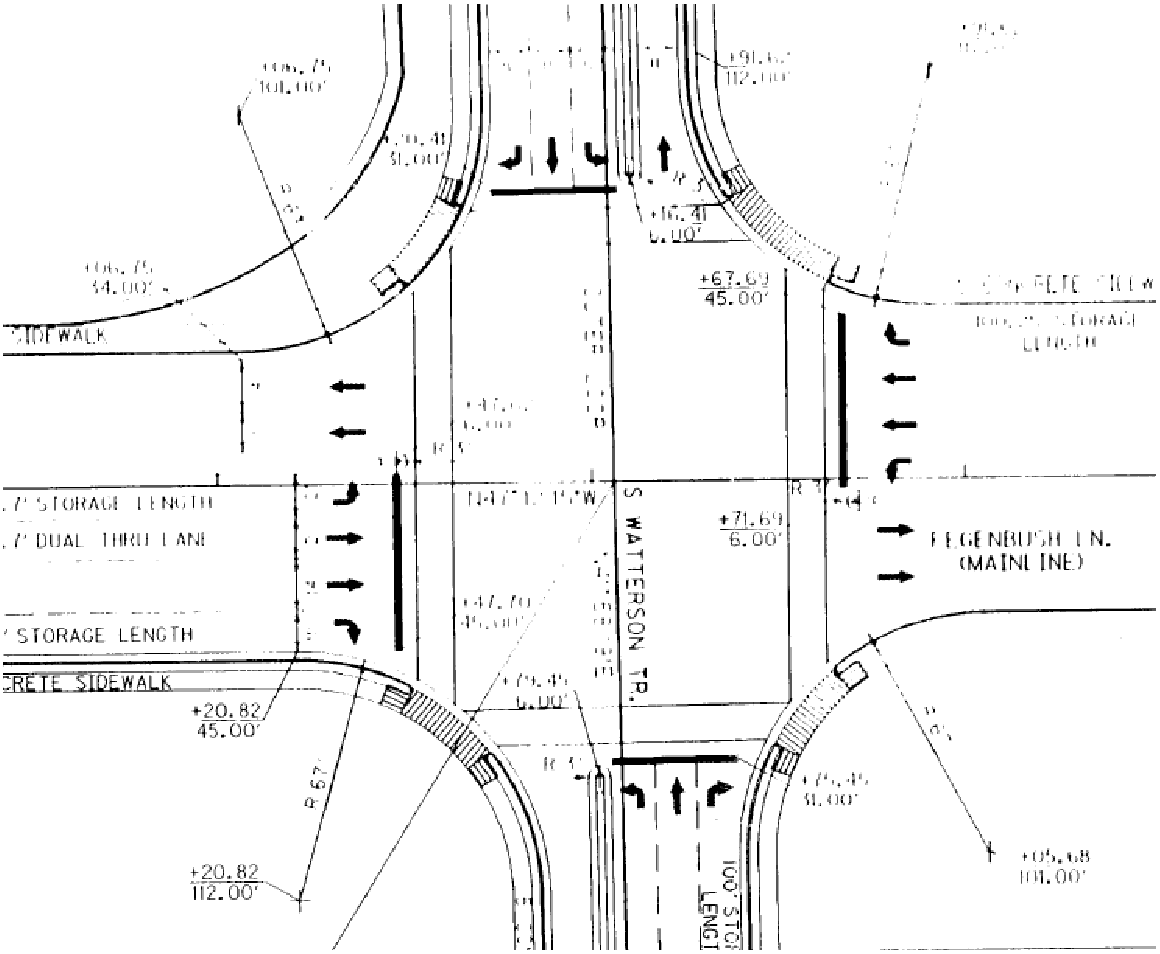
VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

1. “As Proposed” *(continued)*

PROPOSED IMPROVEMENTS

The as proposed design increases the capacity of the existing signalized intersection of Fegenbush Lane, Outer Loop and S. Watterson Trace by widening the intersection and approaches to the following configuration:



AS PROPOSED INTERSECTION

1. NB & SB Fegenbush Lane approaches:
    a. 2 – Through lanes
    b. 1 – Left Turn lane
    c. 1 – Right Turn lane

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

1. “As Proposed” *(continued)*

2. Outer Loop approach:
   a. 1 – Through lane
   b. 1 – Left Turn lane
   c. 1 – Right Turn lane
3. S. Watterson Trace approach:
   a. 1 – Through lane
   b. 1 – Left Turn lane
   c. 1 – Right Turn lane

TRAFFIC ANALYSIS

The Value Engineering Team completed a Highway Capacity Analysis of the widened intersection utilizing the Planning Model and the provided AM & PM Design Year traffic volumes. The traffic analysis indicated that the as proposed design would provide a V/C Ratio of 0.90 (Near Capacity) for the AM Peak and a V/C Ratio of 0.75 (Under Capacity) for the PM Peak. The as proposed intersection should therefore provide adequate capacity for the projected 2028 design year traffic volumes. Traffic analysis data sheets are included on following pages.

R/W REQUIREMENTS

These improvements, as designed, will require the acquisition of nearly 74,500 SF of fee simple right of way from 12 different parcels. The fee simple acquisition is estimated to cost approximately $1,400,000.

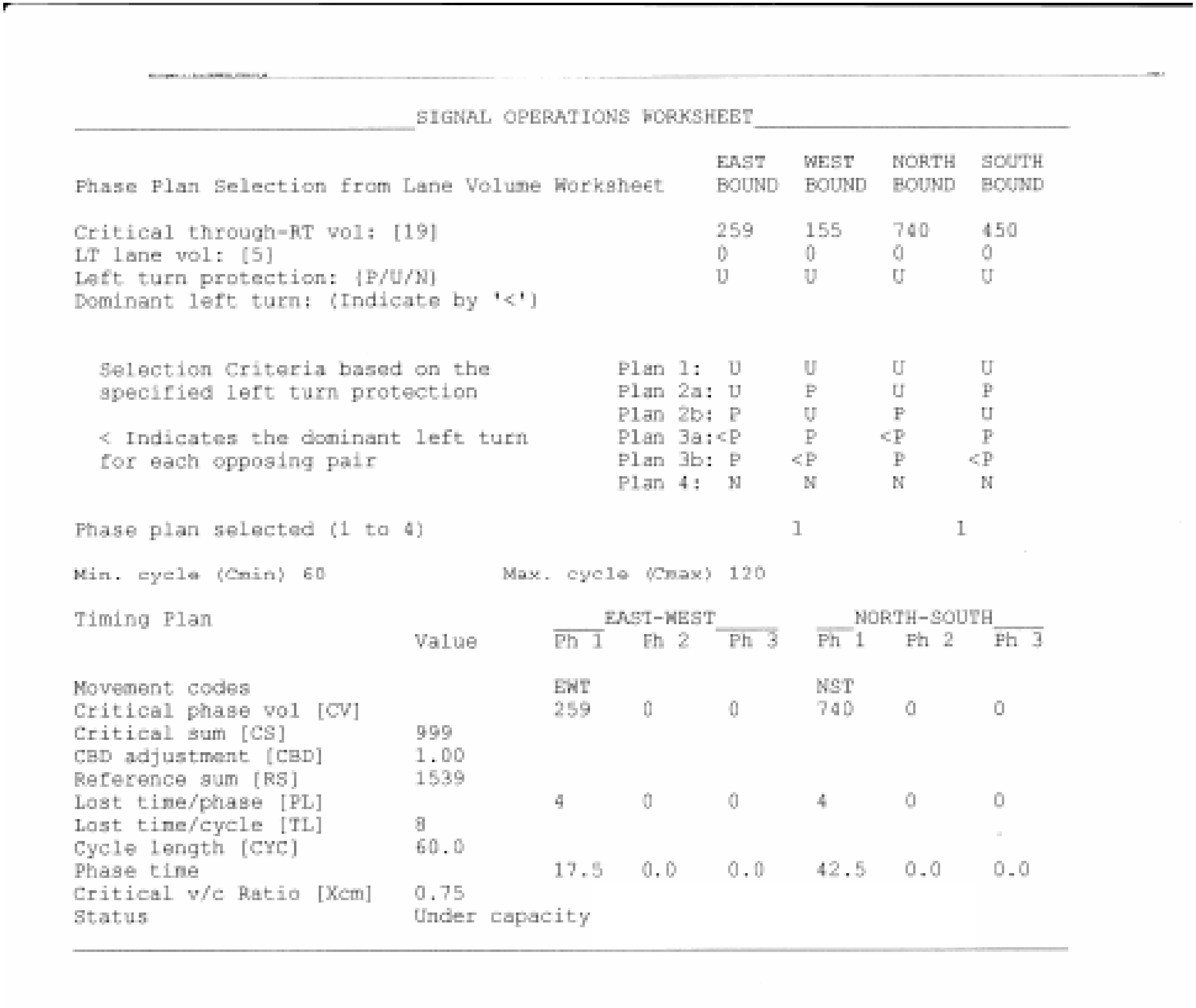
CONSTRUCTION COST

The estimated construction cost of the as proposed intersection improvements that include widening the intersection and approaches, installing curb and gutter, sidewalks, and a closed drainage system is approximately $1,273,000.

DESIGN BUILD CONCEPT

Although the Value Engineering Team did not make a detailed evaluation of utilizing the design-build concept, it was concluded that this project would be a viable candidate for this type of contract since the design parameters and project limits are well defined. In addition, the project has progressed to the final design stage with adequate data available to prepare the scope of work for this type of Contract. The obvious advantages of the design-build concept are that the design would become a factor in the competitive selection process and some savings in time would be realized.

It is appropriate to note that the Department now has a good design consultant under contract who is very familiar with the project. If a decision is made to adopt some or all of the Value Engineering Team recommendations, the existing design can be cost effectively revised within a short period of time.



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___________________________SIGNAL OPERATIONS WORKSHEET_________________________

                                                      EAST    WEST    NORTH   SOUTH
Phase Plan Selection from Lane Volume Worksheet      BOUND   BOUND   BOUND   BOUND

Critical through-RT vol: [19]                         259     155     740     450
LT lane vol: [5]                                      0       0       0       0
Left turn protection: (P/U/N)                         U       U       U       U
Dominant left turn: (Indicate by '<')


  Selection Criteria based on the            Plan 1:  U       U       U       U
  specified left turn protection             Plan 2a: U       P       U       P
                                             Plan 2b: P       U       P       U
  < Indicates the dominant left turn         Plan 3a:<P       P      <P       P
  for each opposing pair                     Plan 3b: P      <P       P      <P
                                             Plan 4:  N       N       N       N

Phase plan selected (1 to 4)                                  1               1

Min. cycle (Cmin) 60               Max. cycle (Cmax) 120

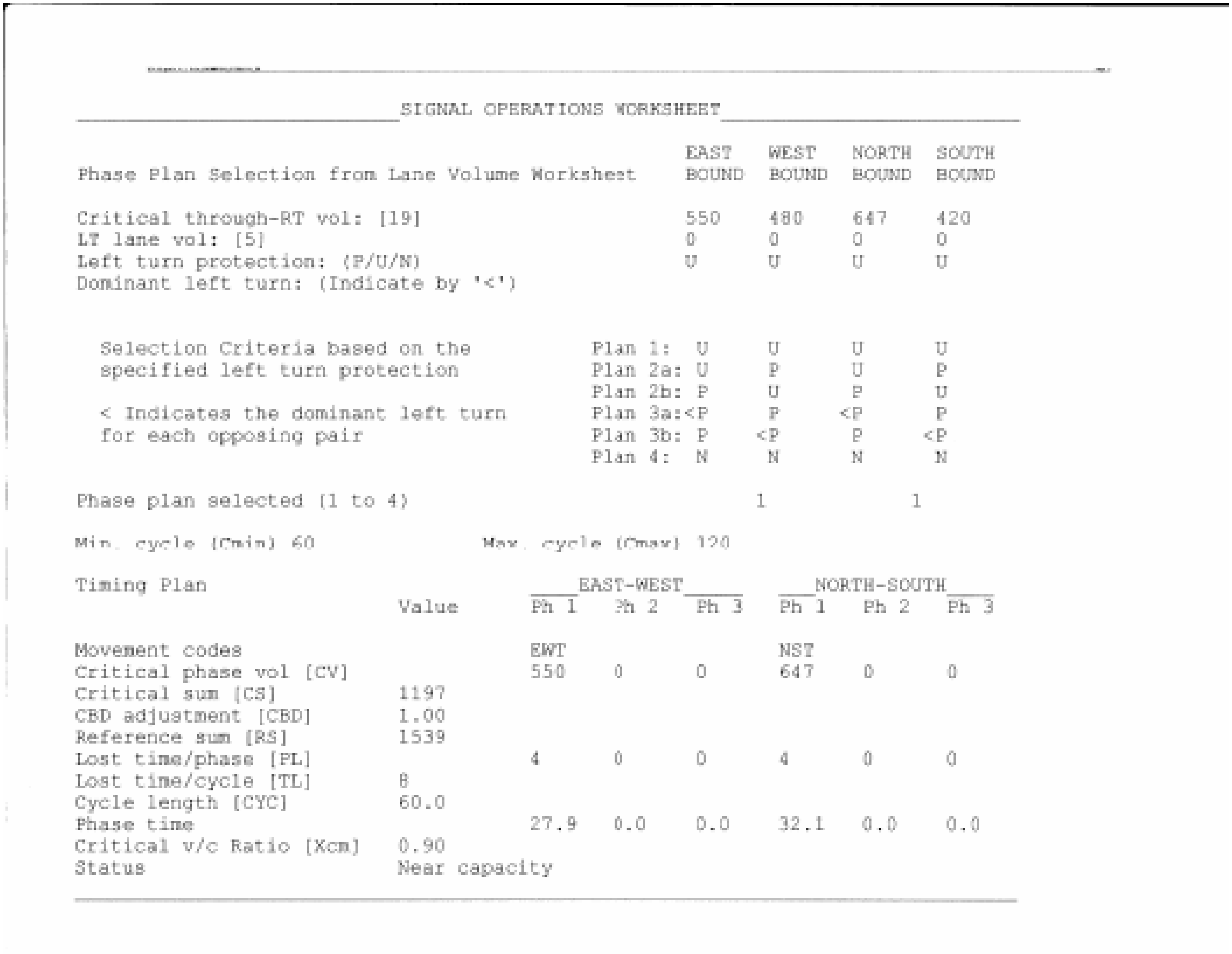
Timing Plan                                 ____EAST-WEST_____    ___NORTH-SOUTH____
                           Value            Ph 1   Ph 2   Ph 3    Ph 1   Ph 2   Ph 3

Movement codes                              EWT                   NST
Critical phase vol [CV]                     259    0      0       740    0      0
Critical sum [CS]          999
CBD adjustment [CBD]       1.00
Reference sum [RS]         1539
Lost time/phase [PL]                        4      0      0       4      0      0
Lost time/cycle [TL]       8
Cycle length [CYC]         60.0
Phase time                                  17.5   0.0    0.0     42.5   0.0    0.0
Critical v/c Ratio [Xcm]   0.75
Status                     Under capacity
________________________________________________________________________________
```

VII. Development Phase

A. Fegenbush Lane/S. Watterson Trace/Outer Loop Intersection

1. “As Proposed”



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_____________________________SIGNAL OPERATIONS WORKSHEET___________________________

                                                     EAST   WEST   NORTH  SOUTH
Phase Plan Selection from Lane Volume Workshest      BOUND  BOUND  BOUND  BOUND

Critical through-RT vol: [19]                        550    480    647    420
LT lane vol: [5]                                     0      0      0      0
Left turn protection: (P/U/N)                        U      U      U      U
Dominant left turn: (Indicate by '<')


  Selection Criteria based on the           Plan 1:  U      U      U      U
  specified left turn protection            Plan 2a: U      P      U      P
                                            Plan 2b: P      U      P      U
  < Indicates the dominant left turn        Plan 3a:<P      P     <P      P
  for each opposing pair                    Plan 3b: P     <P      P     <P
                                            Plan 4:  N      N      N      N

Phase plan selected (1 to 4)                             1             1

Min. cycle (Cmin) 60            Max. cycle (Cmax) 120

Timing Plan                              ____EAST-WEST_____    ___NORTH-SOUTH____
                            Value        Ph 1   Ph 2   Ph 3    Ph 1   Ph 2   Ph 3

Movement codes                           EWT                   NST
Critical phase vol [CV]                  550    0      0       647    0      0
Critical sum [CS]           1197
CBD adjustment [CBD]        1.00
Reference sum [RS]          1539
Lost time/phase [PL]                     4      0      0       4      0      0
Lost time/cycle [TL]        8
Cycle length [CYC]          60.0
Phase time                               27.9   0.0    0.0     32.1   0.0    0.0
Critical v/c Ratio [Xcm]    0.90
Status                      Near capacity
```

VII. Development Phase
A. Fegenbush Lane/S. Watterson Trace/Outer Loop Intersection
1. "As Proposed"

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

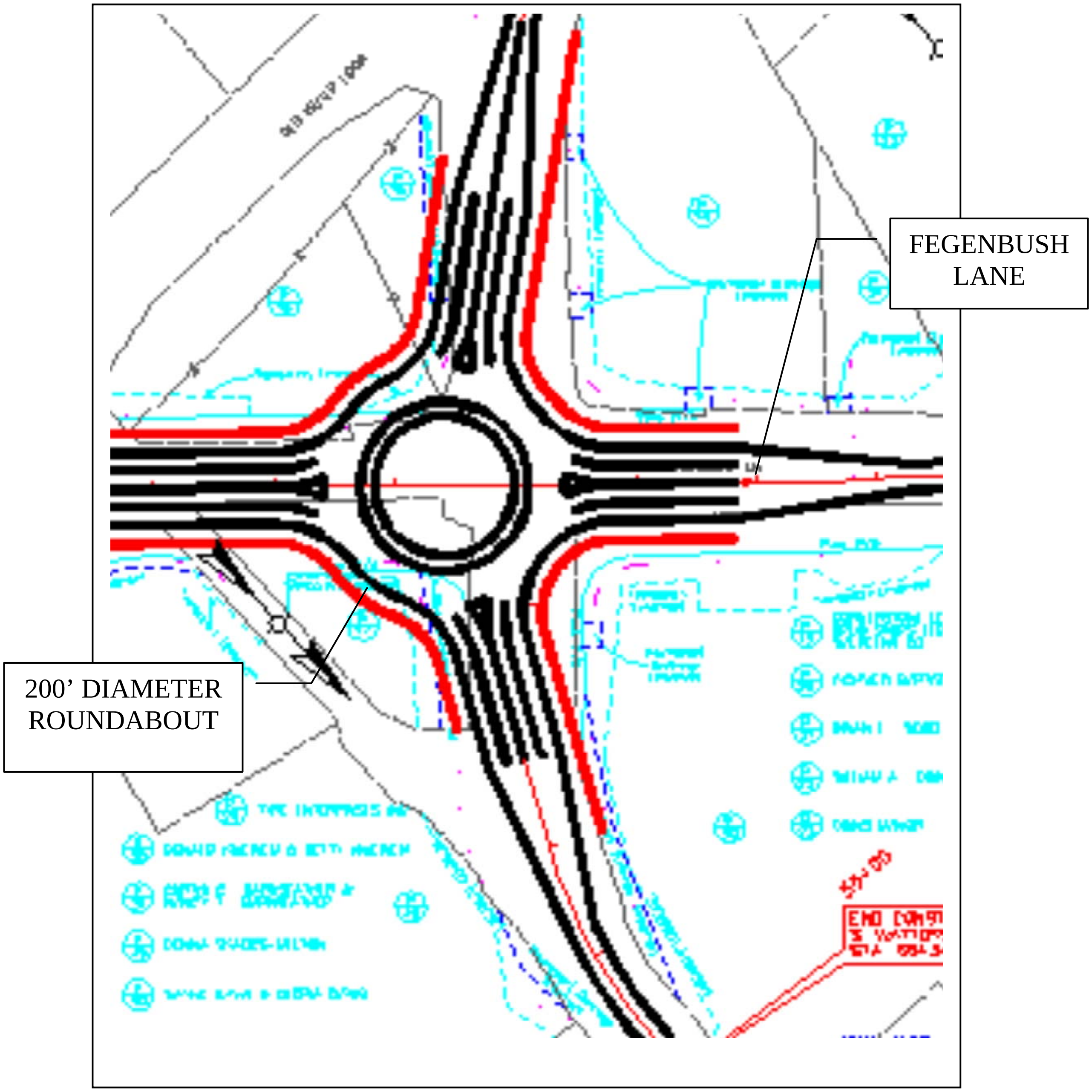
2. Value Engineering Alternative

After reviewing the project in the field, the Value Engineering Team concluded that a possible viable alternative design is a Roundabout in lieu of a signalized intersection. A Roundabout configured as shown in the layout on the following page, was developed for further evaluation as the Value Engineering Alternative.

One of the obvious advantages of a Roundabout as compared to a signalized intersection is that it provides for the free flow of traffic, thereby reducing traffic delays. Although Roundabouts are not a viable design for higher speed arterials, it does operate very efficiently at an operational speed commensurate with the 35 mph designated design speed for this project.

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

2. *Value Engineering Alternative* *(continued)*



VALUE ENGINEERING ALTERNATIVE ROUNDABOUT
FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

2. *Value Engineering Alternative* *(continued)*

TRAFFIC ANALYSIS

Based on an initial traffic analysis completed by the Value Engineering Team, a two-lane Roundabout has the capacity to accommodate traffic volumes in excess of the design year projections.

A more in-depth analysis was completed with the Rodel Software for a 165’ Roundabout. The analysis indicated that this Roundabout would operate at an LOS of A utilizing the projected design year traffic volumes. The analysis also projected that the maximum queue length that would develop would be five vehicles for one of the approaches. The layout shown above with a diameter of 200 ft. could therefore probably be safely reduced to the diameter utilized in the Rodel analysis, assuming that the relatively low percent of trucks does not support the need for a larger diameter Roundabout. Printouts of the results of the Rodel Roundabout Traffic analysis are shown in the data sheets on following pages. Additional traffic capacity analysis data sheets are included in the Appendices.

In addition to providing adequate capacity for the design year traffic projections, it is also appropriate to point out that the Roundabout provides a free flowing intersection for all traffic movements. With an operational speed compatible with the project design speed of 35 mph, the Roundabout should operate in a very efficient manner.

R/W REQUIREMENTS

The major cost savings associated with the Value Engineering Roundabout is the reduction in right of way required to construct the Roundabout as compared to the signalized intersection. The required right of way for the Value Engineering Alternative Roundabout is approximately 28,400 SF from 3 parcels at an estimated cost of approximately $532,000 whereas the as proposed signalized intersection will require approximately 74,500 SF at an estimated acquisition cost of approximately $1,396,000.

CONSTRUCTION COST

Construction cost savings can be realized with the Roundabout as a result of an overall reduction in pavement, drainage, and signalization costs. The estimated construction cost of the Value Engineering Alternative is approximately $809,000 as compared to approximately $1,272,000 for the as proposed design.

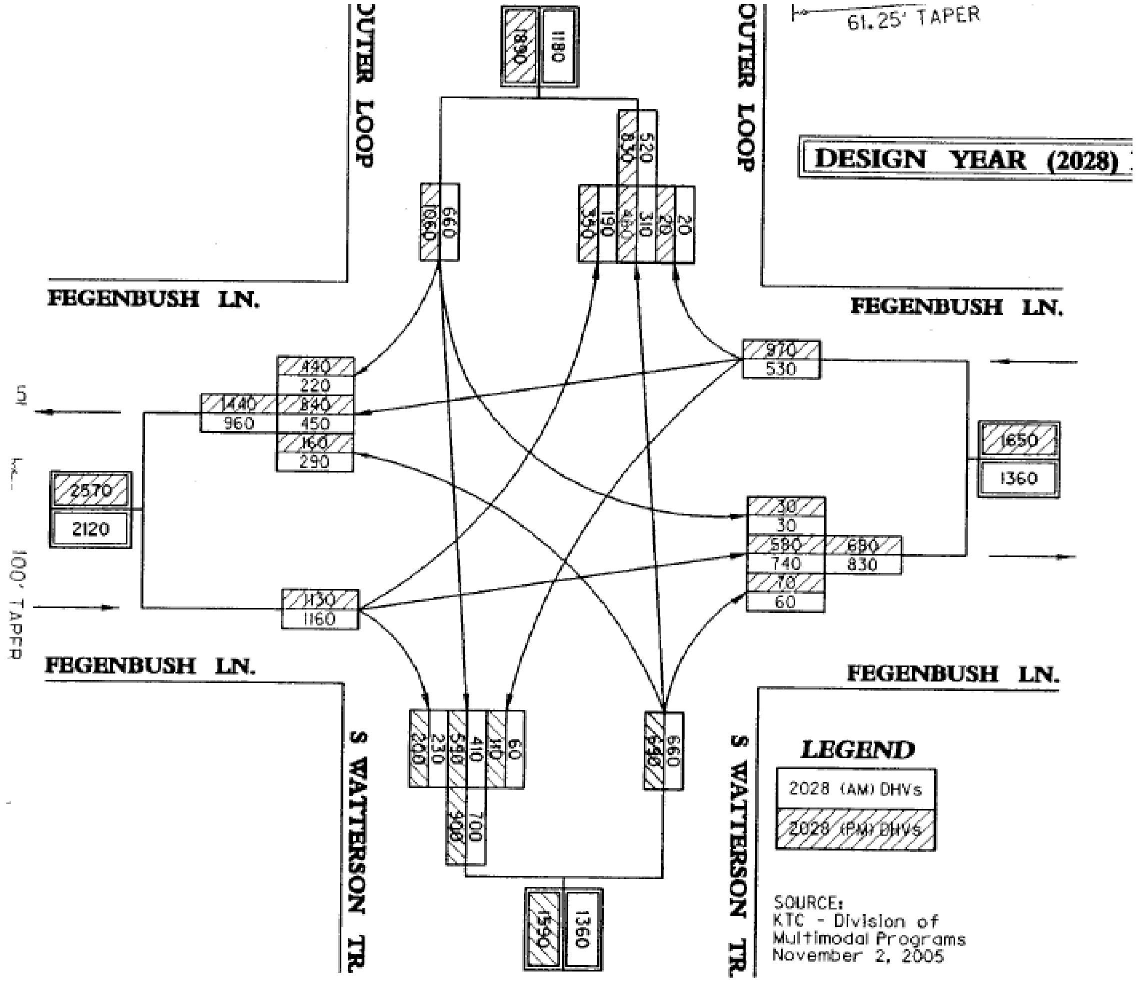
RECOMMENDATION

The Value Engineering Team recommends that the Value Engineering Alternative Roundabout be selected as a basis for the development of the final plans since it will function as a free flowing intersection with a desirable LOS and will provide a possible total project cost savings of $1,327,420.

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

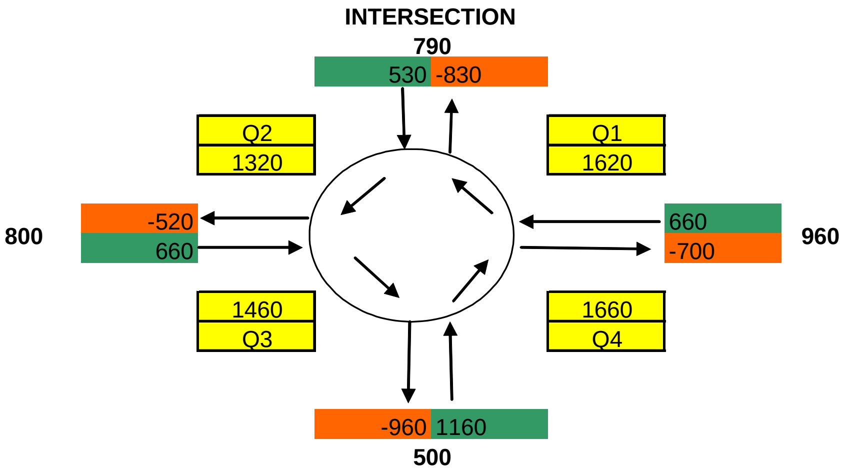
2. *Value Engineering Alternative (continued)*

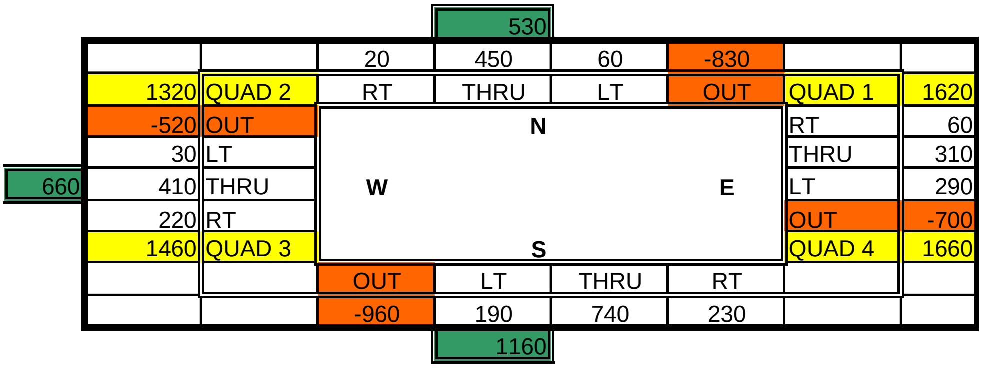


SOURCE:
KTC - Division of
Multimodal Programs
November 2, 2005

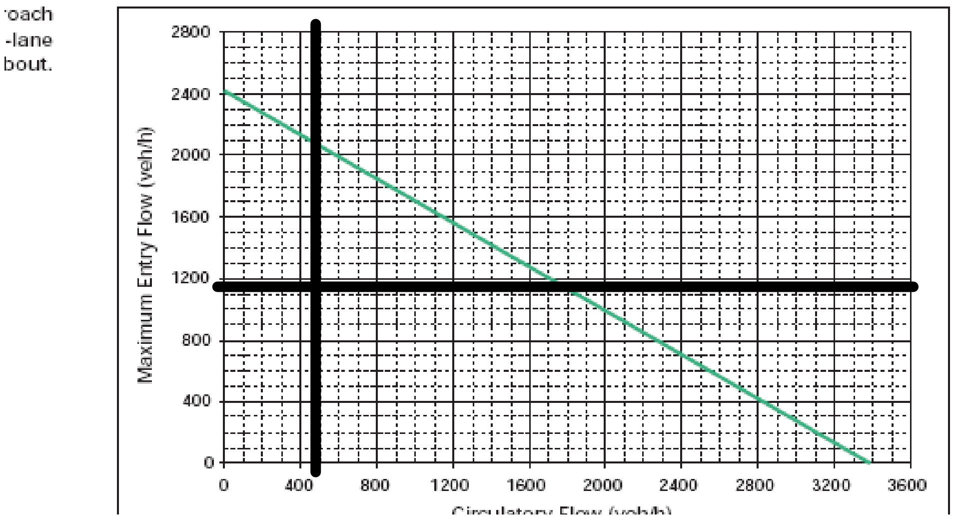
A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

2. *Value Engineering Alternative* (continued)





				530				
			20	450	60	-830		
	1320	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1620
	-520	OUT		N			RT	60
	30	LT					THRU	310
660	410	THRU	W			E	LT	290
	220	RT					OUT	-700
	1460	QUAD 3		S			QUAD 4	1660
			OUT	LT	THRU	RT		
			-960	190	740	230		
				1160				

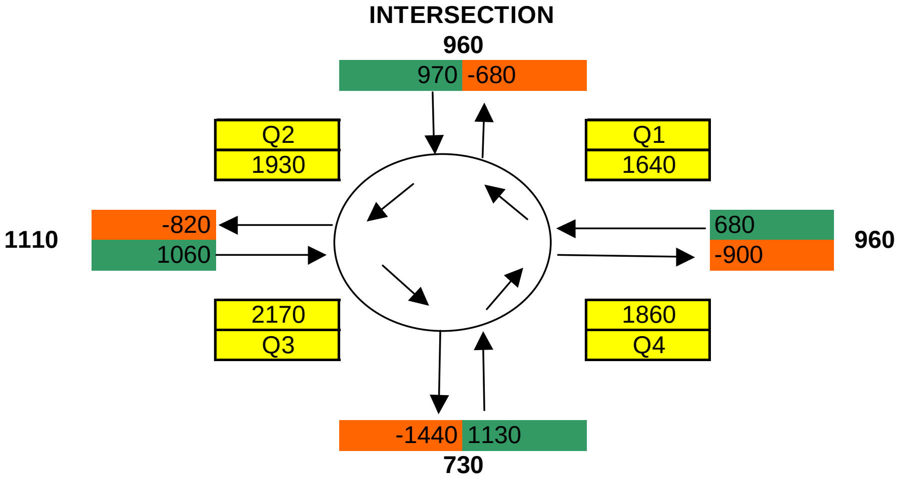


AM PEAK

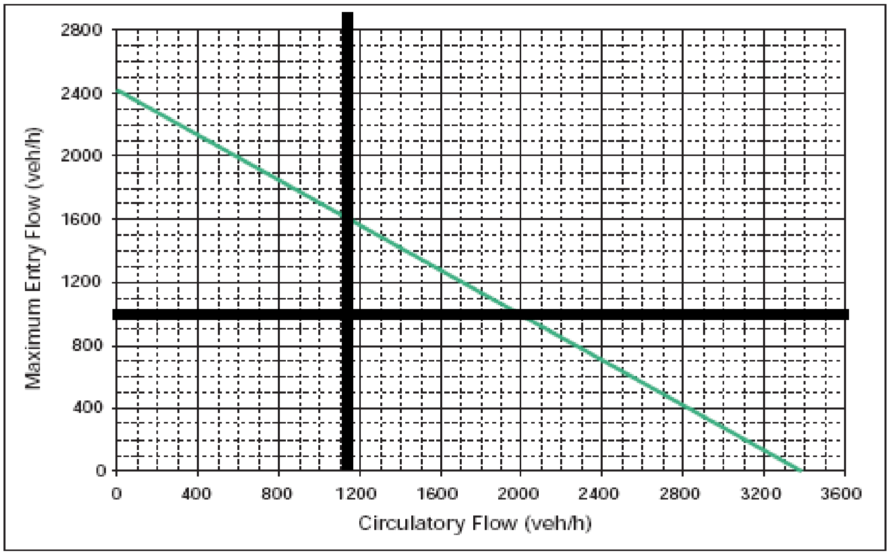
VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

2. *Value Engineering Alternative* (continued)



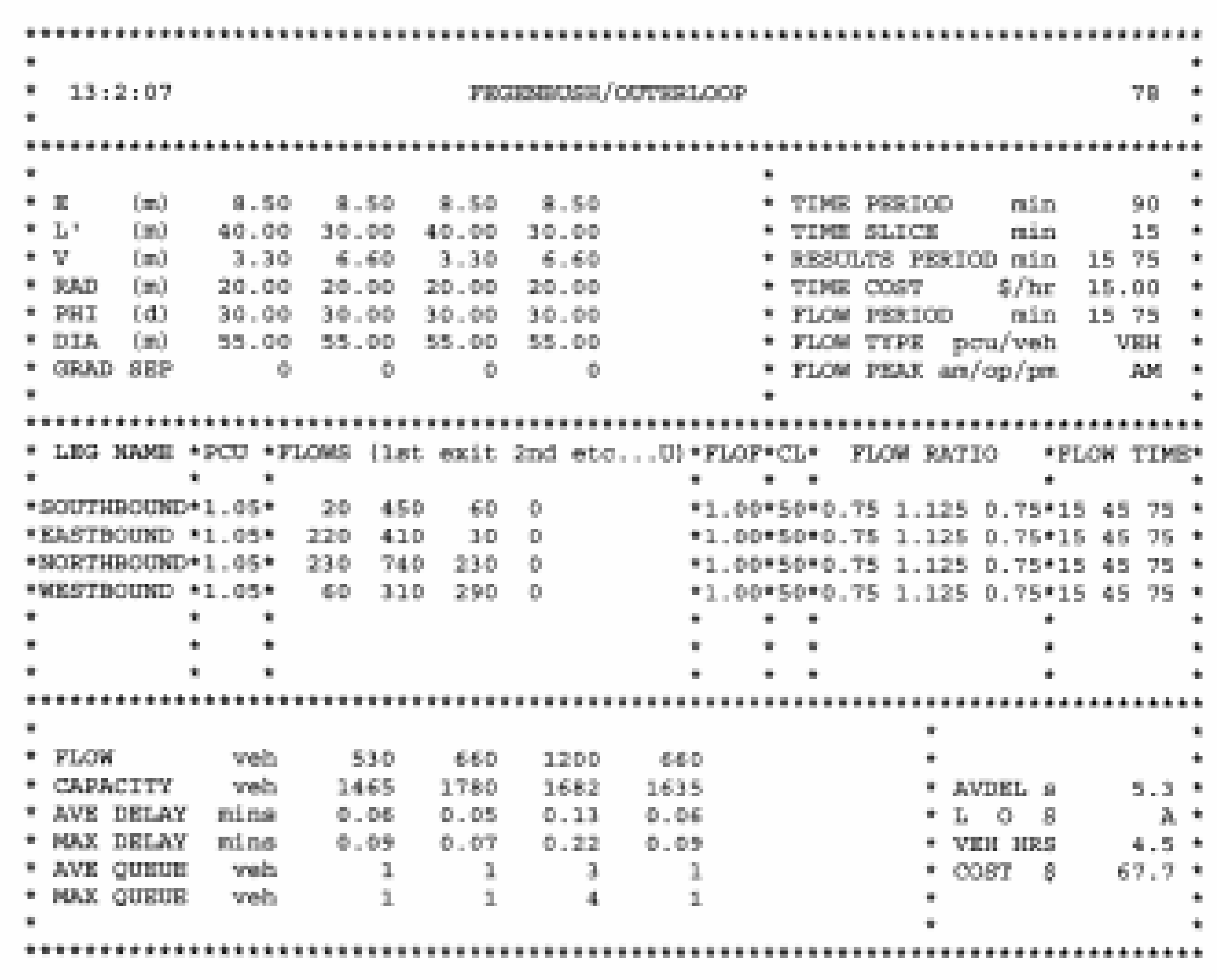
				970					
			20	840	110	-680			
	1930	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1640	
	-820	OUT		N			RT	70	
	30	LT					THRU	450	
1060	590	THRU	W			E	LT	160	680
	440	RT					OUT	-900	
	2170	QUAD 3		S			QUAD 4	1860	
			OUT	LT	THRU	RT			
			-1440	350	580	200			
				1130					



PM PEAK

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

2. Value Engineering Alternative (continued)



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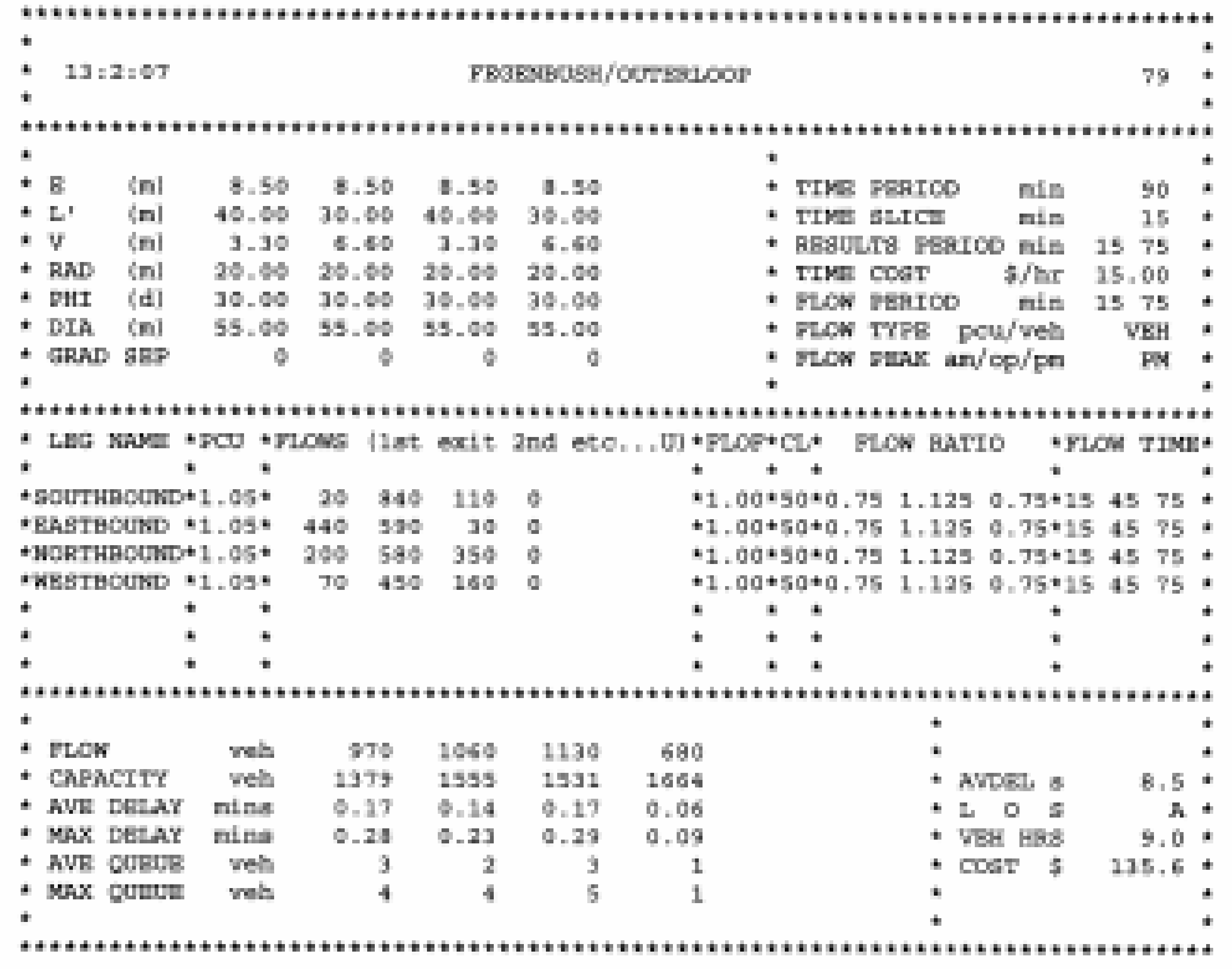
*********************************************************************************
*                                                                               *
*  13:2:07                     FEGENBUSH/OUTERLOOP                         78   *
*                                                                               *
*********************************************************************************
*                                                  *                            *
* E    (m)    8.50   8.50   8.50   8.50            * TIME PERIOD    min     90  *
* L'   (m)   40.00  30.00  40.00  30.00            * TIME SLICE     min     15  *
* V    (m)    3.30   6.60   3.30   6.60            * RESULTS PERIOD min  15 75  *
* RAD  (m)   20.00  20.00  20.00  20.00            * TIME COST     $/hr  15.00  *
* PHI  (d)   30.00  30.00  30.00  30.00            * FLOW PERIOD    min  15 75  *
* DIA  (m)   55.00  55.00  55.00  55.00            * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0      0            * FLOW PEAK am/op/pm     AM  *
*                                                  *                            *
*********************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *               *         *
*SOUTHBOUND*1.05*    20  450   60  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*EASTBOUND *1.05*   220  410   30  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*   230  740  230  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*    60  310  290  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                             *    *  *               *         *
*          *    *                             *    *  *               *         *
*          *    *                             *    *  *               *         *
*********************************************************************************
*                                                             *                 *
* FLOW         veh     530    660   1200    660               *                 *
* CAPACITY     veh    1465   1780   1682   1635               * AVDEL s     5.3 *
* AVE DELAY mins    0.06   0.05   0.11   0.06               * L  O  S       A *
* MAX DELAY mins    0.09   0.07   0.22   0.09               * VEH HRS     4.5 *
* AVE QUEUE    veh       1      1      3      1               * COST  $    67.7 *
* MAX QUEUE    veh       1      1      4      1               *                 *
*                                                             *                 *
*********************************************************************************
```

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S. WATTERSON TRACE/OUTER LOOP INTERSECTION

2. Value Engineering Alternative ***(continued)***



```
*******************************************************************************
*                                                                             *
*  13:2:07                    FEGENBUSH/OUTERLOOP                          79 *
*                                                                             *
*******************************************************************************
*                                                *                            *
* E    (m)    8.50   8.50   8.50   8.50          * TIME PERIOD     min     90 *
* L'   (m)   40.00  30.00  40.00  30.00          * TIME SLICE      min     15 *
* V    (m)    3.30   6.60   3.30   6.60          * RESULTS PERIOD  min  15 75 *
* RAD  (m)   20.00  20.00  20.00  20.00          * TIME COST      $/hr  15.00 *
* PHI  (d)   30.00  30.00  30.00  30.00          * FLOW PERIOD     min  15 75 *
* DIA  (m)   55.00  55.00  55.00  55.00          * FLOW TYPE   pcu/veh    VEH *
* GRAD SEP       0      0      0      0          * FLOW PEAK  am/op/pm     PM *
*                                                *                            *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                           *    *  *               *         *
*SOUTHBOUND*1.05*   20  940  110  0         *1.00*50*0.75 1.125 0.75*15 45 75 *
*EASTBOUND *1.05*  440  590   30  0         *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*  200  580  350  0         *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*   70  450  160  0         *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                           *    *  *               *         *
*          *    *                           *    *  *               *         *
*          *    *                           *    *  *               *         *
*******************************************************************************
*                                                           *                 *
* FLOW         veh      970   1060   1130    680            *                 *
* CAPACITY     veh     1379   1555   1531   1664            * AVDEL s     8.5 *
* AVE DELAY   mins     0.17   0.14   0.17   0.06            * L  O  S       A *
* MAX DELAY   mins     0.28   0.23   0.29   0.09            * VEH HRS     9.0 *
* AVE QUEUE    veh        3      2      3      1            * COST  $   135.6 *
* MAX QUEUE    veh        4      4      5      1            *                 *
*                                                           *                 *
*******************************************************************************
```

FEGENBUSH LANE/SOUTH WATERSON TRACE/OUTER LOOP INTERSECTION
VALUE ENGINEERING ALTERNATIVE
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
SIGNAL SYSTEM	LS	$100,000.00	1.0	$100,000	0.0	$0
DRAINAGE SYSTEM	LS	$335,000.00	1.0	$335,000	0.8	$268,000
PAVEMENT	SY	$62.21	9,700.0	$603,437	6,300.0	$391,923
SUBTOTAL				**$1,038,437**		**$659,923**
RIGHT OF WAY	SF	$18.75	74,457	$1,396,069	28,391	$532,331
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		5.0%		$57,114		$36,296
TRAFFIC CONTROL/MOT		7.0%		$72,691		$46,195
CONTINGENCY		10.0%		$103,844		$65,992
GRAND TOTAL				**$2,668,155**		**$1,340,737**

POSSIBLE SAVINGS: $1,327,418

VII. DEVELOPMENT PHASE

A. FEGENBUSH LANE/S.WATTERSON TRACE/OUTER LOOP INTERSECTION

COST COMPARISON SHEET BACK UP CALCULATIONS

PARCEL #	SF	AC	AP	VE 3 LEG	AP	VE 4 LEG
1	-	-	-		-	
2	6,438.00	0.15			6,438.00	
3	2,827.00	0.06			2,827.00	
4	2,893.00	0.07			2,893.00	
5	10,394.00	0.24			10,394.00	
6	27,559.00	0.63	27,559.00	610		
7	3,132.00	0.07			3,132.00	
8	4,710.00	0.11	4,710.00			
9	5,360.00	0.12	5,360.00			
10	4,961.00	0.11	4,961.00			
11	24,536.00	0.56	24,536.00	24,536		
12	29,381.00	0.67	29,381.00	29,381		
13	9,625.00	0.22	9,625.00	2,810		
14	4,237.00	0.10	4,237.00	310		
15	6,765.00	0.16			6,765.00	2878
16	4,366.00	0.10			4,366.00	9300
17	12,927.00	0.30			12,927.00	16203
18	-	-			-	
19	138.00	0.00			138.00	
20	21,482.00	0.49			21,482.00	
21	-	-			-	
22	1,045.00	0.02			1,045.00	
23	2,050.00	0.05			2,050.00	
24	-	-	-		-	
25	-	-	-		-	
26	-	-	-		-	
27	-	-	-		-	
28	-	-	-			
29	-	-	-			
30	-	-	-			
31	-	-	-			
32	-	-	-			
33	1,545.00	0.04	1,545.00			
34	2,260.00	0.05	2,260.00			
35	3,631.00	0.08	3,631.00			
36	2,820.00	0.06	2,820.00			
37	1,936.00	0.04	1,936.00			
38	2,658.00	0.06	2,658.00			
39	-	-	-		-	
	199,676.00	4.58	125,219.00	57,647.00	74,457.00	28,381.00
	TAKE					
	$ 18.75					
	$ 3,743,925		$ 2,347,856	$ 1,080,881	$ 1,396,069	$ 532,144

PAVEMENT UNIT COST = $1,218,708/19,590 SY = $58.15/SY

VII. DEVELOPMENT PHASE

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

1. "As Proposed"

This intersection is a part of the Congestion Mitigation Project designed to improve the operational characteristics of the roadway system within the project limits. The existing conditions are depicted in the following photographs:

EXISTING 3-LEGGED INTERSECTION LOOKING WEST

The three approach roadways are 2-lane rural typical sections from the east and west and a 3 – lane (two way left turn lane) from the south.

FEGENBUSH LANE WEST APPROACH

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

1. “As Proposed” *(continued)*

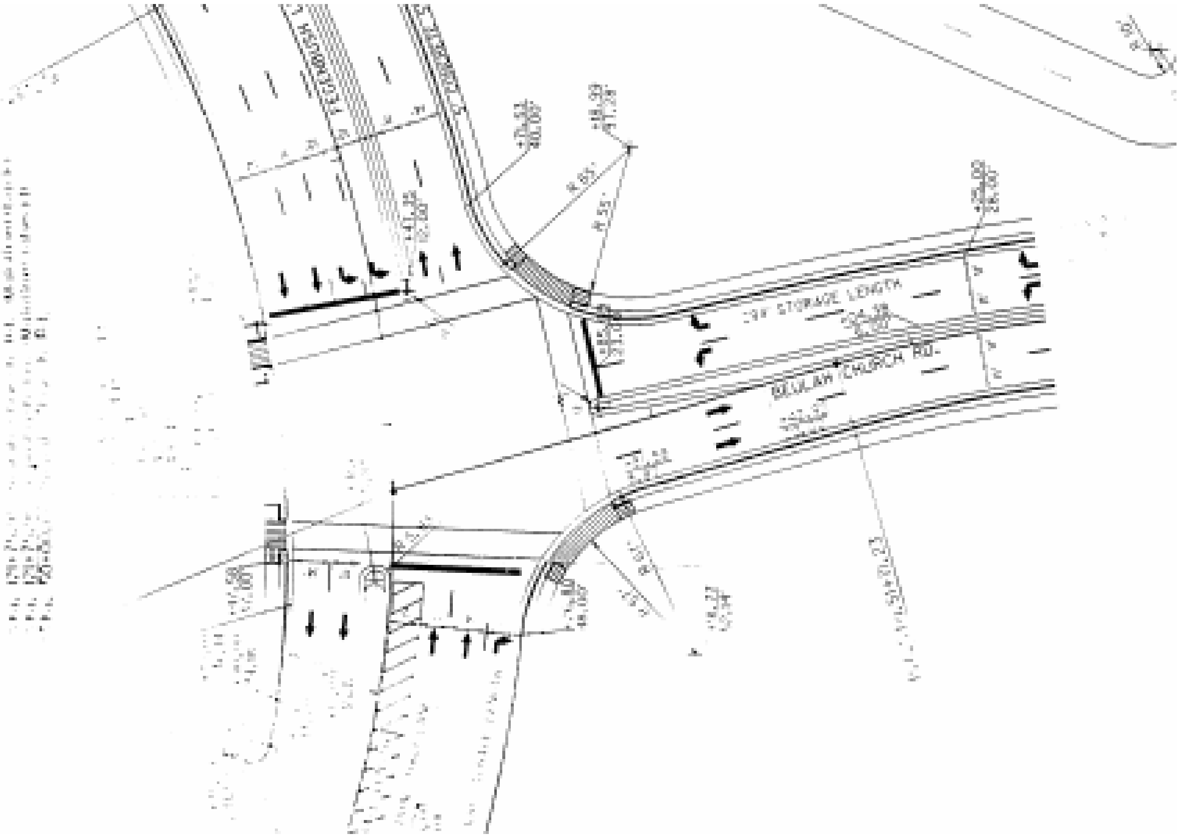
BEULAH CHURCH ROAD EAST APPROACH

AS PROPOSED INTERSECTION DESIGN

The as proposed design increases the capacity of the signalized intersection at the Fegenbush Lane/Beulah Church Road by expanding the intersection and approaches to the following configuration:

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

1. "As Proposed" *(continued)*



4. Fegenbush Lane approaches:
    a. 2 – Through lanes
    b. 2 – Left Turn lane

5. NB Beulah Church Road approach:
    a. 2 – Through lane
    b. 1 – Right Turn lane

6. WB Beulah Church Road approach:
    a. 1 – Left Turn lane
    b. 1 – Right Turn lane

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

1. “As Proposed” *(continued)*

TRAFFIC ANALYSIS

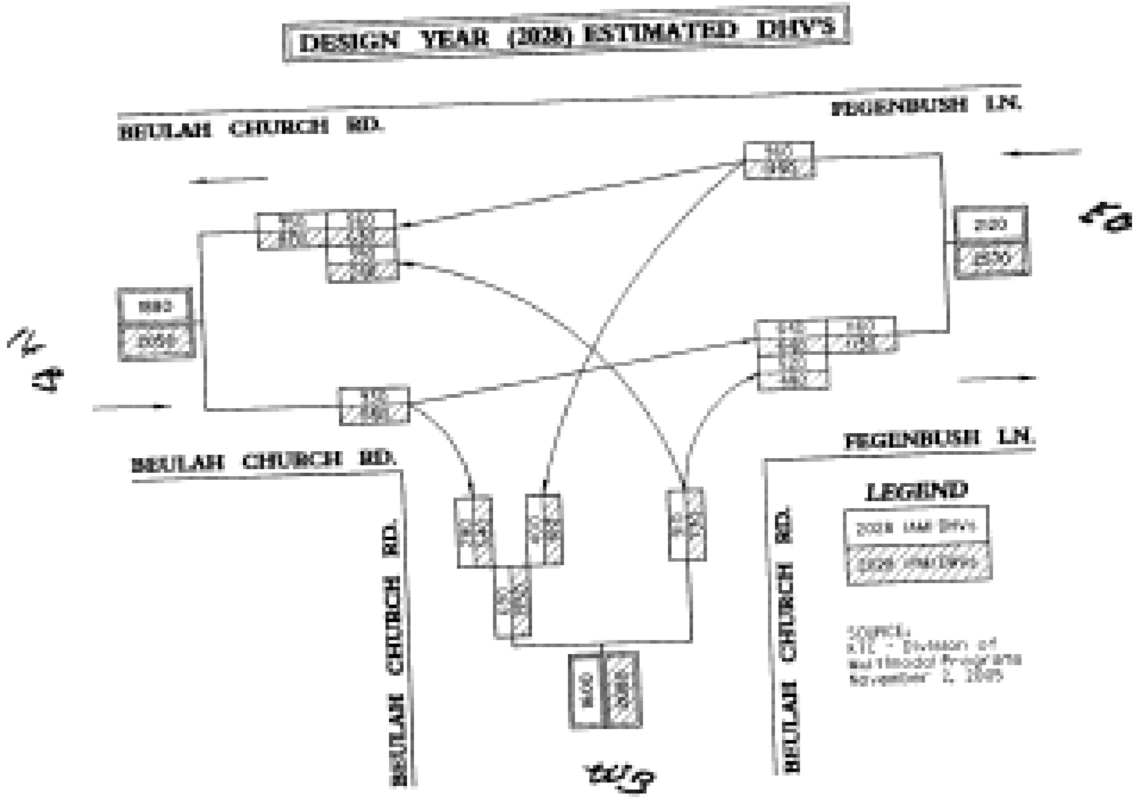
The Value Engineering Team completed a Highway Capacity Software Analysis of the intersection using the Planning Model with the AM & PM design year traffic volumes provided. As shown in the capacity analysis results on following pages, the improved intersection, with AM design hour volumes will operate with a V/C Ratio of 0.95 (At Capacity) and with a V/C Ratio of 1.19 (Over Capacity) for the PM Peak. This means that the as proposed design will fail with 2028-design year PM traffic volumes.

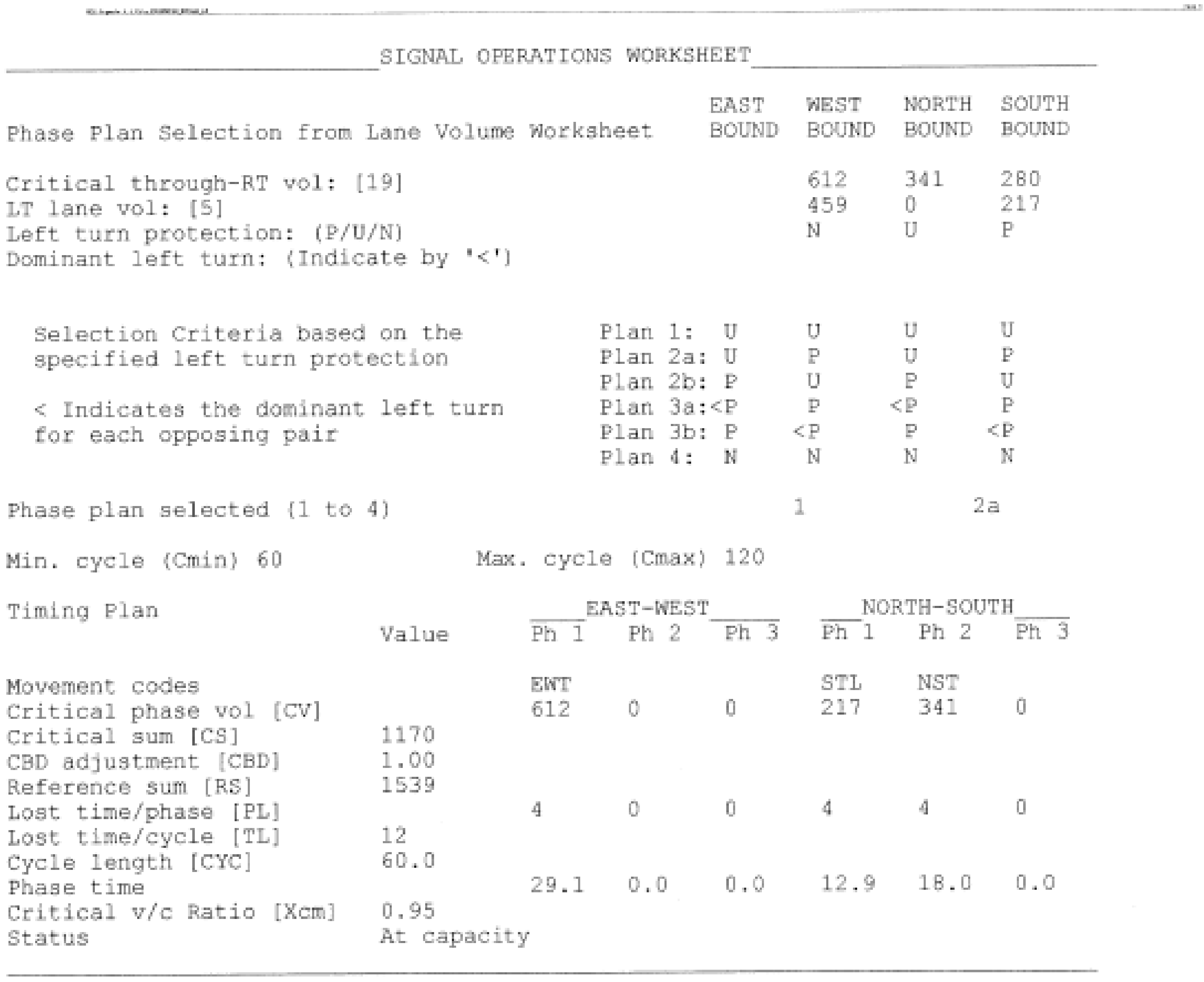
R/W REQUIREMENTS

The as proposed improvements, as designed, will require the acquisition of nearly 125,200 SF of fee simple right of way from 14 different parcels. The fee simple acquisitions will cost approximately $2,350,000.

CONSTRUCTION COST

The estimated construction cost of the as proposed intersection improvements that includes widening the intersection and approaches, installing curb and gutter, sidewalks, and a closed drainage system is approximately $1,251,000.





```
                            SIGNAL OPERATIONS WORKSHEET
                                                          EAST   WEST   NORTH  SOUTH
Phase Plan Selection from Lane Volume Worksheet          BOUND  BOUND  BOUND  BOUND

Critical through-RT vol: [19]                                   612    341    280
LT lane vol: [5]                                                459    0      217
Left turn protection: (P/U/N)                                   N      U      P
Dominant left turn: (Indicate by '<')


  Selection Criteria based on the               Plan 1:  U      U      U      U
  specified left turn protection                Plan 2a: U      P      U      P
                                                Plan 2b: P      U      P      U
  < Indicates the dominant left turn            Plan 3a:<P      P     <P      P
  for each opposing pair                        Plan 3b: P     <P      P     <P
                                                Plan 4:  N      N      N      N

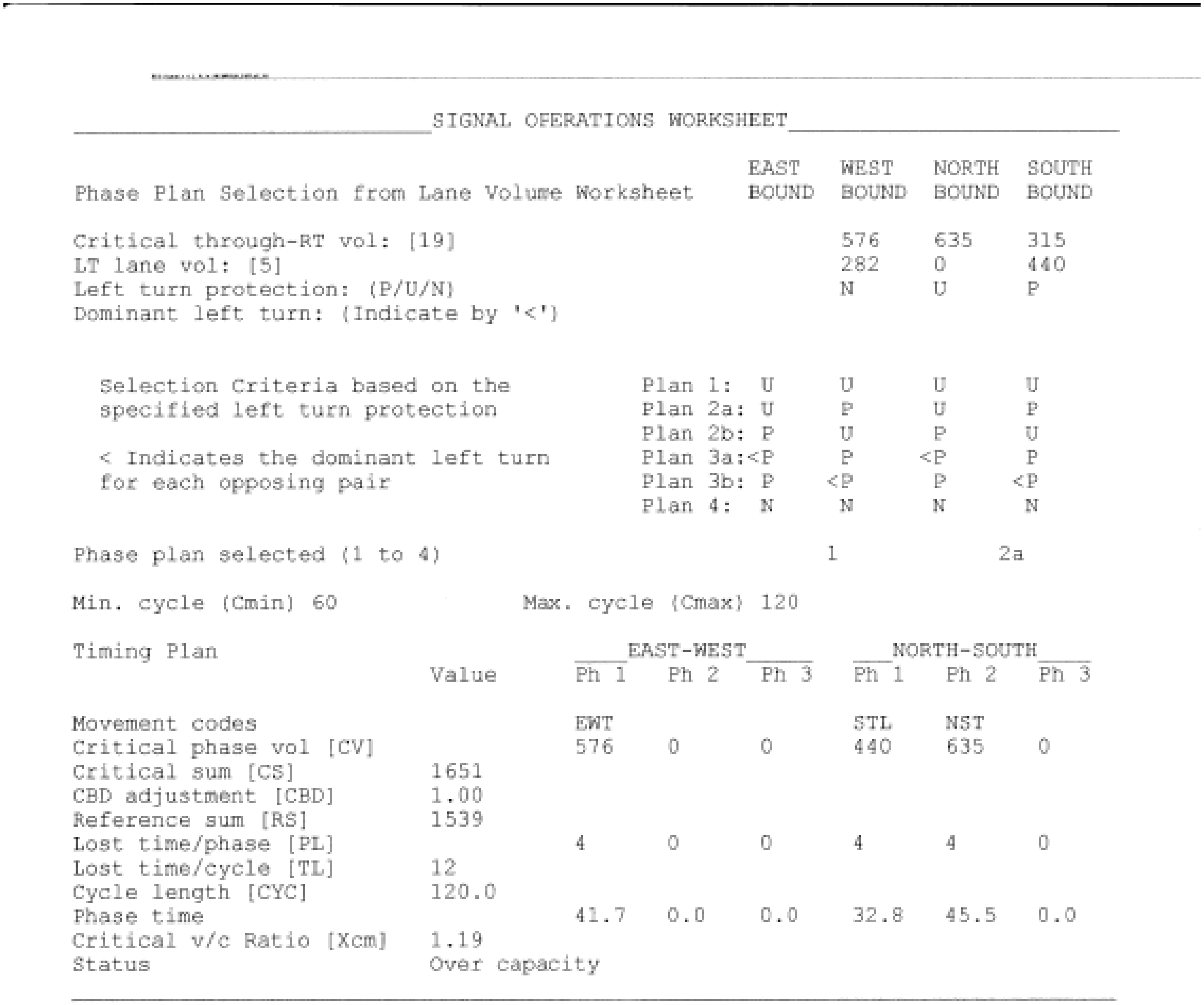
Phase plan selected (1 to 4)                                    1             2a

Min. cycle (Cmin) 60            Max. cycle (Cmax) 120

Timing Plan                            ____EAST-WEST_____    ___NORTH-SOUTH____
                           Value       Ph 1   Ph 2   Ph 3    Ph 1   Ph 2   Ph 3

Movement codes                         EWT                   STL    NST
Critical phase vol [CV]                612    0      0       217    341    0
Critical sum [CS]          1170
CBD adjustment [CBD]       1.00
Reference sum [RS]         1539
Lost time/phase [PL]                   4      0      0       4      4      0
Lost time/cycle [TL]       12
Cycle length [CYC]         60.0
Phase time                             29.1   0.0    0.0     12.9   18.0   0.0
Critical v/c Ratio [Xcm]   0.95
Status                     At capacity
```

VII. Development Phase
B. Fegenbush Lane/Beulah Church Road Intersection
1. “As Proposed”



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____________________________SIGNAL OPERATIONS WORKSHEET__________________________

                                                  EAST    WEST    NORTH   SOUTH
Phase Plan Selection from Lane Volume Worksheet   BOUND   BOUND   BOUND   BOUND

Critical through-RT vol: [19]                             576     635     315
LT lane vol: [5]                                          282     0       440
Left turn protection: (P/U/N)                             N       U       P
Dominant left turn: (Indicate by '<')


  Selection Criteria based on the         Plan 1:  U      U       U       U
  specified left turn protection          Plan 2a: U      P       U       P
                                          Plan 2b: P      U       P       U
  < Indicates the dominant left turn      Plan 3a:<P      P      <P       P
  for each opposing pair                  Plan 3b: P     <P       P      <P
                                          Plan 4:  N      N       N       N

Phase plan selected (1 to 4)                              1              2a

Min. cycle (Cmin) 60             Max. cycle (Cmax) 120

Timing Plan                               ____EAST-WEST_____    ___NORTH-SOUTH____
                            Value         Ph 1   Ph 2   Ph 3    Ph 1   Ph 2   Ph 3

Movement codes                            EWT                   STL    NST
Critical phase vol [CV]                   576    0      0       440    635    0
Critical sum [CS]           1651
CBD adjustment [CBD]        1.00
Reference sum [RS]          1539
Lost time/phase [PL]                      4      0      0       4      4      0
Lost time/cycle [TL]        12
Cycle length [CYC]          120.0
Phase time                                41.7   0.0    0.0     32.8   45.5   0.0
Critical v/c Ratio [Xcm]    1.19
Status                      Over capacity
_________________________________________________________________________________
```

VII. Development Phase

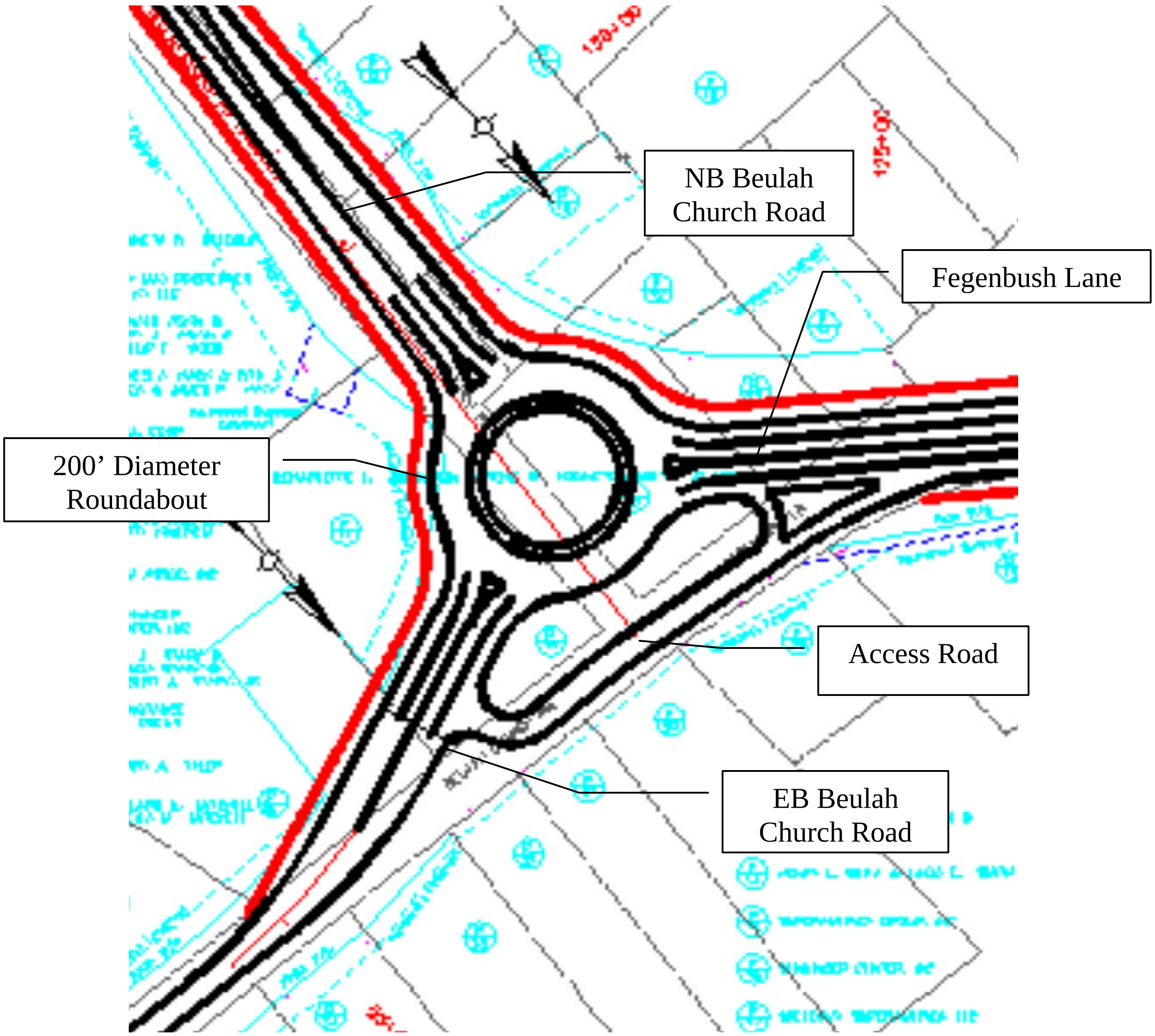
B. Fegenbush Lane/Beulah Church Road Intersection

1. "As Proposed"

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. Value Engineering Alternative

The Value Engineering Team recommends replacing the signalized intersection with a Roundabout configured as shown in the following layout. Access is maintained to the parcels north of the Roundabout via an access road as shown.



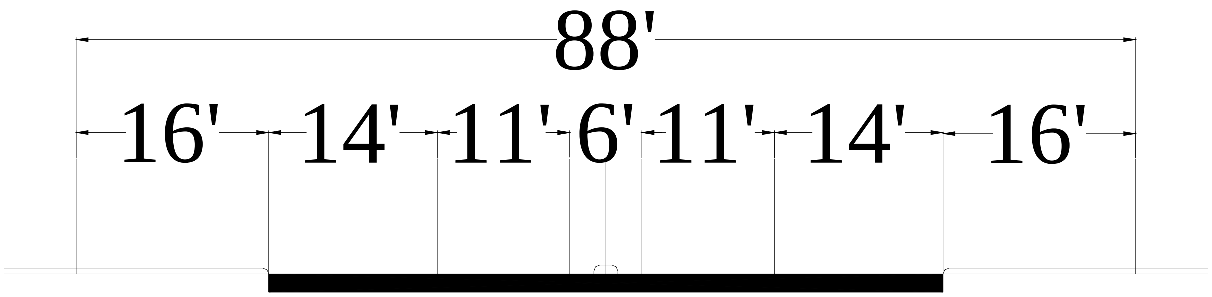
VALUE ENGINEERING ALTERNATIVE ROUNDABOUT LAYOUT AT FEGENBUSH LANE/BEULAH CHURCH RD. INT'N

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. *Value Engineering Alternative* *(continued)*

The above could be reduced to a smaller diameter depending on the need to accommodate the truck traffic estimated to be 6.5% of the total traffic.

Fegenbush Lane between the Roundabouts would remain a 4-lane roadway with a barrier curb in the median as shown below:

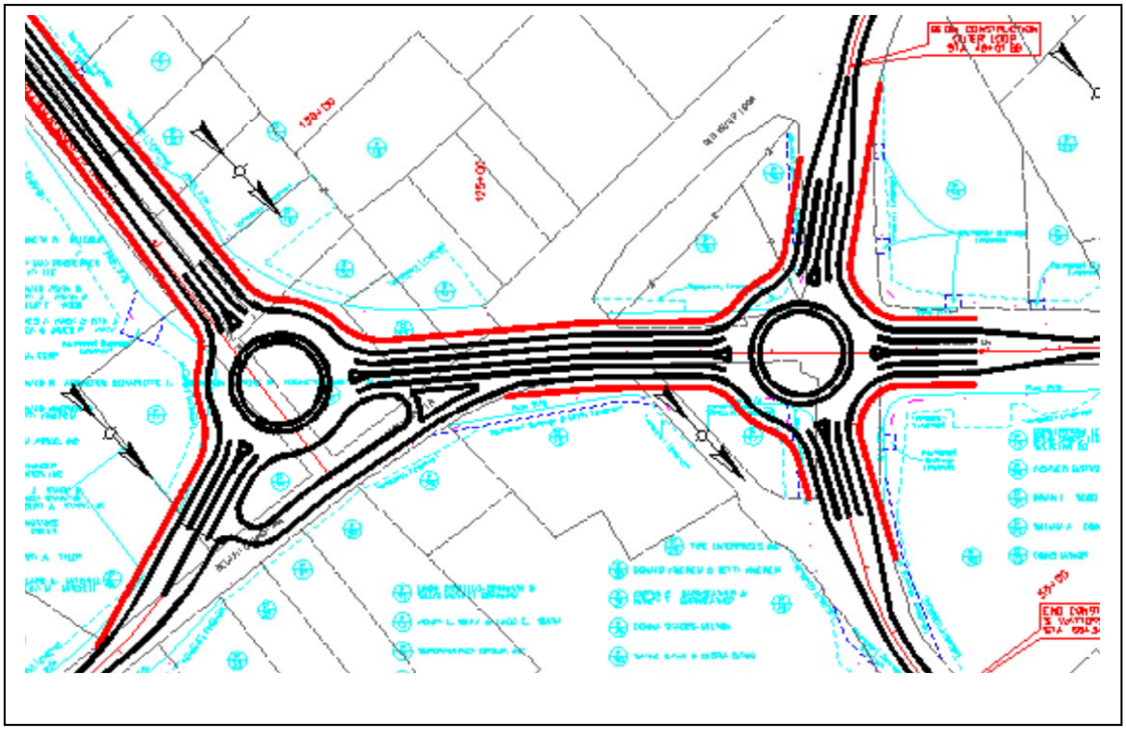


FEGENBUSH LANE TYPICAL SECTION

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. *Value Engineering Alternative* *(continued)*

If both of the Roundabout Value Engineering Alternatives are accepted, the project layout would be as shown below:



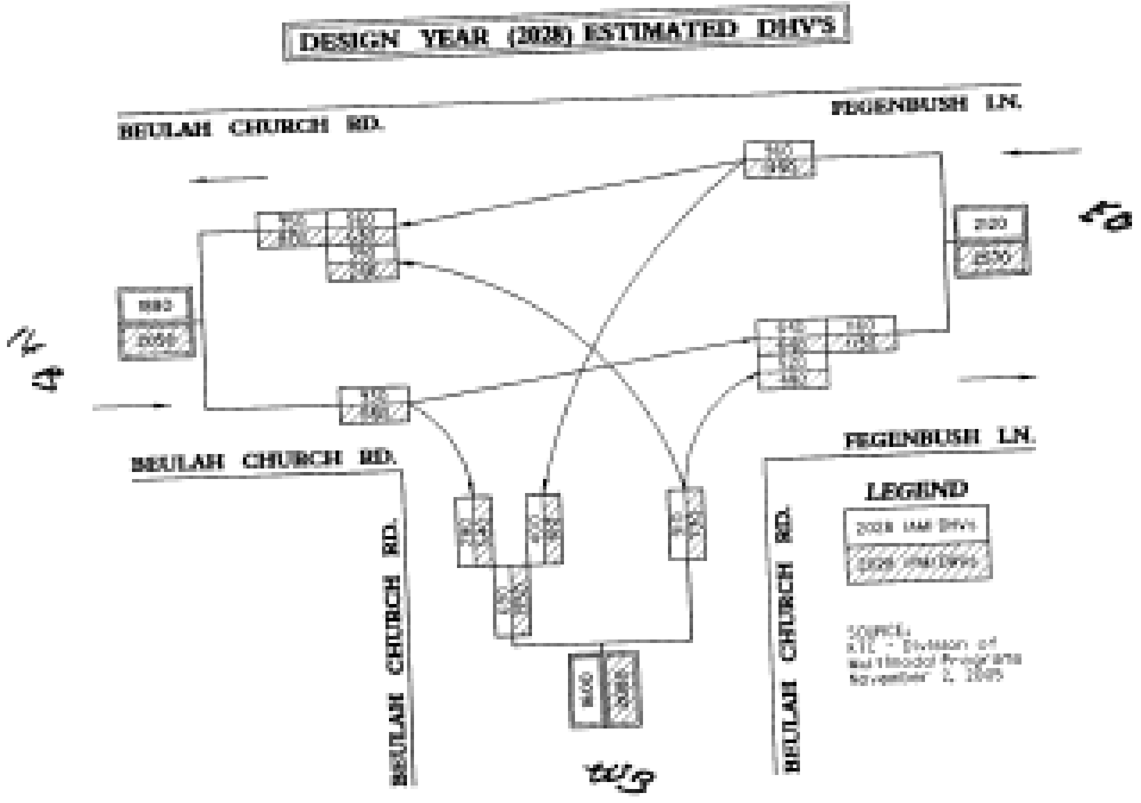
VALUE ENGINEERING ALTERNATIVE PROJECT LAYOUT

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. *Value Engineering Alternative* *(continued)*

TRAFFIC ANALYSIS:

An initial traffic analysis indicated that a two lane Roundabout has the capacity to meet the demand well past the design year. A more in depth analysis was completed with the Rodel Software for a 165’ roundabout. The analysis indicated that this roundabout would operate at LOS of A with design year traffic volumes and with a maximum queue length of 8 vehicles for one of the approaches. Results of the Rodel Analysis are included on following pages.



B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. *Value Engineering Alternative* *(continued)*

R/W REQUIREMENTS

The major cost savings is the reduction in right of way required to construct the Value Engineering Alternative Roundabout. The required right of way is approximately 57,650 SF from 5 parcels at an estimated acquisition cost of approximately $1,081,000 as compared to an estimated acquisition cost of approximately $2,348,000 for the right of way to accommodate the as proposed intersection improvements.

CONSTRUCTION COST

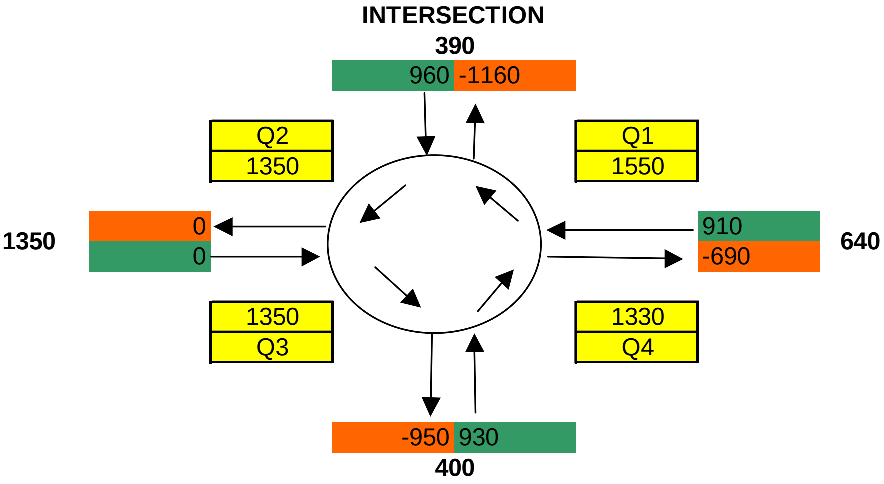
The Value Engineering Alternative Roundabout will reduce construction costs, primarily as a result of a decrease in pavement and drainage quantities. In addition, the traffic signalization system is eliminated. The estimated construction cost of the Value Engineering Alternative is approximately $872,000 as compared to approximately $1,251,000 for the as proposed intersection.

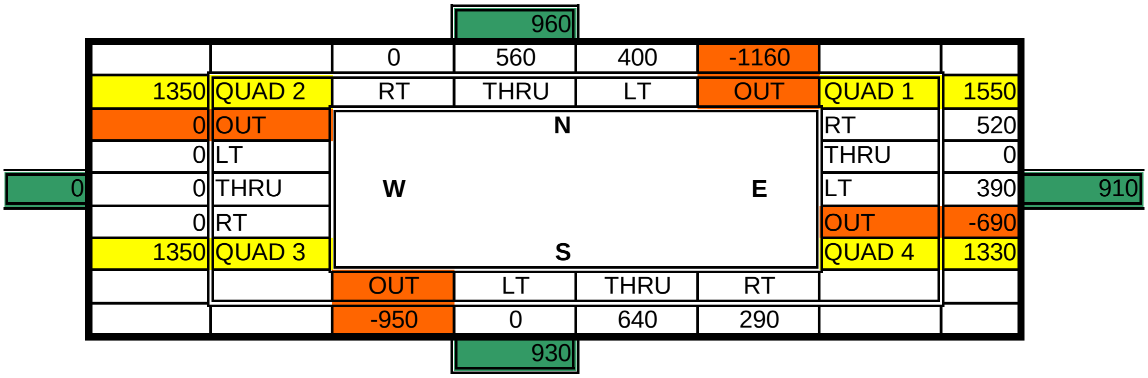
RECOMMENDATION

The Value Engineering Team recommends that the Value Engineering Alternative Roundabout be selected as a basis for the development of the final plans since it will function as a free flowing intersection with a desirable LOS and will provide a possible total project cost savings of $1,654,604.

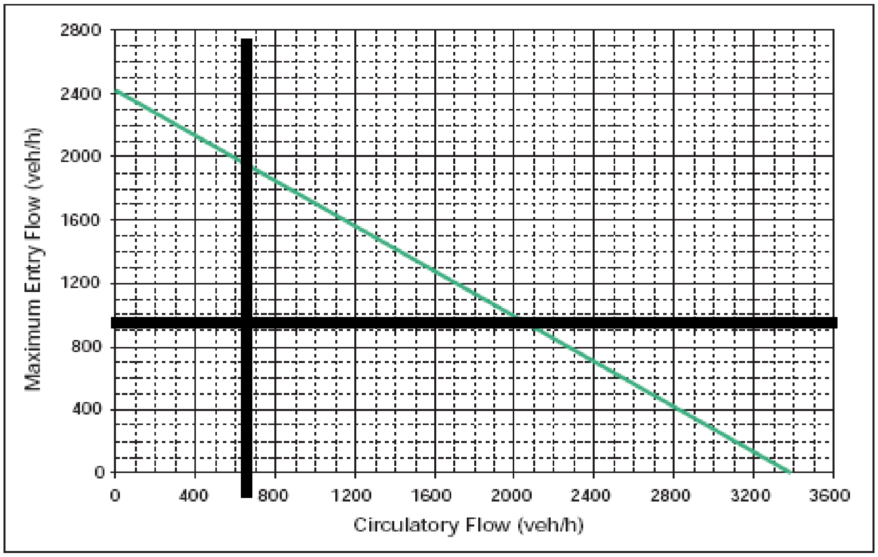
B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. *Value Engineering Alternative* (continued)





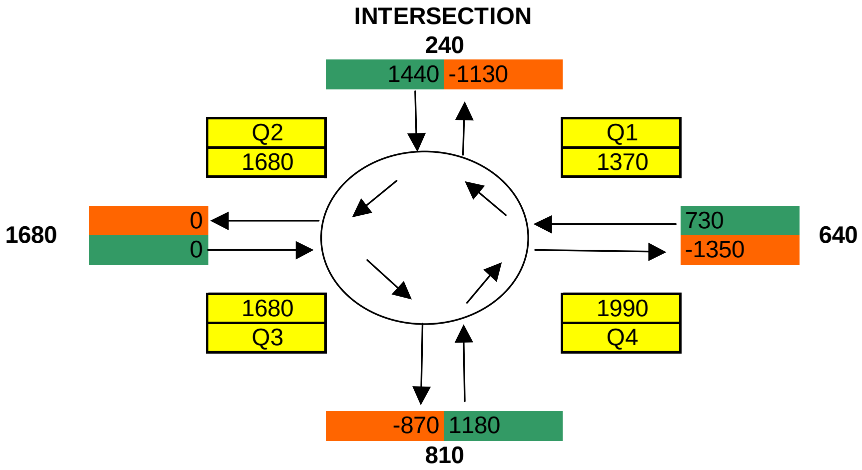
				960					
			0	560	400	-1160			
	1350	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1550	
	0	OUT		N			RT	520	
	0	LT					THRU	0	
0	0	THRU	W			E	LT	390	910
	0	RT					OUT	-690	
	1350	QUAD 3		S			QUAD 4	1330	
			OUT	LT	THRU	RT			
			-950	0	640	290			
				930					



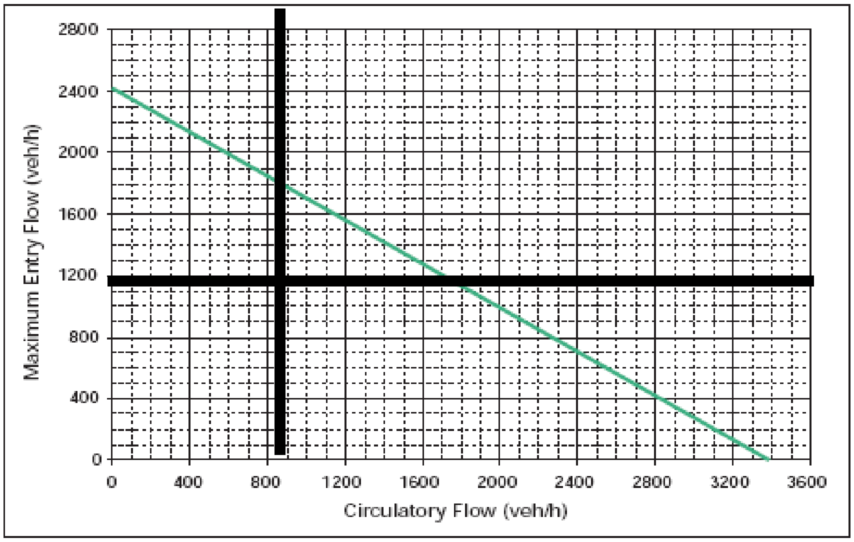
AM PEAK

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. *Value Engineering Alternative* *(continued)*



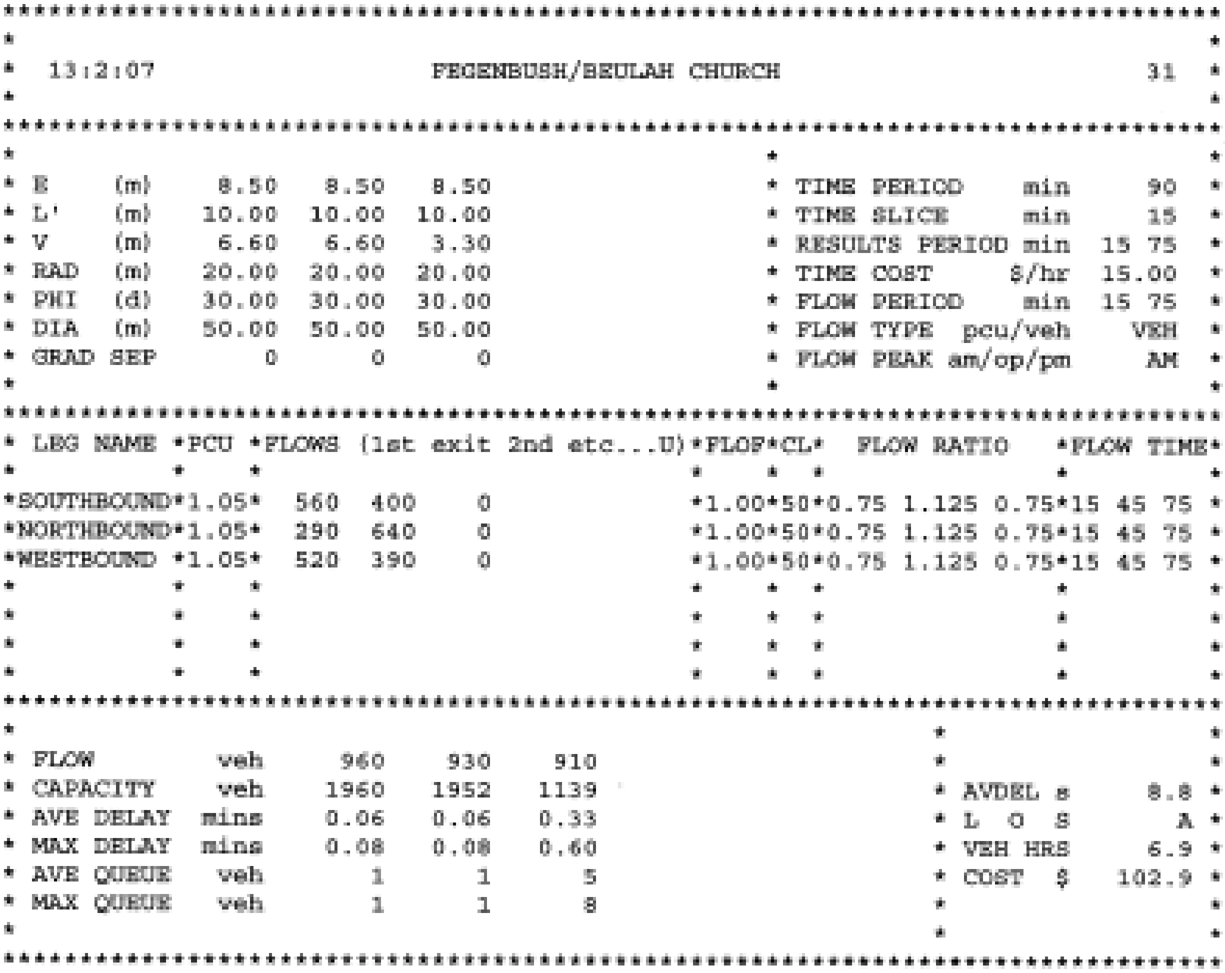
				1440					
			0	630	810	-1130			
	1680	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1370	
	0	OUT		N			RT	490	
	0	LT					THRU	0	
0	0	THRU	W			E	LT	240	730
	0	RT					OUT	-1350	
	1680	QUAD 3		S			QUAD 4	1990	
			OUT	LT	THRU	RT			
			-870	0	640	540			
				1180					



PM PEAK

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

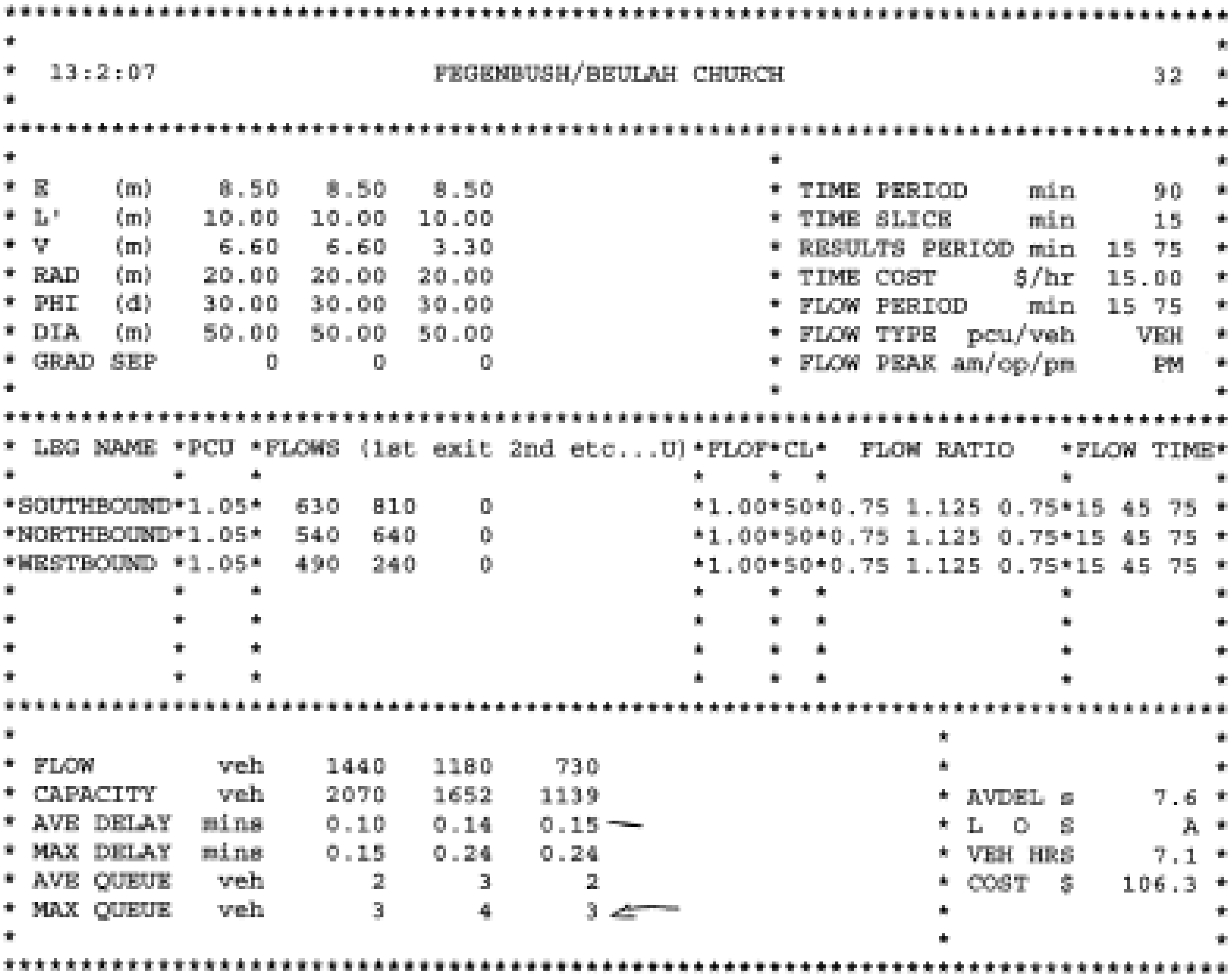
2. Value Engineering Alternative *(continued)*



```
*****************************************************************************
*                                                                           *
*  13:2:07                  FEGENBUSH/BEULAH CHURCH                     31  *
*                                                                           *
*****************************************************************************
*                                                *                          *
* E    (m)     8.50   8.50   8.50                * TIME PERIOD    min     90  *
* L'   (m)    10.00  10.00  10.00                * TIME SLICE     min     15  *
* V    (m)     6.60   6.60   3.30                * RESULTS PERIOD min  15 75  *
* RAD  (m)    20.00  20.00  20.00                * TIME COST      $/hr  15.00 *
* PHI  (d)    30.00  30.00  30.00                * FLOW PERIOD    min  15 75  *
* DIA  (m)    50.00  50.00  50.00                * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0                * FLOW PEAK am/op/pm     AM  *
*                                                *                          *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*SOUTHBOUND*1.05*  560  400    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*  290  640    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*  520  390    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                         *                 *
* FLOW         veh      960    930    910                 *                 *
* CAPACITY     veh     1960   1952   1139                 * AVDEL s    8.8  *
* AVE DELAY   mins     0.06   0.06   0.33                 * L  O  S      A  *
* MAX DELAY   mins     0.08   0.08   0.60                 * VEH HRS    6.9  *
* AVE QUEUE    veh        1      1      5                 * COST  $  102.9  *
* MAX QUEUE    veh        1      1      8                 *                 *
*                                                         *                 *
*****************************************************************************
```

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

2. Value Engineering Alternative *(continued)*



```
*****************************************************************************
*                                                                           *
*  13:2:07                  FEGENBUSH/BEULAH CHURCH                     32  *
*                                                                           *
*****************************************************************************
*                                                *                          *
* E     (m)     8.50    8.50    8.50             * TIME PERIOD    min    90 *
* L'    (m)    10.00   10.00   10.00             * TIME SLICE     min    15 *
* V     (m)     6.60    6.60    3.30             * RESULTS PERIOD min 15 75 *
* RAD   (m)    20.00   20.00   20.00             * TIME COST     $/hr 15.00 *
* PHI   (d)    30.00   30.00   30.00             * FLOW PERIOD    min 15 75 *
* DIA   (m)    50.00   50.00   50.00             * FLOW TYPE  pcu/veh   VEH *
* GRAD SEP         0       0       0             * FLOW PEAK am/op/pm    PM *
*                                                *                          *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*SOUTHBOUND*1.05*  630  810    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*  540  640    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*  490  240    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                         *                 *
* FLOW          veh     1440    1180     730              *                 *
* CAPACITY      veh     2070    1652    1139              * AVDEL s     7.6 *
* AVE DELAY    mins     0.10    0.14    0.15              * L  O  S       A *
* MAX DELAY    mins     0.15    0.24    0.24              * VEH HRS     7.1 *
* AVE QUEUE     veh        2       3       2              * COST  $   106.3 *
* MAX QUEUE     veh        3       4       3              *                 *
*                                                         *                 *
*****************************************************************************
```

FEGENBUSH LN/BEULAH CHURCH INTERSECTION
VALUE ENGINEERING ALTERNATIVE
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
SIGNAL SYSTEM	LS	$100,000.00	1.0	$100,000	0.0	$0
DRAINAGE	LS	$330,000.00	1.0	$330,000	0.8	$264,000
PAVEMENT	SY	$62.21	9,500.0	$590,995	7,200.0	$447,912
SUBTOTAL				**$1,020,995**		**$711,912**
RIGHT OF WAY	SF	$18.75	125,219	$2,347,856	57,647	$1,080,881
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		5.0%		$56,155		$39,155
TRAFFIC CONTROL/MOT		7.0%		$71,470		$49,834
CONTINGENCY		10.0%		$102,100		$71,191
GRAND TOTAL				**$3,598,576**		**$1,952,973**

POSSIBLE SAVINGS: $1,645,603

VII. DEVELOPMENT PHASE

B. FEGENBUSH LANE/BEULAH CHURCH ROAD INTERSECTION

B. COST COMPARISON SHEET BACK UP CALCULATIONS

R/W:

PARCEL #	SF	AC	AP	VE 3 LEG	AP	VE 4 LEG
1	-	-	-		-	
2	6,438.00	0.15			6,438.00	
3	2,827.00	0.06			2,827.00	
4	2,893.00	0.07			2,893.00	
5	10,394.00	0.24			10,394.00	
6	27,559.00	0.63	27,559.00	610		
7	3,132.00	0.07			3,132.00	
8	4,710.00	0.11	4,710.00			
9	5,360.00	0.12	5,360.00			
10	4,961.00	0.11	4,961.00			
11	24,536.00	0.56	24,536.00	24,536		
12	29,381.00	0.67	29,381.00	29,381		
13	9,625.00	0.22	9,625.00	2,810		
14	4,237.00	0.10	4,237.00	310		
15	6,765.00	0.16			6,765.00	2878
16	4,366.00	0.10			4,366.00	9300
17	12,927.00	0.30			12,927.00	16203
18	-	-			-	
19	138.00	0.00			138.00	
20	21,482.00	0.49			21,482.00	
21	-	-			-	
22	1,045.00	0.02			1,045.00	
23	2,050.00	0.05			2,050.00	
24	-	-	-		-	
25	-	-	-		-	
26	-	-	-		-	
27	-	-	-		-	
28	-	-	-			
29	-	-	-			
30	-	-	-			
31	-	-	-			
32	-	-	-			
33	1,545.00	0.04	1,545.00			
34	2,260.00	0.05	2,260.00			
35	3,631.00	0.08	3,631.00			
36	2,820.00	0.06	2,820.00			
37	1,936.00	0.04	1,936.00			
38	2,658.00	0.06	2,658.00			
39	-	-	-		-	
	199,676.00	4.58	125,219.00	57,647.00	74,457.00	28,381.00
	TAKE					
	$ 18.75					
	$ 3,743,925		$ 2,347,856	$ 1,080,881	$ 1,396,069	$ 532,144

PAVEMENT UNIT COST = $1,218,200/19,590 SY = $58.15/SY

C. PAVEMENT DESIGN

"As Proposed"

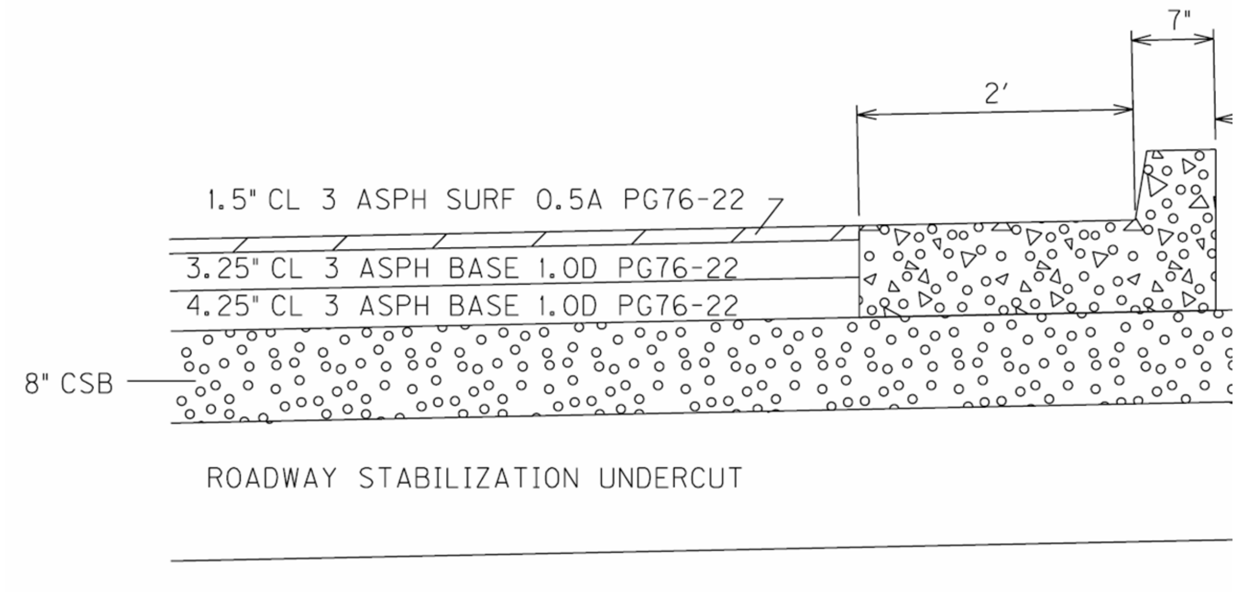
The mainline pavement design as proposed has several different pavement designs, with the majority of the pavement designs on the mainline calling for:

- 1.5" CL3 ASPH SURF 0.5A PG 76-22
- 3.25" CL3 ASPH BASE 1.0D PG 76-22
- 3.5" CL3 ASPH BASE 1.0D PG 76-22
- 8" CRUSHED STONE BASE
- And an undetermined quantity and type of roadway stabilization

The pavement design, as proposed, uses the higher-grade binder of PG 76-22 for the mainline surface layers and the top two base courses. When a third base course is needed PG 64-22 binder is used. PG 64-22 binder is also used for the surface and base layers on the shoulders, although this quantity is small for this project.

For cost analysis purposes, 1' of #2 stone was assumed to be the roadway stabilization.

The typical as proposed pavement section, characterized as having a maximum aggregate base with minimum asphalt concrete, is shown on the following schematic layout.



AS PROPOSED PAVEMENT DESIGN

C. PAVEMENT DESIGN

Value Engineering Alternative

The Value Engineering Alternative pavement design uses a maximum thickness of asphalt concrete with a minimum aggregate base design without roadway stabilization. The pavement structure is shown schematically on a following page and is described below:

- 1.25” CL3 ASPH SURF 0.38A PG 64-22
- 3.25” CL3 ASPH BASE 1.0D PG 64-22
- 3.5” CL3 ASPH BASE 1.0D PG 64-22
- 4” CL3 ASPH BASE 1.0D PG 64-22
- 8” DRAINAGE BLANKET TY II
- 4” DGA

For simplicity of construction and due to the short length of this project, this alternative uses the same pavement design throughout the project. The traffic forecast from the Kentucky Transportation Cabinet predicted 5,900,000 20 yr. ESALS for this project. This ESAL count was used in determining the required structural number of 6.27 and therefore used to determine the layer thicknesses.

Economy can be realized on this project by using PG 64-22 binder for each mix instead of the 76-22 binder proposed. The pavement is expected to have less than 7.0 million 20-yr. ESALS and therefore only requires a PG64-22 binder according to the “Kentucky Department of Highways Warrants for Selecting Asphalt Mixtures and Compaction Options.” It is also recommended that Class 3 asphalt be used on both the mainline pavement and shoulders since only a limited quantity of Class 2 will be needed (less than 1,000 tons). Consistencies in the mix are expected to achieve more savings here than lowering the mixture grade.

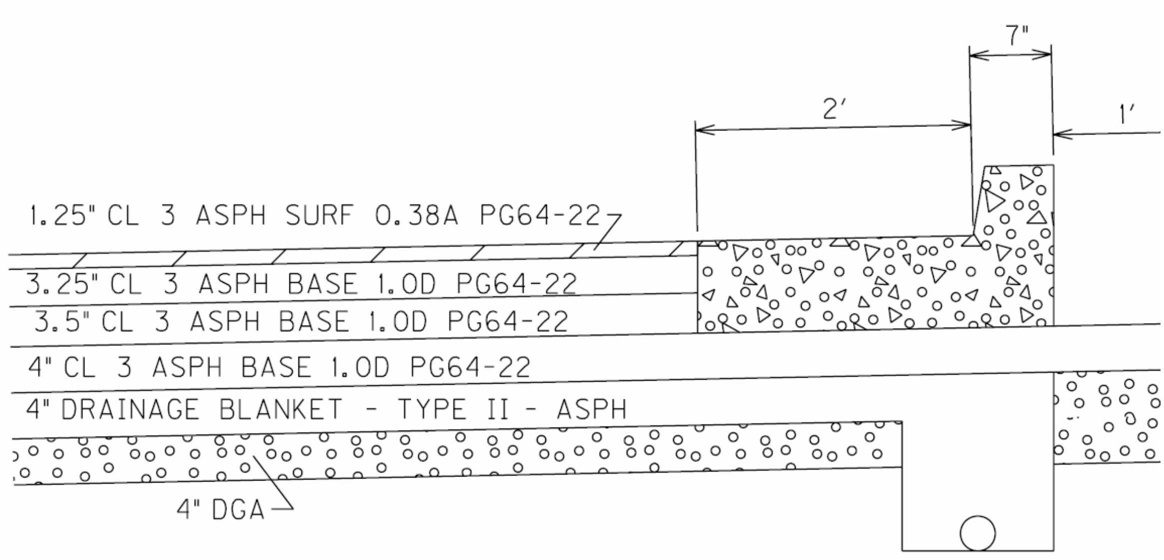
It is also recommended that the roadway not be stabilized chemically due to the added time required for maintenance of traffic. The roadbed is expected to be wet and will have to be dried out first, thereby increasing the amount of time that traffic will have to be maintained in construction zones.

RECOMMENDATION

Based on the preceding factors and a possible construction cost savings of $115,829, the Value Engineering Alternative Pavement Design is recommended for adoption.

C. PAVEMENT DESIGN

Value Engineering Alternative *(continued)*



VALUE ENGINEERING ALTERNATIVE PAVEMENT DESIGN

PAVEMENT DESIGN
VALUE ENGINEERING ALTERNATIVE
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
CL2 ASPH SURF PG 64-22	TON	$85.00	155.0	$13,175		
CL3 ASPH SURF PG 64-22	TON	$65.00			1,477.0	$96,005
CL3 ASPH SURF PG 76-22	TON	$71.60	2,391.0	$171,196		
CL2 ASPH BASE PG 64-22	TON	$78.60	463.0	$36,392		
CL3 ASPH BASE PG 64-22	TON	$51.11			12,696.0	$648,893
CL3 ASPH BASE PG 76-22	TON	$64.10	7,812.0	$500,749		
DRAINAGE BLANKET TYPE II	TON	$35.85			4,295.0	$153,976
DGA	TON	$17.90	11,363.0	$203,398	5,939.0	$106,308
STABILIZATION	TN	$15.00	5,300.0	$79,500		
MTV	TON	$1.80	1,576.0	$2,837		
EXCAVATION	CUYD	$9.50	23,646.0	$224,637	13,517.0	$128,412
SUBTOTAL				**$1,231,884**		**$1,133,594**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			5.0%	$67,754	4.0%	$50,785
TRAFFIC CONTROL/MOT			7.0%	$86,232	5.0%	$56,680
CONTINGENCY			10.0%	$123,188	12.0%	$136,031
GRAND TOTAL				**$1,509,058**		**$1,377,090**

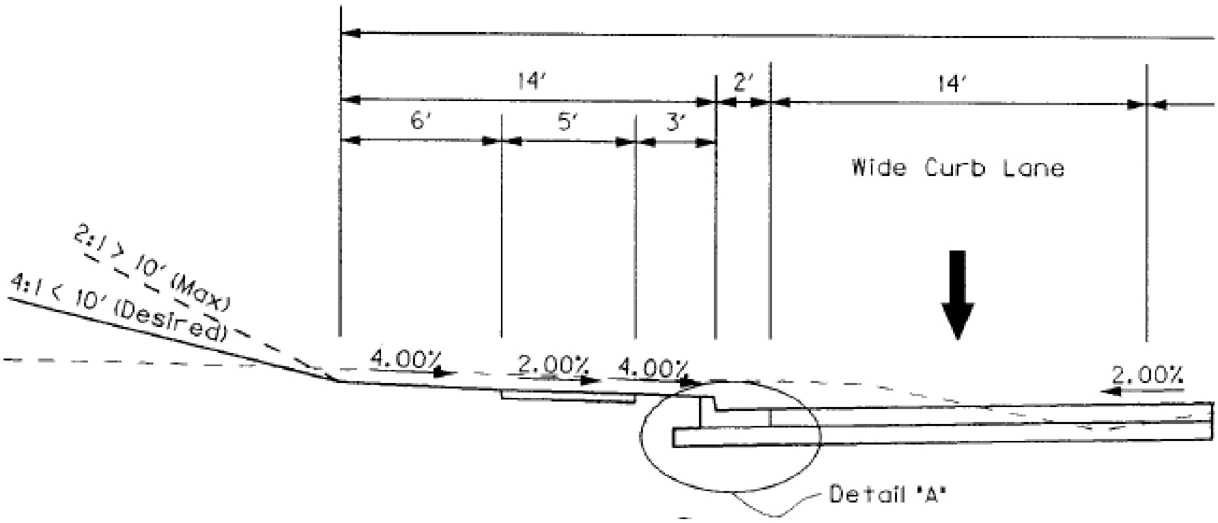
POSSIBLE SAVINGS: $131,968

D. DRAINAGE SYSTEM

1. “As Proposed”

The as proposed drainage design for the project consists primarily of curb and gutter with a closed drainage system. Transition swales are provided to match the existing open channel swales on the intersection approaches.

The as proposed typical curb and gutter section is shown in the layout below:



AS PROPOSED TYPICAL CURB AND GUTTER SECTION

There are 46 curb inlets and 25-drop box inlets with corresponding storm sewer pipe connections to convey the storm water runoff to outfalls within the project limits.

It should also be noted that sidewalks are proposed on each side of the paved roadways within the project limits even though none of the existing intersection approaches now have sidewalks to connect to the as proposed sidewalks.

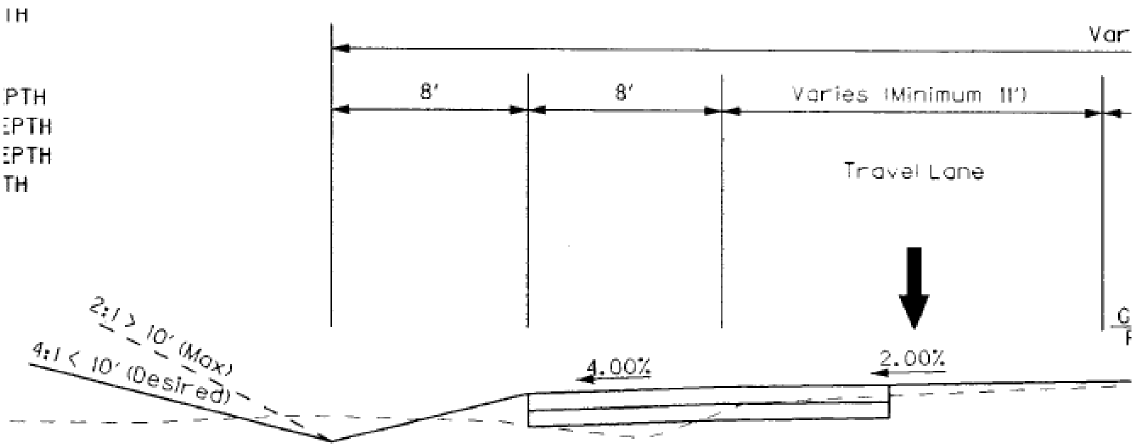
VII. DEVELOPMENT PHASE

D. DRAINAGE SYSTEM

2. Value Engineering Alternative

The Value Engineering Alternative is to maintain the existing rural section with open drainage swales and 8’ wide paved shoulders for this relatively short project (0.93miles) as shown in the typical section below. This typical section provides minimum 11’ wide outside thru lanes as is currently proposed with 8’ paved shoulders, 4 to 1 front slope, 2’ deep drainage swales, and 4 to 1 typical back slopes with a maximum of 2: 1. Since there are no existing sidewalks or curb and gutter within the confines of the proposed project, the Value Engineering Team concluded that the project should match the existing conditions.

The 8’ paved shoulder can be utilized for bicycles, a safety lane for stranded motorists, a storage area for snow removal, and by the occasional pedestrian.



VALUE ENGINEERING ALTERNATIVE TYPICAL SECTION

The proposed cross sections indicate that the Value Engineering Alternative typical rural section can be constructed within the proposed right of way limits established for the as proposed design.

The Value Engineering Team concluded that the curb and gutter section shown at the right of Sta. 121+50 should be constructed as proposed for the entire triangle to define access to adjacent businesses.

Although not included in the cost estimate, permitting the use of high-density polyethylene (HDPE) pipe as an acceptable alternate for storm drains may be cost effective. A local pipe supplier advised the Value Engineering Team that the HDPE pipe could be supplied for approximately two percent less than acceptable alternate types of pipe. It is therefore recommended that a special provision be included in the construction contract documents permitting the use of HDPE pipe for storm drains.

VII. DEVELOPMENT PHASE

D. DRAINAGE SYSTEM

2. Value Engineering Alternative *(continued)*

RECOMMENDATION

As shown in the attached cost comparison tabulation, the Value Engineering Alternate may provide an estimated savings of $197,037. Based on this potential savings and the desirability of maintaining the existing typical roadway section on the approach roadways with the open channel drainage swales, the Value Engineering Alternative typical section is recommended for further consideration.

DRAINAGE
VALUE ENGINEERING ALTERNATIVE COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
Standard Curb And Gutter	LF	$17.10	7,593.0	$129,840	515.0	$8,807
Storm Sewer Pipe-15”	LF	$35.80	2,961.0	$106,004	840.0	$30,072
Storm Sewer Pipe-18”	LF	$39.80	2,299.0	$91,500	730.0	$29,054
Storm Sewer Pipe-24”	LF	$53.40	472.0	$25,205	350.0	$18,690
Storm Sewer Pipe-30”	LF	$62.30	257.0	$16,011	0.0	$0
Storm Sewer Pipe-36”	LF	$78.00	40.0	$3,120	40.0	$3,120
Storm Sewer Pipe-48”	LF	$109.70	58.0	$6,363	58.0	$6,363
Storm Sewer Pipe-48” Eq	LF	$125.00	50.0	$6,250	50.0	$6,250
Sloped Box Outlet Type 1-15”	EACH	$1,369.20	1.0	$1,369	11.0	$15,061
Curb Box Inlet Type A	EACH	$3,576.80	40.0	$143,072	0.0	$0
Curb Box Inlet Type F	EACH	$2,000.00	5.0	$10,000	0.0	$0
Drop Box Inlet Type 3	EACH	$2,494.80	1.0	$2,495	9.0	$22,453
Drop Box Inlet Type 11	EACH	$1,500.00	9.0	$13,500	11.0	$16,500
Drop Box Inlet Type 13g	EACH	$2,280.00	13.0	$29,640	0.0	$0
Adjust Manhole Frame To Grade	EACH	$445.00	2.0	$890	2.0	$890
Channel Lining Class III	TON	$28.80	70.0	$2,016	70.0	$2,016
Concrete Class A	CU YD	$714.60	53.0	$37,874	53.0	$37,874
Steel Reinforcement	LB	$1.50	1,222.0	$1,833	53.0	$80
Entrance Pipe-15”	LF	$33.10	218.0	$7,216	770.0	$25,487
Entrance Pipe-18”	LF	$35.20	42.0	$1,478	0.0	$0
Entrance Pipe-24”	LF	$57.60	82.0	$4,723	45.0	$2,592
Entrance Pipe-24” Equiv	LF	$80.00	95.0	$7,600	95.0	$7,860
Channel Lining Class Ii	TON	$31.96		$0	100.0	$3,196
Junction Box-24”	EACH	$1,693.80		$0	1.0	$1,694
SUBTOTAL 1ST PAGE				**$647,999**		**$237,799**

(continued)

(continued)

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
Junction Box-36”	EACH	$1,434.70	2.0	$2,869	2.0	$2,869
Junction Box-48”	EACH	$1,800.00	2.0	$3,600	2.0	$3,600
Erosion Control Blanket (Special)	SQ. YD	$10.00		$0	100.0	$1,000
Temporary Mulch	SQ. YD	$0.17	76,500.0	$13,005	77,000.0	$13,090
Temporary Ditch	LF	$1.50	4,915.0	$7,373	4,915.0	$7,373
Temporary Silt Fence	LF	$2.60	4,915.0	$12,779	4,915.0	$12,779
Clean Temporary Silt Fence	LF	$0.36	14,745.0	$5,308	14,745.0	$5,308
Silt Trap Type A	EACH	$360.90	16.0	$5,774	16.0	$5,774
Clean Silt Trap Type A	EACH	$64.90	48.0	$3,115	48.0	$3,115
Silt Trap Type B	EACH	$378.00	64.0	$24,192	64.0	$24,192
Clean Silt Trap Type B	EACH	$61.00	192.0	$11,712	192.0	$11,712
Silt Trap Type C	EACH	$238.80	32.0	$7,642	32.0	$7,642
Clean Silt Trap C	EACH	$76.10	96.0	$7,306	96.0	$7,306
Temp Seeding And Protection	SQ. YD	$0.10	55,540.0	$5,554	55,540.0	$5,554
Seeding And Protection	SQ. YD	$0.30	32,000.0	$9,600	33,000.0	$9,900
Sodding	SQ. YD	$4.00	6,080.0	$24,320	6,100.0	$24,400
Erosion Control Blanket	SQ. YD	$1.70	2,910.0	$4,947	3,800.0	$6,460
Cored Hole Drainage Box Con-4”	EACH	$161.00	50.0	$8,050	50.0	$8,050
Perforated Pipe-4”	LF	$5.50	200.0	$1,100	2,000.0	$11,000
Sidewalk-4” Conc	SQ. YD	$29.50	3,425.0	$101,038	0.0	$0
Paved-8’ Shoulder	SQ YD	$43.26			7,796.0	$337,255
Additional Perm. Easement	SQ. FT.	$16.88			859.0	$14,500
SUBTOTAL 1ST PAGE				**$259,284**		**$522,879**

(continued)

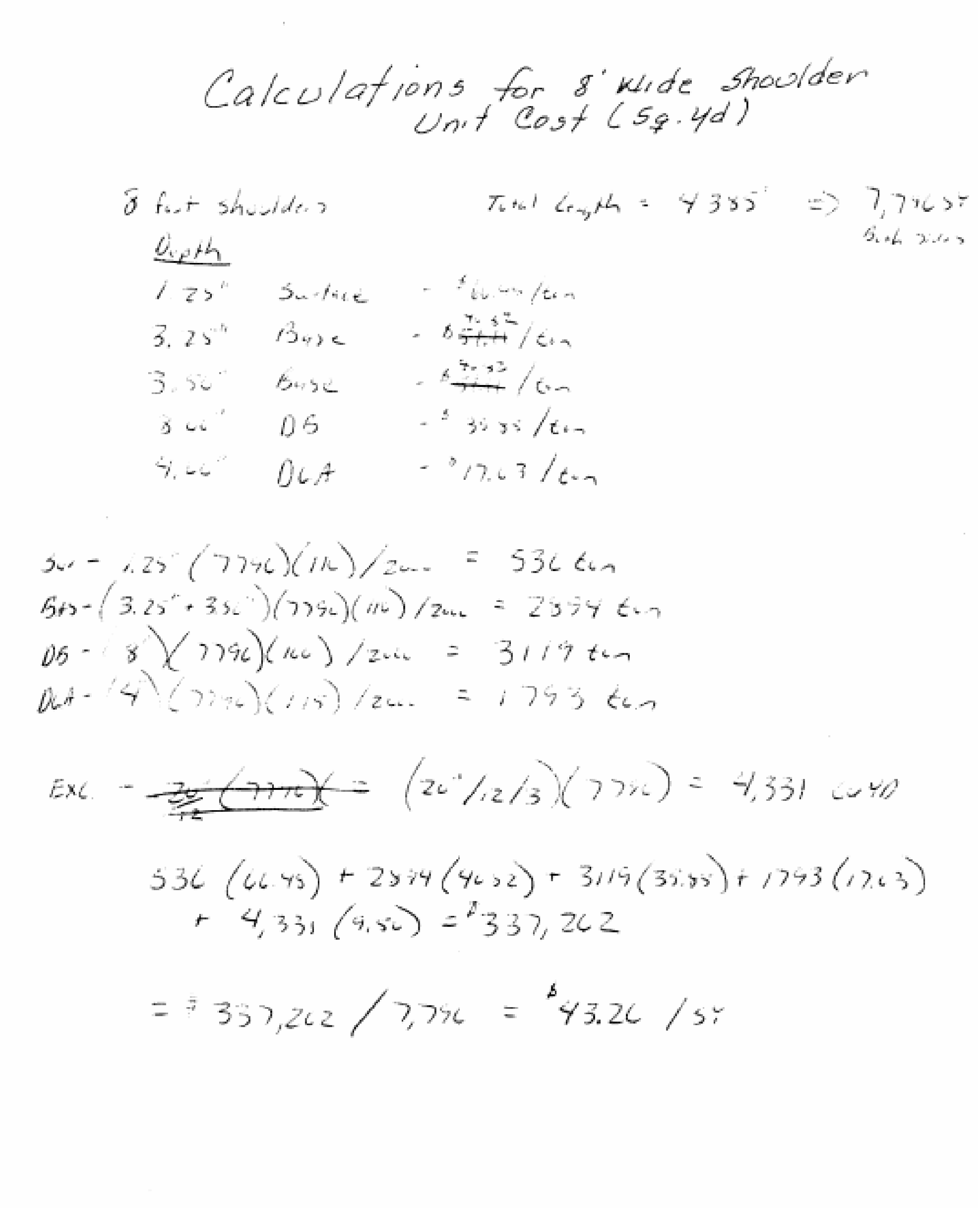
(continued)

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
SUBTOTAL 1ST PAGE				**$647,999**		**$237,799**
SUBTOTAL 2ND PAGE				**$259,284**		**$522,879**
SUBTOTAL				**$907,283**		**$760,678**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			5.0%	$49,901	5.0%	$41,873
TRAFFIC CONTROL/MOT			7.0%	$63,510	7.0%	$53,247
CONTINGENCY			10.0%	$90,728	10.0%	$76,068
GRAND TOTAL				**$1,111,422**		**$931,866**
POSSIBLE SAVINGS:				**$179,556**		

VII. DEVELOPMENT PHASE

D. DRAINAGE SYSTEM

COST COMPARISON SHEET BACK UP CALCULATIONS



Calculations for 8' wide shoulder
Unit Cost (Sq. yd)

8 foot shoulders   Total Length = 4385' => 7,796 SY
Both sides

Depth		
1.25"	Surface	- $66.45/ton
3.25"	Base	- $ ~~51.44~~ 46.52 /ton
3.50"	Base	- $ ~~51.44~~ 46.52 /ton
8.00"	DG	- $ 35.85 /ton
4.00"	DGA	- $17.63 /ton

Sur - 1.25" (7796)(110)/2000 = 536 ton

Bas - (3.25" + 3.50")(7796)(110)/2000 = 2894 ton

DG - 8"(7796)(100)/2000 = 3119 ton

DGA - 4"(7796)(115)/2000 = 1793 ton

Exc. - ~~30/12 (7796)~~ = (20"/12/3)(7796) = 4,331 CuYd

536 (66.45) + 2894 (46.52) + 3119 (35.85) + 1793 (17.63)
+ 4,331 (9.50) = $337,262

= $337,262 / 7,796 = $43.26 /SY

E. DESIGN COMMENTS – MOT

PRELIMINARY DISCUSSION

This design comment addresses only the portion of the Mainline north of Sta. 127+50 and is considered by the Value Engineering Team as a possible alternative MOT plan.

The Value Engineering Team accepts the “As Proposed” MOT south of Sta. 125+00.

It is noted that the “As Proposed” MOT is shown in nine phases, and the MOT is portrayed this way for clarity in presentation on the plans.

Phases 1 thru 5 primarily concern the work on the Mainline from the beginning of the project (Sta. 110+00) to just south of the Outer Loop/S.Watterson Trace intersection (Sta.129+60), including all the work on Beulah Church Road east.

Phases 6 and 7 concern the construction of Fergenbush Lane northward from the Outer Loop/S.Watterson Trace intersection, and reconstruction within the intersection.

Phases 8 and 9 concern the construction of Outer Loop westward from the Outer Loop/S.Watterson Trace intersection, and reconstruction within the intersection..

A contractor could actually do the work shown in Phases 6, 7, 8 and 9 during the same time that work is being done on Phases 1 thru 5.

AS PROPOSED MOT

In Phase 1, traffic on Fegenbush Lane between Sta. 126+50 and Sta. 130+00 is maintained on the westerly 33’ of the existing pavement while the east side of the new roadway is constructed. Also, traffic on S. Watterson Trace between Sta. 50+40 and Sta. 54+00 is maintained on the existing pavement while some work on the south side of the existing roadway is constructed.

In Phase 2, traffic on Fegenbush Lane between Sta. 126+50 and Sta. 130+00 is maintained on the easterly 33’ of the newly constructed existing pavement while the west side of the new roadway is constructed, thereby completing this 350’ portion of Fegenbush Lane.

In Phases 6 and 7, first the east half and then the west half of Fegenbush Lane from Sta.130+40 to the End of Project is constructed while maintaining one-way southbound traffic, (with some restrictions to access). Northbound Fegenbush Lane traffic is detoured west on Outer Loop to a right turn northward on Vaughn Mill Road.

In Phase 8, all of S. Watterson Trace, together with the east portion of the intersection, is completed. At the intersection, two-way traffic is maintained alternately on each side. East of the intersection, the construction on S. Watterson Trace is primarily an overlay of the existing pavement.

In Phase 9 all of Outer Loop, together with the west portion of the intersection, is completed. At the intersection, two-way traffic is maintained alternately on each side. West of the intersection, the construction on Outer Loop is primarily an overlay of the existing pavement.

E. DESIGN COMMENTS – MOT

This Design Comment suggests a way to reconstruct the intersection at Outer Loop/S. Watterson Trace in only two sequences, rather than the six sequences called for in the “As Proposed” Plans.

Building in a lot of different phases and in close proximity to traffic may make it more difficult for the contractor to attain quality in construction and maintain worker safety at this intersection.
MAINTENANCE OF TRAFFIC

VALUE ENGINEERING SUGGESTION

The old pre-1950 pavements of Outer Loop and of S. Watterson Trace can be utilized to detour most of the traffic away from the intersection of Mainline (Fegenbush Lane) and Outer Loop/ S. Watterson Trace.

These two detour roads meet the Mainline at Sta. 127, where a temporary signal is necessary. This signal can reuse the same equipment that the “As Proposed” MOT Phase 3 uses at Sta. 124.

The following traffic movements can then be removed from the intersection at Sta. 130:

- NB Fegenbush Lane - all turning traffic to Outer Loop and to S. Watterson Trace. Thru traffic is routed on the detour road to Outer Loop and then, by a turn, thru the intersection.
- S. Watterson Trace – all traffic.
- Outer Loop – all traffic except EB to NB

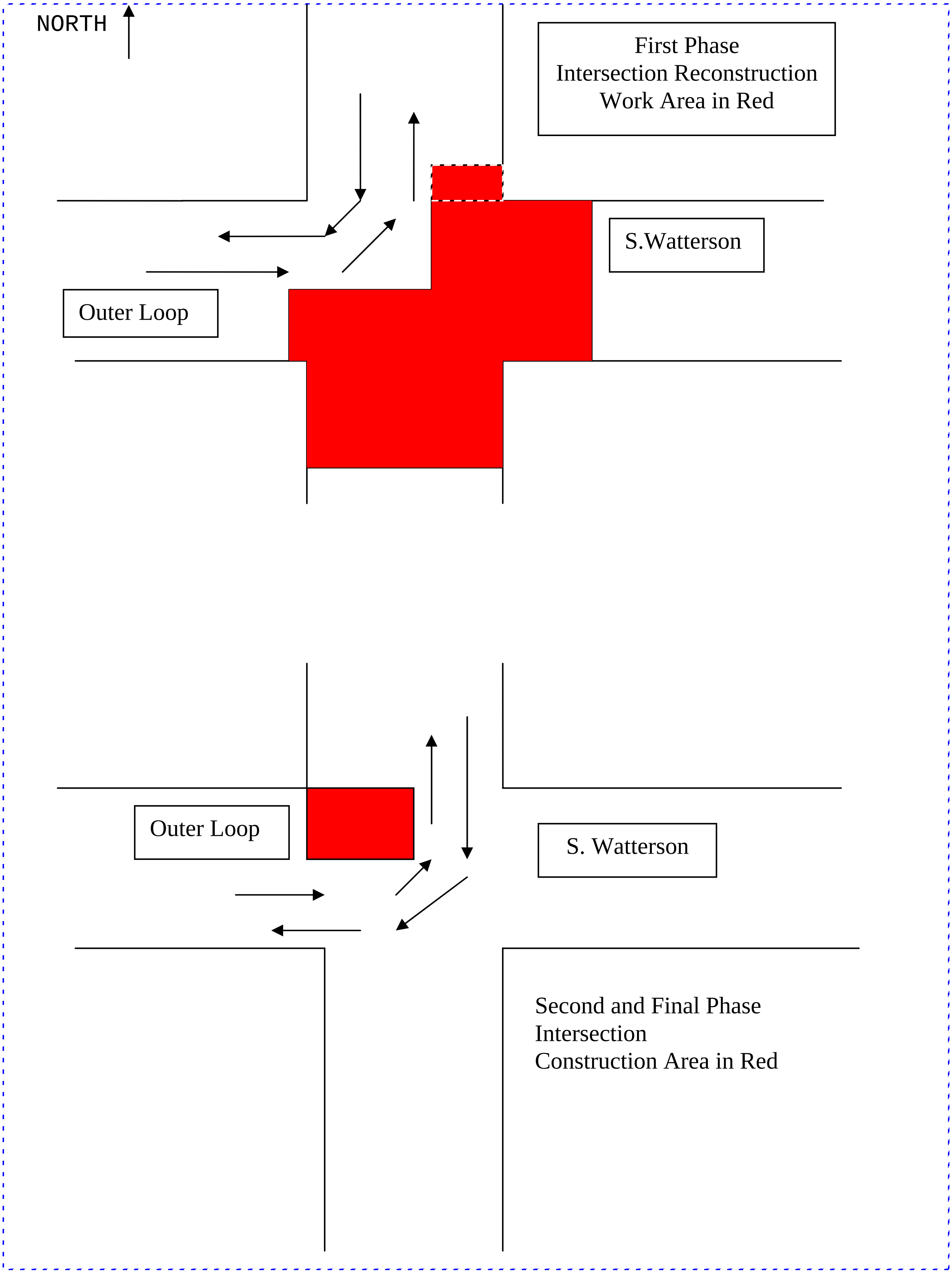
The only traffic still operating thru the intersection is the two-way traffic to and from Fegenbush Lane and Outer Loop.

In the initial phase, that turning traffic can operate on the northwest quadrant of the intersection, freeing the other three quadrants of the intersection for the roadway reconstruction in a single phase.

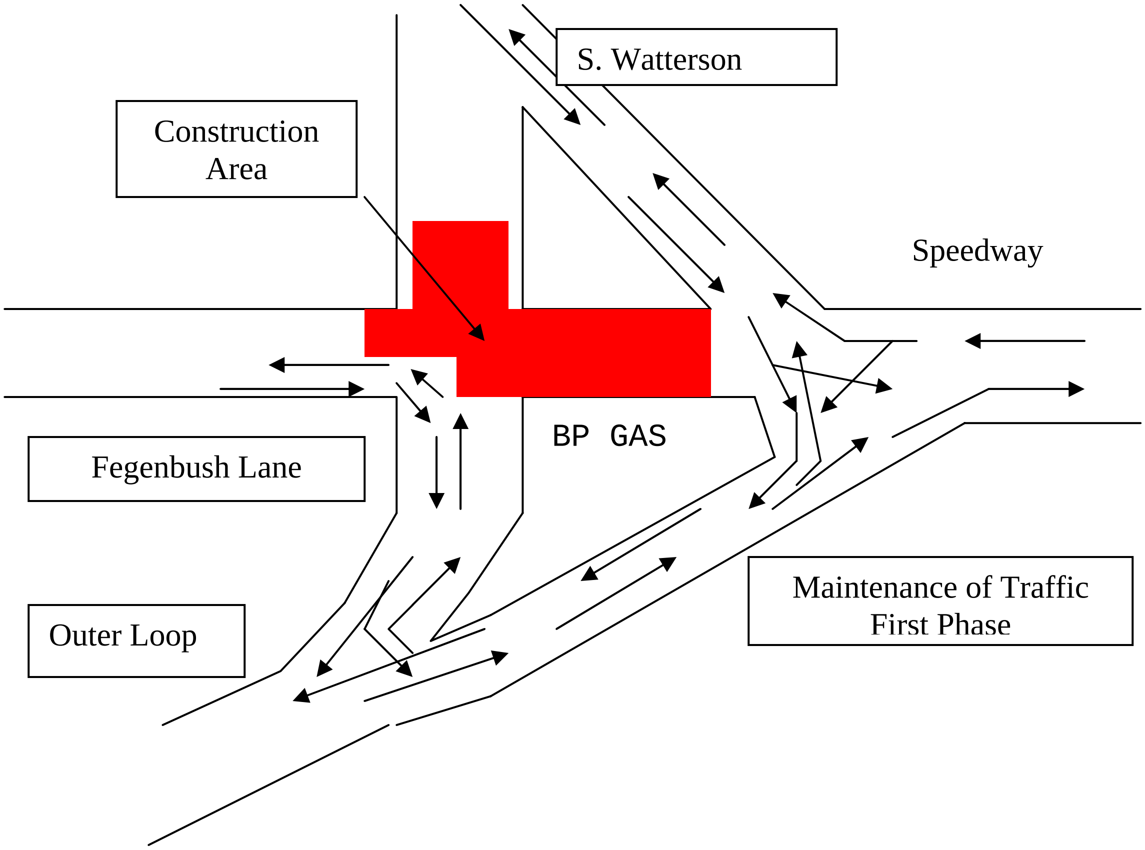
The intersection roadway reconstruction can then be completed in a second phase when the turning traffic uses the previously reconstructed part of the intersection.. These suggested construction phases are shown schematically on following pages.

The advantage of this suggested MOT method is that it allows the intersection of Mainline (Fegenbush Lane) and Outer Loop/ S.Watterson Trace to be built during two phases rather than four phases (six segments), with substantially fewer shifts of traffic.

There may be an additional cost for temporary pavement and the temporary signal, but that cost is probably offset by a reduction in construction costs and the cost of shifting traffic numerous times.



VII. Development Phase
E. Design Comments-MOT



VII. Development Phase
E. Design Comments-MOT

VIII. SUMMARY OF RECOMMENDATIONS

It is the recommendation of the Value Engineering Team that the following Value Engineering Alternatives be carried into the Project Development process for further development.

Recommendation Number 1: Fegenbush lane/S.Watterson Trace/Outer loop Intersection

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative provides a free flowing Roundabout in lieu of a signalized intersection.

If this recommendation can be implemented, there is a possible savings of ***$1,327,418.***

Recommendation Number 2: Fegenbush Lane/Beulah Church Road Intersection

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative provides a free flowing Roundabout in lieu of a signalized intersection.

If this recommendation can be implemented, there is a possible savings of ***$1,645,603.***

Recommendation Number 3: Pavement Design

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative minimizes the thickness of the aggregate base and maximizes the depth of the asphalt concrete to obtain the required pavement structural support for the design year traffic.

If this recommendation can be implemented, there is a possible savings of ***$131,968.***

Recommendation Number 4: Drainage System

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative has open channel swales with 8 ft. paved shoulders as the typical section instead of curbs and gutters with a closed drainage system. High-density polyethylene pipes are proposed as an acceptable alternate for all storm drains.

If this recommendation can be implemented, there is a possible savings of ***$179,556.***

FENGENBUSH LANE AND BEULAH CHURCH ROAD INTERSECTION
VALUE ENGINEERING STUDY PRESENTATION
February 12-16, 2007

NAME	AFFILIATION	PHONE
Robert T. Semons	KYTC VE Coordinator Program Performance	502-564-4555
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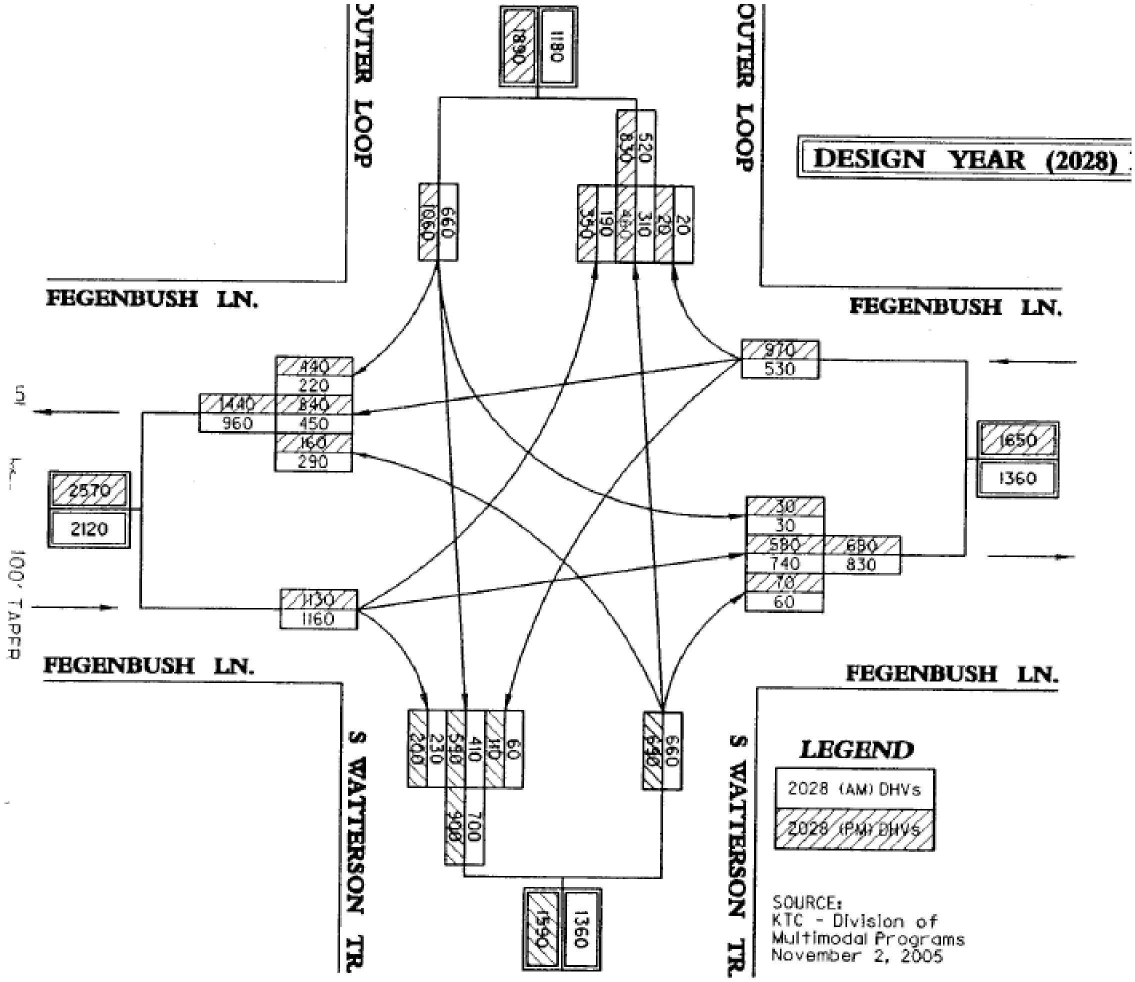
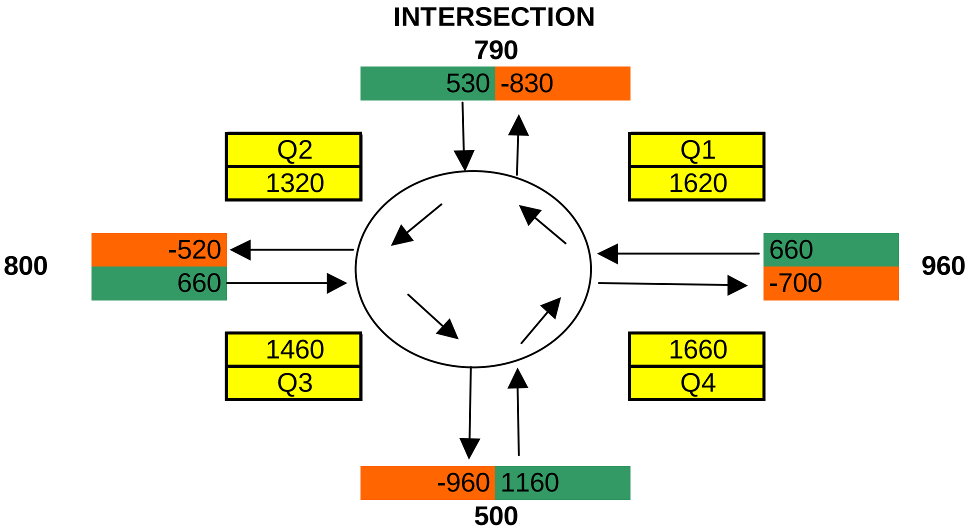
Mike Bezold	KYTC Dist.6	859-341-2700
Kelly Meyer	Quest Engineers	502-584-4118
Joe Tucker	KYTC Design	502-564-3280
Brent A. Sweger	KYTC Planning	502-564-7183
Erin Van Zee	KYTC Planning	502-564-7183
Joel Pate	VE Group	850-627-3900
Thomas Hartley	VE Group	850-627-3900
Ananias Calvin III	KYTC Highway Design	502-564-3280
Tala Quino	KYTC Dist 5 Design	502-367-6411
John Callihan	KYTC Dist. 5 Preconstruction	502-367-6411

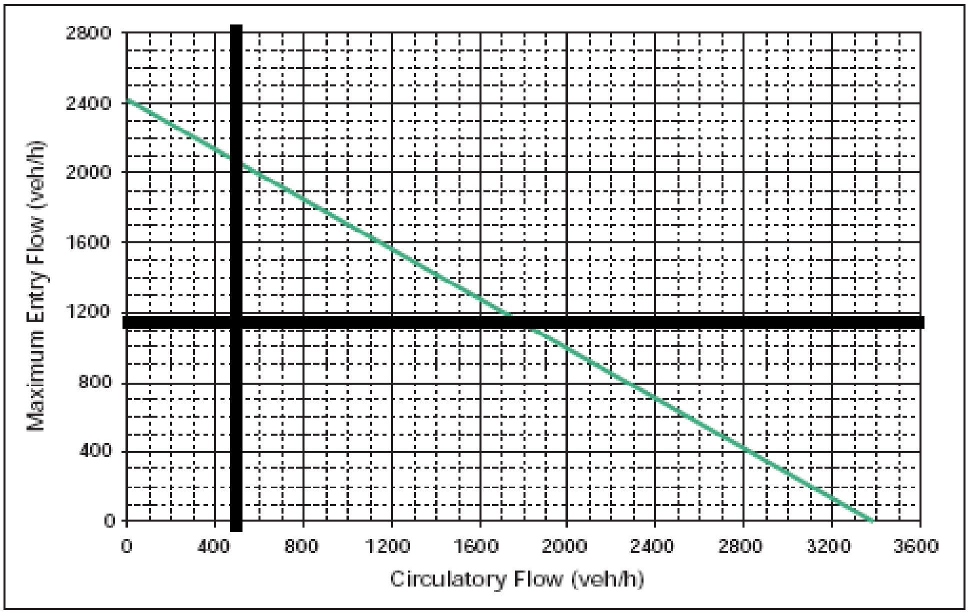
IX. APPENDICES

FEGENBUSH/OUTER LOOP TRAFFIC ANALYSIS:





				530					
			20	450	60	-830			
	1320	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1620	
	-520	OUT		N			RT	60	
	30	LT					THRU	310	
660	410	THRU	W			E	LT	290	660
	220	RT					OUT	-700	
	1460	QUAD 3		S			QUAD 4	1660	
			OUT	LT	THRU	RT			
			-960	190	740	230			
				1160					



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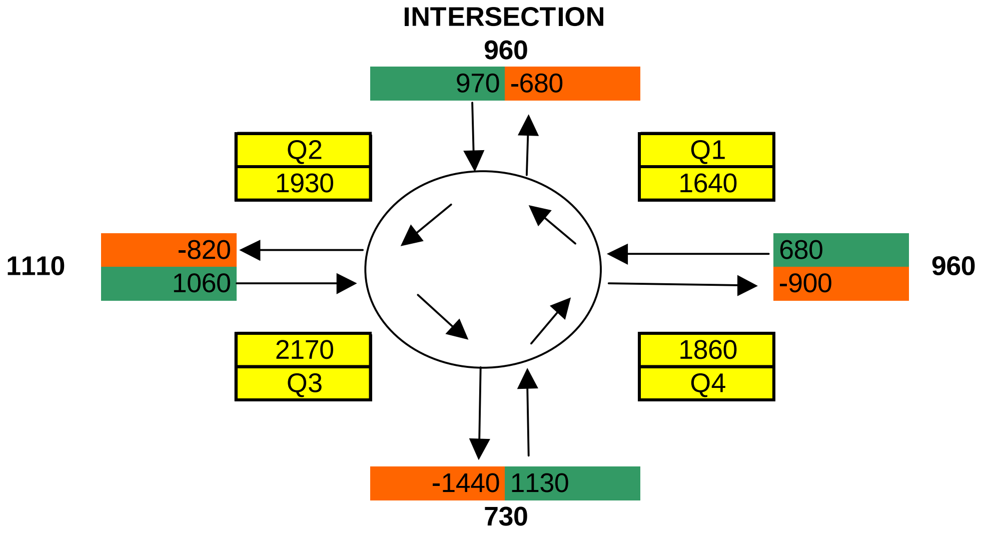
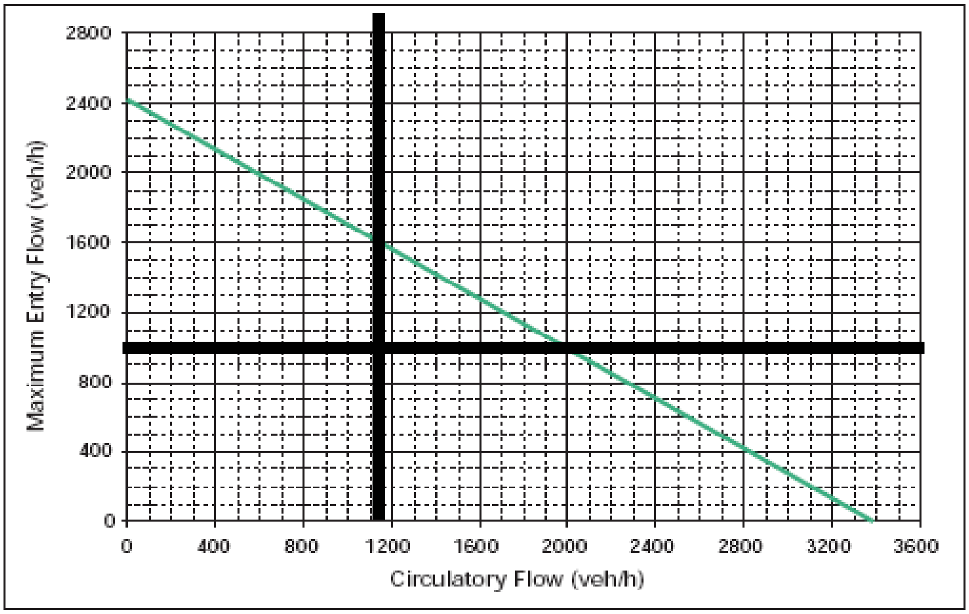


				970					
			20	840	110	-680			
	1930	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1640	
	-820	OUT		N			RT	70	
	30	LT					THRU	450	
1060	590	THRU	W			E	LT	160	680
	440	RT					OUT	-900	
	2170	QUAD 3		S			QUAD 4	1860	
			OUT	LT	THRU	RT			
			-1440	350	580	200			
				1130					



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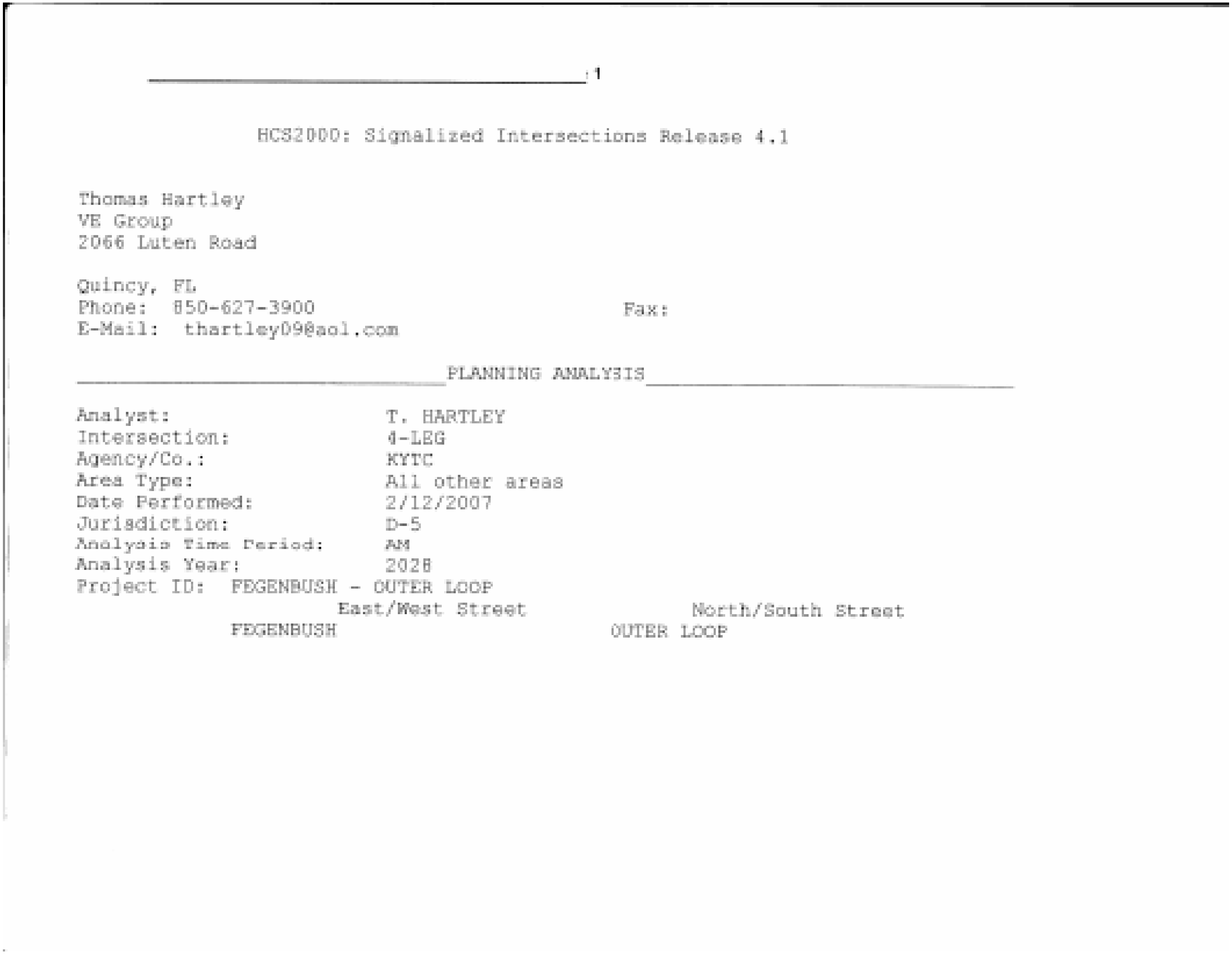


```
____________________________________________1

              HCS2000: Signalized Intersections Release 4.1

Thomas Hartley
VE Group
2066 Luten Road

Quincy, FL
Phone:  850-627-3900                            Fax:
E-Mail:  thartley09@aol.com

_______________________________PLANNING ANALYSIS_______________________________

Analyst:                     T. HARTLEY
Intersection:                4-LEG
Agency/Co.:                  KYTC
Area Type:                   All other areas
Date Performed:              2/12/2007
Jurisdiction:                D-5
Analysis Time Period:        AM
Analysis Year:               2028
Project ID:  FEGENBUSH - OUTER LOOP
                      East/West Street              North/South Street
             FEGENBUSH                       OUTER LOOP
```

```
________________________________VOLUME DATA_________________________________

            |  Eastbound      |  Westbound      |  Northbound     |  Southbound     |
            | L    T    R     | L    T    R     | L    T    R     | L    T    R     |
            |________________ |________________ |________________ |________________ |
Num. Lanes  |1    1    1      |1    1    1      |1    2    1      |1    2    1      |
Volume      |30   550  440    |160  480  70     |350  580  550    |110  840  20     |
Parking     |     N           |     N           |     N           |     N           |
Coord.      |     N           |     N           |     N           |     N           |
LT Treat.   | U               | U               | U               | U               |
Peak hour factor:  0.90        Area Type: All other areas
```

```
                         LANE VOLUME WORKSHEET
                                                 EAST   WEST   NORTH  SOUTH
                                                 BOUND  BOUND  BOUND  BOUND

LEFT TURN MOVEMENT

  1. LT volume                                   30     160    350    110
  2. Opposing mainline volume                    550    990    860    1130
  3. Number of exclusive LT lanes                1      1      1      1
  Cross Product [2] * [1]                        16500  158400 301000 124300

  Left Lane Configuration (E=Excl, S=Shrd):      E      E      E      E
  Left Turn Treatment Type:                      U      U      U      U

  4. LT adjustment factor                        1.000  1.000  1.000  1.000
  5. LT lane vol                                 0      0      0      0

RIGHT TURN MOVEMENT

  Right Lane Configuration (E=Excl, S=Shrd)      E      E      E      E
  6. RT volume                                   440    70     550    20
  7. Exclusive lanes                             1      1      1      1
  8. RT adjustment factor                        0.850  0.850  0.850  0.850
  9. Exclusive RT lane volume                    518    82     647    24
 10. Shared lane vol

THROUGH MOVEMENT

 11. Thru volume                                 550    480    580    840
 12. Parking adjustment factor                   1.00   1.00   1.00   1.00
 13. No. of thru lanes including shared          1      1      2      2
 14. Total approach volume                       550    480    580    840
 15. Prop. of left turns in lane group           0.00   0.00   0.00   0.00
 16. Left turn equivalence                       2.42   3.70   3.26   4.22
 17. LT adj. factor:
 18. Through lane volume                         550    480    290    420
 19. Critical lane volume                        550    480    647    420
```

```
Left Turn Check (if [16] > 3.5)
20. Permitted left turn sneaker capacity:        60      60      60      60
          7200/Cmax
```

```
___________________________SIGNAL OPERATIONS WORKSHEET_______________________

                                                    EAST   WEST   NORTH  SOUTH
Phase Plan Selection from Lane Volume Worksheet     BOUND  BOUND  BOUND  BOUND

Critical through-RT vol: [19]                       550    480    647    420
LT lane vol: [5]                                    0      0      0      0
Left turn protection: (P/U/N)                       U      U      U      U
Dominant left turn: (Indicate by '<')


  Selection Criteria based on the           Plan 1:  U      U      U      U
  specified left turn protection            Plan 2a: U      P      U      P
                                            Plan 2b: P      U      P      U
  < Indicates the dominant left turn        Plan 3a:<P      P     <P      P
  for each opposing pair                    Plan 3b: P     <P      P     <P
                                            Plan 4:  N      N      N      N

Phase plan selected (1 to 4)                              1             1

Min. cycle (Cmin) 60              Max. cycle (Cmax) 120

Timing Plan                                 ____EAST-WEST_____  ___NORTH-SOUTH____
                           Value            Ph 1   Ph 2   Ph 3   Ph 1   Ph 2   Ph 3

Movement codes                              EWT                  NST
Critical phase vol [CV]                     550    0      0      647    0      0
Critical sum [CS]          1197
CBD adjustment [CBD]       1.00
Reference sum [RS]         1539
Lost time/phase [PL]                        4      0      0      4      0      0
Lost time/cycle [TL]       8
Cycle length [CYC]         60.0
Phase time                                  27.9   0.0    0.0    32.1   0.0    0.0
Critical v/c Ratio [Xcm]   0.90
Status                     Near capacity
_____________________________________________________________________________
```

```
____________________________________1

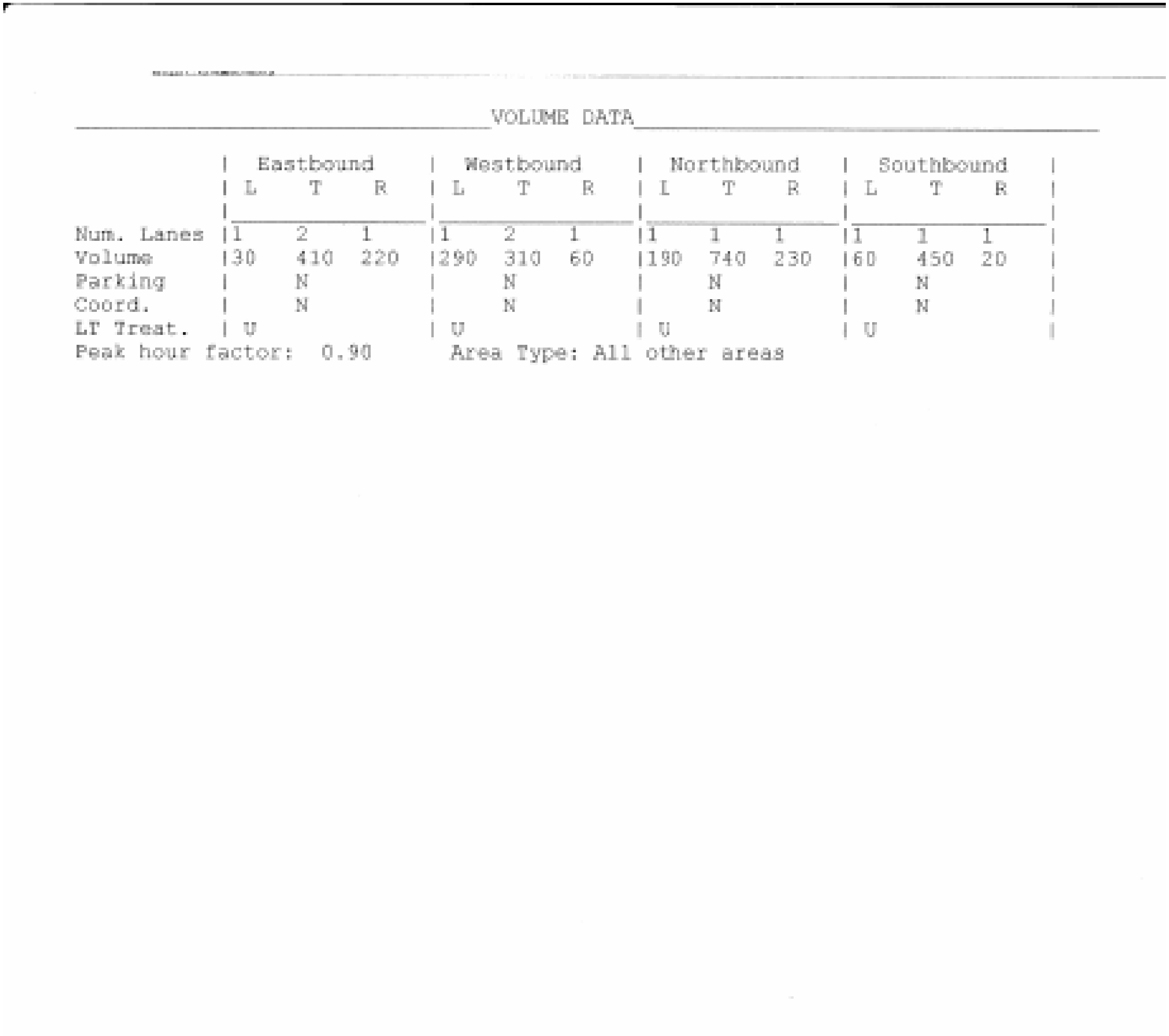
            HCS2000: Signalized Intersections Release 4.1


     Thomas Hartley
     VE Group
     2066 Luten Road

     Quincy, FL
     Phone:  850-627-3900                      Fax:
     E-Mail:  thartley09@aol.com

     ________________________________PLANNING ANALYSIS________________________________

     Analyst:                   T. HARTLEY
     Intersection:              4-LEG
     Agency/Co.:                KYTC
     Area Type:                 All other areas
     Date Performed:            2/12/2007
     Jurisdiction:              D-5
     Analysis Time Period:      AM
     Analysis Year:             2028
     Project ID:  FEGENBUSH - OUTER LOOP
                          East/West Street              North/South Street
                  FEGENBUSH                       OUTER LOOP
```



```
________________________________VOLUME DATA________________________________

              |  Eastbound      |  Westbound      |  Northbound     |  Southbound     |
              | L    T    R     | L    T    R     | L    T    R     | L    T    R     |
              |_________________|_________________|_________________|_________________|
Num. Lanes    |1     2    1     |1     2    1     |1     1    1     |1     1    1     |
Volume        |30    410  220   |290   310  60    |190   740  230   |60    450  20    |
Parking       |      N          |      N          |      N          |      N          |
Coord.        |      N          |      N          |      N          |      N          |
LT Treat.     | U               | U               | U               | U               |
Peak hour factor:  0.90      Area Type: All other areas
```

```
                          LANE VOLUME WORKSHEET
                                                 EAST   WEST   NORTH  SOUTH
                                                 BOUND  BOUND  BOUND  BOUND

LEFT TURN MOVEMENT

  1. LT volume                                   30     290    190    60
  2. Opposing mainline volume                    370    630    470    970
  3. Number of exclusive LT lanes                1      1      1      1
  Cross Product [2] * [1]                        11100  182700 89300  58200

  Left Lane Configuration (E=Excl, S=Shrd):      E      E      E      E
  Left Turn Treatment Type:                      U      U      U      U

  4. LT adjustment factor                        1.000  1.000  1.000  1.000
  5. LT lane vol                                 0      0      0      0

RIGHT TURN MOVEMENT

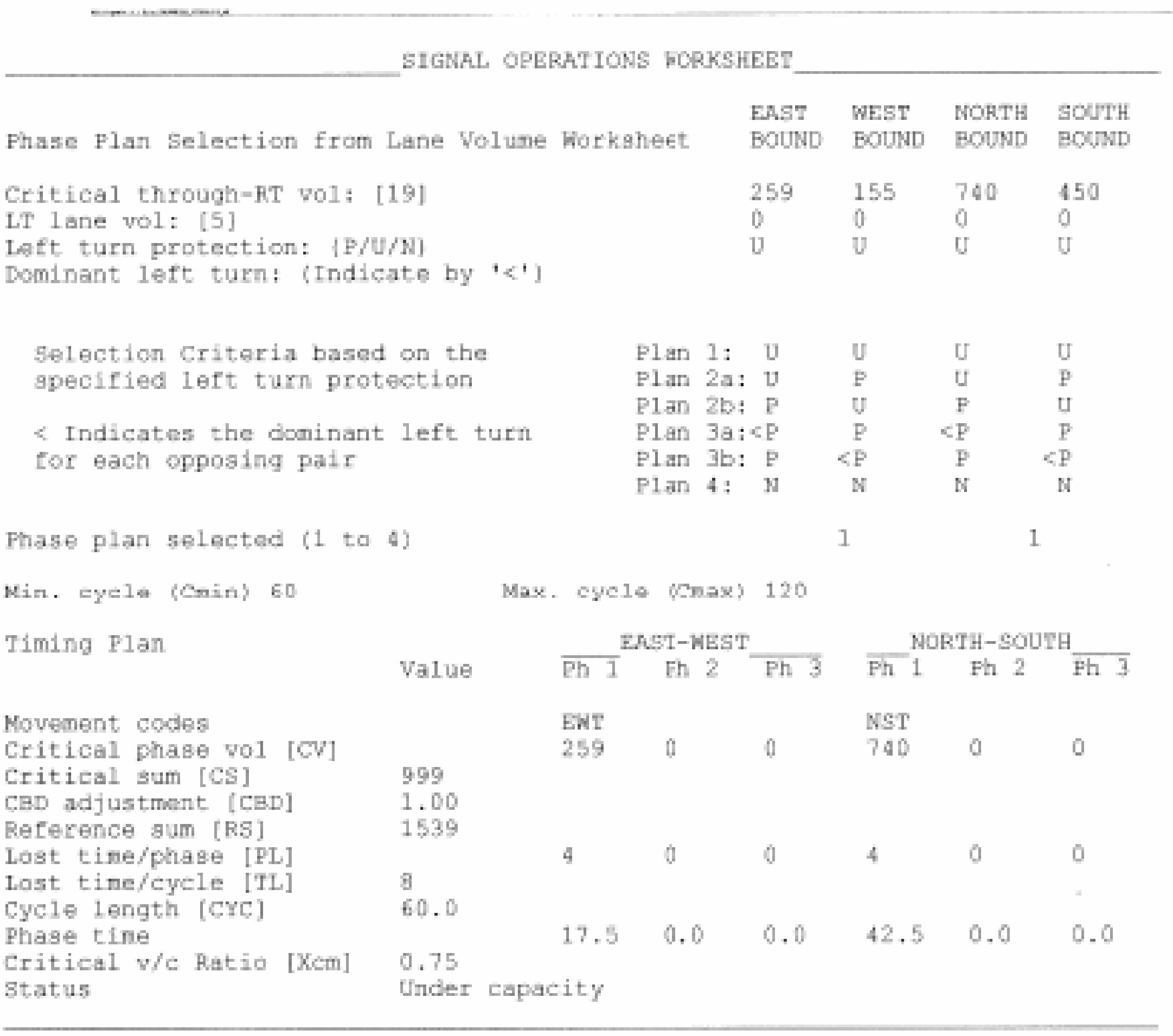
  Right Lane Configuration (E=Excl, S=Shrd)      E      E      E      E
  6. RT volume                                   220    60     230    20
  7. Exclusive lanes                             1      1      1      1
  8. RT adjustment factor                        0.850  0.850  0.850  0.850
  9. Exclusive RT lane volume                    259    71     271    24
 10. Shared lane vol

THROUGH MOVEMENT

 11. Thru volume                                 410    310    740    450
 12. Parking adjustment factor                   1.00   1.00   1.00   1.00
 13. No. of thru lanes including shared          2      2      1      1
 14. Total approach volume                       410    310    740    450
 15. Prop. of left turns in lane group           0.00   0.00   0.00   0.00
 16. Left turn equivalence                       2.02   2.61   2.23   3.63
 17. LT adj. factor:
 18. Through lane volume                         205    155    740    450
 19. Critical lane volume                        259    155    740    450
```

Left Turn Check (if [16] > 3.5)

20. Permitted left turn sneaker capacity: 7200/Cmax	60	60	60	60



```
                         SIGNAL OPERATIONS WORKSHEET
                                                       EAST   WEST   NORTH  SOUTH
Phase Plan Selection from Lane Volume Worksheet        BOUND  BOUND  BOUND  BOUND

Critical through-RT vol: [19]                          259    155    740    450
LT lane vol: [5]                                       0      0      0      0
Left turn protection: (P/U/N)                          U      U      U      U
Dominant left turn: (Indicate by '<')

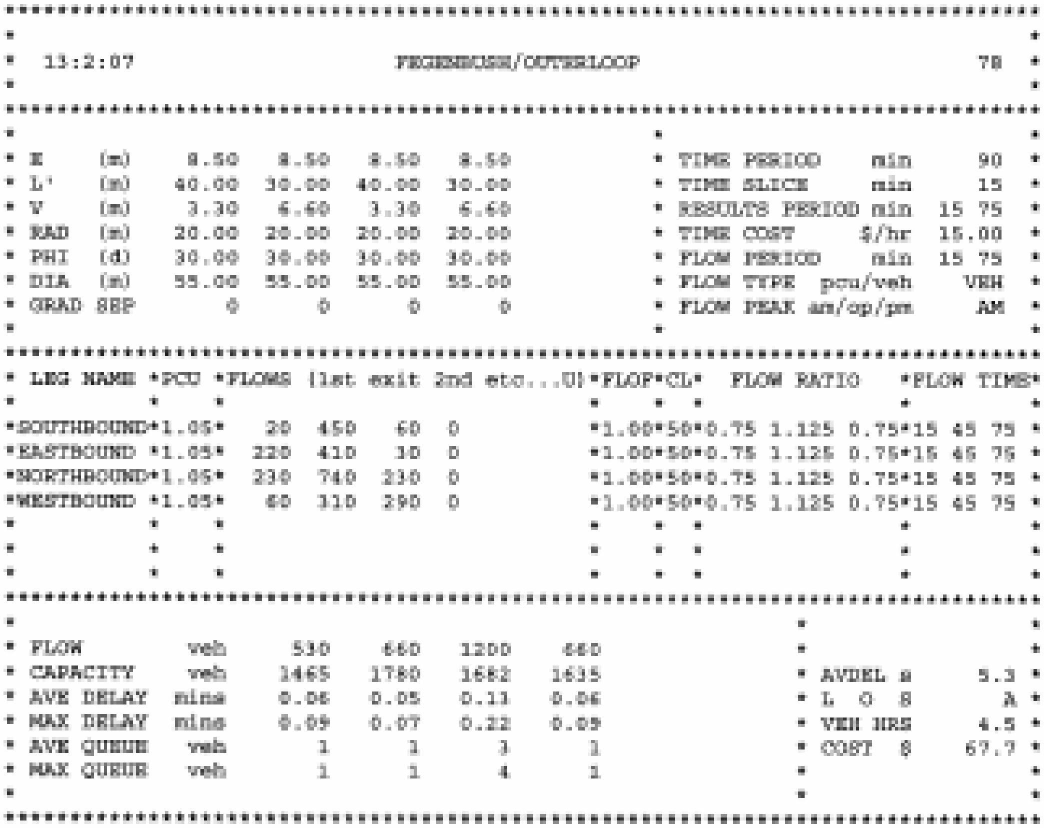

  Selection Criteria based on the               Plan 1:  U     U      U      U
  specified left turn protection                Plan 2a: U     P      U      P
                                                Plan 2b: P     U      P      U
  < Indicates the dominant left turn            Plan 3a:<P     P     <P      P
  for each opposing pair                        Plan 3b: P    <P      P     <P
                                                Plan 4:  N     N      N      N

Phase plan selected (1 to 4)                              1             1

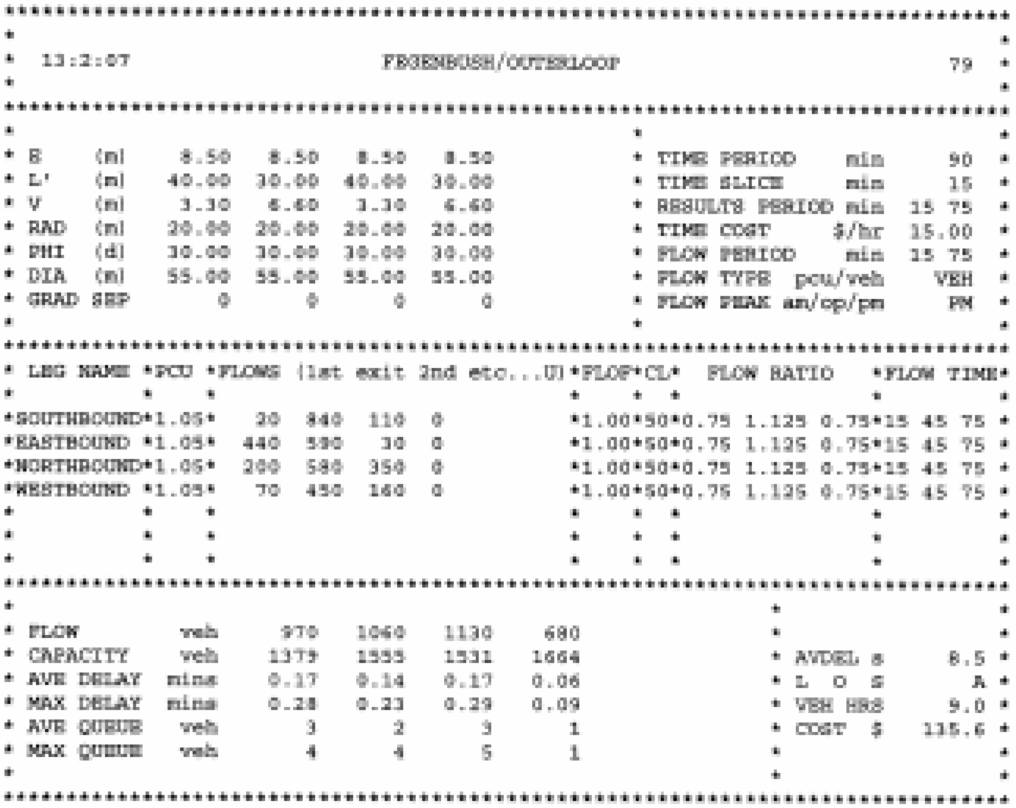
Min. cycle (Cmin) 60              Max. cycle (Cmax) 120

Timing Plan                                 ____EAST-WEST_____   ____NORTH-SOUTH____
                           Value      Ph 1   Ph 2   Ph 3   Ph 1   Ph 2   Ph 3

Movement codes                        EWT                  NST
Critical phase vol [CV]               259    0      0      740    0      0
Critical sum [CS]          999
CBD adjustment [CBD]       1.00
Reference sum [RS]         1539
Lost time/phase [PL]                  4      0      0      4      0      0
Lost time/cycle [TL]       8
Cycle length [CYC]         60.0
Phase time                            17.5   0.0    0.0    42.5   0.0    0.0
Critical v/c Ratio [Xcm]   0.75
Status                     Under capacity
```



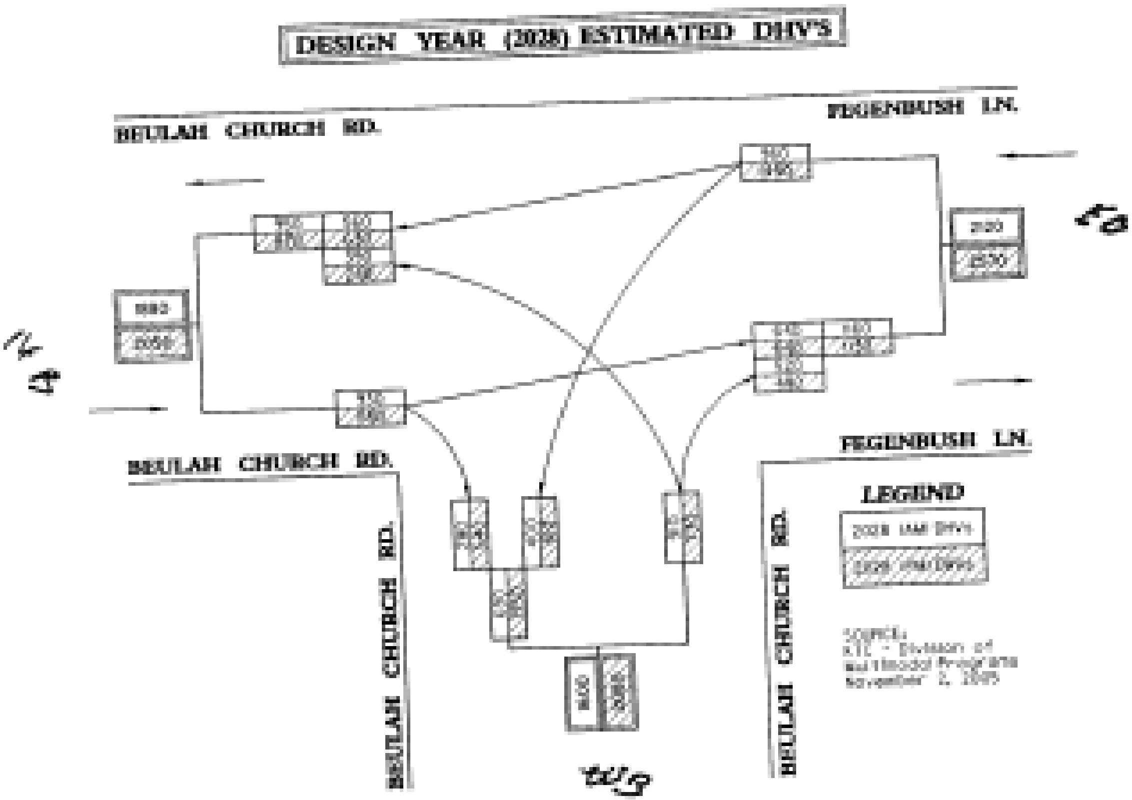
```
********************************************************************************
*                                                                              *
*  13:2:07                    FEGENBUSH/OUTERLOOP                          78  *
*                                                                              *
********************************************************************************
*                                                 *                            *
* E    (m)    8.50   8.50   8.50   8.50           * TIME PERIOD    min     90  *
* L'   (m)   40.00  30.00  40.00  30.00           * TIME SLICE     min     15  *
* V    (m)    3.30   6.60   3.30   6.60           * RESULTS PERIOD min  15 75  *
* RAD  (m)   20.00  20.00  20.00  20.00           * TIME COST     $/hr  15.00  *
* PHI  (d)   30.00  30.00  30.00  30.00           * FLOW PERIOD    min  15 75  *
* DIA  (m)   55.00  55.00  55.00  55.00           * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0      0           * FLOW PEAK am/op/pm     AM  *
*                                                 *                            *
********************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOP*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*SOUTHBOUND*1.05*   20  450   60  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*EASTBOUND *1.05*  220  410   30  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*  230  740  230  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*   60  310  290  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
********************************************************************************
*                                                           *                  *
* FLOW         veh     530    660   1200    660             *                  *
* CAPACITY     veh    1465   1780   1682   1635             * AVDEL s      5.3 *
* AVE DELAY  mins     0.06   0.05   0.11   0.06             * L  O  S        A *
* MAX DELAY  mins     0.09   0.07   0.22   0.09             * VEH HRS      4.5 *
* AVE QUEUE    veh       1      1      3      1             * COST  $     67.7 *
* MAX QUEUE    veh       1      1      4      1             *                  *
*                                                           *                  *
********************************************************************************
```



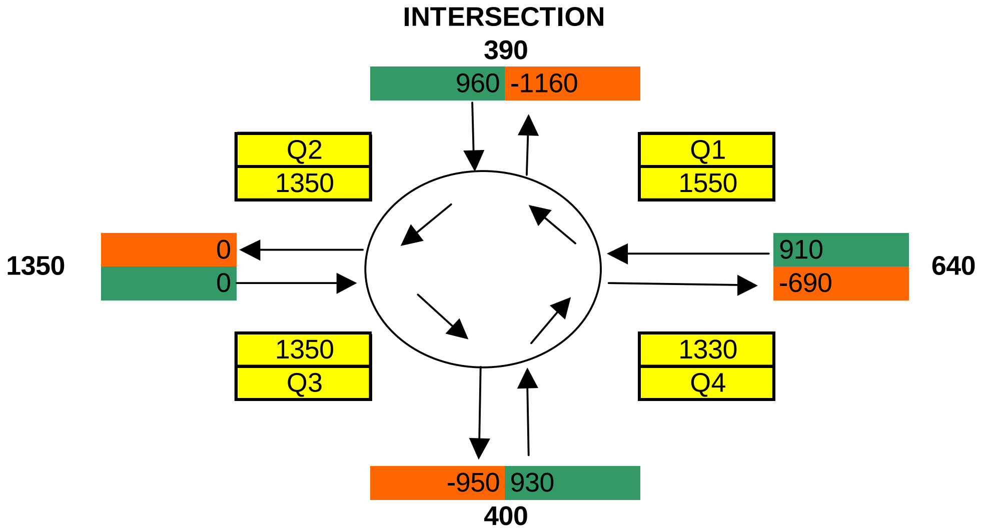
```
********************************************************************************
*                                                                              *
*  13:2:07                        FEGENBUSH/OUTERLOOP                     79   *
*                                                                              *
********************************************************************************
*                                                        *                     *
* E     (m)     8.50    8.50    8.50    8.50             * TIME PERIOD    min      90  *
* L'    (m)    40.00   30.00   40.00   30.00             * TIME SLICE     min      15  *
* V     (m)     3.30    6.60    3.30    6.60             * RESULTS PERIOD min  15 75  *
* RAD   (m)    20.00   20.00   20.00   20.00             * TIME COST      $/hr 15.00  *
* PHI   (d)    30.00   30.00   30.00   30.00             * FLOW PERIOD    min  15 75  *
* DIA   (m)    55.00   55.00   55.00   55.00             * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP         0       0       0       0             * FLOW PEAK am/op/pm     PM  *
*                                                        *                     *
********************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO    *FLOW TIME*
*          *    *                            *    *  *                *          *
*SOUTHBOUND*1.05*   20  840  110  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*EASTBOUND *1.05*  440  590   30  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*  200  580  350  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*   70  450  160  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *          *
*          *    *                            *    *  *                *          *
*          *    *                            *    *  *                *          *
********************************************************************************
*                                                           *                  *
* FLOW          veh      970    1060    1130     680        *                  *
* CAPACITY      veh     1379    1555    1531    1664        * AVDEL s      8.5 *
* AVE DELAY    mins     0.17    0.14    0.17    0.06        * L  O  S        A *
* MAX DELAY    mins     0.28    0.23    0.29    0.09        * VEH HRS      9.0 *
* AVE QUEUE     veh        3       2       3       1        * COST  $    135.6 *
* MAX QUEUE     veh        4       4       5       1        *                  *
*                                                           *                  *
********************************************************************************
```

5% trucks

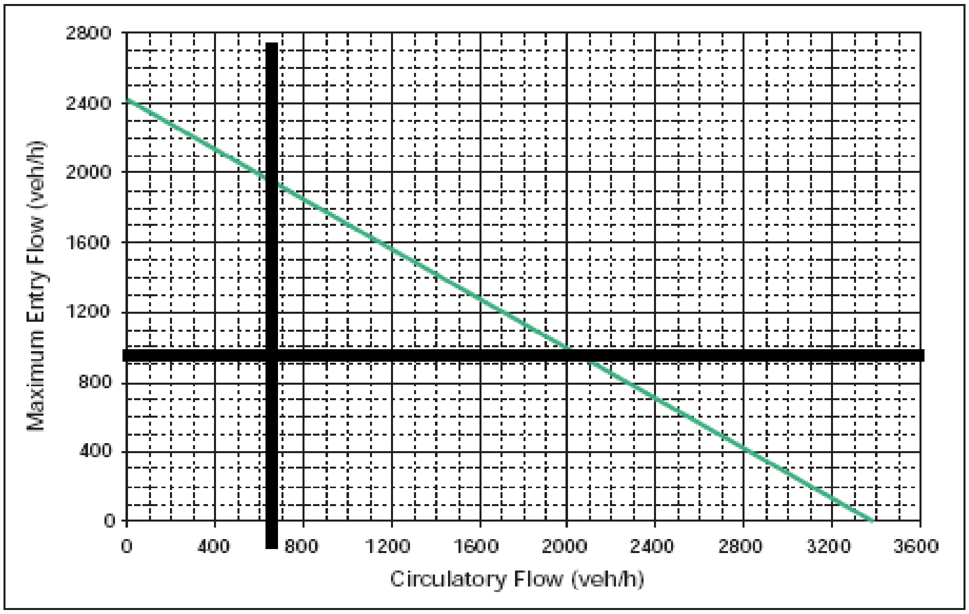
FEGENBUSH/BEULAH CHURCH TRAFFIC ANALYSIS:



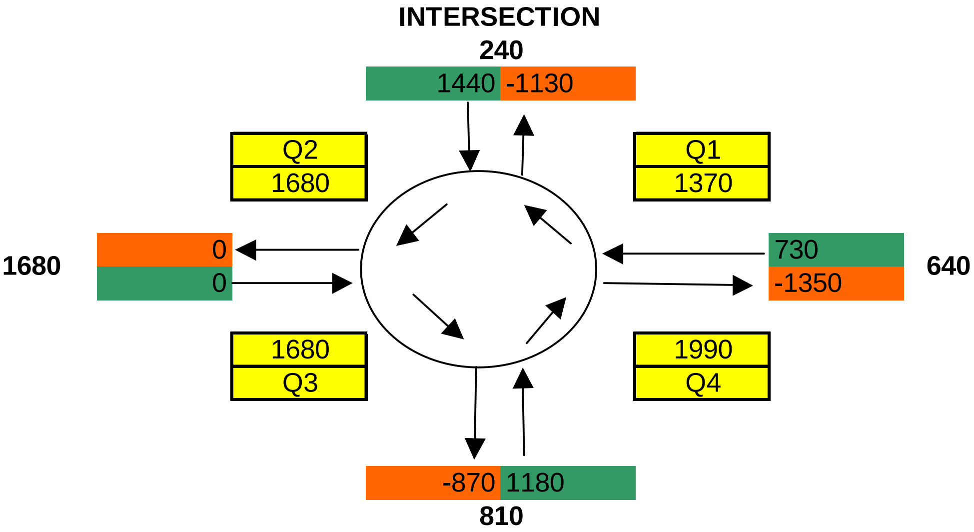
SOURCE:
KTC - Division of
Multimodal Programs
November 2, 2005

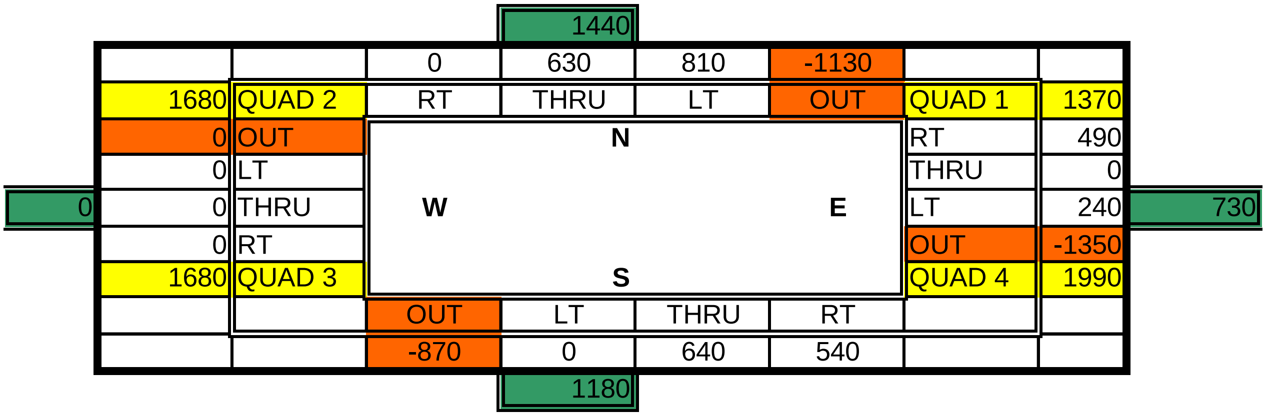


				960					
			0	560	400	-1160			
	1350	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1550	
	0	OUT		N			RT	520	
	0	LT					THRU	0	
0	0	THRU	W			E	LT	390	910
	0	RT					OUT	-690	
	1350	QUAD 3		S			QUAD 4	1330	
			OUT	LT	THRU	RT			
			-950	0	640	290			
				930					

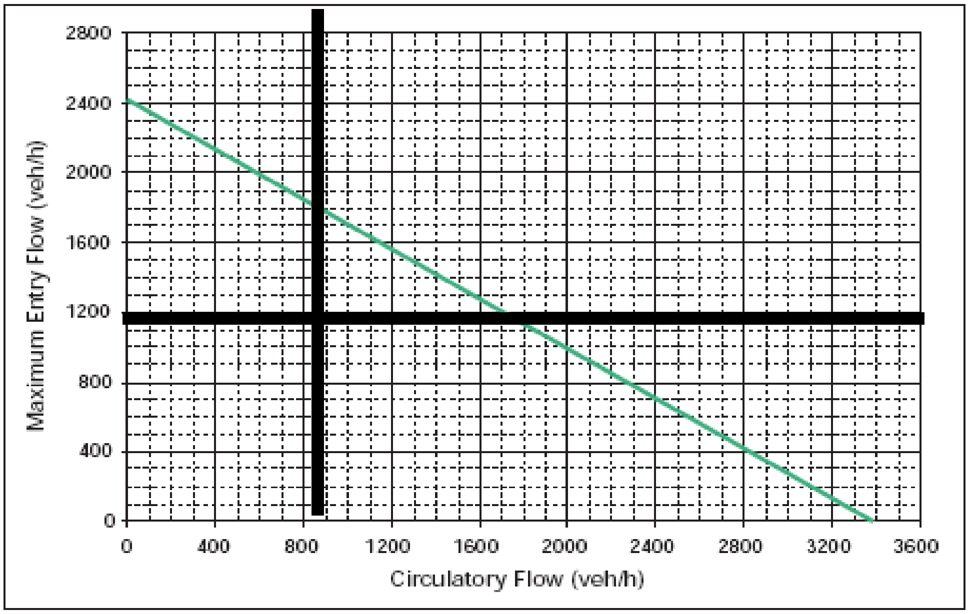


AM PEAK

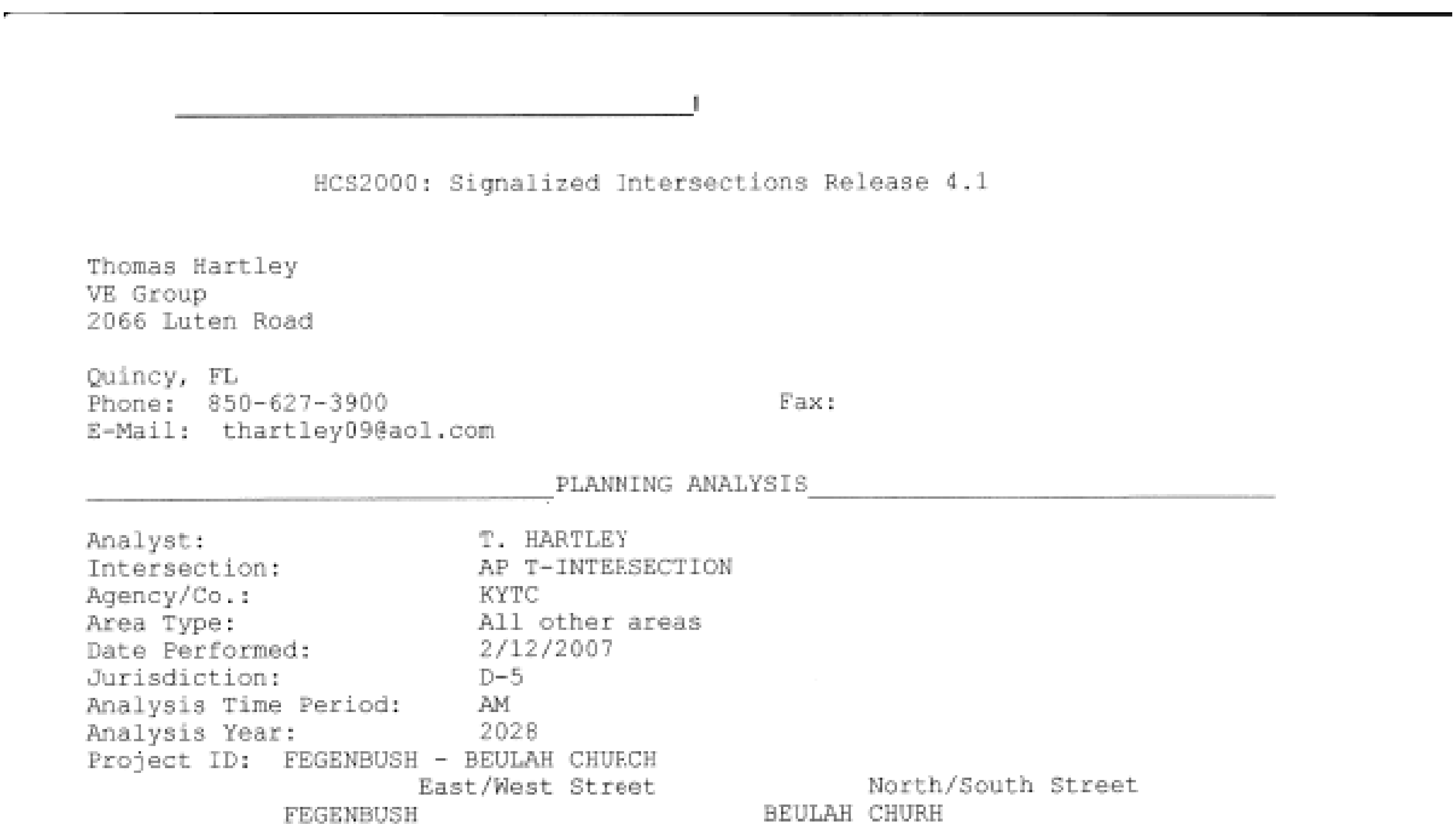




				1440					
			0	630	810	-1130			
	1680	QUAD 2	RT	THRU	LT	OUT	QUAD 1	1370	
	0	OUT		N			RT	490	
	0	LT					THRU	0	
0	0	THRU	W			E	LT	240	730
	0	RT					OUT	-1350	
	1680	QUAD 3		S			QUAD 4	1990	
			OUT	LT	THRU	RT			
			-870	0	640	540			
				1180					



PM PEAK



```
                HCS2000: Signalized Intersections Release 4.1

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______________________________PLANNING ANALYSIS______________________________

Analyst:                   T. HARTLEY
Intersection:              AP T-INTERSECTION
Agency/Co.:                KYTC
Area Type:                 All other areas
Date Performed:            2/12/2007
Jurisdiction:              D-5
Analysis Time Period:      AM
Analysis Year:             2028
Project ID:  FEGENBUSH - BEULAH CHURCH
                      East/West Street               North/South Street
             FEGENBUSH                       BEULAH CHURH
```

```
________________________________VOLUME DATA______________________________

            |  Eastbound      |  Westbound      |  Northbound     |  Southbound     |
            | L     T     R   | L     T     R   | L     T     R   | L     T     R   |
            |_________________|_________________|_________________|_________________|
Num. Lanes  |0     0     0    |1     0     1    |0     2     1    |2     2     0    |
Volume      |                 |390         520  |0     640   290  |400   560   0    |
Parking     |                 |      N          |      N          |      N          |
Coord.      |                 |      N          |      N          |      N          |
LT Treat.   |                 | N               | ?               | ?               |
Peak hour factor:  0.90       Area Type: All other areas
```

```
                         LANE VOLUME WORKSHEET
                                                 EAST   WEST   NORTH  SOUTH
                                                 BOUND  BOUND  BOUND  BOUND

LEFT TURN MOVEMENT

 1. LT volume                                           390    0      400
 2. Opposing mainline volume                            0      560    930
 3. Number of exclusive LT lanes                        1      0      2
 Cross Product [2] * [1]                                0      0      372000

 Left Lane Configuration (E=Excl, S=Shrd):              E      S      E
 Left Turn Treatment Type:                              N      U      P

 4. LT adjustment factor                                0.850         0.920
 5. LT lane vol                                         459    0      217

RIGHT TURN MOVEMENT

 Right Lane Configuration (E=Excl, S=Shrd)              E      E      S
 6. RT volume                                           520    290    0
 7. Exclusive lanes                                     1      1      0
 8. RT adjustment factor                                0.850  0.850  0.850
 9. Exclusive RT lane volume                            612    341
10. Shared lane vol                                                   0

THROUGH MOVEMENT

11. Thru volume                                         0      640    560
12. Parking adjustment factor                           1.00   1.00   1.00
13. No. of thru lanes including shared                  0      2      2
14. Total approach volume                               0      640    560
15. Prop. of left turns in lane group                   0.00   0.00   0.00
16. Left turn equivalence                                      2.44
17. LT adj. factor:                                            1.000
18. Through lane volume                                 0      320    280
19. Critical lane volume                                612    341    280
```

```
Left Turn Check (if [16] > 3.5)
20. Permitted left turn sneaker capacity:                         60
        7200/Cmax
```

```
_____________________________SIGNAL OPERATIONS WORKSHEET___________________________

                                                       EAST    WEST    NORTH   SOUTH
Phase Plan Selection from Lane Volume Worksheet        BOUND   BOUND   BOUND   BOUND

Critical through-RT vol: [19]                                  612     341     280
LT lane vol: [5]                                               459     0       217
Left turn protection: (P/U/N)                                  N       U       P
Dominant left turn: (Indicate by '<')


  Selection Criteria based on the               Plan 1:  U      U       U       U
  specified left turn protection                Plan 2a: U      P       U       P
                                                Plan 2b: P      U       P       U
  < Indicates the dominant left turn            Plan 3a:<P      P      <P       P
  for each opposing pair                        Plan 3b: P     <P       P      <P
                                                Plan 4:  N      N       N       N

Phase plan selected (1 to 4)                                   1               2a

Min. cycle (Cmin) 60            Max. cycle (Cmax) 120

Timing Plan                                  ____EAST-WEST_____   ___NORTH-SOUTH____
                           Value             Ph 1   Ph 2   Ph 3   Ph 1   Ph 2   Ph 3

Movement codes                               EWT                  STL    NST
Critical phase vol [CV]                      612    0      0      217    341    0
Critical sum [CS]          1170
CBD adjustment [CBD]       1.00
Reference sum [RS]         1539
Lost time/phase [PL]                         4      0      0      4      4      0
Lost time/cycle [TL]       12
Cycle length [CYC]         60.0
Phase time                                   29.1   0.0    0.0    12.9   18.0   0.0
Critical v/c Ratio [Xcm]   0.95
Status                     At capacity
_____________________________________________________________________________________
```

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              HCS2000: Signalized Intersections Release 4.1

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_______________________________PLANNING ANALYSIS_______________________________

Analyst:                    T. HARTLEY
Intersection:               T - INTERSECTION
Agency/Co.:                 KYTC
Area Type:                  All other areas
Date Performed:             2/12/2007
Jurisdiction:               D-5
Analysis Time Period:       PM
Analysis Year:              2028
Project ID:  FEGENBUSH - BEULAH CHURCH
                      East/West Street              North/South Street
             FEGENBUSH                        BEULAH CHURH
```

```
________________________________VOLUME DATA________________________________

             |  Eastbound      |  Westbound      |  Northbound     |  Southbound     |
             | L    T    R     | L    T    R     | L    T    R     | L    T    R     |
             |_________________|_________________|_________________|_________________|
Num. Lanes   |0     0    0     |1     0    1     |0     2    1     |2     2    0     |
Volume       |                 |240        490   |0     640  540   |810   630  0     |
Parking      |                 |      N          |      N          |      N          |
Coord.       |                 |      N          |      N          |      N          |
LT Treat.    |                 | ?               | ?               | ?               |
Peak hour factor:   0.90      Area Type: All other areas
```

```
_____________________________LANE VOLUME WORKSHEET___________________________
                                                 EAST   WEST   NORTH  SOUTH
                                                 BOUND  BOUND  BOUND  BOUND
_____________________________________________________________________________
LEFT TURN MOVEMENT

  1. LT volume                                          240    0      810
  2. Opposing mainline volume                           0      630    1180
  3. Number of exclusive LT lanes                       1      0      2
  Cross Product [2] * [1]                               0      0      955800

  Left Lane Configuration (E=Excl, S=Shrd):             E      S      E
  Left Turn Treatment Type:                             N      U      P

  4. LT adjustment factor                               0.850         0.920
  5. LT lane vol                                        282    0      440

RIGHT TURN MOVEMENT

  Right Lane Configuration (E=Excl, S=Shrd)             E      E      S
  6. RT volume                                          490    540    0
  7. Exclusive lanes                                    1      1      0
  8. RT adjustment factor                               0.850  0.850  0.850
  9. Exclusive RT lane volume                           576    635
 10. Shared lane vol                                                  0

THROUGH MOVEMENT

 11. Thru volume                                        0      640    630
 12. Parking adjustment factor                          1.00   1.00   1.00
 13. No. of thru lanes including shared                 0      2      2
 14. Total approach volume                              0      640    630
 15. Prop. of left turns in lane group                  0.00   0.00   0.00
 16. Left turn equivalence                                     2.61
 17. LT adj. factor:                                           1.000
 18. Through lane volume                                0      320    315
 19. Critical lane volume                               576    635    315
```

```
 Turn Check (if [16] > 3.5)
Permitted left turn sneaker capacity:                    60
     7200/Cmax
```

```
______________________________SIGNAL OPERATIONS WORKSHEET____________________________

                                                      EAST    WEST    NORTH   SOUTH
Phase Plan Selection from Lane Volume Worksheet       BOUND   BOUND   BOUND   BOUND

Critical through-RT vol: [19]                                 576     635     315
LT lane vol: [5]                                              282     0       440
Left turn protection: (P/U/N)                                 N       U       P
Dominant left turn: (Indicate by '<')

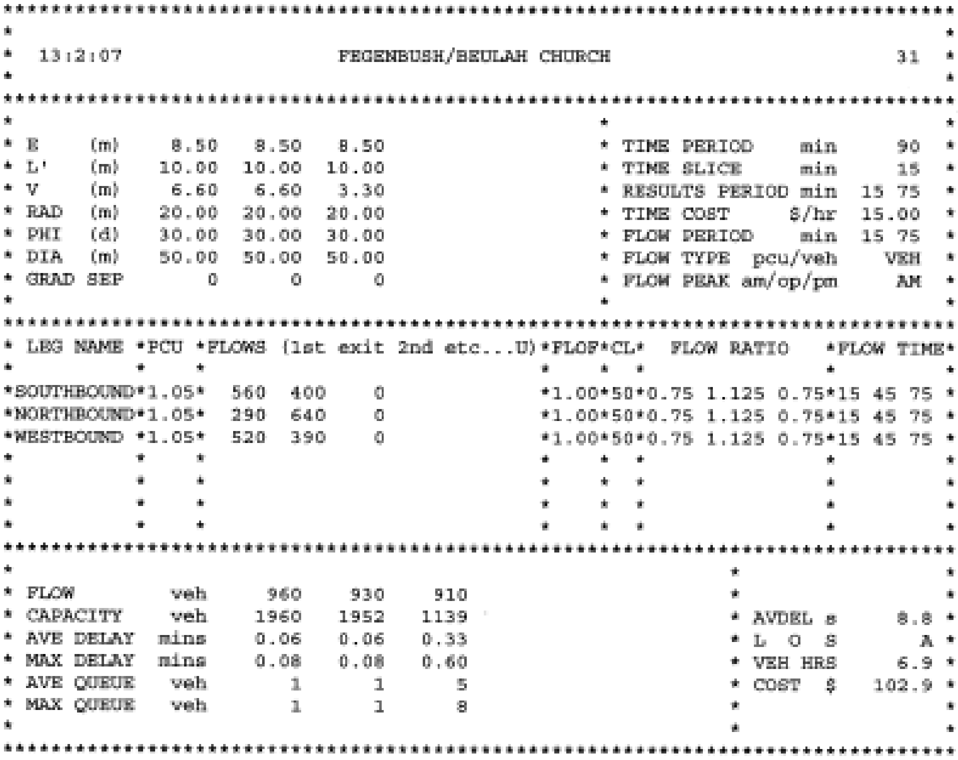

  Selection Criteria based on the           Plan 1:  U      U       U       U
  specified left turn protection            Plan 2a: U      P       U       P
                                            Plan 2b: P      U       P       U
  < Indicates the dominant left turn        Plan 3a:<P      P      <P       P
  for each opposing pair                    Plan 3b: P     <P       P      <P
                                            Plan 4:  N      N       N       N

Phase plan selected (1 to 4)                               1             2a

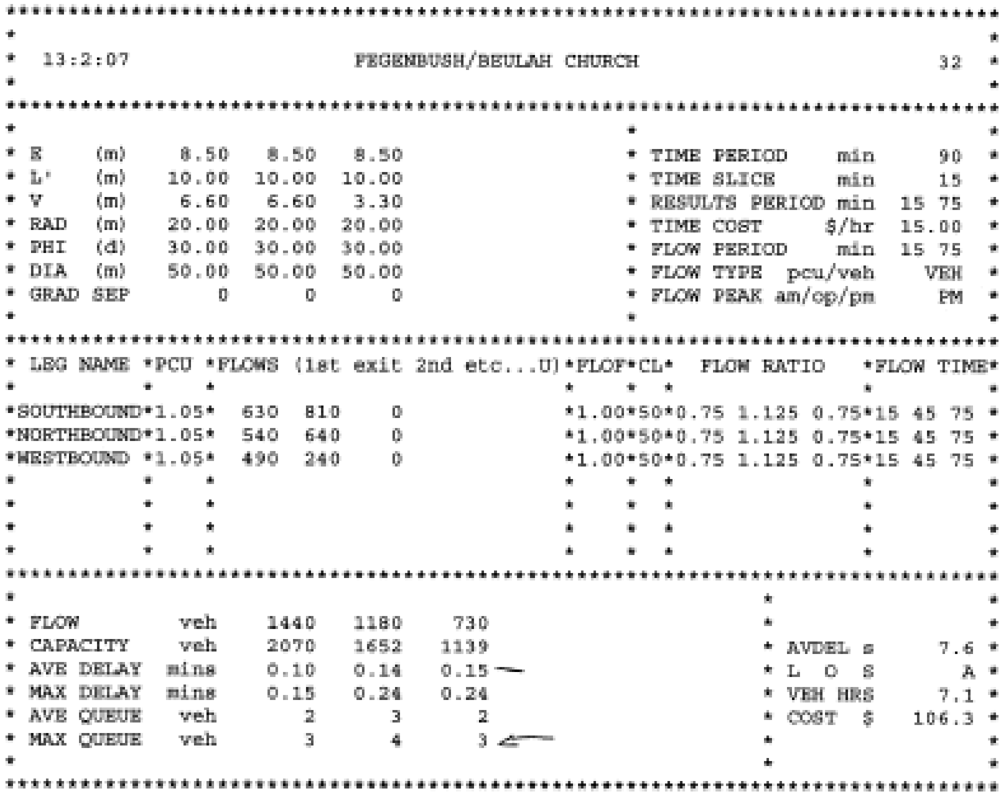
Min. cycle (Cmin) 60              Max. cycle (Cmax) 120

Timing Plan                                ____EAST-WEST_____    ___NORTH-SOUTH____
                              Value        Ph 1    Ph 2    Ph 3    Ph 1    Ph 2    Ph 3

Movement codes                             EWT                     STL     NST
Critical phase vol [CV]                    576     0       0       440     635     0
Critical sum [CS]             1651
CBD adjustment [CBD]          1.00
Reference sum [RS]            1539
Lost time/phase [PL]                       4       0       0       4       4       0
Lost time/cycle [TL]          12
Cycle length [CYC]            120.0
Phase time                                 41.7    0.0     0.0     32.8    45.5    0.0
Critical v/c Ratio [Xcm]      1.19
Status                        Over capacity
______________________________________________________________________________________
```



```
*********************************************************************************
*                                                                               *
*  13:2:07                  FEGENBUSH/BEULAH CHURCH                        31   *
*                                                                               *
*********************************************************************************
*                                                 *                             *
* E    (m)     8.50   8.50   8.50                 * TIME PERIOD     min      90  *
* L'   (m)    10.00  10.00  10.00                 * TIME SLICE      min      15  *
* V    (m)     6.60   6.60   3.30                 * RESULTS PERIOD min   15 75  *
* RAD  (m)    20.00  20.00  20.00                 * TIME COST      $/hr  15.00  *
* PHI  (d)    30.00  30.00  30.00                 * FLOW PERIOD     min  15 75  *
* DIA  (m)    50.00  50.00  50.00                 * FLOW TYPE   pcu/veh    VEH  *
* GRAD SEP        0      0      0                 * FLOW PEAK am/op/pm      AM  *
*                                                 *                             *
*********************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO    *FLOW TIME*
*          *    *                            *    *  *                *         *
*SOUTHBOUND*1.05*  560  400    0             *1.00*50*0.75 1.125 0.75*15 45 75  *
*NORTHBOUND*1.05*  290  640    0             *1.00*50*0.75 1.125 0.75*15 45 75  *
*WESTBOUND *1.05*  520  390    0             *1.00*50*0.75 1.125 0.75*15 45 75  *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*********************************************************************************
*                                                             *                 *
* FLOW         veh     960    930    910                      *                 *
* CAPACITY     veh    1960   1952   1139                      * AVDEL s     8.8 *
* AVE DELAY   mins    0.06   0.06   0.33                      * L  O  S       A *
* MAX DELAY   mins    0.08   0.08   0.60                      * VEH HRS     6.9 *
* AVE QUEUE    veh       1      1      5                      * COST  $   102.9 *
* MAX QUEUE    veh       1      1      8                      *                 *
*                                                             *                 *
*********************************************************************************
```



```
*******************************************************************************
*                                                                             *
*  13:2:07                   FEGENBUSH/BEULAH CHURCH                      32  *
*                                                                             *
*******************************************************************************
*                                                *                            *
* E     (m)     8.50   8.50   8.50               * TIME PERIOD    min      90 *
* L'    (m)    10.00  10.00  10.00               * TIME SLICE     min      15 *
* V     (m)     6.60   6.60   3.30               * RESULTS PERIOD min   15 75 *
* RAD   (m)    20.00  20.00  20.00               * TIME COST     $/hr  15.00 *
* PHI   (d)    30.00  30.00  30.00               * FLOW PERIOD    min   15 75 *
* DIA   (m)    50.00  50.00  50.00               * FLOW TYPE  pcu/veh    VEH *
* GRAD SEP         0      0      0               * FLOW PEAK am/op/pm     PM *
*                                                *                            *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                           *    *  *               *         *
*SOUTHBOUND*1.05*  630  810    0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*NORTHBOUND*1.05*  540  640    0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*WESTBOUND *1.05*  490  240    0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                           *    *  *               *         *
*          *    *                           *    *  *               *         *
*          *    *                           *    *  *               *         *
*          *    *                           *    *  *               *         *
*******************************************************************************
*                                                           *                 *
* FLOW         veh     1440   1180    730                   *                 *
* CAPACITY     veh     2070   1652   1139                   * AVDEL s     7.6 *
* AVE DELAY   mins     0.10   0.14   0.15                   * L  O  S       A *
* MAX DELAY   mins     0.15   0.24   0.24                   * VEH HRS     7.1 *
* AVE QUEUE    veh        2      3      2                   * COST  $   106.3 *
* MAX QUEUE    veh        3      4      3                   *                 *
*                                                           *                 *
*******************************************************************************
```

5% trucks?