

TRAFFIC IMPACT STUDY

FOR THE

PROPOSED BLACK HILLS CENTER

RAPID CITY, SOUTH DAKOTA



Prepared For:



In Cooperation With:



&



April 2010

Prepared By:



Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

TRAFFIC IMPACT STUDY
FOR THE
PROPOSED BLACK HILLS CENTER
RAPID CITY, SOUTH DAKOTA
REVISED APRIL 23, 2010

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**The Traffic Impact Study is prepared for the exclusive use of THF Realty,
Walmart Stores, Inc. and their respective successors and assigns.**

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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 study 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.
- Construct dual eastbound left-turn lanes on Stumer Road at 5th Street. 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.
- 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 to provide 460 feet of storage.
- 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 serving 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 potential development of 150 acres in the southwest quadrant of Catron Boulevard and 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 study to address the traffic impacts associated with the proposed Black Hills Center commercial development in Rapid City, South Dakota. This study 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**.

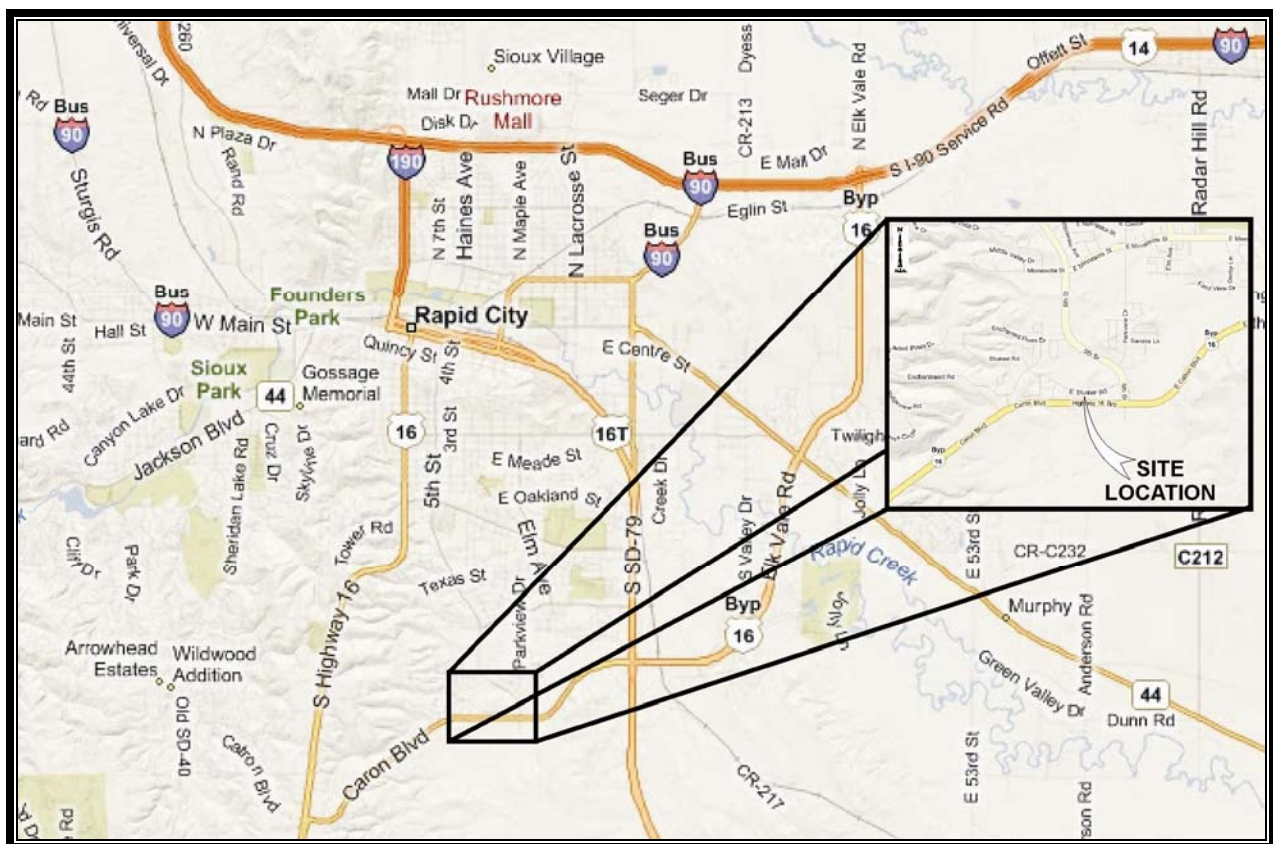


Figure 1: Site Location Map

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 signaling 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.

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 east side to Highway 44 on the western end. 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. Additionally, auxiliary turn lanes at the intersections of Black Hills Boulevard and at 5th Street are planned as part of the construction project. 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 either side 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.

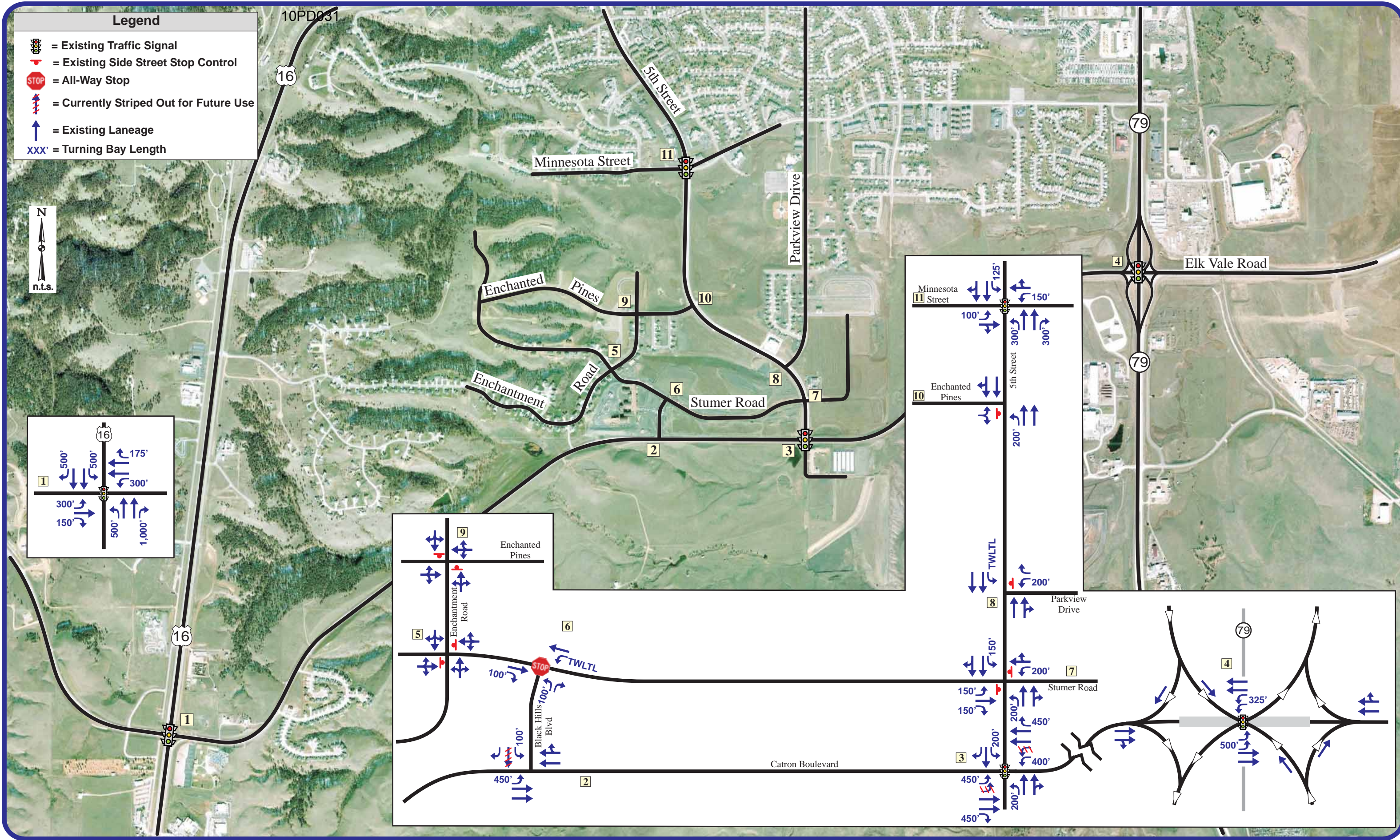


Exhibit 2: 2010 No Build Lane Assignments and Traffic Control

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

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**.

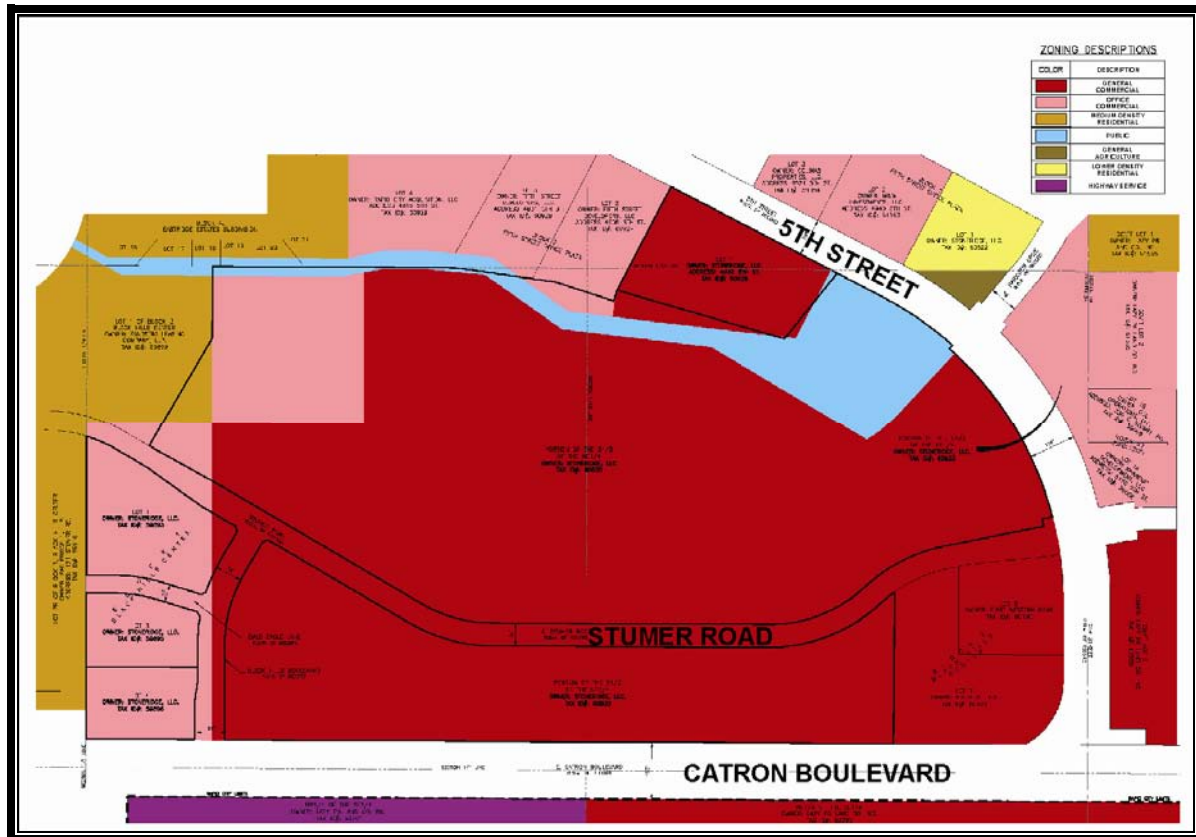


Figure 4: Land Use Zoning Map

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.

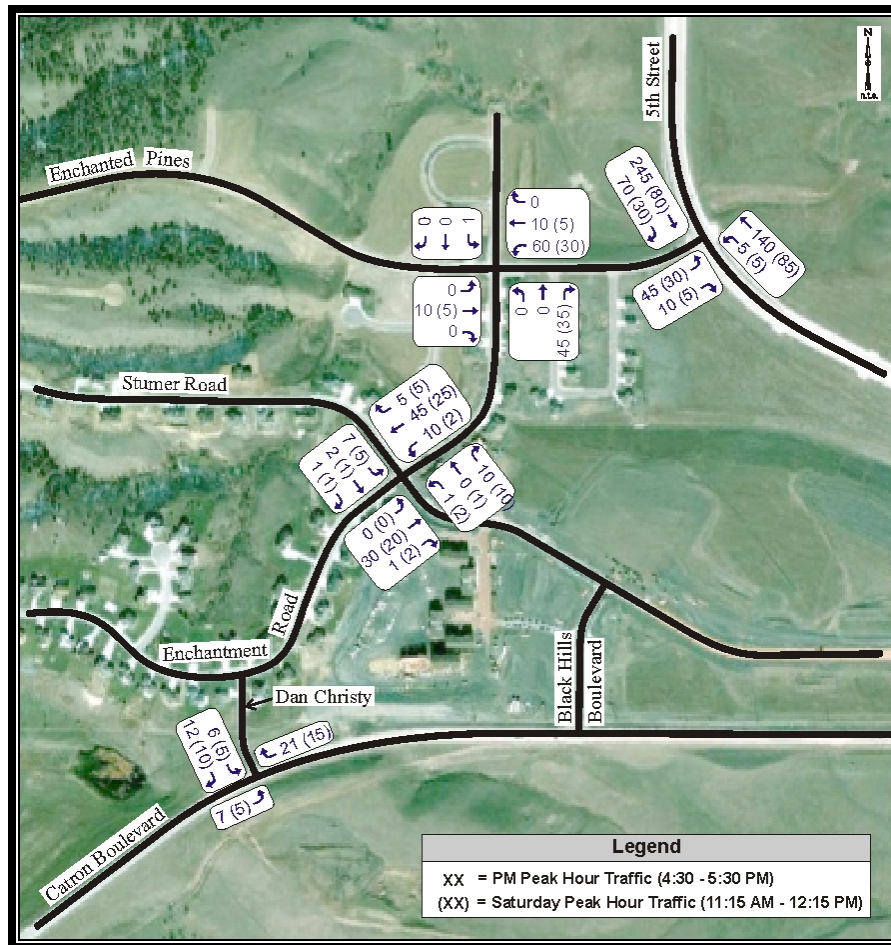



Figure 5: Dan Christy Lane Existing Traffic Volumes

10PD031

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

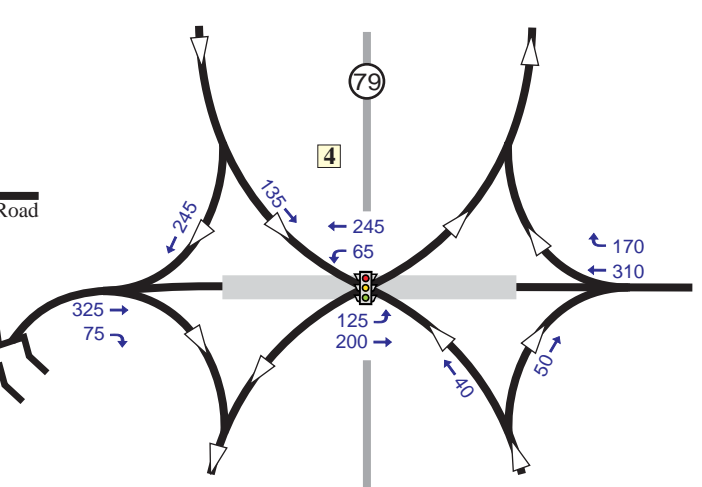
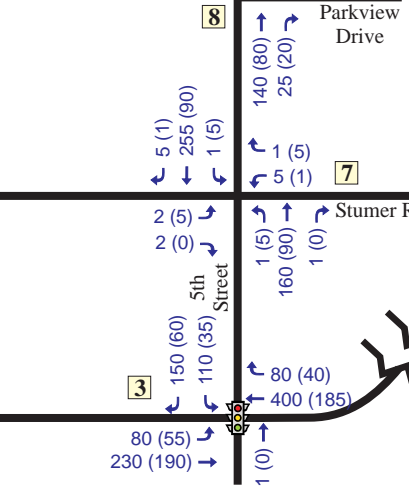
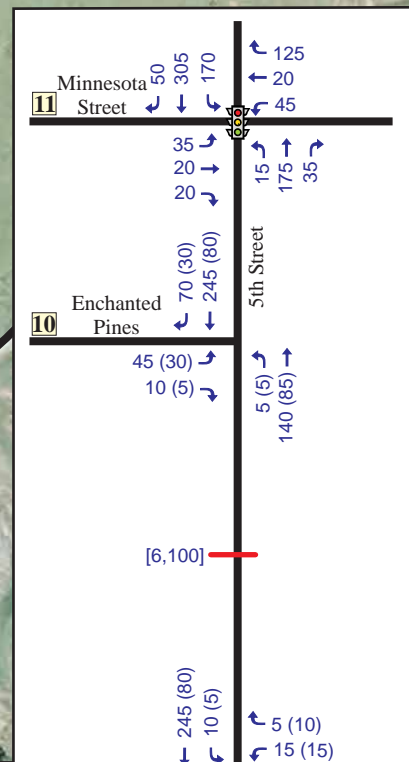
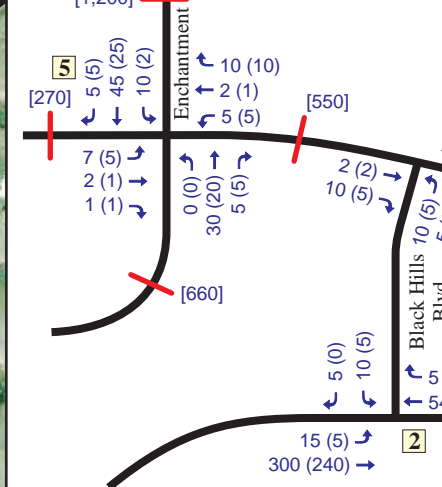
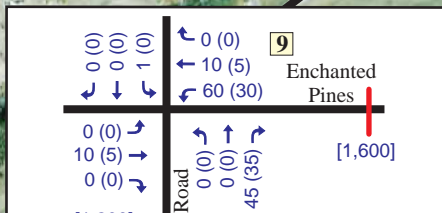
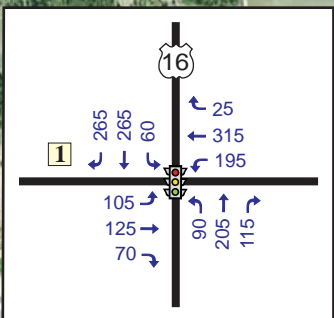
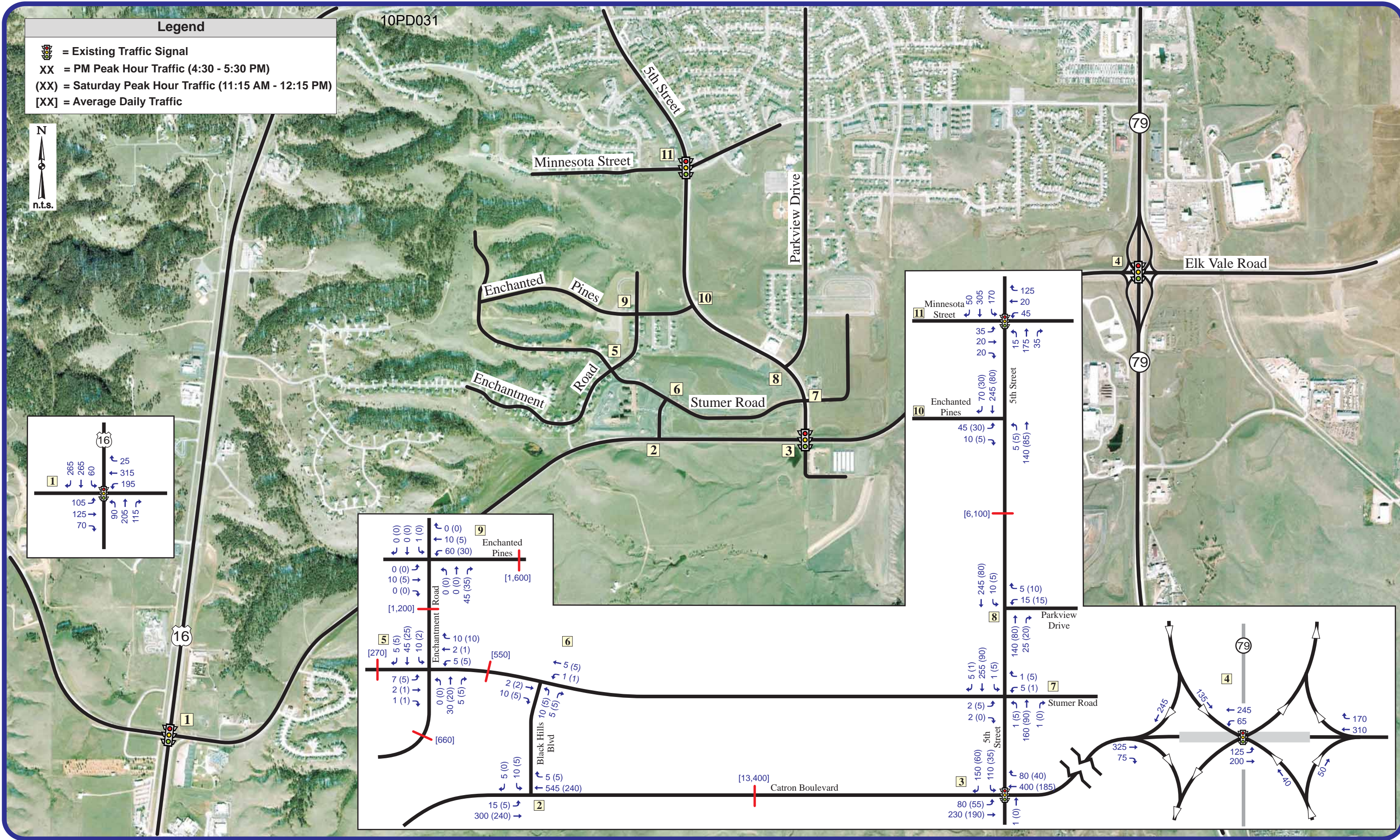


Exhibit 3: 2010 No Build Traffic Volumes

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

<i>Level of Service (LOS)</i>	<i>Control Delay per Vehicle (sec/veh)</i>	
	<i>Signalized Intersections</i>	<i>Unsignalized Intersections</i>
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
<i>Catron Boulevard & 5th Street (signalized)</i>		
Eastbound Catron Boulevard Approach	A (7.3)	A (5.4)
Westbound Catron Boulevard Approach	B (15.6)	B (11.8)
Northbound 5 th Street Approach	C (24.0)	B (19.0)
Southbound 5 th Street Approach	A (8.2)	A (5.0)
<i>Overall Intersection</i>	<i>B (11.3)</i>	<i>A (7.9)</i>
<i>Catron Boulevard & Black Hills Boulevard (Side-Street Stop)</i>		
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)
<i>5th Street & Stumer Road (Side-Street Stop)</i>		
Eastbound Stumer Road Approach	B (11.5)	A (9.7)
Westbound Stumer Road Approach	B (10.9)	A (9.7)
Northbound 5 th Street Left-Turn	A (7.8)	A (7.4)
Southbound 5 th Street Left-Turn	A (7.6)	A (7.4)
<i>Black Hills Boulevard & Stumer Road (All-Way Stop)</i>		
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)
<i>5th Street & Parkview Drive (Side-Street Stop)</i>		
Westbound Parkview Drive Left-Turn	B (10.7)	A (9.5)
Westbound Parkview Drive Right-Turn	A (8.8)	A (8.6)
Southbound 5 th Street Left-Turn	A (7.6)	A (7.4)
<i>5th Street & Enchanted Pines Drive (Side-Street Stop)</i>		
Eastbound Enchanted Pines Drive Approach	B (11.5)	A (9.5)
Northbound 5 th 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
<i>Enchanted Pines Drive & Enchantment Road (Side-Street Stop)</i>		
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)
<i>Stumer Road & Enchantment Road (Side-Street Stop)</i>		
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
<i>Catron Boulevard & Highway 16 (signalized)</i>	
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)
<i>Overall Intersection</i>	C (21.4)
<i>Catron Boulevard & Highway 79 (signalized)</i>	
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)
<i>Overall Intersection</i>	B (12.5)
<i>5th Street & Minnesota Street (signalized)</i>	
Eastbound Minnesota Street Approach	B (15.7)
Westbound Minnesota Street Approach	B (10.7)
Northbound 5 th Street Approach	B (18.9)
Southbound 5 th Street Approach	B (10.9)
<i>Overall Intersection</i>	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 ft² of retail space;
- 110,600 ft² of office space;
- 10,000 ft² of high turnover sit-down restaurant space (2 restaurants);
- 15,000 ft² of bank space (2 banks);
- a 15,000 ft² 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 ft² Walmart Supercenter;
- 90,900 ft² of retail space;
- 64,000 ft² of office space;
- 10,000 ft² of high turnover sit-down restaurant space (2 restaurants);
- 6,000 ft² of fast-food restaurant space (2 restaurants);
- a 45,000 ft² 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 ft² 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 Adjusted 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 ft ²	13,000	565	565	1130	565	565	1130
820	Retail Space	90,900 ft ²	6,385	290	305	595	420	385	805
710	Office Space	126,600 ft ²	1,600	40	180	220	25	20	45
932	HTSD Restaurant	5,000 ft ²	635	35	20	55	65	35	100
932	HTSD Restaurant	5,000 ft ²	635	35	20	55	65	35	100
934	Fast-Food Restaurant	3,000 ft ²	1,490	55	50	105	90	85	175
934	Fast-Food Restaurant	3,000 ft ²	1,490	55	50	105	90	85	170
445	Multiplex Theater	45,000 ft ²	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
<i>Gross Total Trips</i>			<i>30,725</i>	<i>1,420</i>	<i>1,475</i>	<i>2,895</i>	<i>1,680</i>	<i>1,495</i>	<i>3,175</i>
<i>Common Trip Reduction (15%)</i>			<i>(2,660)</i>	<i>(130)</i>	<i>(135)</i>	<i>(265)</i>	<i>(165)</i>	<i>(140)</i>	<i>(305)</i>
<i>New Trips</i>			<i>28,065</i>	<i>1,290</i>	<i>1,340</i>	<i>2,630</i>	<i>1,515</i>	<i>1,355</i>	<i>2,870</i>

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.

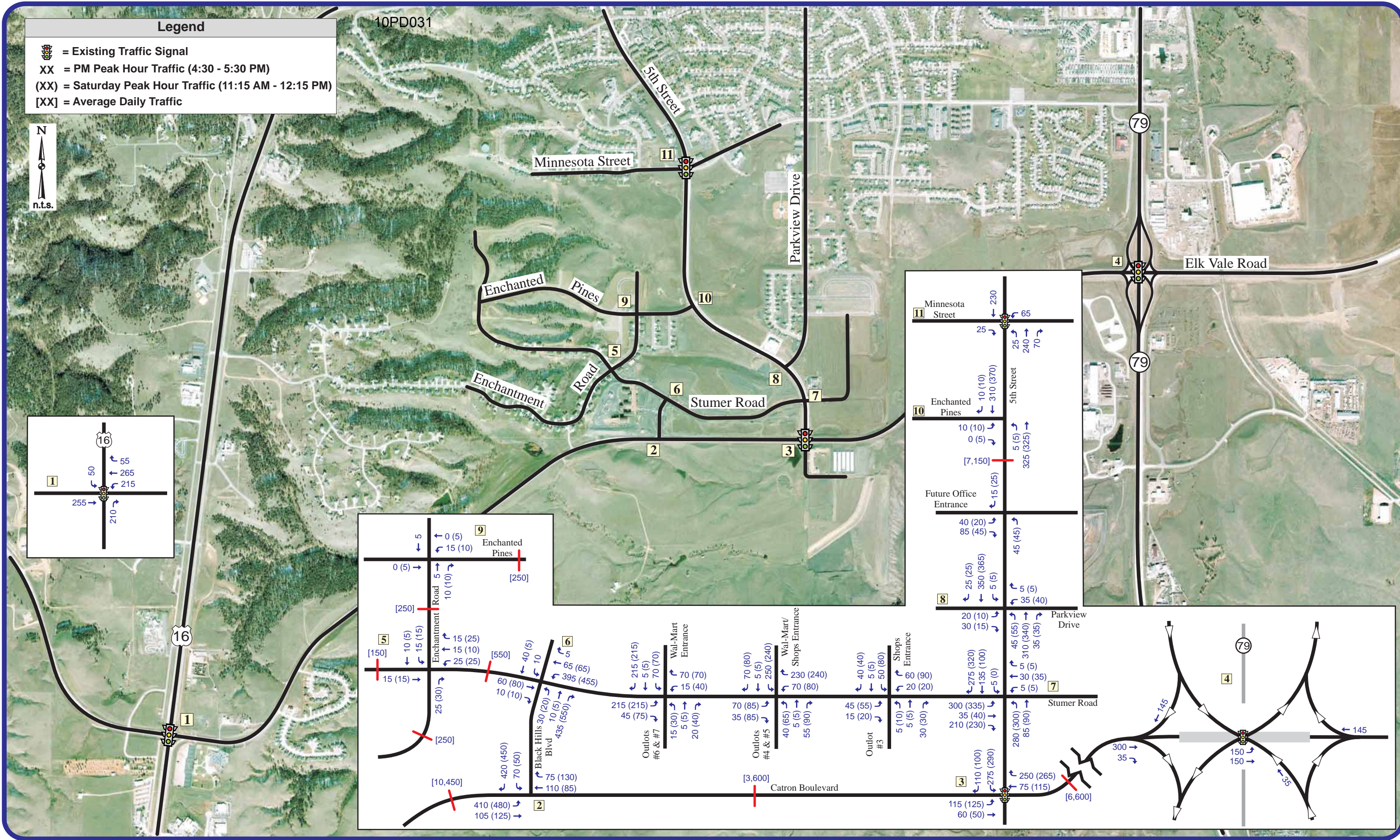


Exhibit 4: Site-Generated Trips

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**.

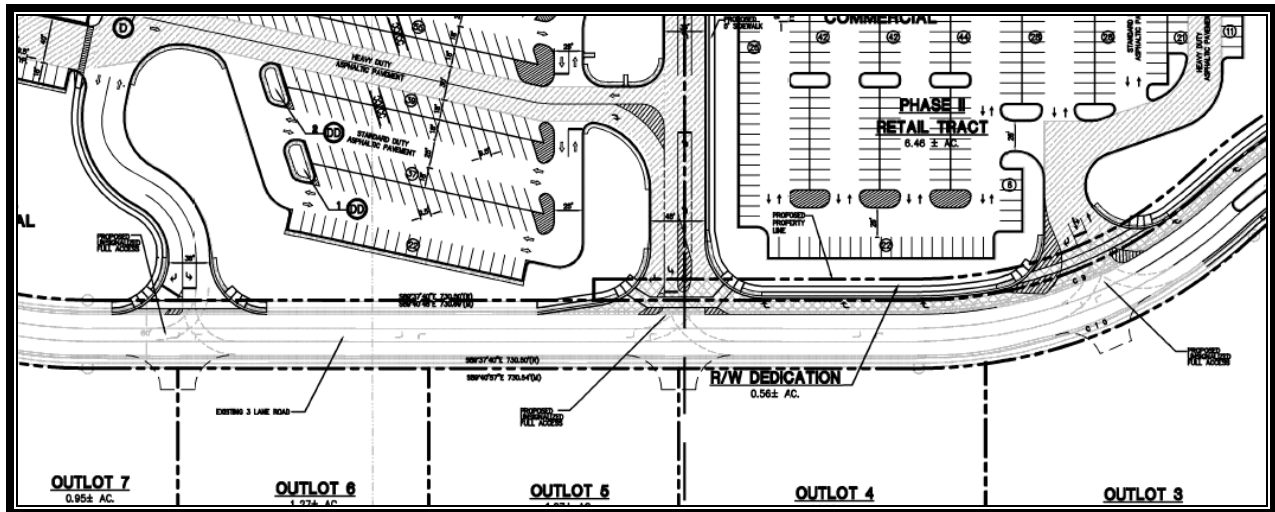


Figure 6: Proposed Access along Stumer Road

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
^d 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

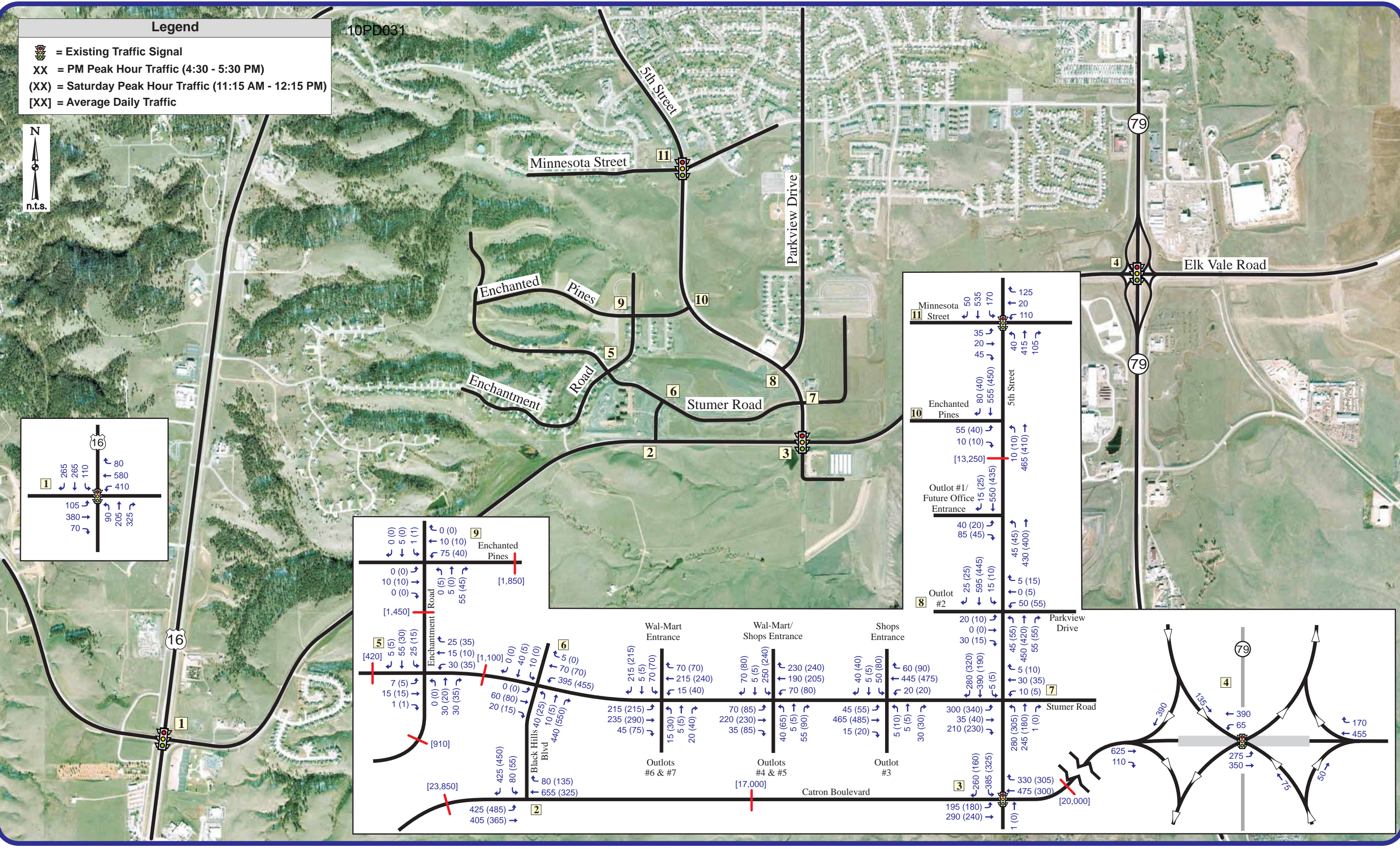


Exhibit 5: 2010 Build Traffic Volumes

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 4/21/10

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.

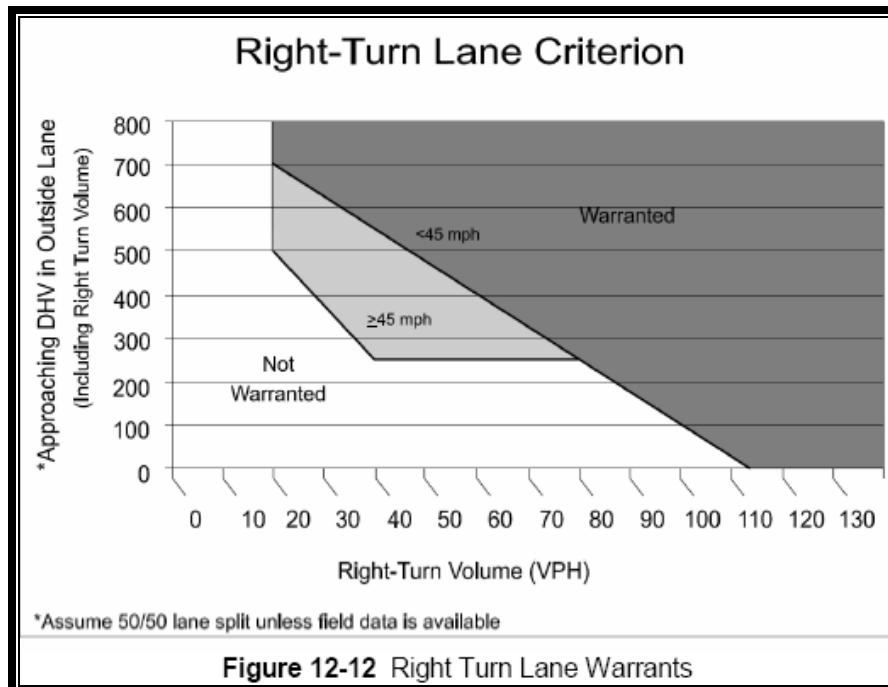


Figure 8: SDDOT Right-Turn Lane Warrants

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 Outlot 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-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. 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
<i>Catron Boulevard & 5th Street (signalized)</i>		
Eastbound Catron Boulevard Approach	C (25.3)	C (26.5)
Westbound Catron Boulevard Approach	B (17.9)	B (16.2)
Northbound 5 th Street Approach	A (10.0)	B (11.3)
Southbound 5 th Street Approach	B (13.7)	B (18.1)
<i>Overall Intersection</i>	<i>B (18.4)</i>	<i>B (19.7)</i>
<i>Catron Boulevard & Black Hills Boulevard (signalized)</i>		
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)
<i>Overall Intersection</i>	<i>C (20.4)</i>	<i>C (22.0)</i>
<i>5th Street & Stumer Road (signalized)</i>		
Eastbound Stumer Road Approach	D (35.5)	D (35.2)
Westbound Stumer Road Approach	D (40.5)	D (44.2)
Northbound 5 th Street Approach	A (7.8)	A (9.8)
Southbound 5 th Street Approach	B (11.7)	B (10.1)
<i>Overall Intersection</i>	<i>B (18.6)</i>	<i>C (20.3)</i>
<i>Black Hills Boulevard & Stumer Road (Side-Street Stop)</i>		
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)
<i>5th Street & Parkview Drive (Side-Street Stop)</i>		
Eastbound Parkview Drive Approach	C (18.9)	C (15.1)
Westbound Parkview Drive Approach	D (31.9)	C (24.6)
Northbound 5 th Street Left-Turn	A (9.2)	A (8.6)
Southbound 5 th Street Left-Turn	A (8.6)	A (8.5)
<i>5th Street & Enchanted Pines Drive (Side-Street Stop)</i>		
Eastbound Enchanted Pines Drive Approach	C (21.2)	C (16.0)
Northbound 5 th 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
<i>Black Hills Boulevard & Stumer Road (Roundabout)</i>		
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']
<i>Overall Intersection</i>	<i>A (3.5)</i>	<i>A (3.4)</i>
<i>Black Hills Boulevard & Stumer Road (Roundabout with a Northbound By-Pass Lane)</i>		
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']
<i>Overall Intersection</i>	<i>A (3.3)</i>	<i>A (3.2)</i>

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
<i>Enchanted Pines Drive & Enchantment Road (Side-Street Stop)</i>		
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)
<i>Stumer Road & Enchantment Road (Side-Street Stop)</i>		
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
<i>Stumer Road & West Walmart Driveway (Side-Street Stop)</i>		
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)
<i>Stumer Road & East Walmart Driveway (Side-Street Stop)</i>		
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)
<i>Stumer Road & Retail Shops Driveway (Side-Street Stop)</i>		
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
<i>Catron Boulevard & Highway 16 (signalized)</i>	
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)
<i>Overall Intersection</i>	C (32.5)
<i>Catron Boulevard & Highway 79 (signalized)</i>	
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)
<i>Overall Intersection</i>	B (17.4)
<i>5th Street & Stumer Road (signalized)</i>	
Eastbound Stumer Road Approach	B (14.6)
Westbound Stumer Road Approach	B (13.2)
Northbound 5 th Street Approach	B (18.4)
Southbound 5 th Street Approach	B (15.2)
<i>Overall Intersection</i>	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.

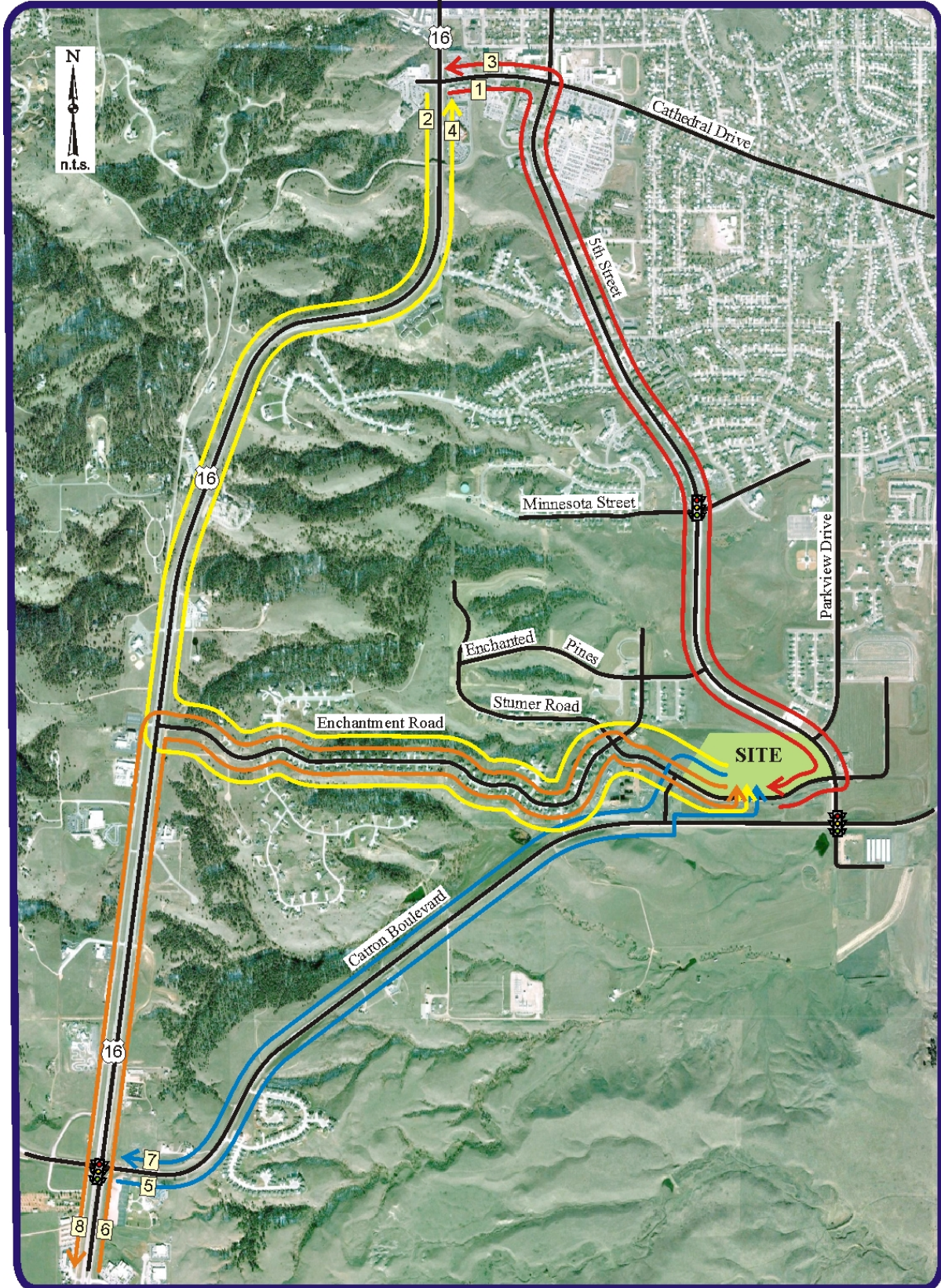


Figure 9: Primary and Cut-Thru Travel Routes

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			
<i>Route</i>		<i>Distance</i>	<i>Travel Time</i>
<i>Alternative Routes from the North to the Black Hills Shopping Center</i>			
1	From the North via 5 th Street Existing Travel Time <u>Estimated Additional Signal Delay</u> Forecasted Travel Time	2.6 miles	4 min 45 sec <u>+ 9 sec</u> 4 min 54 sec
2	From the North via Highway 16 thru the Neighborhood Existing Travel Time	3.6 miles	6 min 35 sec
<i>Alternative Routes from the Black Hills Shopping Center to the North</i>			
3	To the North via 5 th Street Existing Travel Time <u>Estimated Additional Signal Delay</u> Forecasted Travel Time	2.6 miles	5 min 25 sec <u>+ 44 sec</u> 6 min 9 sec
4	To the North via Highway 16 thru the Neighborhood Existing Travel Time	3.6 miles	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			
<i>Route</i>		<i>Distance</i>	<i>Travel Time</i>
<i>Alternative Routes from the Southwest to the Black Hills Shopping Center</i>			
5	From the Southwest via Catron Boulevard Existing Travel Time <u>Estimated Additional Signal Delay</u> Forecasted Travel Time	2.1 miles	2 min 55 sec <u>+ 50 sec</u> 3 min 45 sec
6	From the Southwest via Highway 16 thru the Neighborhood Existing Travel Time	2.8 miles	5 min 10 sec
<i>Alternative Routes from the Black Hills Shopping Center to the Southwest</i>			
7	To the Southwest via Catron Boulevard Existing Travel Time <u>Estimated Additional Signal Delay</u> Forecasted Travel Time	2.1 miles	3 min 20 sec <u>+ 15 sec</u> 3 min 35 sec
8	To the Southwest via Highway 16 thru the Neighborhood Existing Travel Time	2.8 miles	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 of vision 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 potential development of 150 acres in the southwest quadrant of Catron Boulevard and 5th Street. City staff provided assumed uses for the 150 acres, as well as the corresponding trip generation for inclusion in the 20 year analysis. 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.

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.

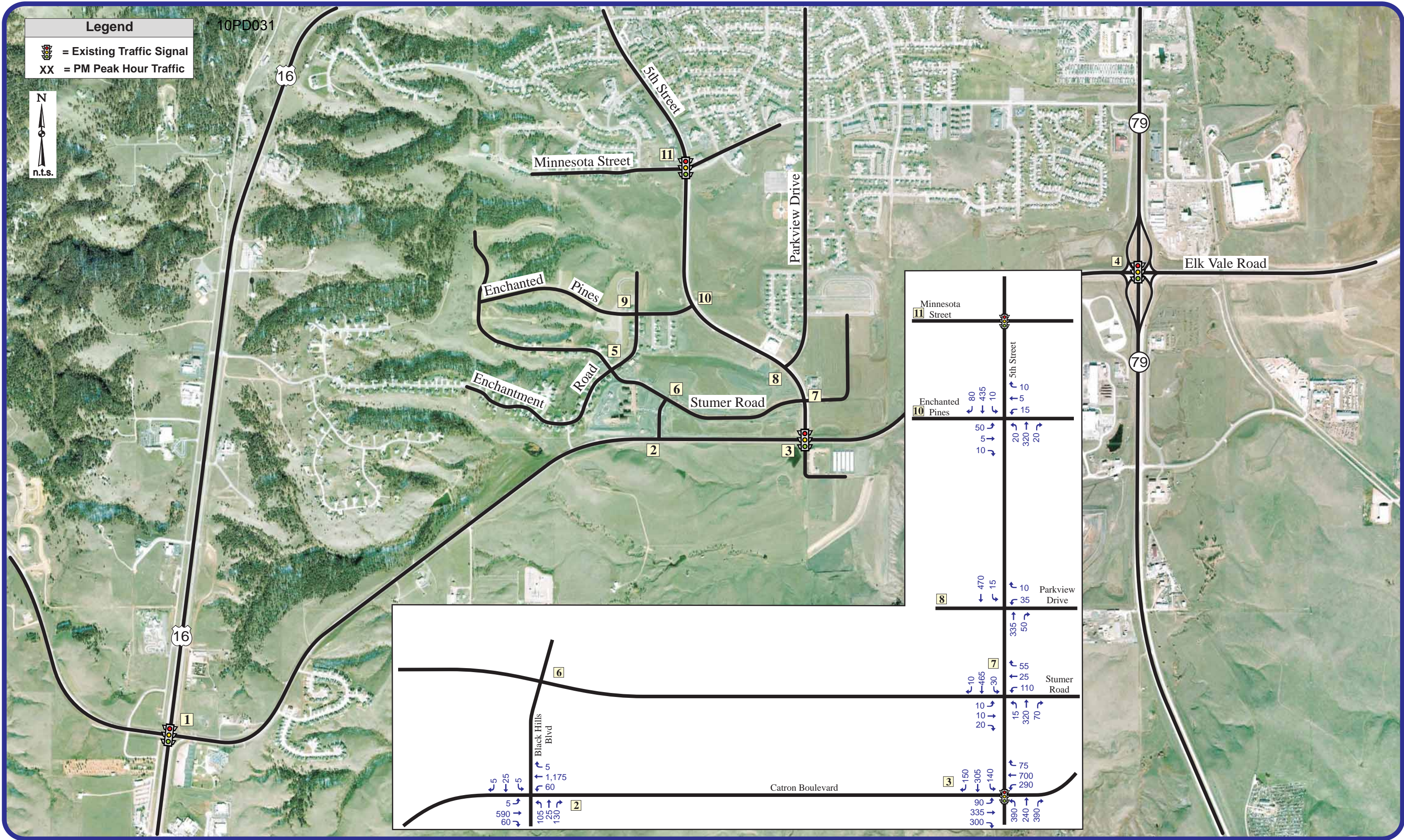


Exhibit 6: 2030 No Build Traffic Volumes

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

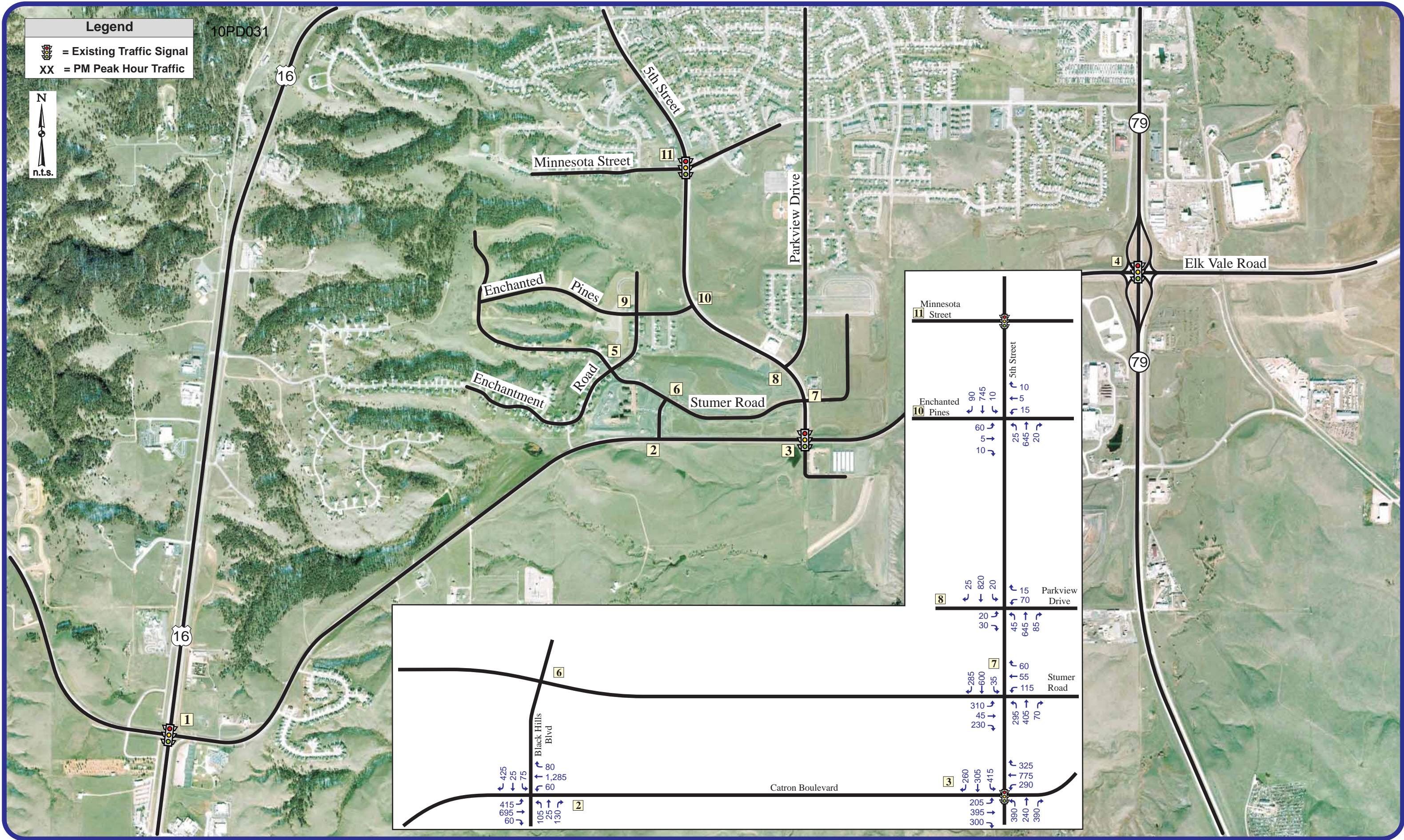


Exhibit 7: 2030 Build Traffic Volumes

Table 14: 2030 Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Weekday PM Peak Hour (Improved)
<i>Catron Boulevard & 5th Street (signalized)</i>		
Eastbound Catron Boulevard Approach	C (25.7)	NA
Westbound Catron Boulevard Approach	D (38.3)	NA
Northbound 5 th Street Approach	D (45.6)	NA
Southbound 5 th Street Approach	C (33.2)	NA
<i>Overall Intersection</i>	<i>D (36.2)</i>	NA
<i>Catron Boulevard & Black Hills Boulevard (signalized)</i>		
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)
<i>Overall Intersection</i>	<i>D (46.5)</i>	<i>D (37.3)</i>
<i>5th Street & Stumer Road (signalized)</i>		
Eastbound Stumer Road Approach	D (42.1)	NA
Westbound Stumer Road Approach	E (59.3)	NA
Northbound 5 th Street Approach	B (10.0)	NA
Southbound 5 th Street Approach	C (20.2)	NA
<i>Overall Intersection</i>	<i>C (25.8)</i>	NA
<i>5th Street & Parkview Drive (Side-Street Stop)</i>		
Eastbound Parkview Drive Approach	D (30.2)	NA
Westbound Parkview Drive Left-Turn	F (89.8)	NA
Northbound 5 th Street Left-Turn	B (10.2)	NA
Southbound 5 th Street Left-Turn	A (9.3)	NA
<i>5th Street & Enchanted Pines Drive (Side-Street Stop)</i>		
Eastbound Enchanted Pines Drive Approach	F (84.6)	NA
Westbound Enchanted Pines Drive Approach	D (34.1)	NA
Northbound 5 th Street Left-Turn	B (10.0)	NA
Southbound 5 th 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 study 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.
- Construct dual eastbound left-turn lanes on Stumer Road at 5th Street. 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.
- 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 to provide 460 feet of storage.
- 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 serving 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.

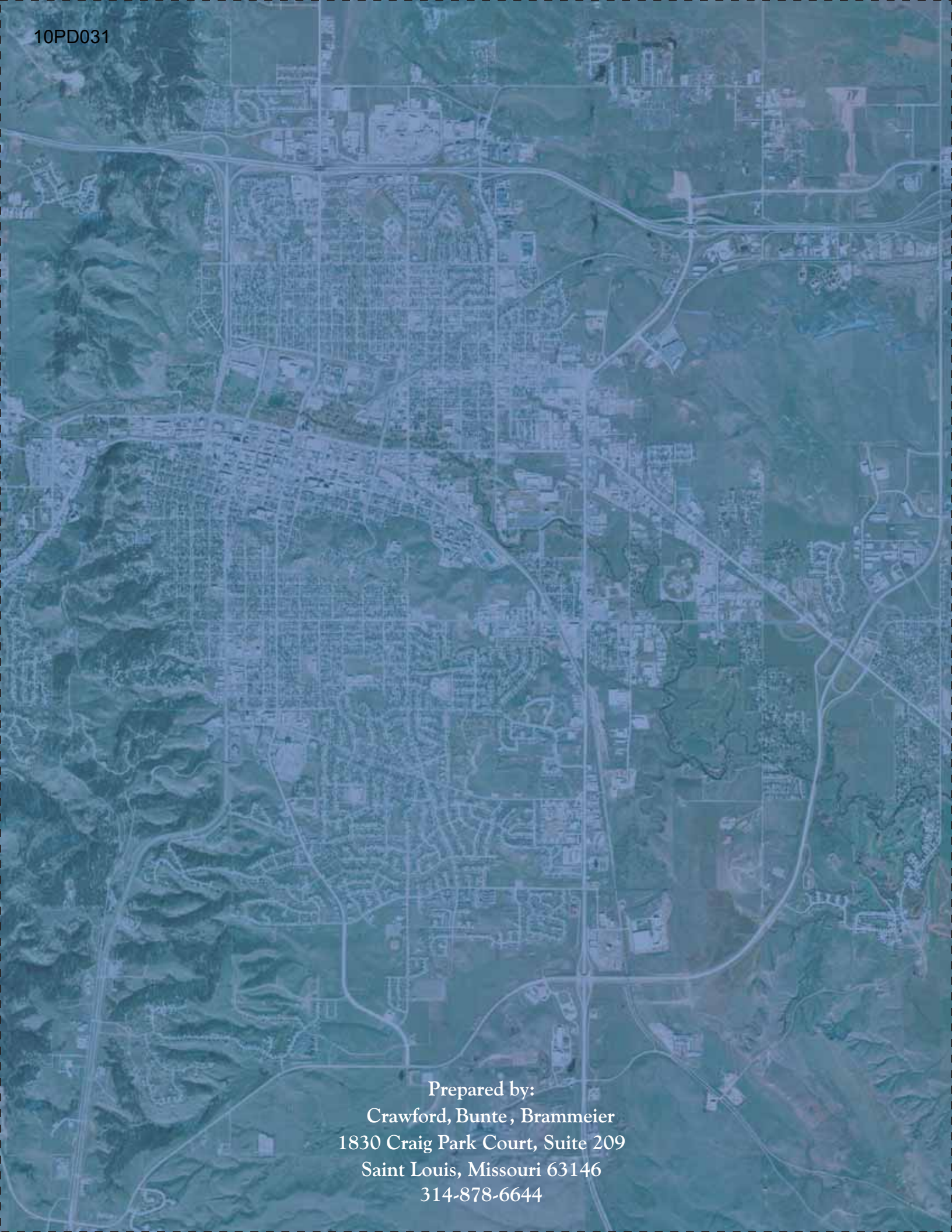
Even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 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 potential development of 150 acres in the southwest quadrant of Catron Boulevard and 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.



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