Interchange Justification Report

I-29 Exit 130 (20th Street South)
Interchange Justification Study

Brookings, South Dakota

September 30, 2020

brookings
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Abbreviations

AASHTO	American Association of State Highway Transportation Officials
AWSC	All-way Stop-control
EB, WB, NB, SB	Eastbound, Westbound, Northbound, Southbound
FHWA	Federal Highway Administration
F+I	Fatal and Injury Crashes
HCM6	6th Edition of Highway Capacity Manual
HCS	Highway Capacity Software
HSM	Highway Safety Manual
I-29	Interstate 29
IHSDM	Interactive Highway Safety Design Module
IJR	Interchange Justification Report
LOS	Level of Service
MEV	Million Entering Vehicles
MVMT	Million Vehicle Miles Traveled
NEPA	National Environmental Policy Act
PDO	Property Damage Only Crash
RTI	Ramp Terminal Intersection
SD 324	South Dakota Highway 324
SDDOT	South Dakota Department of Transportation
STIP	Statewide Transportation Improvement Program
TWSC	Two-way Stop-control
US 14	US Highway 14

1.0 Executive Summary

Plans for a new interchange on Interstate 29 (I-29) at 20th Street South in Brookings, SD, have appeared in statewide and local planning documents for many years. The City of Brookings, in conjunction with the South Dakota Department of Transportation (SDDOT) and the Federal Highway Administration (FHWA), have undertaken this study to provide a technical evaluation of traffic operations and safety of the proposed improvements. This report presents an analysis to satisfy requirements presented in the Policy on Access to the Interstate System, dated May 22, 2017.

The purpose of the Project is to relieve congestion on major north/south and east/west arterials and to improve transportation connectivity for community access and to facilitate growth of the local economy. Need for the Project includes system linkage and traffic capacity.

This study analyzed the operations and safety characteristics of the existing roadway system and found the need for operational and safety improvements. Future traffic operations (Years 2022 and 2045) were analyzed under the following traffic scenarios:

- No Build
- Build overpass for 20th Street South on I-29
- Build interchange for 20th Street South on I-29

The No Build and six Build alternatives were analyzed:

- No Build
- Build Alternative 1 – single point interchange with crossroad over Interstate
- Build Alternative 2 – single point interchange with Interstate over crossroad
- Build Alternative 3 – partial cloverleaf interchange (Parclo B)
- Build Alternative 4 – half diamond interchange (Parclo AB)
- Build Alternative 5 – single loop interchange
- Build Alternative 6 – 20th Street South overpass

The IJR-recommended alternative is Build alternative 5, single loop interchange, which constructs a new interchange at I-29 and 20th Street South (proposed Exit 130). The recommended configuration is a modified standard diamond interchange that includes a southbound loop off-ramp instead of a diagonal ramp. As part of the proposed interchange Project, 20th Street South will be reconstructed between 22nd Avenue and 34th Avenue, through the interchange, to provide system linkage across and to I-29. Existing 20th Street South intersections with 22nd Avenue and 34th Avenue will also be improved as part of the interchange Project.

The response to the two requirements presented in FHWA's Policy on Access to the Interstate System, dated May 22, 2017, is as follows.

1. **An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title**

23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

The operational and safety analysis contained in this study shows that Build alternative 5, single loop interchange, is not expected to adversely affect the safety or efficiency of the Interstate system.

The No Build alternative and six Build alternatives were reviewed for operational capacity using Highway Capacity Manual 6th Edition methodology and Highway Capacity Software, version 7. All interchange Build alternatives achieve LOS C in the 2045 Planning Horizon at all intersections, along arterial corridor segments, and along Interstate segments within the study area. While the Build overpass alternative 6 improves traffic operations when compared to the No Build condition, it does not achieve LOS C at the 22nd Avenue/6th Street intersection. The No Build condition does not meet LOS C at the 22nd Avenue/6th Street intersection.

Build alternatives 3, 4, and 5 provide greater operational benefit when compared to Build alternatives 1 and 2. For 1 and 2, a single point interchange requires signalization upon opening and thus introduces signal delay to 20th Street South corridor traffic. This delay would not be experienced in Build alternatives 3, 4, and 5 because traffic signals are not shown to be needed until the latter years of the 2045 Planning Horizon. Further, Build alternatives 3, 4, and 5, are expected to provide LOS C or better ramp terminal intersection operations farther into the future than Build alternatives 1 and 2.

All Build alternatives were found to improve safety within the study area when compared to the No Build alternative. The Build alternative 6 provided the least reduction in crashes, approximately four percent, of all Build alternatives. Build alternative 5 is expected to reduce crashes by approximately 9.6 percent.

In summary, a new I-29 interchange at 20th Street South is expected to provide the following benefits to Brookings area traffic:

- *Reduce traffic demand along the 6th Street corridor.*
- *The Build interchange alternatives meet LOS goals at all study intersections, while the No Build and Build overpass alternatives do not without further modifications.*
- *Provide additional connectivity between Brookings area development west and east of I-29.*
- *This is of particular importance for commute traffic as 20th Street South will provide efficient connectivity between residential developments in the southern half of Brookings west of I-29 with employment centers east of I-29.*
- *Provide additional connectivity between Brookings and I-29, particularly for existing and future development south of 6th Street and east of I-29.*
- *Foster development along the I-29 and 20th Street South corridors.*

Managed access as part of this proposed project will provide 660 feet controlled access along 20th Street South extending outward from the ramp terminal intersections. The first local network intersection beyond the ramp terminal intersections are pending, but 900 feet is shown in ***Figure 43****.*

20th Street South corridor Improvements required to the local network include:

- *Reconstruction of 20th Street South corridor to provide a paved roadway and bicycle/pedestrian connectivity through the interchange, between 22nd Avenue and 34th Avenue (the next adjacent north/south arterial roadways).*
- *Reconstruction of 22nd Avenue intersection and 34th Avenue intersection through phased improvements. The incremental build-out will address anticipated traffic volume increases and changes in traffic patterns through the 2045 Planning Horizon.*
    - *22nd Avenue*
        - *Year of Opening: restripe southbound approach to provide LT, T, RT configuration. Add northbound LT lane to provide LT, T/RT configuration. Construct WB approach to provide LT, T, RT configuration. Maintain existing eastbound LT, T/RT configuration. Signalize intersection.*
        - *Build-out when warranted to match recommendations from City of Brookings 22nd Avenue Corridor Study.*
    - *34th Avenue*
        - *Year of Opening: construct eastbound approach to provide LT, T/RT configuration. Add southbound RT lane to provide LT/T, RT configuration. Maintain shared lane for westbound and northbound approaches. Stop-control the eastbound and westbound approaches.*
        - *Build-out when warranted to address traffic growth, may include: addition of northbound/southbound LT lanes, splitting the westbound shared lane to include a separate LT, T/RT configuration, and reviewing traffic control.*

A conceptual signing plan for the recommended Build alternative 5, and all other Build alternatives, was developed and included in this report.

2. ***Access from Public Road Access and Traffic Movements Provided:*** **The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

The proposed access is a configuration of an interchange with full access to an arterial city street and includes all movements. The conceptual drawings have been prepared using current standards and further design using current standards is anticipated. Additional refinement will take place during the environmental and design phases of the project.

2.0 Introduction

2.1 Background

The City of Brookings, South Dakota, initially documented the need for an Interstate 29 (I-29) interchange at 20th Street in their Vision 2020 – Comprehensive Plan. That plan stressed the importance of providing adequate travel routes between employment and residential areas. Since then, several planning studies such as the 2011 Brookings Area Master Transportation Plan and the 2010 Decennial Interstate Corridor Study have identified a potential crossing or interchange at I-29 and 20th Street South. This connection would support route connectivity between employment and residential areas east and west of I-29, alleviate congestion along the 6th Street (US 14) corridor, and support development along the I-29 corridor.

In 2015, the City of Brookings in conjunction with South Dakota Department of Transportation (SDDOT) and the Federal Highway Administration (FHWA) initiated a study to evaluate the feasibility of a new I-29 interchange at 20th Street South. The interchange access report evaluated traffic operations for an overpass and several different interchange options. The study was completed in September 2016 and recommended construction of an interchange.

A recent 2017 reconstruction project of 6th Street and the I-29 Exit 132 ramp terminal intersections improved capacity along the corridor to address long-term traffic demand from a corridor standpoint. However, given the importance of 6th Street as the primary east/west crossing of I-29 between residential (west of I-29) and industrial/entertainment (east of I-29) areas, increasing traffic would be expected to lead to isolated congestion at some point in the future. Examples of these anticipated point-congestion areas include the 6th Street/22nd Avenue intersection and side street queues leaving the industrial area in the afternoon peak commute period.

In 2019, the City of Brookings was awarded a BUILD grant for the study, design, and construction of an interchange at 20th Street South, to be known as Exit 130.

2.2 Project Purpose and Need

The purpose of the Project is to relieve congestion on major north/south and east/west arterials and to improve transportation connectivity for community access and to facilitate growth of the local economy. Need for the Project includes system linkage and traffic capacity.

2.2 Study Area

The proposed interchange is at I-29 mileage reference marker (MRM) 130 in southeast Brookings, SD. This location is adjacent to the developed Brookings urban area. Adjacent I-29 interchanges to the proposed interchange location include:

- 217th Street / South Dakota Highway 324 (SD 324) at Exit 127
    - 3 miles south of proposed Exit 130 interchange.
    - Crossroad corridor to be referred as 217th Street/SD 324 in IJR text.
- 6th Street / US Highway 14 (US 14) at Exit 132
    - 2 miles north of proposed Exit 130 interchange.
    - Crossroad corridor to be referred as 6th Street in IJR text.

The IJR study area extends along I-29 from MRM 126 to MRM 133.56 and includes the existing interchanges at Exit 127 and Exit 132. Crossroad corridors of 6th Street, 20th Street South, and 217th Avenue/SD 324 are also included in the study.

Primary study area local network corridors include:

- **217th Street (SD 324)**: two-lane rural highway through Exit 127 (southern east-west study corridor).
- **6th Street (US 14)**: four-lane median-divided roadway through Exit 132 (northern east-west study corridor).
    - Reconstructed in 2017.
- **22nd Avenue**: five-lane urban roadway that transitions to a two-lane rural roadway south of 20th Street South (western north/south study corridor).
- **34th Avenue**: three-lane roadway that transitions to a two-lane rural roadway south of Prince Drive (eastern north/south study corridor).
- **20th Street South**: currently a gravel roadway that does not cross I-29.

The following existing street intersections are included in the study analysis:

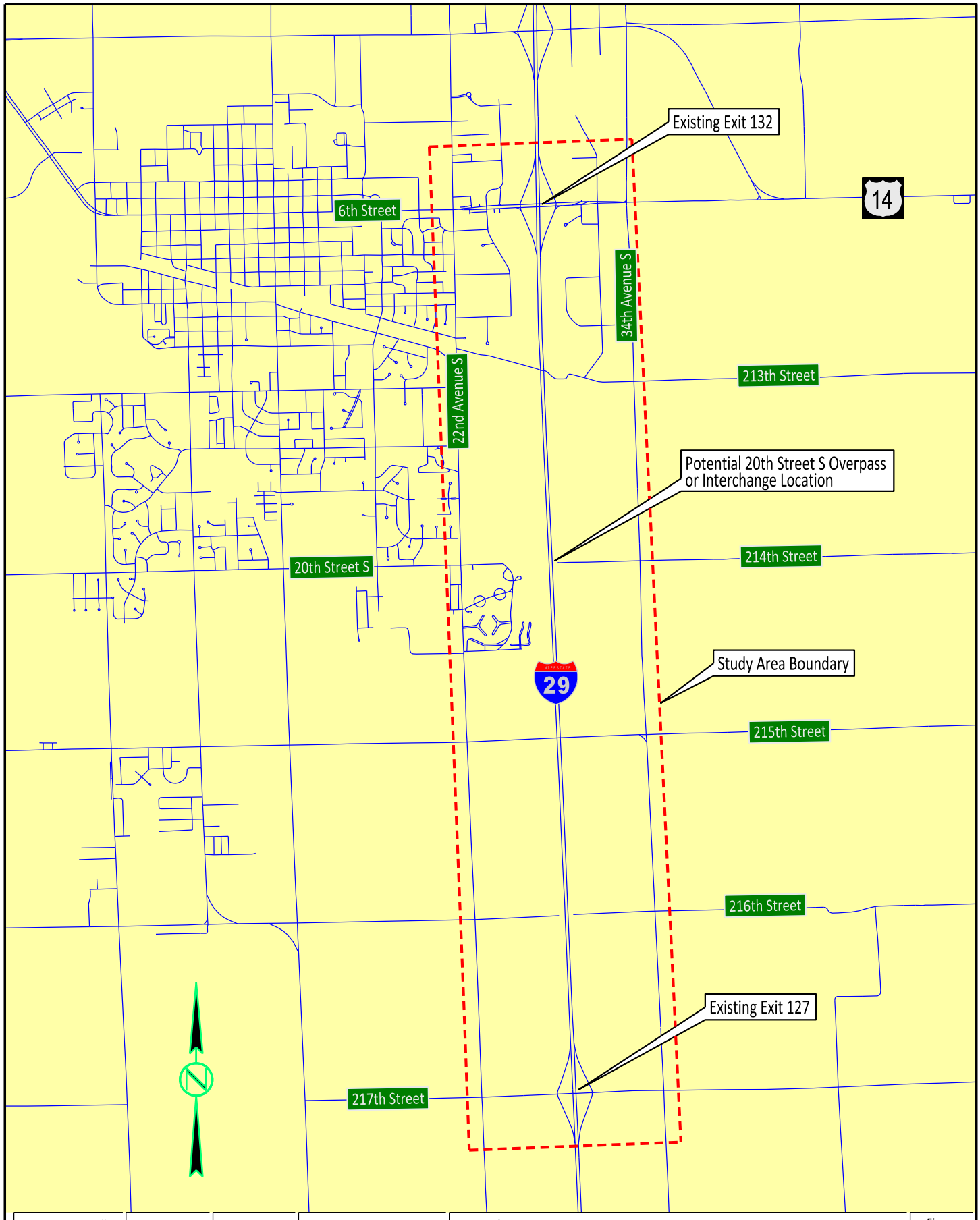
1. 6th Street (US 14)/22nd Avenue
2. 6th Street (US 14)/Sunrise Ridge Road
3. 6th Street (US 14)/Interstate 29 Southbound Ramp Terminal
4. 6th Street (US 14)/Interstate 29 Northbound Ramp Terminal
5. 6th Street (US 14)/32nd Avenue
6. 6th Street (US 14)/34th Avenue
7. 20th Street South/22nd Avenue South
8. 217th Street/22nd Avenue South
9. 217th Street (SD 324)/Interstate 29 Southbound Ramp Terminal
10. 217th Street (SD 324)/Interstate 29 Northbound Ramp Terminal
11. 217th Street (SD 324)/34th Avenue South
12. 20th Street South/34th Avenue South

The study area is shown in **Figure 1**.

Interstate operations analyses of mainlines, ramps and weaving were conducted on I-29 segments within the study area.

2.3 Methods and Assumptions

The analysis methods and assumptions used in this study are documented in a separate Methods and Assumptions document that was negotiated between the supervising agencies and the consultant. A copy of the Methods and Assumptions document is provided in **Appendix A**.



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

DOT

brookings

HDR

BANNER

Study Area

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure
1

3.0 Operational and Safety Analysis

3.1 Existing Conditions Analysis

Demographics

The Brookings area enjoys a robust economy and sustained population growth. Between 1980 and 2010, population grew at a steady rate of between 1% and 2% per year. The 2018 Census estimate shows the city with a population of 24,509[1].

Generally, employment for the Brookings area has grown at a similar rate as population. Based on the most currently available City of Brookings Annual Financial Report[2], unemployment in Brookings was at 3.1%. This was well below the 2018 national average of 3.9%. Commercial and industrial employment is concentrated within the study area, while institutional employment is concentrated adjacent to the study area at South Dakota State University, the City's largest employer.

Existing and Future Land Use

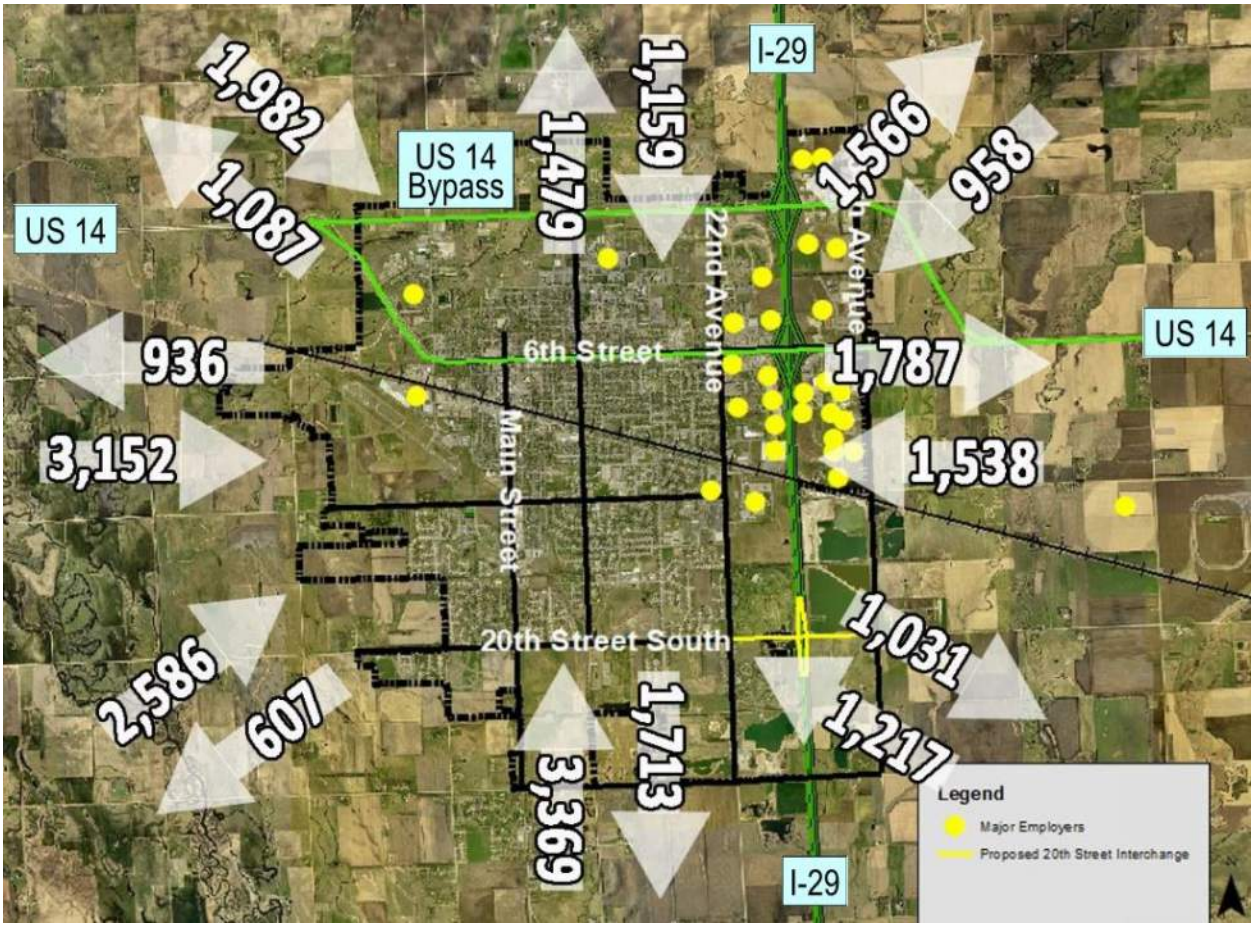
The northern half of the study area is comprised mainly of commercial and industrial uses, including several large manufacturing facilities and big-box retail stores. This land use generates a significant amount of traffic in the Brookings area. An estimation of commuter traffic distribution (originating from/destined to Brookings) is shown in **Figure 2**. Currently, much of the traffic entering or leaving the Brookings area via I-29 or US 14 are doing so via the 6th Street corridor and interchange.

Further south and surrounding the potential interchange area, there is a considerable amount of land available for development and redevelopment. In general, Brookings is landlocked by floodplain and much of the developable land in the southern half of Brookings is the only remaining location for development in the immediate area. In the environmental/floodplain constraint areas, current land use is typically agriculture, aggregate quarries, or maintained as waterways and grassland.

The BUILD grant identified previously planned development areas in the vicinity of 20th Street South. These areas would help meet the needed residential, commercial, and industrial opportunities for this growing community. On the east side of I-29, 20 acres of multi-family housing, 20 acres of commercial space, and 65 single family lake front properties could be developed. On the west side of I-29, 240 acres of future residential and 160 acres of commercial land could be developed.

1 https://www.census.gov/quickfacts/fact/table/brookingscitysouthdakota,brookingscountysouthdakota/PST045218

2 http://www.cityofbrookings.org/202/Financial-Reports



Description: Figure shows estimated commuter distribution originating from or destined to Brookings, SD. The major employment centers in Brookings are primarily located along the I-29 corridor (designated by yellow circles). Modified from: Bridging the Interstate Divide, 20th Street South Interchange Project. BUILD grant application submitted on July 10, 2019.

Figure 2: Commuter Flow Map

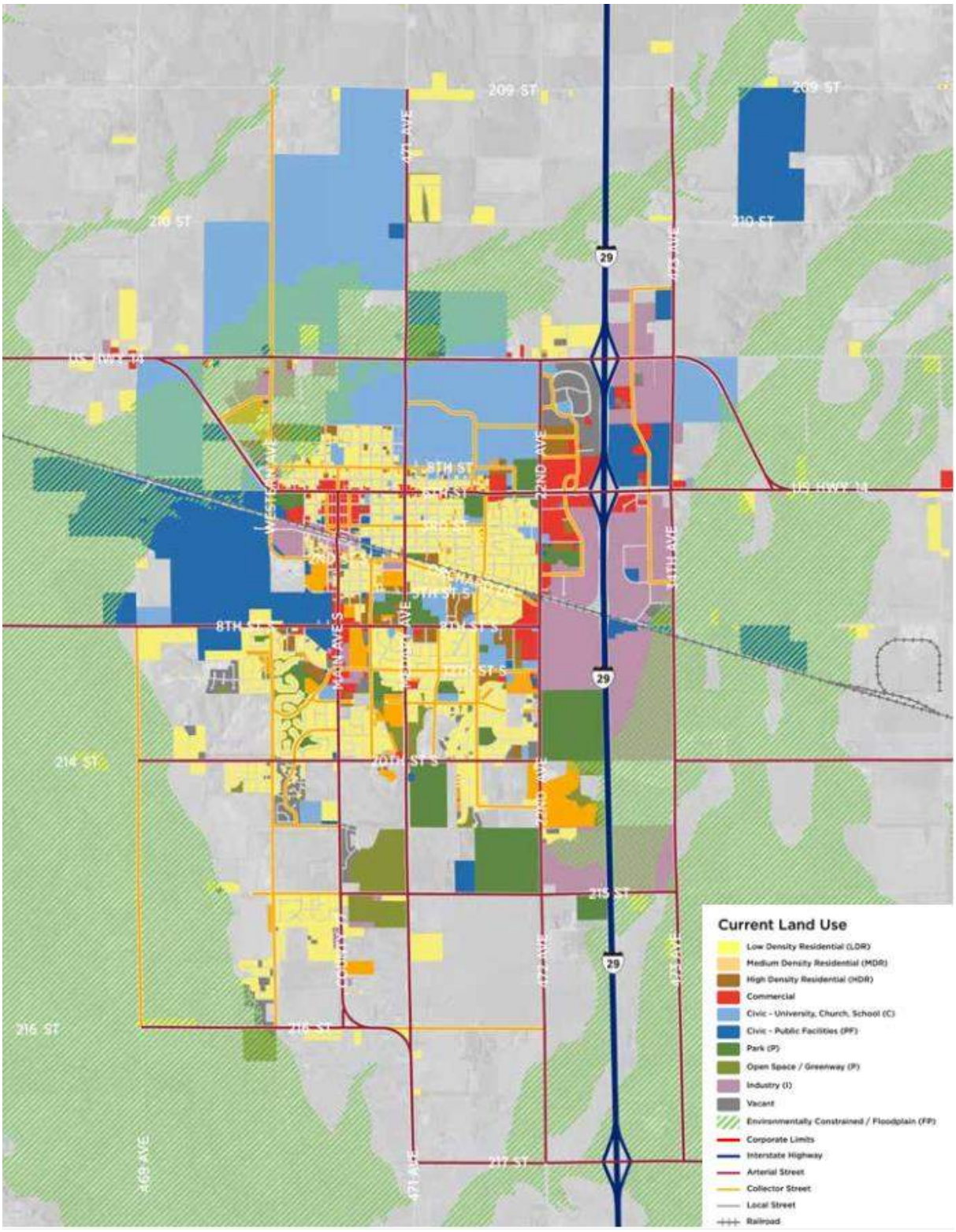
A Quick Response System II (QRS II) travel demand model was developed as part of the 2011 Brookings Area Master Transportation Plan. This model subdivided the Brookings area into over 65 different Traffic Analysis Zones (TAZs) to reflect home and work-based trips based on existing and future development. The future land use in the QRS II model was last updated in 2015 as part of the calibration process in preparation for the 2016 interchange access study.

Since completion of the 2016 interchange access study, the City of Brookings published their 2040 Brookings Comprehensive Plan[3] existing and future land use maps shown in **Figure 3** and **Figure 4**, respectively. When comparing the two maps, much of the future development surrounding the core Brookings area is expected to occur along the southern edges and I-29 corridor. The proposed interchange is located right in the heart of the I-29 corridor future development. Model-derived traffic forecasts for this study were updated to account for any new future development identified in the 2040 comprehensive plan.

[3] https://cityofbrookings.org/141/Long-Range-Planning

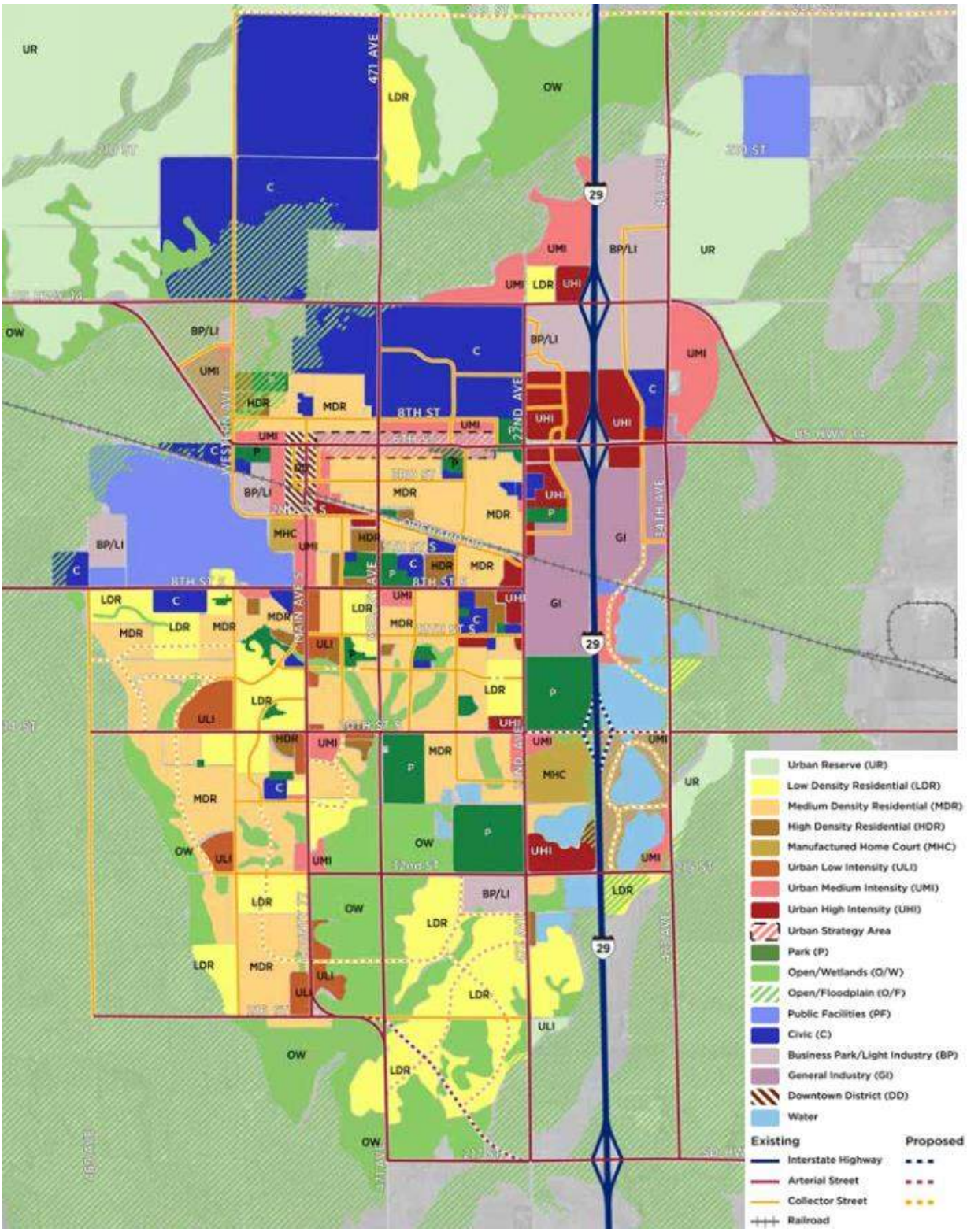
It is anticipated that construction of the proposed interchange at 20th Street South would be a catalyst for future development, particularly for developable land along and east of I-29. It is expected that land surrounding an interchange would be developed/redeveloped to a higher density type of land use and occur more quickly compared to No Build or overpass conditions. An interchange is much more desirable for development in this area due to improved connectivity across and access to I-29. The No Build and overpass conditions lack one of both of these desirable connections for future development.

Because of these anticipated differences in future development, the traffic forecasts developed for this study account for the varying degrees of development associated with each future-year scenario. Additional information regarding the effect of future land use on traffic volumes can be found in the *Traffic Forecasting Adjustments to Brookings Travel Demand Model Output* technical memo in **Appendix B**.



Source: 2040 Brookings Comprehensive Plan, Figure 2.4.

Figure 3: Existing Land Use



Source: 2040 Brookings Comprehensive Plan, Figure 3.5.

Figure 4: Brookings Future Land Use Plan

Existing Roadway Network

As previously identified, the existing major roadways within the study area include *(functional classification)*:

- **I-29**: four lane median-divided (depressed) interstate highway *(Urban or Rural Interstate Highway)*.
- **6th Street (US 14)**: four lane median-divided (raised) urban roadway *(Urban Minor Arterial)*.
- **217th Street (SD 324)**: two lane rural roadway *(Rural Major Collector)*.
- **22nd Avenue**: five lane urban roadway that transitions to a two lane rural roadway south of 20th Street South *(Urban Minor Arterial or Rural Major Collector)*.
- **34th Avenue**: three lane urban roadway that transitions to a two lane rural roadway south of Prince Drive *(Urban Collector, Rural Major Collector, or Rural Local Road)*.
- **20th Street South**: gravel roadway with no crossing of I-29 *(Urban or Rural Local Road)*.

Alternative Travel Modes

Travel within the study area is primarily by automobile. Pedestrian and bicycle modes are used mainly for recreation, although a few bicycle commuters use streets and trails within the study area. The area is currently served by municipal on-demand transit for local travel and Jefferson Lines for regional travel. The Brookings airport is located on the west side of Brookings, between the 6th Street and 8th Street South corridors.

Existing Interchanges

Existing interchanges within the study area include:

- **I-29 Exit 127 (217th Street/SD 324)**: diamond design interchange.
- **I-29 Exit 132 (6th Street/US 14)**: diamond design interchange.

Aerial photos of the existing interchanges have been included in the **Appendix C**.

Existing Data

Most study data were available from the participating agencies, including traffic counts and crash data. The available data was supplemented with additional counts, travel demand model output, and traffic observations. The data is recent and of high quality.

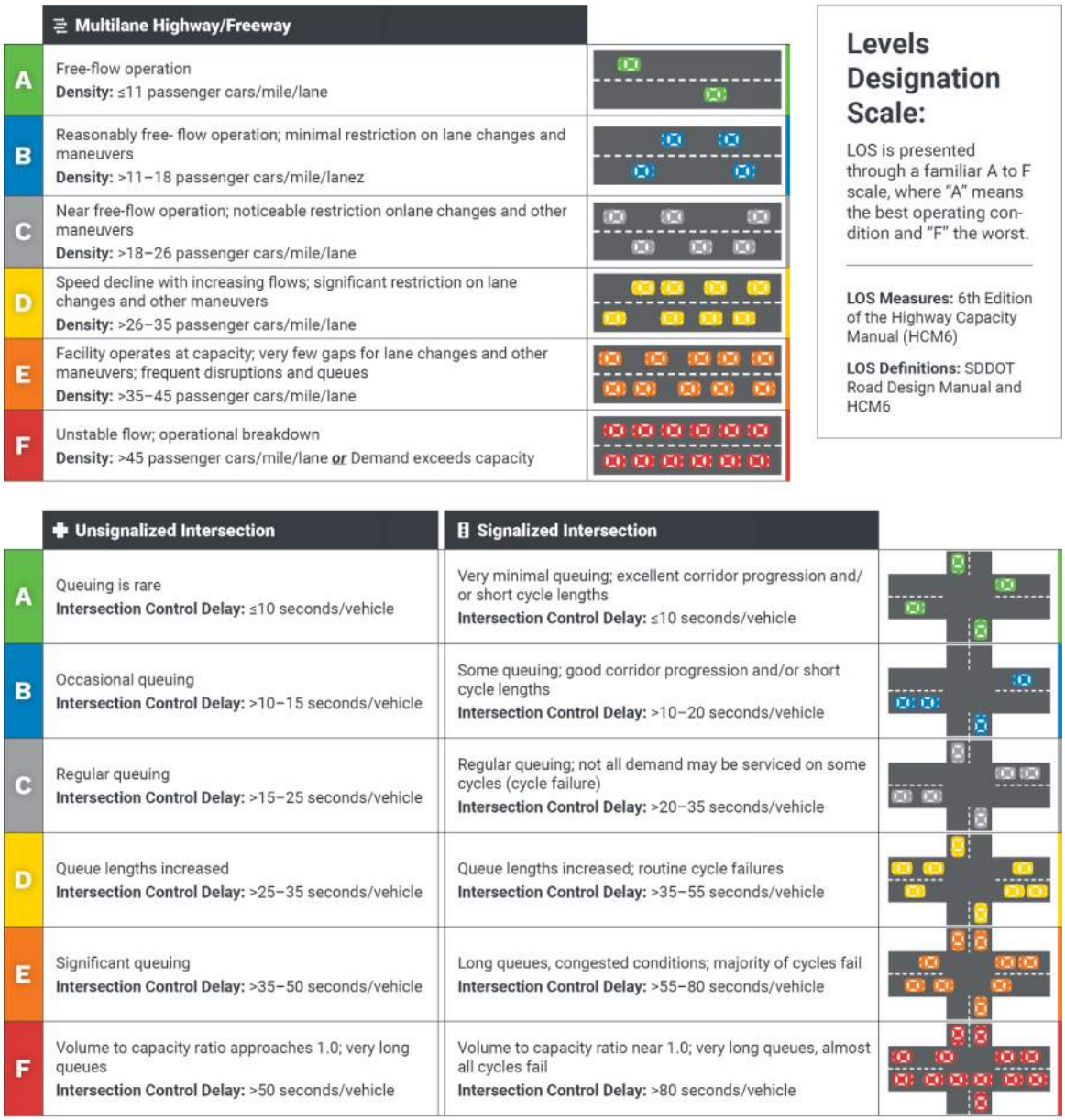
- Existing intersection turning movement counts: April 2, 2019, April 24, 2019, and March 17-18, 2020.
- Existing I-29 mainline counts at MRM 129: October 15, 2019.
- Existing daily traffic volumes: SDDOT GIS.
- Seasonal traffic volume factors: SDDOT.
- Countywide traffic volume growth factors: SDDOT.
- Traffic forecasts: Brookings QRS II travel demand model.
- Crash data: State of South Dakota crash database, provided in a GIS geodatabase by SDDOT, for the complete years of 2015 through 2019.
- Geometric data: SDDOT-provided construction plans and aerial mapping.

The existing conditions AM and PM peak hour intersection turning movement volumes and daily volumes are summarized in **Figure 6** and **Figure 7** in the next section. Traffic count data collected in 2019 and 2020 was assembled and balanced to produce a coherent representation

of peak hour traffic volumes along the primary study area corridors of 6th Street, 20th Street South, 217th Street (SD 324), and I-29.

Operational Performance

Operation performance of highways is evaluated in terms of the quality of service, which describes how well a transportation facility operates from the traveler's perspective. Quality of service is usually measured with "Level of Service" (LOS), a letter grade similar to those used in school. A summary of LOS measures for different roadway facilities pertinent to this study are provided in **Figure 5**.



Note: Unsignalized intersection control delay shown in figure for overall (or weighted) intersection delay. Two-way stop-control delay is measured from the worst-case stop-controlled approach with the same average delay (seconds/vehicle) thresholds.

Figure 5: Level of Service Descriptions

LOS goals established for this interchange justification include:

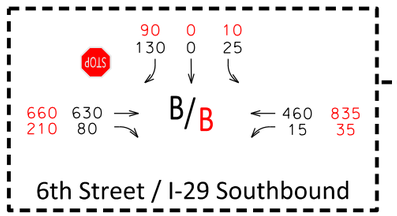
- **Ramp terminal intersections**: LOS C
- **I-29 freeway segments**: LOS C
- **City of Brookings intersections**: LOS C

Peak hour LOS is calculated for study area intersections and roadway segments using Highway Capacity Software, Version 7 (HCS7) and methodology described in the 6th Edition of the Highway Capacity Manual (HCM6). Guidelines for use of HCS7 in this study is documented in the Methods and Assumptions document. A summary of the following operational measures and associated LOS thresholds applicable to this study area are provided in **Appendix D**.

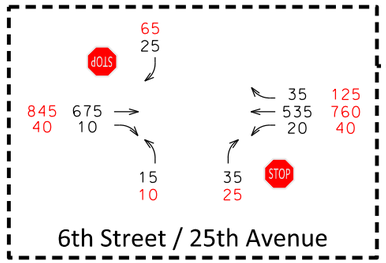
- Intersections
    - Two-way stop-control (TWSC)
        - Worst-case stop-control delay measured at ramp terminal intersections.
        - Overall (weighted) intersection delay measured at all other intersections.
    - All-way stop-control (AWSC)
    - Roundabouts
    - Signalized intersections
- Overall interchange delay
- Roadway corridors
    - Freeway facilities and segments (merge, diverge, and basic segments)
    - 2-lane highways
    - Urban streets
    - Bicycle and pedestrian multimodal

The existing study area corridors of 6th Street, 20th Street South, 217th Street (SD 324), and I-29 were analyzed to identify any immediate transportation needs with existing traffic volumes. Existing signal timings were used for the existing conditions analysis. A slight deviation was needed at the 6th Street and 32nd Avenue intersection to align split times with the overall plan sheet coordinated cycle length (appeared that 0.5-second intervals were used in the analysis-derived split times but not conveyed on the plan sheets).

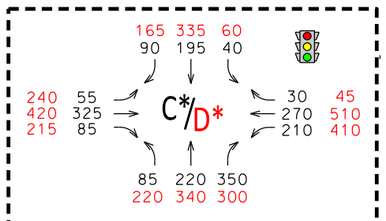
It was found that all study intersections (**Figure 6** and **Figure 7**) and corridor segments (**Table 26** and **Table 29**) operate at acceptable LOS for this study. The lone exception was at 6th Street/22nd Avenue intersection where an update to signal timings would improve analysis-measured LOS from D to C. Along the 6th Street corridor in particular, the recent 6th Street reconstruction project added beneficial capacity at the major intersections to address emerging operational issues. HCS files for the 2020 existing conditions analysis are provided in **Appendix E**.



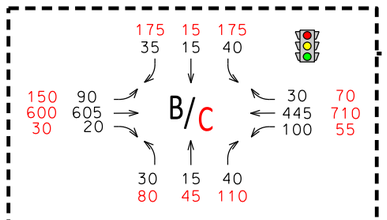
6th Street / I-29 Southbound



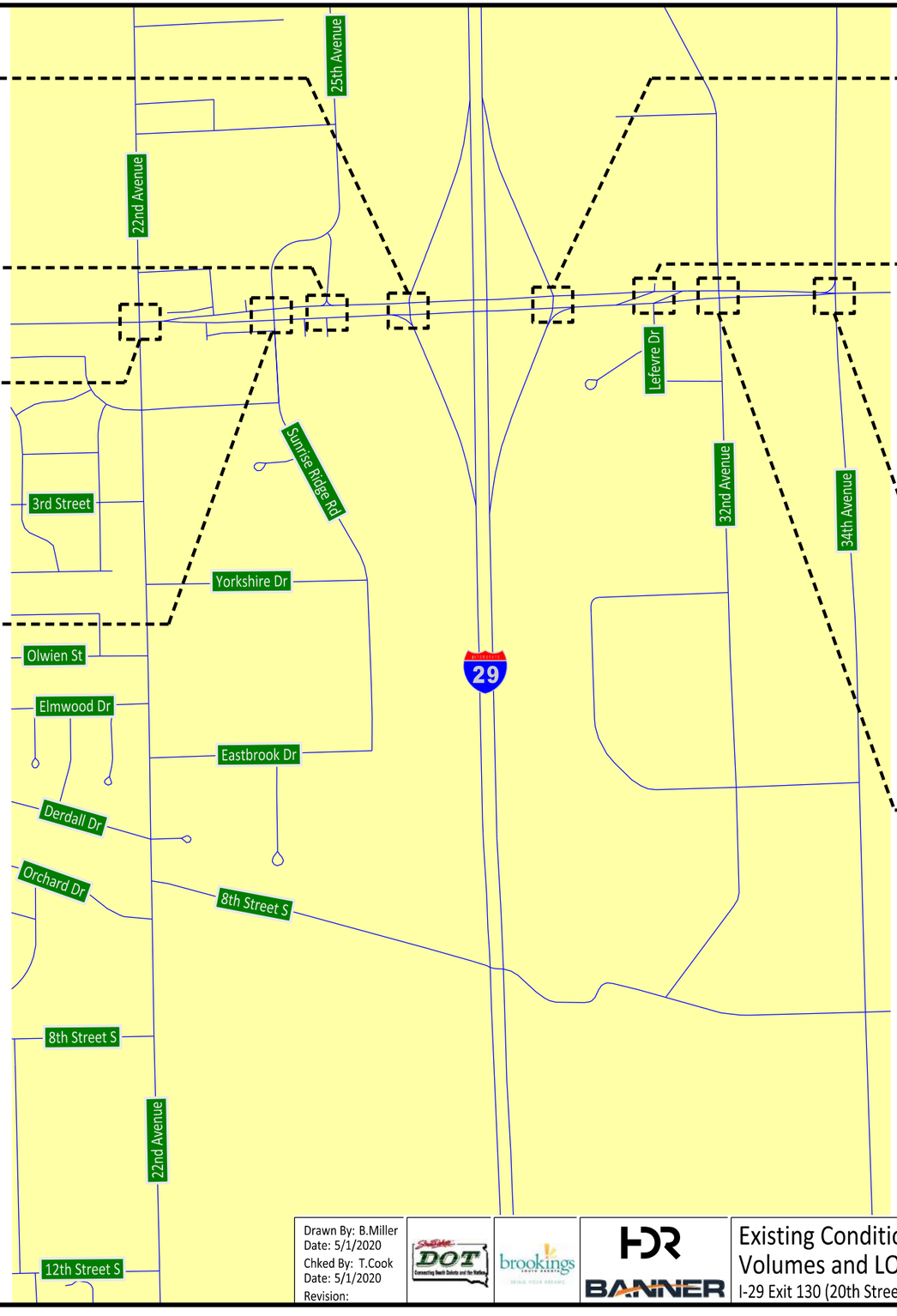
6th Street / 25th Avenue

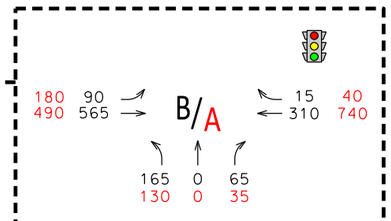


6th Street / 22nd Avenue

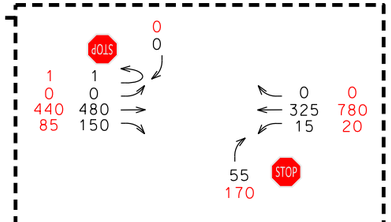


6th Street / Sunrise Ridge Road

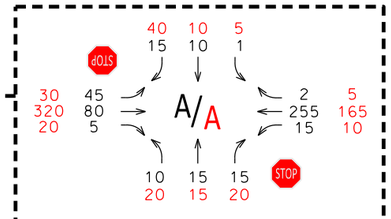




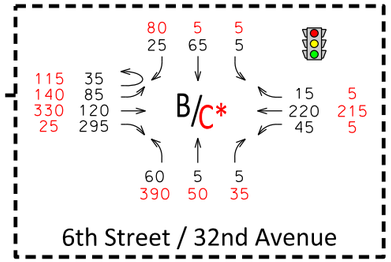
6th Street / I-29 Northbound



6th Street / Lefevre Drive



6th Street / 34th Avenue



6th Street / 32nd Avenue

* One or more turn lanes experience a queue storage ratio greater than 1.0 (HCS-measured 95th percentile queue is longer than the existing turn lane storage length). HCS does not account for the effect of auxiliary lane spill-back and the actual LOS may be worse than what is shown. This measured queue is not caused by the proposed Project and it is anticipated the issue will be mitigated if/when the problem occurs in the field.

Signal Timings

- Existing traffic signal timings were used in the Existing Conditions analysis. Optimized signal timings reflecting the analyzed traffic volumes would improve 6th Street & 22nd Avenue intersection LOS to C.

Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

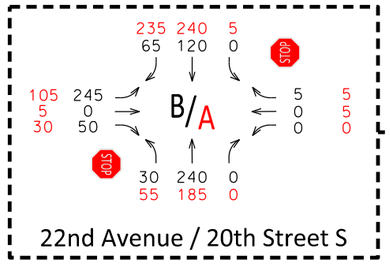
Existing Conditions (Intersections) - Peak Hour Volumes and LOS

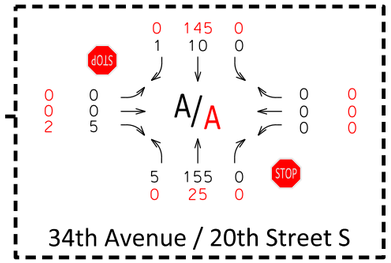
I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

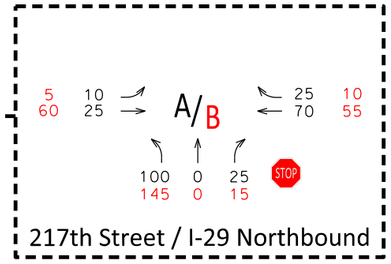
Figure 6a

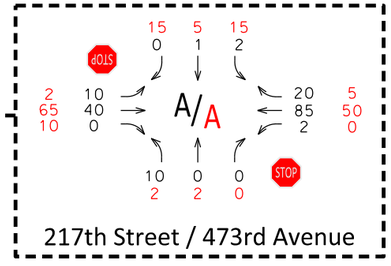
Stop-Controlled Intersection Level of Service Reporting

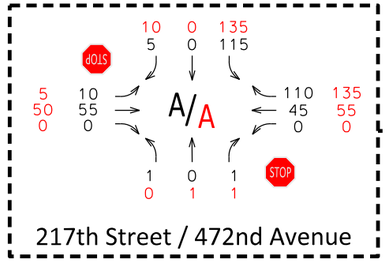
- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

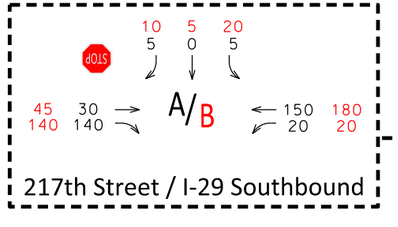


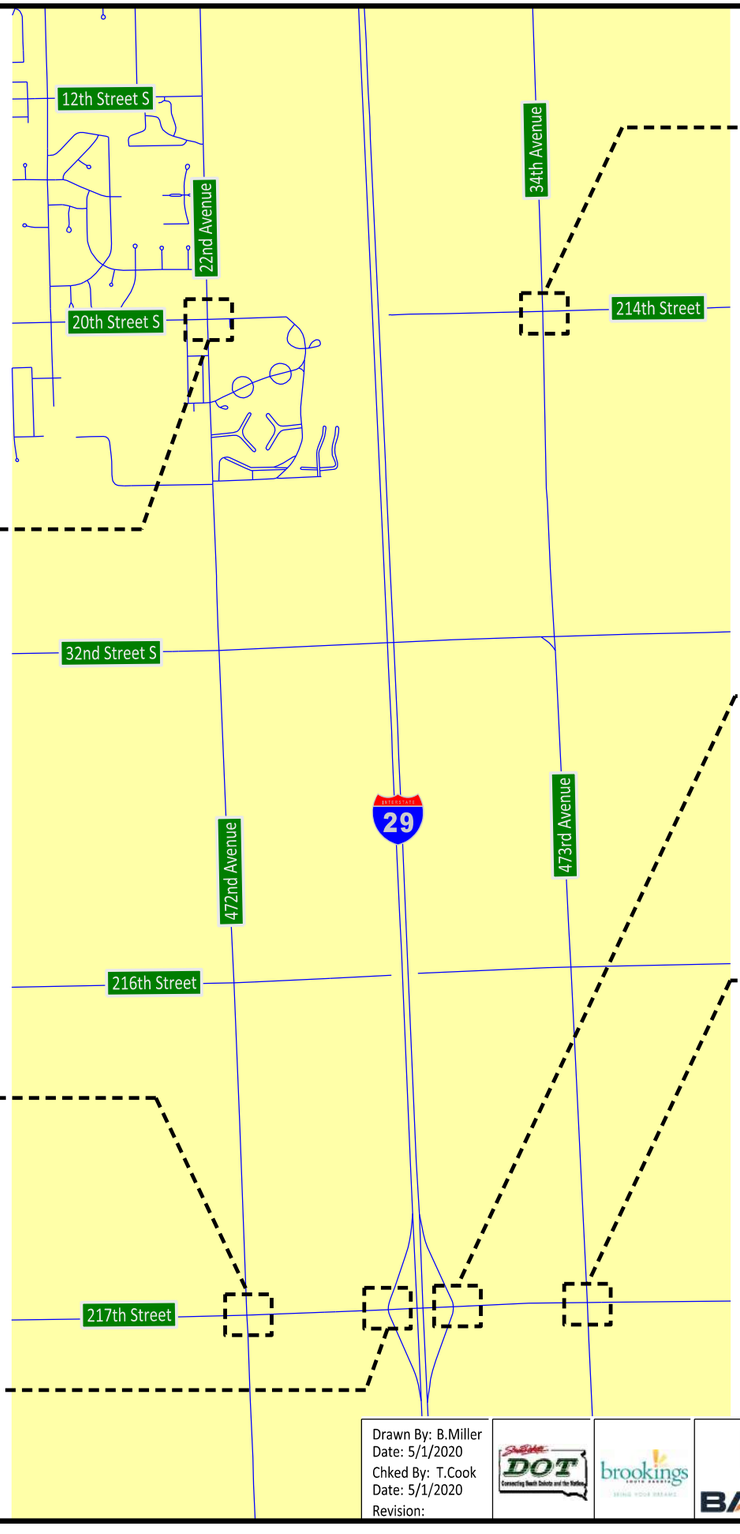












Legend

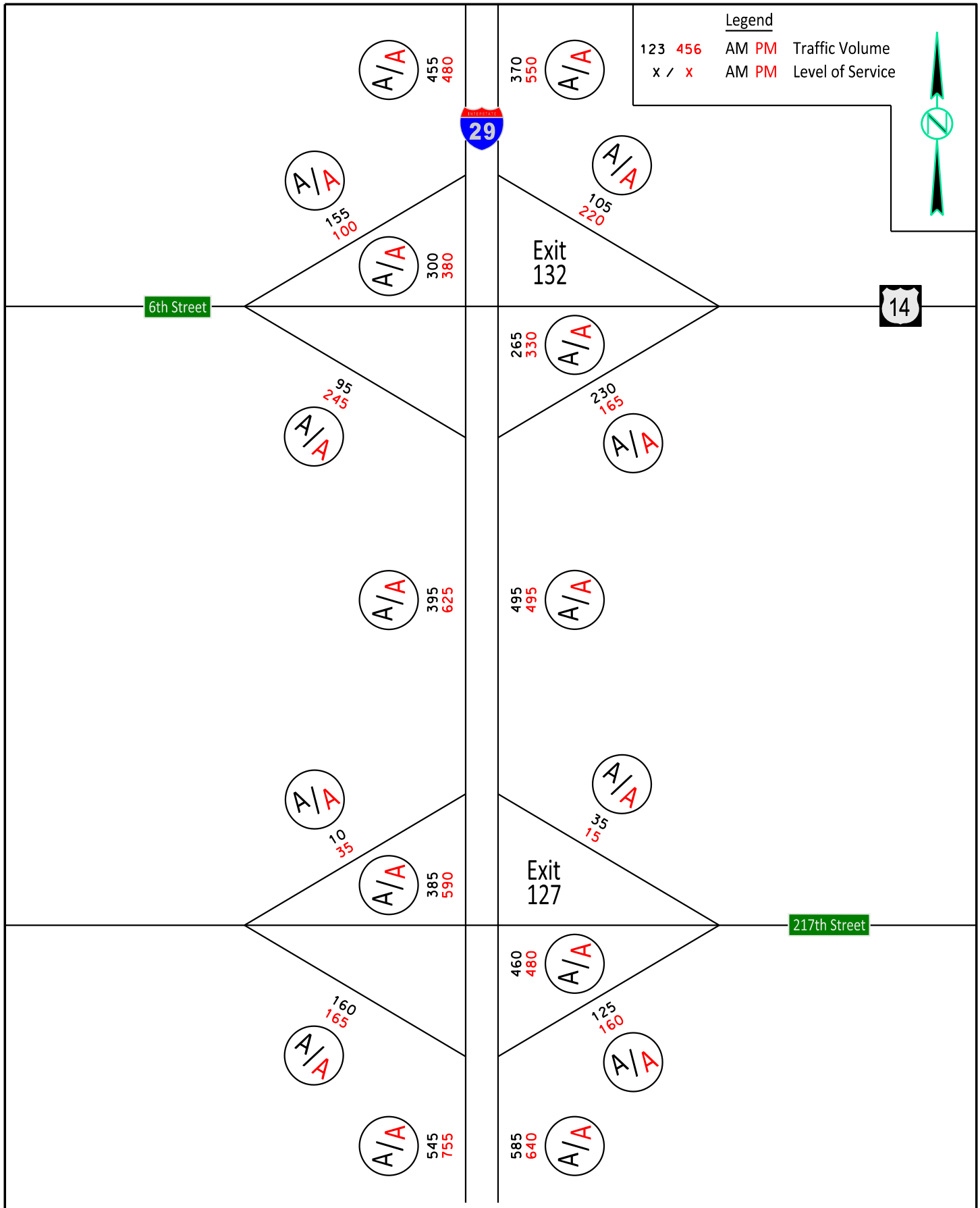
123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Existing Conditions (Intersections) - Peak Hour Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 6b



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Existing Conditions (Interchanges) - Peak Hour Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 7

Safety

Crash records from the State of South Dakota crash database for years 2015 through 2019 were provided by the SDDOT in a GIS geodatabase. The following sections summarize relevant crash characteristics for study intersections and the I-29 corridor. Crash location maps and record tables are provided in **Appendix F**.

Crash Review Methodology

The study area was broken up into the following for analysis:

- Arterial intersections
- Arterial corridor segments
- I-29 segments.

All crashes occurring along the arterial corridors of 6th Street, 20th Street South, and 217th Street were sorted based on whether they were related to an intersection or roadway segment. All crashes occurring along I-29 were sorted on whether they occurred along a freeway segment, within the area of a ramp junction, or along an interchange ramp. Where the appropriate classification was difficult to discern, crashes were assigned to the respective intersection or segment based on location. Crash characteristics, such as total crashes, crash severity, manner of collision, light condition, and road surface condition were tabulated and presented in the crash tables.

Crash rates and critical crash rates were calculated for both intersections and roadway segments. Intersection crash rates were calculated in terms of crashes per million entering vehicles (crashes/MEV). Roadway segment crash rates were calculated in terms of million vehicle miles traveled (crashes/MVMT).

Critical crash rates were calculated based on the statistical populations for each crash location (intersection or segment), using methods presented in the Highway Safety Manual (American Association of State Highway and Transportation Officials (AASHTO), 2010). A critical crash rate accounts for a desired level of confidence (95 percent used in this study), vehicle exposure, and similar facility types. Intersections and segments where the crash rate exceeds the critical rate should be investigated further.

Intersection and segment crash rates were calculated with available daily traffic count data provided by the SDDOT or collected as part of this study.

In light of the 2017 reconstruction of the 6th Street corridor, only crashes occurring along the corridor after the reconstruction was complete are included in the analysis. The approximate timeframe is from October 2017 through December 2019.

Study Intersections

Summaries of intersection crash characteristics are provided in **Table 1** through **Table 4**. Overall, study intersection crashes were generally low severity, with no fatal or incapacitating injury crashes. Crashes were primarily concentrated at the intersections of 6th Street/22nd Avenue and 20th Street South/22nd Avenue. Both exhibited crash rates that exceeded the critical crash rate.

At the signalized 6th Street/22nd Avenue intersection, only two years of post-construction data was available and thus the much shorter timeframe of crash history should be considered with regard to the findings. However, within the available 27 analysis months, 16 crashes occurred. Thirteen of the 16 were no injury crashes and approximately half were angle and half were rear-end crashes. Over half of the crashes occurred on pavement conditions that were not dry.

The 20th Street South/22nd Avenue intersection was the second intersection where the crash rate exceeded the critical crash rate. This unsignalized intersection has a propensity for angle crashes, representing 12 of the 13 intersection crashes. Eight of these angle crashes involved eastbound and southbound vehicles, four of which included icy or snow road conditions. Contributing factors could be occlusion of southbound through traffic by southbound right turn traffic or misjudging gaps in traffic.

A third intersection with a crash rate that exceeded the critical crash rate was the 22nd Avenue (472nd Avenue)/217th Street intersection. While only four crashes occurred at this intersection, entering volumes were notably lower than other intersections located in the northern half of the study area. Crash rates tend to overemphasize low volume intersections due to the influence of lower traffic volumes. Two of the four were angle crashes due to failure to yield to oncoming traffic, and both resulted in non-incapacitating injuries.

Arterial Corridor Segments

All remaining crashes along east/west corridors not assigned to study intersections were categorized as segment crashes. A review for hot spots did not identify any clusters of crashes or segments with a crash rate exceeding the critical crash rate, summarized in **Table 5**. In general, most crashes occurring on the local network were intersection crashes.

I-29 Segments and Ramps

A summary of I-29 freeway and interchange ramp segment crash characteristics are provided in **Table 6** through **Table 9**. There were no I-29 freeway or ramp segment crash rates that exceeded the segments' respective critical crash rate. Overall, the I-29 segments exhibited typical crash patterns for what would be expected through this area. There was one fatality and three incapacitating injuries, all of which occurred between Exit 132 and Exit 127 and involved snow or ice road conditions. Speed was noted as a contributing factor in the overturn/rollover fatal crash occurring in the northbound direction at night. Most crashes along the freeway segments were single vehicle crashes and thirteen of the 21 injury crashes occurred on any icy or snowy roadway surface.

Table 1: Intersection Crash Summary (2015- 2019) – Injury Severity and Manner of Collision

Int. No.	Intersection	Total Crashes	Injury Severity					Manner of Collision				
			Fatal	Incap. Injury	Non-Incap. Injury	Possible Injury	No Injury	Single Vehicle	Rear-end	Head-on	Angle	Sideswipe
1	6th St & 22nd Ave	16	0	0	1	2	13	0	7	0	8	1
2	6th St & Sunrise Ridge Rd	4	0	0	0	1	3	0	2	0	2	0
3	6th St & I-29 SB RTI	1	0	0	0	0	1	0	1	0	0	0
4	6th St & I-29 NB RTI	1	0	0	0	1	0	0	1	0	0	0
5	6th St & 32nd Ave	3	0	0	0	0	3	0	1	0	1	1
6	6th St & 34th Ave	0	0	0	0	0	0	0	0	0	0	0
7	22nd Ave & 20th St S	13	0	0	1	1	11	0	1	0	12	0
8	472nd Ave & 217th St	4	0	0	2	0	2	2	0	0	2	0
9	SD 324 & I-29 SB RTI	0	0	0	0	0	0	0	0	0	0	0
10	SD 324 & I-29 NB RTI	3	0	0	0	1	2	1	0	0	2	0
11	SD 324 & 473rd Ave	0	0	0	0	0	0	0	0	0	0	0
12	34th Ave & 20th St S	0	0	0	0	0	0	0	0	0	0	0
	Totals:	*45*	*0*	*0*	*4*	*6*	*35*	*3*	*13*	*0*	*27*	*2*

Shaded row indicate signalized intersection.
6th Street crash summary only includes crashes occurring after completion of the 6th Street reconstruction project (includes October 2017 – December 2019).

Table 2: Intersection Crash Summary (2015- 2019) – Light Condition and Road Surface Condition

Int. No.	Intersection	Total Crashes	Light Condition				Road Surface Condition			
			Daylight	Dark – Not Lighted	Dark – Lighted	Dawn/ Dusk	Dry	Wet	Snow	Slush/ Ice/ Frost
1	6th St & 22nd Ave	16	12	0	4	0	6	4	4	2
2	6th St & Sunrise Ridge Rd	4	4	0	0	0	3	0	1	0
3	6th St & I-29 SB RTI	1	1	0	0	0	0	0	1	0
4	6th St & I-29 NB RTI	1	1	0	0	0	1	0	0	0
5	6th St & 32nd Ave	3	2	0	1	0	1	0	2	0
6	6th St & 34th Ave	0	0	0	0	0	0	0	0	0
7	22nd Ave & 20th St S	13	12	0	0	1	6	1	3	3
8	472nd Ave & 217th St	4	4	0	0	0	1	1	2	0
9	SD 324 & I-29 SB RTI	0	0	0	0	0	0	0	0	0
10	SD 324 & I-29 NB RTI	3	3	0	0	0	1	1	1	0
11	SD 324 & 473rd Ave	0	0	0	0	0	0	0	0	0
12	34th Ave & 20th St S	0	0	0	0	0	0	0	0	0
	Totals:	*45*	*39*	*0*	*5*	*1*	*19*	*7*	*14*	*5*

Shaded row indicate signalized intersection.
6th Street crash summary only includes crashes occurring after completion of the 6th Street reconstruction project (includes October 2017 – December 2019).

Table 3: Signalized Intersection Crash Rates (2015- 2019)

Int. No.	Intersection	Total Crashes	Daily Entering Vehicles	Million Entering Vehicles	Crash Rate	Critical Crash Rate	Ratio
1	6th St & 22nd Ave	16	27,800	22.8	**0.70**	**0.65**	**1.1**
2	6th St & Sunrise Ridge Rd	4	19,900	16.3	0.24	0.70	0.4
4	6th St & I-29 NB RTI	1	15,100	12.4	0.08	0.74	0.1
5	6th St & 32nd Ave	3	9,300	7.6	0.39	0.85	0.5
		HSM Weighted Average Crash Rate for Signalized Intersections = 0.41					

Intersections with a crash rates exceeding the critical crash rate (ratio > 1.0) noted in **Red Bold**.
6th Street crash summary only includes crashes occurring after completion of the 6th Street reconstruction project (includes October 2017 – December 2019).

Table 4: Unsignalized Intersection Crash Rates (2015- 2019)

Int. No.	Intersection	Total Crashes	Daily Entering Vehicles	Million Entering Vehicles	Crash Rate	Critical Crash Rate	Ratio
3	6th St & I-29 SB RTI	1	16,300	13.4	0.07	0.56	0.4
6	6th St & 34th Ave	0	6,400	5.3	0	0.75	0
7	22nd Ave & 20th St S	13	8,900	16.2	**0.80**	**0.53**	**1.5**
8	472nd Ave & 217th St	4	2,700	4.9	**0.82**	**0.78**	**1.1**
9	SD 324 & I-29 SB RTI	0	3,000	5.4	0.00	0.74	0
10	SD 324 & I-29 NB RTI	3	2,600	4.8	0.62	0.78	0.8
11	SD 324 & 473rd Ave	0	1,800	3.4	0	0.90	0
12	34th Ave & 20th St S	0	1,800	3.3	0	0.91	0
		HSM Weighted Average Crash Rate for Unsignalized Intersections = 0.28					

Intersections with a crash rates exceeding the critical crash rate (ratio > 1.0) noted in **Red Bold**.
6th Street crash summary only includes crashes occurring after completion of the 6th Street reconstruction project (includes October 2017 – December 2019).

Table 5: Local Network Segment Crash Rates (2015- 2019)

Int. No.	Segment	Total Crashes	Daily Vehicles	Million Vehicle Miles Traveled	Crash Rate	Critical Crash Rate	Ratio
1	6th Street: 22nd Avenue to I-29 NB Ramp Terminal	2	15,500	7.45	0.27	1.07	0.25
2	6th Street: I-29 NB Ramp Terminal to 34th Avenue	2	5,500	1.76	1.14	1.73	0.64
3	20th Street South: 22nd Avenue to I-29	0	70	0.03	0	22.30	0
4	20th Street South: I-29 to 34th Avenue	0	130	0.11	0	8.97	0
5	217th Street: 22nd Avenue to 34th Avenue	4	1,500	2.74	1.46	1.47	0.99
		HSM Weighted Average Crash Rate for Local Network Segments = 0.63					

Segments with a crash rates exceeding the critical crash rate (ratio > 1.0) noted in **Red Bold**.

Table 6: I-29 Freeway and Ramp Crash Summary (2015- 2019) – Injury Severity and Manner of Collision

Seg. No.	Segment	Total Crashes	Injury Severity					Manner of Collision				
			Fatal	Incap. Injury	Non-Incap. Injury	Possible Injury	No Injury*	Single Vehicle	Rear-end	Head-on	Angle	Sideswipe
1	SB I-29 6th St Interchange Area	5	0	0	3	0	2	3	0	0	1	1
2	SB I-29, between 6th St and SD 324 Interchanges	36	0	2	1	7	26	24	8	0	3	1
3	SB I-29 SD 324 Interchange Area	6	0	0	0	2	4	4	2	0	0	0
4	NB I-29 SD 324 Interchange Area	2	0	0	0	0	2	2	0	0	0	0
5	NB I-29, between 6th St and SD 324 Interchanges	40	1	1	3	1	34	33	3	0	2	2
6	NB I-29 6th St Interchange Area	2	0	0	0	0	2	1	1	0	0	0
7	SB I-29 Exit Ramp @ 6th St	0	0	0	0	0	0	0	0	0	0	0
8	SB I-29 Entrance Ramp @ 6th St	0	0	0	0	0	0	0	0	0	0	0
9	SB I-29 Exit Ramp @ SD 324	0	0	0	0	0	0	0	0	0	0	0
10	SB I-29 Entrance Ramp @ SD 324	1	0	0	0	0	1	1	0	0	0	0
11	NB I-29 Entrance Ramp @ 6th St	0	0	0	0	0	0	0	0	0	0	0
12	NB I-29 Exit Ramp @ 6th St	1	0	0	0	1	0	0	1	0	0	0
13	NB I-29 Entrance Ramp @ SD 324	0	0	0	0	0	0	0	0	0	0	0
14	NB I-29 Exit Ramp @ SD 324	0	0	0	0	0	0	0	0	0	0	0

Shaded row indicates I-29 freeway mainline segment.
* No injury crashes includes wild animal hit.

Table 7: I-29 Freeway and Ramp Crash Summary (2015- 2019) – Light Condition and Road Surface Condition

Seg. No.	Segment	Total Crashes	Light Condition				Road Surface Condition			
			Daylight	Dark – Not Lighted	Dark – Lighted	Dawn/ Dusk	Dry	Wet	Snow	Slush/ Ice/ Frost
1	SB I-29 6th St Interchange Area	5	3	1	0	1	2	0	0	3
2	SB I-29, between 6th St and SD 324 Interchanges	36	23	12	0	1	17	2	6	11
3	SB I-29 SD 324 Interchange Area	6	3	3	0	0	2	0	1	3
4	NB I-29 SD 324 Interchange Area	2	1	1	0	0	1	0	0	1
5	NB I-29, between 6th St and SD 324 Interchanges	40	18	20	0	2	26	3	6	5
6	NB I-29 6th St Interchange Area	2	2	0	0	0	2	0	0	0
7	SB I-29 Exit Ramp @ 6th St	0	0	0	0	0	0	0	0	0
8	SB I-29 Entrance Ramp @ 6th St	0	0	0	0	0	0	0	0	0
9	SB I-29 Exit Ramp @ SD 324	0	0	0	0	0	0	0	0	0
10	SB I-29 Entrance Ramp @ SD 324	1	0	1	0	0	0	0	1	0
11	NB I-29 Entrance Ramp @ 6th St	0	0	0	0	0	0	0	0	0
12	NB I-29 Exit Ramp @ 6th St	1	0	0	0	1	1	0	0	0
13	NB I-29 Entrance Ramp @ SD 324	0	0	0	0	0	0	0	0	0
14	NB I-29 Exit Ramp @ SD 324	0	0	0	0	0	0	0	0	0

Shaded row indicate signalized intersection.
6th Street crash summary only includes crashes occurring after completion of the 6th Street reconstruction project (includes October 2017 – December 2019).

Table 8: I-29 Freeway Segment Crash Rates (2015- 2019)

Int. No.	Segment	Total Crashes	Daily Vehicles	Million Vehicle Miles Traveled	Crash Rate	Critical Crash Rate	Ratio
1	SB I-29 6th St Interchange Area	5	5,900	6.4	0.78	1.15	0.68
2	SB I-29, between 6th St and SD 324 Interchanges	36	7,100	57.4	0.63	0.75	0.84
3	SB I-29 SD 324 Interchange Area	6	7,300	7.9	0.76	1.08	0.70
4	NB I-29 SD 324 Interchange Area	2	7,300	7.8	0.26	1.09	0.24
5	NB I-29, between 6th St and SD 324 Interchanges	40	7,100	57.5	0.70	0.75	0.93
6	NB I-29 6th St Interchange Area	2	5,900	6.3	0.32	1.15	0.28
		HSM Weighted Average Crash Rate for I-29 Segments = 0.57					

Segments with a crash rates exceeding the critical crash rate (ratio > 1.0) noted in **Red Bold**.

Table 9: I-29 Interchange Ramp Segment Crash Rates (2015- 2019)

Int. No.	Intersection	Total Crashes	Daily Vehicles	Million Vehicle Miles Traveled	Crash Rate	Critical Crash Rate	Ratio
7	SB I-29 Exit Ramp @ 6th St	0	1,500	0.86	0	1.9	0
8	SB I-29 Entrance Ramp @ 6th St	0	1,900	1.09	0	1.67	0
9	SB I-29 Exit Ramp @ SD 324	0	500	0.26	0	4.10	0
10	SB I-29 Entrance Ramp @ SD 324	1	1,300	0.75	1.33	2.06	0.65
11	NB I-29 Entrance Ramp @ 6th St	0	1,700	0.95	0	1.81	0
12	NB I-29 Exit Ramp @ 6th St	1	2,000	1.17	0.85	1.61	0.53
13	NB I-29 Entrance Ramp @ SD 324	0	600	0.32	0	3.54	0
14	NB I-29 Exit Ramp @ SD 324	0	1,200	0.67	0	2.20	0
		HSM Weighted Average Crash Rate for I-29 Interchange Ramps = 0.32					

Intersections with a crash rates exceeding the critical crash rate (ratio > 1.0) noted in **Red Bold**.
6th Street crash summary only includes crashes occurring after completion of the 6th Street reconstruction project (includes October 2017 – December 2019).

3.2 Alternatives

The 2016 interchange access study developed several different interchange and overpass concepts for analysis. The following conceptual alternatives represent refined scenarios carried forward from the study or developed specific to this interchange justification study:

- No Build
- Build Alternative 1 – single point interchange with crossroad over Interstate
- Build Alternative 2 – single point interchange with Interstate over crossroad
- Build Alternative 3 – partial cloverleaf interchange (Parclo B)
- Build Alternative 4 – half diamond interchange (Parclo AB)
- Build Alternative 5 – single loop interchange
- Build Alternative 6 – 20th Street South overpass

The Build alternatives are shown in **Figure 8** through **Figure 13** on the following pages.

Date of aerial photography: 2019

Drawn By: B.Miller
Date: 5/1/2020
Chked By: S.Slowey
Date: 5/1/2020
Revision: 8/27/2020

Alternative 1 - Single Point Interchange (20th St. S. over I-29)

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 8

Date of aerial photography: 2019

Drawn By: B.Miller
Date: 5/1/2020
Chked By: S.Slowey
Date: 5/1/2020
Revision: 8/27/2020

Alternative 2 - Single Point Interchange (I-29 over 20th St. S.)

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 9

Date of aerial photography: 2019

Drawn By: B.Miller
Date: 5/1/2020
Chked By: S.Slowey
Date: 5/1/2020
Revision: 8/27/2020

Alternative 3 - Partial Cloverleaf Interchange ("Parclo B")

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 10

Date of aerial photography: 2019

Drawn By: B.Miller
Date: 5/1/2020
Chked By: S.Slowey
Date: 5/1/2020
Revision: 8/27/2020

Alternative 4 - Half Cloverleaf Interchange ("Parclo AB")

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 11

Date of aerial photography: 2019

Drawn By: B.Miller
Date: 5/1/2020
Chked By: S.Slowey
Date: 5/1/2020
Revision: 8/27/2020

Alternative 5 - Single Loop Interchange

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 12

Date of aerial photography: 2019

Drawn By: B.Miller
Date: 5/1/2020
Chked By: S.Slowey
Date: 5/1/2020
Revision: 8/27/2020

Alternative 6 - 20th Street S. Overpass Only

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 13

3.3 Future Year Traffic

Future Year Volume Development

Year 2022 (project opening) and year 2045 (planning horizon) traffic forecasts were prepared using the QRS II travel demand model developed in conjunction with the 2011 Brookings Area Master Transportation Plan. The travel demand model developed two different volume scenarios:

- **2015 base model**: reflects 2015 development and traffic conditions.
- **2045 model horizon**: reflects anticipated development and traffic volumes up to year 2045.

The most recent update to the travel demand model occurred in 2015 in preparation for the 2016 interchange access study. Future land use incorporated into the model was current as of 2015. Since then, the City of Brookings released their 2040 Brookings Comprehensive Plan with an updated future land use plan that includes additional development identified in the Brookings area.

To better understand, and incorporate, the differences between the 2040 future land use plan and the land use coded into the travel demand model, land uses were compared to identify any areas where additional traffic needed to be added to the forecasts. It was found that the model TAZs surrounding the proposed interchange underrepresented anticipated development in the area and thus additional traffic representative of this development would need to be added to any model-derived forecasts.

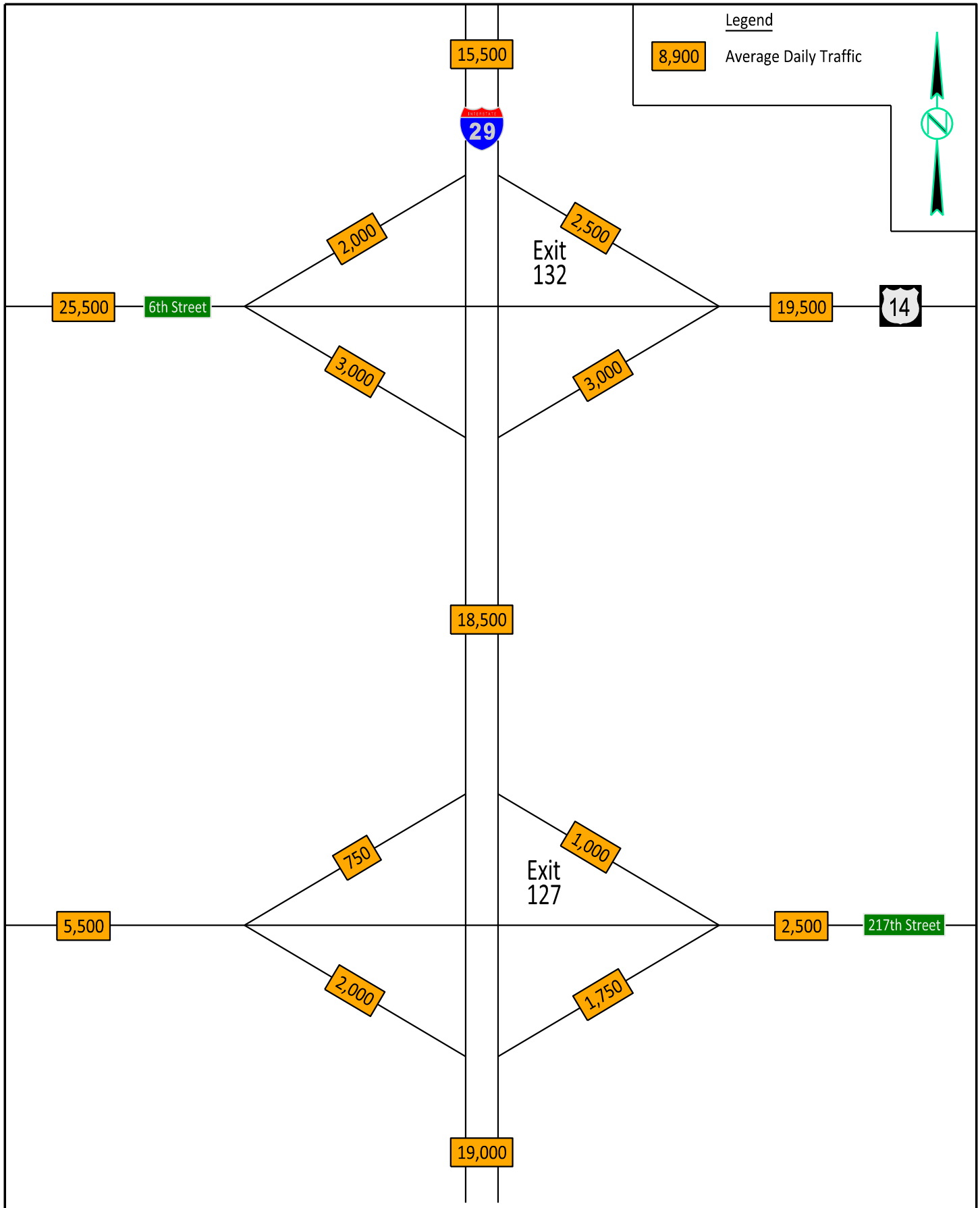
As previously noted, it is anticipated that construction of an I-29 interchange at 20th Street South will drive higher density development and redevelopment when compared to constructing just an overpass or not constructing anything at all. Because an interchange combines both benefits of convenient access to I-29 and another east/west crossing of I-29, surrounding areas would be attractive to development and support higher density. It is also anticipated that an interchange would drive development to occur much quicker than the No Build or overpass scenarios. Therefore, two different sets of future-year traffic volumes were developed:

1) **No Build and Build overpass volumes**: accounts for lower density development/redevelopment along the 20th Street South corridor and east of I-29 within the study area.
2) **Build interchange volumes**: accounts for higher density development/redevelopment in all quadrants surrounding the proposed interchange within the study area.

Additional information on the review of future land use in the travel demand model and differences in associated trip generation for each of the scenarios is provided in **Appendix B**.

The traffic forecasting process followed NCHR 765 methodologies for traffic forecasts using travel demand models. Agreed upon requirements for the forecasting process can be found in the Methods and Assumptions document in **Appendix A**. Supporting information for this process as well as responses to the four FHWA requirements for use of a travel demand model in planning studies is provided in **Appendix G**.

Daily traffic forecasts for the 2045 planning horizon for the No Build, Build overpass, and Build interchange conditions are shown in **Figure 14**, **Figure 15**, and **Figure 16**, respectively.

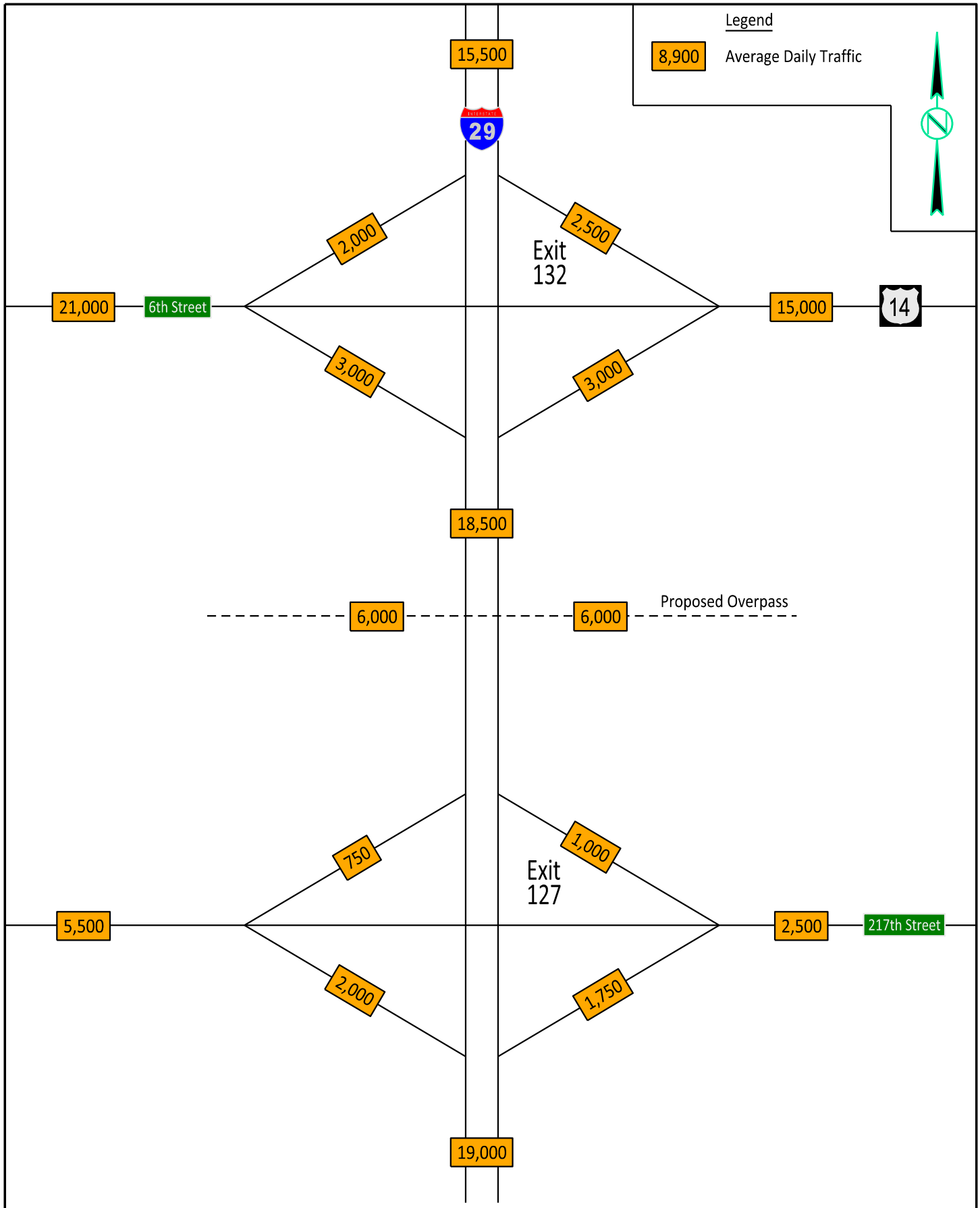


Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

2045 No Build Conditions Daily Traffic

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 14



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

DOT

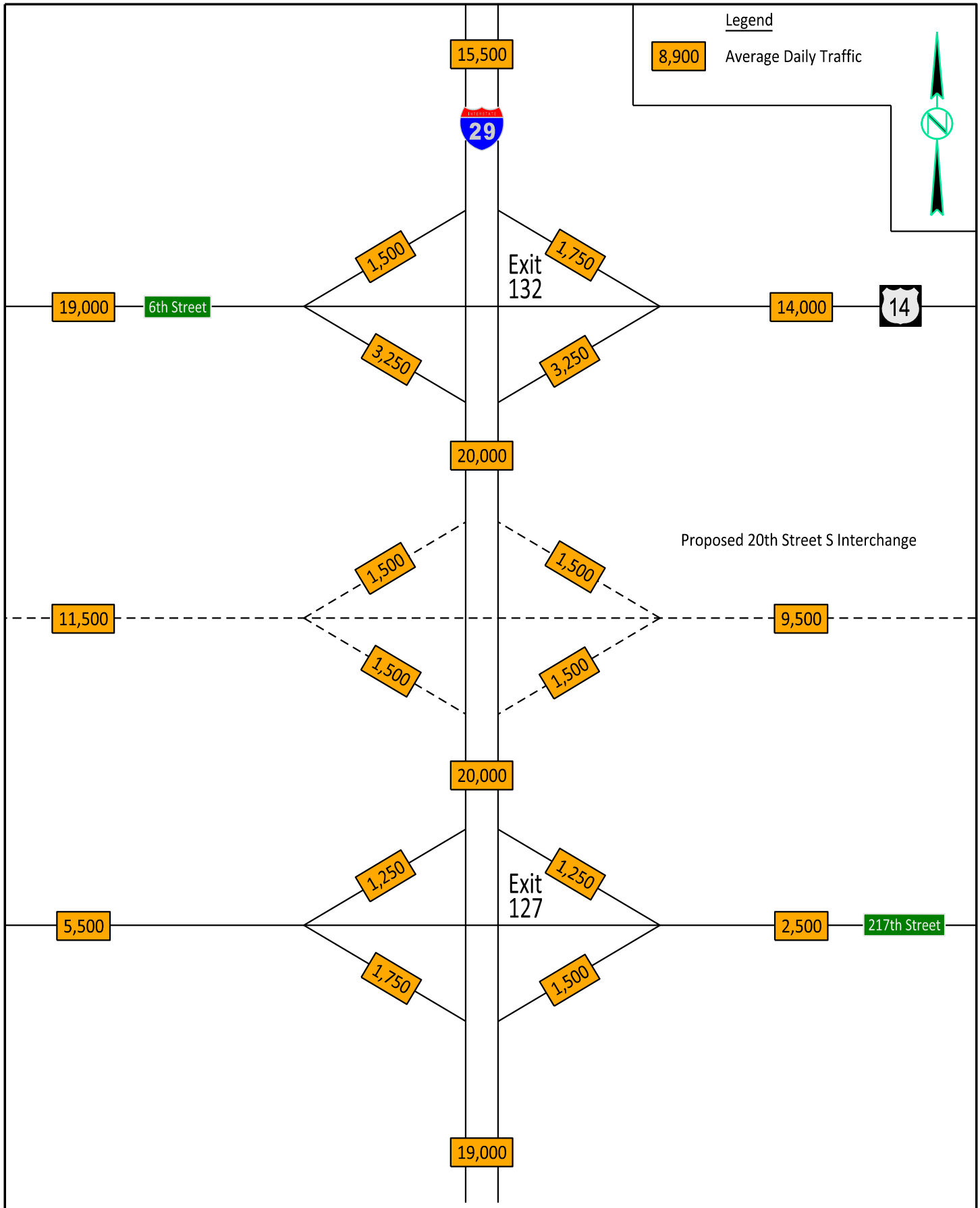
brookings

HDR
BANNER

2045 Build Overpass Conditions Daily Traffic

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure
15



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

2045 Build Interchange Conditions Daily Traffic

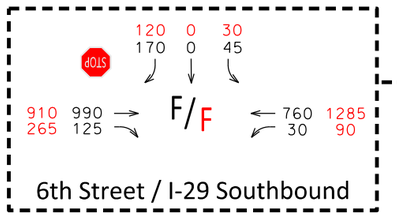
I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

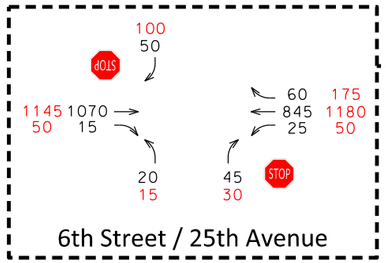
Figure 16

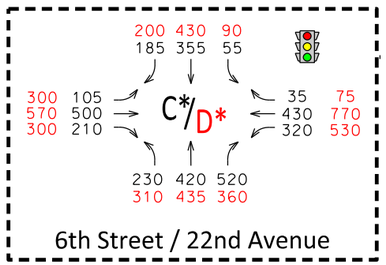
Future Year Peak Hour Traffic Volumes and Operations Analysis Results

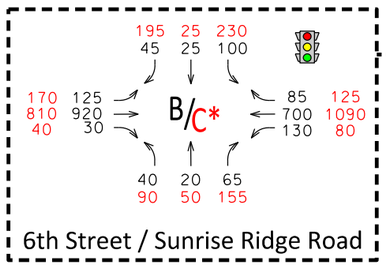
Future year peak hour traffic volumes and operational analysis results are summarized in the following figures. All future conditions analyses incorporate updated (optimized) traffic signal timings as it would be expected they would continually be updated along the corridor to address growing traffic and shifting patterns regardless of future infrastructure projects. HCS reports are included in the respective **Appendix**.

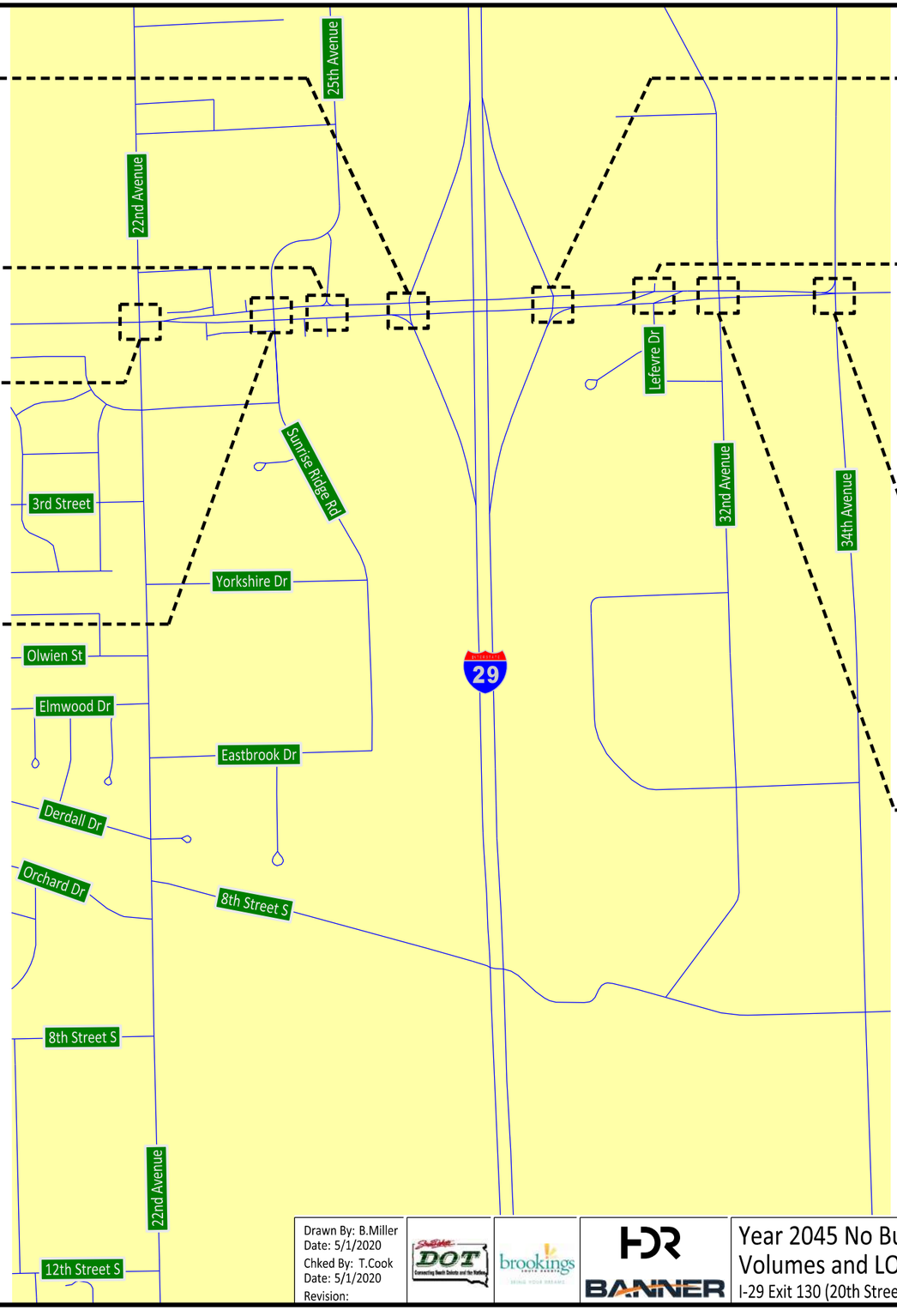
- **Figure 17 – Figure 18**: 2045 planning horizon No Build condition peak hour traffic volumes and operational results.
    - HCS reports: **Appendix H**.
- **Figure 19 – Figure 20**: 2045 planning horizon Build overpass condition peak hour volumes and operational results.
    - HCS reports: **Appendix I**.
- **Figure 21 – Figure 27**: 2045 planning horizon Build interchange condition peak hour volumes and operational results.
    - HCS reports: **Appendix J**.
- **Figure 28**– **Figure 29**: 2022 year of completion No Build condition peak hour traffic volumes and operational results.
    - HCS reports: **Appendix K**.
- **Figure 30** – **Figure 31**: 2022 year of completion Build overpass condition peak hour volumes and operational results.
    - HCS reports: **Appendix L**.
- **Figure 32** – **Figure 38**: 2022 year of completion Build interchange condition peak hour volumes and operational results.
    - HCS reports: **Appendix M**.

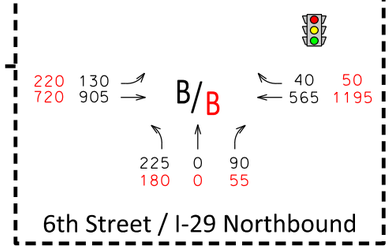


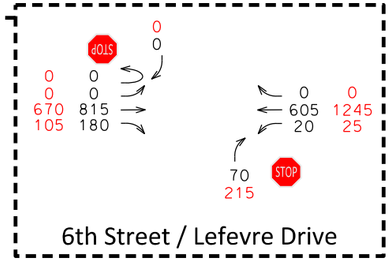


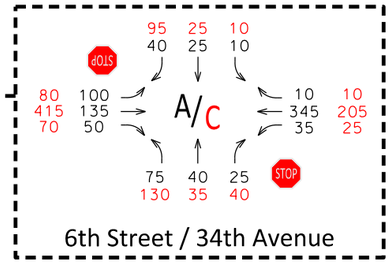


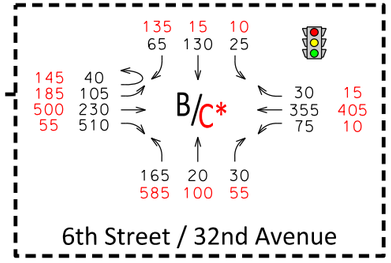












* One or more turn lanes experience a queue storage ratio greater than 1.0 (HCS-measured 95th percentile queue is longer than the existing turn lane storage length). HCS does not account for the effect of auxiliary lane spill-back and the actual LOS may be worse than what is shown. This measured queue is not caused by the proposed Project and it is anticipated the issue will be mitigated if/when the problem occurs in the field.

Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

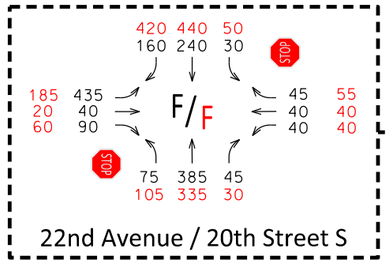
Year 2045 No Build - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

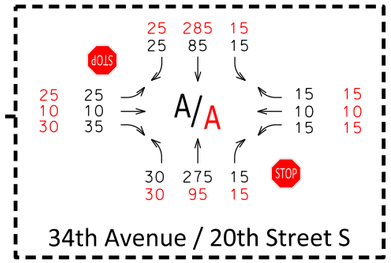
Figure 17a

Stop-Controlled Intersection Level of Service Reporting

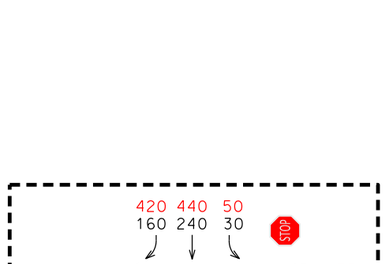
- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.



22nd Avenue / 20th Street S

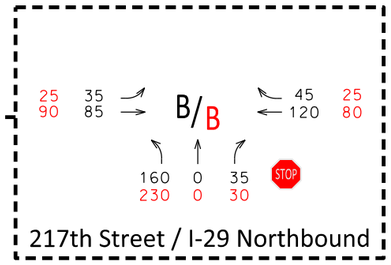


34th Avenue / 20th Street S

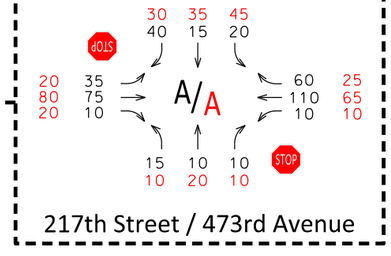


217th Street / 472nd Avenue

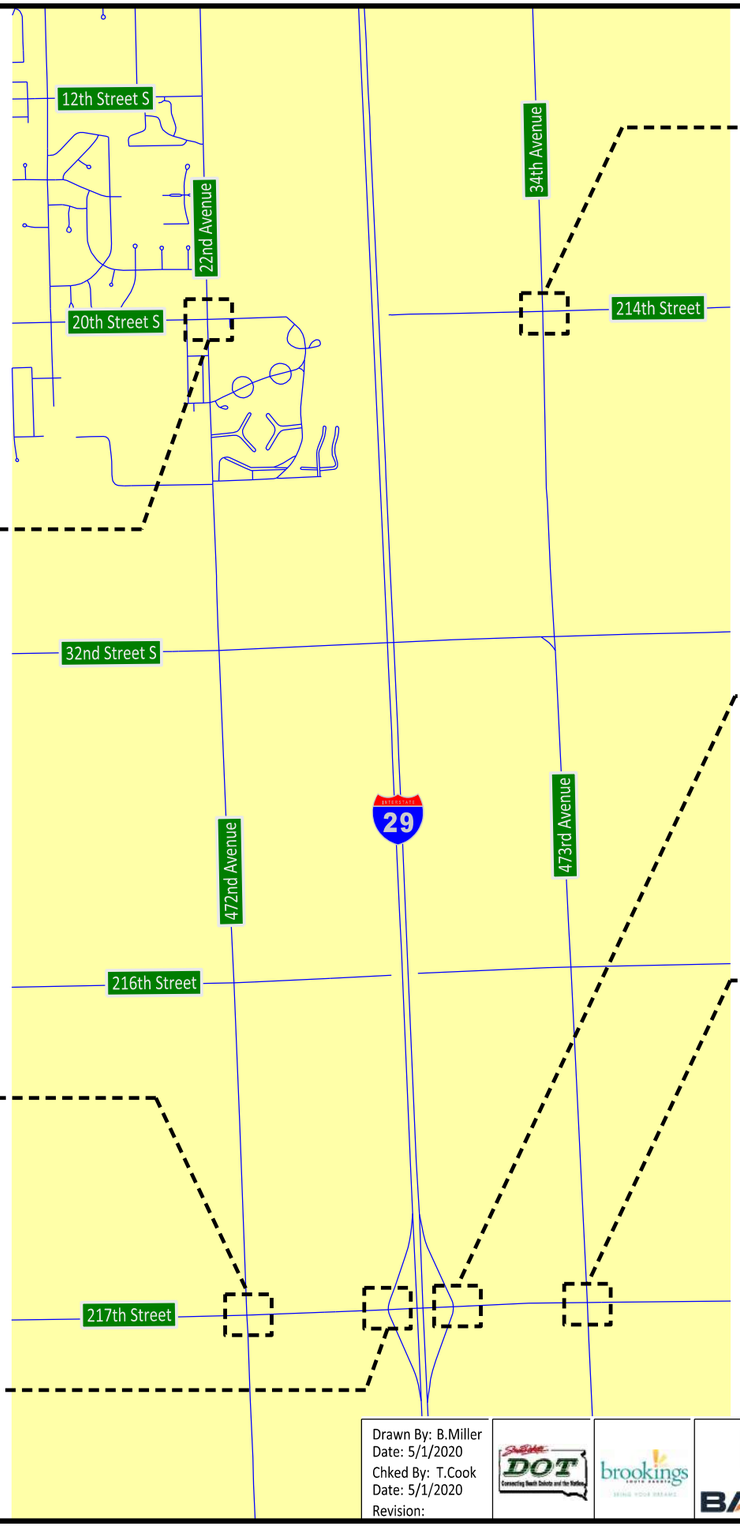
217th Street / I-29 Southbound



217th Street / I-29 Northbound



217th Street / 473rd Avenue



Legend

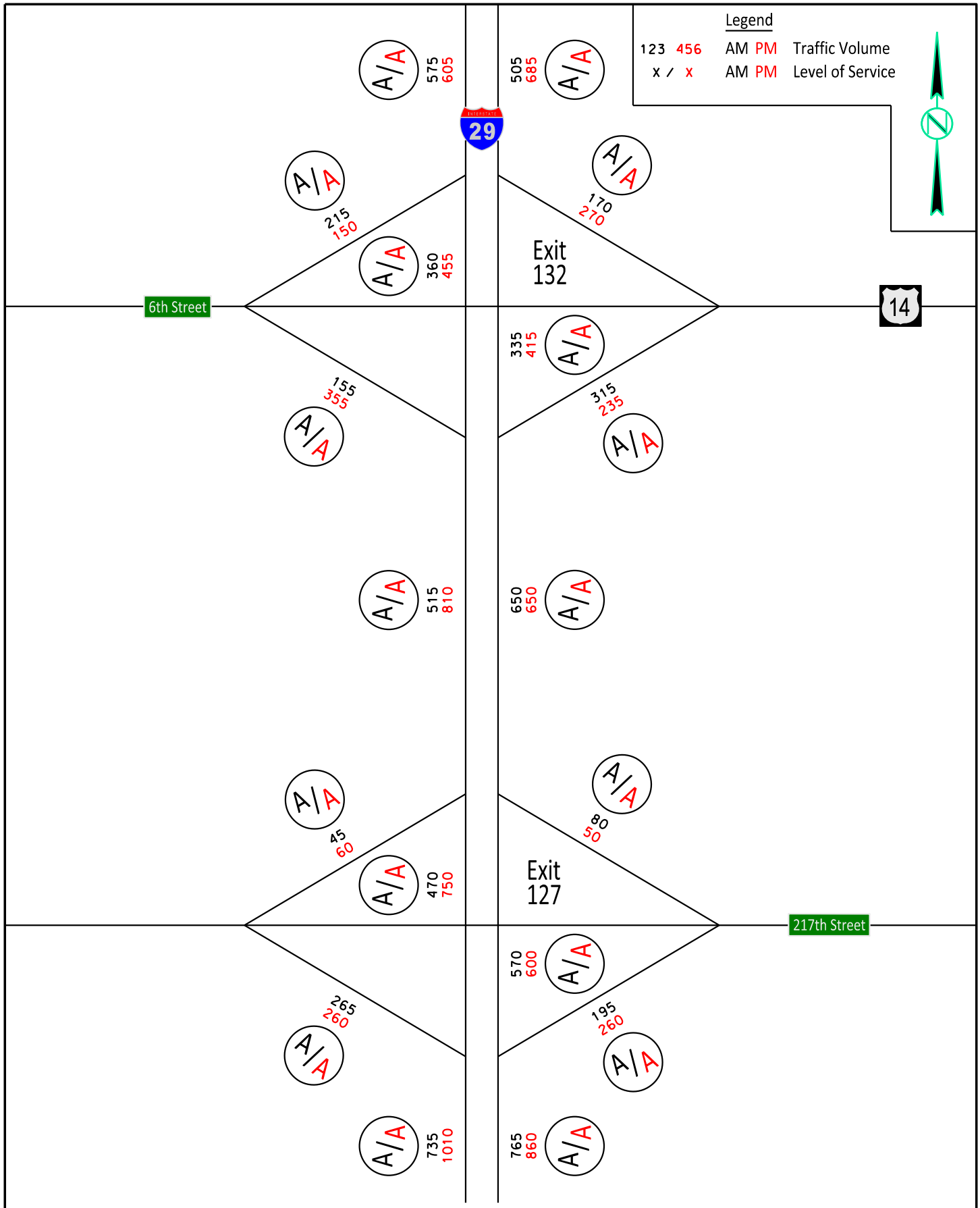
123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

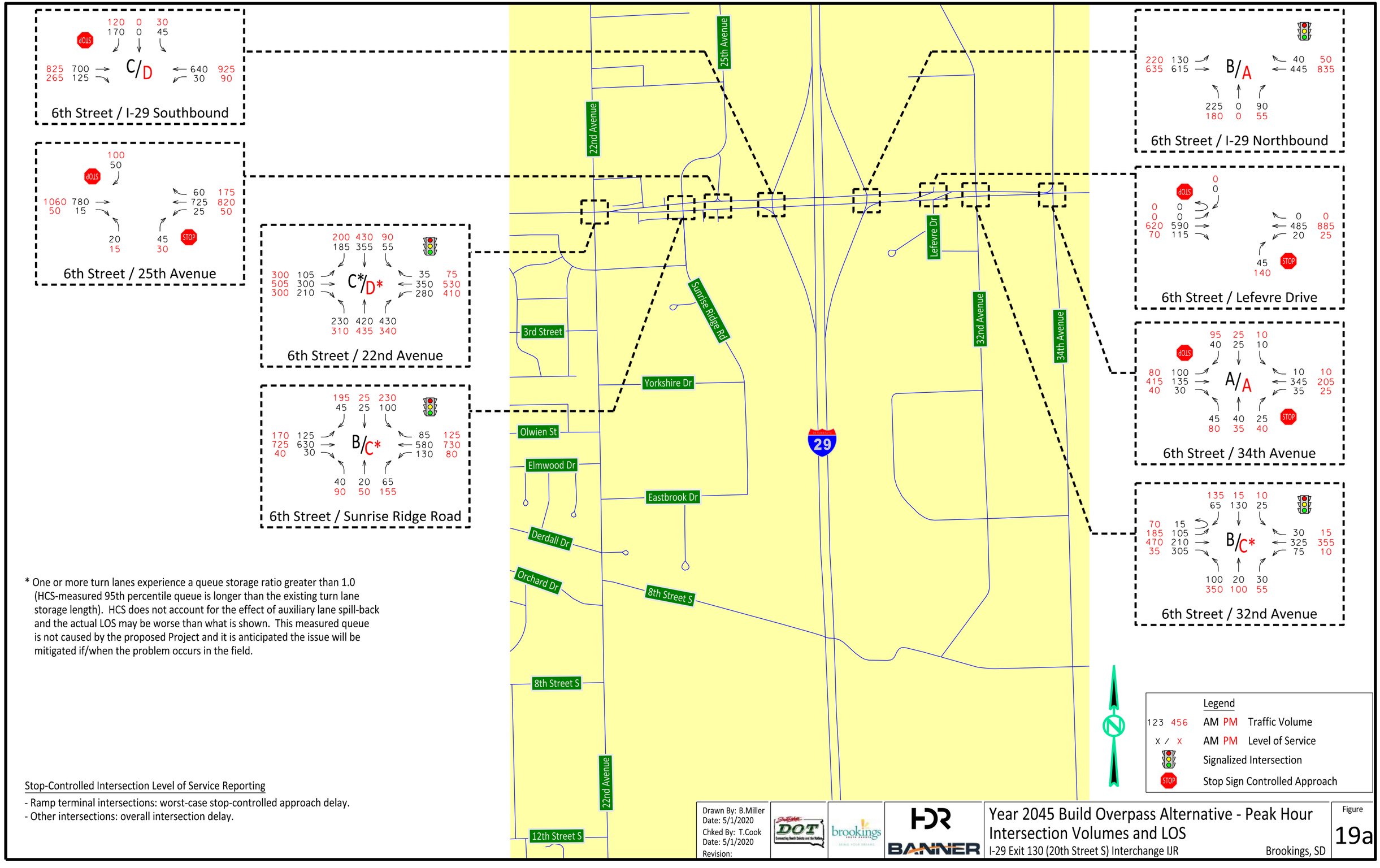
Year 2045 No-Build - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 17b



Drawn By: B.Miller Date: 5/1/2020 Chked By: T.Cook Date: 5/1/2020 Revision:	SD DOT	brookings	HDR BANNER	Year 2045 No Build - Peak Hour Interstate Volumes and LOS I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD	Figure 18



* One or more turn lanes experience a queue storage ratio greater than 1.0 (HCS-measured 95th percentile queue is longer than the existing turn lane storage length). HCS does not account for the effect of auxiliary lane spill-back and the actual LOS may be worse than what is shown. This measured queue is not caused by the proposed Project and it is anticipated the issue will be mitigated if/when the problem occurs in the field.

Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

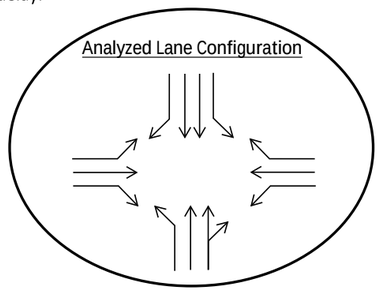
Year 2045 Build Overpass Alternative - Peak Hour Intersection Volumes and LOS

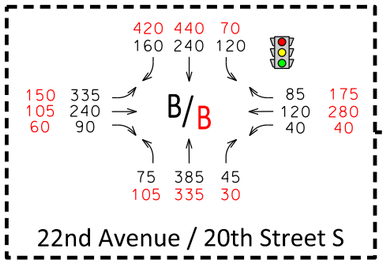
I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 19a

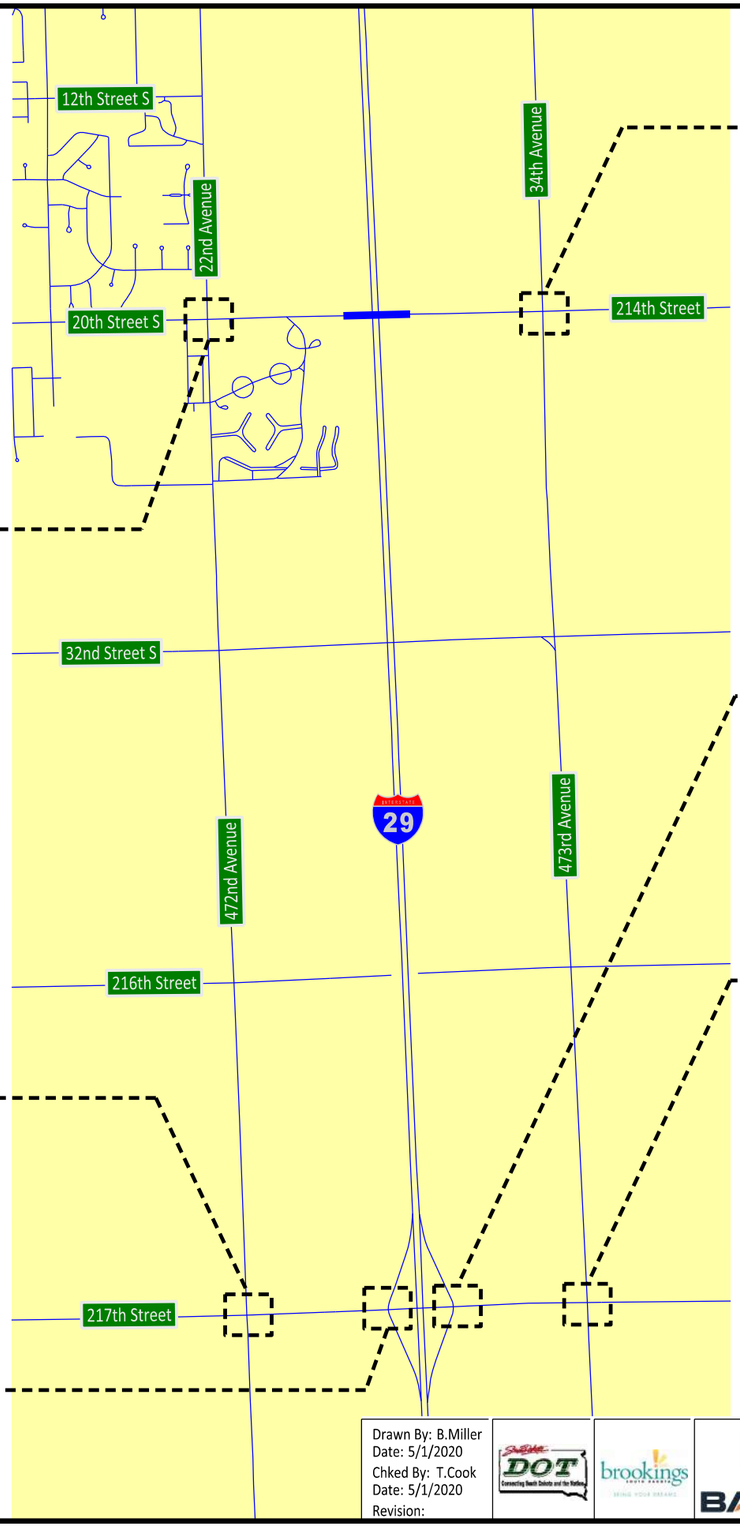
Stop-Controlled Intersection Level of Service Reporting

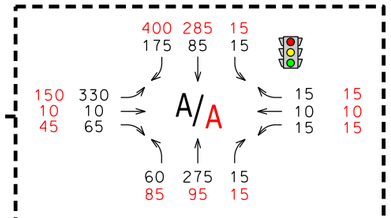
- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.





22nd Avenue / 20th Street S

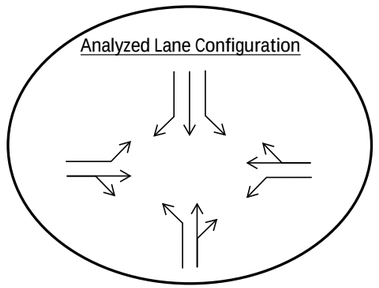


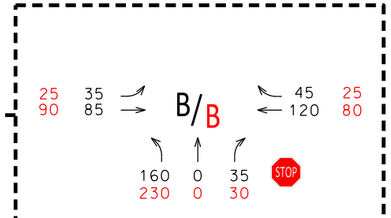


34th Avenue / 20th Street S

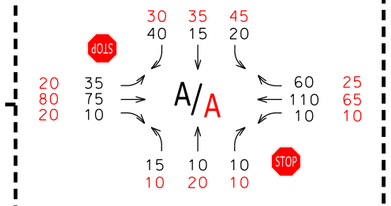
Traffic Control
Scenarios Analyzed
TWSC: F/A
AWSC: C/D
Signal: A/A
Roundabout: A/A

See report text for traffic control year of need analysis.

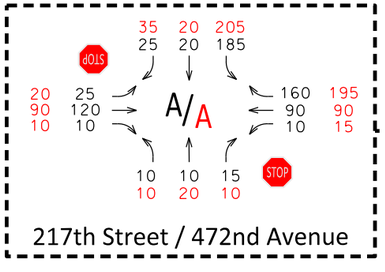




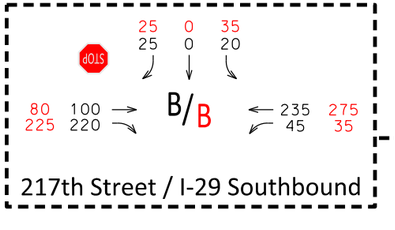
217th Street / I-29 Northbound



217th Street / 473rd Avenue



217th Street / 472nd Avenue



217th Street / I-29 Southbound

Legend

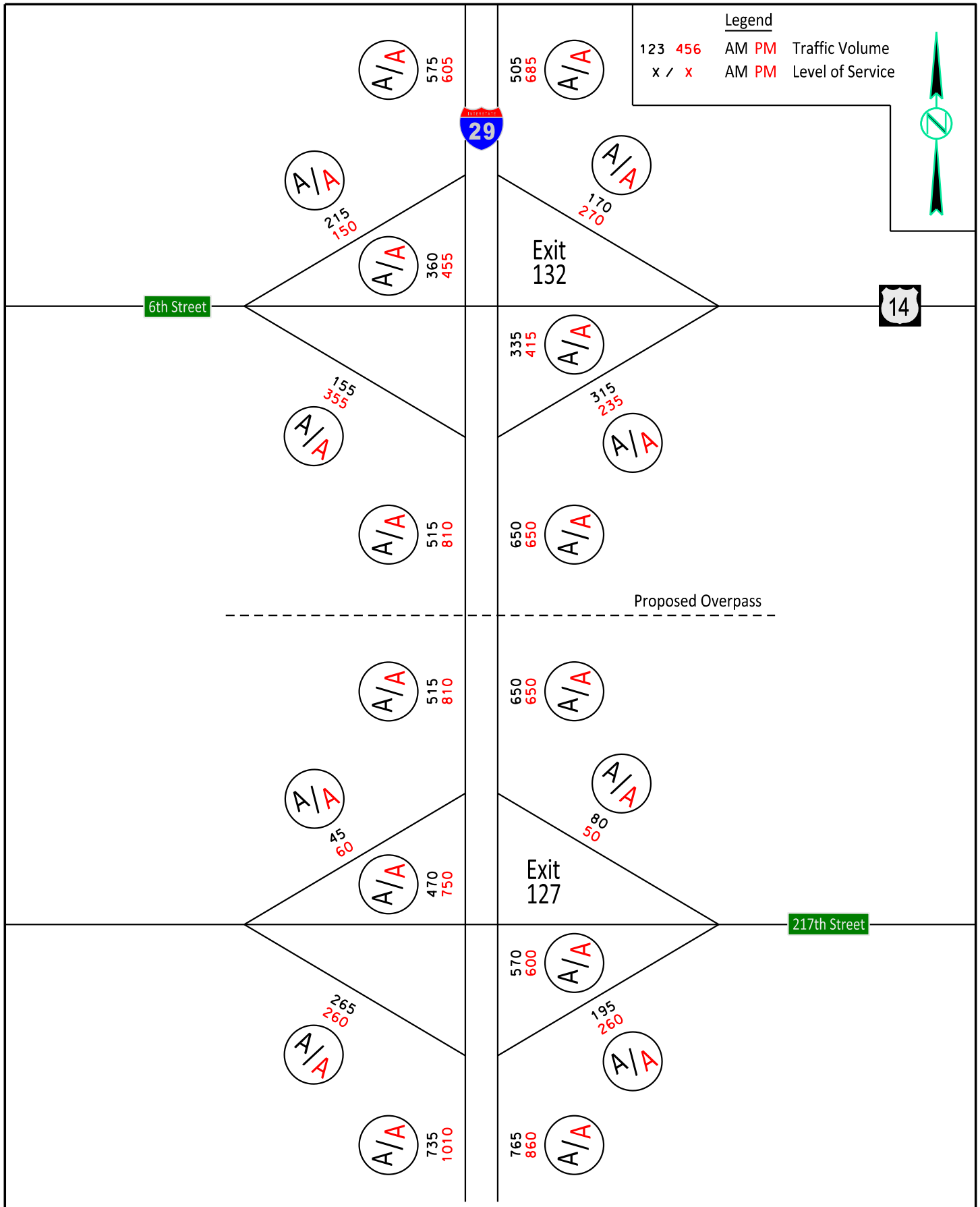
123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

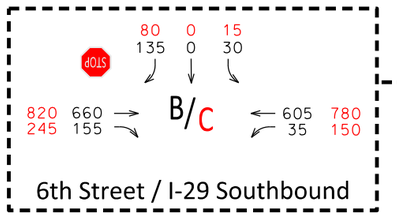
Year 2045 Build Overpass Alternative - Peak Hour Intersection Volumes and LOS

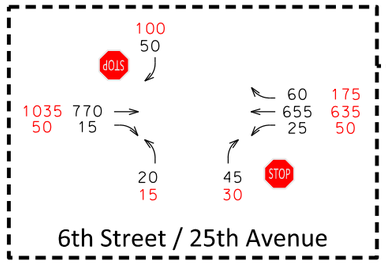
I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

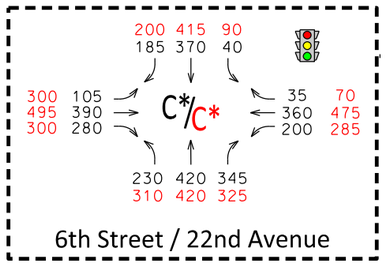
Figure 19b

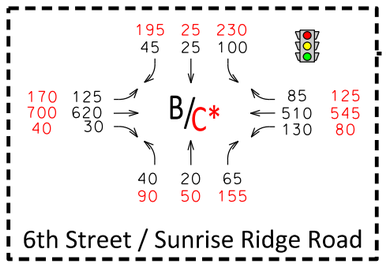


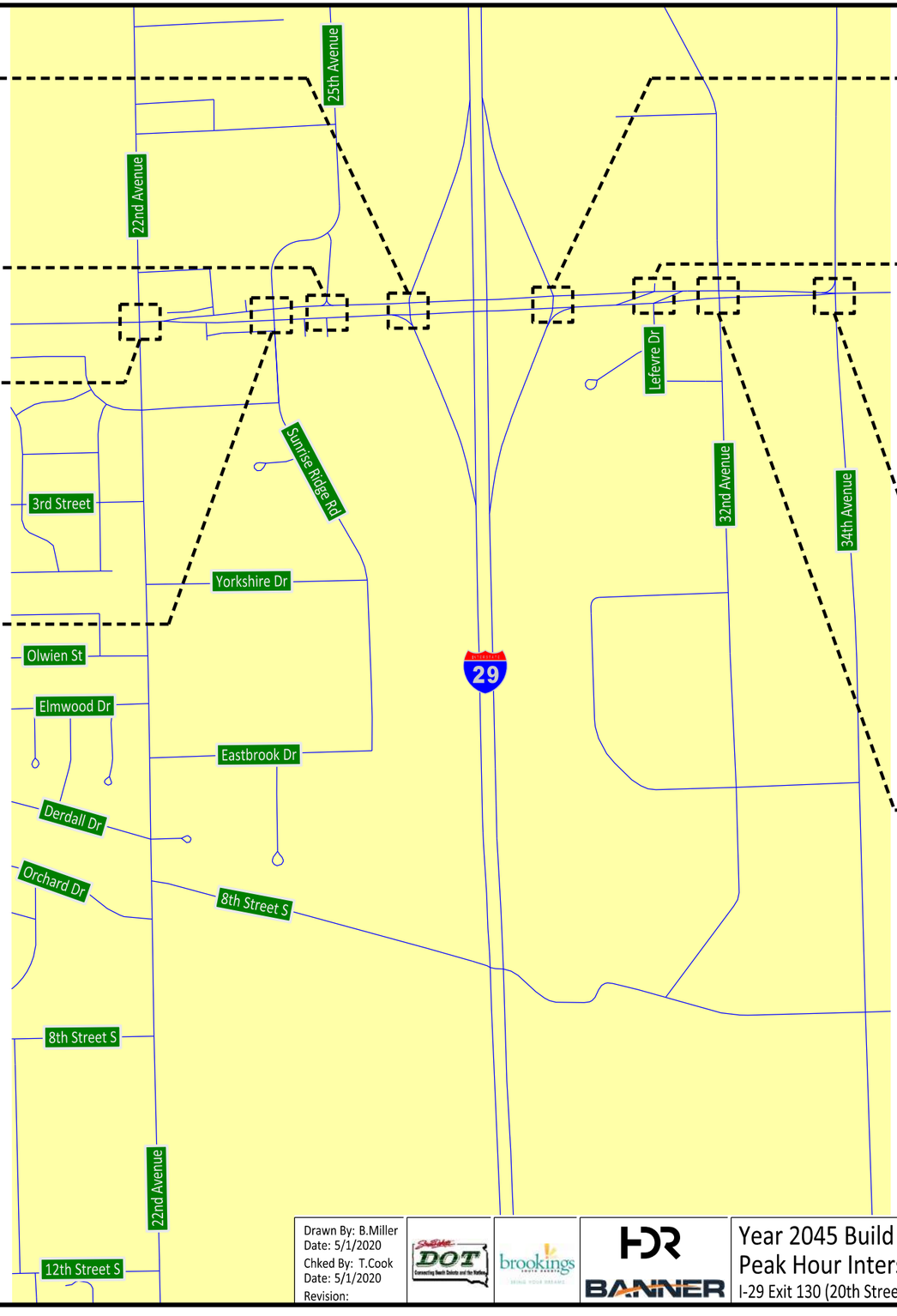
Drawn By: B.Miller Date: 5/1/2020 Chked By: T.Cook Date: 5/1/2020 Revision:	SD DOT	brookings	HDR BANNER	Year 2045 Build Overpass Alternative - Peak Hour Interstate Volumes and LOS I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD	Figure 20

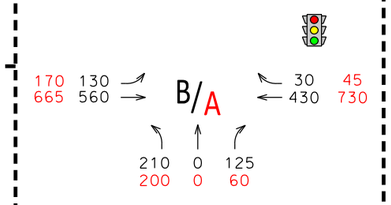


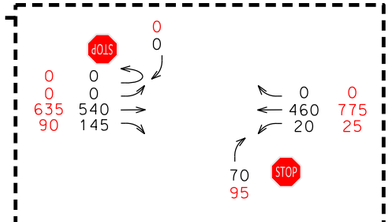


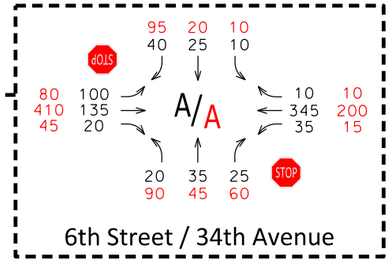


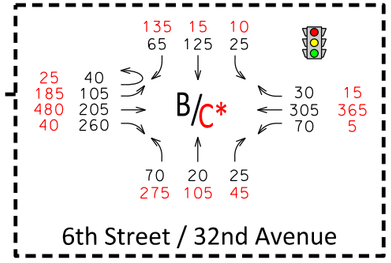












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Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

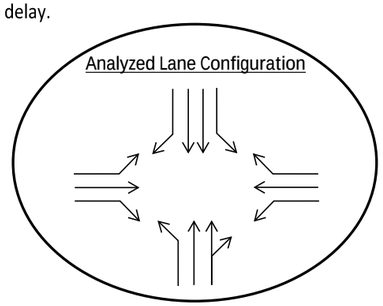
Year 2045 Build Interchange Alternatives - Peak Hour Intersection Volumes and LOS

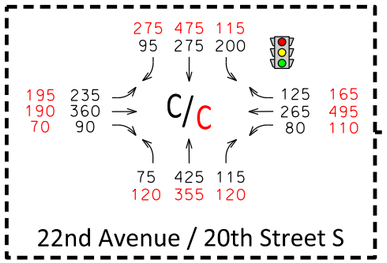
I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

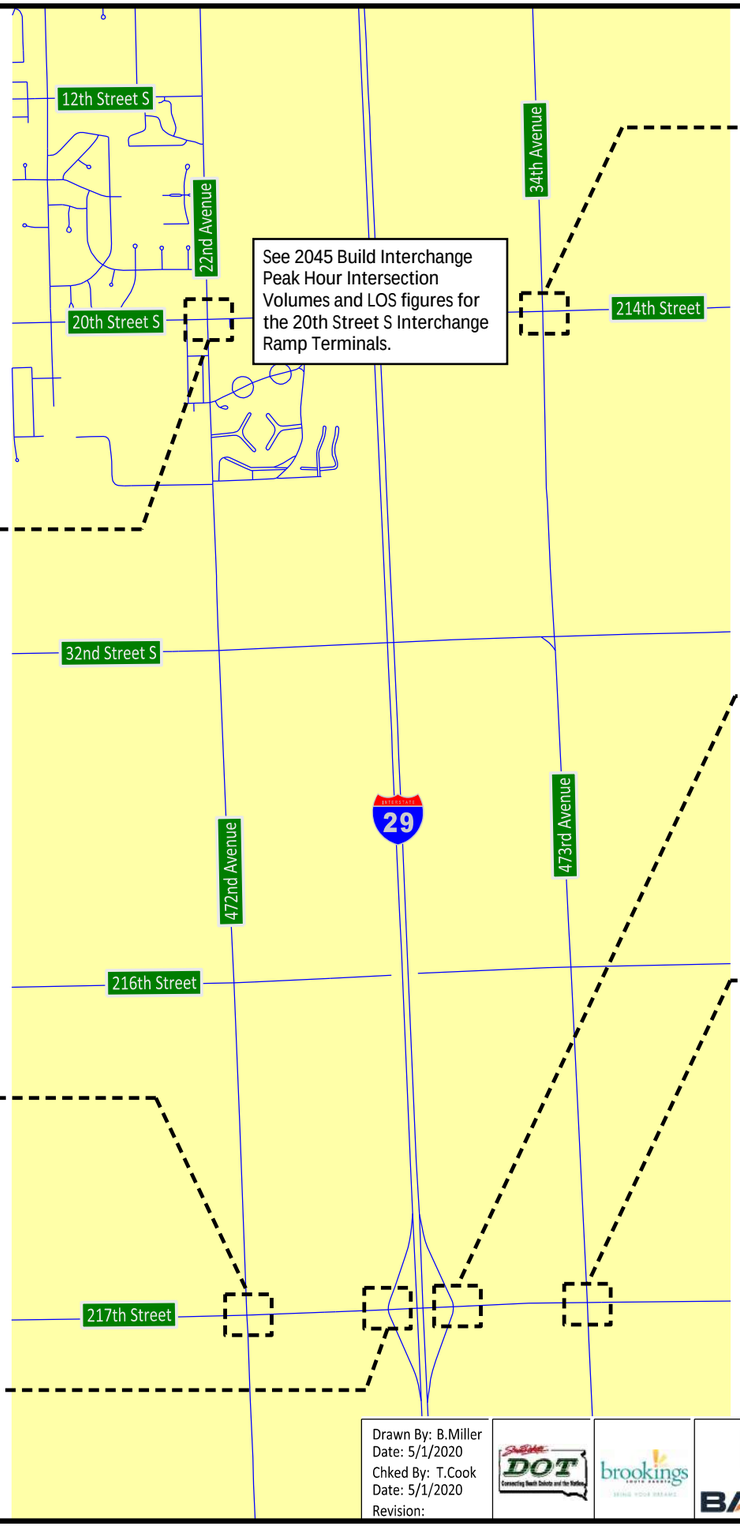
Figure 21a

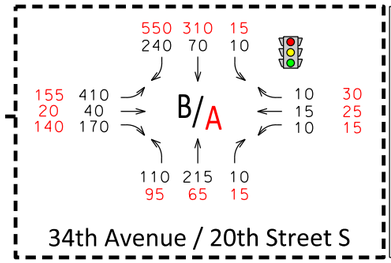
Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.



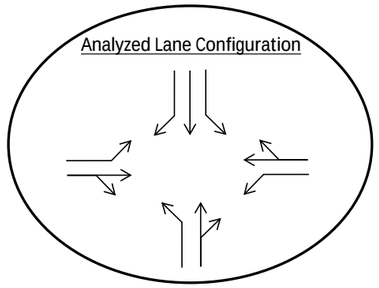


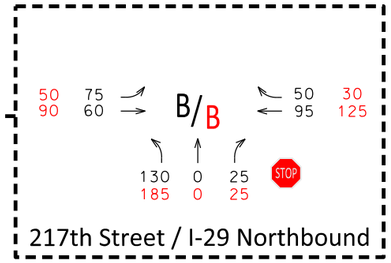


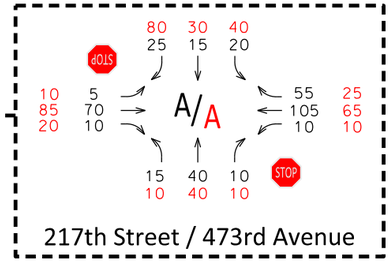


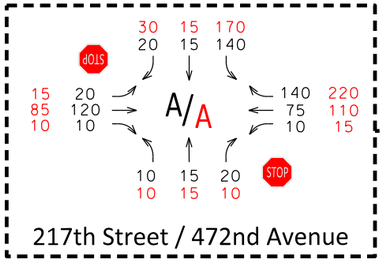
Traffic Control Scenarios Analyzed
TWSC: F/A
AWSC: F/E
Signal: B/A
Roundabout: B/C

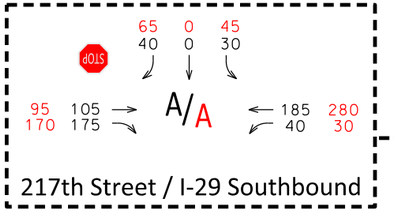
See report text for traffic control year of need analysis.











Legend

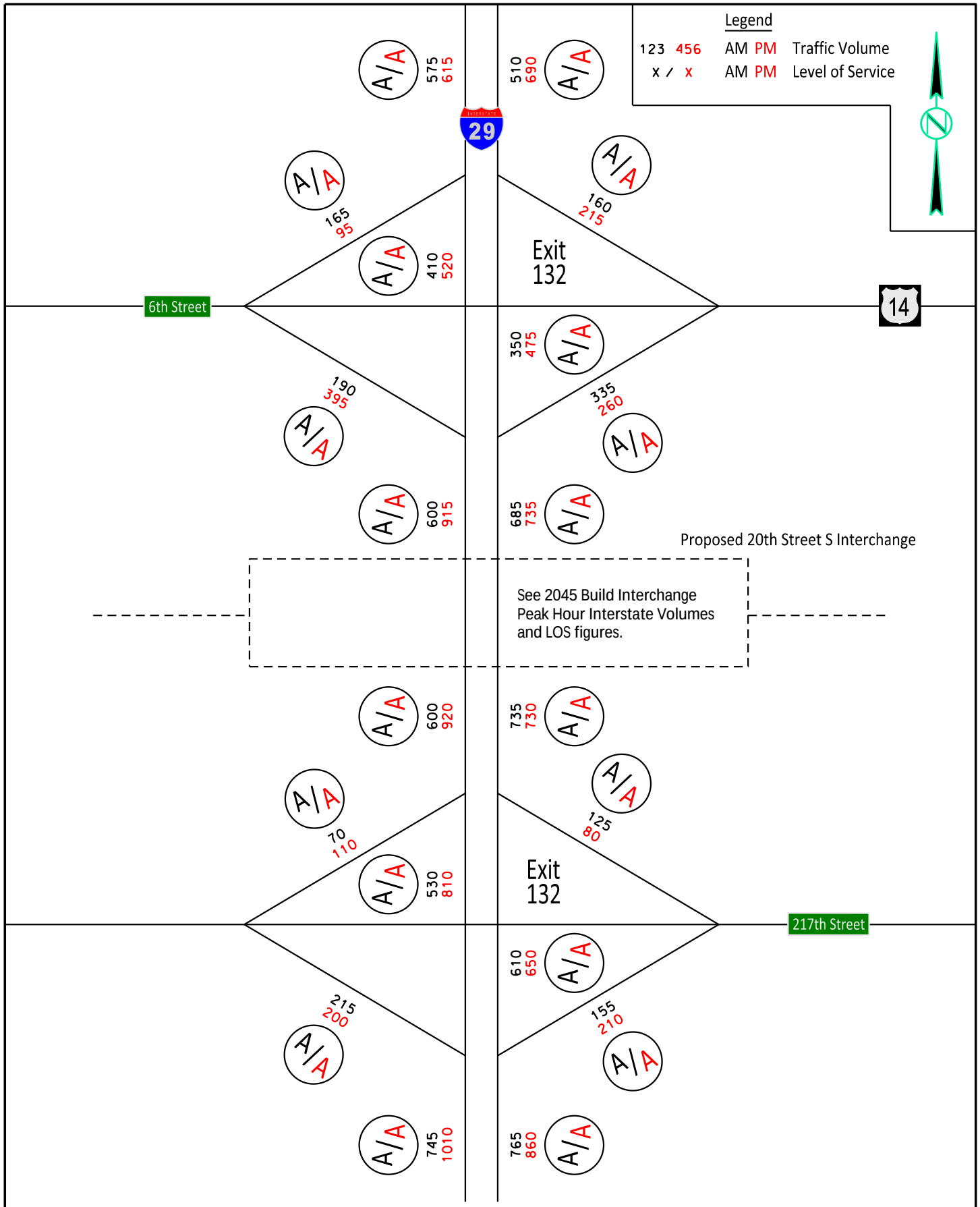
123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2045 Build Interchange Alternatives - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 21b



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2045 Build Interchange Alternatives - Peak Hour Interstate Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure 22

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2045 Build Interchange Alt. 1 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

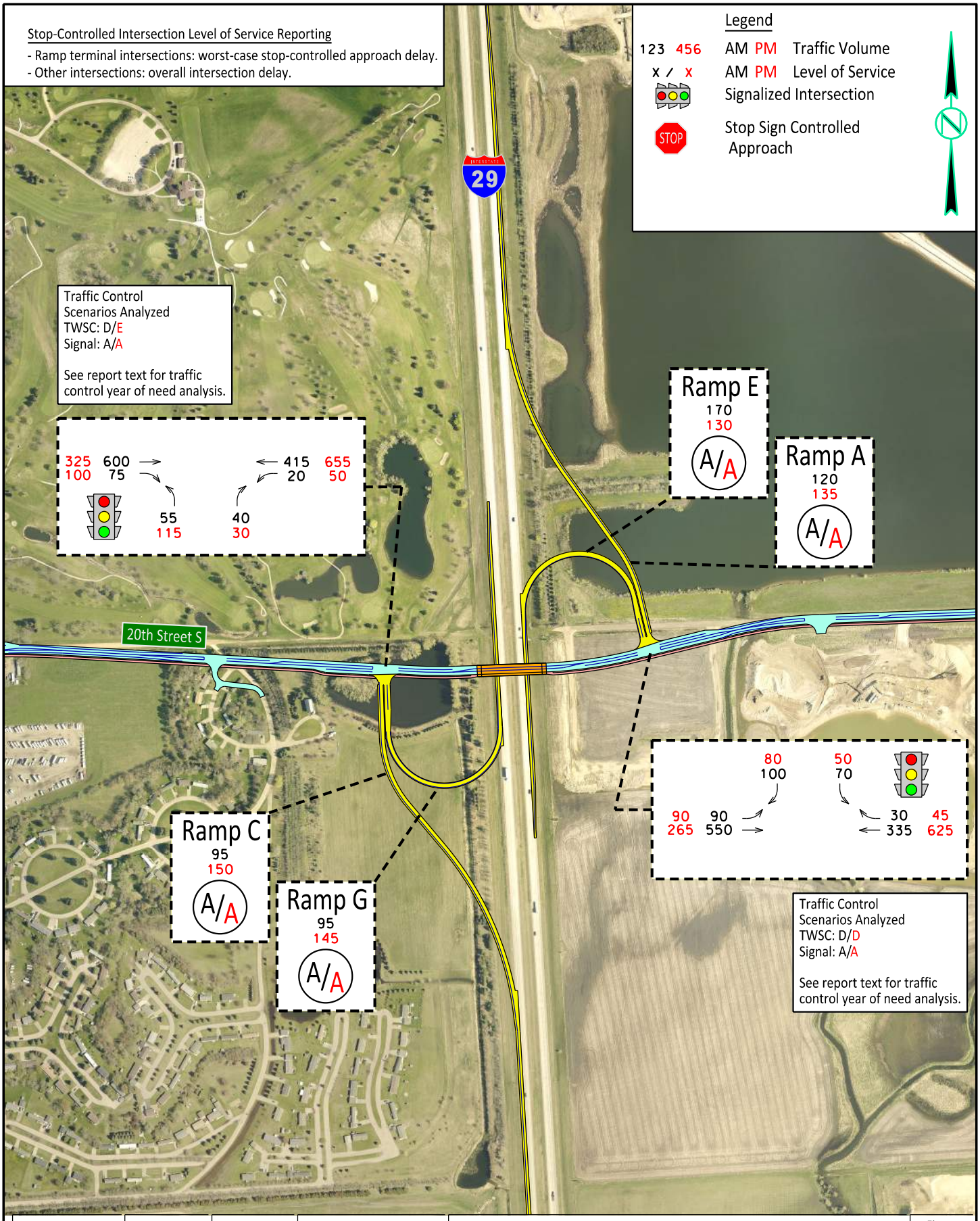
Figure 23

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2045 Build Interchange Alt. 2 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure 24



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2045 Build Interchange Alt. 3 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

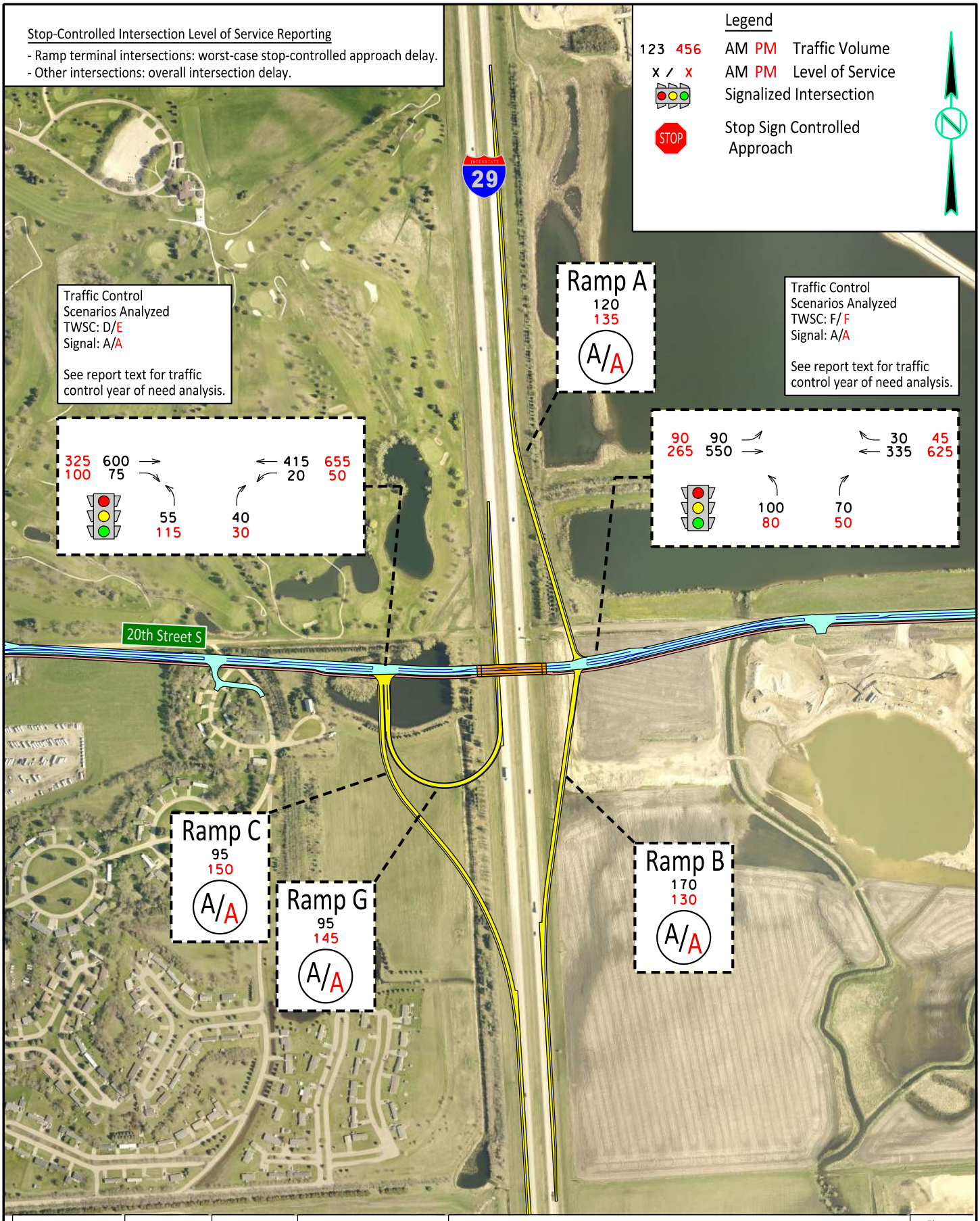
Figure 25

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2045 Build Interchange Alt. 4 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure 26

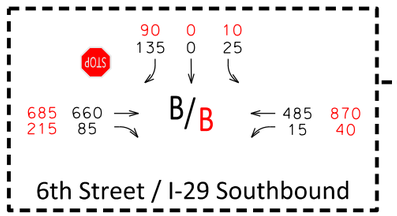


Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

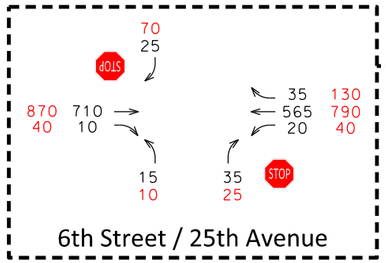
Year 2045 Build Interchange Alt. 5 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

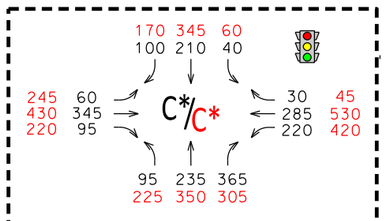
Figure 27



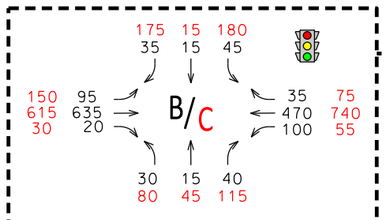
6th Street / I-29 Southbound



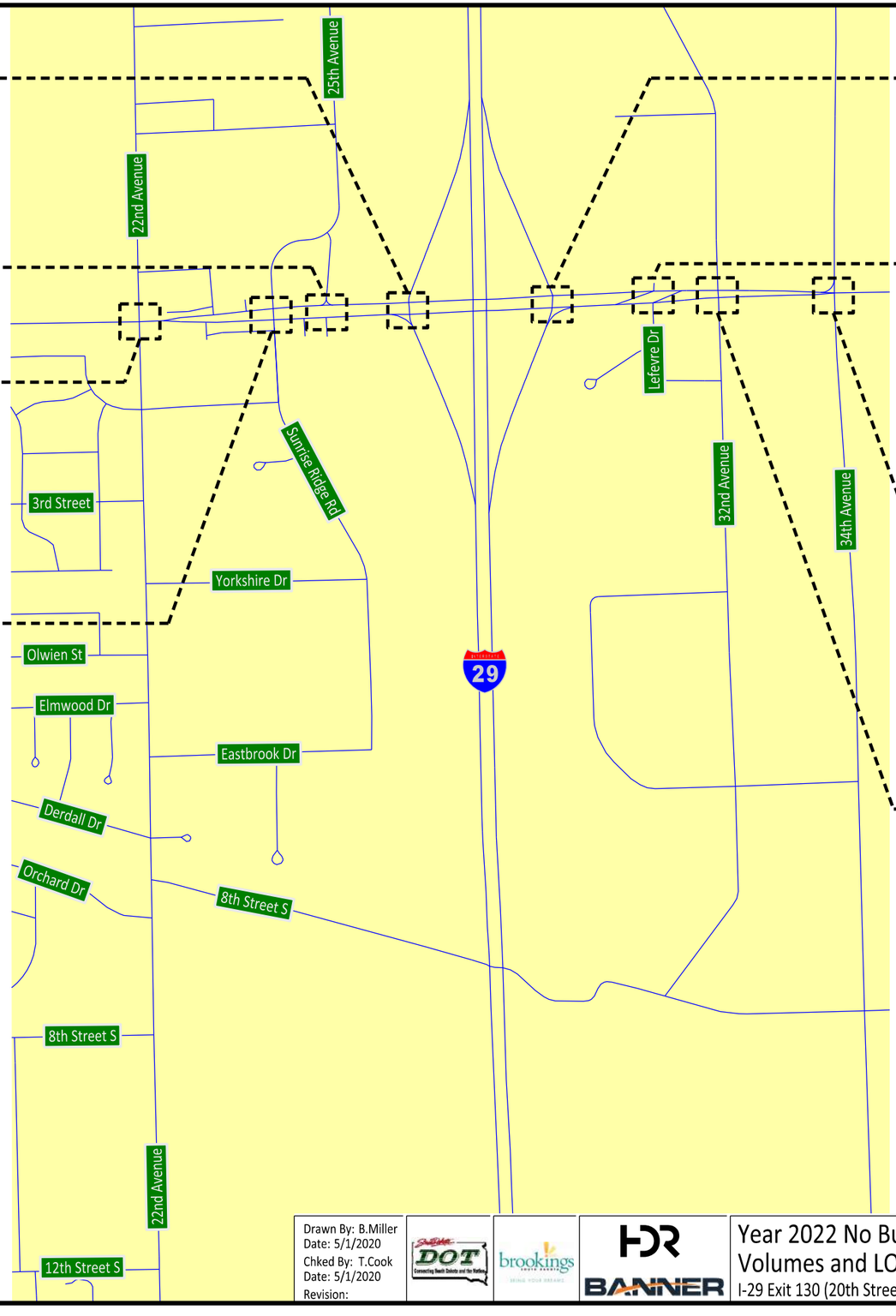
6th Street / 25th Avenue

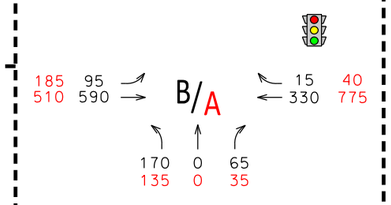


6th Street / 22nd Avenue

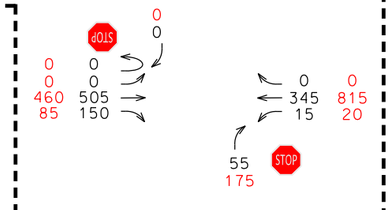


6th Street / Sunrise Ridge Road

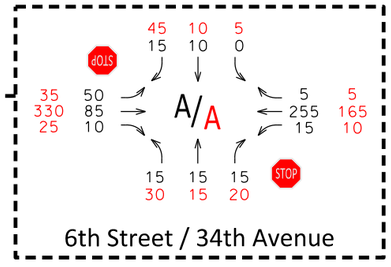




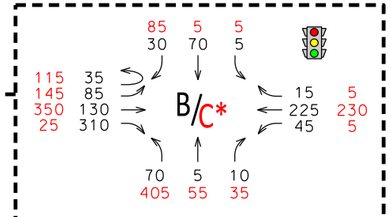
6th Street / I-29 Northbound



6th Street / Lefevre Drive



6th Street / 34th Avenue



6th Street / 32nd Avenue

* One or more turn lanes experience a queue storage ratio greater than 1.0 (HCS-measured 95th percentile queue is longer than the existing turn lane storage length). HCS does not account for the effect of auxiliary lane spill-back and the actual LOS may be worse than what is shown. This measured queue is not caused by the proposed Project and it is anticipated the issue will be mitigated if/when the problem occurs in the field.

Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

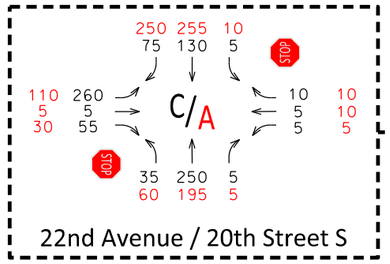
Year 2022 No Build - Peak Hour Intersection Volumes and LOS

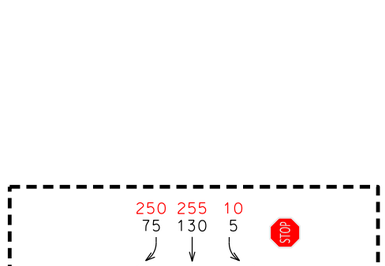
I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

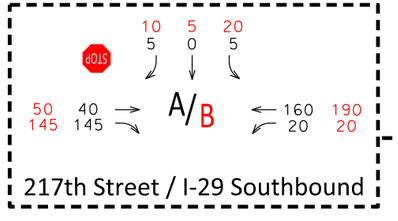
Figure 28a

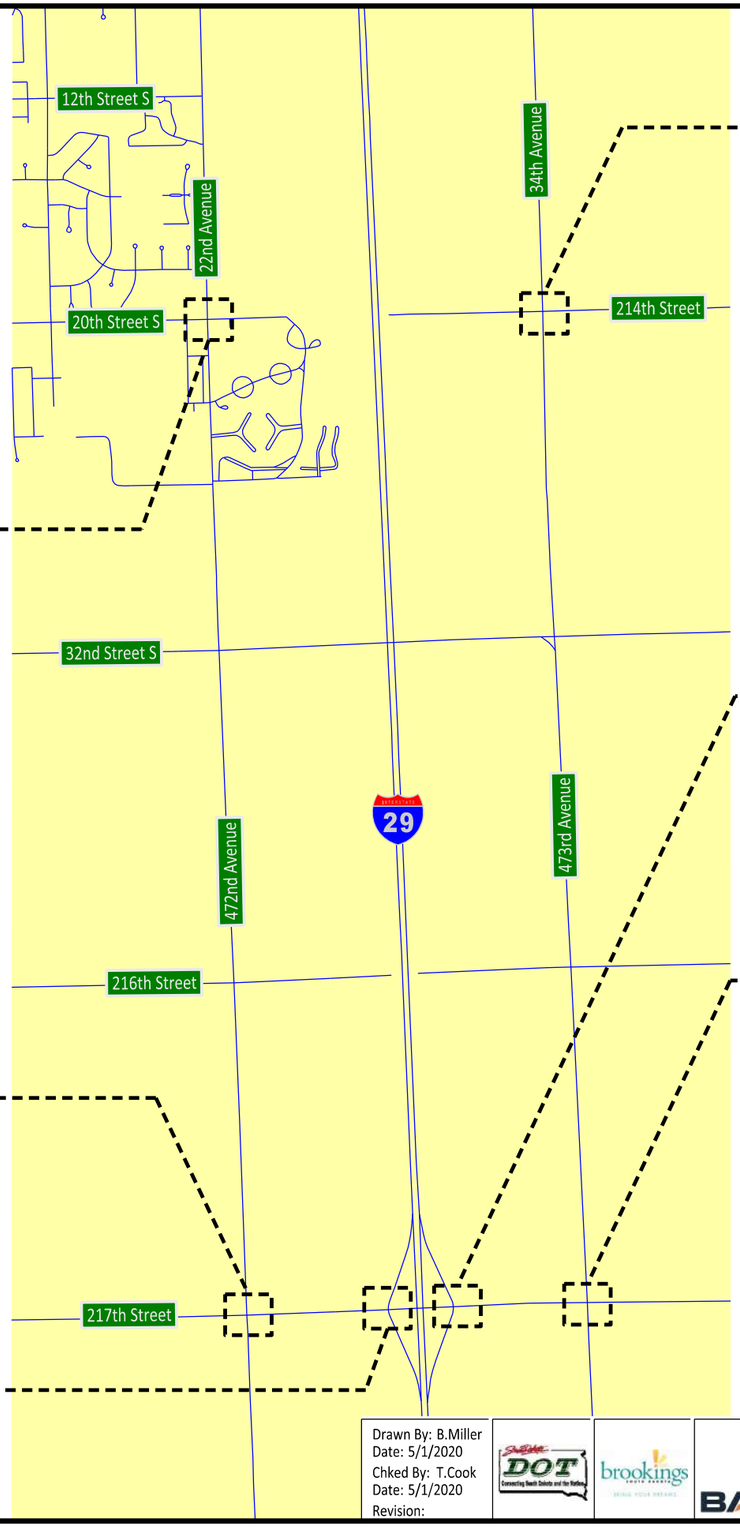
Stop-Controlled Intersection Level of Service Reporting

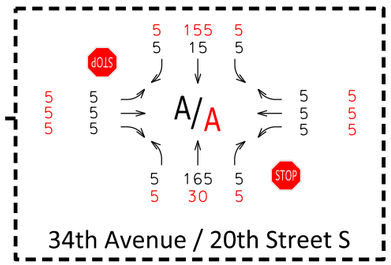
- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

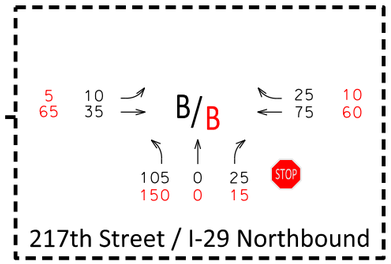


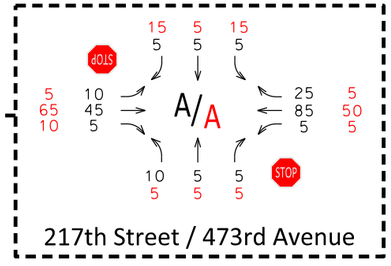












Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

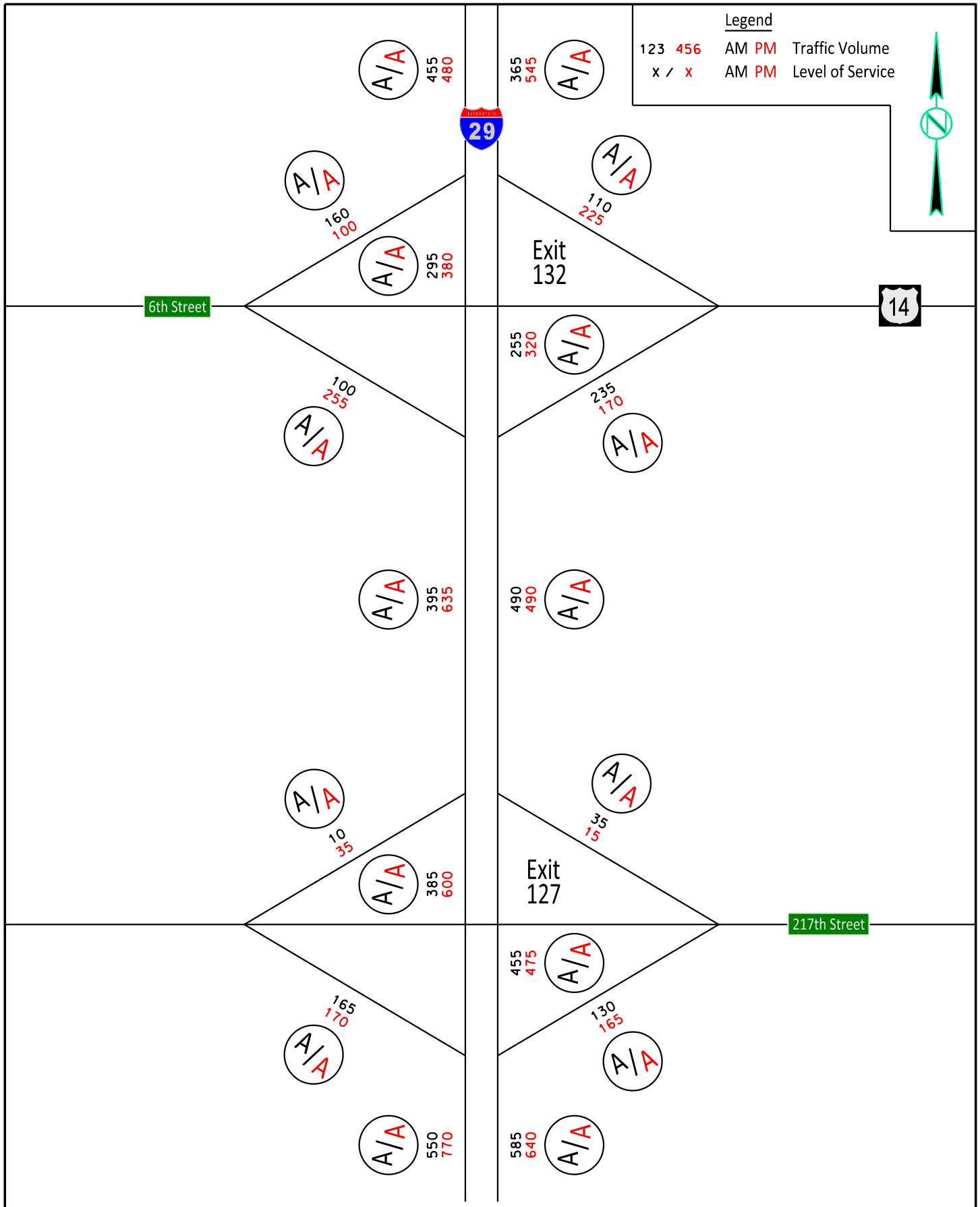
Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 No-Build - Peak Hour Intersection Volumes and LOS

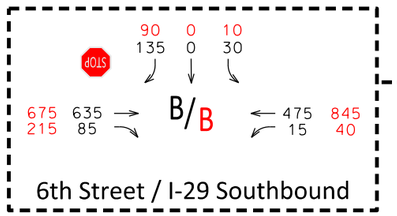
I-29 Exit 130 (20th Street S) Interchange IJR

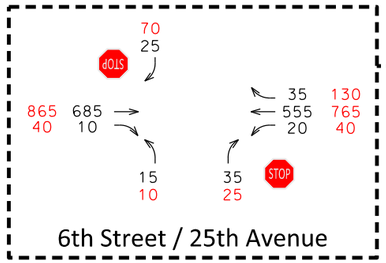
Brookings, SD

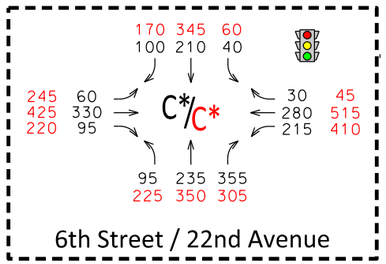
Figure 28b

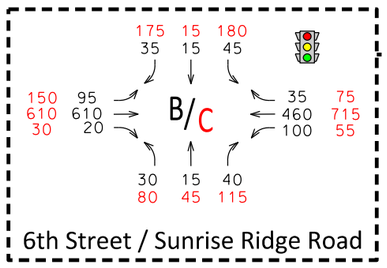


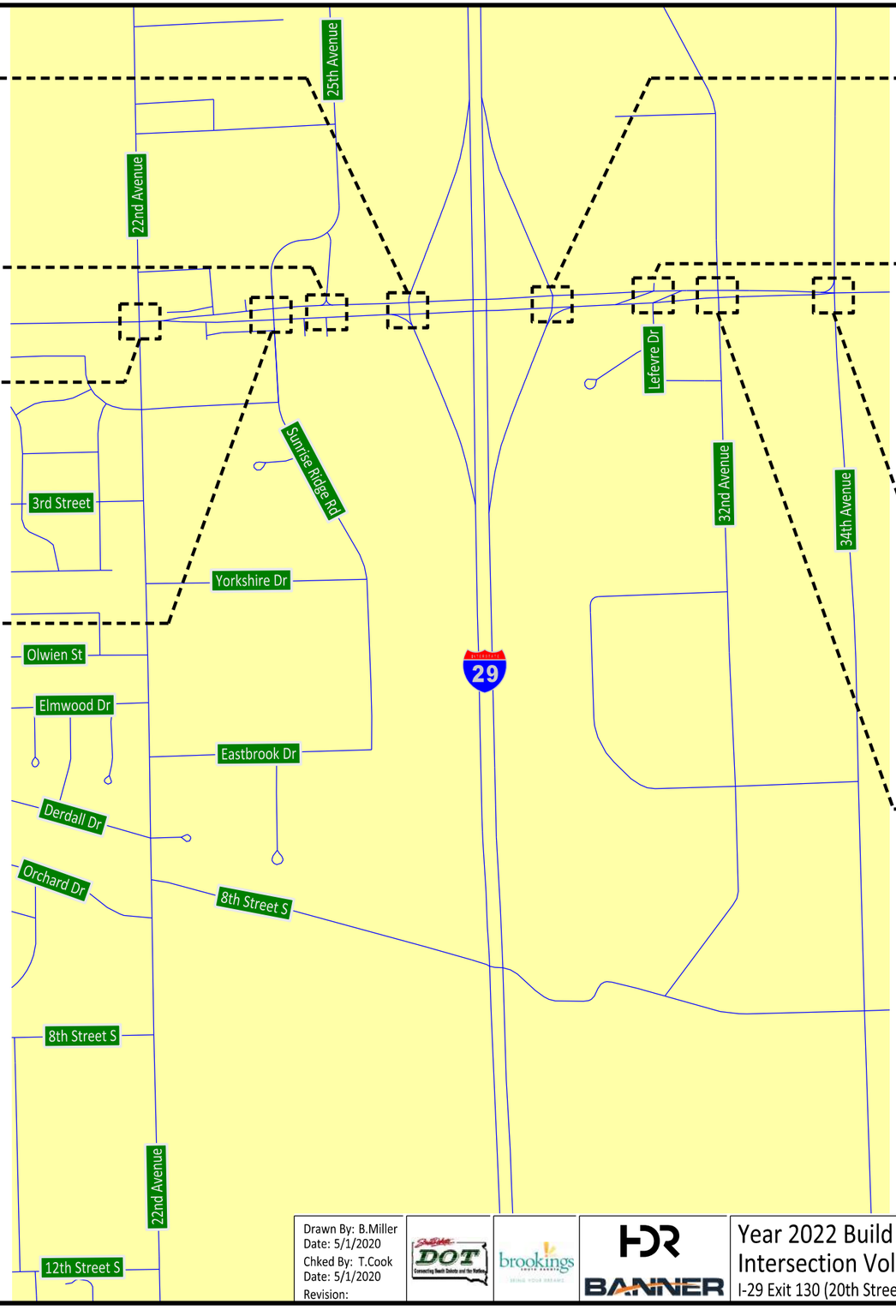
Drawn By: B.Miller Date: 5/1/2020 Chked By: T.Cook Date: 5/1/2020 Revision:	SD DOT	brookings	HDR BANNER	Year 2022 No Build - Peak Hour Interstate Volumes and LOS I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD	Figure 29

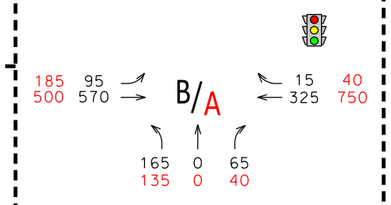


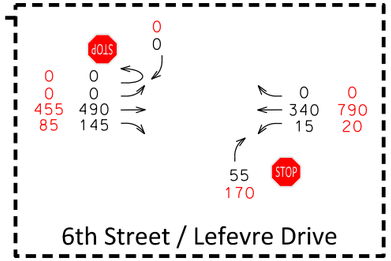


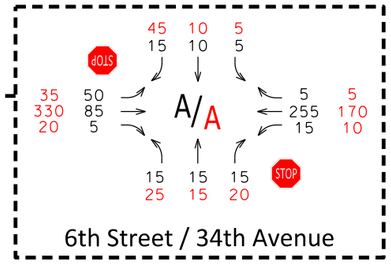


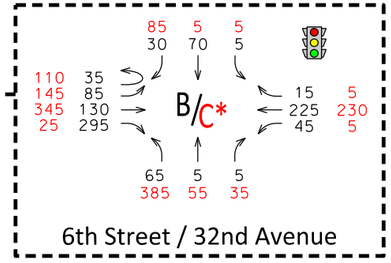












* One or more turn lanes experience a queue storage ratio greater than 1.0 (HCS-measured 95th percentile queue is longer than the existing turn lane storage length). HCS does not account for the effect of auxiliary lane spill-back and the actual LOS may be worse than what is shown. This measured queue is not caused by the proposed Project and it is anticipated the issue will be mitigated if/when the problem occurs in the field.

Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

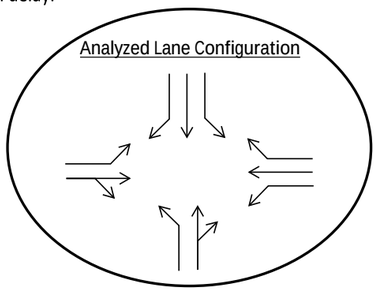
Year 2022 Build Overpass Alternative - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 30a

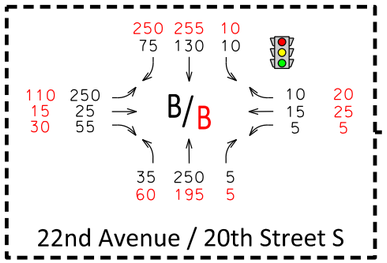
Stop-Controlled Intersection Level of Service Reporting

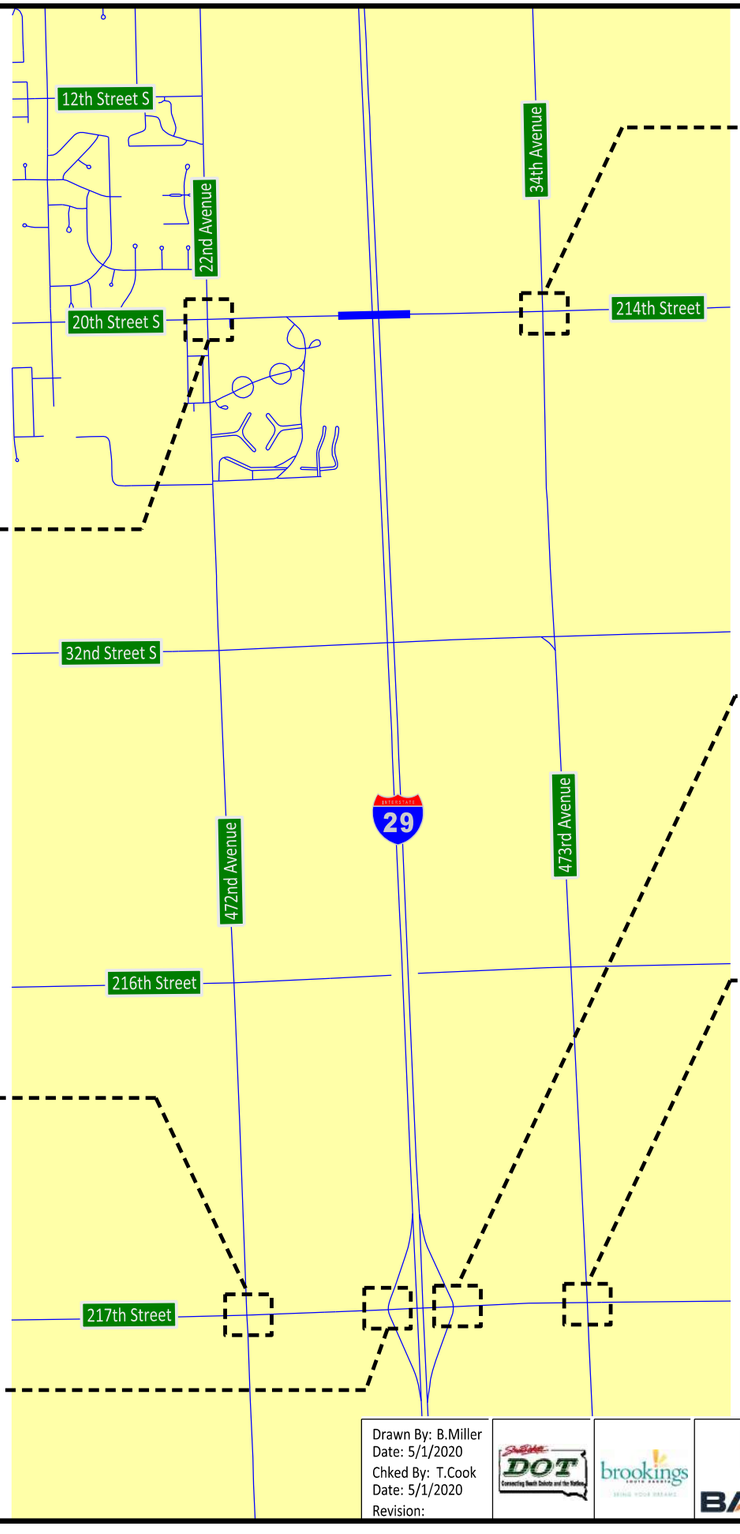
- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

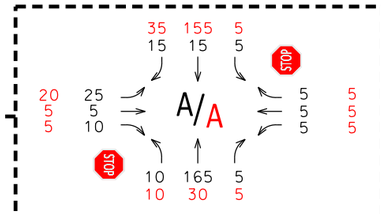


Traffic Control
Scenarios Analyzed
TWSC: C/A
Signal: B/B

See report text for traffic control year of need analysis.

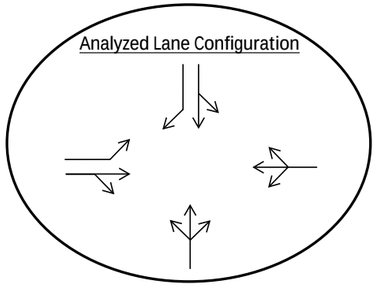


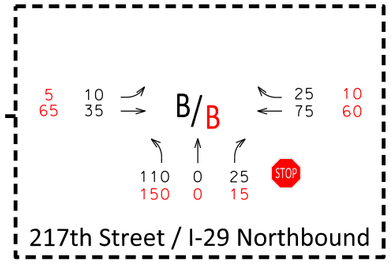


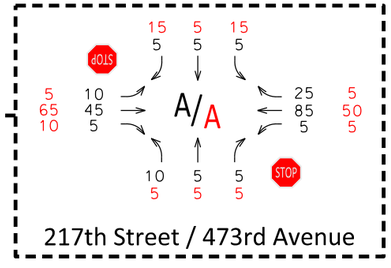


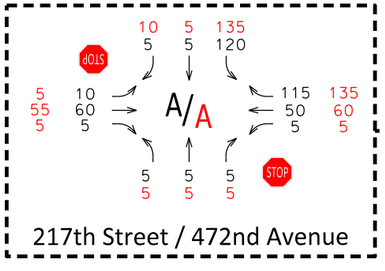
Traffic Control
Scenarios Analyzed
TWSC: A/A
Roundabout: A/A

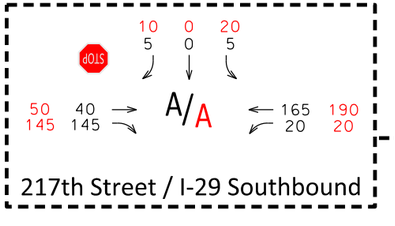
See report text for traffic control year of need analysis.











Legend

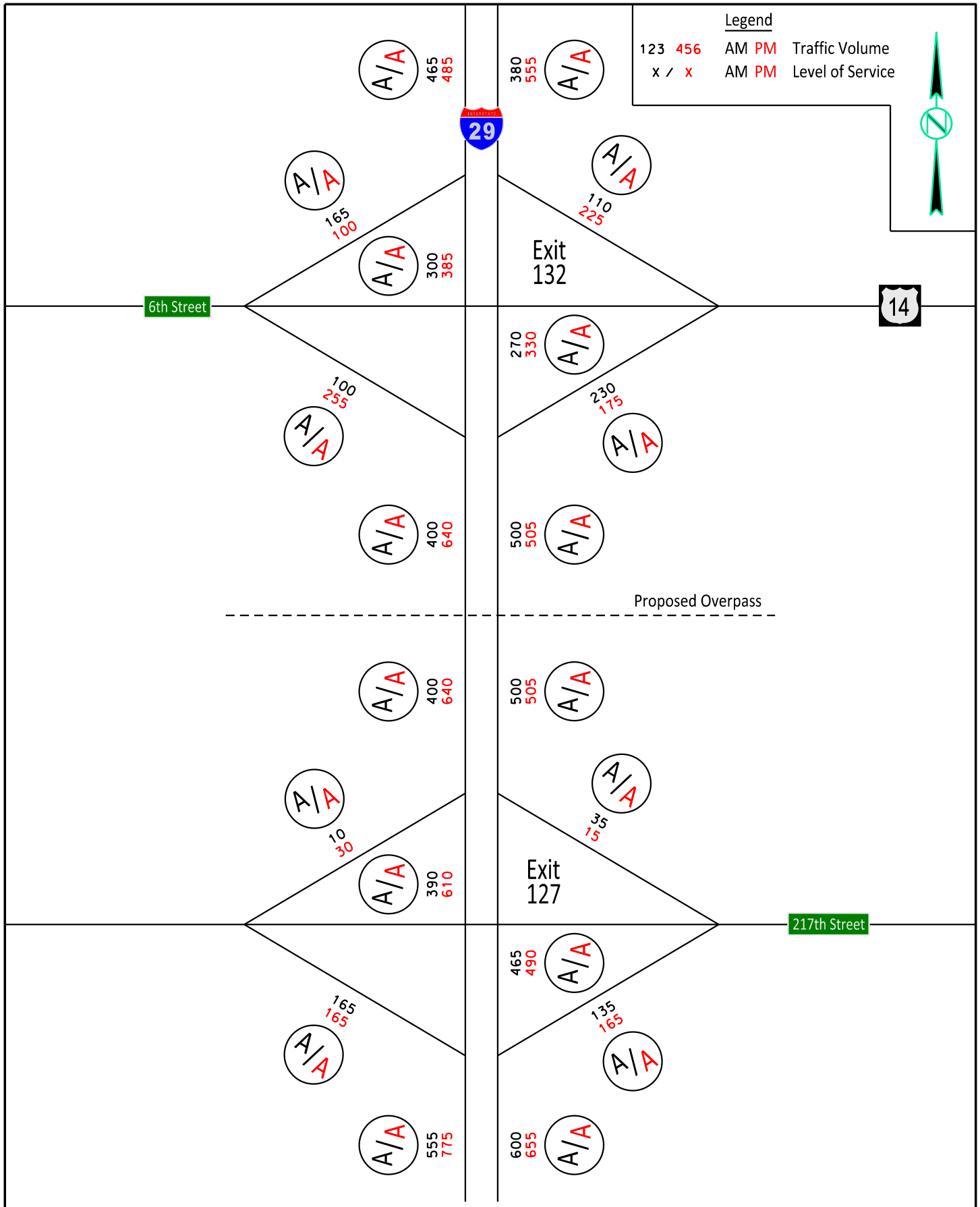
123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 Build Overpass Alternative - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 30b

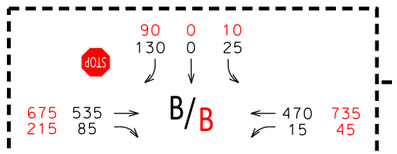


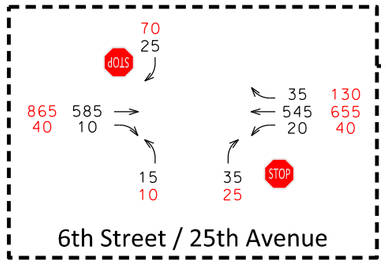
Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

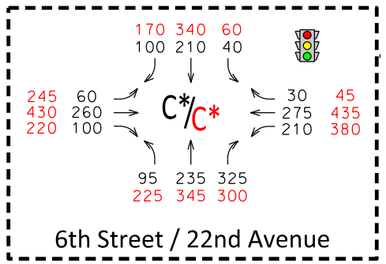
Year 2022 Build Overpass Alternative - Peak Hour Interstate Volumes and LOS

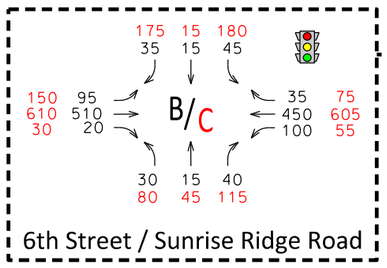
I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

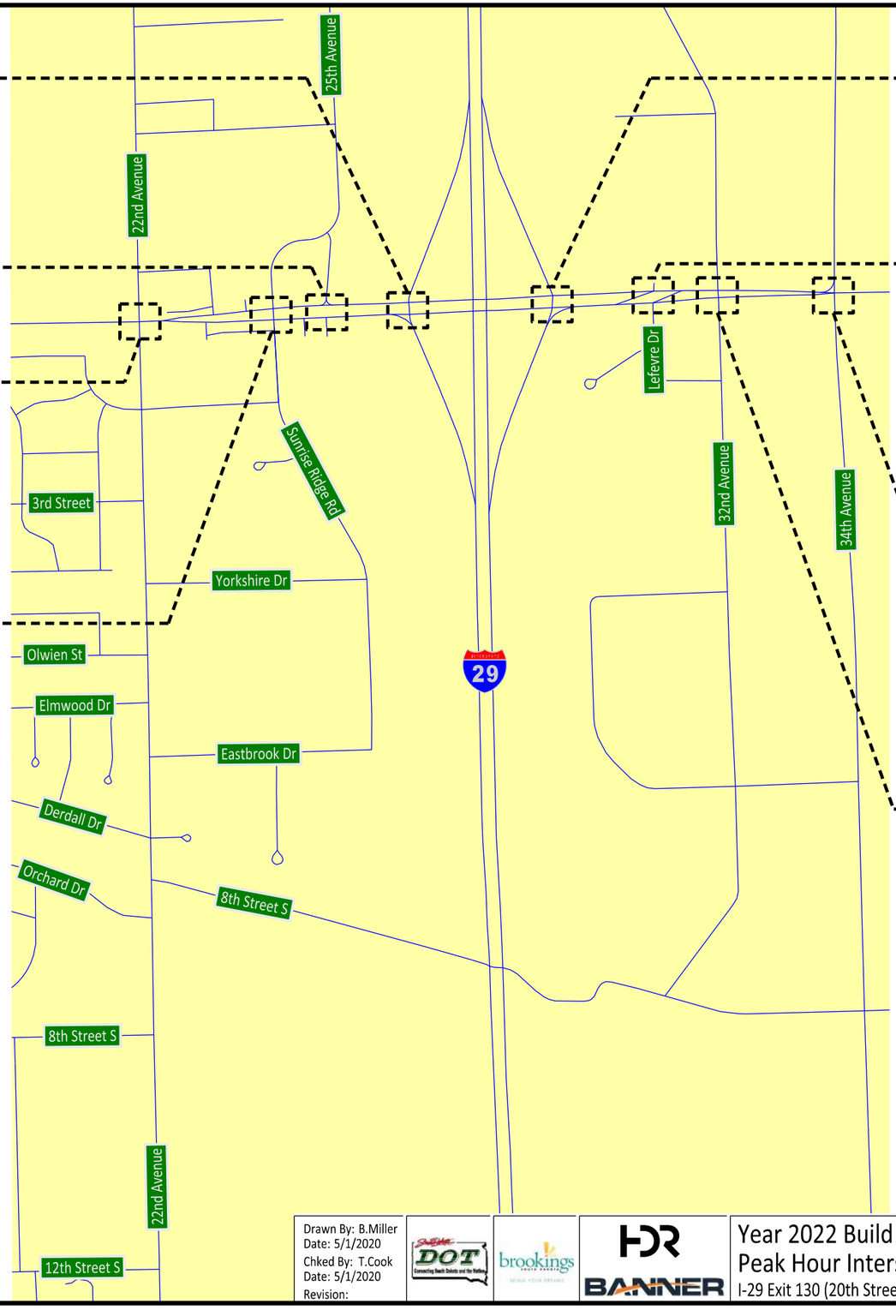
Figure 31

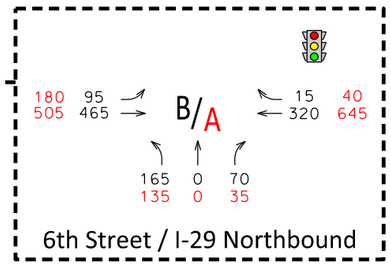


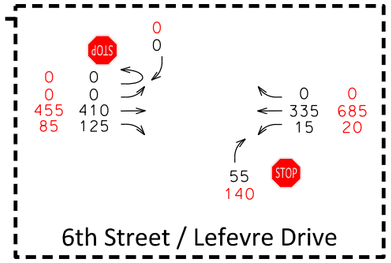


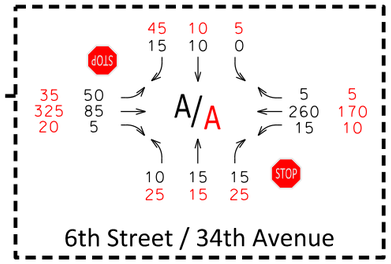


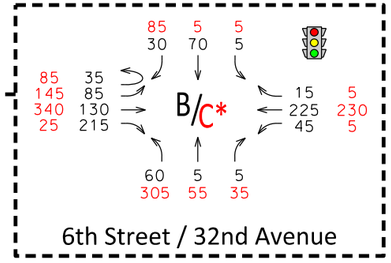












* One or more turn lanes experience a queue storage ratio greater than 1.0 (HCS-measured 95th percentile queue is longer than the existing turn lane storage length). HCS does not account for the effect of auxiliary lane spill-back and the actual LOS may be worse than what is shown. This measured queue is not caused by the proposed Project and it is anticipated the issue will be mitigated if/when the problem occurs in the field.

Stop-Controlled Intersection Level of Service Reporting

- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.

Legend

123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

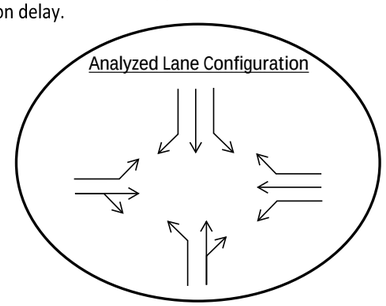
Year 2022 Build Interchange Alternatives - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 32a

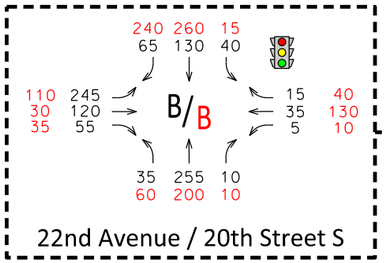
Stop-Controlled Intersection Level of Service Reporting

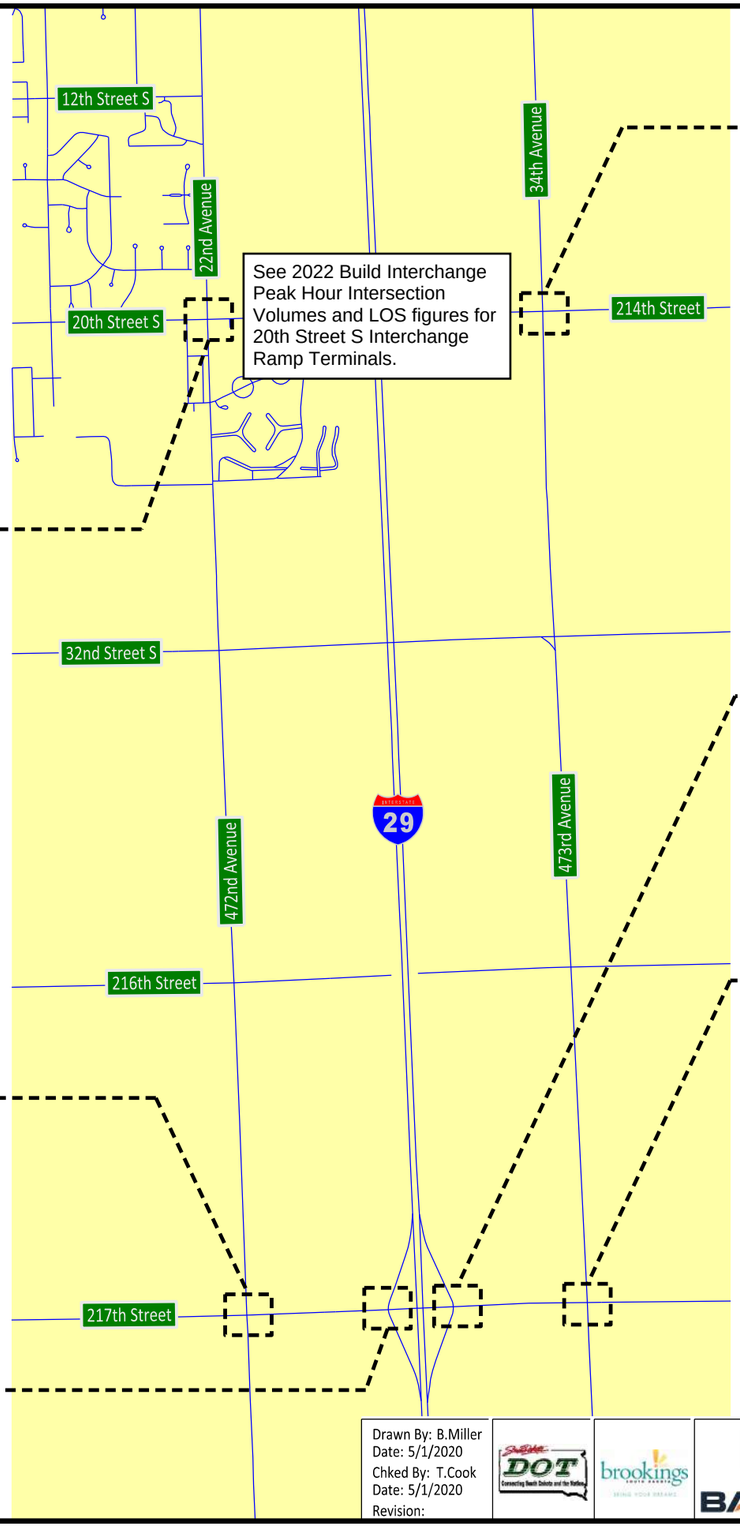
- Ramp terminal intersections: worst-case stop-controlled approach delay.
- Other intersections: overall intersection delay.



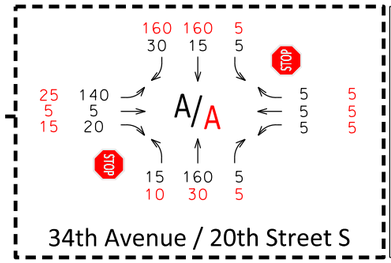
Traffic Control
Scenarios Analyzed
TWSC: D/C
Signal: B/B

See report text for traffic control year of need analysis.



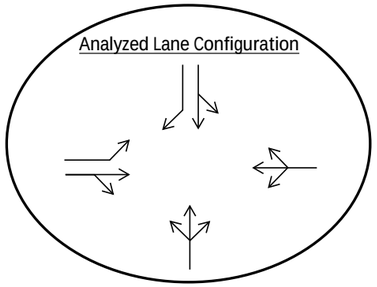


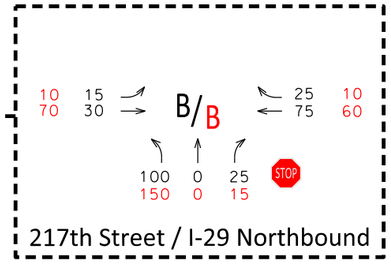
See 2022 Build Interchange Peak Hour Intersection Volumes and LOS figures for 20th Street S Interchange Ramp Terminals.

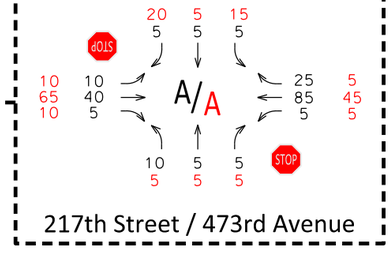


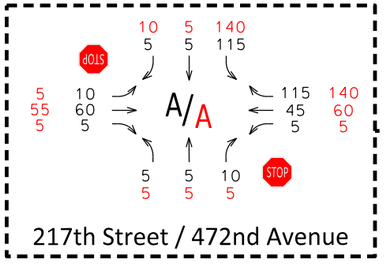
Traffic Control
Scenarios Analyzed
TWSC: A/A
Roundabout: A/A

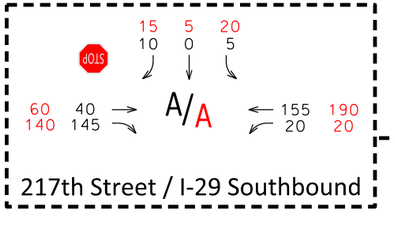
See report text for traffic control year of need analysis.











Legend

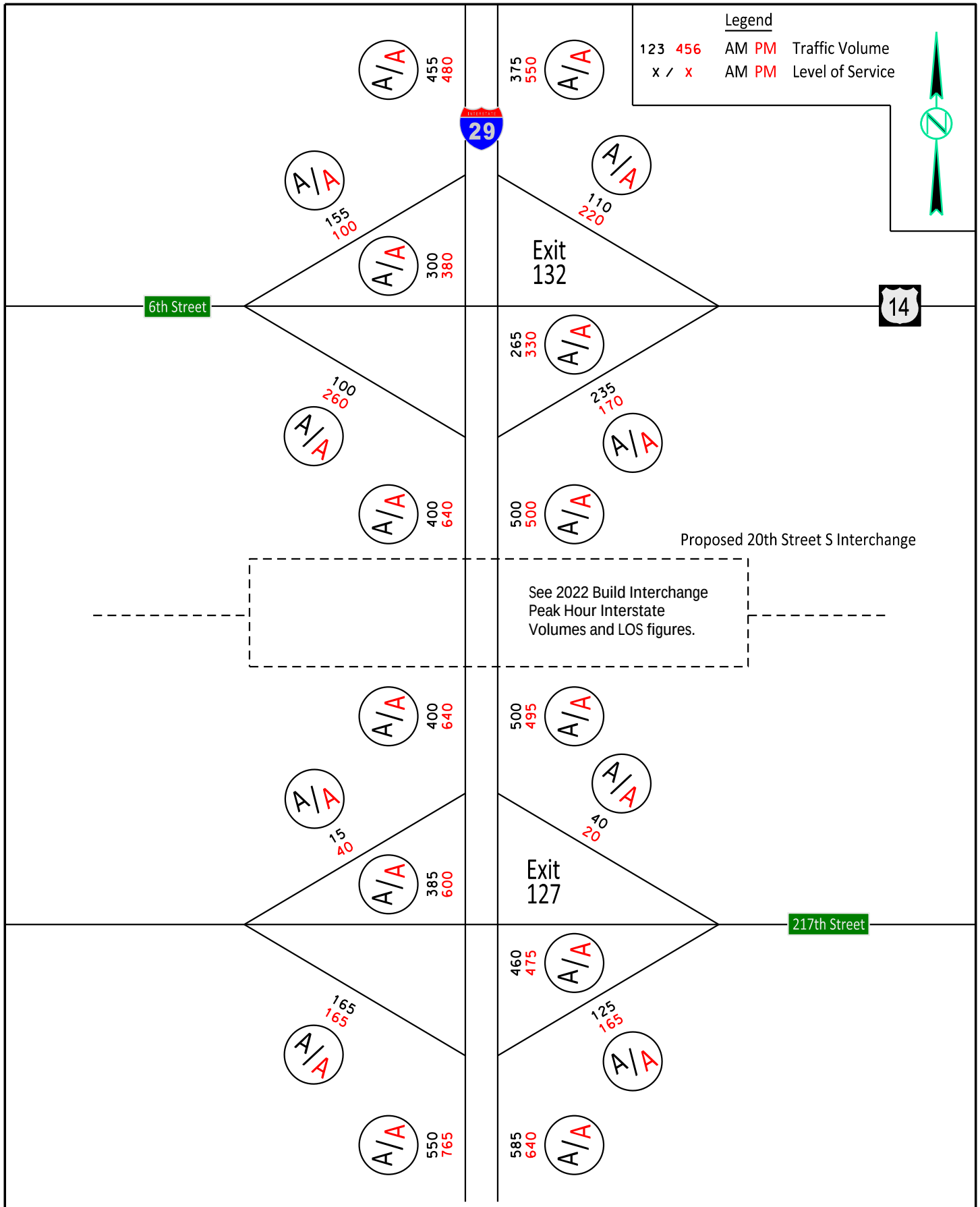
123 456	AM PM Traffic Volume
X / X	AM PM Level of Service
	Signalized Intersection
STOP	Stop Sign Controlled Approach

Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 Build Interchange Alternatives - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 32b



Drawn By: B.Miller Date: 5/1/2020 Chked By: T.Cook Date: 5/1/2020 Revision:	SD DOT	brookings	HDR BANNER	Year 2022 Build Interchange Alternatives - Peak Hour Interstate Volumes and LOS I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD	Figure 33

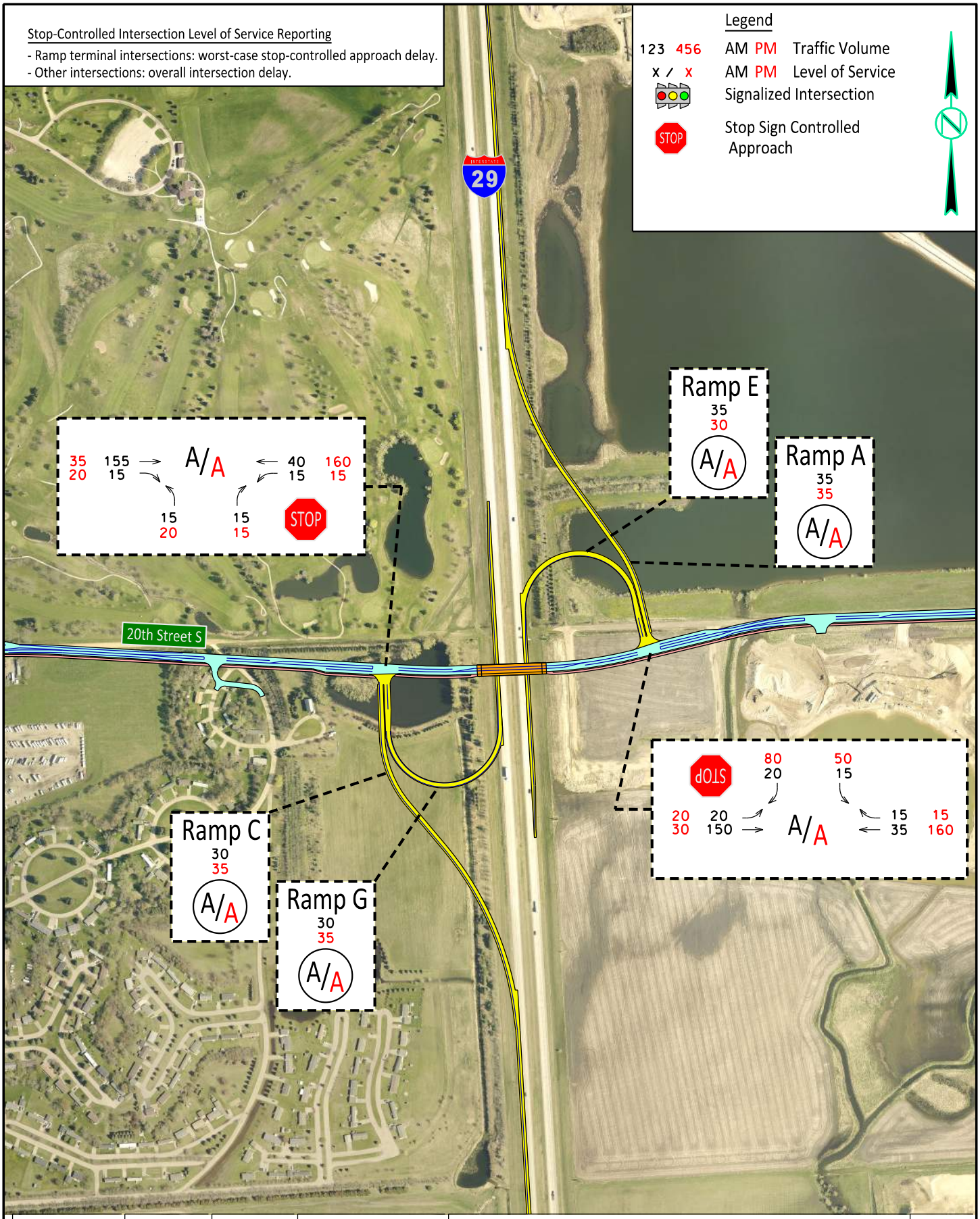
Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 Build Interchange Alt. 1 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure 34

Drawn By: B.Miller Date: 5/1/2020 Chked By: T.Cook Date: 5/1/2020 Revision:	SD DOT	brookings	HDR BANNER	Year 2022 Build Interchange Alt. 2 - Peak Hour Intersection Volumes and LOS I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD	Figure 35

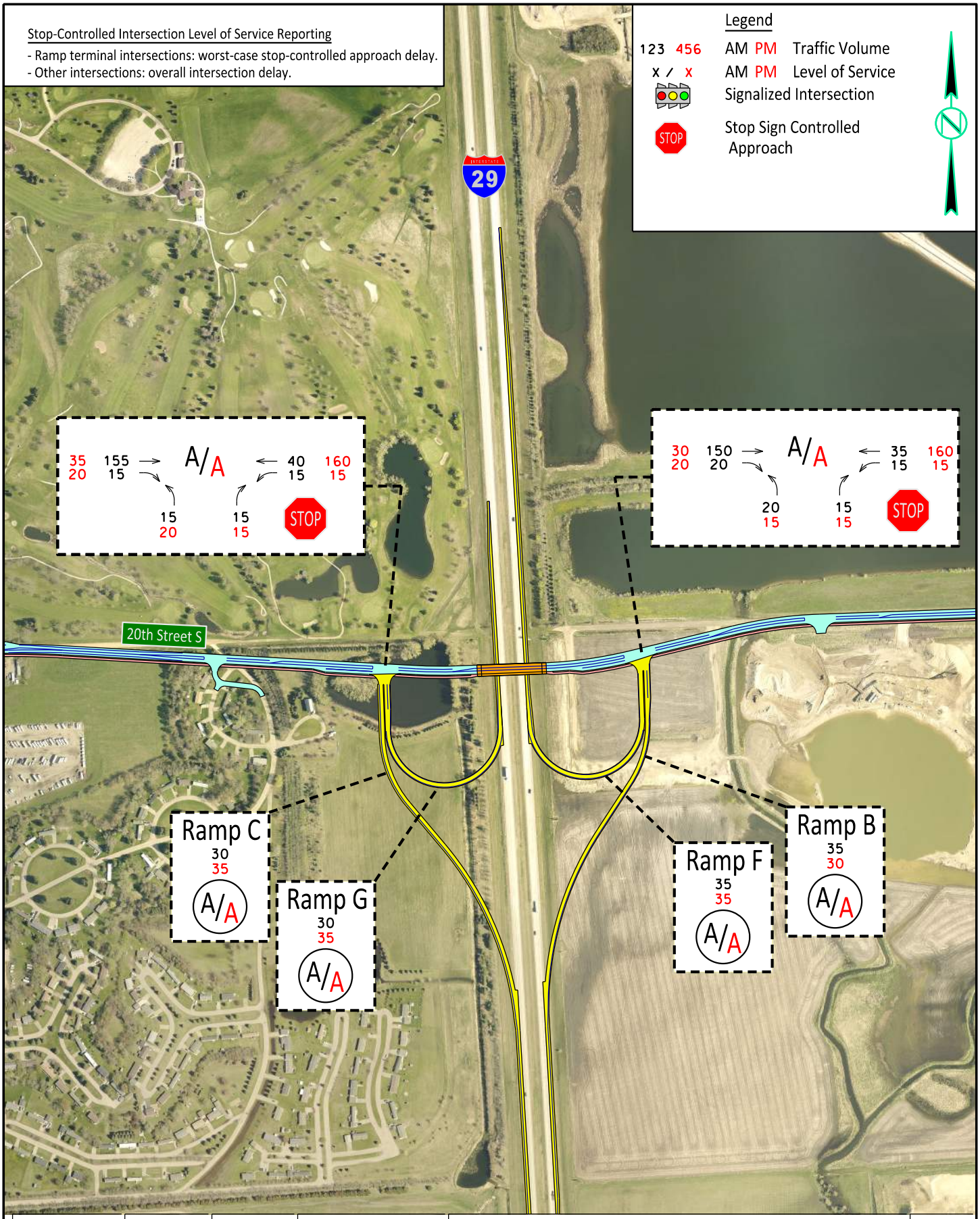


Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 Build Interchange Alt. 3 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure 36

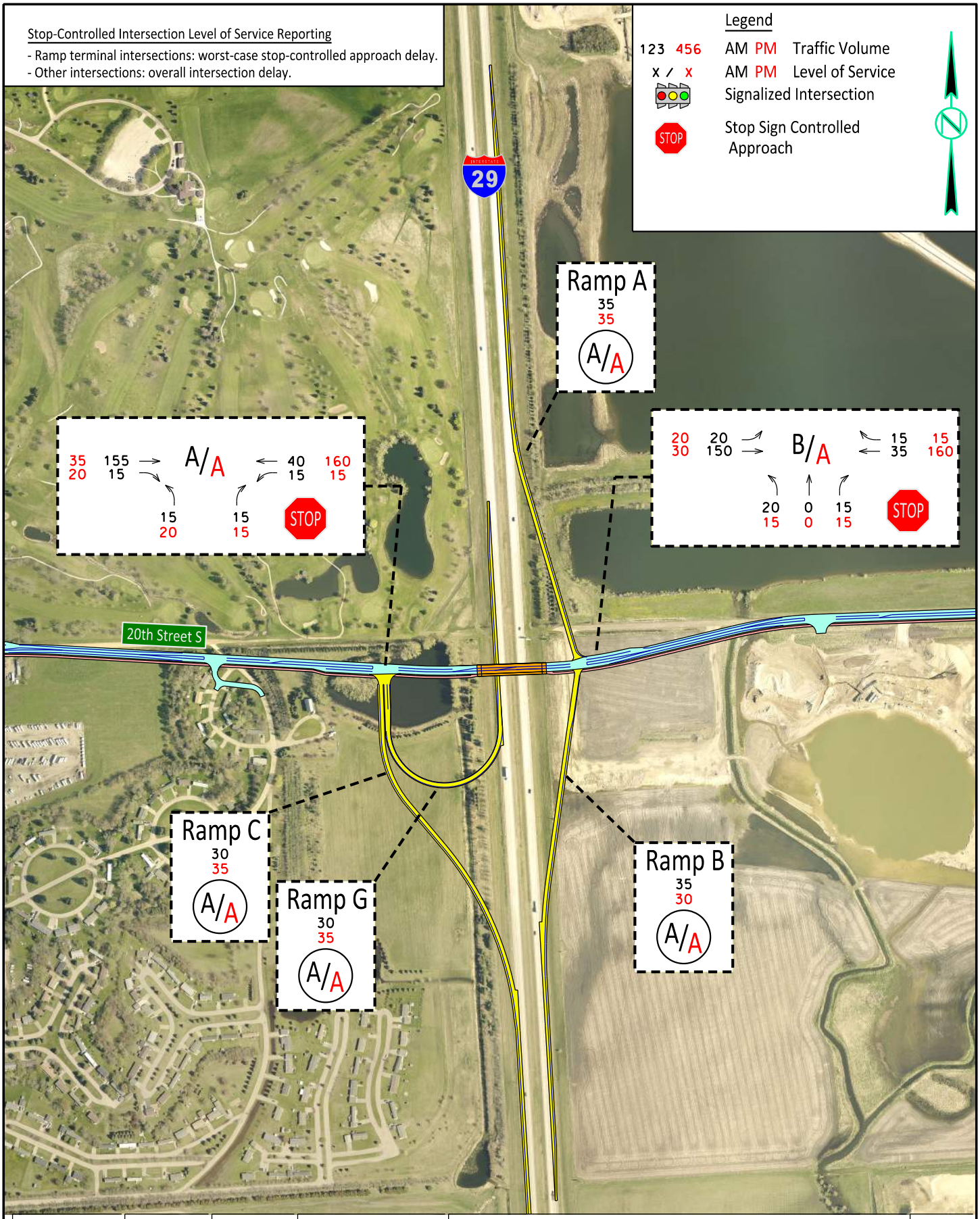


Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 Build Interchange Alt. 4 - Peak Hour Intersection Volumes and LOS

I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure 37



Drawn By: B.Miller
Date: 5/1/2020
Chked By: T.Cook
Date: 5/1/2020
Revision:

Year 2022 Build Interchange Alt. 5 -
Peak Hour Intersection Volumes and LOS
I-29 Exit 130 (20th Street S) Interchange IJR Brookings, SD

Figure
38

20th Street South Corridor Year of Need Analysis

The following provides supporting information regarding timing of turn lane and traffic control needs along the 20th Street South corridor. It should be noted, this review is geared towards identifying an approximate year of need and does not necessitate installation of turn lanes and/or traffic signals. This information supports plans for whether to include turn lanes and/or traffic signal components with the initial build or whether those components will be phased into the corridor over time when warranted.

Unsignalized intersection turn lane traffic volume warrants are based on methodology outlined in the SDDOT Road Design Manual, Chapter 15. Future-year Build interchange peak hour volumes were the basis of the review and are only applicable to the unsignalized, major route movements at TWSC intersections. Turn lane warrants at signalized intersections are determined through traffic operations analysis.

A review of traffic signal warrants are based on guidance provided in the Manual on Uniform Traffic Control Devices (MUTCD). Because of the proposed east/west connection of 20th Street South and subsequent redistribution of area traffic, peak hour volumes are the only applicable future-year volumes developed for this study. While the peak hour warrant will likely not be applicable to any of the intersections along the 20th Street South corridor, per guidance in the MUTCD, it can provide an approximation for when the 4-hour and 8-hour warrants may start getting close to being met. The actual signalization of an intersection is typically based on counts of existing traffic volumes.

A summary of year of need spreadsheet calculations and associated HCS reports are provided in **Appendix N**.

22nd Avenue Intersection

The existing 22nd Avenue/20th Street South intersection is an unsignalized, two-way stop-control intersection with stop signs on the eastbound and westbound approaches. The 22nd Avenue corridor cross-section currently transitions at the intersection from an urban to rural section through lane add/drop on the north leg. The west leg of 20th Street South is an urban 3-lane section, while the east leg is a local gravel road.

In 2018, the City of Brookings completed a 22nd Avenue Corridor Study to look at reconstructing 22nd Avenue from 20th Street South northward to the US 14 Bypass. Five segments were identified and prioritized for project implementation. The segment from 20th Street South to 12th Street South was prioritized as number four. The first segment, 6th Street to Eastbrook Drive, was completed in the summer of 2019.

In light of the recommended 22nd Avenue corridor reconstruction project phasing, two scenarios were developed for analysis of peak hour traffic signal warrants and year of LOS C/D transition. These two scenarios represent incremental build-out considerations and illustrate the relationship between unsignalized intersection turn lane warrants, traffic signal warrants, and the effect additional turn lanes have on both traffic operations and traffic signal warrants.

1. **Warranted turn lane scenario**: Existing lane configuration plus,
    a. Warranted 22nd Avenue turn lanes and
    b. Build-out of westbound 20th Street South approach.
2. **Intersection Build-out scenario**: incorporates 22nd Avenue Corridor Study recommendations for the 22nd Avenue approaches plus,
    a. Build-out of westbound 20th Street South approach.

Table 10 provides a summary of unsignalized intersection turn lane warrants, traffic signal warrants, and TWSC intersection operations.

Table 10: 20th Street South/22nd Avenue Warrant Review

Approach	Unsignalized Intersection Turn Lane Warrant Review	Traffic Signal Warrant Review[1]	TWSC Operations Review [2]
SB	**LT Lane Approximate Year of Warrant:** 2022 (AM) 2024 (PM)	**Warranted turn lane scenario** **Approximate Year of Warrant:** 2029 (AM) 2028 (PM) **Intersection build-out scenario** **Approximate Year of Warrant:** 2033 (AM) 2030 (PM)	**Warranted turn lane scenario** **Approximate Year of LOS D:** 2022 (AM) 2023 (PM) **Intersection build-out scenario** **Approximate Year of LOS D:** 2023 (AM) 2024 (PM)
NB	**LT Lane Approximate Year of Warrant:** 2022 (AM) 2022 (PM) **RT Lane Approximate Year of Warrant:** 2033 (AM) 2033 (PM)		
EB	Stop-controlled approach.		
WB	Stop-controlled approach.		

[1] Peak hour warrant review based on recommended 2045 Build condition lane configuration and Interchange Build Alternative traffic volumes.
- Warranted turn lane scenario based on 2 or more lanes and 1 lane peak hour warrant threshold.
- Intersection build-out scenario based on 2 or more lanes and 2 or more lanes peak hour warrant threshold.

[2] LOS D applies to overall intersection delay. Lane configuration based on 2022 recommendation with warranted turn lanes to determine how long that configuration will maintain LOS C operations.

Key findings from this review includes:

- Westbound right turn lane is needed in the PM peak hour for both stop-controlled and signalized intersections.
- Northbound and southbound left turn lanes are warranted at the time of project completion with an unsignalized intersection.
- Warranted turn lane scenario:
  - TWSC anticipated to be at or exceed the LOS C/D threshold in years 2022-2023.
  - Signalization of this configuration is needed to meet LOS C goals.
  - Traffic signal estimated to be warranted within six years of interchange project completion.
- Intersection build-out scenario:
  - TWSC anticipated to be at or exceed the LOS C/D threshold in years 2024-2025, if constructed as part of the interchange project.
  - Signalization will be needed at or shortly after configuration is constructed to meet LOS goals.
  - Traffic signal estimated to be warranted within six years of interchange project completion.

Based on these findings, phased improvements to the 20th Street South/22nd Avenue were developed and summarized in the following tables. Proposed methods to incorporate these improvements are illustrated in **Figure 39**.

The Year 2022 lane configuration, summarized in **Table 11**, represents a bridge between existing conditions and the future build-out of the intersection. These improvements are proposed for construction in conjunction with the proposed I-29/20th Street South interchange project. It is recommended that a traffic signal be installed as part of the intersection improvements. Traffic volumes are anticipated to be on the cusp of warranting a traffic signal and TWSC LOS may quickly deteriorate if 20th Street South traffic volumes exceed those presented in this analysis.

Table 11: 20th Street South/22nd Avenue Intersection – Recommended Year 2022 Lanes

Approach	Lanes	Notes	Traffic Control
SB	LT, T, RT	2022 warranted turn lane.	Signalize. *Recommend installing traffic signal with interim intersection due to anticipated traffic demand at intersection in interim conditions.*
NB	LT, T/RT	2022 warranted turn lane.	
EB	LT, T/RT	Existing configuration	
WB	LT, T, RT	Required to meet study LOS goals.	

Table 12 represents the minimum build-out lane configuration for the 20th Street South/22nd Avenue intersection to meet this study's 2045 LOS goals and incorporate 22nd Avenue Corridor Study recommendations for the 22nd Avenue approaches.

Table 12: 20th Street South/22nd Avenue Intersection – Recommended Intersection Build-Out Lanes

Approach	Lanes	Notes	Traffic Control
SB	LT, T, T, RT	22nd Ave Corridor Study configuration.	Signalize. *Update traffic signal for new intersection configuration.*
NB	LT, T, T/RT	22nd Ave Corridor Study configuration.	
EB	LT, T, RT	22nd Ave Corridor Study configuration.	
WB	LT, T, RT	22nd Ave Corridor Study configuration.	

Existing Conditions

With Year 2022 Interchange Project

By Year 2045

Legend
- Roadway Construction
- Sidewalk
- Shared Use Path
- Previously Constructed
- Existing ROW / Property Line
- Traffic Signal Arm with Street Light

SCALE IN FEET
0 50 100

20th Street S

22nd Avenue S

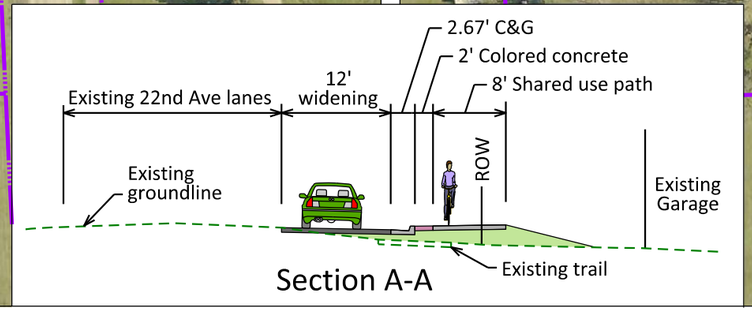
New pavement markings

Install traffic signals with 2022 interchange project

East side signal poles to remain in place; Install new west side signal poles.

A A

Match existing



Section A-A

Drawn By: B.Miller
Date: 8/3/2020
Chked By: J.Unruh
Date: 8/3/2020
Revision: 8/28/2020

20th Street S / 22nd Avenue S Intersection
Phased Improvements
I-29 Exit 130 (20th Street S) Interchange IJR
Brookings, SD

Figure 39

I-29 SPI Intersection – Interchange Alternatives 1-2

The SPI Build alternatives require signalization of the main single point intersection upon opening and thus unsignalized intersection turn lane volume warrants and traffic signal warrants were not reviewed. Recommended turn lanes are based on signalized operational and/or SPI geometric need. It was found that from an operations standpoint, exclusive eastbound and westbound 20th Street South right turn lanes were not needed for the ramp terminal intersection to meet LOS goals for this study. The recommended lane configuration to be constructed as part of the interchange project is summarized in **Table 13**.

Table 13: 20th Street South/I-29 Interchange Build Alternatives 1-2 – Recommended Lanes

Approach	Lanes	Notes	Traffic Control
SB off-ramp	LT, RT	Provides LT and RT split for SPI geometrics	Traffic signal.
NB off-ramp	LT, RT	Provides LT and RT split for SPI geometrics	
EB	LT, T/RT	-	
WB	LT, T/RT	-	

Analyzed as signalized intersection. Turn lane needs based on signalized operations.

I-29 Southbound Ramp Terminal Intersection – Interchange Alternatives 3-5

The I-29 southbound ramp terminal intersection with 20th Street South exhibits a similar configuration for Build interchange 3, 4, and 5. A summary of analyzed warrants is shown in **Table 14**. Traffic signal warrants are based on an intersection configuration that includes warranted turn lanes for unsignalized intersections.

Table 14: 20th Street South/I-29 Southbound RTI Warrant Review - Alternatives 3-5

Approach	Unsignalized Intersection Turn Lane Warrant Review	Traffic Signal Warrant Review [1]	TWSC Operations Review [2]
SB off-ramp	Stop-controlled approach	**Approximate Year of Warrant:** Not warranted before 2045	**Approximate Year of LOS D:** 2043 (AM) 2041 (PM) **95% ramp queues at year of LOS D:** AM: 35 ft. PM: 53 ft.
EB	**RT Lane Approximate Year of Warrant:** 2036 (AM) 2040 (PM)		
WB	**LT Lane Approximate Year of Warrant:** 2032 (AM) 2029 (PM)		

[1] Peak hour warrant review based on lane configuration with warranted, unsignalized intersection turn lanes and Interchange Build Alternative traffic volumes.
[2] LOS D applies to off-ramp approach (worst-case stop-controlled approach).

While this ramp terminal intersection is not able to achieve LOS C goals in the 2045 planning horizon, a review of traffic signal peak hour warrants and LOS C/D transition timeframes found that it would be expected to:

- Operate at LOS C through most of the 20-year planning horizon as a stop-controlled intersection,
- Manage queues to three vehicles or less within the LOS C threshold, and
- Not meet traffic signal volume warrants for signalization within the 20-year planning horizon.

Based on these findings, a configuration with warranted left and right turn lanes on 20th Street South and stop control for the off-ramp approach will meet study goals through most of the 2045 planning horizon. A summary of recommended lane configuration and traffic control for a proposed interchange project is provided in **Table 15**.

Table 15: 20th Street South/I-29 Interchange Build Alternatives 3-5 – Recommended Lanes

Approach	Lanes	Notes	Traffic Control
SB off-ramp	LT, RT	Split of LT and RT lanes benefits operations.	TWSC.
EB	T, RT	Warranted RT lane.	
WB	LT, T	Warranted LT lane.	

I-29 Northbound Ramp Terminal Intersection – Interchange Alternatives 3-5

The I-29 northbound ramp terminal intersection with 20th Street South is slightly different for interchange Build alternatives 3-5. A summary of analyzed warrants are shown in **Table 16** through **Table 18**. Traffic signal warrants are based on an intersection configuration that includes warranted turn lanes for unsignalized intersections.

Table 16: 20th Street South/I-29 Northbound RTI Warrant Review – Alternative 3

Approach	Unsignalized Intersection Turn Lane Warrant Review	Traffic Signal Warrant Review [1]	TWSC Operations Review [2]
NB off-ramp	Stop-controlled approach	**Approximate Year of Warrant:** Not warranted before 2045	**Approximate Year of LOS D:** 2044 (AM) 2045 (PM) **95% ramp queues at year of LOS D:** AM: 65 ft. PM: 40 ft.
EB	**LT Lane Approximate Year of Warrant:** 2027 (AM) 2026 (PM)		
WB	**RT Lane Approximate Year of Warrant:** After 2045 (AM) 2041 (PM)		

[1] Peak hour warrant review based on lane configuration with warranted, unsignalized intersection turn lanes and Interchange Build Alternative traffic volumes.
[2] LOS D applies to off-ramp approach (worst-case stop-controlled approach).

Table 17: 20th Street South/I-29 Northbound RTI Warrant Review – Alternative 4

Approach	Unsignalized Intersection Turn Lane Warrant Review	Traffic Signal Warrant Review [1]	TWSC Operations Review [2]
NB off-ramp	Stop-controlled approach	**Approximate Year of Warrant:** Not warranted before 2045	**Approximate Year of LOS D:** 2042 (AM) Beyond 2045 (PM) **95% ramp queues at year of LOS D:** AM: 60 ft. PM: -
EB	**RT Lane Approximate Year of Warrant:** 2035 (AM) 2041 (PM)		
WB	**LT Lane Approximate Year of Warrant:** 2033 (AM) 2030 (PM)		

[1] Peak hour warrant review based on lane configuration with warranted, unsignalized intersection turn lanes and Interchange Build Alternative traffic volumes.
[2] LOS D applies to off-ramp approach (worst-case stop-controlled approach).

Table 18: 20th Street South /I-29 Northbound RTI Warrant Review – Alternative 5

Approach	Unsignalized Intersection Turn Lane Warrant Review	Traffic Signal Warrant Review [1]	TWSC Operations Review [2]
NB off-ramp	Stop-controlled approach	**Approximate Year of Warrant:** Not warranted before 2045	**Approximate Year of LOS D:** 2038 (AM) 2041 (PM) **95% ramp queues at year of LOS D:** AM: 60 ft. PM: 45 ft.
EB	**LT Lane Approximate Year of Warrant:** 2027 (AM) 2026 (PM)		
WB	**RT Lane Approximate Year of Warrant:** After 2045 (AM) 2041 (PM)		

[1] Peak hour warrant review based on lane configuration with warranted, unsignalized intersection turn lanes and Interchange Build Alternative traffic volumes.
[2] LOS D applies to off-ramp approach (worst-case stop-controlled approach).

Similar to the southbound I-29 ramp terminal intersection, the 2045 traffic operations analysis showed the northbound ramp terminal intersection to not meet LOS goals as a two-way stop-control intersection. Through a review of traffic signal peak hour warrant and a LOS C/D transition timeframes, it was found that the northbound I-29 ramp terminal intersection configurations for Build alternatives 3, 4, and 5 would be expected to:

- Operate at LOS C through most of the 20-year planning horizon as a stop-controlled intersection,
- Manage queues to three vehicles or less within the LOS C threshold, and
- Not meet traffic signal volume warrants for signalization within the 20-year planning horizon.

Based on these findings, a configuration with warranted left and right turn lanes on 20th Street South and stop control for the off-ramp approach will meet study goals through most of the 2045

planning horizon. Recommended lane configurations for Build alternatives 3, 4, and 5 as part of the proposed interchange project are summarized in **Table 19**, **Table 20**, and **Table 21**, respectively.

Table 19: 20th Street South /I-29 Interchange Build Alternative 3 – Recommended Lanes

Approach	Lanes	Notes	Traffic Control
NB off-ramp	LT, RT	Split needed to meet LOS goals.	TWSC.
EB	LT, T	Warranted LT lane.	
WB	T, RT	Warranted RT lane.	

Table 20: 20th Street South /I-29 Interchange Build Alternative 4 – Recommended Lanes

Approach	Lanes	Notes	Traffic Control
NB off-ramp	LT, RT	Split needed to meet LOS goals.	TWSC.
EB	T, RT	Warranted RT lane.	
WB	LT, T	Warranted LT lane.	

Table 21: 20th Street South /I-29 Interchange Build Alternative 5 – Recommended Lanes

Approach	Lanes	Notes	Traffic Control
NB off-ramp	LT, RT	Split needed to meet LOS goals.	TWSC.
EB	LT, T	Warranted LT lane.	
WB	T, RT	Warranted RT lane.	

34th Avenue Intersection

The 34th Avenue corridor through the 20th Street South intersection is currently a paved, bituminous roadway with a rural cross-section. The existing intersection is stop-controlled from the 20th Street South approaches and all turning movements occur from shared lanes.

For this review, intersection improvement phasing assumes an incremental build-out that starts with an unsignalized intersection and warranted turn lanes. When operations reach a point where future improvements are needed, the next steps would be to consider a roundabout, all-way stop-control, or signalized intersection depending on traffic demand and patterns. For reference, a roundabout option and all-way stop-control intersection option was incorporated in the traffic operations figures.

A summary of analyzed warrants are shown in **Table 22**. Traffic signal warrants are based on a configuration that includes warranted turn lanes for unsignalized intersections.

Table 22: 20th Street South/34th Avenue Warrant Review

Approach	Unsignalized Intersection Turn Lane Warrant Review	Traffic Signal Warrant Review[1]	TWSC Operations Review [2]
SB	**LT lane** not warranted by volumes, but recommended for installation with a warranted NB left turn lane. **RT Lane Approximate Year of Warrant:** 2032 (AM) 2022 (PM)	**Approximate Year of Warrant:** 2044 (AM) Beyond 2045 (PM)	**Approximate Year of LOS D:** 2037 (AM) Beyond 2045 (PM)
NB	**LT Lane Approximate Year of Warrant:** 2027 (AM) 2029 (PM) **RT lane** not warranted.		
EB	Stop-controlled approach.		
WB	Stop-controlled approach.		

[1] Peak hour warrant review based on lane configuration with warranted, unsignalized intersection turn lanes and Interchange Build Alternative traffic volumes.
[2] LOS D applies to overall intersection delay with Interchange Build alternative traffic volumes. Lane configuration includes warranted, unsignalized intersection turn lanes.

Similar to the 20th Street South/22nd Avenue intersection, a phased implementation of improvements summarized in the following tables and **Figure 40** is proposed.

Year 2022 improvements, summarized in **Table 23**, address warranted turn lane and operational needs at opening of the proposed interchange. These improvements are proposed for construction in conjunction with the proposed I-29/20th Street South interchange project.

Table 23: 20th Street South/34th Avenue Intersection – Recommended Year 2022 Lanes

Approach	Lanes	Notes	Traffic Control
SB	LT/T, RT	Warranted RT lane.	TWSC.
NB	LT/T/RT	-	
EB	LT, T/RT	Splits left and right turn movements.	
WB	LT/T/RT	Low volume approach.	

Beyond the proposed Year 2022 improvements, the need for 34th Avenue left turn lanes is likely related to future development east of I-29 and south of 20th Street South. While the turn lane warrant review table shows years 2027 (AM) and 2029 (PM) being the approximate year of warrant, it is based on a straight-line growth of development traffic and the warrant likely will not be met until development commences in the area. Therefore, it is proposed that 34th Avenue left turn traffic continue to be monitored for general traffic growth and potential impacts of

planned development be assessed when site plans are available. When warranted, a potential interim lane configuration, to bridge Year 2022 and build-out configurations, is summarized in **Table 24**.

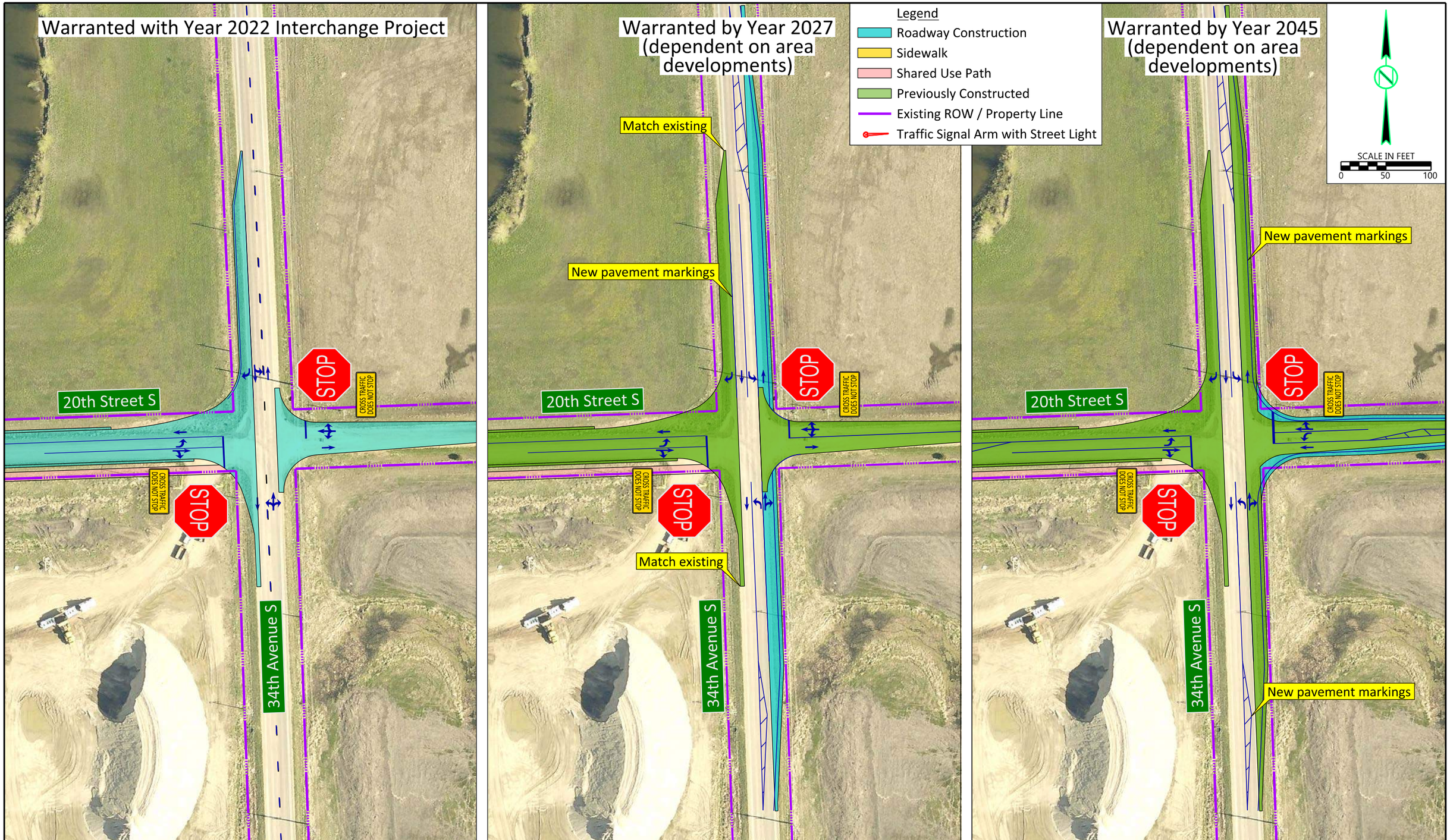
Table 24: 20th Street South/34th Avenue Intersection – Potential Interim Lanes (Dependent on Future Development)

Approach	Lanes	Notes	Traffic Control
SB	LT, T, RT	New: LT lane in conjunction with opposing warranted NB LT lane.	TWSC.
NB	LT, T/RT	New: Warranted LT lane.	
EB	LT, T/RT	-	
WB	LT/T/RT	-	

Table 25 represents the minimum build-out lane configuration for the 20th Street South/34th Avenue intersection to meet this study's 2045 LOS goals.

Table 25: 20th Street South/34th Avenue Intersection – Recommended Build-Out Lanes

Approach	Lanes	Notes	Traffic Control
SB	LT, T, RT	-	TWSC. *Consider alternative traffic control if warranted (AWSC, traffic signal, roundabout)*
NB	LT, T/RT	-	
EB	LT, T/RT	-	
WB	LT/T/RT	Low volume approach. Turn lanes not required to meet LOS goals, but consider LT lane in conjunction with EB LT lane.	



Drawn By: B.Miller
Date: 8/3/2020
Chked By: J.Unruh
Date: 8/3/2020
Revision: 8/28/2020

20th Street S / 34th Avenue S Intersection
Phased Improvements
I-29 Exit 130 (20th Street S) Interchange IJR
Brookings, SD

Figure
40

Crossroad Corridor Segment LOS Summary

Interchange crossroad corridors of 6th Street, 20th Street South, and 217th Street/SD 324 were analyzed with multimodal considerations, including vehicular, pedestrian, and bicycle traffic when supported by HCS7 modules.

The corridors were analyzed using either HCS7 Streets Module when traffic signals are/will be present at bookend intersections or HCS7 Two-Lane Highway Module (2019 release) for 2-lane highway segments where traffic signals are not/will not be present along the corridor.

Pedestrian and bicycle LOS measures are HCM6-developed 'scores' based on user perception of a facility and not a single measure of operations used in automobile analyses. The score incorporates several geometric and operational measures for travel along the corridor. One thing to note regarding bicycle LOS is that it is a score for on-street bicycle facilities, such as shoulders or bicycle lanes.

The following tables present multimodal LOS for the overall corridor facility, or series of segments between bookend intersections. Refer to the respective No Build or Build conditions **Appendix** for more information regarding individual segment LOS measures.

Table 26: 6th Street Corridor Multimodal Analysis Summary – Existing and No Build Conditions

Analysis Conditions	Multimodal Corridor Analysis Limits	Peak Hour	Direction	Facility LOS		
				Automobile LOS	Pedestrian LOS	Bicycle LOS
2020 Existing *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	C	C	C
			WB	C	C	C
		PM	EB	C	C	C
			WB	C	C	C
2022 No Build *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	B	C	C
			WB	B	C	C
		PM	EB	C	C	C
			WB	C	C	C
2045 No Build *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	C	C	C
			WB	C	C	C
		PM	EB	D	C	C
			WB	C	D	C

Table 27: 6th Street Corridor Multimodal Analysis Summary – Build Conditions

Analysis Conditions	Multimodal Corridor Analysis Limits	Peak Hour	Direction	Facility LOS		
				Automobile LOS	Pedestrian LOS	Bicycle LOS
2022 Build Overpass *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	B	C	C
			WB	B	C	C
		PM	EB	C	C	C
			WB	C	C	C
2045 Build Overpass *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	C	C	C
			WB	C	C	C
		PM	EB	C	C	C
			WB	C	C	C
2022 Build Interchange *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	B	C	C
			WB	B	C	C
		PM	EB	C	C	C
			WB	C	C	C
2045 Build Interchange *Signalized Streets Corridor*	22nd Avenue to 32nd Avenue	AM	EB	C	C	C
			WB	C	C	C
		PM	EB	C	C	C
			WB	C	C	C

Green shading: Build condition maintains or improves analysis LOS measure when compared to No Build.

Table 28: 20th Street South Corridor Multimodal Analysis Summary – Build Conditions

Analysis Conditions	Multimodal Corridor Analysis Limits	Peak Hour	Direction	Facility LOS		
				Automobile LOS	Pedestrian LOS (a)	Bicycle LOS (b)
2022 Build Overpass *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	A
			WB	A	-	A
		PM	EB	A	-	A
			WB	A	-	B
2045 Build Overpass *Signalized Streets Corridor (d)*	22nd Avenue to 34th Avenue	AM	EB	A	C	D
			WB	B	C	C
		PM	EB	A	C	C
			WB	B	C	D
2022 Build Interchange 1-2 *Signalized Streets Corridor*	22nd Avenue to SPI (c)	AM	EB	B	C	C
			WB	B	C	C
		PM	EB	B	C	C
			WB	B	C	C
2045 Build Interchange 1-2 *Signalized Streets Corridor*	22nd Avenue to SPI (c)	AM	EB	C	D	D
			WB	C	C	D
		PM	EB	B	C	D
			WB	C	D	D
2022 Build Interchange 3-5 *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	B – D
			WB	A	-	A – B
		PM	EB	A	-	A – B
			WB	A	-	B – D
2045 Build Interchange 3-5 *Signalized Streets Corridor*	22nd Avenue to 34th Avenue	AM	EB	B	D	D
			WB	C	C	D
		PM	EB	B	C	D
			WB	C	C	D

(a) Pedestrian LOS not measured in HCS7 two-lane highway module.
(b) For two-lane highway bicycle LOS on corridors with multiple segments, a range of segment LOS scores is presented. HCS7 does not provide an overall facility Bicycle LOS score.
(c) Signalized segment extends between two bookend signalized intersections at 22nd Avenue and the SPI main intersection.
(d) Corridor also analyzed as two-lane highway for scenarios with TWSC or roundabout 34th Avenue intersection. See HCS pdfs in the Appendix.

Table 29: 217th Street/SD 324 Corridor Multimodal Analysis Summary – Existing and No Build Conditions

Analysis Conditions	Multimodal Corridor Analysis Limits	Peak Hour	Direction	Facility LOS		
				Automobile LOS	Pedestrian LOS (a)	Bicycle LOS (b)
2020 Existing *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	A – E
			WB	A	-	B – E
		PM	EB	A	-	A – D
			WB	A	-	A – E
2022 No Build *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	A – E
			WB	A	-	B – E
		PM	EB	A	-	A – D
			WB	A	-	A – E
2045 No Build *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	B	-	B – E
			WB	B	-	D – E
		PM	EB	A	-	A – E
			WB	B	-	B - E

(a) Pedestrian LOS not measured in HCS7 two-lane highway module.
(b) For two-lane highway bicycle LOS on corridors with multiple segments, a range of segment LOS scores is presented. HCS7 does not provide an overall facility Bicycle LOS score.
Bicycle LOS E measured on the west end of 217th Street where there is higher volumes and a narrow shoulder.

Table 30: 217th Street/SD 324 Corridor Multimodal Analysis Summary – Build Conditions

Analysis Conditions	Multimodal Corridor Analysis Limits	Peak Hour	Direction	Facility LOS		
				Automobile LOS	Pedestrian LOS (a)	Bicycle LOS (b)
2022 Build Overpass *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	A – E
			WB	A	-	B - E
		PM	EB	A	-	A – D
			WB	A	-	A – E
2045 Build Overpass *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	B – E
			WB	B	-	D – E
		PM	EB	A	-	A – E
			WB	B	-	B – E
2022 Build Interchange *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	A – E
			WB	A	-	B – E
		PM	EB	A	-	A – D
			WB	A	-	A – E
2045 Build Interchange *Two-Lane Hwy Corridor*	22nd Avenue to 34th Avenue	AM	EB	A	-	A – E
			WB	A	-	C – E
		PM	EB	A	-	A – D
			WB	A	-	C – E

Green shading: Build condition maintains or improves analysis LOS measure when compared to No Build.
(a) Pedestrian LOS not measured in HCS7 two-lane highway module.
(b) For two-lane highway bicycle LOS on corridors with multiple segments, a range of segment LOS scores is presented. HCS7 does not provide an overall facility Bicycle LOS score.

Key corridor-level multimodal analysis findings related to the proposed interchange improvements include:

- Constructing an I-29 interchange at 20th Street South provides the greatest benefit to multimodal corridor operations on 6th Street.
- When comparing Build interchange alternatives,
    - Alternatives 3, 4, and 5 provide slightly better automobile and pedestrian LOS when compared to the SPI alternatives 1 and 2.
    - There is minimal difference in multimodal facility measures between Build alternatives 3, 4, or 5.

I-29 Exit 130 (20th Street South) Interchange Year of LOS D Analysis

A supplemental analysis was conducted for each Build interchange alternative ramp terminal intersection to determine at what volume intersection operations would be expected to operate at LOS D. Per methods and assumptions established for this study, LOS D represents unacceptable ramp terminal intersection operations. An approximate timeframe for this volume was estimated from a straight-line forecasts between year 2022 and year 2045 Build interchange traffic volumes.

The following assumptions were incorporated in the analysis:

- 20th Street South maintained as a 3-lane corridor (1 through lane in each direction plus center left turn lane).
    - Right turn lanes added to SPI configuration; all interchange layouts have left and right turn lanes on 20th Street South when applicable.
- One left turn and one right turn lane maintained on the off-ramp approaches.
- Ramp terminal intersections are signalized.
- A ramp terminal intersection must exhibit LOS C or better for the overall ramp terminal intersection and LOS D or better for all individual movements.
    - If either of these two LOS thresholds are not achieved, the intersection is considered to have unacceptable operations.
- Next adjacent local network intersections may fail before ramp terminal intersections. This review focuses on ramp terminal intersections.

A summary of findings from this analysis is provided in **Table 31**. Associated HCS files are provided in **Appendix N.**

Table 31: I-29 Exit 130 Year of LOS C/D Threshold Analysis

Interchange Build Alternative	Ramp Terminal Intersection (RTI)	
	SB Year Range (peak hour)	**NB** Year Range (peak hour)
Build Alternatives 1-2	2065-2070 (AM) 2060-2065 (PM)	
Build Alternative 3	2075-2080 (AM)	2070-2075 (PM)
Build Alternative 4	2070-2075 (AM)	2080-2085 (PM)
Build Alternative 5	2075-2080 (AM)	2070-2075 (PM)

5-year range in which the LOS transitions from acceptable to unacceptable traffic operations.

Key findings from this analysis are as follows:

- Build interchange alternatives 1 and 2 (SPI) are expected to reach unacceptable operations first out of all interchange alternatives.
    - Signalization of a single, main intersection is the primary constraint.
- Build interchange alternatives 3, 4, and 5 year of LOS D is generally 5-20 years later than the SPI interchange alternatives.

- The earlier LOS D years can be attributed to a 20th Street South left turn movement at the northbound ramp terminal intersection needing protective-permissive phasing to achieve LOS goals.
  - This shortens the opposing through movement green time, which is typically the peak direction through movement.
  - Alt. 3 and 5: PM peak hour EB LT and WB through at the northbound ramp terminal intersection.
  - Alt. 4: AM peak hour WB LT and EB through at the northbound ramp terminal intersection.
- When a 20th Street South left turn movement does not dictate, the highest volume through movement entering a ramp terminal intersection was typically the first to reach capacity.
  - Alt. 3 and 5: EB through movement at the southbound ramp terminal intersection.
  - Alt. 4: WB through movement at the northbound ramp terminal intersection.
- Off-ramp turning movements are not generally high enough to significantly impact traffic operations through the interchange.

It can be concluded that the Build alternatives 3, 4, and 5 provide the greatest additional capacity within the recommended lane configurations. Amongst those three, the range of LOS C/D thresholds are fairly similar with the primary differentiator being when a higher volume 20th Street South left turn movement must turn left across the directional commute traffic in the peak hour.

3.4 Alternatives Analysis

The No Build condition and Build alternatives were analyzed and compared to determine which may be most suitable for meeting the project purpose and need. The areas of analysis and comparison are discussed in the following sections.

Conformance with Transportation Plans

Local and State transportation plans, including the Brookings Master Transportation Plan and the 2010 Decennial Interstate Corridor Study, have reviewed the feasibility of a full access I-29 interchange at 20th Street South. The 2040 Brookings Comprehensive Plan identifies an interchange at this location in support of addressing future travel demand and route connectivity needs in Brookings. The 2040 comprehensive plan also outlines goals for development and redevelopment along the 20th Street South and I-29 corridors and how an interchange at Exit 130 would support this development/redevelopment.

The City of Brookings was awarded BUILD grant funding for study, right-of-way, environmental, design, and construction of an interchange at I-29 Exit 130 (20th Street South). As part of the grant, the City of Brookings, Brookings County, and private business have committed to a local match for the project.

Compliance with Policies and Engineering Standards

Each Build alternative is based on the latest guidance from AASHTO, SDDOT, and FHWA and final design may be accomplished without conflict to geometric design standards. The Build

interchange alternatives provide I-29 interchange spacing of at least one mile in keeping with the relevant FHWA interchange spacing standards.

Safety

A predictive safety analysis was performed to analyze predicted crashes anticipated within the study area for the No-Build and Build alternatives. This analysis was based on principles and methods of the Highway Safety Manual using Interactive Highway Safety Design Model (IHSDM) software. The *Predictive Safety Analysis* technical memo can be found in **Appendix O** and presents a summary of the methodology and findings for the predicted safety performance analysis for the No Build and Build interchange alternatives.

Seven scenarios were evaluated with this predictive safety analysis including the No Build, two variations of a SPI (Build alternative 1 and 2), three variations of a partial cloverleaf (Build alternatives 3, 4, and 5), and an overpass with no interchange (Build alternative 6). The analysis limits for the predictive safety analysis extended from Exit 132 (6th Street) at the northern extent to Exit 127 (217th Street) at the southern extent. The opening year of the interchange is planned for year 2022 and the planning year of the interchange is year 2045. Thus, the evaluation period of the analysis was from year 2022 to year 2045.

A summary of predicted average annual crash frequencies for the six scenarios is presented in **Figure 1** and includes a breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes. Additional details regarding the predicted crashes at the different ramps, ramp terminals and freeway segments can be found in the *Predictive Safety Analysis* memorandum.

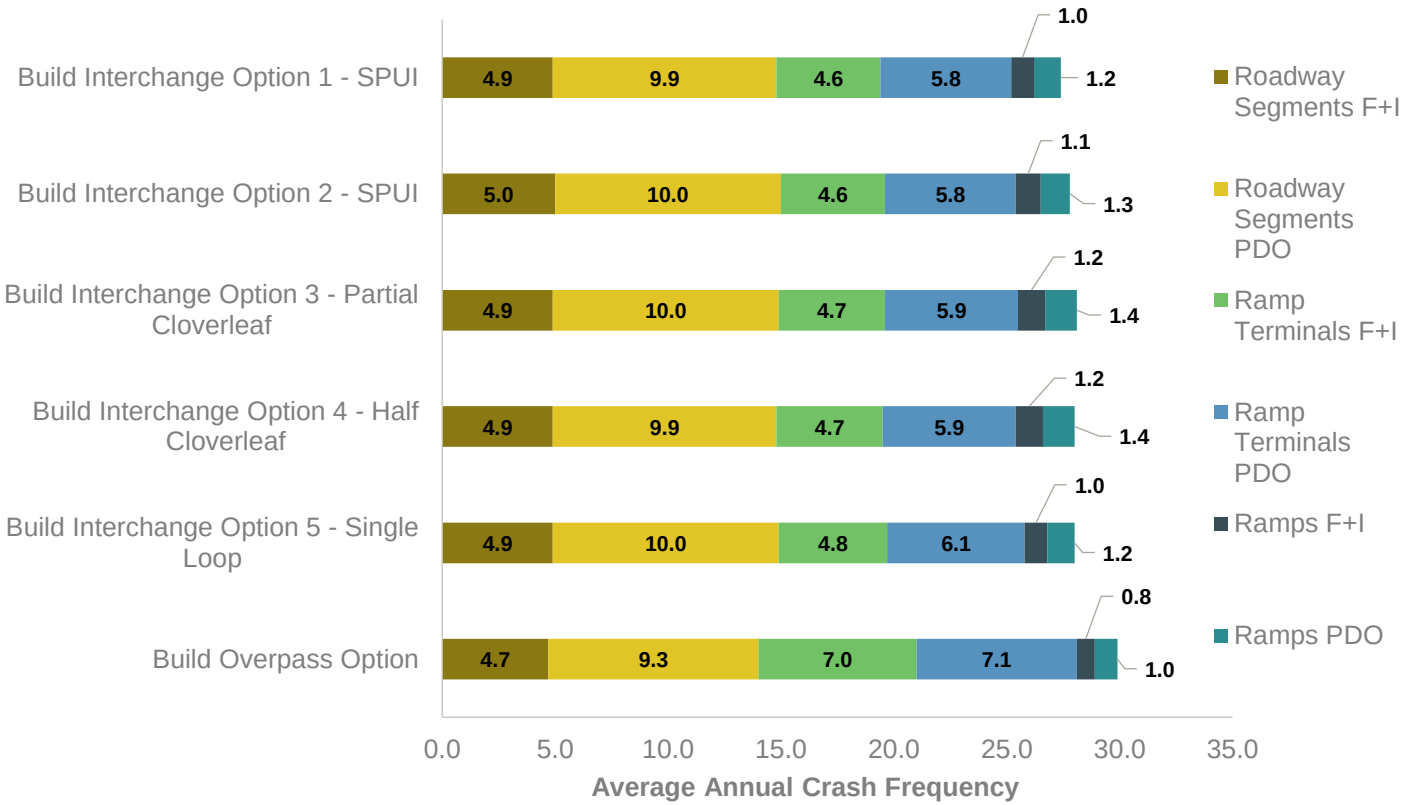


Figure 41: Predicted Average Annual Crash Frequencies (2022-2045)

The predicted average annual crash frequencies from the Build interchange alternatives ranged from 27.5 to 28.1 and the predicted crash totals ranged from 660 to 674 crashes between opening year of the proposed interchange (year 2022) to the planning year (year 2045). The predicted annual crash frequencies from the Build overpass alternative was 30 and the predicted crash total was 720 from 2022 to 2045. Compared to the No Build alternative, the reduction in predicted crashes for the Build conditions was:

- Build interchange alternatives: 72 to 86 fewer crashes
- Build overpass alternative: 26 fewer crashes.

This result can be attributed to the redistribution of traffic between the three interchanges, thereby alleviating the concentration of traffic at the existing cross streets and interchanges, most notably along 6th Street. The reduction in traffic along 6th Street was the difference between a two-way stop controlled intersection for the Build interchange alternatives and a signalized intersection in the No Build and Build overpass alternatives at the 6th Street southbound ramp terminal. For the No Build alternative, this increased the predicted annual average crash frequency at this intersection by 4.7 crashes per year, or a 65% higher crash frequency at this intersection than the Build interchange alternatives. For the Build interchange alternative, this increased the predicted annual average crash frequency at this intersection by 4.1 crashes per year, or a 56% higher crash frequency than the Build interchange options.

The SPI Build alternative 1 is predicted to result in the lowest average annual crash frequency with 27.5 crashes per year, a reduction of 11.6% compared to the No Build. The runner up was the SPI Build alternative 2 with a predicted average annual crash frequency of 27.7, a 10.9% reduction compared to the No Build. Moreover, the partial cloverleaf Build alternatives 3, 4, and 5 are predicted to have almost identical results with a total average crashes per year of 28.1, a reduction of 9.6% compared to the No Build. The SPI Build alternatives 1 and 2 are predicted to reduce the number of crashes by an additional 9 to 14 crashes compared to the partial cloverleaf Build alternatives 3, 4, and 5 over the evaluation period.

The Build overpass alternative 6 is projected to decrease the average number of crashes per year by roughly 4% during the planning evaluation period between 2022 and 2045, but is predicted have a less significant decrease in the crash frequency. Although the overpass does reduce the volume of expected traffic on the 6th Street Corridor, it does not realize the full potential of volume reduction on 6th Street as the proposed Build interchange alternatives.

All Build interchange alternatives are predicted to decrease the average number of crashes per year by roughly 10% to 12% during the planning evaluation period between 2022 and 2045. Based on the HSM analysis, it is concluded that all the build options are likely to exhibit similar overall crash frequencies and have an overall reduction in the number of crashes compared to the no-build option. The safety analysis does not suggest one of the Build interchange alternatives will be significantly safer than the other.

Operational Performance

The No Build alternative shows pockets of congestion in year 2045, primarily focused at the following locations:

- **6th Street/22nd Avenue Intersection:** LOS D in PM peak hour due to growing volumes on both 6th Street and 22nd Avenue. Queue lengths begin to push limits of available storage.
- **6th Street/I-29 Southbound Ramp Terminal Intersection:** Need for change in traffic control from stop sign to traffic signal due to growing volumes on 6th Street corridor.

- **6th Street/32nd Avenue Intersection:** 32nd Avenue northbound queues continue to grow during the PM peak hour with departing traffic from the industrial area.

The Build alternative traffic operations analysis indicates that the interstate mainline and ramp junction LOS between 217th Street/SD 324 and 6th Street would remain at a high level of service, regardless of the alternative employed. The 20th Street corridor will operate acceptably within LOS C goals as a 3-lane section (one lane in each direction plus a center left turn lane at major access points) between 22nd Avenue and 34th Avenue.

The Build overpass alternative 6 alleviates congestion shown in the 2045 No Build condition. However, it does not address all intersection queues that may potentially block specific movements at the 6th Street/22nd Avenue intersection. Further, this Build alternative does not reduce traffic demand at the I-29/6th Street interchange or provide additional connectivity to I-29 at 20th Street South.

The Build interchange alternatives provide the best operational results from a study area perspective when compared to the Build overpass alternative and No Build alternative. These Build alternatives are also accommodating greater traffic volumes than the No Build and Build overpass alternative due to the anticipated higher density development around the proposed I-29/20th Street South interchange. The 6th Street corridor operations are expected to meet LOS C goals and the proposed interchange configurations are anticipated to achieve acceptable operations through the 2045 planning horizon.

When comparing individual Build interchange alternatives, the primary difference is the SPI Build alternatives 1 and 2 require signalization of the main intersection upon opening. This creates immediate intersection delay for through and left turn movements due to the traffic signal. As this interchange is expected to exhibit low volumes for some time, particularly on the ramp approaches, the traffic signal may create unnecessary delay for vehicles. Another drawback is the estimated year of LOS C/D transition is sooner than the Build alternatives 3, 4, and 5 with a 3-lane 20th Street South corridor.

There is little operational difference between Build alternatives 3, 4, and 5 from an overall intersection and corridor LOS perspective. The southbound I-29 ramp terminal intersection configuration is the same across all three alternatives. While slight, the primary difference between these alternatives is left turn configurations at the northbound ramp terminal intersection. Build alternatives 3 and 5 have an eastbound left turn across westbound through traffic which contributes to traffic signal timing considerations and lowers the ceiling for LOS C/D transition by 5 years or so (applicable to both TWSC to signal needs as well as LOS C/D transition for a signalized intersection). Build interchange 5 is shown to likely be the first of these alternatives to reach those LOS C/D transition for a TWSC intersection.

The anticipated year of need for unsignalized intersection turn lane warrants, signalized intersection turn lane warrants, and traffic signal warrants were determined for 20th Street South intersections associated with each of the Build interchange alternative proposed Projects.

Specific to a proposed interchange, key findings include:

- SPI Build alternatives 1 and 2 main SPI intersection
    - EB and WB right turn lanes not needed to meet operational goals.
    - Splitting off-ramp turning movements into left and right turn lanes provides operational benefits.
- Build alternatives 3, 4, and 5 ramp terminal intersections
    - EB and WB left and right turn lanes warranted with unsignalized intersection conditions.

  - Splitting off-ramp turning movements extends operational acceptability as a TWSC intersection.
  - Both ramp terminal intersections are anticipated to function acceptably through much of the planning horizon as TWSC intersections.
- 20th Street South corridor intersections
  - 22nd Avenue/20th Street South intersection: WB right turn lane needed in year 2045 with a signalized intersection and 2022 as TWSC intersection.
  - 34th Avenue/20th Street South intersection: EB left turn lane needed to provide a separate lane for the predominant movement from EB right turn traffic.

Other lane needs on the 20th Street South bookend intersections include:

- 22nd Avenue
  - SB left turn lane (and maintaining SB right turn lane) and NB left turn lane warranted in 2022 (opening of interchange) with unsignalized conditions.
  - Traffic signal warrants likely to be met within 10 years of interchange project completion.
  - The 22nd Avenue approaches are planned to be built-out in the future as part of the overall 22nd Avenue corridor reconstruction project.
- 34th Avenue
  - SB right turn lane warranted in 2022 (opening of interchange) with unsignalized conditions.
  - NB left turn lane warranted within 5-10 years of 2022 (opening of interchange) with unsignalized conditions. SB left turn lane is recommended for inclusion to balance the intersection geometrics.
  - A roundabout at this intersection provides the greatest long-term accommodation of traffic volumes without a need to modify traffic control or add turn lanes.
  - Traffic signals not anticipated to be warranted until closer to the 2045 planning horizon and the 34th Avenue and 20th Street South corridors are further developed.

Environmental Impacts

The environmental evaluation compares the impacts of Build alternatives from the 20th Street South project's area of potential impact. The preliminary environmental impacts of each Build alternative are summarized in **Table 32**.

Table 32: Environmental Screening Summary

Alt. No.	Meet P & N?	Section 4(f) Acquisition	Section 6(f) Acquisition	Westland/ Other Waters of US	Noise Analysis	Cultural Resources	Env. Justice	Floodplain	Residential Acquisition	Acquisition of Property
1	Yes	Yes	Yes	Low	Low	Low	None	Low	5	Low
2	Yes	Yes	Yes	Low	Low	Low	None	Low	5	Low
3	Yes	No	No	High	Low	Low	None	Low	5	Med
4	Yes	No	No	Low	Low	Low	None	Low	5	High
5	Yes	No	No	Low	Low	Low	None	Low	5	Med
6	**No**	---	---	---	---	---	---	---	---	---

The following summarizes findings from the environmental screening:

- Build alternative 6 does not meet the purpose and need criterion for traffic capacity.
- For Section 6(f), Alternatives 1 and 2 would require a Conversion of Use process for incorporation of recreational land into transportation ROW. The process would require the Section 6(f) property converted to non-recreational area to be replaced in-kind. In addition, the process would require proof that all practical alternatives to the conversion have been evaluated and rejected on a sound basis.
- Build alternative 3 would impact a wetland created for mitigation. Impacting a mitigated wetland can be difficult to permit if alternatives exist that can avoid the alternative. In addition, the alternative would have over 2 acres of impact to a large jurisdictional pond.
- Build alternative 4 requires additional acquisition of private property, more than double the area that Alternative 5 requires. Alternative 4 and 5 provide the same level of functionality and improvement to the transportation system and have similar impacts to environmental resources. However, Alternative 4 requires an unjustified additional amount of ROW needed when compared to Alternative 5.
- Build alternative 5 exhibits the least environmental impact of all Build alternatives.

Additional information regarding environmental impacts is provided in **Appendix P**.

Evaluation of Alternatives

Each Build alternative was evaluated on how they compare with the other Build and No Build alternatives and whether they met study goals. This evaluation, shown in **Table 33**, is summarized through the following numbering/color coding in the evaluation matrix.

- **'5' and '4' Bold Green** text indicates a Build Option measure was favorable compared to the other Build Options in a category. An underlined **5** indicates the best alternative within a given category.
- '3' Black text indicates a Build Option measure was in the middle compared to other Build Options in a category. This measure indicates that the alternative may have flaws that would require careful consideration for it to move forward in the study process.
- **'1' and '2' Bold Red** text indicates a Build Option measure was unfavorable compared to the other Build Options in a category, the measure does not meet study goals, or has critical flaws.

Table 33: Evaluation Matrix

Alternative	Conformance with Plans	Compliance with Standards	Operational Performance	Safety	Environmental Screening
No Build	**1**	**5**	**1**	3	**5**
Build Interchange Alt. 1	**5**	**5**	**4**	**5**	**2**
Build Interchange Alt. 2	**5**	**5**	**4**	**5**	**2**
Build Interchange Alt. 3	**5**	**5**	**5**	**5**	3
Build Interchange Alt. 4	**5**	**5**	**5**	**5**	3
Build Interchange Alt. 5	**5**	**5**	**5**	**5**	**4**
Build Overpass Alt. 6	3	**5**	2	**4**	**1**

The Build overpass alternative does not realize full conformance with City of Brookings planning documents for an I-29 interchange at 20th Street South. While it does address some of the concern with 6th Street corridor traffic, the Build overpass alternative 6 does not reduce traffic demand at adjacent interchanges or provide the desired system linkage for existing and future development along the I-29 corridor. The Build interchange alternatives better align with Brookings area planning documentation when compared to the No Build and Build overpass alternatives.

From an operations and safety standpoint, all proposed Build interchange alternatives meet the required traffic operations MOEs and reduce crash frequency compared to the No Build alternative through the planning horizon. All are expected to provide notable improvements to long-term 6th Street corridor operations and improve overall safety within the study area. The Build overpass alternative 6 is expected to provide the least operational benefit to the 6th Street corridor of all Build alternatives. Fewer vehicles are expected to change their route to 20th Street South if only an overpass is constructed and thus there are long-term 6th Street intersection LOS drawbacks to this alternative.

The slight operational difference that supports Build alternatives 3, 4, and 5 is the intersection traffic control flexibility afforded to the ramp terminal intersections to grow with traffic volumes. The SPI requires a traffic signal upon installation and thus initiates signal-induced delay on traffic that is expected to exhibit low volumes for several years. This can create situations of driver frustration for 20th Street South corridor traffic and lead to safety issues with running red lights and queued traffic. With Build alternatives 3, 4, and 5, however, the ramp terminal intersections can start with stop-controlled off-ramp approaches and provide free movements for the higher volume east/west 20th Street South corridor traffic. Delay, as shown in the operations analysis, is expected to be minimal for the off-ramp volumes for several years. Long-term, the SPI Build alternatives 1 and 2 are shown to have a lower ceiling in the transition from LOS C to LOS D when compared to the other three Build interchange alternatives.

The environmental screening column summarizes categories previously presented in **Table 32** and discussed in the respective section. Given the many similarities in operational performance and safety across the Build interchange alternatives, the environmental impacts provide the greatest support for recommending a Build alternative to be carried forward. The following highlights key environmental categories where differentiation occurs and subsequent elimination of Build alternatives. The Environmental Assessment document provides additional information on the respective categories and environmental screening.

- Build alternative 6 does not meet the purpose and need criterion for traffic capacity. Therefore, Alternative 6 is eliminated from further consideration.
- For Section 6(f), Build alternatives 1 and 2 would require a Conversion of Use process for incorporation of recreational land into transportation ROW and thus are proposed to be eliminated from further consideration.
- Build alternative 3 would impact a wetland created for mitigation and is therefore proposed to be eliminated from further consideration.
- Build alternative 4 requires additional acquisition of private property, more than double the area that Alternative 5 requires. Build alternatives 4 and 5 provide the same level of functionality and improvement to the transportation system and have similar impacts to environmental resources. Due to the similarity in improvement to the transportation system, Build alternative 4 is proposed to be eliminated because of the unjustified additional amount of ROW needed.

Based on the environmental screening, Build alternative 5 is recommended to be carried forward with the No Build alternative for further consideration.

Coordination

Stakeholder and public coordination has been ongoing since an interchange was first introduced as part of the 2011 Brookings Area Master Transportation Plan. A summary of public engagement through previous studies to date is as follows (not all encompassing).

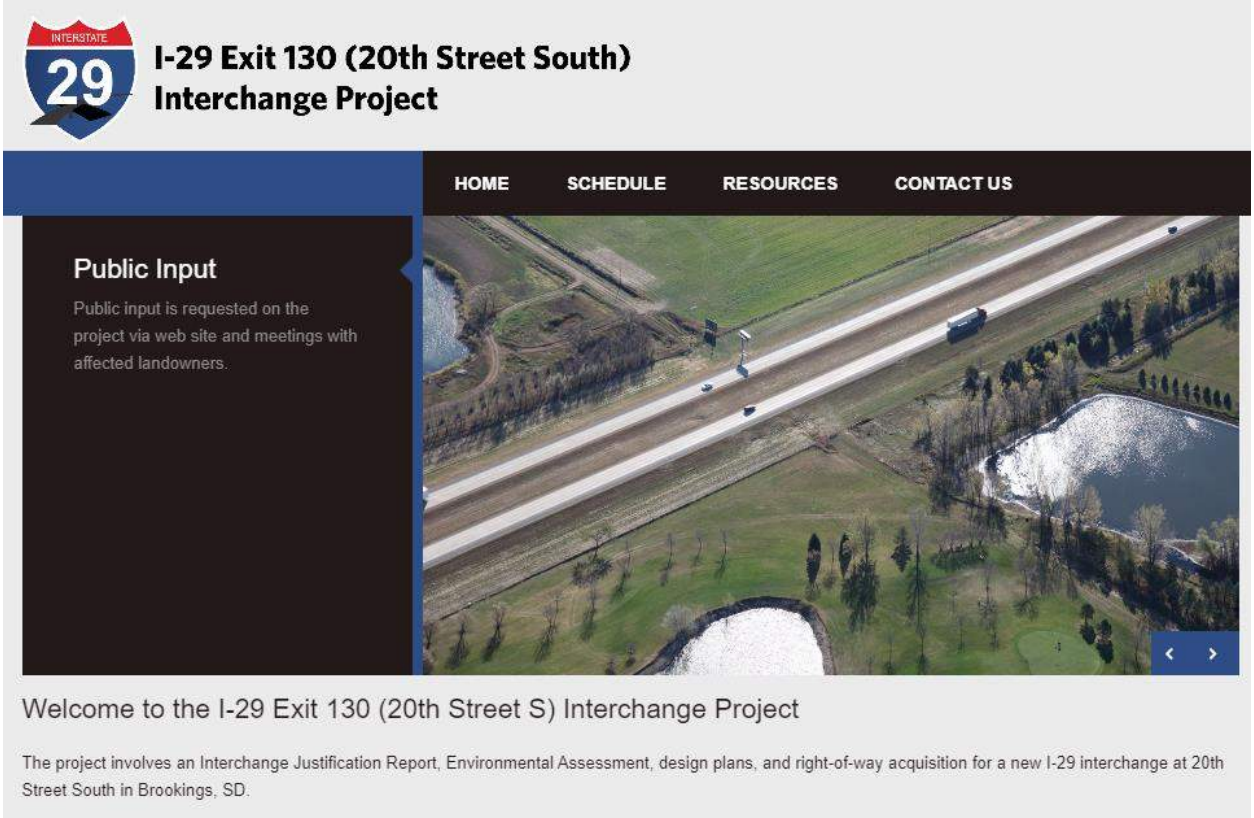
- Vision 2020 – Comprehensive Plan for the City of Brookings.
- 2011 Brookings Area Master Transportation Plan – public and stakeholder meetings as part of the study.
- 2016 Interstate Access Study – stakeholder discussions through Brookings Economic Development Corporation.
- 2018 22nd Avenue Corridor Study – presentation of recommendations to Brookings City Council, which included the 20th Street South/22nd Avenue intersection. Traffic forecasts used in this study considered a future 20th Street South interchange with I-29.
- 2040 Brookings Comprehensive Plan – public meetings and workshops in conjunction with development of the plan.

Specific to this interchange justification study, there are three sets of public and landowner meetings planned as follows:

- Public/landowner meetings #1: project purpose and need.
    - Website and public meeting presentation were released on April 20, 2020. (No public meeting was held due to COVID-19 restrictions.)
    - Landowner meetings (virtual) were held on April 20 and 21, 2020.
- Public/landowner meetings #2: in conjunction with release of the draft EA, including the recommended alternative.
    - Planned October/November 2020
    - Due to continued COVID-19 restrictions, meetings will again be virtual.
- Public meeting #3: FONSI release
    - Planned November 2020 (if necessary pending EA comments).

The first public meeting was held online on April 20, 2020, in conjunction with the website launch. A pre-recorded presentation was available introducing the project and presenting transportation-related needs in the study area. Public comments received from this meeting were typically in support of the project. There were several questions and suggestions related to EdgeBrook Golf Course impacts. A summary of comments and responses is provided in the Environmental Assessment document.

A project website (https://www.20thstinterchange.com/) has been created to provide information to and gather feedback from the public and project stakeholders. A screenshot of the main page is shown in **Figure 42**.



https://www.20thstinterchange.com/

Figure 42: I-29 Exit 130 (20th Street South) Interchange Project Website

3.5 Conceptual Signing Plan

A conceptual signing plan for each design alternative is provided in **Appendix Q**.

4.0 Funding Plan

The City of Brookings' Bridging the Interstate Divide, 20th Street South Interchange Project, BUILD grant application outlined anticipated costs and funding commitments to complete the Project. The use of funds were identified for the tasks of design and engineering, ROW acquisition, permitting, wetland mitigation, construction engineering, and construction. Costs and funding sources identified in the grant agreement are summarized as follows:

Anticipated Project Cost: $23,347,037

Funding Sources

1. Base Phase (Preliminary Engineering, ROW, and Utility Relocation) Eligible Costs

BUILD Funds :	$	2,260,000.00
Local Funds (City of Brookings and Brookings County):	$	565,000.00
Total:	$	2,825,000.00

2. Option Phase 1 (Construction, Construction Engineering, and Wetland Mitigation) Eligible Costs

BUILD Funds	$	16,417,630.00
Other Federal Funds	$	-
State Funds	$	-
Local Funds (City of Brookings and Brookings County):	$	3,435,000.00
Other Funds (Private Donors):	$	669,407.00
Total:	$	20,522,037.00

Based on the Preliminary Design Inspection plans dated August 12, 2020 (approximately 30% plans), the estimated cost for construction only is $18.5M.

5.0 Recommendation

The technical analysis contained in this Interchange Justification Report has found that Build alternative 5, the single loop interchange, provides the best technical solution for transportation needs in the study area. Alternative 5 interchange also provides operations and safety improvements to the local street system.

The two considerations and requirements for the Interstate access are addressed below:

1. **An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate**

facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

The operational and safety analysis contained in this study shows that Build alternative 5, single loop interchange, is not expected to adversely affect the safety or efficiency of the Interstate system.

The study area extends from Exit 127 to Exit 132 on I-29. The local street network corridors of 6th Street, 20th Street South, and 217th Street/SD 324 between 22nd Avenue South and 34th Avenue South are also included in the study.

The No Build alternative and six Build alternatives were reviewed for operational capacity using Highway Capacity Manual 6th Edition methodology and Highway Capacity Software, version 7. All interchange Build alternatives achieve LOS C in the 2045 Planning Horizon at all intersections, along arterial corridor segments, and along Interstate segments within the study area. While the Build overpass alternative 6 improves traffic operations when compared to the No Build condition, it does not achieve LOS C at the 22nd Avenue/6th Street intersection. The No Build condition does not meet LOS C at the 22nd Avenue/6th Street intersection.

Build alternatives 3, 4, and 5 provide greater operational benefit when compared to Build alternatives 1 and 2. For 1 and 2, a single point interchange requires signalization upon opening and thus introduces signal delay to 20th Street South corridor traffic. This delay would not be experienced in Build alternatives 3, 4, and 5 because traffic signals are not shown to be needed until the latter years of the 2045 Planning Horizon. Further, Build alternatives 3, 4, and 5, are expected to provide LOS C or better ramp terminal intersection operations farther into the future than Build alternatives 1 and 2.

All Build alternatives were found to improve safety within the study area when compared to the No Build alternative. The Build alternative 6 provided the least reduction in crashes, approximately four percent, of all Build alternatives. Build alternative 5 is expected to reduce crashes by approximately 9.6 percent.

In summary, a new I-29 interchange at 20th Street South is expected to provide the following benefits to Brookings area traffic:

- *Reduce traffic demand along the 6th Street corridor.*
- *The Build interchange alternatives meet LOS goals at all study intersections, while the No Build and Build overpass alternatives do not without further modifications.*
- *Provide additional connectivity between Brookings area development west and east of I-29.*
- *This is of particular importance for commute traffic as 20th Street South will provide efficient connectivity between residential developments in the southern half of Brookings west of I-29 with employment centers east of I-29.*
- *Provide additional connectivity between Brookings and I-29, particularly for existing and future development south of 6th Street and east of I-29.*
- *Foster development along the I-29 and 20th Street South corridors.*

Managed access as part of this proposed project will provide 660 feet controlled access along 20th Street South extending outward from the ramp terminal intersections. The first local network intersection beyond the ramp terminal intersections are pending, but 900 feet is shown in ***Figure 43****.*

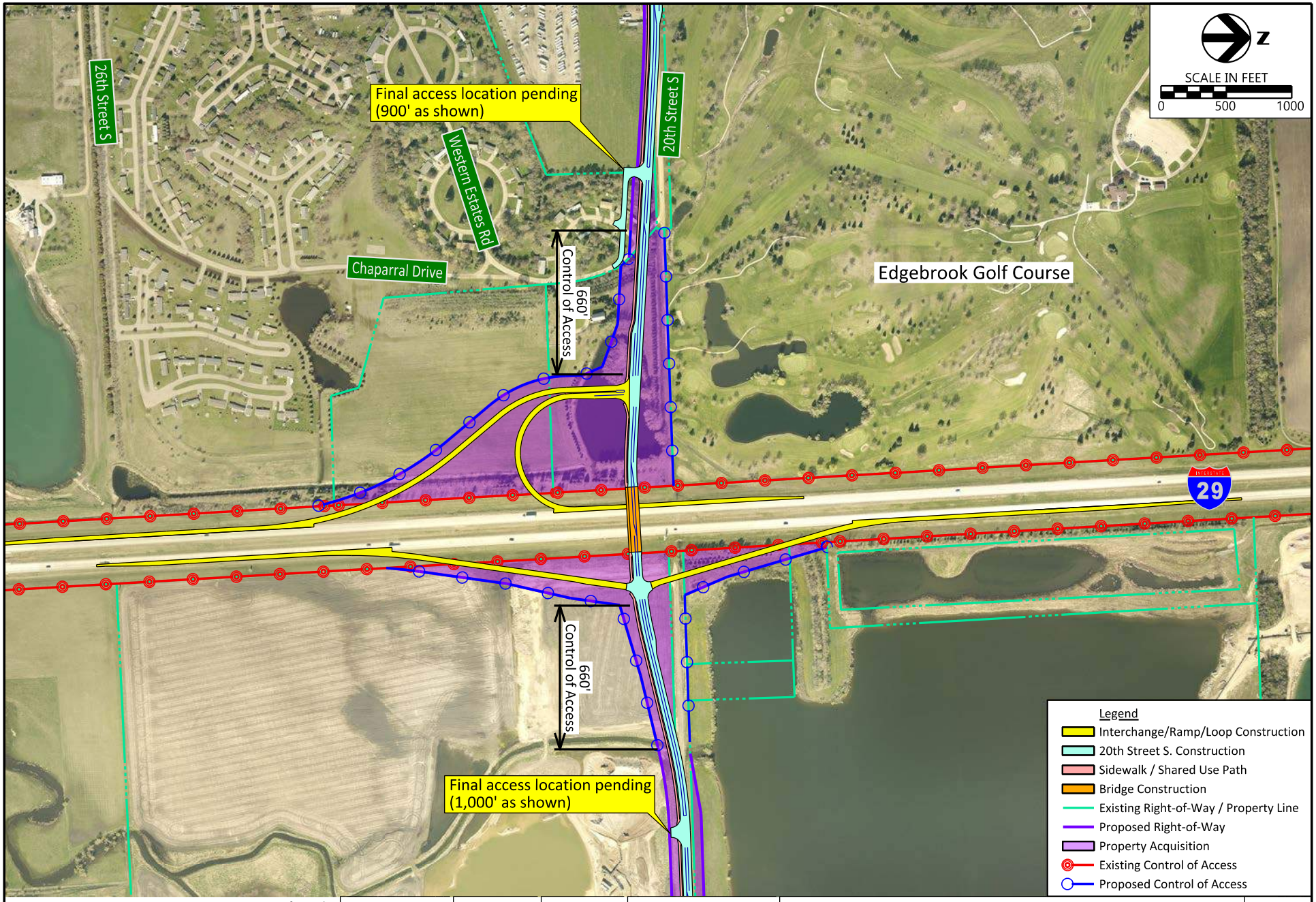
20th Street South corridor Improvements required to the local network include:

- *Reconstruction of 20th Street South corridor to provide a paved roadway and bicycle/pedestrian connectivity through the interchange, between 22nd Avenue and 34th Avenue (the next adjacent north/south arterial roadways).*
- *Reconstruction of 22nd Avenue intersection and 34th Avenue intersection through phased improvements. The incremental build-out will address anticipated traffic volume increases and changes in traffic patterns through the 2045 Planning Horizon.*
    - *22nd Avenue*
        - *Year of Opening: restripe southbound approach to provide LT, T, RT configuration. Add northbound LT lane to provide LT, T/RT configuration. Construct WB approach to provide LT, T, RT configuration. Maintain existing eastbound LT, T/RT configuration. Signalize intersection.*
        - *Build-out when warranted to match recommendations from City of Brookings 22nd Avenue Corridor Study.*
    - *34th Avenue*
        - *Year of Opening: construct eastbound approach to provide LT, T/RT configuration. Add southbound RT lane to provide LT/T, RT configuration. Maintain shared lane for westbound and northbound approaches. Stop-control the eastbound and westbound approaches.*
        - *Build-out when warranted to address traffic growth, may include: addition of northbound/southbound LT lanes, splitting the westbound shared lane to include a separate LT, T/RT configuration, and reviewing traffic control.*

A conceptual signing plan for the recommended Build alternative 5 is displayed in **Figure 44***. A conceptual signing plan has been development and included in* ***Appendix Q*** *for each additional Build alternative.*

2. ***Access from Public Road Access and Traffic Movements Provided:*** **The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

The proposed access is a configuration of an interchange with full access to an arterial city street and includes all movements. The conceptual drawings have been prepared using current standards and further design using current standards is anticipated. Additional refinement will take place during the environmental and design phases of the project.



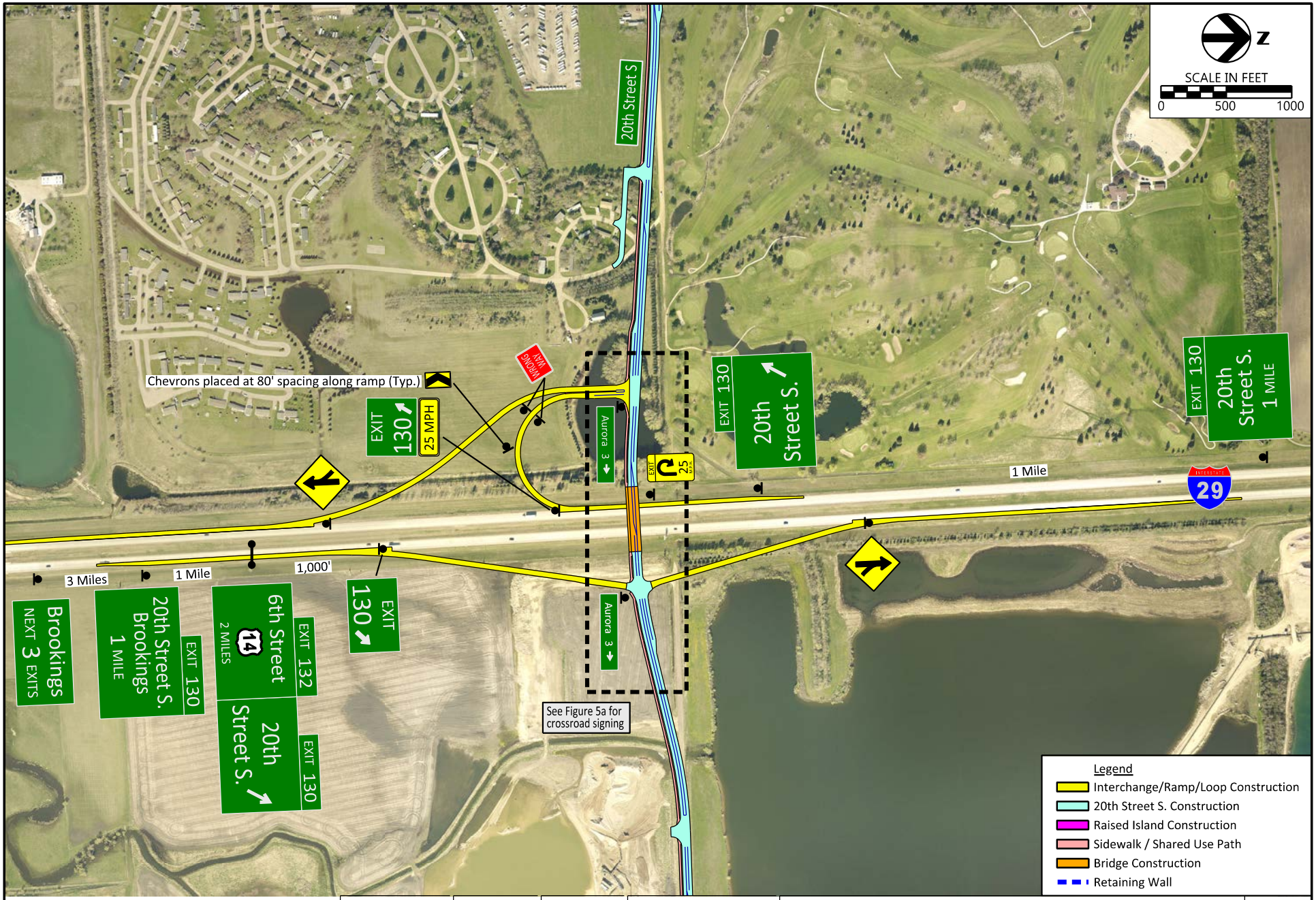
Date of aerial photography: 2019

Drawn By: B.Miller
Date: 9/1/2020
Chked By: J.Unruh
Date: 9/1/2020
Revision:

Alternative 5 - Single Loop Interchange Recommended Alternative

I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

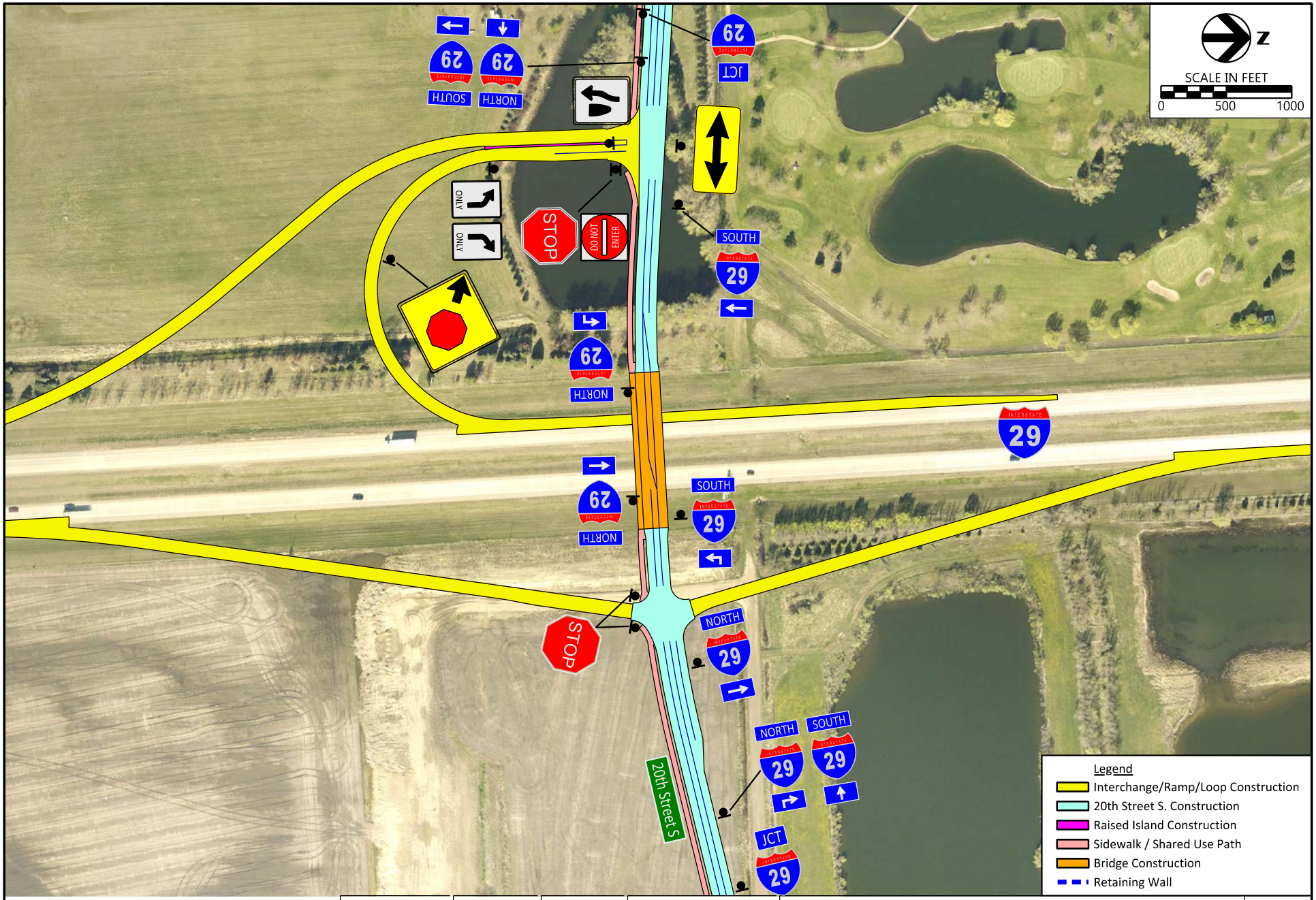
Figure 43



Drawn By: B.Miller
Date: 5/1/2020
Chked By: J.Unruh
Date: 5/1/2020
Revision: 10/15/2020

I-29 Conceptual Signing Plan
Alternative 5 - Single Loop Interchange
I-29 Exit 130 (20th Street S) Interchange IJR — Brookings, SD

Figure 44a



Drawn By: B.Miller
Date: 5/1/2020
Chked By: J.Unruh
Date: 5/1/2020
Revision: 10/15/2020

Crossroad Conceptual Signing Plan - Alternative 5

I-29 Exit 130 (20th Street S) Interchange IJR

Brookings, SD

Figure 44b

Appendix

A. **Methods and Assumptions Document**
B. **Traffic Forecasting Adjustments to Brookings Travel Demand Model Output Technical Memo**
C. **Existing Interchange Aerials**
D. **Level of Service Threshold Tables**
E. **2020 Existing Conditions HCS Reports**
F. **Historical Crash Data**
G. **Traffic Forecasting Process Summary**
H. **2045 Planning Horizon HCS Reports – No Build Conditions**
I. **2045 Planning Horizon HCS Reports – Build Overpass Conditions**
J. **2045 Planning Horizon HCS Reports – Build Interchange Conditions**
K. **2022 Year of Completion HCS Reports – No Build Conditions**
L. **2022 Year of Completion HCS Reports – Build Overpass Conditions**
M. **2022 Year of Completion HCS Reports – Build Interchange Conditions**
N. **20th Street South Intersection and Interchange Build Condition Year of Need Tables and HCS Reports**
O. **Predictive Safety Analysis Technical Memo**
P. **Environmental Analysis Memorandum**
Q. **Conceptual Signing Plans**