TRAFFIC IMPACT STUDY

FOR THE

PROPOSED BLACK HILLS CENTER

RAPID CITY, SOUTH DAKOTA

Prepared For:

THF Realty

In Cooperation With:

City of Rapid City & South Dakota DOT

May **2010**

Prepared By:

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

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FOR THE

PROPOSED BLACK HILLS CENTER

RAPID CITY, SOUTH DAKOTA

REVISED MAY 24, 2010

Prepared For:

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Table of Contents

Table of Contents ..... **ii**

List of Exhibits ..... **iii**

List of Figures ..... **iii**

List of Tables ..... **iv**

Executive Summary **1**

2010 No Build Conditions *1*

2010 Build Conditions *2*

2030 Build Conditions *3*

Introduction **4**

Existing Roadway & 2010 No Build Traffic Conditions **7**

Existing and Proposed Roadway Network *7*

Existing Land Uses *9*

Existing Traffic Volumes *11*

2010 No Build Operating Conditions *14*

Site-Generated Traffic **19**

Trip Generation Estimate *19*

Trip Distribution Estimate *22*

2010 Build Conditions **24**

Proposed Development Access *24*

2010 Build Traffic Volumes *25*

Traffic Signal Warrant Analysis *25*

Catron Boulevard and Black Hills Boulevard 27

5th Street and Stumer Road 27

Auxiliary Lane Requirements *28*

5th Street and Stumer Road 28

5th Street and Parkview Drive 28

5th Street and Enchanted Pines Drive 29

Catron Boulevard and Black Hills Boulevard 29

Stumer Road and Proposed Access Drives 29

Black Hills Boulevard and Proposed Access for Outlot 10 29

2010 Build Operating Conditions *29*
Future Access Drives on Stumer Road 35
Probability of Cut-Thru Traffic in the Adjacent Neighborhood *35*
Potential Traffic Calming Measures for the Adjacent Neighborhood *39*
2030 Build Conditions **44**
2030 No Build and Build Traffic Volumes *44*
2030 Build Operating Conditions *45*
Conclusions **50**
2010 No Build Conditions *50*
2010 Build Conditions *50*
2030 Build Conditions *51*

List of Exhibits

Exhibit 1: Proposed Site Plan 6
Exhibit 2: 2010 No Build Lane Assignment and Traffic Control 10
Exhibit 3: 2010 No Build Traffic Volumes 13
Exhibit 4: Black Hills Center Trip Generation 23
Exhibit 5: 2010 Build Traffic Volumes 26
Exhibit 6: 2030 No Build Traffic Volumes 46
Exhibit 7: 2030 Build Traffic Volumes 47

List of Figures

Figure 1: Site Location Map 4
Figure 2: Black Hills Boulevard – Catron Boulevard to Stumer Road 8
Figure 3: 5th Street and Stumer Road Intersection 8
Figure 4: Land Use Zoning Map 9
Figure 5: Dan Christy Lane Existing Traffic Volumes 14
Figure 6: Proposed Access along Stumer Road 24
Figure 7: MUTCD Warrant 1, Eight Hour Vehicular Volume 25
Figure 8: SDDOT Right-Turn Lane Warrants 28
Figure 9: Primary and Cut-Thru Travel Routes 36
Figure 10: South Robbinsdale Future Land Use Area – Non-Residential Areas 45

List of Tables

Table 1: Level of Service Thresholds 15
Table 2: 2010 No Build Operating Conditions 16
Table 3: 2010 No Build Operating Conditions (Neighborhood Intersections) 17
Table 4: 2010 No Build Operating Conditions (Perimeter Intersections) 18
Table 5: Discount Supercenter Trip Generation Rate Comparison 20
Table 6: Black Hills Center Trip Generation Estimate 21
Table 7: 2010 Build Operating Conditions 30
Table 8: Stumer Road and Black Hills Boulevard Roundabout Analysis 32
Table 9: 2010 Build Operating Conditions (Neighborhood Intersections) 32
Table 10: 2010 Build Operating Conditions (Major Access Driveways) 33
Table 11: 2010 Build Operating Conditions (Perimeter Intersections) 34
Table 12: Summary of the Primary and Cut-Thru Routes to/from the North 37
Table 13: Summary of the Primary and Cut-Thru Routes to/from the Southwest 38
Table 14: 2030 Build Operating Conditions 48

List of Supplemental Correspondence

Supplemental Correspondence Item 1:
April 8, 2010 City Comments on March 2010 Black Hills Center Traffic Impact Study and CBB's Response

Supplemental Correspondence Item 2:
May 14, 2010 City Comments on April 2010 Revised Black Hills Center Traffic Impact Study and CBB's Response

Supplemental Correspondence Item 3:
May 17, 2010 Letter Addressing the Driveway Widths for the Initial Planned Development

Supplemental Correspondence Item 4:
May 24, 2010 Letter Addressing the Pharmacy Drive-thru Operations for the Initial Planned Development

Supplemental Correspondence Item 5:
May 24, 2010 Letter Addressing the Recommended Roadway Improvement Plan for the Initial Planned Development (Phases I and II)

Executive Summary

THF Realty is proposing a commercial development, known as Black Hills Center, in the northwest quadrant of Catron Boulevard and 5th Street in Rapid City, South Dakota. Based on the latest plan, the proposed 58 acre site would consist of a 154,750 square feet Walmart supercenter, approximately 46,900 square feet of retail space and 14 outlots. Access to the Walmart Supercenter would be provided via three full-access driveways on Stumer Road which runs parallel to Catron Boulevard and intersects 5th Street just north of Catron Boulevard. Access is also provided off Catron Boulevard via Black Hills Boulevard which ties into Stumer Road.

A traffic impact study for essentially the same development area was previously prepared in July 2005 by Felsburg Holt & Ullevig (FHU). However, the FHU study considered a development area of approximately 87 acres. Since the 2005 FHU study, minimal development has occurred on the site. Stumer Road has been constructed and is a hybrid between the two options considered in the study. Based on the current proposed development plan, Parkview Drive would not connect to the main development area or extend to Stumer Road as previously assumed in the FHU study.

At the request of the City of Rapid City and the South Dakota Department of Transportation (SDDOT), a new Traffic Impact Study was completed for the current development plan under consideration, as well as the approximate 30 acres adjacent to the site in order to account for the entire 87 acres available for development. This report was prepared in accordance with parameters discussed with both the City and the SDDOT.

2010 No Build Conditions

In order to identify the traffic impacts associated with the proposed development, it was first necessary to quantify the 2010 No Build (base) roadway, traffic, and operating conditions. To that end, an operational analysis of the 2010 No Build traffic volumes on the surrounding road system was performed.

In order to establish the baseline traffic conditions, manual peak period traffic counts were conducted in February 2010 at the critical intersections within the study area during the weekday p.m. and Saturday midday peak periods. In general, traffic volumes were fairly light throughout the study corridor with plenty of excess capacity at the study intersections. Also considered in the 2010 Build conditions was the planned widening of Catron Boulevard from Highway 16 to just west of Highway 79 to a four-lane roadway with a raised median.

Based on the evaluation of the 2010 No Build conditions, all of the study intersections had overall favorable operating conditions during the weekday p.m. and Saturday midday peak hours with each intersection approach operating at LOS C or better with the majority operating at LOS A or B during the peak hours.

It is apparent that the recent extension of 5th Street and the planned widening of Catron Boulevard will provide significant excess capacity on the roadway network. In fact, the need for

these programmed roadway projects was based, in part, on additional commercial development along the corridors.

2010 Build Conditions

Forecasts were prepared for the proposed Black Hills Center development area by calculating the trip generation and directional distribution for the proposed uses. Based on the current plan, the proposed development would be expected to generate a total of 2,630 *new* trips during the weekday p.m. peak hour and 2,870 *new* trips during the Saturday midday peak hour.

It is important to note, that the trip generation rate utilized for the Walmart Supercenter was approximately 40% higher than the rate typically used throughout the country. However, based on the existing trip generation for the Rapid City Walmart, staff felt the inflated rate was appropriate at this location.

In order to accommodate the proposed development traffic, the following roadway and traffic control improvements are recommended:

- Signalize the intersection of Catron Boulevard and Black Hills Boulevard.
- Signalize the intersection of 5th Street and Stumer Road.
- Coordinate the two proposed traffic signals with the existing traffic signal at Catron Boulevard and 5th Street with a hard wire interconnect.
- Construct dual eastbound left-turn lanes on Stumer Road at 5th Street. It may be appropriate to only utilize one of the left-turn lanes until the traffic volumes warrant the dual left-turn or safety becomes an issue with the driveway serving the future bank and gas station.
- Construct a separate southbound right-turn lane on 5th Street at Stumer Road.
- Construct a separate westbound right-turn lane on Catron Boulevard at Black Hills Boulevard.
- Coordinate with the SDDOT to extend the eastbound left-turn storage at the intersection of Catron Boulevard and Black Hills Boulevard from 400 feet to 460 feet.
- Construct dual southbound left-turn lanes on 5th Street at Catron Boulevard.
- Convert the existing all-way STOP at Stumer Road and Black Hills Boulevard to a side-street STOP condition with Black Hills Boulevard operated under stop control and Stumer Road maintaining the right-of-way. Alternatively, a single-lane roundabout would also provide favorable operations.
- Construct a separate westbound right-turn lane on Stumer Road at the main Walmart drive.
- Construct a separate westbound right-turn lane at the east driveway on Stumer Road servicing the retail shops.
- Consider providing a separate northbound right-turn lane on Black Hills Boulevard at Outlot 10.

- Maintain free operation for the three perimeter traffic signals at Highway 16 and Catron Boulevard, Highway 79 and Catron Boulevard, and 5th Street and Minnesota Street.

The 2010 Build traffic volumes were reanalyzed in an effort to identify the impacts of the proposed development and to evaluate the adequacy of the proposed roadway and traffic control improvements to mitigate those impacts. The evaluation reflected the implementation of the proposed improvements noted above.

Even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 5th Street and the widening project on Catron Boulevard. Both of these roadways were designed taking into account the potential future commercial within the 5th Street and Catron Boulevard corridors.

The access along Stumer Road, as proposed in the current plan, exceeds the desired spacing of 200 feet identified in the City's Street Design Criteria Manual. Ideally, the access for adjoining outlots could share one access drive onto Stumer Road. However, as specific users are identified, there may be a need to modify the access along Stumer Road from that shown in the current site plan. In general, any modifications to the access should, at a minimum, provide 105 feet of separation, and ideally provide the desired 200 feet.

2030 Build Conditions

"Design Year" 2030 traffic conditions were evaluated in an effort to determine the ability of the area road system to accommodate long-term traffic demands. The 2030 Build analyses include the future non-residential development of the property south of Catron Boulevard from approximately 1200 feet west of Black Hills Boulevard to approximately 1200 feet east of 5th Street. By year 2030, it is anticipated that both Black Hills Boulevard and 5th Street would extend south of Catron Boulevard. The addition of a fourth leg to the intersections of Catron Boulevard with 5th Street and with Black Hills Boulevard introduces additional signal phases not required in the 2010 Build conditions. As a result of the fourth leg and the substantial increase in traffic due to the 150 acre tract, the two intersections would decline to LOS D overall.

Consequently, the following roadway improvement may be necessary to accommodate the 2030 traffic conditions:

- Consider providing eastbound dual-left turn lanes on Catron Boulevard at Black Hills Boulevard. In order to accommodate the eastbound dual left-turns, Black Hills Boulevard would require two northbound through lanes from Catron Boulevard to Stumer Road.

Introduction

Crawford, Bunte, Brammeier prepared the following report to address the traffic impacts associated with the proposed Black Hills Center commercial development in Rapid City, South Dakota. This report was prepared in accordance with parameters discussed with both the City of Rapid City and the South Dakota Department of Transportation (SDDOT). The site is located in the northwest quadrant of Catron Boulevard and 5th Street. The site is approximately 58 acres and is zoned commercial. Currently, the site is vacant with the exception of a small apartment complex in the northwest quadrant of Catron Boulevard and Black Hills Boulevard. The study area is depicted in **Figure 1**.

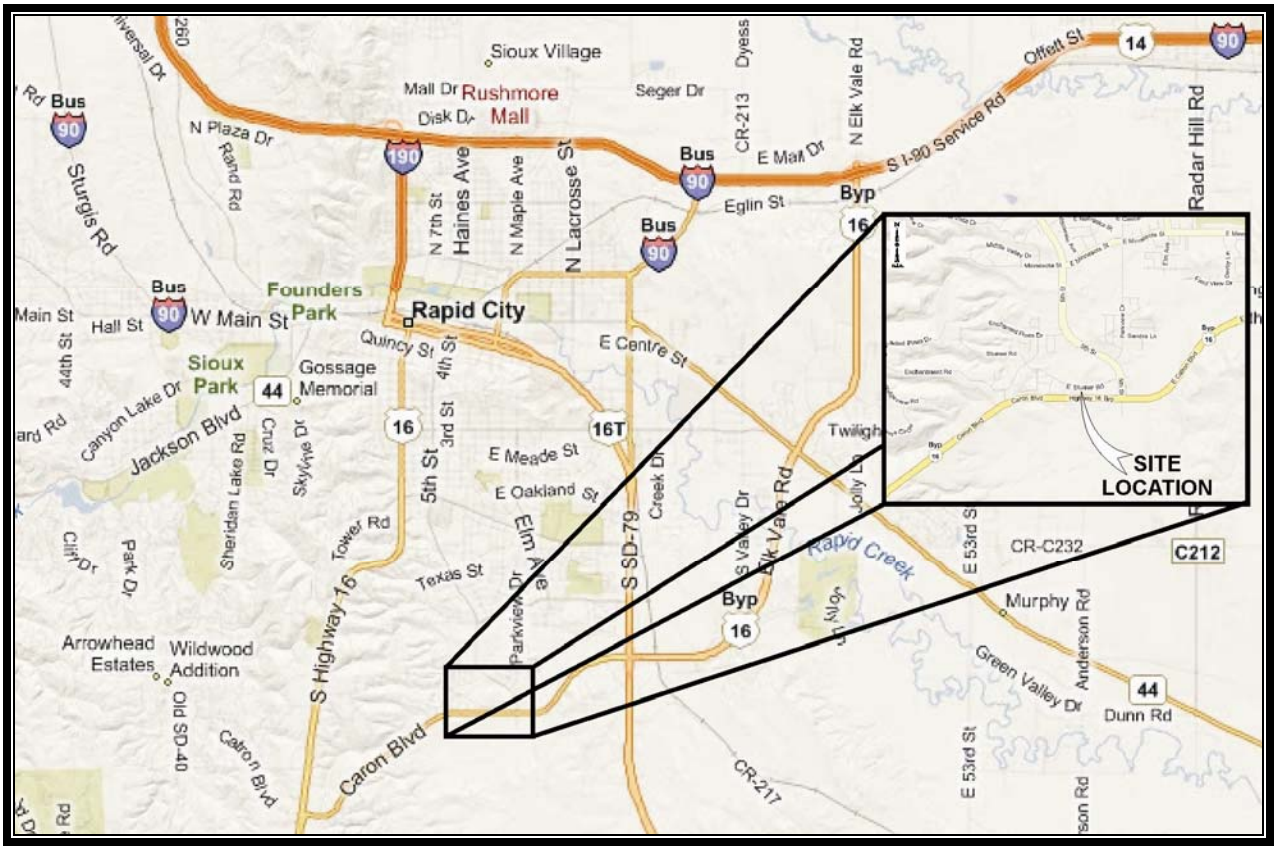

Figure 1: Site Location Map

A traffic impact study for essentially the same development area was previously prepared in July 2005 by Felsburg Holt & Ullevig (FHU). However, the FHU study considered a development area of approximately 87 acres. Several recommendations were offered by FHU including signalizing the intersections of Catron Boulevard with Black Hills Boulevard and 5th Street with Stumer Road. Additionally, two options for the alignment of Stumer Road through the development area were considered. Option 1 aligned Stumer Road through the southern portion of the site and required the signalization of 5th Street with Parkview Drive, while Option 2 aligned Stumer Road through the northern portion of the site and recommended to monitor the intersection of 5th Street with Parkview Drive for future signal warrants.

Since the 2005 FHU study, minimal development (approximately 96 apartment units) has occurred on the site. Stumer Road has been constructed and is a hybrid between the two options, though the constructed alignment follows more of a southern tract through the development area. Based on the current proposed development plan, Parkview Drive would not connect to the main development area or extend to Stumer Road. Thus, it may not be necessary to signalize 5th Street and Parkview Drive as previously recommended in the FHU study. Additionally, with the redistribution of site-generated traffic from Parkview Drive to Stumer Road, the roadway geometrics at 5th Street and Stumer Road need to be reevaluated to determine if any improvements are necessary to accommodate the current proposed development plan.

To that end, a new Traffic Impact Study was completed for the current development plan under consideration, as well as the approximate 30 acres adjacent to the site in order to account for the entire 87 acres available for development. Based on the latest plan submitted by THF Realty (and prepared by Wolverton & Associates, Inc.), the proposed 58 acre site would consist of a 154,750 square feet Walmart supercenter, approximately 46,900 square feet of retail space and 14 outlots. Access to the Walmart Supercenter would be provided via three full-access driveways on Stumer Road. Stumer Road runs parallel to Catron Boulevard and intersects 5th Street just north of Catron Boulevard. Access is also provided off Catron Boulevard via Black Hills Boulevard which ties into Stumer Road. The proposed site plan is depicted in **Exhibit 1**.

The purpose of this study was to determine the amount of traffic that would be generated by the proposed Black Hills Center development, evaluate its impact upon the adjoining road system and identify the need for roadway and/or traffic control improvements to mitigate those impacts. The focus of the analysis was the p.m. peak hour of a typical weekday and the midday peak period of a Saturday since these represent the most critical time periods with regards to traffic operations for the proposed commercial development.

The following report summarizes our findings regarding existing conditions (2010 No Build) and forecasted conditions (2010 Build and 2030 Build). The methodology employed to complete this study, along with the findings and recommendations, are discussed in greater detail in the subsequent sections.

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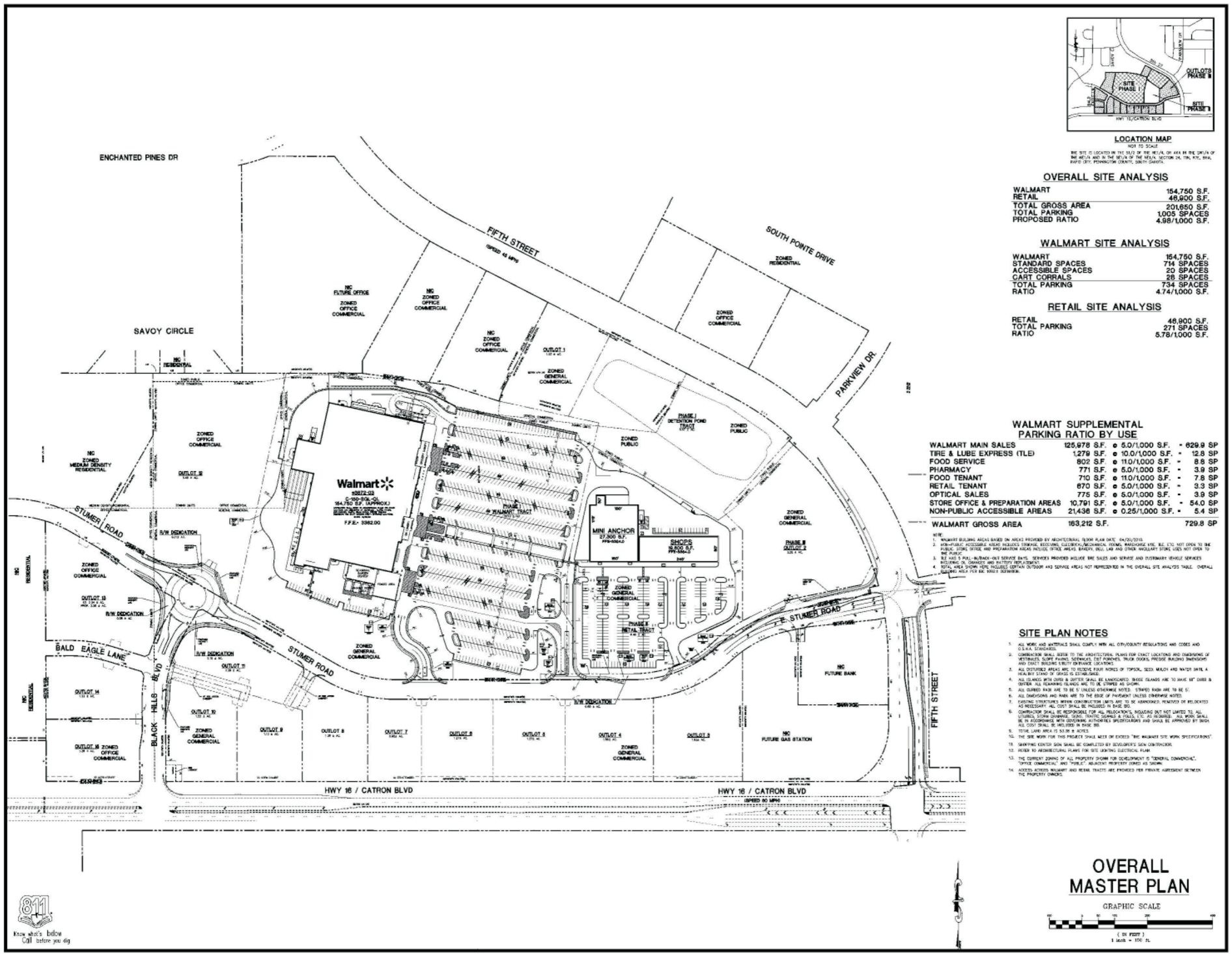


LOCATION MAP

NOT TO SCALE

THE SITE IS LOCATED IN THE S1/2 OF THE NE1/4, OR AKA IN THE SW1/4 OF THE NE1/4 AND IN THE NE1/4 OF THE NE1/4, SECTION 24, T1N, R7E, BHM, RAPID CITY, PENNINGTON COUNTY, SOUTH DAKOTA.

OVERALL SITE ANALYSIS

WALMART	154,750 S.F.
RETAIL	46,900 S.F.
TOTAL GROSS AREA	201,650 S.F.
TOTAL PARKING	1,005 SPACES
PROPOSED RATIO	4.98/1,000 S.F.

WALMART SITE ANALYSIS

WALMART	154,750 S.F.
STANDARD SPACES	714 SPACES
ACCESSIBLE SPACES	20 SPACES
CART CORRALS	26 SPACES
TOTAL PARKING	734 SPACES
RATIO	4.74/1,000 S.F.

RETAIL SITE ANALYSIS

RETAIL	46,900 S.F.
TOTAL PARKING	271 SPACES
RATIO	5.78/1,000 S.F.

WALMART SUPPLEMENTAL PARKING RATIO BY USE

WALMART MAIN SALES	125,978 S.F.	@ 5.0/1,000 S.F.	=	629.9 SP
TIRE & LUBE EXPRESS (TLE)	1,279 S.F.	@ 10.0/1,000 S.F.	=	12.8 SP
FOOD SERVICE	802 S.F.	@ 11.0/1,000 S.F.	=	8.8 SP
PHARMACY	771 S.F.	@ 5.0/1,000 S.F.	=	3.9 SP
FOOD TENANT	710 S.F.	@ 11.0/1,000 S.F.	=	7.8 SP
RETAIL TENANT	670 S.F.	@ 5.0/1,000 S.F.	=	3.3 SP
OPTICAL SALES	775 S.F.	@ 5.0/1,000 S.F.	=	3.9 SP
STORE OFFICE & PREPARATION AREAS	10,791 S.F.	@ 5.0/1,000 S.F.	=	54.0 SP
NON-PUBLIC ACCESSIBLE AREAS	21,436 S.F.	@ 0.25/1,000 S.F.	=	5.4 SP
WALMART GROSS AREA	163,212 S.F.			729.8 SP

NOTE:
1. WALMART BUILDING AREAS BASED ON AREAS PROVIDED BY ARCHITECTURAL FLOOR PLAN DATE: 04/20/2010.
2. NON-PUBLIC ACCESSIBLE AREAS INCLUDES STORAGE, RECEIVING, ELECTRICAL/MECHANICAL ROOMS, WAREHOUSE AISLE, ETC. NOT OPEN TO THE PUBLIC. STORE OFFICE AND PREPARATION AREAS INCLUDE OFFICE AREAS, BAKERY, DELI, LAB AND OTHER ANCILLARY STORE USES NOT OPEN TO THE PUBLIC.
3. TLE HAS 5 PULL-IN/BACK-OUT SERVICE BAYS. SERVICES PROVIDED INCLUDE TIRE SALES AND SERVICE AND INTERMARY VEHICLE SERVICES INCLUDING OIL CHANGES AND BATTERY REPLACEMENT.
4. TOTAL AREA SHOWN HERE INCLUDES CERTAIN OUTDOOR AND SERVICE AREAS NOT REPRESENTED IN THE OVERALL SITE ANALYSIS TABLE. OVERALL BUILDING AREA PER BBC SOURCE DEFINITION.

SITE PLAN NOTES

1. ALL WORK AND MATERIALS SHALL COMPLY WITH ALL CITY/COUNTY REGULATIONS AND CODES AND U.S.A.B. STANDARDS.
2. CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS FOR EXACT LOCATIONS AND DIMENSIONS OF VESTIBULES, SLOPE PAVING, SIDEWALKS, EXIT DOORWAYS, TRUCK DOORS, PRECISE BUILDING DIMENSIONS AND EXACT BUILDING UTILITY ENTRANCE LOCATIONS.
3. ALL DISTURBED AREAS ARE TO RECEIVE FOUR INCHES OF TOPSOIL, SEED, MULCH AND WATER UNTIL A HEALTHY STAND OF GRASS IS ESTABLISHED.
4. ALL ISLANDS WITH CURB & GUTTER SHALL BE LANDSCAPED. RAISED ISLANDS ARE TO HAVE 18" CURB & GUTTER. ALL REMAINING ISLANDS ARE TO BE STRIPED AS SHOWN.
5. ALL CURBED RADII ARE TO BE 5' UNLESS OTHERWISE NOTED. STRIPED RADII ARE TO BE 5'.
6. ALL DIMENSIONS AND RADII ARE TO THE EDGE OF PAVEMENT UNLESS OTHERWISE NOTED.
7. EXISTING STRUCTURES WITHIN CONSTRUCTION LIMITS ARE TO BE ABANDONED, REMOVED OR RELOCATED AS NECESSARY. ALL COST SHALL BE INCLUDED IN BASE BID.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL RELOCATIONS, INCLUDING BUT NOT LIMITED TO, ALL UTILITIES, STORM DRAINAGE, SIGNS, TRAFFIC SIGNALS & POLES, ETC. AS REQUIRED. ALL WORK SHALL BE IN ACCORDANCE WITH CONFORMING AUTHORITIES SPECIFICATIONS AND SHALL BE APPROVED BY SAME. ALL COST SHALL BE INCLUDED IN BASE BID.
9. TOTAL LAND AREA IS 53.06 ± ACRES.
10. THE SITE WORK FOR THIS PROJECT SHALL MEET OR EXCEED "BBC WALMART SITE WORK SPECIFICATIONS".
11. SHOPPING CENTER SIGN SHALL BE COMPLETED BY DEVELOPER'S SIGN CONTRACTOR.
12. REFER TO ARCHITECTURAL PLANS FOR SITE LIGHTING ELECTRICAL PLAN.
13. THE CURRENT ZONING OF ALL PROPERTY SHOWN FOR DEVELOPMENT IS "GENERAL COMMERCIAL", "OFFICE COMMERCIAL" AND "PUBLIC". ADJACENT PROPERTY ZONED AS SHOWN.
14. ACCESS ACROSS WALMART AND RETAIL TRACTS ARE PROVIDED PER PRIVATE AGREEMENT BETWEEN THE PROPERTY OWNERS.

OVERALL MASTER PLAN

GRAPHIC SCALE

(IN FEET)
1 inch = 100 ft.

Wolverton & Associates
Consulting Engineers + Land Surveyors
6140 Stonehill Parkway - Suite 100 - Duluth, Georgia 30097
Phone (770) 495-8003 - Fax (770) 495-8070
www.wolverton-assoc.com

PROPOSED BLACK HILLS CENTER
Walmart SUPERCENTER #3872-03
RAPID CITY, PENNINGTON COUNTY, S.D.
BY: THF, STONERIDGE DEVELOPMENT, LLC
ST. LOUIS, MO

REVISIONS	BY

DRAWN BY	DMN
CHECKED BY	KJW
DATE	05/20/2010
SCALE	1" = 100'
JOB No.	08-140
SHEET NUMBER	C-1
OF	SHEETS

Exhibit 1: Site Plan

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Existing Roadway & 2010 No Build Traffic Conditions

Before analyzing the impacts of the proposed Black Hills Center development area, it was first necessary to establish the baseline traffic conditions on the adjacent roadways *without* the additional traffic that would be generated by the proposed development.

Existing and Proposed Roadway Network

Catron Boulevard is a primary east-west expressway through the southern portion of the City of Rapid City. Catron Boulevard currently extends from Sheridan Lake Road on the west to SD79/Cambell Street on the east. Catron Boulevard adjacent to the subject site is currently three lanes (two westbound lanes and one eastbound lane), east of 5th Street Catron Boulevard narrows to two lanes. Catron Boulevard has a posted speed of 60 miles per hour (mph) and serves as a truck bypass route for Highway 16.

Based on recent conversations with the SDDOT, construction is expected to begin this fall to widen Catron Boulevard from Highway 16 to just west of Highway 79 to a four-lane roadway with a raised center median. The following additional roadway improvements are planned as part of the Catron Boulevard construction project:

- Construction of a 480 foot eastbound right-turn lane (exclusive of tapers) at 5th Street;
- An extension of the existing westbound right-turn lane at 5th Street to 480 feet (exclusive of tapers); and
- Construction of 450 foot dual eastbound and westbound left-turn lanes (exclusive of tapers) at 5th Street. The second left-turn lane would be stripped out for future use when the traffic volumes warrant the additional left-turn lane.

The existing eastbound 400 foot left-turn lane (exclusive of tapers) at Black Hills Boulevard would be maintained with the widening of Catron Boulevard. In conjunction with the widening, Dan Christy Lane which is just west of Black Hills Boulevard will be converted from a full access intersection to a right-in/right-out only intersection.

Fifth Street is a primary north-south roadway through the central portion of the City. Fifth Street is classified as a principal arterial in the City's Major Street Plan. Fifth Street through the study area is a five-lane roadway with two lanes in each direction and a center left-turn lane. A raised median exists between Catron Boulevard and Parkview Drive and on both sides of Enchanted Pines Drive. The posted speed along 5th Street is 45 mph.

Black Hills Boulevard is a commercial/industrial street serving as the main access off Catron Boulevard for the Black Hills center development area. Black Hills Boulevard is a three lane roadway with one lane in each direction with left-turn lanes provided at Stumer Road and Bald Eagle Lane. Additionally, a southbound thru lane is provided at Catron Boulevard, though it is currently striped for future use. **Figure 2** provides an aerial view of Black Hills Boulevard between Catron Boulevard and Stumer Road.

Figure 2: Black Hills Boulevard – Catron Boulevard to Stumer Road

Stumer Road, west of 5th Street, is a commercial/industrial street that parallels Catron Boulevard to its north. The prior property ownership recently constructed Stumer Road through the development area. Stumer Road between Black Hills Boulevard and 5th Street is a three-lane roadway with one lane in each direction and a center left-turn lane. The posted speed limit on Stumer Road is 25 mph. **Figure 3** provides an aerial view of the 5th Street and Stumer Road intersection.

Figure 3: 5th Street and Stumer Road Intersection

Parkview Drive, Enchanted Pines Drive, Dan Christy Lane and Enchantment Road between Stumer Road and Enchanted Pines are all classified as collectors in the City's Major Street Plan.

The intersection of Catron Boulevard and 5th Street is signalized. The traffic signal operates free. Currently, the left-turn movements on Catron Boulevard operate under protected/permissive left-turn phasing; however, as the traffic volumes along Catron Boulevard increase, it is anticipated that the left-turn phasing would be converted to protected-only phasing.

The intersection of Catron Boulevard and Black Hills Boulevard is operated as side-street STOP control with Black Hills Boulevard required to stop.

Likewise, the intersections of 5th Street with Stumer Road, Parkview Drive and Enchanted Pines Drive are all operated as side-street STOP control with the side streets required to stop and 5th Street maintaining the right-of-way.

The intersection of Black Hills Boulevard and Stumer Road is operated as an all-way STOP control intersection.

The 2010 No Build lane configurations and traffic control at each study intersection are graphically illustrated in **Exhibit 2**. Note that the planned roadway improvement project along Catron Boulevard is depicted in the 2010 No Build roadway network.

Existing Land Uses

The proposed development area is located in the northwest quadrant of Catron Boulevard and 5th Street. The study site is bordered by Catron Boulevard to the south, 5th Street to the east and north, and Enchantment Road to the west. The land surrounding the proposed development area is largely undeveloped, though the City's Zoning Map shows that much of the land bordering 5th Street and Catron Boulevard is zoned General Commercial, Office Commercial or Highway Service. The zoning outside of these areas is mostly Lower and Medium Density Residential. An excerpt from the City's Land Use Zoning Map is shown in **Figure 4**.

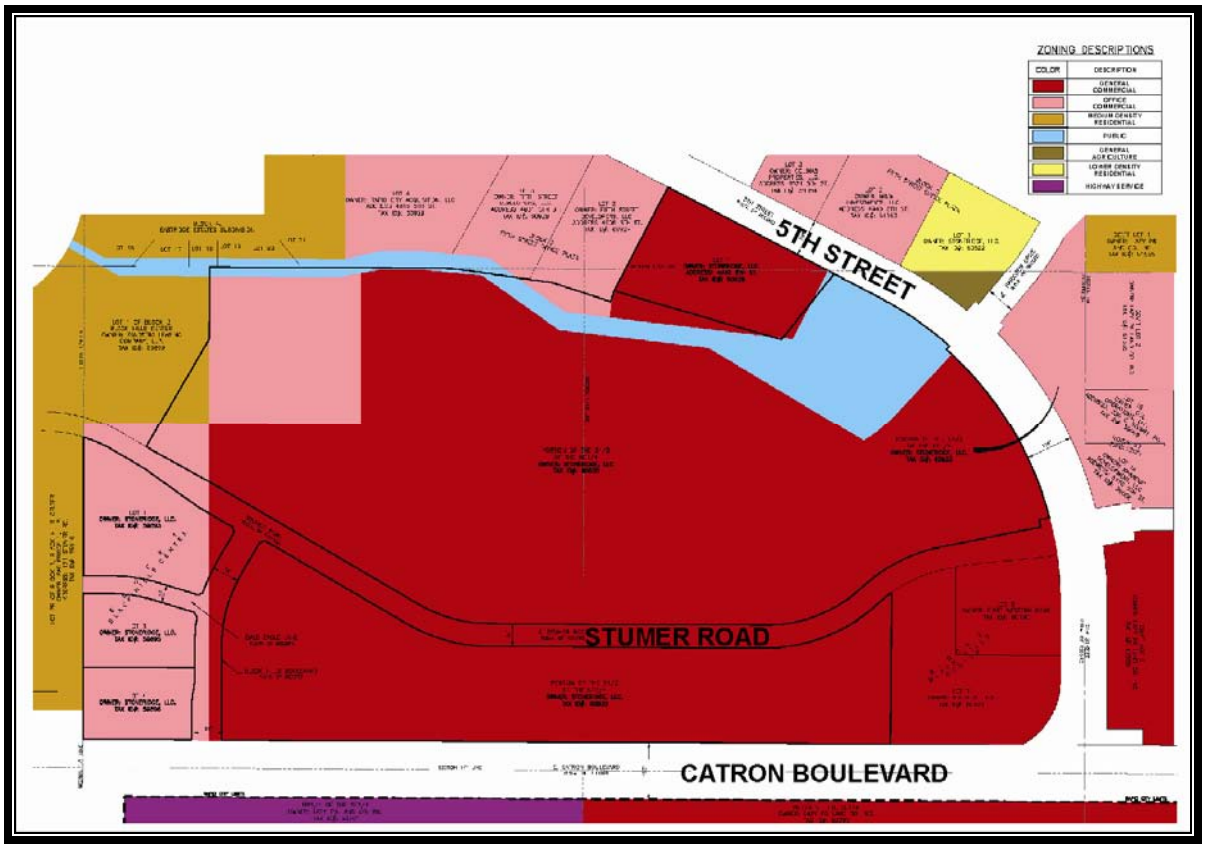


Figure 4: Land Use Zoning Map

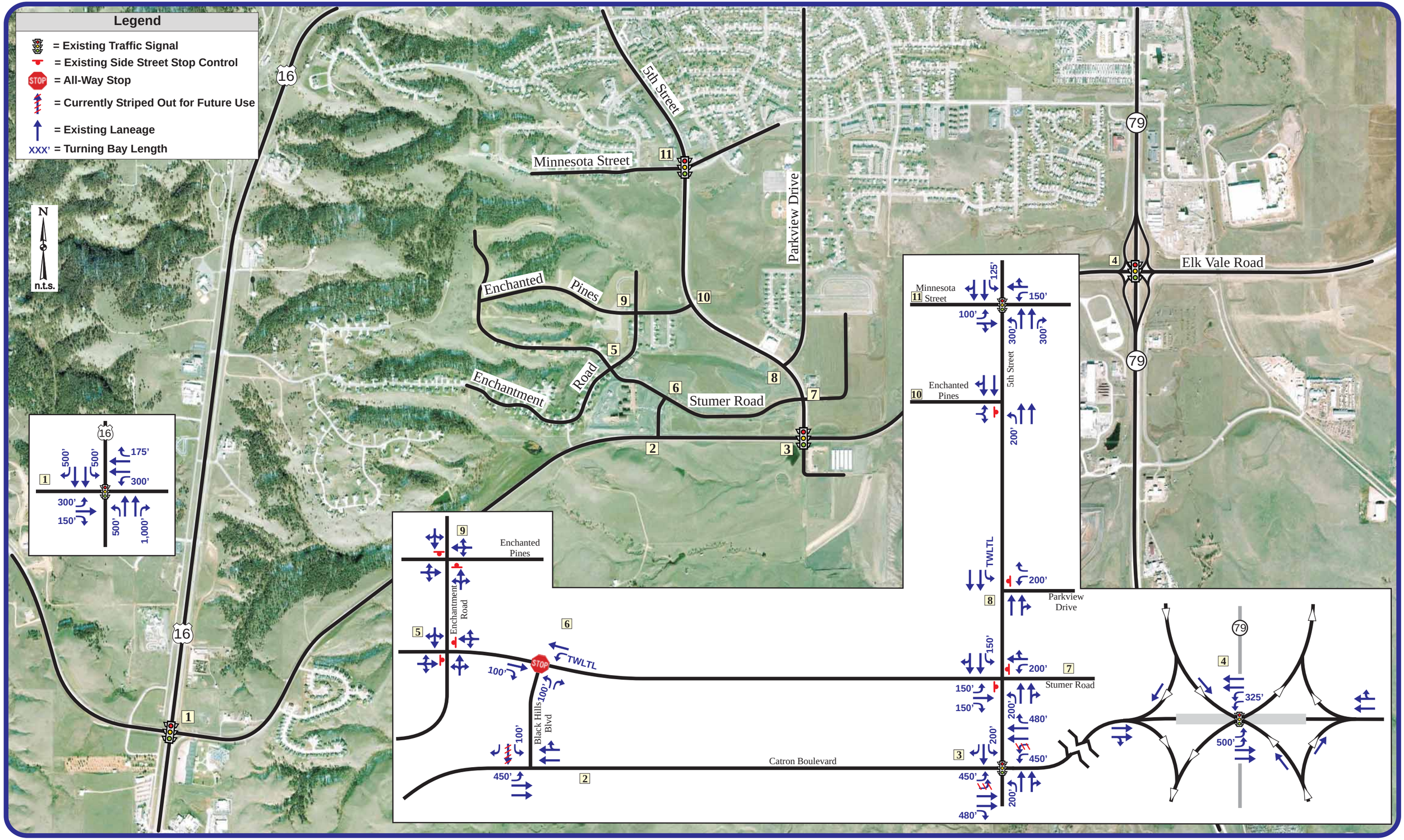


Exhibit 2: 2010 No Build Lane Assignments and Traffic Control

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
5/24/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Existing Traffic Volumes

The immediate study area for the analyses includes the following intersections:

- Catron Boulevard and 5th Street (signalized);
- Catron Boulevard and Black Hills Boulevard (unsignalized);
- 5th Street and Stumer Road (unsignalized);
- 5th Street and Parkview Drive (unsignalized);
- 5th Street and Enchanted Pines Drive (unsignalized);
- Stumer Road and Black Hills Boulevard (unsignalized);
- Enchanted Pines Drive and Enchantment Road (unsignalized); and
- Stumer Road and Enchantment Road (unsignalized).

At the request of Rapid City and SDDOT, the following additional intersections were evaluated for the weekday p.m. peak hour scenario:

- Catron Boulevard and Highway 16 (signalized);
- Catron Boulevard and Highway 79 (signalized); and
- 5th Street and Minnesota Street (signalized).

In order to quantify the existing traffic conditions near the site, turning movement counts were performed at the aforementioned study intersections during the weekday afternoon (4:00-6:00 p.m.) peak period and the Saturday midday peak period (11:00 a.m. - 1:00 p.m.) in February 2010. The City and SDDOT provided the weekday p.m. peak hour traffic counts for the additional intersections noted above.

Based on these counts, a weekday afternoon peak hour (4:30 to 5:30 p.m.) and a Saturday midday peak hour (11:15 a.m. to 12:15 p.m.) were chosen for analysis. These peak periods of the adjacent roadway would coincide with the peak trip generation times for the proposed Black Hills Center development. Therefore, if traffic from the proposed Black Hills Center development can be accommodated at these times, it can be reasoned that adequate capacity would be available throughout the remainder of the day.

Additionally, daily traffic volumes were provided by the City and SDDOT for 5th Street and Catron Boulevard in the vicinity of the development. A review of this count data found that traffic volumes along Catron Boulevard are approximately 800 vehicles per hour (vph) for the weekday a.m. and p.m. peak hours, while the traffic volumes are fairly consistent from approximately 8:00 a.m. to 4:00 p.m. with two-way traffic volumes of approximately 500 vph. During the weekday p.m. peak hour, the traffic volumes along Catron Boulevard are heavier in the westbound direction. For the Saturday midday peak hour, the traffic volumes along Catron Boulevard are much lower with approximately 500 vph. The traffic flow on Saturday is balanced between the eastbound and westbound directions.

Traffic volumes along 5th Street are approximately 450 vph for the weekday a.m. and p.m. peak hours, while the traffic volumes are fairly consistent through the midday with two-way traffic volumes of approximately 240 vph. During the weekday p.m. peak hour, the traffic volumes along 5th Street are heavier in the southbound direction. For the Saturday midday peak hour, the traffic volumes along 5th Street are much lower with approximately 200 vph. The traffic flow on Saturday is fairly balanced between the northbound and southbound directions.

According to the daily traffic volumes provided by the City and SDDOT, Catron Boulevard carries nearly 13,400 vehicles per day (vpd) during a typical weekday, while 5th Street carries nearly 6,100 vpd during a typical weekday.

The City collected additional daily traffic counts in April 2010 on Enchanted Pines Drive, Enchantment Road and Stumer Road. Based on this data, Enchanted Pines Drive east of Enchantment Road carries nearly 1,600 vpd during a typical weekday, Enchantment Road south of Enchanted Pines Drive carries nearly 1,200 vpd, Stumer Road west of Enchantment Road carries nearly 270 vpd, and Stumer Road east of Enchantment Road carries nearly 550 vpd.

As discussed with the City and SDDOT, due to the seasonal fluctuations in the traffic volumes in the area as a result of the tourism industry, the existing traffic volumes were adjusted. Based on data provided by the City, the adjustment factor for the month of February is 1.04. Thus, the existing traffic counts were increased by a factor of 1.04 and rounded to the nearest 5. The base, 2010 No Build, traffic volumes are summarized in **Exhibit 3**.

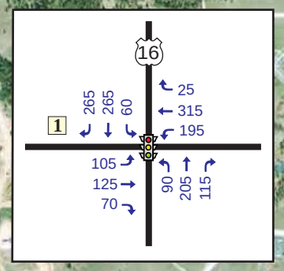
As mentioned previously, with the widening of Catron Boulevard, Dan Christy Lane will be converted from a full access intersection to a right-in/right-out only intersection. As a result, the limited number of motorists currently using Dan Christy Lane to make an eastbound left-turn or a southbound left-turn would be accommodated via Black Hills Boulevard. The existing traffic volumes on Dan Christy Lane accessing the residential area are shown in **Figure 5**. The 2010 No Build Traffic Volumes were adjusted to account for the restricted access at Dan Christy Lane.

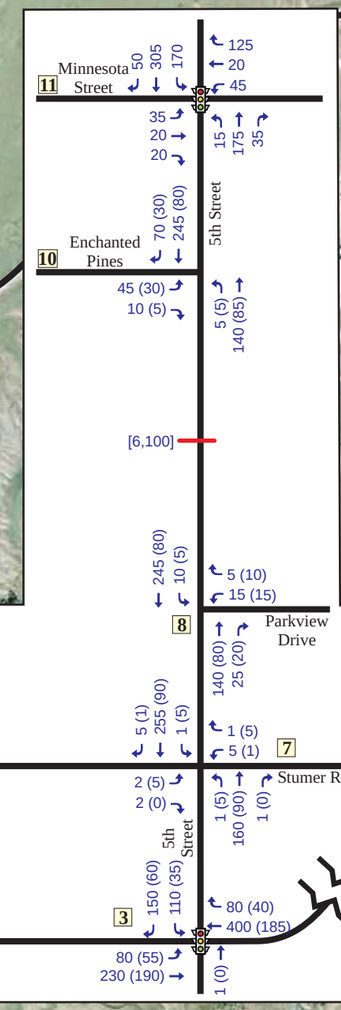
Legend

= Existing Traffic Signal
XX = PM Peak Hour Traffic (4:30 - 5:30 PM)
(XX) = Saturday Peak Hour Traffic (11:15 AM - 12:15 PM)
[XX] = Average Daily Traffic

N
n.t.s.

Minnesota Street
5th Street
Parkview Drive
Elk Vale Road
Enchanted Pines
Enchantment Road
Stumer Road
Black Hills Blvd
Catron Boulevard
5th Street
16
79





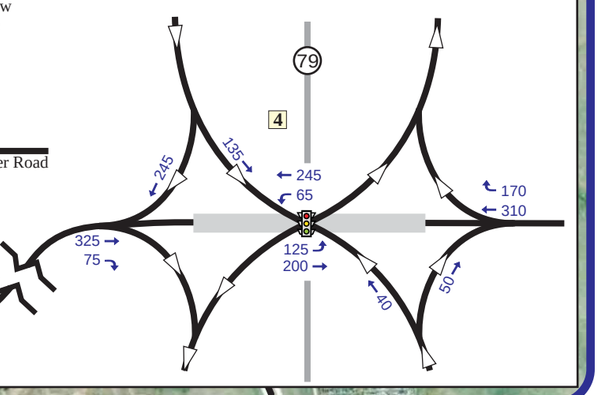


Exhibit 3: 2010 No Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
4/21/10

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Traffic and Transportation Engineers

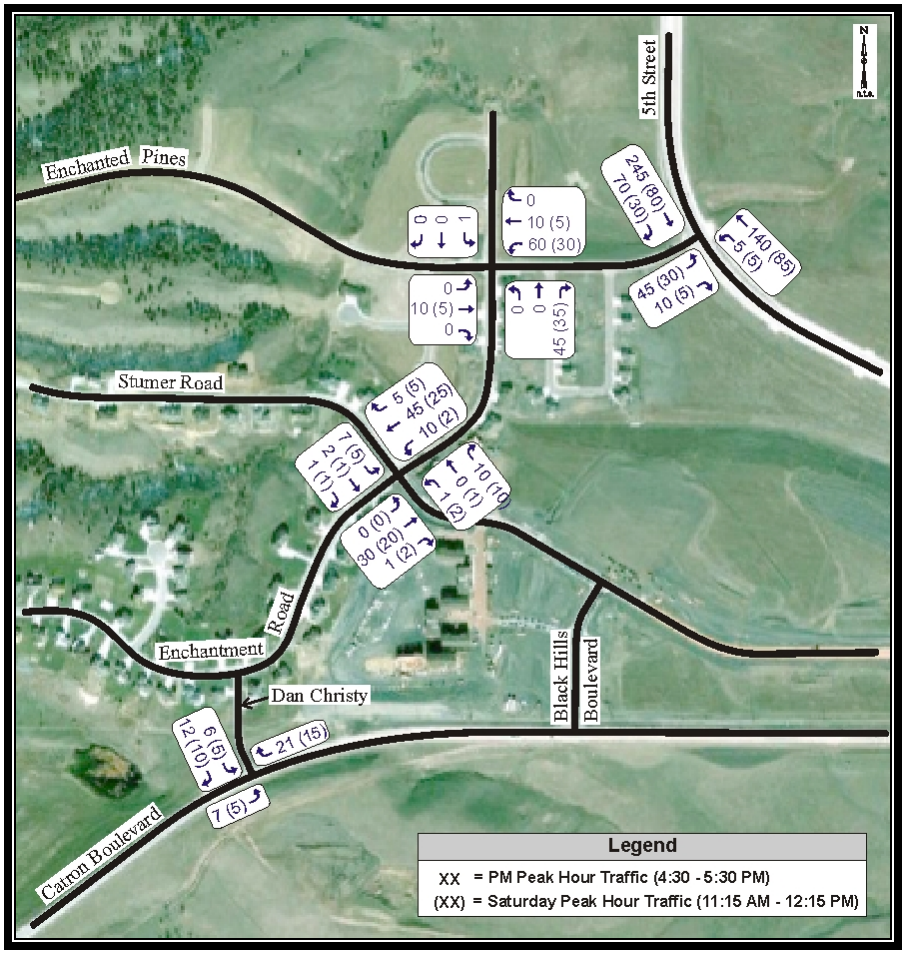

Figure 5: Dan Christy Lane Existing Traffic Volumes

2010 No Build Operating Conditions

The intersections within the study area were evaluated to quantify the 2010 No Build operating conditions. The analysis was completed using SYNCHRO 7, which is based upon the methodologies outlined in the "Highway Capacity Manual" (HCM) published in 2000 by the Transportation Research Board. This manual, which is used universally by highway and traffic engineers to measure roadway capacity, established six levels of traffic service: "Most Desirable" (Level A), to "Fully Loaded" (Level F).

Levels of traffic service are measures of traffic flow, which consider such factors as speed and delay time, traffic interruptions, safety, driving comfort and convenience. Level C, which is normally used for highway design, represents a roadway with volumes ranging from 70% to 80% of its capacity. However, Level D is often considered acceptable for peak period operating conditions in urban areas.

Level of Service (LOS) and vehicular delay are key Measures of Effectiveness in the analysis of traffic operations. The thresholds that define LOS are based upon the type of traffic control used at an intersection, i.e. whether it is signalized or unsignalized. For signalized and all-way stop controlled intersections, the average control delay per vehicle is estimated for each movement and aggregated for each approach and the intersection as a whole. At intersections with partial (side-street) stop control, the delay is determined for each minor movement instead of the intersection as a whole since motorists on the main road are not required to stop.

LOS is directly related to control delay. At signalized intersections, the LOS criteria differ from that at unsignalized intersections primarily because different transportation facilities create different driver expectations. The expectation is that a signalized intersection is designed to carry higher traffic volumes and, consequently, may experience greater delay than an unsignalized intersection. **Table 1** summarizes the LOS thresholds used in the analysis.

Table 1: Level of Service Thresholds

Level of Service (LOS)	Control Delay per Vehicle (sec/veh)	
	Signalized Intersections	*Unsignalized Intersections*
A	≤ 10	0-10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

The 2010 No Build operating conditions at the immediate study intersections are summarized in **Table 2**. As can be seen, all of the study intersections within the immediate area operate favorably during the weekday p.m. and Saturday midday peak hours. In fact, each intersection approach operates at LOS C or better, with the majority operating at LOS A or B during the peak hours analyzed. It is apparent that the recent extension of 5th Street and the planned widening of Catron Boulevard will provide significant excess capacity on the roadway network. In fact, the need for these roadway projects was based, in part, on additional commercial development along the corridors.

Table 2: 2010 No Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	A (7.3)	A (5.4)
Westbound Catron Boulevard Approach	B (15.6)	B (11.8)
Northbound 5th Street Approach	C (24.0)	B (19.0)
Southbound 5th Street Approach	A (8.2)	A (5.0)
Overall Intersection	*B (11.3)*	*A (7.9)*
Catron Boulevard & Black Hills Boulevard (Side-Street Stop)		
Eastbound Catron Boulevard Left-Turn	A (8.8)	A (7.8)
Southbound Black Hills Boulevard Left-Turn	C (16.5)	B (11.3)
Southbound Black Hills Boulevard Right-Turn	B (10.2)	A (9.0)
5th Street & Stumer Road (Side-Street Stop)		
Eastbound Stumer Road Approach	B (11.5)	A (9.7)
Westbound Stumer Road Approach	B (10.9)	A (9.7)
Northbound 5th Street Left-Turn	A (7.8)	A (7.4)
Southbound 5th Street Left-Turn	A (7.6)	A (7.4)
Black Hills Boulevard & Stumer Road (All-Way Stop)		
Eastbound Stumer Road Approach	A (5.8)	A (5.9)
Westbound Stumer Road Approach	A (6.5)	A (6.5)
Northbound Black Hills Boulevard Approach	A (6.6)	A (6.3)
5th Street & Parkview Drive (Side-Street Stop)		
Westbound Parkview Drive Left-Turn	B (10.7)	A (9.5)
Westbound Parkview Drive Right-Turn	A (8.8)	A (8.6)
Southbound 5th Street Left-Turn	A (7.6)	A (7.4)
5th Street & Enchanted Pines Drive (Side-Street Stop)		
Eastbound Enchanted Pines Drive Approach	B (11.5)	A (9.5)
Northbound 5th Street Left-Turn	A (8.0)	A (7.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

The 2010 No Build operating conditions at the study intersections within the neighboring residential area are summarized in **Table 3**. As can be seen, both of the neighboring residential intersections operate favorably during the weekday p.m. and Saturday midday peak hours. In fact, each intersection approach operates at LOS B or better, with the majority operating at LOS A during the peak hours analyzed.

Table 3: 2010 No Build Operating Conditions (Neighborhood Intersections)

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Enchanted Pines Drive & Enchantment Road (Side-Street Stop)		
Eastbound Enchanted Pines Approach	A (<1.0)	A (<1.0)
Westbound Enchanted Pines Approach	A (1.2)	A (<1.0)
Northbound Enchantment Road Approach	A (8.5)	A (8.5)
Southbound Enchantment Road Approach	B (10.1)	A (9.4)
Stumer Road & Enchantment Road (Side-Street Stop)		
Eastbound Stumer Road Approach	A (9.3)	A (9.0)
Westbound Stumer Road Approach	A (8.9)	A (8.7)
Northbound Enchantment Road Approach	A (<1.0)	A (<1.0)
Southbound Enchantment Road Approach	A (1.1)	A (<1.0)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As requested by the City and SDDOT, the closest major intersections on 5th Street and Catron Boulevard to the study area were evaluated to assess any traffic signal timing modifications that may be necessary during the weekday p.m. peak hour. The 2010 No Build operating conditions for the perimeter intersections are summarized in **Table 4**. As can be seen, the intersections operate favorably during the weekday p.m. peak hour with each signalized intersection operating at LOS C or better. Additionally, each intersection approach operates at LOS B or C.

The three perimeter intersections all operate free. In free operation, the traffic signal runs based on its own demand and timing parameters based on the information provided by its detectors. The signal does not operate under any background cycle length. If there are no nearby traffic signals, free operation will often provide the most favorable operations.

Table 4: 2010 No Build Operating Conditions (Perimeter Intersections)

Intersection/Movement	Weekday PM Peak Hour
Catron Boulevard & Highway 16 (signalized)	
Eastbound Catron Boulevard Approach	C (21.5)
Westbound Catron Boulevard Approach	C (21.8)
Northbound Highway 16 Approach	C (22.4)
Southbound Highway 16 Approach	C (20.4)
Overall Intersection	C (21.4)
Catron Boulevard & Highway 79 (signalized)	
Eastbound Catron Boulevard Approach	B (14.2)
Westbound Catron Boulevard Approach	B (12.3)
Northbound Highway 79 Approach	B (11.2)
Southbound Highway 79 Approach	B (11.5)
Overall Intersection	*B (12.5)*
5th Street & Minnesota Street (signalized)	
Eastbound Minnesota Street Approach	B (15.7)
Westbound Minnesota Street Approach	B (10.7)
Northbound 5th Street Approach	B (18.9)
Southbound 5th Street Approach	B (10.9)
Overall Intersection	*B (13.0)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Site-Generated Traffic

Once the base roadway and traffic conditions within the study area have been established, it was then necessary to consider the traffic associated with the proposed Black Hills Center development area. As a primary step in this analysis, trip generation forecasts and directional distribution estimates for the proposed development area were generated.

As mentioned previously, a Traffic Impact Study was prepared by FHU for essentially the same development area in July 2005, then called Black Hills Estates. The FHU study considered a development area of approximately 87 acres and was based on a development plan consisting of the following uses:

- 328,000 ft^2 of retail space;
- 110,600 ft^2 of office space;
- 10,000 ft^2 of high turnover sit-down restaurant space (2 restaurants);
- 15,000 ft^2 of bank space (2 banks);
- a 15,000 ft^2 theater;
- a gas station (8 pumps);
- an 80 room motel;
- a 70 room hotel;
- 140 apartments; and
- a 64 unit assisted living facility.

However, to date, only Phase I of the apartment complex has been constructed on the site. Based on the 2005 FHU study, the previous development plan was expected to generate approximately 1,210 trips during the a.m. peak hour and 3,215 trips during the p.m. peak hour.

Trip Generation Estimate

THF Realty is now considering a revised development plan of approximately 58 acres which would include a Walmart Supercenter as the major anchor. Based on the site plan provided by Wolverton and Associates, dated January 14, 2010, the revised development (58 acres) would consist of the following uses (uses were assumed for the outparcels):

- a 154,750 ft^2 Walmart Supercenter;
- 90,900 ft^2 of retail space;
- 64,000 ft^2 of office space;
- 10,000 ft^2 of high turnover sit-down restaurant space (2 restaurants);
- 6,000 ft^2 of fast-food restaurant space (2 restaurants);
- a 45,000 ft^2 theater;
- an 80 room motel; and
- a 70 room hotel.

However, in order to account for the entire 87 acre development area, the adjacent parcels previously included in the FHU Study were added to the current development area. The adjacent parcels were previously assumed to include the following uses:

- a 64 unit assisted living facility (parcel between Outlot 11 and Enchantment Road);
- 62,600 ft^2 of office space (three parcels in the southwest quadrant of Fifth Street and Enchanted Pines Drive);
- a gas station (northwest quadrant of Catron Boulevard and Fifth Street);
- a bank (northwest quadrant of Catron Boulevard and Fifth Street); and
- 58 apartments (Phase II of the apartment complex).

The number of trips that would be generated by the revised Black Hills Center development area was estimated using data provided in the *Trip Generation Manual*, 8th Edition, published by the Institute of Transportation Engineers (ITE). This publication is a standard resource for transportation engineers and consists of a compilation of nationwide studies documenting the characteristics of various land uses.

It should be noted that the trip generation forecasts for the Walmart Supercenter were based on a review of several sources, including the *Trip Generation Manual*, the *Nationwide Walmart Supercenter Study* prepared by the Texas Transportation Institute (TTI) in 2008 which represents data from 32 stores nationwide, and the *Verify Certain ITE Trip Generation Rate Applications in South Dakota* study prepared by the SDDOT in October 2005. The various trip generation rates are summarized in **Table 5**.

Table 5: Discount Supercenter Trip Generation Rate Comparison

Period	Trip Generation Rate							
	ITE 8th Ed	TTI Study[2]	Sioux Falls[3]	Rapid City[3 4]	Pierre[3]	Spearfish[3]	Yankton[3]	Water town[3]
Weekday a.m. peak hour (7:00 - 9:00 a.m.)	1.67	1.46	1.3	NA	1.92	0.79	1.15	0.75
Weekday p.m. peak hour (4:00 - 6:00 p.m.)	4.61	4.5	5.81	8.69	9.48	3.41	4.88	3.41
Saturday midday peak hour (11:00 a.m.- 2:00 p.m.)	5.64	5.63	5.18	9.55	8.37	3.88	5.71	4.54
Weekday Daily	53.13	53.04	66.14	101.95	107.23	42.54	55.16	45.03

[1] Trip rates are trips per 1,000 square feet GFA.
[2] Nationwide Walmart Supercenter Study, Texas Transportation Institute, March 2008
[3] Verify Certain ITE Trip Generation Rate Applications in South Dakota, SDDOT, October 2005
[4] Adusted to account for the exclusion of the Golden Coral restaurant

Based on discussions with the City and SDDOT staff, it was agreed that a rate between the existing Rapid City store (SDDOT Study) and the Sioux Falls store (SDDOT Study) would be used. Thus, a rate of 7.3 was utilized for both the weekday p.m. and Saturday midday peak hours. It should be noted that this rate is approximately 40% higher than the rates provide by both the *Trip Generation Manual* and the *Nationwide Walmart Supercenter Study*. However, based on the existing trip generation for the Rapid City Walmart, staff felt the inflated rate was appropriate at this location.

The resulting trip generation estimates for the *entire* Black Hills Center development area are summarized in **Table 6**.

Table 6: Black Hills Center Trip Generation Estimate

ITE Code	Land Use	Size	Average Daily Trips (vpd)	Weekday PM Peak Hour			Saturday Midday Peak Hour		
				In	Out	Total	In	Out	Total
SDDOT	Walmart Supercenter	154,750 ft²	13,000	565	565	1130	565	565	1130
820	Retail Space	90,900 ft²	6,385	290	305	595	420	385	805
710	Office Space	126,600 ft²	1,600	40	180	220	25	20	45
932	HTSD Restaurant	5,000 ft²	635	35	20	55	65	35	100
932	HTSD Restaurant	5,000 ft²	635	35	20	55	65	35	100
934	Fast-Food Restaurant	3,000 ft²	1,490	55	50	105	90	85	175
934	Fast-Food Restaurant	3,000 ft²	1,490	55	50	105	90	85	170
445	Multiplex Theater	45,000 ft²	800	135	85	220	115	40	155
320	Motel	80 rooms	450	20	15	35	30	25	55
310	Hotel	70 rooms	570	20	20	40	30	25	55
254	Assisted Living	64 units	220	5	10	15	10	10	20
912	Drive-In Bank	4 lanes	555	55	55	110	55	60	115
945	Gas Station	12 pumps	1,955	80	80	160	100	100	200
220	Apartments (Phase II)	58 units	940	30	20	50	20	25	45
Gross Total Trips			*30,725*	*1,420*	*1,475*	*2,895*	*1,680*	*1,495*	*3,175*
Common Trip Reduction (15%)			*(2,660)*	*(130)*	*(135)*	*(265)*	*(165)*	*(140)*	*(305)*
New Trips			*28,065*	*1,290*	*1,340*	*2,630*	*1,515*	*1,355*	*2,870*

As shown in Table 6, based on the revised development plan, the entire development area would be expected to generate a "gross" increase in trips of approximately 2,895 trips during the weekday p.m. peak hour and 3,175 trips during the Saturday midday peak hour. Based on the 2005 FHU study, the previous development plan was expected to generate approximately 3,215 trips during the p.m. peak hour. Thus, the revised plan would actually generate approximately 320 fewer trips during the weekday p.m. peak hour as compared to the 2005 trip generation estimates for the same development area.

It is important to note that ITE estimates assume each of the development's uses would be freestanding. Instead, the uses within the development area would share access to the main roadways surrounding the site and in many cases parking. Published studies show that patrons of multi-use developments often visit more than one use within the development during a single

visit. As a result, a portion of the trips generated by the development would be captured internally and not impact the external road system. To account for internal capture trips within the proposed Black Hills Center, a 15% "common trip" reduction was applied during the weekday p.m. and Saturday midday peak hours. These common trips were assigned between the respective uses along Stumer Road. It is important to note that the Walmart Supercenter was considered as the anchor for the development area and, as such, a common trip reduction was not applied to the Walmart in order to be conservative.

The gross trip generation shown in Table 6 was adjusted to account for common trips. As a result, the proposed Black Hills Center development area would generate 2,630 "new" trips during the weekday p.m. peak hour and 2,870 "new" trips during the Saturday peak hour.

Based on conversations with the City and SDDOT staff, it was agreed that no further reductions would be made to account for pass-by trips (traffic already present on the adjacent roads attracted to the development on their way to or from home, work or another destination). Although pass-by trips do not represent an increase in traffic along the adjacent roads, they do represent turning movements into and out of the development.

Trip Distribution Estimate

The traffic generated by the proposed Black Hills Center development was assigned to the adjoining road system based upon the site's access configuration, existing traffic patterns, anticipated operating characteristics and proximity to other Walmart stores. Based on conversations with the City and SDDOT staff, it was agreed that the new trips generated by the proposed development would be oriented as follows:

- 40% to/from the west on Catron Boulevard;
- 25% to/from the east on Catron Boulevard;
- 25% to/from the north on 5th Street;
- 4% to/from the west on Stumer Road;
- 3% to/from the east on Stumer Road; and
- 3% to/from the northeast on Parkview Drive.

Based on the trip generation and distribution estimates, the site-generated traffic for the proposed Black Hills Center development area was assigned to the adjoining road system as shown in **Exhibit 4.**

As can be seen, the proposed Black Hills Center development area would be expected to generate a significant increase in the volumes along Catron Boulevard and 5th Street and specifically the turning movements at the intersections of 5th Street and Catron Boulevard, 5th Street and Stumer Road and Catron Boulevard and Black Hills Boulevard.

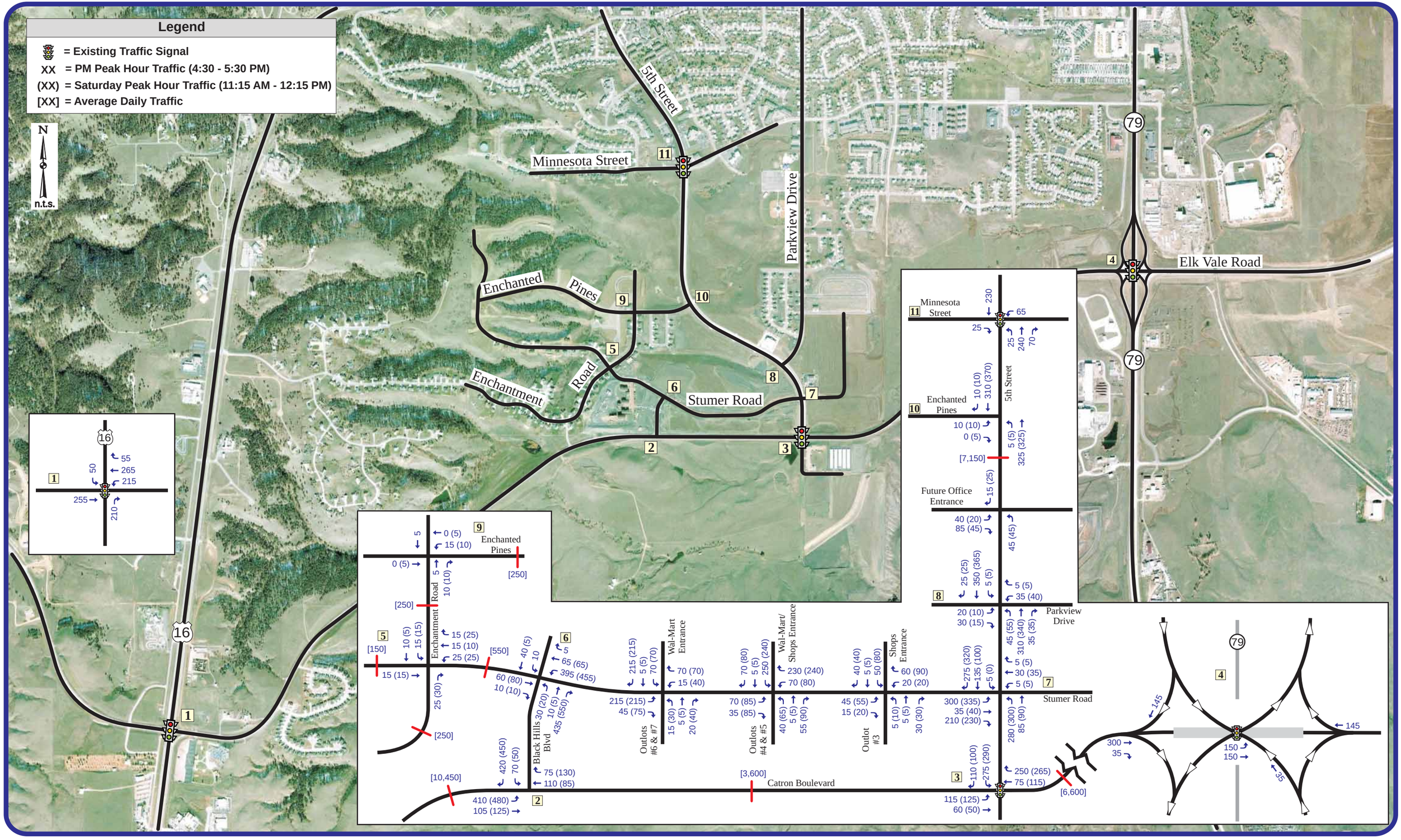

Exhibit 4: Site-Generated Trips

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
4/21/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2010 Build Conditions

Once the base roadway and traffic conditions have been established, the site-generated traffic associated with the proposed development area can be layered onto the system and reanalyzed so as to determine the associated impacts of the proposed development area.

Proposed Development Access

As depicted in Figure 1, the primary access for the Black Hills Center development would be via Stumer Road. Specifically access for the proposed Walmart Supercenter and supporting retail shops would be via three driveways off Stumer Road. All of the drives are proposed as side-street STOP with Stumer Road having the right-of-way and the proposed driveways operated under stop control. A zoomed in view of the proposed site plan showing the three driveways serving the Walmart Supercenter is shown in **Figure 6**.

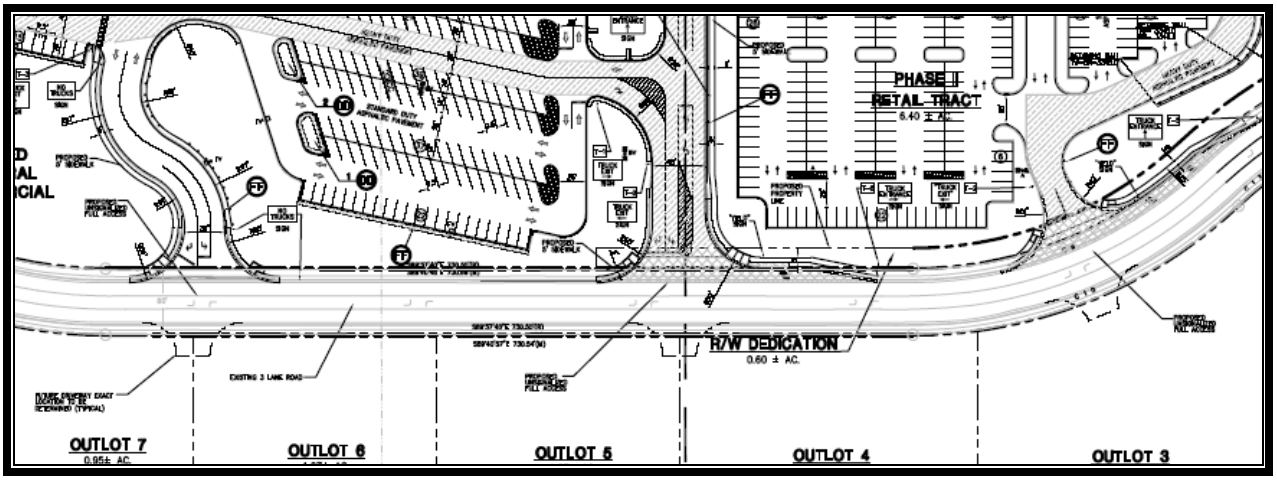

Figure 6: Proposed Access along Stumer Road

Access for Outlot 1 and the future office in the southwest quadrant of 5th Street and Enchanted Pines Drive is proposed via two existing stub access drives on 5th Street. Access for Outlot 2 is proposed on 5th Street opposite Parkview Drive and via a new driveway off Stumer Road. Access for Outlot 3 is proposed off Stumer Road opposite the access drive for the retail shops. Access for Outlots 4 and 5 is proposed via a shared access drive off Stumer Road opposite the main access for the Walmart Supercenter. Access for Outlots 6 and 7 is proposed via a shared access drive off Stumer Road opposite the west access for the Walmart Supercenter. Access for Outlots 8 and 9 is proposed via a shared access drive off Stumer Road. Access for Outlot 10 is proposed off Black Hills Boulevard opposite Eagle Ridge Lane. Access for Outlot 11 is proposed off Stumer Road opposite Black Hills Boulevard. Access for Outlot 12 is proposed via a new curb cut on Stumer Road and via a new curb cut on Eagle Ridge Lane. Access for Outlots 13 and 14 is proposed via a right-in/right-out on Black Hills Boulevard and via Eagle Ridge Lane.

Access for the planned future bank and gas station in the northwest quadrant of 5th Street and Catron Boulevard is platted via a right-in/right-out only on 5th Street and via Stumer Road.

2010 Build Traffic Volumes

The traffic generated by the proposed Black Hills Center development area (Exhibit 4) was aggregated with the 2010 No Build traffic volumes (Exhibit 3) to reflect the 2010 Build, or forecasted, conditions following build-out of the Black Hills Center development. **Exhibit 5** reflects the 2010 Build traffic volumes.

Traffic Signal Warrant Analysis

In order to accommodate the Black Hills Center development area, traffic signals are proposed at the intersections of Catron Boulevard with Black Hills Boulevard and 5th Street with Stumer Road. In order to verify the need for a traffic signal, signal warrant analyses were conducted by comparing forecasted traffic volumes to the standard warrants for signalization published in the *Manual on Uniform Traffic Control Devices* (MUTCD). Part Four of this manual, Highway Traffic Signals, provides eight different warrants for signalization that are based upon hourly traffic volumes, traffic operation, pedestrian volumes or accident experience. The City of Rapid City and SDDOT typically require intersections to satisfy Warrant 1 (eight hour volume) or Warrant 2 (four hour volume) before approving a new signal installation.

Warrant 1 has two conditions, "A" and "B". Condition "A" (Minimum Vehicular Volume) is intended for application where a large volume of intersecting traffic is the principal reason to consider a signal. Condition "B" (Interruption of Continuous Traffic) is intended for application where traffic volumes on a major street are so heavy that traffic on the minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. The minimum volume requirements are shown in **Figure 7**.

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures
[c] May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Figure 7: MUTCD Warrant 1, Eight Hour Vehicular Volume

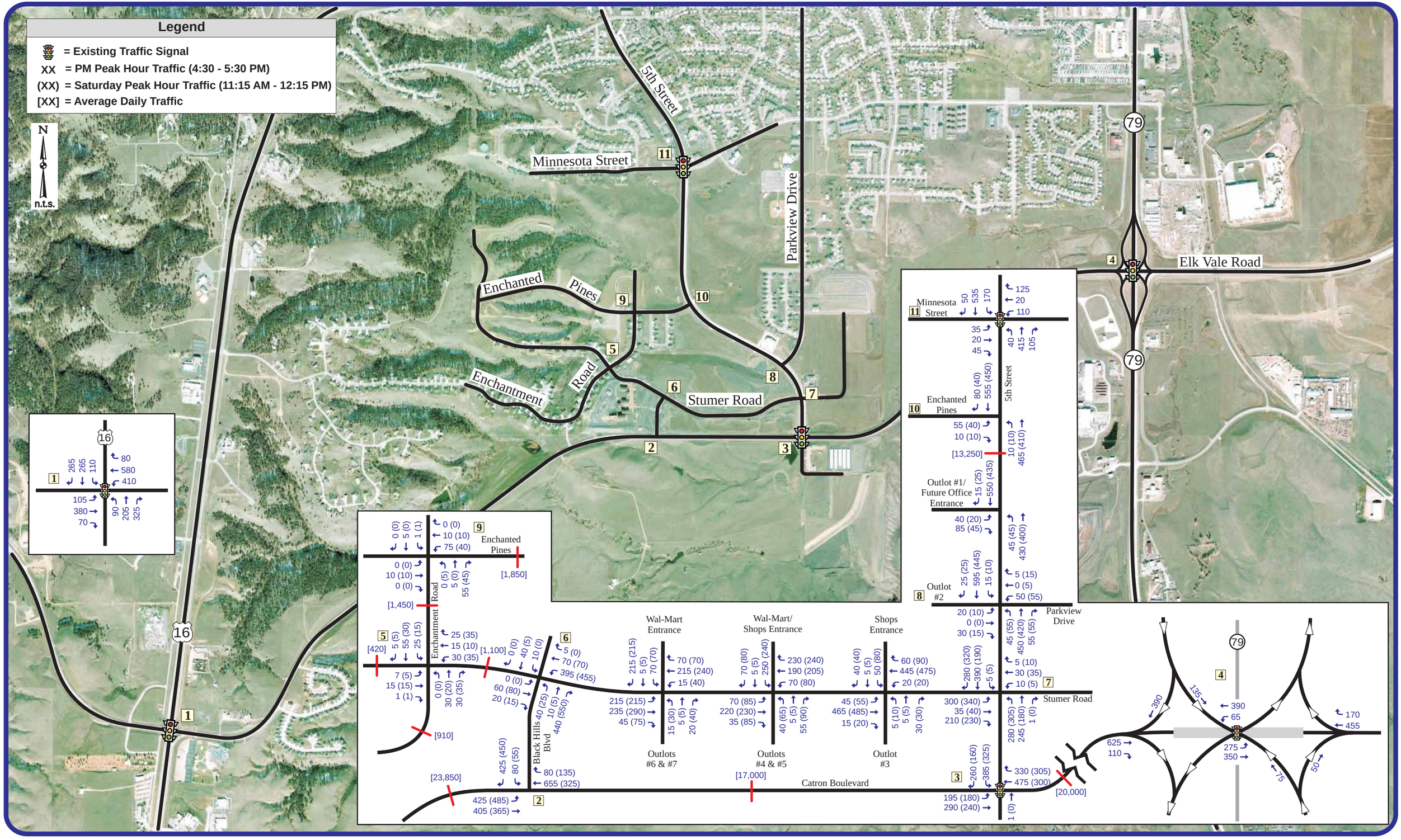

Exhibit 5: 2010 Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
4/21/10

CBB Crawford, Bunte, Brammeier
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In the absence of eight-hour traffic counts, the 8th highest hourly volumes are commonly estimated as 55% of peak hour traffic. In this case, based on the traffic counts provided by SDDOT, the 8th highest hour represents approximately 51% of the peak hour prior to the introduction of any development traffic. However, based on the 12-hour traffic counts collected as part of the SDDOT *Verify Certain ITE Trip Generation Rate Applications in South Dakota* study, for the Rapid City, Pierre and Sioux Falls Walmart stores the 8th highest hour represented approximately 65% to 75% of the peak hour. Thus, the commonly estimated 8th highest hourly volume as 55% of the peak hour traffic would provide a conservative approach.

Catron Boulevard and Black Hills Boulevard

The intersection of Catron Boulevard with Black Hills Boulevard was evaluated to determine whether a signal would be warranted based on the addition of the site traffic volumes to the existing traffic volumes. With respect to the side-street right-turn movements, when a separate right-turn lane is provided the volume is often discounted all together or reduced. In this case, given the heavy side street right-turn volume and the speed along Catron Boulevard, we felt it was appropriate to reduce the right-turn volume by 50% for the signal warrant analysis. Additionally, reduced warrants are applicable at locations where the speed of the major street exceeds 40 mph. In this case the posted speed on Catron Boulevard is 60 mph, so the traffic volumes in the 70% column of the table shown in Figure 7 may be used.

As indicated by the 2010 Build traffic volumes, the total approach volume on Catron Boulevard would amount to 1,565 vph during the weekday p.m. peak hour, while the approach volume on Black Hills Boulevard (discounting 50% of the right-turn volume) would amount to 292 vph. At 55% of the peak hour, the 8th highest hourly volume is estimated to be approximately 860 vph on Catron Boulevard and 161 vph on Black Hills Boulevard. As a result, both Warrants 1A and 1B would be satisfied in accordance with the reduced warrants for speeds in excess of 40 mph on the major street. Therefore, it can be concluded that signalization of the Catron Boulevard and Black Hills Boulevard intersection is warranted in accordance with the MUTCD.

Based on the posted speed limit of 60 mph on Catron Boulevard, the proposed traffic signal at Black Hills Boulevard should be designed with advance detection loops. The traffic signal design, including any safety features necessary such as the advance detection loops, will be prepared in cooperation with the SDDOT.

5th Street and Stumer Road

The intersection of 5th Street and Stumer Road was evaluated to determine whether a signal would be warranted based on the addition of the site traffic volumes to the existing traffic volumes. In this case, as a conservative approach, the side-street right-turn volume was discounted entirely since the speed and traffic volume on 5th Street was lower. Again, based on the posted speed of 45 mph on 5th Street, the traffic volumes in the 70% column of the table shown in Figure 7 may be used.

As indicated by the 2010 Build traffic volumes, the total approach volume on 5th Street would amount to 1,070 vph during the weekday p.m. peak hour, while the approach volume on Stumer Road (discounting the right-turn volume) would amount to 340 vph. At 55% of the peak hour, the 8th highest hourly volume is estimated to be approximately 589 vph on 5th Street and 187 vph

on Stumer Road. As a result, Warrants 1A would be satisfied in accordance with the reduced warrants for speeds in excess of 40 mph on the major street. Therefore, it can be concluded that signalization of the 5th Street and Stumer Road intersection is warranted in accordance with the MUTCD.

Auxiliary Lane Requirements

The need for auxiliary lanes was assessed for the intersections along 5th Street and Stumer Road to determine if auxiliary lanes are warranted per SDDOT's Roadway Design Guide. Along Catron Boulevard, right and left-turn lanes are planned at 5th Street as part of the widening project anticipated to start later this year. Along 5th Street and Stumer Road, the existing center left-turn lane will be adequate to accommodate the left-turn traffic. Thus, the need for separate right-turn lanes was evaluated utilizing Figure 12-12 in the SDDOT Roadway Design Guide, depicted in **Figure 8** below.

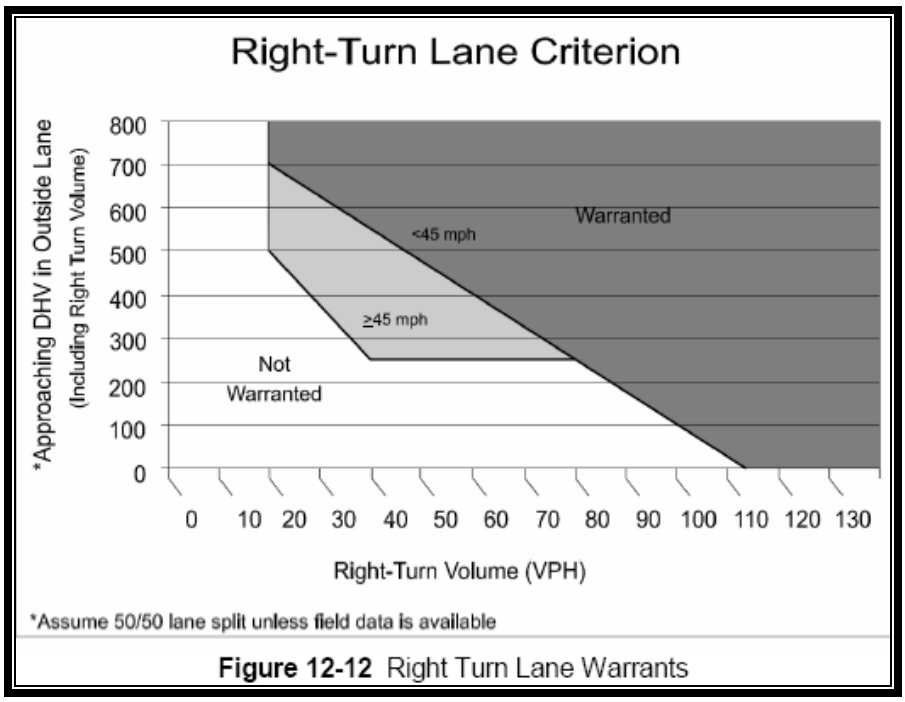

Figure 8: SDDOT Right-Turn Lane Warrants

5th Street and Stumer Road

Based on a posted speed of 45 mph, a southbound advancing volume during the p.m. peak hour of 475 vph in the outside lane and a right-turn volume of 280 vph, a southbound right-turn lane is warranted.

5th Street and Parkview Drive

Based on a posted speed of 45 mph, a northbound advancing volume during the p.m. peak hour of 293 vph in the outside lane and a right-turn volume of 55 vph, a northbound right-turn lane is not warranted. Likewise, based on a southbound advancing volume during the p.m. peak hour of 323 vph in the outside lane and a right-turn volume of 25 vph, a southbound right-turn lane is not warranted.

5th Street and Enchanted Pines Drive

Based on a posted speed of 45 mph, a southbound advancing volume during the p.m. peak hour of 358 vph in the outside lane and a right-turn volume of 80 vph, a southbound right-turn lane would likely be warranted upon full build-out of the entire 87 acre development area.

Catron Boulevard and Black Hills Boulevard

Based on a posted speed of 60 mph, a westbound advancing volume during the p.m. peak hour of 408 vph in the outside lane and a right-turn volume of 80 vph, a westbound right-turn lane is warranted.

Stumer Road and Proposed Access Drives

Based on a posted speed of 25 mph, a separate westbound right-turn lane is warranted at both the main Walmart/retail shops driveway and the eastern driveway serving the retail shops.

Black Hills Boulevard and Proposed Access for Outlot 10

Based on the projected traffic volumes a separate northbound right-turn lane into Outlot 10 is not warranted; however, based on the anticipated stream of northbound thru traffic from the traffic signal and the proximity of the access drive to Catron Boulevard, it is recommended that a separate northbound right-turn lane on Black Hills Boulevard into Oulot 10 be considered.

2010 Build Operating Conditions

The 2010 Build traffic volumes were reanalyzed using the same methodology as before in an effort to identify the impacts of the proposed Black Hills Center development area. **Table 7** summarizes the 2010 Build Levels of Service and average delay at each study intersection within the immediate study area during the weekday p.m. and Saturday midday peak hours.

The 2010 Build analyses reflect the recommended auxiliary lanes discussed in the previous section. Additionally, in order to provide adequate storage for the southbound left-turn movement at the intersection of Catron Boulevard and 5th Street, a dual-left turn lane is necessary. This dual-left turn is reflected in the 2010 Build analyses.

Furthermore, although the eastbound Stumer Road approach at 5th Street would operate acceptably at LOS C during the weekday p.m. and Saturday midday peak hours with a single eastbound left-turn lane, the 95th percentile queue for the left-turn is estimated at 240 feet for the p.m. peak and 290 feet for the Saturday peak, with average queues of 165 feet and 205 feet for the p.m. and Saturday peak hours respectively. Based on the desire to maintain access to the previously platted bank and gas station in the southwest quadrant of 5th Street and Stumer Road, it may be necessary to provide dual eastbound left-turn lanes to shorten the anticipated queues and reduce the occurrence of vehicles blocking the driveway to the future bank and gas station.

However, given that it will take several years for the entire 87 acres to build out, it may be appropriate to only utilize one of the left-turns lanes until the traffic volumes warrant the dual left-turn or safety becomes an issue with the driveway serving the future bank and gas station. By utilizing a single left-turn in the interim, the left-turn phasing could operate under protected-permissive control which usually provides more efficient operations.

Table 7: 2010 Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	C (25.3)	C (26.5)
Westbound Catron Boulevard Approach	B (18.0)	B (16.3)
Northbound 5th Street Approach	A (10.0)	B (11.3)
Southbound 5th Street Approach	B (13.7)	B (18.1)
Overall Intersection	*B (18.4)*	*B (19.7)*
Catron Boulevard & Black Hills Boulevard (signalized)		
Eastbound Catron Boulevard Approach	C (27.2)	C (30.6)
Westbound Catron Boulevard Approach	B (13.2)	A (9.4)
Southbound Black Hills Boulevard Approach	B (19.5)	B (18.9)
Overall Intersection	*C (20.4)*	*C (22.0)*
5th Street & Stumer Road (signalized)		
Eastbound Stumer Road Approach	D (35.5)	D (35.2)
Westbound Stumer Road Approach	D (40.5)	D (44.2)
Northbound 5th Street Approach	A (7.8)	A (9.8)
Southbound 5th Street Approach	B (11.7)	B (10.1)
Overall Intersection	*B (18.6)*	*C (20.3)*
Black Hills Boulevard & Stumer Road (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (7.4)	A (7.4)
Westbound Stumer Road Left-Turn	A (8.3)	A (8.6)
Northbound Black Hills Boulevard Left-Turn/Thru	B (13.9)	D (30.7)
Northbound Black Hills Boulevard Right-Turn	B (13.9)	B (14.4)
Southbound Black Hills Boulevard Approach	E (43.4)	C (24.7)
5th Street & Parkview Drive (Side-Street Stop)		
Eastbound Parkview Drive Approach	C (18.9)	C (15.1)
Westbound Parkview Drive Approach	D (31.9)	C (24.6)
Northbound 5th Street Left-Turn	A (9.2)	A (8.6)
Southbound 5th Street Left-Turn	A (8.6)	A (8.5)
5th Street & Enchanted Pines Drive (Side-Street Stop)		
Eastbound Enchanted Pines Drive Approach	C (21.2)	C (16.0)
Northbound 5th Street Left-Turn	A (9.0)	A (8.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Based on the distance between the existing traffic signal at Catron Boulevard and 5th Street and the proposed signals at 5th Street and Stumer Road and Catron Boulevard and Black Hills Boulevard, it is recommended that the three signals be coordinated to progress traffic through the intersections. A cycle length of 100 seconds was used for the weekday p.m. peak hour and a cycle length of 110 seconds was used for the Saturday midday peak hour. Additionally, in order to provide improved progression of the traffic along Catron Boulevard, the eastbound left-turn movement at 5th Street was analyzed as a lagging left-turn phase.

As shown in Table 7, even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 5th Street and the pending widening project on Catron Boulevard. Both of these roadways were designed taking into account the potential future commercial within the 5th Street and Catron Boulevard corridors.

It is acknowledged there is potential for the eastbound left-turn on Catron Boulevard at Black Hills Boulevard to queue out of the 400' left-turn bay proposed as part of the Catron Boulevard widening project. The left-turn 95th percentile queue is estimated at 380 feet for the p.m. peak hour and 460 feet for the Saturday peak hour, with average queues of 270 feet and 340 feet for the p.m. and Saturday peak hours respectively. Although, the left-turn movement is only estimated to exceed the available storage for the peak 10 or 15 minutes during the Saturday midday peak hour; it is recommended that the storage for eastbound left-turn on Catron Boulevard at Black Hills Boulevard be extended 60 feet to provide a total of 460 feet of storage. This design modification would be coordinated with the SDDOT.

As shown in Table 7, the majority of the movements at the unsignalized intersections are also anticipated to operate at acceptable levels of service for both the weekday p.m. and Saturday midday peak hours with the exception of the southbound approach at the intersection of Black Hills Boulevard and Stumer Road which is anticipated to operate at LOS E during the weekday p.m. peak hour. This southbound approach is the proposed access for Outlot 11. In order to more effectively accommodate the forecasted traffic volumes, the current all-way STOP control was changed to reflect side-street STOP conditions with Black Hills Boulevard/Outlot 11 operated under stop control and Stumer Road maintaining the right-of-way. Consequently, as stated, the southbound approach would operate at LOS E during the weekday p.m. peak hour.

As an alternative, a single-lane roundabout was considered for the intersection of Black Hills Boulevard and Stumer Road. The results of the roundabout analysis are summarized in **Table 8** which include an option with a northbound right-turn by-pass lane. The 95th percentile queue for each approach is also shown in the table.

As shown in Table 8, a roundabout would provide LOS A for all approaches for both the weekday p.m. and Saturday midday peak hours. Given that the intersection would operate at LOS A, the addition of a northbound right-turn by-pass lane would not provide any measurable difference in the operations, though the northbound queues would slightly decrease. Consequently, a northbound right-turn by-pass lane is not necessary should a roundabout be chosen as the preferred control for the Black Hills Boulevard and Stumer Road intersection.

Table 8: Stumer Road and Black Hills Boulevard Roundabout Analysis

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Black Hills Boulevard & Stumer Road (Roundabout)		
Eastbound Stumer Road Approach	A (3.7) [20']	A (3.9) [25']
Westbound Stumer Road Approach	A (5.1) [95']	A (5.0) [105']
Northbound Black Hills Boulevard Approach	A (1.8) [110']	A (1.9) [150']
Southbound Outlot 11 Approach	A (5.1) [20']	A (5.0) [20']
Overall Intersection	*A (3.5)*	*A (3.4)*
Black Hills Boulevard & Stumer Road (Roundabout with a Northbound By-Pass Lane)		
Eastbound Stumer Road Approach	A (3.7) [20']	A (3.9) [25']
Westbound Stumer Road Approach	A (5.1) [95']	A (5.0) [105']
Northbound Black Hills Boulevard Approach	A (1.4) [85']	A (1.3) [125']
Southbound Outlot 11 Approach	A (5.1) [20']	A (5.0) [20']
Overall Intersection	*A (3.3)*	*A (3.2)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle) [95th percentile queue]

The 2010 Build traffic volumes were reanalyzed for the study intersections within the neighboring residential area and are summarized in **Table 9**. As can be seen, both of the neighboring residential intersections would continue to operate favorably during the weekday p.m. and Saturday midday peak hours. In fact, each intersection approach would continue to operate at LOS B or better, with the majority operating at LOS A during the peak hours analyzed.

Table 9: 2010 Build Operating Conditions (Neighborhood Intersections)

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Enchanted Pines Drive & Enchantment Road (Side-Street Stop)		
Eastbound Enchanted Pines Approach	A (<1.0)	A (<1.0)
Westbound Enchanted Pines Approach	A (1.1)	A (1.4)
Northbound Enchantment Road Approach	A (8.8)	A (8.7)
Southbound Enchantment Road Approach	B (10.5)	A (9.3)
Stumer Road & Enchantment Road (Side-Street Stop)		
Eastbound Stumer Road Approach	B (10.2)	A (9.8)
Westbound Stumer Road Approach	A (9.8)	A (9.4)
Northbound Enchantment Road Approach	A (<1.0)	A (<1.0)
Southbound Enchantment Road Approach	A (1.7)	A (1.6)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

The primary access drives along Stumer Road serving the proposed Black Hills Center, and specifically the Walmart Supercenter, were analyzed using the same methodology as before in an effort to identify any necessary improvements at the access drives. **Table 10** summarizes the 2010 Build Levels of Service and average delay at each of the access drives during the weekday p.m. and Saturday midday peak hours.

Table 10: 2010 Build Operating Conditions (Major Access Driveways)

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Stumer Road & West Walmart Driveway (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (8.5)	A (8.6)
Westbound Stumer Road Left-Turn	A (7.9)	A (8.2)
Northbound Outlot 6/7 Approach	C (18.0)	D (26.2)
Southbound Walmart Drive Approach	B (14.5)	C (16.9)
Stumer Road & East Walmart Driveway (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (7.8)	A (7.9)
Westbound Stumer Road Left-Turn	A (8.0)	A (8.2)
Northbound Outlot 4/5 Approach	B (13.1)	C (15.9)
Southbound Walmart/Shops Drive Approach	D (27.8)	E (48.7)
Stumer Road & Retail Shops Driveway (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (8.7)	A (9.1)
Westbound Stumer Road Left-Turn	A (8.5)	A (8.6)
Northbound Outlot 3 Approach	B (13.3)	B (14.5)
Southbound Retail Shops Drive Approach	C (17.1)	C (21.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As shown in Table 10, the majority of the movements at the access drives are anticipated to operate at acceptable levels of service for both the weekday p.m. and Saturday midday peak hours with the exception of the southbound approach at the main entrance for the Walmart which is anticipated to operate at LOS E with approximately 49 seconds of delay during the Saturday midday peak hour.

Although not ideal, LOS E is often anticipated at unsignalized intersections within retail centers, especially during the Saturday peak hour. Additionally, given that the condition is only anticipated during the Saturday peak hour, and the fact that there are alternative means to access Stumer Road, this operation is not considered critical. In this case, there are alternative routes out of the Walmart Supercenter and retail shops to access Stumer Road. For instance, both the driveway to the east and west of this main drive are anticipated to operate at LOS C during the Saturday midday peak hour. Consequently, during peak shopping times on a Saturday, motorists may disperse to the adjacent drives to exit the center if the delays at the main entrance are longer than the alternative routes.

The perimeter intersections on 5th Street and Catron Boulevard were reanalyzed for the 2010 Build traffic volumes in an effort to identify any potential timing changes needed at the intersections as a result of the proposed Black Hills Center development. **Table 11** summarizes the 2010 Build Levels of Service and average delay at the perimeter intersections during the weekday p.m. peak hour.

Table 11: 2010 Build Operating Conditions (Perimeter Intersections)

Intersection/Movement	Weekday PM Peak Hour
Catron Boulevard & Highway 16 (signalized)	
Eastbound Catron Boulevard Approach	D (41.8)
Westbound Catron Boulevard Approach	C (27.8)
Northbound Highway 16 Approach	C (31.5)
Southbound Highway 16 Approach	C (33.2)
Overall Intersection	C (32.5)
Catron Boulevard & Highway 79 (signalized)	
Eastbound Catron Boulevard Approach	B (17.1)
Westbound Catron Boulevard Approach	C (20.6)
Northbound Highway 79 Approach	B (15.7)
Southbound Highway 79 Approach	B (14.6)
Overall Intersection	*B (17.4)*
5th Street & Stumer Road (signalized)	
Eastbound Stumer Road Approach	B (14.6)
Westbound Stumer Road Approach	B (13.2)
Northbound 5th Street Approach	B (18.4)
Southbound 5th Street Approach	B (15.2)
Overall Intersection	*B (15.9)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As mentioned previously, the three perimeter intersections all operate free. Although a new traffic signal is proposed on Catron Boulevard at Black Hills Boulevard that would be coordinated with the existing signal at 5th Street, given the distance to the perimeter intersections on Catron Boulevard coordination with the signals at Highway 16 and Highway 79 would not be recommended.

The signal at Highway 16 is approximately 1.8 miles west of the proposed signal at Black Hills Boulevard, while the signal at Highway 79 is approximately 1.2 miles east of the existing signal at 5th Street. With distances in excess of one mile, it is difficult to maintain a platoon of traffic in order to realize the benefits of signal coordination. Furthermore, maintaining free operation would provide the most favorable traffic conditions.

Likewise, the signal at 5th Street and Minnesota Street is approximately 4,600 feet north of the proposed signal at Stumer Road. Thus, it is recommended that this intersection continue to operate free as well.

Future Access Drives on Stumer Road

Based on Rapid City's Street Design Criteria Manual, the desired distance between driveways along high volume collectors in commercial areas is 200 feet of full vertical curb (measured from the near radius point to near radius point). However where this spacing cannot be attained, a minimum of 105 feet is required on streets with a posted speed of 25 mph like Stumer Road.

The access along Stumer Road, as depicted in the current site plan shown in Exhibit 1, exceeds the desired spacing of 200 feet. Ideally, the access for adjoining outlots could share one access drive onto Stumer Road. However, as specific users are identified, there may be a need to modify the access along Stumer Road from that shown in the current site plan. In general, any modifications to the access should, at a minimum, provide 105 feet of separation and ideally provide the desired 200 feet.

According to the Street Design Criteria Manual, for signalized intersections on arterial streets the minimum spacing for a driveway on the side street is 230 feet (measured from the stop bar to the edge of the driveway). Thus, it is recommended that access for Outlot 2 be located a minimum of 230 feet from 5th Street. It is anticipated that the access for Outlot #2 would align opposite the access for the future gas station and bank.

Probability of Cut-Thru Traffic in the Adjacent Neighborhood

Throughout the study process, residents in the neighborhood to the west of the development have expressed a concern over the potential for cut-thru traffic on their neighborhood streets as a result of the proposed Black Hills Center development. To that end, the "cut-thru routes" and the "primary routes" to and from the shopping center and the associated travel times were evaluated.

For traffic to and from the shopping center from the north, there are two probable travel routes: 5th Street or Highway 16. For patrons originating north of Cathedral Drive along Highway 16, they can either 1) travel east on Cathedral Drive to south on 5th Street to Stumer Road to the shopping center or 2) travel south on Highway 16 to east on Enchantment Road to east on Stumer Road to the shopping center. For trips exiting the shopping center, the reverse alternative travel routes were assumed. The travel routes evaluated for trips to and from the north (the red and yellow routes) are illustrated in **Figure 9**.

Similarly, for traffic to and from the shopping center from the southwest, there are two probable travel routes: Catron Boulevard or Highway 16. For patrons south and west of the intersection of Highway 16 and Catron Boulevard, they can either 1) travel west on Catron Boulevard to north on Black Hills Boulevard to east on Stumer Road to the shopping center or 2) travel north on Highway 16 to east on Enchantment Road to east on Stumer Road to the shopping center. For trips exiting the shopping center, the reverse alternative travel routes were assumed. The travel routes evaluated for trips to and from the southwest (the blue and orange routes) are also illustrated in Figure 9.

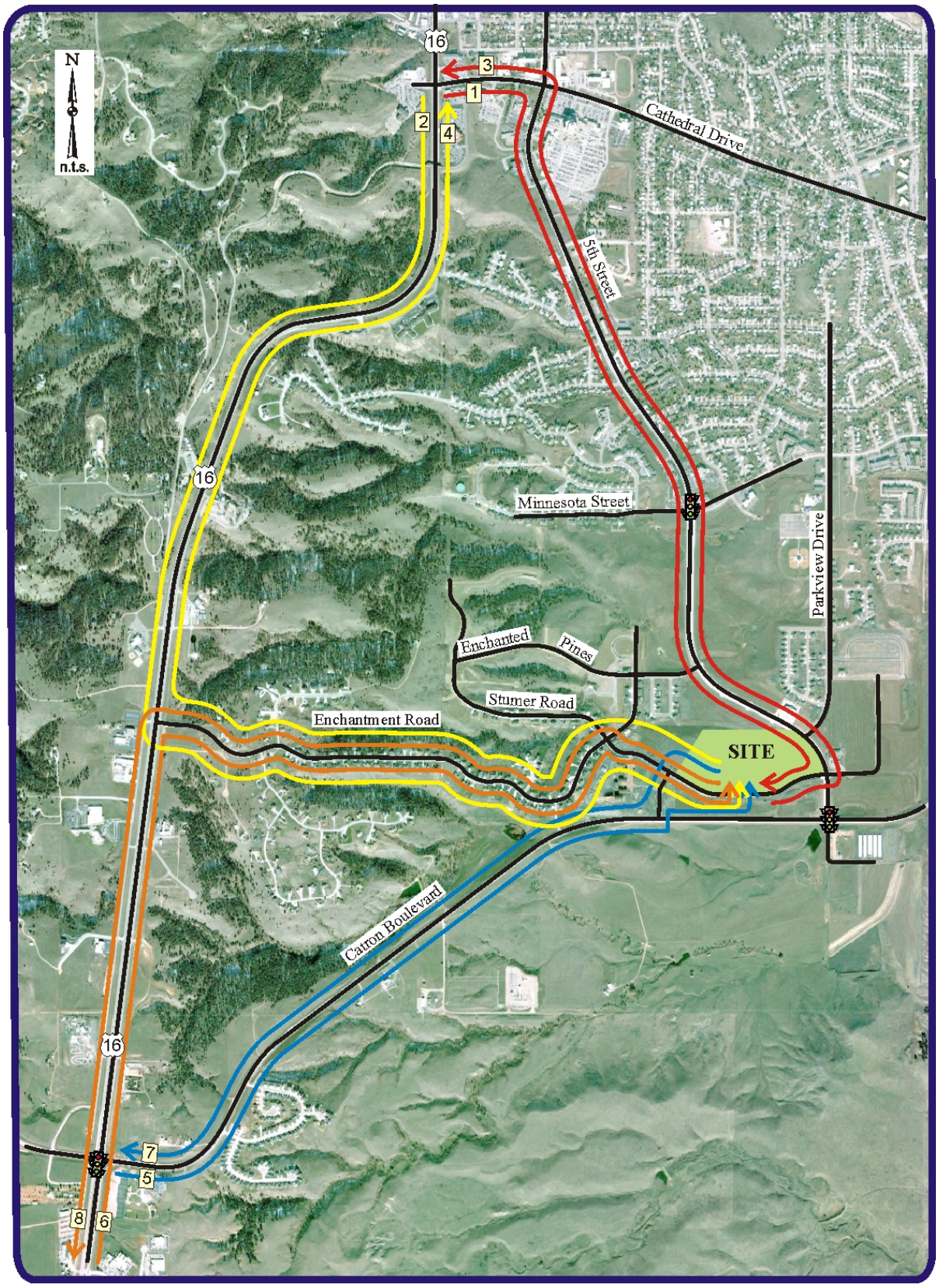

Figure 9: Primary and Cut-Thru Travel Routes

Multiple field measurements were collected during the peak periods to determine average travel times for each route. In order to provide a relative comparison between the existing and forecasted travel times, it was necessary to incorporate the increased traffic and the resulting additional traffic signal delay experienced as a result of the build-out of the 87 acre Black Hills Center development. Specifically, for trips to and from the north the additional signal delay estimated at the intersections of 5th Street and Minnesota Street and 5th Street and Stumer Road were added to the existing travel time runs in order to estimate the forecasted travel times. **Table 12** summarizes the existing and forecasted travel times during the afternoon peak period for the cut-thru and primary routes to and from the north.

Table 12: Summary of the Primary and Cut-Thru Routes to/from the North

Comparison of Primary and Cut-Thru Travel Times To/From the North P.M. Peak Hour			
	Route	*Distance*	*Travel Time*
	Alternative Routes from the North to the Black Hills Shopping Center		
1	From the North via 5th Street	2.6 miles	
	Existing Travel Time		4 min 45 sec
	Estimated Additional Signal Delay		+ 9 sec
	Forecasted Travel Time		4 min 54 sec
2	From the North via Highway 16 thru the Neighborhood	3.6 miles	
	Existing Travel Time		6 min 35 sec
	Alternative Routes from the Black Hills Shopping Center to the North		
3	To the North via 5th Street	2.6 miles	
	Existing Travel Time		5 min 25 sec
	Estimated Additional Signal Delay		+ 44 sec
	Forecasted Travel Time		6 min 9 sec
4	To the North via Highway 16 thru the Neighborhood	3.6 miles	
	Existing Travel Time		7 min 10 sec

Based on the samples collected, for trips from the north utilizing the cut-thru route takes an average of 6 minutes, 35 seconds to traverse, while the primary route takes an average of 4 minutes, 54 seconds including the additional signal delay. In other words, it takes nearly 1 minute, 40 seconds or 25% less time to access the site via 5th Street as compared to cutting thru the residential neighborhood. Conversely, for trips exiting the shopping center to the north utilizing the cut-thru route takes an average of 7 minutes, 10 seconds to traverse, while the primary route takes an average of 6 minutes, 9 seconds including the additional signal delay. In other words, it takes nearly 1 minute or 15% less time to access the site via 5th Street as compared to cutting thru the residential neighborhood. Therefore, most motorists would have very little incentive to cut-thru the neighborhood to access the proposed development site from the north.

Additionally, a cut-thru route utilizing the neighborhood streets is approximately one mile longer, or 38% longer, than one accessing the development via 5th Street. Furthermore, it is

important to recognize that only a marginal portion of the proposed development's traffic would come from the north, approximately 25%. The majority of the site's traffic would be expected to be oriented to the Catron Boulevard corridor, and those motorists would have no incentive to utilize the residential streets under consideration.

In order to provide a relative comparison between the existing and forecasted travel times to and from the southwest, it was necessary to incorporate the additional traffic signal delay experienced as a result of the proposed signal at Catron Boulevard and Black Hills Boulevard. **Table 13** summarizes the existing and forecasted travel times during the afternoon peak period for the cut-thru and primary routes to and from the southwest.

Table 13: Summary of the Primary and Cut-Thru Routes to/from the Southwest

Comparison of Primary and Cut-Thru Travel Times To/From the Southwest P.M. Peak Hour			
	Route	*Distance*	*Travel Time*
	Alternative Routes from the Southwest to the Black Hills Shopping Center		
5	From the Southwest via Catron Boulevard	2.1 miles	
	Existing Travel Time		2 min 55 sec
	Estimated Additional Signal Delay		+ 50 sec
	Forecasted Travel Time		3 min 45 sec
6	From the Southwest via Highway 16 thru the Neighborhood	2.8 miles	
	Existing Travel Time		5 min 10 sec
	Alternative Routes from the Black Hills Shopping Center to the Southwest		
7	To the Southwest via Catron Boulevard	2.1 miles	
	Existing Travel Time		3 min 20 sec
	Estimated Additional Signal Delay		+ 15 sec
	Forecasted Travel Time		3 min 35 sec
8	To the Southwest via Highway 16 thru the Neighborhood	2.8 miles	
	Existing Travel Time		5 min 35 sec

Based on the samples collected, for trips from the southwest utilizing the cut-thru route takes an average of 5 minutes, 10 seconds to traverse, while the primary route takes an average of 3 minutes, 45 seconds including the additional signal delay. In other words, it takes nearly 1 minute, 25 seconds or 27% less time to access the site via Catron Boulevard as compared to cutting thru the residential neighborhood. Conversely, for trips exiting the shopping center to the southwest utilizing the cut-thru route takes an average of 5 minutes, 35 seconds to traverse, while the primary route takes an average of 3 minutes, 35 seconds including the additional signal delay. In other words, it takes nearly 2 minutes or 35% less time to access the site via Catron Boulevard as compared to cutting thru the residential neighborhood. Again, most motorists would have very little incentive to cut-thru the neighborhood to access the proposed development site from the southwest.

Additionally, a cut-thru route utilizing the neighborhood streets is approximately seven tenths of a mile longer, or 33% longer, than one accessing the development via Catron Boulevard.

It is acknowledged that patrons of the shopping center originating from Highway 16 between Cathedral Drive and Catron Boulevard would likely be inclined to use Enchantment Road since it would provide a travel time savings for these patrons. However, there is very little housing along this section of Highway 16 and as result very few trips that could be attracted to Enchantment Road.

Based on this analysis, it may be concluded that the proposed development would attract a negligible volume of cut-thru traffic and would have relatively little impact on the adjacent residential neighborhood. Instead, the majority of the site-generated trips that would travel into or out of the adjacent neighborhoods would be made by residents of those neighborhoods. Consequently, it appears that there would be little incentive to dead-end Stumer Road east of Enchantment Road, as has been discussed.

Nevertheless, it is important to recognize the potential impacts associated with such a restriction. A closure would impact traffic flows by eliminating neighborhood circulation. Additionally, all of the trips associated with the residential neighborhood to and from the proposed Black Hills shopping center would be forced to circle around the development on the arterial streets of 5th Street and Catron Boulevard creating unnecessary turning movements at those primary study intersections.

Thus, it is recommended that Stumer Road remain open and easily accessible to the residents that live in the adjacent neighborhood. It does not appear that cut-thru traffic would be likely given the lack of incentive for motorists to utilize the residential streets for access to the proposed development. Furthermore, as an alternative to closing the street, it would be prudent for the neighborhood to consider the installation of streetscape and traffic calming features at the entrance to the subdivision and along the neighborhood streets, thereby reinforcing the residential nature of those streets, delineating the boundary between the commercial and residential areas, and dissuading commercial traffic from entering the neighborhood (accidentally or otherwise).

Potential Traffic Calming Measures for the Adjacent Neighborhood

It is our understanding, that regardless of the actual known presence of any “cut-thru” traffic, the residents in the neighborhood to the west of the proposed Black Hills Center, as well as City staff, are considering possible traffic calming measures along Enchanted Pines Drive, Enchantment Road and Stumer Road, including the closure of Stumer Road. In order for a traffic calming plan to be successful, it is imperative that it involve the residents, as well as City staff and the emergency response users to develop a detailed study to determine the type and location of any traffic calming measures.

Based on the analysis completed for the proposed Black Hills Center development and the subsequent travel time runs, it is our position that the Black Hills Center development will not adversely affect the traffic operations on Enchanted Pines Drive, Enchantment Road and Stumer

Road. However, ongoing discussions with the property owners and the City are being held to review traffic calming measures should cut-through traffic become a problem.

Traffic Calming is the combination of mainly physical measures designed to control traffic speeds and encourage driving behavior appropriate to the environment. Traffic calming objectives include:

- improving driver behavior, concentration and awareness;
- reducing speed, disturbance and anxiety; and
- enhancing the environment.

Traffic calming devices may be used individually or collectively in order to produce a comprehensive plan that best balances the priorities of access for residents and the protection of quality of life issues related to through traffic. Several of these alternatives are listed below.

Street Narrowing techniques, often referred to as "chokers", are created by curb modifications, channelization and landscaping features that narrow the roadway to a minimum width (for two-lanes) for a short distance. Consequently, the roadway will become less attractive to non-local residents, as well as reduce the possibility of motorists traveling at higher speeds than intended for the roadway. Similar to chokers, neck-downs are located mid-block. They restrict traffic to one-way flow for a portion of the block. Significant volume and speed reduction can occur if narrowing, either physically or psychologically (via pavement markings), limits use of the section to one direction at a time.

Chicanes are a form of curb extension or "chokers" that alternate from one side of the street to the other. They have the advantage of not blocking emergency vehicle access. They should be constructed by use of curb bulbs to allow the emergency vehicles to run over the mountable curbs when opposing traffic is met. The devices should be made visible with signs, painted curbs, landscaping, reflectors, and streetlights. Chicanes create deviations that redirect the path of travel so that the street is no longer straight. This will likely create an environment that is less pleasing to speedy motorists and make alternative routes for through traffic more desirable.

Illustration of a Chicane

Speed Humps are frequently used to control speeds along local streets. Speed humps are carefully profiled humps creating vertical constraints on speed, which are designed based upon the desired vehicle speed. The features are commonly placed at intervals along the roadway ranging from 260 to 425 feet; otherwise the devices can have no significant impact on overall travel speeds on the street segment. They are difficult to construct properly as the height and curvature of the bump greatly affect its performance.

Typically, speed humps have a height of less than five inches and differentiate from speed bumps in that they are much wider, require less maintenance and are gentler to the vehicle's undercarriage. Similarly, they interfere less with snowplow operations during the winter months than do speed bumps. Residents who live along streets with speed humps are generally in favor of their installation and feel they accomplish the desired purpose of reducing speeds and, in some cases, traffic volumes.

Speed Tables are similar to speed humps in the sense that they are vertically applied speed constraints. However, they are often designed so as to include a "table" or flat portion, which typically doubles as a pedestrian crosswalk. Speed tables are often used in roadway environments where other modes of travel (i.e. walking) are given priority. A speed table must be long enough for both the front and rear wheels of a vehicle to be on top of the table at once (8 to 12 feet long). Speed tables are normally 4 inches high and are especially useful in reducing vehicle speeds that are posing a safety concern or nuisance to local residents. Versions of speed tables are also used in order to slow down traffic at dangerous intersections where pedestrian volumes are also high (raised intersections).

Illustration of a Speed Table

Speed Cushions are similar to speed humps and speed tables in the sense that they are vertically applied speed constraints. However, they have been developed to overcome some of the emergency services' objections to speed humps and speed tables, as they allow wide vehicles to straddle the cushion to cross at a higher speed. They are best constructed from removable rubber segments. They should be carefully positioned and dimensioned so as to slow the majority of traffic.

Illustration of a Speed Cushion

Gateway/Perimeter Treatments can be used to passively communicate a message that a motorist is entering an area that is intended for use by local residents only. Signs, landscaping, street narrowing, and other visual and/or physical features can be used individually or in conjunction with a gateway to discourage through traffic. A landscape architect could be consulted to help planners and citizens choose landscaping elements that, when mature, would allow both pedestrians and drivers clear lines of sight while still creating a sense of place. Trees could be planted to enhance the image of street as a place with which residents can identify. Tree plantings can also create the perception of interrupted sight lines and a narrow field view that cause motorists to slow down and widen their field of vision, becoming more aware that there may be pedestrians near the traffic way.

Diagonal Diverters are barriers installed diagonally across standard, four-way intersections to convert them into two unconnected streets. Considered to be a type of street closure, diagonal diverters are intended to reduce cut-through traffic by obstructing traffic movements in one or more directions. Advantages to using diagonal diverters include significant reduction in number of crashes (since conflicting movements are eliminated), reduced traffic volumes and increased pedestrian safety. Disadvantages include inconvenience to residents trying to gain access to their properties, as well as increased noise due to acceleration and deceleration of vehicles through the sharp turns. Also, by limiting access to only one street, traffic volumes can shift to adjacent streets. Therefore, an area-wide approach must be used.

Street Closures are typically used as a last resort. This is a highly constrictive measure, which impacts traffic flows by eliminating neighborhood circulation as well as the through traffic. Street closures are difficult to implement on existing roadways due to right-of-way constraints, disruption to emergency vehicle operation and problems with establishing precedence for street closures. Turn-around areas are necessary for circulation of large vehicles including delivery trucks, trash trucks and emergency response vehicles. The impact on traffic is drastic, reducing volumes to that which is generated by the land use on the abutting properties. Streets could be closed by means of a barrier or planter, which would create an opportunity for landscaping and neighborhood beautification. However, potential conversion of a street use from public to private use requires legal action, and there may be a need to grant easements for utilities and other municipal services.

A street closure should be clearly identified by signs indicating that the street is no longer a through street. The use of dead-end streets to reduce traffic volumes is one of the most expensive and least desirable techniques employed for traffic calming with respect to issues of accessibility for emergency vehicles. In fact, the emergency response agencies should be included in any discussions that affect their access. Existing movement of pedestrians, bicyclists, and people with disabilities should be evaluated and accommodated by provision of through sidewalks with ramps.

2030 Build Conditions

In an effort to determine the ability of the area road system to accommodate long-term traffic demands, "Design Year" 2030 traffic conditions were evaluated.

2030 No Build and Build Traffic Volumes

As discussed with the City, the 2025 No Build traffic volumes presented in the FHU study were increased to account for an additional five years of background traffic growth. As directed by the City, the traffic volumes on Catron Boulevard, 5th Street and Stumer Road were increased by approximately 10%, accounting for an annual growth of approximately 2% per year for years 2025 to 2030. The traffic volumes on Parkview Drive were increased by approximately 5%, accounting for an annual growth of approximately 1% per year for years 2025 to 2030.

The 2030 No Build Traffic Volumes were further adjusted to account for the future non-residential development of the property south of Catron Boulevard from approximately 1200 feet west of Black Hills Boulevard to approximately 1200 feet east of 5th Street. The land uses, anticipated density and resulting number of trips generated from the 150 acres were provided by City staff based on the adopted South Robbinsdale and US Highway 16 Future Land Use Plans. The approximate location of the non-residential development areas are depicted in **Figure 10**. The trip generation rates were based on the *Trip Generation Manual*, 8th Edition, published by ITE. The following trip generation rates were used:

- Shopping Center (ITE Land Use 820) for the land use category general commercial;
- Specialty Retail Center (ITE Land Use 814) for the land use category neighborhood commercial;
- General Light Industrial (ITE Land Use 110) for the land use category light industrial; and
- General Office Building (ITE Land Use 710) for the land use category office commercial.

Specific trip rates based on the actual development plan will be required to be used at the time of the development of the 150 acres. Based on the City's adopted Future Land Use, the 150 acres was assumed to develop with the following uses:

- 65 acres of general commercial;
- 20 acres of neighborhood commercial;
- 50 acres of office commercial; and
- 15 acres of light industrial.

The estimated trip generation for the 150 acres is approximately 1,040 trips entering and 1,350 trips exiting. As requested by the City, these trips were assigned to the roadway network with the majority of trips expected to utilize the intersection of Catron Boulevard and 5th Street.

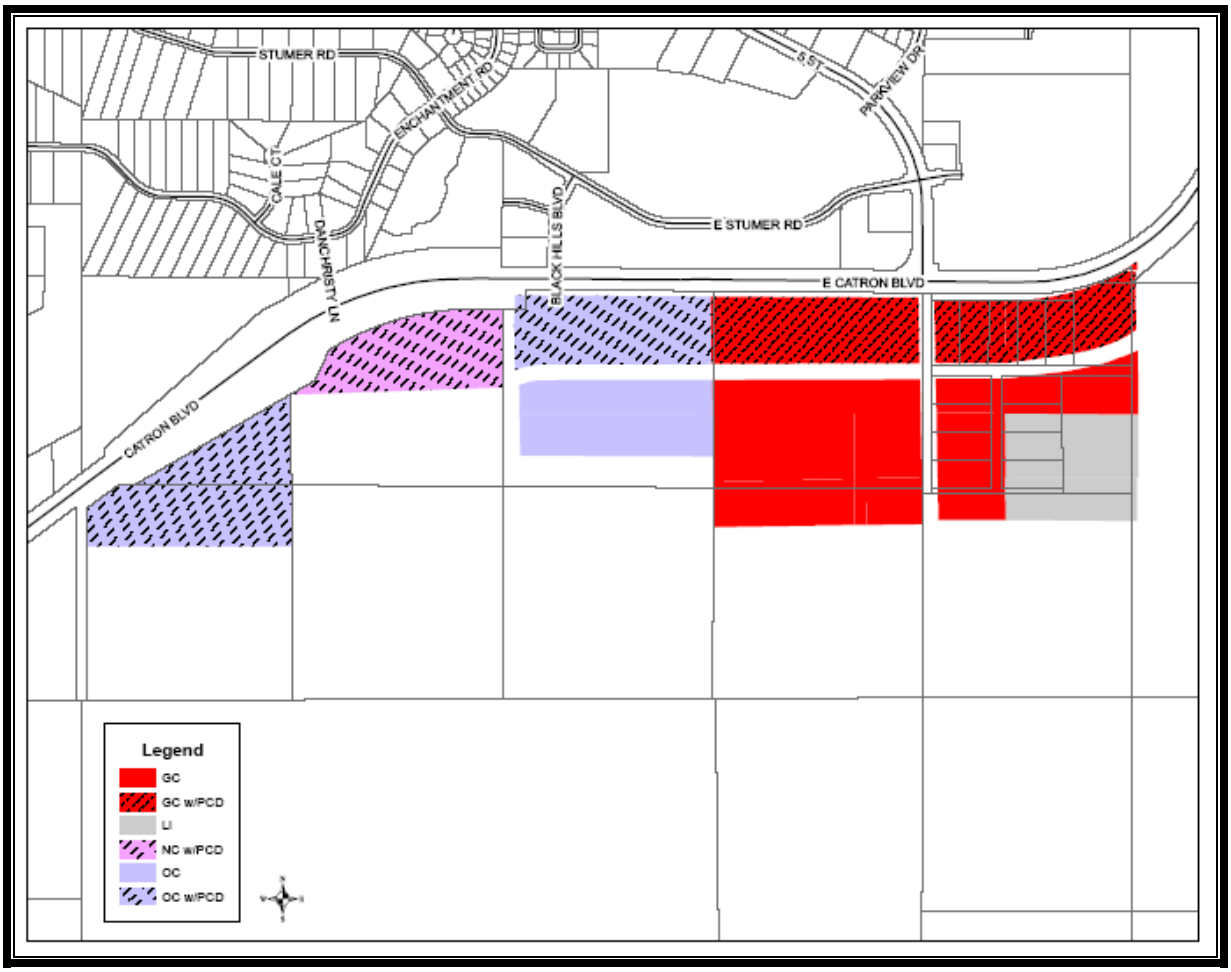

Figure 10: South Robbinsdale Future Land Use Area – Non-Residential Areas

The 2030 No Build Traffic Volumes are depicted in **Exhibit 6**.

The site-generated trips associated with the proposed Black Hills Center development area were aggregated with the 2030 No Build traffic volumes, resulting in the 2030 Build traffic forecast depicted in **Exhibit 7**.

2030 Build Operating Conditions

The 2030 Build traffic volumes were analyzed using the same methodology applied to the previous scenarios. The results of the 2030 Build operating conditions are summarized in **Table 14**.

By year 2030, it is anticipated that both Black Hills Boulevard and 5th Street would extend south of Catron Boulevard. The addition of a fourth leg to the intersections of Catron Boulevard with 5th Street and Black Hills Boulevard requires additional green time for the northbound approach that was not required in the 2010 Build conditions. As a result of the fourth leg and the substantial increase in traffic due to the 150 acre tract, the two intersections would decline to LOS D overall.

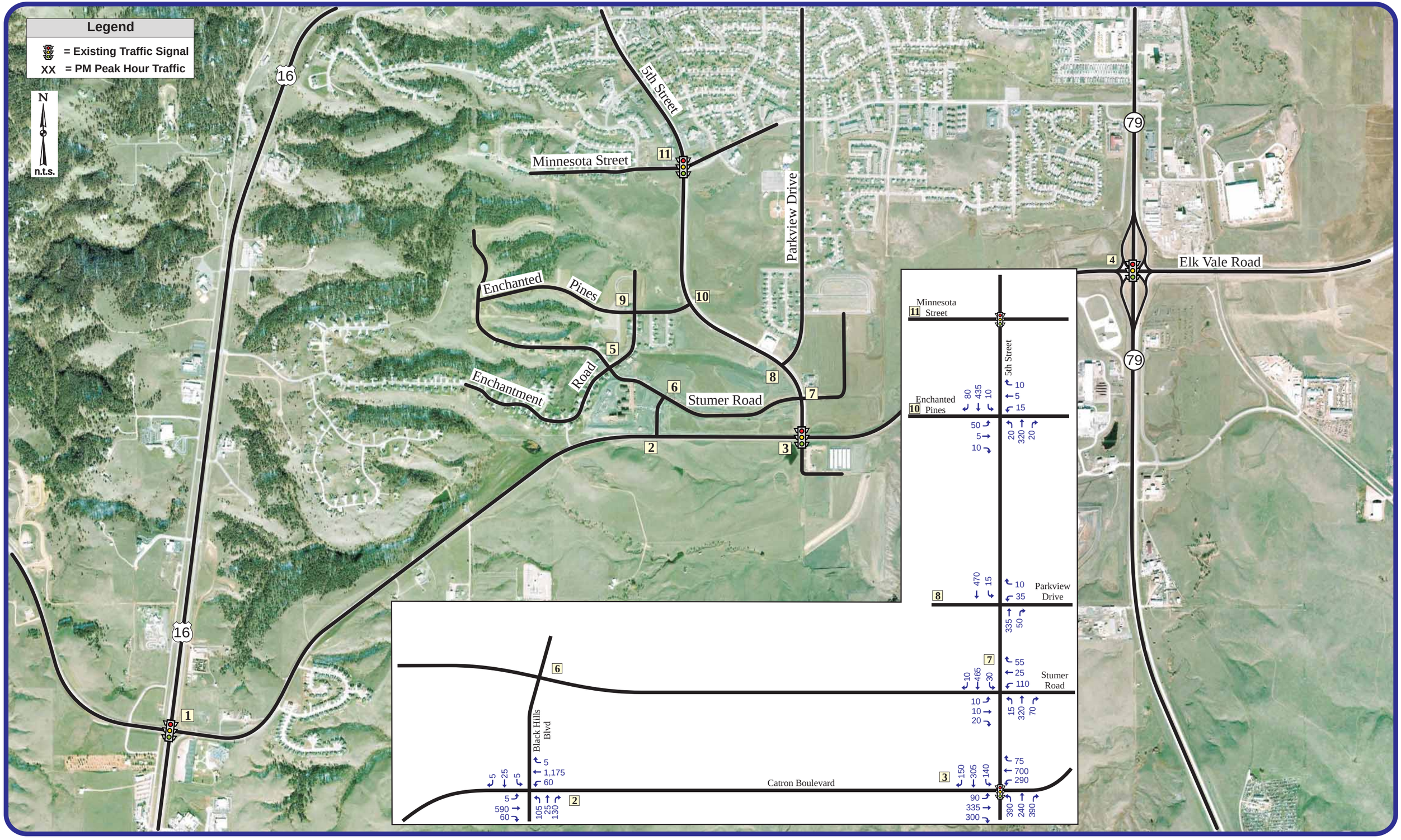

Exhibit 6: 2030 No Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
4/21/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

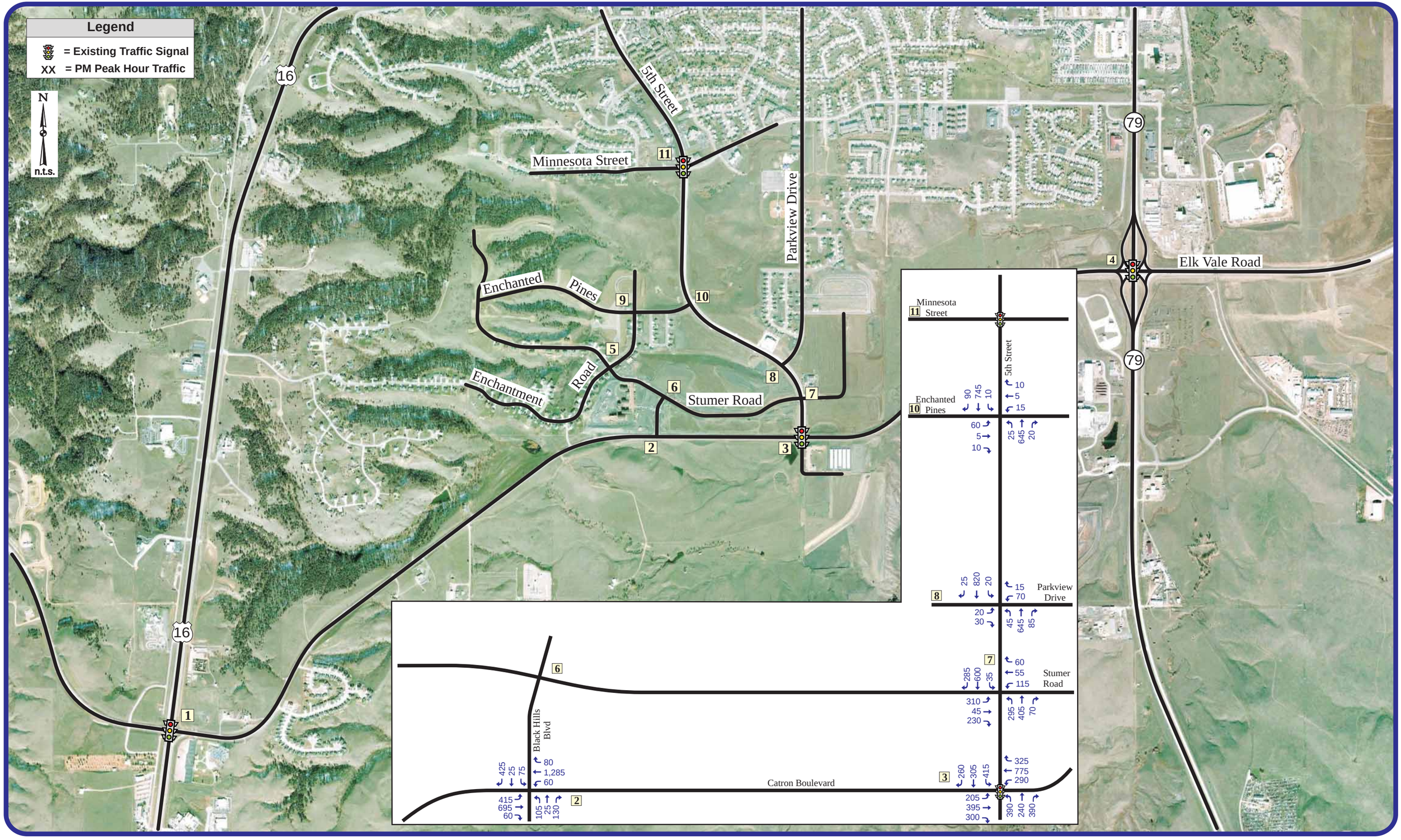

Exhibit 7: 2030 Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
4/21/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Table 14: 2030 Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Weekday PM Peak Hour (Improved)
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	C (25.7)	NA
Westbound Catron Boulevard Approach	D (38.3)	NA
Northbound 5th Street Approach	D (45.6)	NA
Southbound 5th Street Approach	C (33.2)	NA
Overall Intersection	*D (36.2)*	NA
Catron Boulevard & Black Hills Boulevard (signalized)		
Eastbound Catron Boulevard Approach	D (53.3)	C (31.8)
Westbound Catron Boulevard Approach	D (35.8)	C (34.2)
Northbound Black Hills Boulevard Approach	D (42.8)	D (38.1)
Southbound Black Hills Boulevard Approach	E (62.2)	E (57.4)
Overall Intersection	*D (46.5)*	*D (37.3)*
5th Street & Stumer Road (signalized)		
Eastbound Stumer Road Approach	D (42.1)	NA
Westbound Stumer Road Approach	D (44.1)	NA
Northbound 5th Street Approach	B (10.0)	NA
Southbound 5th Street Approach	C (20.2)	NA
Overall Intersection	*C (24.4)*	NA
5th Street & Parkview Drive (Side-Street Stop)		
Eastbound Parkview Drive Approach	D (30.2)	NA
Westbound Parkview Drive Left-Turn	F (89.8)	NA
Northbound 5th Street Left-Turn	B (10.2)	NA
Southbound 5th Street Left-Turn	A (9.3)	NA
5th Street & Enchanted Pines Drive (Side-Street Stop)		
Eastbound Enchanted Pines Drive Approach	F (84.6)	NA
Westbound Enchanted Pines Drive Approach	D (34.1)	NA
Northbound 5th Street Left-Turn	B (10.0)	NA
Southbound 5th Street Left-Turn	A (9.2)	NA

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Additionally, the westbound left-turn at Parkview Drive and the eastbound left-turn at Enchanted Pines Drive onto 5th Street would decline to LOS F by year 2030 should the growth represented in the 2030 volumes be reached. It is recommended that as additional development occurs along

Catron Boulevard and 5th Street that the traffic volumes at 5th Street and Enchanted Pines Drive and 5th Street and Parkview Drive be monitored to determine if traffic signals are warranted.

In order to provide improved operating conditions at the intersection of Catron Boulevard and Black Hills Boulevard, it may be necessary to provide eastbound dual-left turn lanes on Catron Boulevard into the Black Hills development area should the 20-year traffic volumes materialize. Furthermore, in order to accommodate eastbound dual left-turns, Black Hills Boulevard would require two northbound through lanes from Catron Boulevard to Stumer Road. Given the majority of the left-turn motorists are destined to a right turn onto Stumer Road (approximately 600 feet north of the intersection), the dual left-turn lane would have reduced benefit due to the uneven lane utilization of the second turn lane. Although it is not recommended that the dual left-turn lane be constructed at this time, it may be appropriate to preserve the right-of-way required should the dual lefts be necessary in the future. The results of the improved 2030 Build operating conditions are also summarized in Table 14.

Although the 2030 Build forecasts incorporated an estimated impact for the 150 acres in the southwest quadrant of Catron Boulevard and 5th Street, it is important to acknowledge that the estimate was based on an aggressive development assumption for the tract. It is strongly recommended that when an actual development plan for the 150 acres is considered by the City, that a traffic impact study be required at that time for the development to determine the impact of the development plan and to mitigate any adverse impacts. Furthermore, at the City's request the entire trip generation for the 150 acres was assigned to the roadway network via the two intersections of Catron Boulevard and Black Hills Boulevard and Catron Boulevard and 5th Street. It is apparent by the City's Major Street Plan that a portion of these trips would likely be headed south on 5th Street and/or Black Hills Boulevard or along parallel roadways south of Catron Boulevard.

Conclusions

Crawford, Bunte, Brammeier prepared the preceding report to address the traffic impacts associated with the proposed Black Hills Center commercial development in Rapid City, South Dakota. The following sections summarize the findings and recommendations of the scenarios analyzed.

2010 No Build Conditions

Based on the evaluation of the 2010 No Build conditions, all of the study intersections had overall favorable operating conditions during the weekday p.m. and Saturday midday peak hours with each intersection approach operating at LOS C or better with the majority operating at LOS A or B during the peak hours.

It is apparent that the recent extension of 5th Street and the planned widening of Catron Boulevard will provide significant excess capacity on the roadway network. In fact, the need for these programmed roadway projects was based, in part, on additional commercial development along the corridors.

2010 Build Conditions

Traffic forecasts were prepared for the proposed development, which is expected to generate a total of 2,630 *new* trips during the weekday p.m. peak hour and 2,870 *new* trips during the Saturday midday peak hour.

In order to accommodate the proposed development traffic, the following roadway and traffic control improvements are recommended:

- Signalize the intersection of Catron Boulevard and Black Hills Boulevard.
- Signalize the intersection of 5th Street and Stumer Road.
- Coordinate the two proposed traffic signals with the existing traffic signal at Catron Boulevard and 5th Street with a hard wire interconnect.
- Construct dual eastbound left-turn lanes on Stumer Road at 5th Street. It may be appropriate to only utilize one of the left-turn lanes until the traffic volumes warrant the dual left-turn or safety becomes an issue with the driveway serving the future bank and gas station.
- Construct a separate southbound right-turn lane on 5th Street at Stumer Road.
- Construct a separate westbound right-turn lane on Catron Boulevard at Black Hills Boulevard.
- Coordinate with the SDDOT to extend the eastbound left-turn storage at the intersection of Catron Boulevard and Black Hills Boulevard from 400 feet to 460 feet.
- Construct dual southbound left-turn lanes on 5th Street at Catron Boulevard.

- Convert the existing all-way STOP at Stumer Road and Black Hills Boulevard to a side-street STOP condition with Black Hills Boulevard operated under stop control and Stumer Road maintaining the right-of-way. Alternatively, a single-lane roundabout would also provide favorable operations.
- Construct a separate westbound right-turn lane on Stumer Road at the main Walmart drive.
- Construct a separate westbound right-turn lane at the east driveway on Stumer Road servicing the retail shops.
- Consider providing a separate northbound right-turn lane on Black Hills Boulevard at Outlot 10.
- Maintain free operation for the three perimeter traffic signals at Highway 16 and Catron Boulevard, Highway 79 and Catron Boulevard, and 5th Street and Minnesota Street.

The 2010 Build traffic volumes were reanalyzed in an effort to identify the impacts of the proposed development and to evaluate the adequacy of the proposed roadway and traffic control improvements to mitigate those impacts. The evaluation reflected the implementation of the proposed improvements noted above.

Even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 5th Street and the pending widening project on Catron Boulevard. Both of these roadways were designed taking into account the potential future commercial within the 5th Street and Catron Boulevard corridors.

2030 Build Conditions

"Design Year" 2030 traffic conditions were evaluated in an effort to determine the ability of the area road system to accommodate long-term traffic demands. The 2030 Build analyses include the future non-residential development of the property south of Catron Boulevard from approximately 1200 feet west of Black Hills Boulevard to approximately 1200 feet east of 5th Street. By year 2030, it is anticipated that both Black Hills Boulevard and 5th Street would extend south of Catron Boulevard. The addition of a fourth leg to the intersections of Catron Boulevard with 5th Street and with Black Hills Boulevard introduces additional signal phases not required in the 2010 Build conditions. As a result of the fourth leg and the substantial increase in traffic due to the 150 acre tract, the two intersections would decline to LOS D overall.

Consequently, the following roadway improvement may be necessary to accommodate the 2030 traffic conditions:

- Consider providing eastbound dual-left turn lanes on Catron Boulevard at Black Hills Boulevard. In order to accommodate the eastbound dual left-turns, Black Hills Boulevard would require two northbound through lanes from Catron Boulevard to Stumer Road.

Supplemental Correspondence

MEMORANDUM

TO: Robert Green, THF Realty
Shawn White, Crawford, Bunte, Brammeier

FROM: Monica Heller, Community Planning Coordinator

DATE: April 8, 2010

RE: Black Hills Center Traffic Impact Study

Staff from the City of Rapid City and the South Dakota Department of Transportation have reviewed the Traffic Impact Study for the proposed Black Hills Center dated March 2010 and have the following comments:

Comments on the Traffic Impact Study

1. The public has requested that daily trip generation and distribution of daily trips on the roadway network be included in the Traffic Impact Study.

Included in Revised Traffic Impact Study dated April 2010.
Note that the ADT counts were provided by the City.

2. In order to address the public's concerns, the Traffic Impact Study should identify steps to discourage cut through traffic from using the neighborhood road system west of Black Hills Blvd.

Discussion regarding the travel time summary and potential traffic calming measures is provided in the Revised Traffic Impact Study dated April 2010. Although the study does not support the presence of "cut-thru" traffic, it is anticipated that a traffic calming plan will continue to be coordinated between the City, residents and developer.

3. The Traffic Impact Study suggests that there is existing cut-thru traffic from Fifth St to Catron via Enchanted Pines Drive/Enchantment Road/Dan Christy Lane. However, no documentation has been provided in the study. The study should include documentation on how that determination was made, how the proposed development will affect the cut through traffic and the steps that should be taken to address the cut through traffic.

After further data collection, i.e. traffic counts at the intersection of Catron and Dan Christy and vehicle tracing through the subdivision, there is not a current cut-thru issue of motorists traveling through the subdivision to bypass the intersection of Catron and 5th Street. Thus, all text in the preliminary TIS was removed with regards to Dan Christy being used as a cut-thru route. We will remove this section from the report and revise the analysis accordingly. The minimal left-turn movements at Dan Christy (shown in Fig 5 in the TIS) were reassigned to Black Hills Boulevard.

4. Black Hills Blvd and Stumer Road are not collectors on Rapid City's Major Street Plan. Dan Christy Lane is a collector on Rapid City's Major Street Plan. The Traffic Impact Study should be revised to reflect the classifications of these roadways consistent with Rapid City's Major Street Plan.

The correct classification is reflected in the Revised Traffic Impact Study dated April 2010.

5. Include a summary of the analysis of the Enchantment Road/Stumer Road intersection in the Traffic Impact Study.

Included in Revised Traffic Impact Study dated April 2010.

6. Verify that the proposed signal cycle lengths provide adequate time to accommodate pedestrian movements at signalized intersections based on the latest MUTCD.

The pedestrian times were calculated for the intersection of 5th Street and Stumer Road and the signal timings were modified to ensure that the required pedestrian intervals were accommodated.

7. As recently discussed with the developer, the South Dakota Department of Transportation has informed the City of Rapid City that due to difficulties in acquiring right-of-way along Catron Blvd, the widening project has been delayed. The Traffic Impact Study assumes the completion of the Catron Blvd project. Due to the uncertainty of when Catron Blvd will be widened, further discussion and traffic analysis in the Traffic Impact Study is needed to determine how much development can occur prior to the widening of Catron Blvd and what alternative improvements may be needed.

In the revised Traffic Impact Study we stated that the Catron widening project was pending and would likely be delayed until this Fall. We should have a better idea as to the timing of the widening at the Final Development Plan submittal. Regardless, it is anticipated that the widening would occur prior to the Walmart store opening in 2012.

8. The South Dakota Department of Transportation plans for the widening of Catron Blvd. do not show a WB right turn lane at Black Hills Blvd. The traffic analysis was done with a WB right turn lane. Revise analysis to show it will operate without the WB right turn lane or commit to construction of WB right turn lane on Catron Blvd at Black Hills Blvd.

A westbound right-turn lane is warranted and is included as a recommendation in the revised Traffic Impact Study.

9. The 2010 Saturday queue length for the EB left at the intersection of Catron Blvd/Black Hills Blvd. is 457 feet. The proposed left turn lane will only have 400 feet of storage. Work with South Dakota Department of Transportation to extend left turn lane or review a dual EB left turn lane. This would reduce the queue length, but the additional left turn lane will probably not get very good lane utilization and additional ROW would be needed on Black Hills Blvd to add another NB lane. Since the majority of traffic on Black Hills Blvd is heading to Walmart, it may operate better to realign Black Hills Blvd into the east leg of Stumer Road rather than installing a roundabout. The realignment could help accommodate the additional EB left turn lane on Catron. The west leg of Stumer Road would be a stop condition which may reduce cut through traffic in the residential neighborhood.

A recommendation to extend the eastbound left-turn storage is included as a recommendation in the revised Traffic Impact Study.

10. The South Dakota Department of Transportation has expressed concerns regarding the grade of the west leg of the Catron Blvd/Black Hills Blvd intersection. The heavy truck movement, long queues at the proposed signal and the downgrade will required some additional safety measures to be installed with the signal. These may include advance traffic signal ahead warning signs, advanced loops etc. This should be identified in the Traffic Impact Study and coordinated with the South Dakota Department of Transportation.

The need for advance loops and coordination with the SDDOT on the signal design is included in the revised Traffic Impact Study

11. A SB right turn lane does not currently exist at the intersection of Fifth Street and Stumer Road. The analysis was done with a SB right turn lane in place. Revise the analysis to show how it will operate without the SB right turn lane or commit to construction of SB right turn lane.

A southbound right-turn lane is warranted and is included as a recommendation in the revised Traffic Impact Study.

12. The SB left turn lane at Catron Blvd/Fifth Street will not accommodate the anticipated queue length in 2010. Commit to reconstructing the turn lane to provide adequate storage for anticipated queue, (this may require the construction of a dual SB left turn lane.)

Southbound dual-left turns are included as a recommendation in the revised Traffic Impact Study.

13. The Traffic Impact Study shows 120 trips entering and 70 trips exiting the south leg of the Catron Blvd/Black Hills Blvd intersection, with no thru trips and 430 trip entering and 520 trips exiting the south leg of the Catron Blvd/Fifth Street intersection. The engineer for the property owner to the south has objected to the analysis noting that substantial build out of the commercial uses on the south side of Catron Blvd will occur by 2030. The adopted Future Land Use shows approximately 65 acres of General Commercial, 20 acres of Neighborhood Commercial, 50 acres of Office/Commercial and 15 acres of Light Industrial on the south side of Catron Blvd that would access either Black Hills Blvd or Fifth Street. Using general Institute of Transportation Engineer's trip generation rates for these land uses and anticipated build out of the commercial property south of Catron Blvd in 2030, the 2030 volumes should be revised to 47 trips entering and 229 exiting the south leg of the Catron Blvd/Black Hills Blvd intersection

    and 996 trips entering and 1120 trip exiting the south leg of the Catron Blvd/Fifth Street intersection. These trips are an estimate, the actual trips generated by the property to the south will be dependent on the actual uses at the time of development.

The additional trips associated with the 150 acre tract are included in the revised 2030 analysis. However, it is anticipated that when the 150 acres develops, a new traffic impact study would be required to determine the impact of the actual planned development at that time.

14. The Traffic Impact Study indicates the queue length for the EB left at Stumer Road/Fifth Street is 290 feet and the delay is 49 seconds. A dual left turn lane may operate better and reduce the delay and queue length. It will be difficult to provide a left turn lane into the future bank and gas station and maintain adequate storage for the EB left on Stumer Road at Fifth Street if a dual left turn lane is not constructed.

Eastbound dual-left turns are included as a recommendation in the revised Traffic Impact Study.

15. The traffic impact study should address the concern the public has expressed about accessing Fifth Street from Parkview Dr and Fifth Street from Enchanted Drive with the increased traffic on Fifth Street.

Addressed in Table 7 and page 30, paragraph 4 of the revised Traffic Impact Study.

General Traffic Comments

1. Staff recommends that left turns out of the southern most east/west drive aisle within the WalMart site be restricted. This will allow for a longer NB left turn lane and will reduce conflicts.

This modification is reflected in the revised Development Plan.

2. A channelized right turn lane on Stumer is not recommended. These tend to increase speed of right turners and make it more difficult for pedestrians to cross.

This modification is reflected in the revised Development Plan.

3. The location of the driveway to Outlot 10 is shown in different locations on sheet EX-10 and C-1. Please revise sheets to be consistent.

Coordinated with Civil Engineer

4. Please revise the site plan to address truck traffic through the site. The plan showing the truck turning templates, show trucks do not have adequate maneuvering room without encroaching on adjacent travel lanes or landscape islands.

Civil Engineer to provide

5. The proposed roundabout needs to be designed based on FHWA design guidelines.

Understood

6. Sidewalks are required to be constructed along Catron Blvd at the time a building permit is issued for each lot with frontage on Catron Blvd. The need for additional pedestrian access between Catron Blvd and Stumer Road will be reviewed when an Initial Development Plan is submitted for those lots.

Under discussion

7. All traffic signals installed shall have preemption for emergency vehicles.

Understood

8. Bike parking shall be provided. Based on public comment we have received, the bike parking shall be of a design so that the frame of the bike can be easily locked to the bike rack.

Understood

9. Staff has received some indication that a drive thru pharmacy will be included with the proposed WalMart. Adequate stacking and by pass lane will be required.

Civil Engineer

10. Due to the close proximity of residential development to the site, and based on the public comments received, it is anticipated that there will be significant pedestrian and bicycle traffic to and from the site. The Traffic Impact Study and Development plan must demonstrate how pedestrian and bicycles will be accommodated along public right-of-way and internal to the site to address this need.

Understood

In addition, the comments provided by the SDDOT Pierre office are also addressed in the revised Traffic Impact Study per our discussion on Monday, April 19, 2010.

CITY OF RAPID CITY

RAPID CITY, SOUTH DAKOTA 57701-2724

PLANNING DEPARTMENT

300 Sixth Street

Monica Heller, Community Planning Coordinator
Growth Management Department
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Phone: 605-394-4120
Fax: 605-394-6636
e-mail: monica.heller@rcgov.org

MEMORANDUM

TO: Robert Green, THF Realty
Shawn White, Crawford, Bunte, Brammeier

FROM: Monica Heller, Community Planning Coordinator

DATE: May 14, 2010

RE: Black Hills Center Traffic Impact Study

Staff from the City of Rapid City and the South Dakota Department of Transportation have reviewed the Revised Traffic Impact Study for the proposed Black Hills Center dated April 2010 and have the following comments:

Comments on the Traffic Impact Study

1. Page 1, third paragraph, last sentence – change study to report.

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

2. Page 2, third bullet – should address how the signals will be coordinated – will hard wired interconnect be provided?

The traffic signal interconnect would be provided via hard wire interconnect. This revision is reflected in the Revised Traffic Impact Study dated May 2010.

3. Page 2, fourth bullet, second sentence - should be turn not turns.

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

4. Page 2, seventh bullet – Revise to state: Construct eastbound left-turn lane at the intersection of Catron Boulevard and Black Hills Boulevard to provide 460 feet of storage.

The recommendation was revised to state "Coordinate with the SDDOT to extend the westbound left-turn storage at the intersection of Catron Boulevard and Black Hills Boulevard from 400 feet to 460 feet." As addressed in the Phase I & II analysis (Supplemental Correspondence Item 5), the existing 400 foot left-turn bay is sufficient to accommodate the initial planned development.

5. Page 2, eleventh bullet – Revise to state: Construct a separate westbound right-turn lane at the east driveway on Stumer Road servicing the retail shops

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

6. Page 4 first and second sentences – change study to report.

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

7. Exhibit 1: Site Plan – change Eagle Ridge Lane to Bald Eagle Lane

Requested modification to the exhibit is reflected in the Revised Traffic Impact Study dated May 2010.

8. Page 7, second paragraph, second sentence – revise to state: Catron Boulevard currently extends from Sheridan Lake Road on the west to SD79/Cambell Street on the east.

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

9. Page 7, third paragraph, second sentence – clarify what additional turn lanes are included as part of SDDOT's construction project and what will be funded by SDDOT and by Black Hills Center.

The report was revised to state the following:

"Based on recent conversations with the SDDOT, construction is expected to begin this fall to widen Catron Boulevard from Highway 16 to just west of Highway 79 to a four-lane roadway with a raised center median. The following additional roadway improvements are planned as part of the Catron Boulevard construction project:

- Construction of a 400 foot eastbound right-turn lane (exclusive of tapers) at 5th Street;
- An extension of the existing westbound right-turn lane at 5th Street to 400 feet (exclusive of tapers); and
- Construction of 400 foot dual eastbound and westbound left-turn lanes (exclusive of tapers) at 5th Street. The second left-turn lane would be stripped out for future use when the traffic volumes warrant the additional left-turn lane.

The existing eastbound 400 foot left-turn lane (exclusive of tapers) at Black Hills Boulevard would be maintained with the widening of Catron Boulevard. In conjunction with the widening, Dan Christy Lane which is just west of Black Hills Boulevard will be converted from a full access intersection to a right-in/right-out only intersection."

10. Page 7, fourth paragraph, third sentence – change either side to both sides

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

11. Exhibit 3: 2010 No Build Traffic Volumes – explain why EB thru and EB left volumes at the intersection of Black Hills Blvd/Catron Blvd and the EB left volume at the intersection of Fifth Street/Catron Blvd are less than the volumes shown in the March 2010 report.

The March 2010 Traffic Impact Study was based on assumptions regarding the traffic counts at Catron Boulevard and Dan Christy Lane, as the City requested the study include the impact of converting Dan Christy Lane from a full access intersection to a right-in/right-out only intersection after the traffic data collection was completed. Furthermore, a portion of the assumed eastbound left-turns on Catron Boulevard at Dan Christy Lane were assigned to the east on Catron Boulevard and north on 5t Street, thus increasing the thru volumes for those movements and decreasing the eastbound left-turn movement on Enchanted Pines Drive at 5th Street.

As part of the April 2010 revised Traffic Impact Study, actual traffic counts were collected at Catron Boulevard and Dan Christy Lane (reflected in Figure 5 of the Traffic Impact Study) which were less than those assumed for the March 2010 study. Furthermore, based on observations and vehicle tracings through the residential development, there was no observed cut-thru traffic utilizing Dan Christy Lane to Enchantment Road to Enchanted Pines to bypass the signal at Catron Boulevard

and 5th Street. Thus, the slight variance in the volumes reflected in Exhibits 3, 5 and 7 are all due to the inclusion of the actual traffic counts and observations at Dan Christy Lane.

12. Page 23, third paragraph, sentences 7 and 10 – change Eagle Ridge Lane to Bald Eagle Lane.

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

13. Exhibit 5 and Exhibit 7 – explain why the EB left turn lanes are less in 2030 than in 2010.

See note for comment #11.

14. Page 43, third paragraph, revise to state – The 2030 Traffic Volumes were further adjusted to account for the future non residential development of the property south of Catron Blvd from approximately 1200' west of Black Hills Blvd to approximately 1200' east of Fifth Street. The land uses, anticipated density and resulting number of trips generated from the 150 acres were provided by City staff based on the adopted South Robbinsdale and US Highway 16 Future Land Use Plans. The trip generation rates were based on the *Trip Generation, Institute of Transportation Engineers, Eighth Edition, 2008*. The trip generation rates used were: Shopping Center (820) for the land use category general commercial, Specialty Retail Center (814) for the land use category neighborhood commercial, General Light Industrial (110) for the land use category light industrial and General Office Building (710) for the land use category office/commercial. Specific trip rates based on the actual development will be required to be used at the time of the development of the 150 acres. Based on the City's adopted Future Land Use, the 150 acres was assumed to develop with the following uses:

(I will email a pdf map of the area we used to include in the report)

Requested modification to the text and inclusion of the map provided by the City is reflected in the Revised Traffic Impact Study dated May 2010.

15. Page 48, first paragraph, first sentence – change study to report

Requested modification to the text is reflected in the Revised Traffic Impact Study dated May 2010.

16. Page 48 and 49, bullets – should be the same as the bullets on pages 2 and 3, see above comments 2 – 5.

Requested modification to the text reflected in Revised Traffic Impact Study dated May 2010 with the exception of bullet 7 which was revised to state "Coordinate with the SDDOT to extend the westbound left-turn storage at the intersection of Catron Boulevard and Black Hills Boulevard from 400 feet to 460 feet."

17. Technical Appendix – the signal phasing for the intersections of Catron Blvd/Fifth Street and Stumer Road/Fifth Street show a lead/lag left turn phase. Lead/Lag left turn phasing is only allowed if both left turn phases are protected only. Consistent with local practice, timings shall be with leading left turn phasing unless there is justification for lagging.

The April 2010 study reflected lead/lag phasing for the eastbound/westbound approaches at the intersection of 5th Street and Stumer Road in the 2030 Build conditions. As requested, the left-turn phasing for the eastbound/westbound approaches was changed to lead/lead. The April 2010 study reflected lead/lag phasing for the eastbound/westbound approaches at the intersection of 5th Street and Catron Boulevard in the 2010 Build conditions. In order to allow lead/lag phasing for improved progression along Catron Boulevard, the westbound left-turn movement was changed from protected/permissive phasing to protected only phasing. The modifications are reflected in Tables 7 and 14 and in the Technical Appendix.

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Since 1973

May 17, 2010

Ms. Marcia Elkins
Director of Growth Management
City of Rapid City
300 Sixth Street
Rapid City, South Dakota 57701-5035

Re: Driveway Widths
Proposed Black Hills Center
Rapid City, Missouri
CBB Job No. 5-10

Dear Ms. Elkins:

On behalf of THF Realty, Crawford, Bunte, Brammeier (CBB) has prepared the following letter to address the proposed driveway widths for the three access driveways serving the Walmart Supercenter and adjacent retail shops within the proposed Black Hills Center development in Rapid City, South Dakota.

The three driveways in question are depicted in the Figure 1. The west driveway servicing the Walmart is proposed as a 36 foot wide driveway comprised of two exiting lanes and one entering lane. The main driveway servicing the Walmart and retail shops is proposed as a 48 foot wide driveway comprised of two exiting lanes and one entering lane. The east driveway servicing the retail shops is proposed as a 36 foot wide driveway comprised of two exiting lanes and one entering lane.

According to Rapid City's Street Design Criteria Manual, the maximum width for commercial driveways is 28 feet measured at the throat of the driveway. However, a width of 28 feet only allows for one lane entering and one lane exiting the driveway. Based on the higher traffic volumes anticipated at the three driveways serving the proposed Walmart and retail shops, it is desirable to provide two lanes exiting the driveways in order to serve the left- and right-turn movements separately. (For reference, Exhibit 5 - *2010 Build Traffic Volumes* from the Black Hills Center Traffic Impact Study is attached.)

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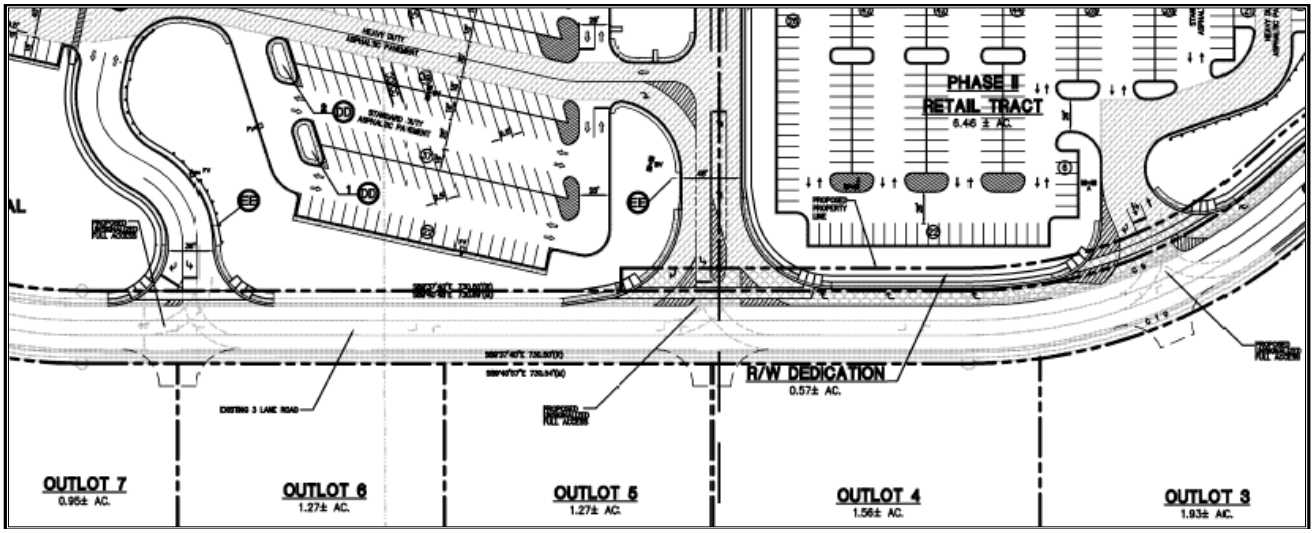

Figure 1: Access Drives Serving the Proposed Walmart and Retail Shops

Furthermore, by providing separate left- and right-turn lanes exiting the proposed driveways, the level of service for the driveway approaches are significantly improved. For example, at the west driveway servicing the Walmart, the southbound approach would decline from LOS B to LOS C during the weekday p.m. peak hour and from LOS C to LOS D during the Saturday midday peak hour if only one exiting lane were provided. Likewise, at the main Walmart/retail shops driveway, the southbound approach would decline from LOS D to LOS E during the weekday p.m. peak hour and from LOS E to LOS F during the Saturday midday peak hour if only one exiting lane were provided.

Although the measured level of service benefits are not as pronounced at the east driveway servicing the retail shops, the delay would be reduced by providing two exiting lanes to separate the left- and right-turn traffic. Furthermore, a driveway width in excess of the 28 feet is required to accommodate the truck turning maneuvers, as depicted in the truck routing plan provided by Wolverton and Associates.

Although 36 feet would accommodate two exiting lanes and one entering lane at the main driveway servicing the Walmart and retail shops, the driveway is proposed as a 48 foot wide driveway in order to allow for a northbound left-turn lane at the first drive aisle servicing the Walmart parking field. This northbound left-turn lane is recommended to separate the left-turn traffic from the through traffic as motorists enter the main Walmart entrance.

In conclusion, in order to provide improved levels of service it is recommended that the three driveways serving the Walmart and retail shops be constructed to provide separate left- and right-turn lanes exiting the driveway and one lane entering the driveway.

We trust that this assessment provides adequate justification for driveway widths in excess of City's maximum 28 feet. Should you have questions or require additional information, please do not hesitate to contact me or Julie Nolfo at 314-878-6644 or via email at swhite@cbbtraffic.com.

Sincerely,

Shawn Lerai White, P.E., PTOE
Senior Traffic Engineer

Julie M Nolfo, PE, PTOE
Senior Traffic Engineer

cc Mr. Robert Green – THF Realty

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Since 1973

May 24, 2010

Ms. Marcia Elkins
Director of Growth Management
City of Rapid City
300 Sixth Street
Rapid City, South Dakota 57701-5035

Re: Pharmacy Drive-thru Circulation
Proposed Black Hills Center
Rapid City, Missouri
CBB Job No. 5-10

Dear Ms. Elkins:

On behalf of THF Realty, Crawford, Bunte, Brammeier (CBB) has prepared the following letter to address the traffic circulation for the proposed pharmacy drive-thru on the north side of the Walmart Supercenter within the proposed Black Hills Center development in Rapid City, South Dakota. The location of the Pharmacy drive-thru relative to the building is depicted in Figure 1.

Figure 1: Pharmacy Drive-Thru Location Relative to the Building

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Based on data provided by Walmart, the proposed pharmacy is estimated to serve approximately 100 customers per day with approximately 10 to 15 of those occurring during the peak hour. As shown in Figure 2, over half of the *hourly* volume could be accommodated within the existing stacking area. Thus, the stacking provided for the pharmacy drive-thru lanes is more than adequate.

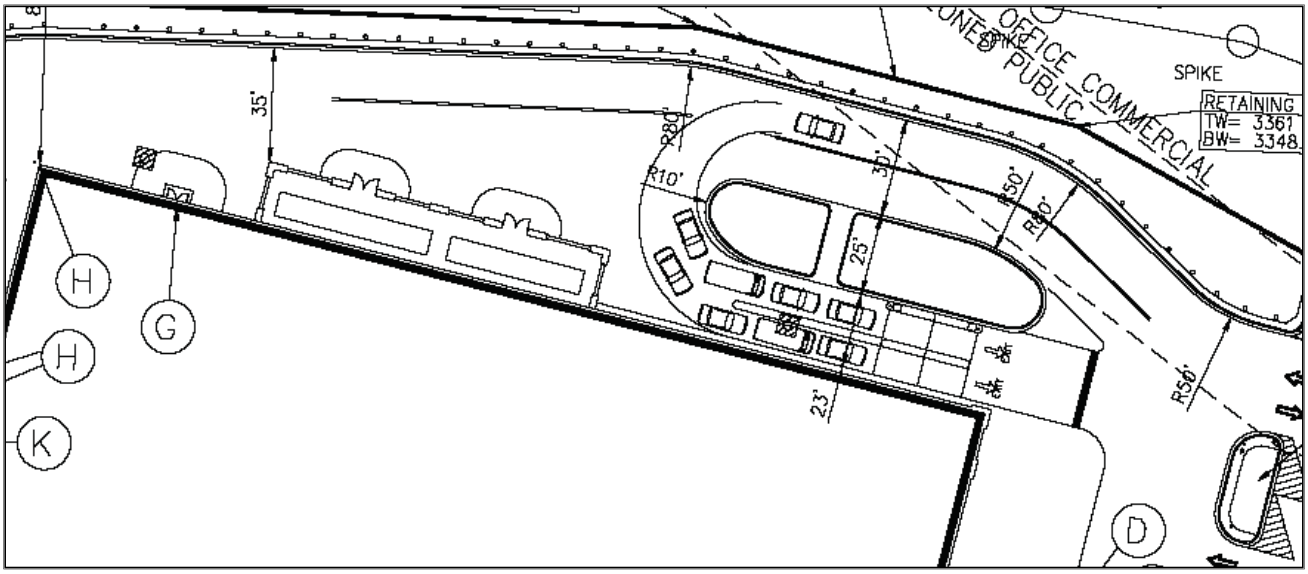

Figure 2: Pharmacy Drive-Thru Queuing

Given the proposed location of the pharmacy drive-thru, the potential for a patron of the pharmacy entering the pharmacy queue to encounter oncoming traffic is very limited. As previously submitted to the City, the estimated number of truck deliveries to the Walmart Supercenter is approximately 88 trucks per day with a majority of the deliveries occurring between 6:00 a.m. and 12:00 a.m. Based on the 18 hour delivery period for the 88 trucks, one could conservatively estimate that 10 to 20 percent of the truck deliveries (or 9 to 18 trucks) could occur within a given hour. However, based on the Truck Routing Plan, trucks enter the delivery behind the building on the north side of the building and exit on the south side of the building, so very minimal truck traffic is expected to be traveling east along the north side of the building potentially opposing pharmacy customers.

Although very minimal eastbound traffic is anticipated along the north side of the building, the access drive around the north side of the building is approximately 30 feet wide which can accommodate two-way traffic. Thus, any pharmacy customers encountering an opposing eastbound vehicle would yield before making their left-turn movement into the Pharmacy drive-thru.

Furthermore, there is approximately 230 feet of sight distance from the location of a vehicle turning into the pharmacy drive-thru to the corner of the Walmart building. Based on the guidelines found in *A Policy on Geometric Design of Highways and Streets* published by

the American Association of State Highway and Transportation Officials often referred to as the *Green Book*, the required stopping sight distance for a design speed of 25 mph is 155 feet. Thus, adequate sight distance is available for pharmacy customers turning into the pharmacy lanes.

The left-turn turning maneuver was verified using AutoTURN to ensure that the left-turn movement into the pharmacy lanes could be completed easily. The left-turn tracing for a passenger vehicle is shown in Figure 3.

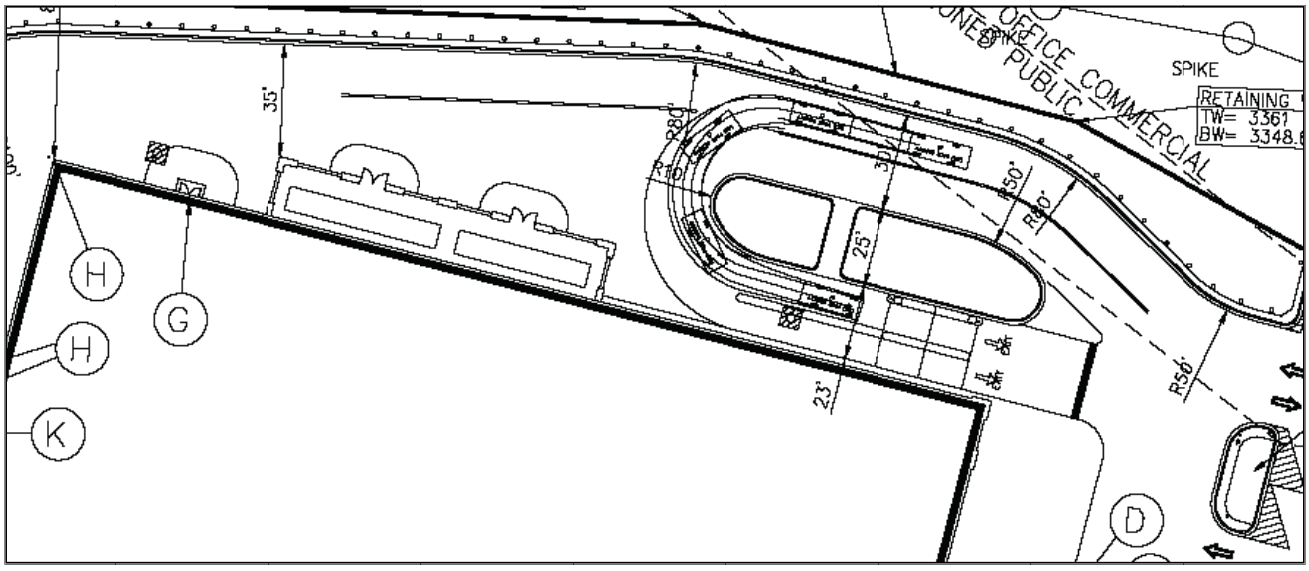

Figure 3: Pharmacy Drive-Thru Left-Turn Maneuver

In conclusion, it is our opinion that the traffic circulation for the proposed pharmacy drive-thru lanes will operate satisfactorily.

We trust that this review of the pharmacy drive-thru circulation adequately addresses the City's concern. Should you have questions or require additional information, please do not hesitate to contact me or Julie Nolfo at 314-878-6644 or via email at swhite@cbbtraffic.com.

Sincerely,

Shawn Lerai White, P.E., PTOE
Senior Traffic Engineer

Julie M Nolfo, PE, PTOE
Senior Traffic Engineer

cc Mr. Robert Green – THF Realty

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Since 1973

May 24, 2010

Ms. Marcia Elkins
Director of Growth Management
City of Rapid City
300 Sixth Street
Rapid City, South Dakota 57701-5035

Re: Recommended Roadway Improvement Plan for the Initial Planned Development (Phases I and II)
Proposed Black Hills Center
Rapid City, Missouri
CBB Job No. 5-10

Dear Ms. Elkins:

On behalf of THF Realty, Crawford, Bunte, Brammeier (CBB) has prepared the following letter to address the roadway improvements required to accommodate Phases I and II of the proposed Black Hills Center development in Rapid City, South Dakota.

Based on discussions with City staff, the question was raised by staff as to what level of improvements would be required to accommodate Phases I and II of the Initial Planned Development for the proposed Black Hills Center which includes the Walmart Supercenter and the supporting retail shops. Although the Black Hills Center Traffic Impact Study looked at the roadway improvements necessary to accommodate a development area of 87 acres, Phases I and II only represent the development of approximately 25.6 acres or 30 percent of the entire development area studied.

Thus, it stands to reason that not all of the roadway improvements identified in the Black Hills Center Traffic Impact Study would be required to accommodate Phases I and II. Another variable which could impact the roadway improvement plan is the timing of the South Dakota Department of Transportation's (SDDOT's) plans to widen Catron Boulevard from Highway 16 to just west of Highway 79 to a four-lane roadway with a raised center median. Based on our conversations with the SDDOT staff, it is our understanding that the project has experienced some delay in the construction due to right-of-way acquisition; however, the SDDOT still anticipates starting construction on the project later this year.

Nevertheless, the analysis of the Phase I and II conditions utilized the existing roadway geometrics in order to answer the "what if the SDDOT project does not happen prior to the

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Walmart opening" question posed by the City. The focus of the Phase I and II analysis was on the following intersections since these intersections represented the locations which required improvements to accommodate the overall 87 acre site:

- Catron Boulevard and 5th Street;
- Catron Boulevard and Black Hills Boulevard; and
- 5th Street and Stumer Road.

Phases I and II Trip Generation Estimate

As discussed in the Black Hills Center Traffic Impact Study, the Walmart Supercenter and supporting retail shops would be expected to generate approximately 1,385 trips during the weekday p.m. peak hour and 1,465 trips during the Saturday midday peak hour which represents a little over 50 percent of the estimated trips for the entire 87 acre development area. Based on the trip generation and distribution estimates, the site-generated traffic for Phases I and II of the proposed Black Hills Center was assigned to the adjoining road system as shown in **Figure 1.**

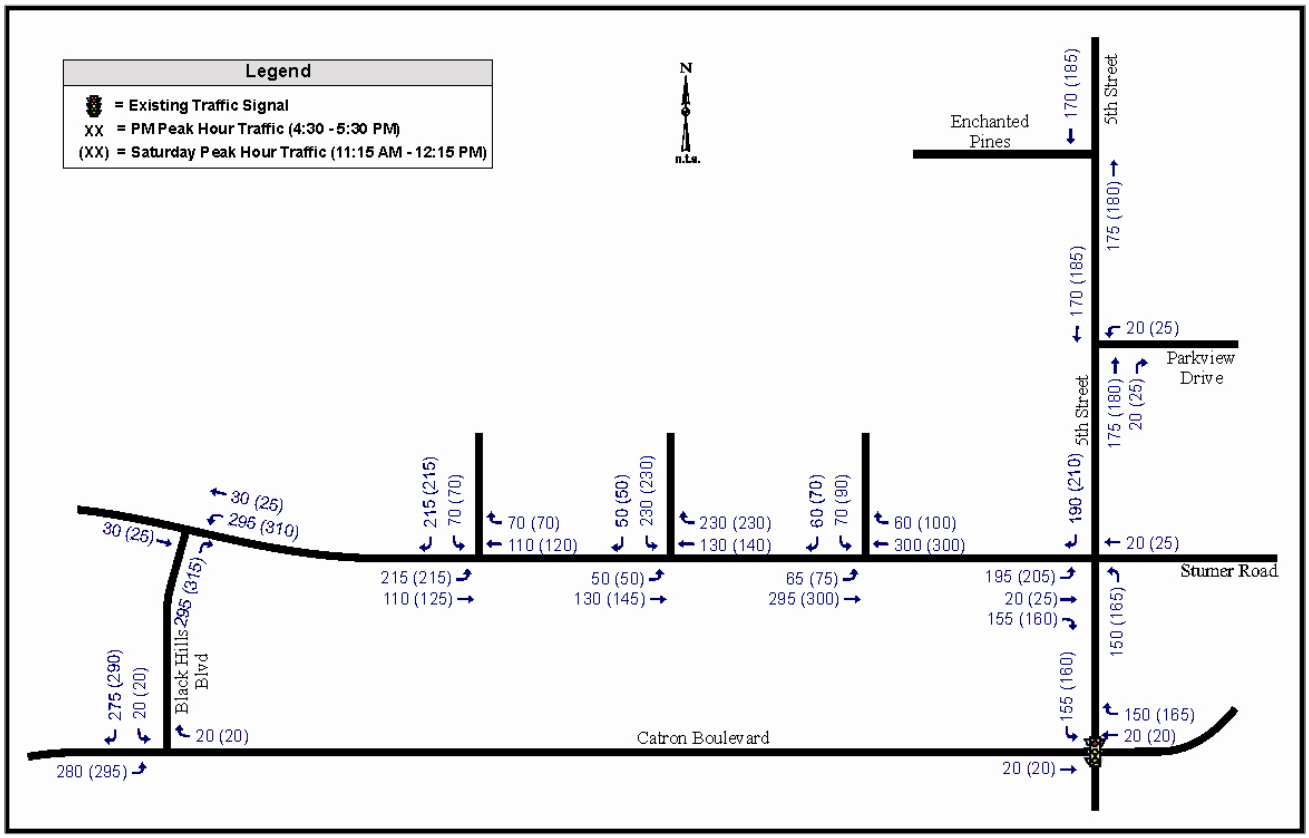

Figure 1: Phases I and II Site-Generated Trips

Phases I and II 2010 Build Traffic Volumes

The traffic generated by Phases I and II of the proposed Black Hills Center (Figure 1) was aggregated with the 2010 No Build traffic volumes (Exhibit 3 in the Black Hills Center Traffic Impact Study) to reflect the 2010 Build conditions for Phases I and II of the proposed Black Hills Center. **Figure 2** reflects the 2010 Build traffic volumes for Phases I and II.

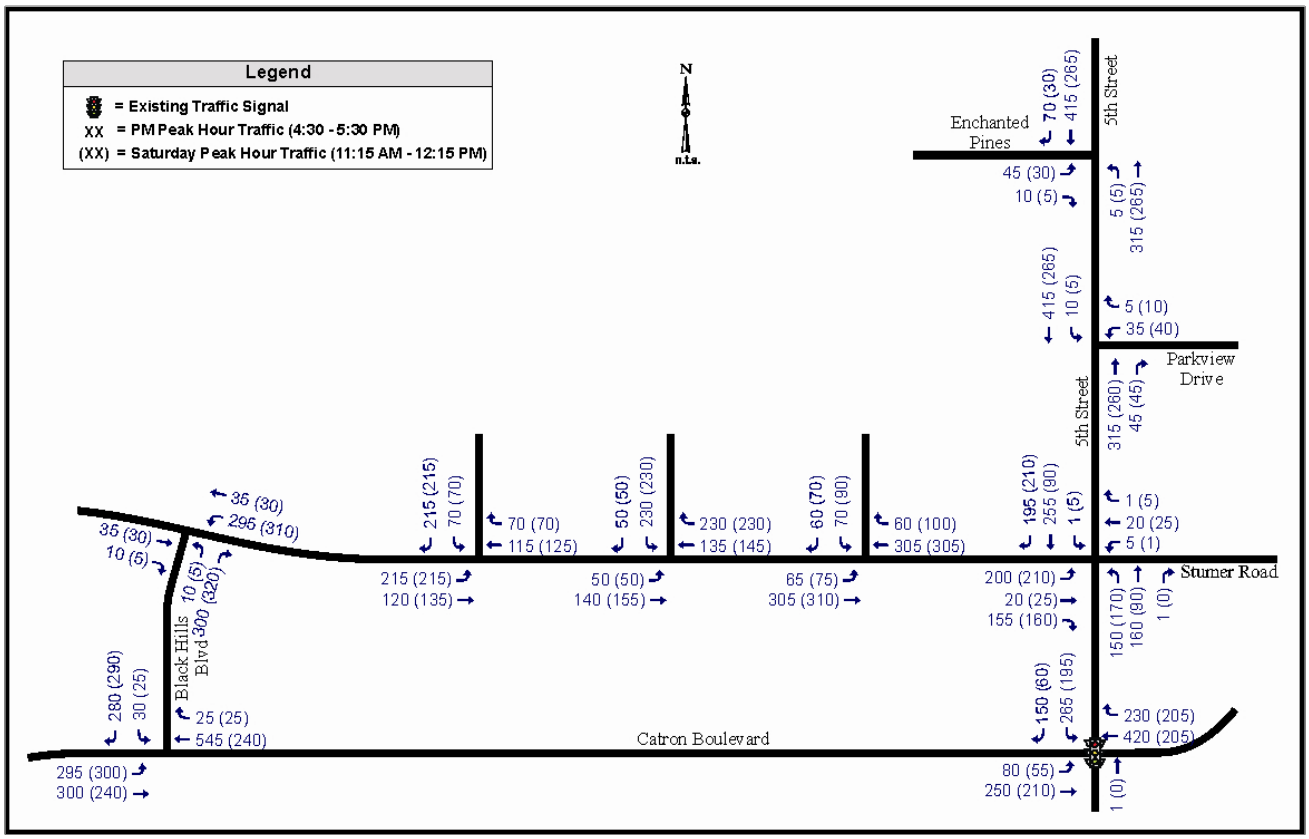

Figure 2: Phases I and II 2010 Build Traffic Volumes

Phases I and II Traffic Signal Warrant Analysis

As discussed in the Black Hills Center Traffic Impact Study, in order to accommodate the entire Black Hills Center development area traffic signals are proposed at the intersections of Catron Boulevard with Black Hills Boulevard and 5th Street with Stumer Road. In order to verify the need for traffic signals with the initial planned development of Phases I and II of the proposed Black Hills Center, the signal warrant analyses were re-evaluated by comparing the Phases I and II 2010 Build Traffic Volumes to the standard warrants for signalization published in the *Manual on Uniform Traffic Control Devices* (MUTCD). As in the Black Hills Center Traffic Impact Study, the 8th highest hourly volume was estimated as 55% of the peak hour traffic.

The intersection of Catron Boulevard with Black Hills Boulevard was re-evaluated to determine whether a signal would be warranted based on the addition of the Phase I and II site-generated traffic volumes to the existing traffic volumes. As indicated by the Phase I and II 2010 Build traffic volumes, the total approach volume on Catron Boulevard would amount to 1,165 vph during the weekday p.m. peak hour, while the approach volume on Black Hills Boulevard (discounting 50% of the right-turn volume) would amount to 170 vph. At 55% of the peak hour, the 8th highest hourly volume is estimated to be approximately 640 vph on Catron Boulevard and 95 vph on Black Hills Boulevard. As a result, Warrant 1B would be satisfied in accordance with the reduced warrants for speeds in excess of 40 mph on the major street. Therefore, it can be concluded that signalization of the Catron Boulevard and Black Hills Boulevard intersection is warranted initially with Phases I and II of the proposed Black Hills Center in accordance with the MUTCD.

The intersection of 5th Street and Stumer Road was also re-evaluated to determine whether a signal would be warranted based on the addition of the Phase I and II site-generated traffic volumes to the existing traffic volumes. As indicated by the Phases I and II 2010 Build traffic volumes, the total approach volume on 5th Street would amount to 760 vph during the weekday p.m. peak hour, while the approach volume on Stumer Road (discounting the right-turn volume) would amount to 220 vph. At 55% of the peak hour, the 8th highest hourly volume is estimated to be approximately 420 vph on 5th Street and 120 vph on Stumer Road. As a result, Warrant 1A would be satisfied in accordance with the reduced warrants for speeds in excess of 40 mph on the major street. Therefore, it can be concluded that signalization of the 5th Street and Stumer Road intersection is warranted initially with Phases I and II of the proposed Black Hills Center in accordance with the MUTCD.

Auxiliary Lane Requirements

The need for a southbound right-turn lane on 5th Street at Stumer Road was reassessed to determine if the southbound right-turn lane would be warranted with Phases I and II of the proposed Black Hills Center per SDDOT's Roadway Design Guide. Based on a posted speed of 45 mph, a southbound advancing volume during the p.m. peak hour of 325 vph in the outside lane and a right-turn volume of 195 vph, a southbound right-turn lane is warranted initially with Phases I and II of the proposed Black Hills Center.

The need for a westbound right-turn lane on Catron Boulevard at Black Hills Boulevard was also reassessed to determine if the westbound right-turn lane would be warranted with Phases I and II of the proposed Black Hills Center per SDDOT's Roadway Design Guide. Based on a posted speed of 60 mph, a southbound advancing volume during the p.m. peak hour of 300 vph in the outside lane and a right-turn volume of 25 vph, a westbound right-turn lane is not warranted initially with Phases I and II of the proposed Black Hills Center.

The westbound right-turn lanes recommended in the Black Hills Center Traffic Impact Study on Stumer Road at the main Walmart drive and at the east driveway servicing the

retail shops would be constructed with the initial Phase I and II development. Conversely, it is not anticipated that a separate northbound right-turn lane on Black Hills Boulevard at Outlot 10 would be provided until Outlot 10 is occupied.

2010 Build Operating Conditions

The 2010 Build traffic volumes for the initial Phases I and II of the proposed Black Hills Center development were reanalyzed using the same methodology as in the Black Hills Center Traffic Impact Study in an effort to identify the impacts of Phases I and II of the proposed Black Hills Center development. **Table 1** summarizes the 2010 Build Levels of Service and average delay at each study intersection within the immediate study area for the initial Phases I and II of the proposed Black Hills Center development during the weekday p.m. and Saturday midday peak hours.

Table 1: Phases I and II 2010 Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	C (26.6)	C (23.6)
Westbound Catron Boulevard Approach	C (21.6)	B (14.6)
Northbound 5th Street Approach	C (34.0)	C (26.7)
Southbound 5th Street Approach	B (11.6)	B (19.6)
Overall Intersection	*B (19.8)*	*B (18.5)*
Catron Boulevard & Black Hills Boulevard (signalized)		
Eastbound Catron Boulevard Approach	C (24.7)	C (27.1)
Westbound Catron Boulevard Approach	A (6.6)	A (4.8)
Southbound Black Hills Boulevard Approach	B (16.5)	B (15.6)
Overall Intersection	*B (16.0)*	*B (18.6)*
5th Street & Stumer Road (signalized)		
Eastbound Stumer Road Approach	C (30.1)	C (28.4)
Westbound Stumer Road Approach	D (38.1)	D (36.7)
Northbound 5th Street Approach	A (5.6)	A (8.5)
Southbound 5th Street Approach	A (7.1)	A (5.8)
Overall Intersection	*B (14.8)*	*B (16.4)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As shown in Table 1, all of the signalized intersections are anticipated to operate at overall LOS B for both the weekday p.m. and Saturday midday peak hours for the initial Phase I and II of the proposed Black Hills Center development.

It is important to note that in order to be conservative, the Phase I and II 2010 Build analyses do not reflect the planned widening of Catron Boulevard by the SDDOT.

However, the Phase I and II 2010 Build analyses do reflect the provision of southbound dual-left turn lanes at the intersection of Catron Boulevard and 5th Street. Furthermore, although the eastbound Stumer Road approach at 5th Street would operate acceptably at LOS C with a single eastbound left-turn lane, in order to minimize the eastbound approach queues and maintain access to the previously platted bank and gas station in the southwest quadrant of 5th Street and Stumer Road, it is recommended that dual eastbound left-turn lanes be provided initially with Phase I and II of the proposed Black Hills Center development.

The 95th percentile queue for the eastbound left-turn on Catron Boulevard at Black Hills Boulevard was also re-evaluated to determine the required storage to accommodate the initial Phase I and II of the proposed Black Hills Center development. The eastbound left-turn 95th percentile queue is estimated at 245 feet for the p.m. peak hour and 250 feet for the Saturday peak hour for the initial Phase I and II of the proposed Black Hills Center development. Thus, the existing 400 foot left-turn bay is more than adequate to serve the left-turn traffic volumes associated with Phases I and II of the Black Hills Center development.

Summary

In conclusion, not all of the previously identified roadway improvements in the Black Hills Center Traffic Impact Study would be necessary to accommodate Phases I and II of the proposed Black Hills Center development. The following is a list of the recommended roadway improvements for the entire 87 acre development area. The highlighted items would be required with Phases I and II of the Initial Planned Development, while the remaining recommendations could be constructed at a later date.

- Signalize the intersection of Catron Boulevard and Black Hills Boulevard.
- Signalize the intersection of 5th Street and Stumer Road.
- Coordinate the two proposed traffic signals with the existing traffic signal at Catron Boulevard and 5th Street with a hard wire interconnect.
- Construct dual eastbound left-turn lanes on Stumer Road at 5th Street. It may be appropriate to only utilize one of the left-turn lanes until the traffic volumes warrant the dual left-turn or safety becomes an issue with the driveway serving the future bank and gas station.
- Construct a separate southbound right-turn lane on 5th Street at Stumer Road.
- Construct a separate westbound right-turn lane on Catron Boulevard at Black Hills Boulevard.

- Coordinate with the SDDOT to extend the westbound left-turn storage at the intersection of Catron Boulevard and Black Hills Boulevard from 400 feet to 460 feet.
- Construct dual southbound left-turn lanes on 5th Street at Catron Boulevard.
- Convert the existing all-way STOP at Stumer Road and Black Hills Boulevard to a side-street STOP condition with Black Hills Boulevard operated under stop control and Stumer Road maintaining the right-of-way. Alternatively, a single-lane roundabout would also provide favorable operations.
- Construct a separate westbound right-turn lane on Stumer Road at the main Walmart drive.
- Construct a separate westbound right-turn lane at the east driveway on Stumer Road servicing the retail shops.
- Consider providing a separate northbound right-turn lane on Black Hills Boulevard at Outlot 10.
- Maintain free operation for the three perimeter traffic signals at Highway 16 and Catron Boulevard, Highway 79 and Catron Boulevard, and 5th Street and Minnesota Street.

We trust that this analysis provides adequate justification as to the necessary roadway improvements required to accommodate Phases I and II of the proposed Black Hills Center development. Should you have questions or require additional information, please do not hesitate to contact me or Julie Nolfo at 314-878-6644 or via email at swhite@cbbtraffic.com.

Sincerely,

Shawn Lerai White, P.E., PTOE
Senior Traffic Engineer

Julie M Nolfo, PE, PTOE
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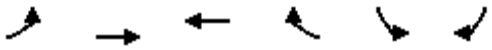
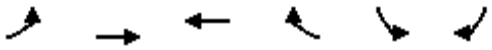
cc Mr. Robert Green – THF Realty



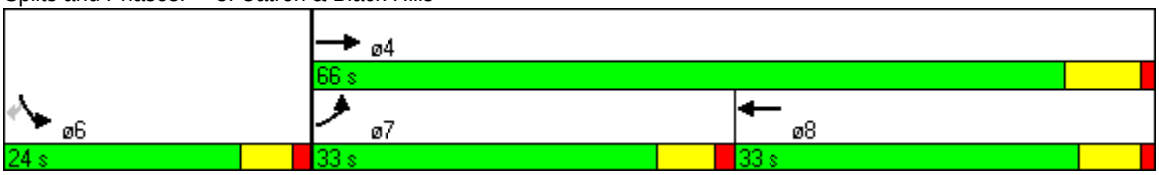
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	295	300	545	25	30	280
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Grade (%)		-4%	4%		0%	
Storage Length (ft)	400			0	100	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Satd. Flow (prot)	1710	1800	3263	0	1676	1500
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1710	1800	3263	0	1676	1500
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			5			304
Link Speed (mph)		60	60		25	
Link Distance (ft)		1300	2300		402	
Travel Time (s)		14.8	26.1		11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)						
Lane Group Flow (vph)	321	326	619	0	33	304
Turn Type	Prot					Perm
Protected Phases	7	4	8		6	
Permitted Phases						6
Detector Phase	7	4	8		6	6
Switch Phase						
Minimum Initial (s)	7.0	12.0	12.0		7.0	7.0
Minimum Split (s)	13.0	19.5	30.4		13.0	13.0
Total Split (s)	33.0	66.0	33.0	0.0	24.0	24.0
Total Split (%)	36.7%	73.3%	36.7%	0.0%	26.7%	26.7%
Maximum Green (s)	27.0	58.8	26.9		18.5	18.5
Yellow Time (s)	4.5	6.0	4.9		4.0	4.0
All-Red Time (s)	1.5	1.2	1.2		1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	7.2	6.1	4.0	5.5	5.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	C-Max	C-Max		None	None
Walk Time (s)			7.0			
Flash Dont Walk (s)			17.0			
Pedestrian Calls (#/hr)			0			
Act Effct Green (s)	21.6	68.0	41.5		9.3	9.3
Actuated g/C Ratio	0.24	0.76	0.46		0.10	0.10
v/c Ratio	0.78	0.24	0.41		0.19	0.71
Control Delay	45.4	4.2	6.6		37.3	14.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	45.4	4.2	6.6		37.3	14.2
LOS	D	A	A		D	B
Approach Delay		24.7	6.6		16.5	
Approach LOS		C	A		B	
Queue Length 50th (ft)	170	39	34		18	0

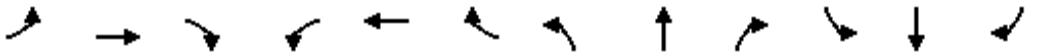


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Length 95th (ft)	246	98	55		42	74
Internal Link Dist (ft)		1220	2220		322	
Turn Bay Length (ft)	400				100	
Base Capacity (vph)	513	1359	1507		345	550
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.63	0.24	0.41		0.10	0.55

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 12 (13%), Referenced to phase 4:EBT and 8:WBT, Start of Green			
Natural Cycle: 65			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 16.0		Intersection LOS: B	
Intersection Capacity Utilization 54.5%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 3: Catron & Black Hills





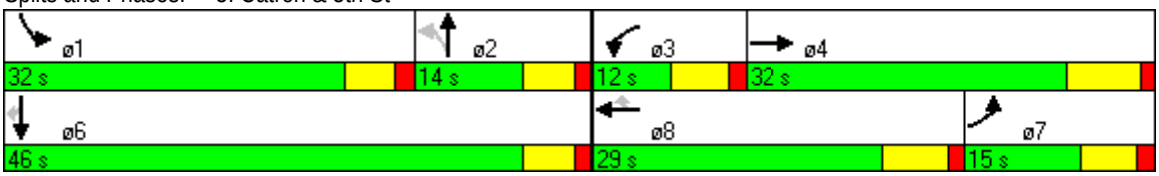
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	80	250	1	1	420	230	1	1	1	265	1	150
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		-3%			2%			0%			0%	
Storage Length (ft)	400		0	100		100	0		0	200		0
Storage Lanes	1		0	1		1	0		0	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1702	1789	0	1660	3319	1485	0	1658	0	1676	1765	1500
Flt Permitted	0.950			0.950						0.950		
Satd. Flow (perm)	1702	1789	0	1660	3319	1485	0	1685	0	1676	1765	1500
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						250		1				163
Link Speed (mph)		60			60			30			45	
Link Distance (ft)		2300			3106			549			650	
Travel Time (s)		26.1			35.3			12.5			9.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	87	273	0	1	457	250	0	3	0	288	1	163
Turn Type	Prot			Prot		Perm	Perm			Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases						8	2					6
Detector Phase	7	4		3	8	8	2	2		1	6	6
Switch Phase												
Minimum Initial (s)	4.0	12.0		4.0	12.0	12.0	7.0	7.0		4.0	12.0	12.0
Minimum Split (s)	10.0	31.3		10.0	30.7	30.7	30.0	30.0		10.0	30.0	30.0
Total Split (s)	15.0	32.0	0.0	12.0	29.0	29.0	14.0	14.0	0.0	32.0	46.0	46.0
Total Split (%)	16.7%	35.6%	0.0%	13.3%	32.2%	32.2%	15.6%	15.6%	0.0%	35.6%	51.1%	51.1%
Maximum Green (s)	9.0	25.0		6.0	22.6	22.6	8.5	8.5		26.5	40.5	40.5
Yellow Time (s)	4.5	5.8		4.5	5.2	5.2	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.5	1.2		1.5	1.2	1.2	1.5	1.5		1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	7.0	4.0	6.0	6.4	6.4	5.5	5.5	4.0	5.5	5.5	5.5
Lead/Lag	Lag	Lag		Lead	Lead	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	C-Max		None	C-Max	C-Max	None	None		Max	Max	Max
Walk Time (s)		7.0			7.0	7.0	7.0	7.0			7.0	7.0
Flash Dont Walk (s)		17.0			17.0	17.0	17.0	17.0			17.0	17.0
Pedestrian Calls (#/hr)		0			0	0	0	0			0	0
Act Effct Green (s)	8.4	34.6		5.6	25.6	25.6		7.3		37.7	40.5	40.5
Actuated g/C Ratio	0.09	0.38		0.06	0.28	0.28		0.08		0.42	0.45	0.45
v/c Ratio	0.55	0.40		0.01	0.48	0.42		0.02		0.41	0.00	0.21
Control Delay	48.0	19.7		40.0	30.0	6.1		34.0		16.8	8.0	2.3
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	0.0
Total Delay	48.0	19.7		40.0	30.0	6.1		34.0		16.8	8.0	2.3
LOS	D	B		D	C	A		C		B	A	A
Approach Delay		26.6			21.6			34.0			11.6	
Approach LOS		C			C			C			B	
Queue Length 50th (ft)	48	83		1	118	0		1		106	0	1

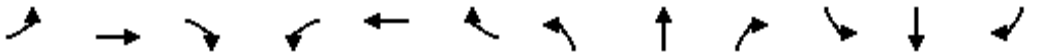
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)	95	176		6	168	57		10		231	m1	2
Internal Link Dist (ft)		2220			3026			469			570	
Turn Bay Length (ft)	400			100		100				200		
Base Capacity (vph)	170	688		111	944	601		160		702	794	765
Starvation Cap Reductn	0	0		0	0	0		0		0	0	0
Spillback Cap Reductn	0	0		0	0	0		0		0	0	0
Storage Cap Reductn	0	0		0	0	0		0		0	0	0
Reduced v/c Ratio	0.51	0.40		0.01	0.48	0.42		0.02		0.41	0.00	0.21

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.55			
Intersection Signal Delay: 19.8		Intersection LOS: B	
Intersection Capacity Utilization 54.9%		ICU Level of Service A	
Analysis Period (min) 15			

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Catron & 5th St



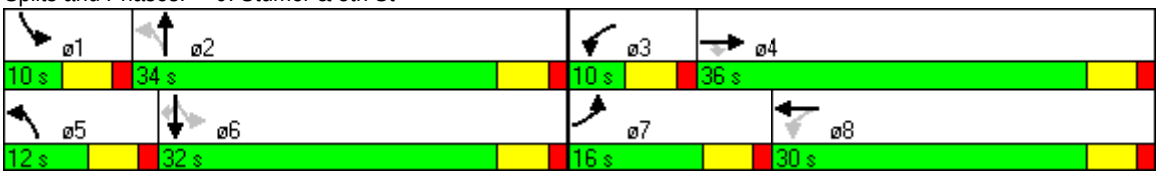


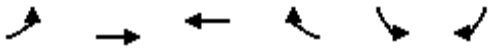
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	20	155	5	20	1	150	160	1	1	255	195
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (ft)	120		150	100		0	200		0	150		150
Storage Lanes	2		1	1		0	1		0	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	3252	1765	1500	1676	1752	0	1676	3350	0	1676	3353	1500
Flt Permitted	0.950			0.930			0.521			0.641		
Satd. Flow (perm)	3252	1765	1500	1641	1752	0	919	3350	0	1131	3353	1500
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			168		1			1				212
Link Speed (mph)		25			25			45			45	
Link Distance (ft)		473			610			650			584	
Travel Time (s)		12.9			16.6			9.8			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	217	22	168	5	23	0	163	175	0	1	277	212
Turn Type	Prot		Perm	pm+pt			pm+pt			pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8			2			6		6
Detector Phase	7	4	4	3	8		5	2		1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	10.0	30.0	30.0	10.0	30.0		10.0	24.0		10.0	28.0	28.0
Total Split (s)	16.0	36.0	36.0	10.0	30.0	0.0	12.0	34.0	0.0	10.0	32.0	32.0
Total Split (%)	17.8%	40.0%	40.0%	11.1%	33.3%	0.0%	13.3%	37.8%	0.0%	11.1%	35.6%	35.6%
Maximum Green (s)	10.5	30.5	30.5	4.5	24.5		6.5	28.5		4.5	26.5	26.5
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5		1.5	1.5		1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	4.0	5.5	5.5	4.0	5.5	5.5	5.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	C-Max
Walk Time (s)		7.0	7.0		7.0			7.0			7.0	7.0
Flash Dont Walk (s)		17.5	17.5		17.5			11.0			15.0	15.0
Pedestrian Calls (#/hr)		0	0		0			0			0	0
Act Effct Green (s)	9.9	13.3	13.3	7.7	6.7		63.0	61.7		56.3	51.8	51.8
Actuated g/C Ratio	0.11	0.15	0.15	0.09	0.07		0.70	0.69		0.63	0.58	0.58
v/c Ratio	0.61	0.08	0.46	0.04	0.18		0.23	0.08		0.00	0.14	0.22
Control Delay	45.7	31.8	9.8	27.6	40.3		5.4	5.9		7.0	10.5	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	45.7	31.8	9.8	27.6	40.3		5.4	5.9		7.0	10.5	2.6
LOS	D	C	A	C	D		A	A		A	B	A
Approach Delay		30.1			38.1			5.6			7.1	
Approach LOS		C			D			A			A	
Queue Length 50th (ft)	61	11	0	3	12		14	7		0	30	0
Queue Length 95th (ft)	97	32	55	10	35		70	44		2	70	36

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		393			530			570			504	
Turn Bay Length (ft)	120		150	100			200			150		150
Base Capacity (vph)	379	598	619	142	478		698	2298		735	1930	954
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.57	0.04	0.27	0.04	0.05		0.23	0.08		0.00	0.14	0.22

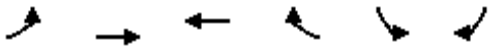
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 40 (44%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.61			
Intersection Signal Delay: 14.8		Intersection LOS: B	
Intersection Capacity Utilization 42.7%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 9: Stumer & 5th St





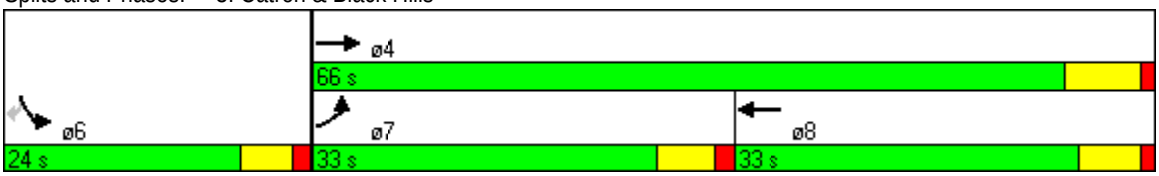
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	300	240	240	25	25	290
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Grade (%)		-4%	4%		0%	
Storage Length (ft)	400			0	100	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Satd. Flow (prot)	1710	1800	3240	0	1676	1500
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1710	1800	3240	0	1676	1500
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			12			315
Link Speed (mph)		60	60		25	
Link Distance (ft)		1463	2300		402	
Travel Time (s)		16.6	26.1		11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)						
Lane Group Flow (vph)	326	261	288	0	27	315
Turn Type	Prot					Perm
Protected Phases	7	4	8		6	
Permitted Phases						6
Detector Phase	7	4	8		6	6
Switch Phase						
Minimum Initial (s)	7.0	12.0	12.0		7.0	7.0
Minimum Split (s)	13.0	19.5	30.4		13.0	13.0
Total Split (s)	33.0	66.0	33.0	0.0	24.0	24.0
Total Split (%)	36.7%	73.3%	36.7%	0.0%	26.7%	26.7%
Yellow Time (s)	4.5	6.0	4.9		4.0	4.0
All-Red Time (s)	1.5	1.2	1.2		1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	7.2	6.1	4.0	5.5	5.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	C-Max	C-Max		None	None
Act Effct Green (s)	21.7	67.9	41.3		9.4	9.4
Actuated g/C Ratio	0.24	0.75	0.46		0.10	0.10
v/c Ratio	0.79	0.19	0.19		0.16	0.72
Control Delay	45.6	4.0	4.8		35.5	13.9
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	45.6	4.0	4.8		35.5	13.9
LOS	D	A	A		D	B
Approach Delay		27.1	4.8		15.6	
Approach LOS		C	A		B	
Queue Length 50th (ft)	173	29	11		15	0
Queue Length 95th (ft)	251	78	24		37	76
Internal Link Dist (ft)		1383	2220		322	
Turn Bay Length (ft)	400				100	
Base Capacity (vph)	513	1358	1493		345	559
Starvation Cap Reductn	0	0	0		0	0

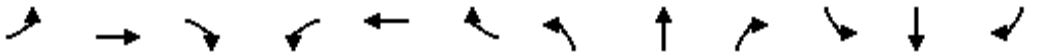


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.64	0.19	0.19		0.08	0.56

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 14 (16%), Referenced to phase 4:EBT and 8:WBT, Start of Green			
Natural Cycle: 65			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay: 18.6		Intersection LOS: B	
Intersection Capacity Utilization 48.0%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 3: Catron & Black Hills



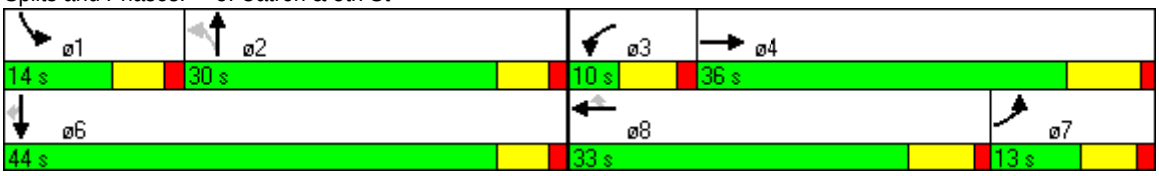


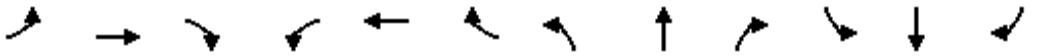
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	210	1	1	205	205	1	1	1	195	1	60
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		-3%			2%			0%			0%	
Storage Length (ft)	400		0	100		100	0		0	200		0
Storage Lanes	1		0	1		1	0		0	2		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1702	1789	0	1660	3319	1485	0	1658	0	3252	1765	1500
Flt Permitted	0.950			0.950				0.888		0.950		
Satd. Flow (perm)	1702	1789	0	1660	3319	1485	0	1497	0	3252	1765	1500
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						223		1				65
Link Speed (mph)		60			60			30			45	
Link Distance (ft)		2300			3079			549			650	
Travel Time (s)		26.1			35.0			12.5			9.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	60	229	0	1	223	223	0	3	0	212	1	65
Turn Type	Prot			Prot		Perm	Perm			Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases						8	2					6
Detector Phase	7	4		3	8	8	2	2		1	6	6
Switch Phase												
Minimum Initial (s)	4.0	12.0		4.0	12.0	12.0	7.0	7.0		4.0	12.0	12.0
Minimum Split (s)	10.0	31.3		10.0	30.7	30.7	30.0	30.0		10.0	30.0	30.0
Total Split (s)	13.0	36.0	0.0	10.0	33.0	33.0	30.0	30.0	0.0	14.0	44.0	44.0
Total Split (%)	14.4%	40.0%	0.0%	11.1%	36.7%	36.7%	33.3%	33.3%	0.0%	15.6%	48.9%	48.9%
Yellow Time (s)	4.5	5.8		4.5	5.2	5.2	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.5	1.2		1.5	1.2	1.2	1.5	1.5		1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	7.0	4.0	6.0	6.4	6.4	5.5	5.5	4.0	5.5	5.5	5.5
Lead/Lag	Lag	Lag		Lead	Lead	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes		
Recall Mode	None	C-Max		None	C-Max	C-Max	None	None		Max	Max	Max
Act Effct Green (s)	6.7	37.0		4.0	29.2	29.2		10.5		32.5	38.5	38.5
Actuated g/C Ratio	0.07	0.41		0.04	0.32	0.32		0.12		0.36	0.43	0.43
v/c Ratio	0.48	0.31		0.01	0.21	0.35		0.02		0.18	0.00	0.10
Control Delay	48.8	17.0		42.0	23.8	5.3		26.7		24.6	13.0	3.5
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	0.0
Total Delay	48.8	17.0		42.0	23.8	5.3		26.7		24.6	13.0	3.5
LOS	D	B		D	C	A		C		C	B	A
Approach Delay		23.6			14.6			26.7			19.6	
Approach LOS		C			B			C			B	
Queue Length 50th (ft)	33	67		1	50	0		1		27	0	0
Queue Length 95th (ft)	74	101		6	79	51		8		#109	m2	21
Internal Link Dist (ft)		2220			2999			469			570	
Turn Bay Length (ft)	400			100		100				200		
Base Capacity (vph)	132	735		74	1077	632		408		1174	755	679
Starvation Cap Reductn	0	0		0	0	0		0		0	0	0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn	0	0		0	0	0		0		0	0	0
Storage Cap Reductn	0	0		0	0	0		0		0	0	0
Reduced v/c Ratio	0.45	0.31		0.01	0.21	0.35		0.01		0.18	0.00	0.10

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.48			
Intersection Signal Delay: 18.6		Intersection LOS: B	
Intersection Capacity Utilization 43.0%		ICU Level of Service A	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 5: Catron & 5th St



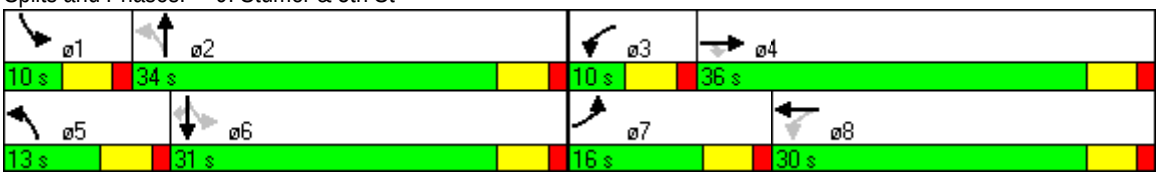


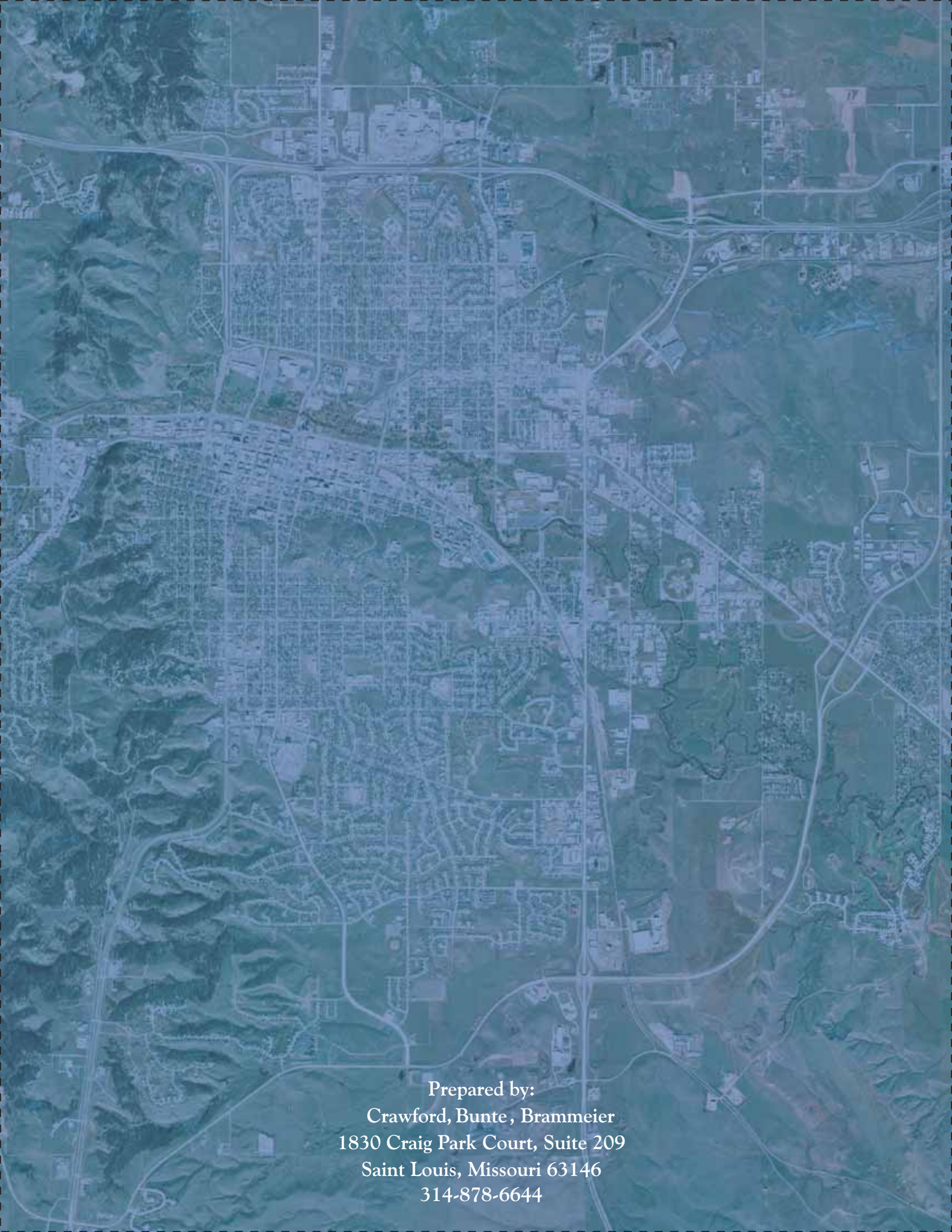
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	25	160	1	25	5	170	90	0	5	90	210
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (ft)	120		150	100		0	200		0	150		150
Storage Lanes	2		1	1		0	1		0	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	3252	1765	1500	1676	1724	0	1676	3353	0	1676	3353	1500
Flt Permitted	0.950			0.740			0.611			0.690		
Satd. Flow (perm)	3252	1765	1500	1306	1724	0	1078	3353	0	1218	3353	1500
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			174		5							228
Link Speed (mph)		25			25			45			45	
Link Distance (ft)		473			610			650			584	
Travel Time (s)		12.9			16.6			9.8			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	228	27	174	1	32	0	185	98	0	5	98	228
Turn Type	Prot		Perm	pm+pt			pm+pt			pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8			2			6		6
Detector Phase	7	4	4	3	8		5	2		1	6	6
Switch Phase												
Minimum Initial (s)	7.0	12.0	12.0	4.0	7.0		7.0	12.0		4.0	12.0	12.0
Minimum Split (s)	13.0	30.0	30.0	10.0	30.0		13.0	30.0		10.0	30.0	30.0
Total Split (s)	16.0	36.0	36.0	10.0	30.0	0.0	13.0	34.0	0.0	10.0	31.0	31.0
Total Split (%)	17.8%	40.0%	40.0%	11.1%	33.3%	0.0%	14.4%	37.8%	0.0%	11.1%	34.4%	34.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5		1.5	1.5		1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	4.0	5.5	5.5	4.0	5.5	5.5	5.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	11.1	17.2	17.2	9.3	7.6		59.3	57.8		51.4	46.9	46.9
Actuated g/C Ratio	0.12	0.19	0.19	0.10	0.08		0.66	0.64		0.57	0.52	0.52
v/c Ratio	0.57	0.08	0.41	0.01	0.21		0.24	0.05		0.01	0.06	0.26
Control Delay	43.5	29.5	8.3	25.0	37.1		8.3	8.9		7.4	12.5	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	43.5	29.5	8.3	25.0	37.1		8.3	8.9		7.4	12.5	2.9
LOS	D	C	A	C	D		A	A		A	B	A
Approach Delay		28.4			36.7			8.5			5.8	
Approach LOS		C			D			A			A	
Queue Length 50th (ft)	64	12	0	0	15		31	7		1	15	0
Queue Length 95th (ft)	102	36	55	4	42		91	31		5	30	39
Internal Link Dist (ft)		393			530			570			504	
Turn Bay Length (ft)	120		150	100			200			150		150
Base Capacity (vph)	401	598	623	153	473		760	2153		719	1747	891
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.57	0.05	0.28	0.01	0.07		0.24	0.05		0.01	0.06	0.26

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 53 (59%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.57			
Intersection Signal Delay: 16.4		Intersection LOS: B	
Intersection Capacity Utilization 43.3%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 9: Stumer & 5th St





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