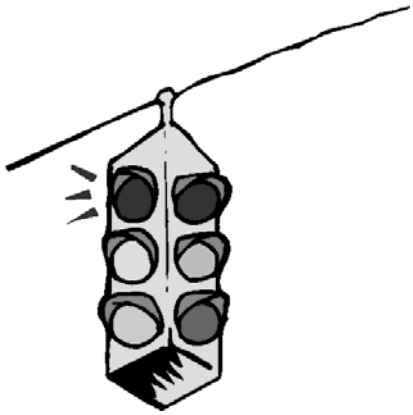
TRAFFIC SIGNAL WARRANT STUDY



E. ST. PATRICK STREET & S. VALLEY DRIVE

February 17, 2010

ENGINEERING SERVICES/PUBLIC WORKS DEPARTMENT

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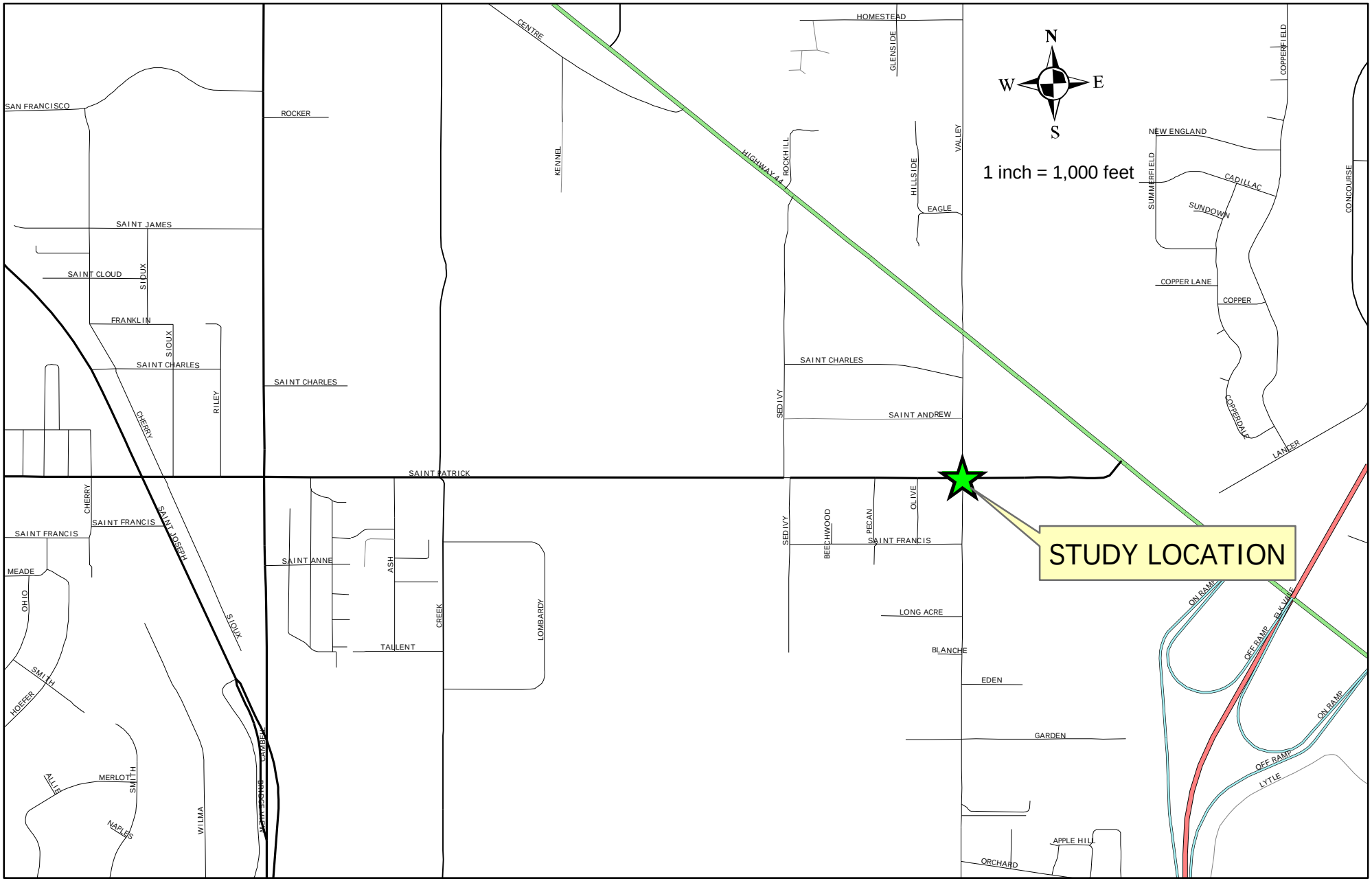
INTERSECTION LOCATION MAP

PW022310-13



Item #13

=:

INTERSECTION APPROACH PHOTOGRAPHS (2007, no significant change)

north leg of S. Valley Drive – looking east

north leg of S. Valley Drive – looking west

south leg of S. Valley Drive – looking east

south leg of S. Valley Drive – looking west

INTRODUCTION

The objective of this engineering report is to assess the continued need for a traffic signal at the intersection of E. St. Patrick Street and S. Valley Drive. A similar assessment was conducted in 2007 following the significant reduction in traffic volumes on E. St. Patrick Street following the opening of South Dakota Highway 16B (Elk Vale Road). That assessment found that the signal was no longer warranted, however, the Pennington County Commission objected to the proposed action and no further action was taken. The signal is presently inoperative due to damage resulting from a motor vehicle crash in December 2009. This report presents an overview of the existing conditions of the intersection, a summary of the crash history, traffic volume data, and an evaluation of each of the eight traffic signal warrants presented in the Manual on Uniform Traffic Control Devices for Streets and Highways (2009 Edition). The report closes with conclusions and recommendations.

EXISTING INTERSECTION CONDITIONS

Topography

Neither the horizontal nor the vertical alignment of E. St. Patrick Street or S. Valley Drive has any significant affect on the operation of the intersection.

Land Use

The land use adjacent to the intersection is a mix of vacant land, commercial development and residential development.

Geometric Configuration

E. St. Patrick Street and S. Valley Drive form a cross intersection. E. St. Patrick Street has two lanes of travel in both directions with a dedicated center left turn at Valley Drive. The road pavement is in good condition. Both approaches of S. Valley Drive are single lane approaches. The S. Valley Drive pavement is asphalt with shoulders and is in poor condition.

Traffic Control Devices

The existing signal operates on a single timing plan and runs in flash operation between 12 AM and 6 AM. No side street vehicle detection devices are utilized at the signal due to the poor condition of the S. Valley Dr. pavement.

Operating Speeds

The speed limit for E. St. Patrick Street is 45 mph; the speed limit for Valley Drive is 25 mph. As part of this report a speed study was completed for E. St. Patrick St.; data was collected manually using a hand-held radar gun and the results of the study follow:

- Total sample size of 908 vehicles.
- Average observed speed was 42.1 MPH.
- The 85th percentile observed speed was 46.2 MPH.
- The 10 MPH pace group was 38 – 47 MPH (81.3% of sample group).

Based on the results, 45 MPH is the appropriate speed limit for E. St. Patrick St.

Intersection Sight Distance

There is adequate intersection sight distance from the north approach of S. Valley Drive for left-turn, crossing, and right-turn maneuvers. There is existing brush and vegetation on the southwest corner that restricts sight distance from the south approach.

Adjacent Traffic Control Signals

The intersection of E. St. Patrick and South Dakota Highway 44 is signalized and is approximately 0.25-miles east of the study intersection. The intersection of E. St. Patrick Street and Creek Drive is signalized and is approximately 0.75-miles west of the study intersection. The location of the existing signal has not created any progression or coordination issues since it has been in operation.

CRASH HISTORY (2005 – 2009)

DATE	CRASH TYPE	COMMENTS
01/11/2005	FIXED OBJECT	ICY ROAD
02/2/2005	SIDE SWIPE	IMPROPER LANE CHANGE
02/12/2005	ANGLE	EB RED LIGHT VIOLATION
03/21/2005	ANGLE	EB RED LIGHT VIOLATION
07/15/2005	ANGLE	EB RED LIGHT VIOLATION
07/29/2005	ANGLE	EB RED LIGHT VIOLATION
08/17/2005	SIDE SWIPE	IMPROPER LANE CHANGE
09/21/2005	REAR END	EB/EB
09/30/2005	ANGLE	EB RED LIGHT VIOLATION
12/6/2005	ANGLE	EB RED LIGHT VIOLATION
02/7/2006	ANIMAL	DEER HIT
02/24/2006	ANGLE	NB RED LIGHT VIOLATION
04/18/2006	LEFT TURN	EB FAILURE TO YIELD
06/17/2006	ANGLE	SB FAILURE TO YIELD
07/31/2006	ANGLE	EB RED LIGHT VIOLATION
10/9/2006	ANGLE	EB RED LIGHT VIOLATION
11/7/2006	ANGLE	EB RED LIGHT VIOLATION
11/24/2006	ANGLE	NB RIGHT TURN FAILURE TO YIELD
02/16/2007	SIDE SWIPE	IMPROPER TURN
07/31/2007	ANGLE	EB RED LIGHT VIOLATION
10/07/2007	ANGLE	EB-NB NO WITNESSES
11/21/2007	SIDE SWIPE	IMPROPER TURN
04/15/2008	ANGLE	NB FLEEING LAW ENFORCEMENT
06/01/2008	ANGLE	EB RED LIGHT VIOLATION
07/04/2008	ANGLE	NB DUI
07/17/2008	SIDE SWIPE	IMPROPER LANE CHANGE
11/10/2008	DEER HIT	
12/17/2008	LEFT TURN	WB LEFT TURN FAILURE TO YIELD
12/08/2009	ANGLE	EB RED LIGHT VIOLATION

The frequency of eastbound red light violations was reviewed in more detail. None of the crash report narratives cited glare as a contributing factor nor was visibility of the signal a contributing factor (the existing signal has twelve-inch indications). Furthermore, the proximity of the Creek Drive signal makes it unlikely that eastbound drivers are “surprised” by the existing signal. One possible explanation is that since the signal is operated as pre-timed (S. Valley Dr. gets a green light with or without vehicles

being present), motorist frustration with having to stop may lead to general disregard for the signal. Absent further narrative detail, no definite conclusions can be reached regarding the frequency of this crash type.

TRAFFIC SIGNAL WARRANTS

The Manual on Uniform Traffic Control Devices for Streets and Highways 2009 Edition (MUTCD) specifies nine warrants to be considered when evaluating an intersection for signalization. The MUTCD further specifies that a traffic signal should not be installed unless at least one of the signal warrants is met and an engineering study indicates that the installation of a traffic signal would improve the overall safety and operation of the intersection. The MUTCD also states that a signal should not be installed if it seriously disrupts the progressive traffic flow. An evaluation of each traffic signal warrants follows.

Warrant 1, Eight-Hour Vehicular Volume

Warrant 1 includes three parts, Condition A, Condition B and a combination of the two. It is intended that Warrant 1 be treated as a single warrant. If either Condition A, Condition B or the combination of A and B is satisfied, then Warrant 1 is satisfied.

The Minimum Vehicular Volume, Condition A, is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal. Condition A is satisfied if for at least eight hours of the day there is a combined traffic volume of at least 420 vehicles per hour (vph) for both approaches of E. St. Patrick Street and at least 105 vph on one approach of S. Valley Drive. As shown in Table 1, the existing traffic volumes do not satisfy Condition A.

The Interruption of Continuous Traffic, Condition B, is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. Condition B is satisfied if for at least eight hours of the day there is a combined traffic volume of at least 630 vph for both

WARRANT 1
CONDITION A

TABLE 1

NUMBER OF LANES FOR MOVING TRAFFIC		MAJOR ROAD SPEED LIMIT
MAJOR	MINOR	
2	1	45

	S. VALLEY DR. MINOR ROAD VOLUMES				ST. PATRICK ST. MAJOR ROAD VOLUMES				
HOUR BEGINNING	NB	SB	MAXIMUM	REQUIRED FOR WARRANT	EB	WB	TOTAL	REQUIRED FOR WARRANT	WARRANT MET?
0000	9	8	9	105	37	28	65	420	NO
0100	2	5	5	105	17	11	28	420	NO
0200	3	3	3	105	14	8	22	420	NO
0300	2	4	4	105	10	21	31	420	NO
0400	5	6	6	105	23	24	47	420	NO
0500	30	7	30	105	63	126	189	420	NO
0600	77	14	77	105	125	202	327	420	NO
0700	130	25	130	105	224	494	718	420	**YES**
0800	62	29	62	105	198	312	510	420	NO
0900	54	36	54	105	183	233	416	420	NO
1000	61	31	61	105	210	228	438	420	NO
1100	68	42	68	105	309	279	588	420	NO
1200	69	55	69	105	319	292	611	420	NO
1300	66	52	66	105	329	268	597	420	NO
1400	71	59	71	105	372	317	688	420	NO
1500	76	52	76	105	466	367	833	420	NO
1600	66	58	66	105	479	337	816	420	NO
1700	74	62	74	105	533	319	851	420	NO
1800	57	48	57	105	371	233	603	420	NO
1900	36	37	37	105	244	136	380	420	NO
2000	35	34	35	105	238	111	349	420	NO
2100	21	23	23	105	167	80	246	420	NO
2200	15	17	17	105	129	57	186	420	NO
2300	12	12	12	105	64	36	100	420	NO
TOTAL	**1095**	**711**			**5118**	**4515**			

# OF HOURS MET	1
WARRANT MET?	**NO**

approaches of E. St. Patrick Street and at least 53 vph on one approach of S. Valley Drive. As shown in Table 2, the existing traffic volumes do not satisfy Condition B.

The combination of Conditions A and B is intended for application at locations where neither Condition A nor Condition B is satisfied. The combination is satisfied if for at least eight hours of the day, both of the following be met:

> A combined traffic volume of at least 336 vph for both approaches of E. St. Patrick Street and at least 84 vph on one approach of S. Valley Drive.
>
> A combined volume of at least 504 vph for both approaches of E. St. Patrick Street and at least 42 vph on one approach of S. Valley Drive.

As shown in Table 3, the existing traffic volumes do not satisfy the combination of Condition A and Condition B.

Warrant 1 is not satisfied.

Warrant 2, Four-Hour Vehicular Volume

The Four-Hour Vehicular Volume signal warrant is applied where the volume of intersecting traffic is the principal reason to consider installing a traffic signal. This warrant is satisfied when, for any four hours of the day, the plotted points representing the total vehicles per hour on both the approaches of major road and the corresponding vehicles per hour on the higher-volume approach of minor road (one direction only) fall above the appropriate curve of Figure 4C-2 of the 2009 MUTCD. Only three of the hourly volumes are above the appropriate curve, therefore, Warrant 2 is not satisfied.

WARRANT 1
CONDITION B

TABLE 2

NUMBER OF LANES FOR MOVING TRAFFIC		MAJOR ROAD SPEED LIMIT
MAJOR	MINOR	
2	1	45

	S. VALLEY DR. MINOR ROAD VOLUMES				ST. PATRICK ST. MAJOR ROAD VOLUMES				
HOUR BEGINNING	NB	SB	MAXIMUM	REQUIRED FOR WARRANT	EB	WB	TOTAL	REQUIRED FOR WARRANT	WARRANT MET?
0000	9	8	9	53	37	28	65	630	NO
0100	2	5	5	53	17	11	28	630	NO
0200	3	3	3	53	14	8	22	630	NO
0300	2	4	4	53	10	21	31	630	NO
0400	5	6	6	53	23	24	47	630	NO
0500	30	7	30	53	63	126	189	630	NO
0600	77	14	77	53	125	202	327	630	NO
0700	130	25	130	53	224	494	718	630	**YES**
0800	62	29	62	53	198	312	510	630	NO
0900	54	36	54	53	183	233	416	630	NO
1000	61	31	61	53	210	228	438	630	NO
1100	68	42	68	53	309	279	588	630	NO
1200	69	55	69	53	319	292	611	630	NO
1300	66	52	66	53	329	268	597	630	NO
1400	71	59	71	53	372	317	688	630	**YES**
1500	76	52	76	53	466	367	833	630	**YES**
1600	66	58	66	53	479	337	816	630	**YES**
1700	74	62	74	53	533	319	851	630	**YES**
1800	57	48	57	53	371	233	603	630	NO
1900	36	37	37	53	244	136	380	630	NO
2000	35	34	35	53	238	111	349	630	NO
2100	21	23	23	53	167	80	246	630	NO
2200	15	17	17	53	129	57	186	630	NO
2300	12	12	12	53	64	36	100	630	NO
TOTAL	**1095**	**711**			**5118**	**4515**			

# OF HOURS WARRANT	5
WARRANT 1B MET?	**NO**

WARRANT 1 COMBINATION

TABLE 3

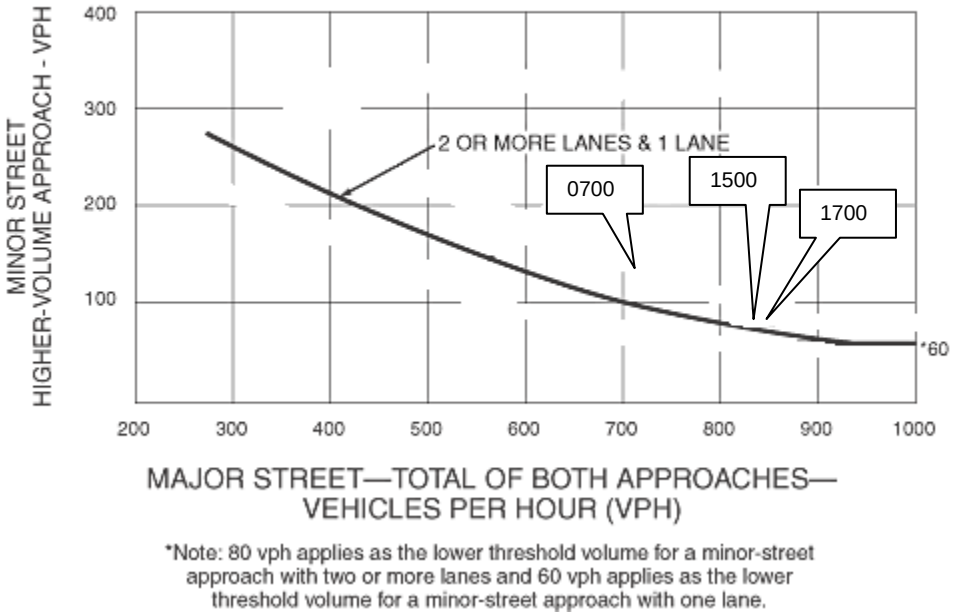
NUMBER OF LANES FOR MOVING TRAFFIC		MAJOR ROAD SPEED LIMIT
MAJOR	MINOR	
2	1	45

	S. VALLEY DR. MINOR ROAD VOLUMES					ST. PATRICK ST. MAJOR ROAD VOLUMES						
HOUR BEGINNING	NB	SB	MAXIMUM	80% VALUE WARRANT A	80% VALUE WARRANT B	EB	WB	TOTAL	80% VALUE WARRANT A	80% VALUE WARRANT B	80% WARRANT A MET?	80% WARRANT B MET?
0000	9	8	9	84	42	37	28	65	336	504	NO	NO
0100	2	5	5	84	42	17	11	28	336	504	NO	NO
0200	3	3	3	84	42	14	8	22	336	504	NO	NO
0300	2	4	4	84	42	10	21	31	336	504	NO	NO
0400	5	6	6	84	42	23	24	47	336	504	NO	NO
0500	30	7	30	84	42	63	126	189	336	504	NO	NO
0600	77	14	77	84	42	125	202	327	336	504	NO	NO
0700	130	25	130	84	42	224	494	718	336	504	**YES**	**YES**
0800	62	29	62	84	42	198	312	510	336	504	NO	**YES**
0900	54	36	54	84	42	183	233	416	336	504	NO	NO
1000	61	31	61	84	42	210	228	438	336	504	NO	NO
1100	68	42	68	84	42	309	279	588	336	504	NO	**YES**
1200	69	55	69	84	42	319	292	611	336	504	NO	**YES**
1300	66	52	66	84	42	329	268	597	336	504	NO	**YES**
1400	71	59	71	84	42	372	317	688	336	504	NO	**YES**
1500	76	52	76	84	42	466	367	833	336	504	NO	**YES**
1600	66	58	66	84	42	479	337	816	336	504	NO	**YES**
1700	74	62	74	84	42	533	319	851	336	504	NO	**YES**
1800	57	48	57	84	42	371	233	603	336	504	NO	**YES**
1900	36	37	37	84	42	244	136	380	336	504	NO	NO
2000	35	34	35	84	42	238	111	349	336	504	NO	NO
2100	21	23	23	84	42	167	80	246	336	504	NO	NO
2200	15	17	17	84	42	129	57	186	336	504	NO	NO
2300	12	12	12	84	42	64	36	100	336	504	NO	NO
TOTAL	**1095**	**711**				**5118**	**4515**					

# HOURS 80% WARRANT A MET	1
# HOURS 80% WARRANT B MET	10
WARRANT 1C MET?	**NO**

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: [Figure 4C-2, MUTCD, Federal Highway Administration, 2009]

Warrant 3, Peak Hour

The Peak Hour signal warrant is applied at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. The MUTCD specifies that this warrant "shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time." The subject intersection does not meet the criteria described, therefore, Warrant 3 is not applicable and hence, not satisfied.

Warrant 4, Pedestrian Volume

The purpose of this warrant is to allow pedestrians to cross a major street at an intersection where sufficient gaps in traffic are not presently available for pedestrians to cross. No sidewalks or crosswalks exist at the study intersection, therefore, pedestrians crossing are not a significant factor and Warrant 4 is not satisfied.

Warrant 5, School Crossing

The School Crossing signal warrant is intended for application where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. The study intersection is not an established school crossing, therefore, Warrant 5 is not satisfied.

Warrant 6, Coordinated Signal System

Traffic signals may be warranted if the combination of proposed and existing signals will collectively provide a progressive operation where no progressive movement presently exists. This intersection is not being considered for signalization based on progression needs, therefore, Warrant 6 is not satisfied.

Warrant 7, Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal. Inasmuch as this study is considering the removal of an existing signal, this warrant is not applicable.

Warrant 8, Roadway Network

Installing a traffic signal may be justified to encourage concentration and organization of traffic flow on a roadway network. This warrant is only applicable to intersections of major routes on a road system. S. Valley Drive Road does not meet the definition of a major route, therefore, Warrant 8 is not satisfied.

Warrant 9, Intersection Near a Grade Crossing

The Intersection Near a Grade Crossing signal warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic

control signal. No grade crossing exists near the intersection, therefore, Warrant 9 is not satisfied.

CONCLUSIONS

1) None of the warrants presented in the Manual of Uniform Traffic Control Devices were satisfied for the existing traffic conditions. The MUTCD specifies that a traffic signal should not be installed unless one or more of the signal warrants are met and an engineering study indicates that the installation of a traffic signal would improve the overall safety and operation of the intersection.
2) The existing 45 MPH speed limit on E. St. Patrick St. is appropriate for existing conditions.
3) The timing plan for the existing signal is a pre-timed plan with the cycle length split 50/50 between both roads; the signal is in flash operation from midnight to 0600. Taking into account when the signal is in flash operation, there are approximately 5,560 vehicles per day that are required to stop at the signal. If the signal were removed and S. Valley Dr. was required to stop 100% of the time, then approximately 1,720 vehicles per day would be required to stop.

RECOMMENDATIONS

The existing traffic signal should be removed in accordance with the following procedure:

1) Brush and vegetation should be removed along E. St. Patrick Street on the southwest corner. The property owner has been contacted and has no objection to the removal.
2) In April 2010, crash data should be reviewed to determine what the effect on crash frequency is. If no adverse effect is seen then permanent STOP and STOP AHEAD signs should be installed on both approaches of S. Valley Drive. Rapid City staff should install the necessary signing and should coordinate that work with Pennington County Highway staff.
3) The remaining traffic signal poles should be removed by Rapid City staff and/or a City-hired contractor.

4) WREA should be consulted regarding the possible relocation of the existing utility pole on the southwest corner.

REFERENCES:

A Policy on Geometric Design of Highways and Streets, 5th edition. American Association of State Highway Officials (AASHTO), Washington, D.C., 2004.

Manual on Uniform Traffic Control Devices. U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., 2009.