Exit 60 – I-90 Interchange Modification Justification Study

Introduction

Exit 60 is a partial interchange providing a connection between I-90 and East North Street (US 16B) in Rapid City. Figure 1 shows the location of Exit 60. The existing configuration does not provide access to north of the interchange, and it does not provide for the westbound on to I-90 movement from East North Street. Access to I-90 west is provided by a westbound on-ramp only on Dyess Avenue located east of Exit 60. The proposed interchange modification would replace the existing partial interchange at Exit 60 with a full movement interchange. The overpass and westbound on-ramp at Dyess Avenue would be removed. The result would be a more efficient interchange that would improve operational service of both the interstate and East North Street.

This study addresses the policy requirements for new or revised access points to the existing Interstate system published in the Federal Register Volume 63 Number 28 February 11, 1998.

1. The existing interchanges and/or local roads and streets in the corridor can neither provide the necessary access nor be improved to satisfactorily accommodate the design year traffic demands while at the same time providing the access intended by the proposal.

Figure 2 shows the existing configuration of Exit 60. The 2001 Interstate Corridor Study reviewed the existing interchange characteristics. Existing geometric features were reviewed using the as-built plans for this interchange. Some of the geometric deficiencies for the interchange include the sag k-value, which relates to headlight sight distance and is substandard for the westbound on ramp from Dyess Avenue. The taper rates for the westbound off ramp and eastbound on ramp to Interstate 90 were also found to be inadequate. The structure for eastbound Interstate 90 that crosses the westbound off ramp has a substandard width. Some deficiencies were also discovered with Dyess Avenue, such as substandard crest k-values and flat vertical grades. These deficiencies are relative to current design standards and practices.

The Corridor Study also identified Exit 60 as a high accident location with most of the crashes occurred during wet, icy, or snow-packed roadway conditions. Investigation of detailed accident reports indicated a large number of crashes on the eastbound I-90 Bridge over East North Street. Several crashes involved losing control during slippery roadway conditions at the westbound off-ramp to East North Street.

Figure 3 shows the existing traffic capacity analysis.

FIGURE 1

Project Location

I-90 - Exit 60 - Rapid City, S. D.

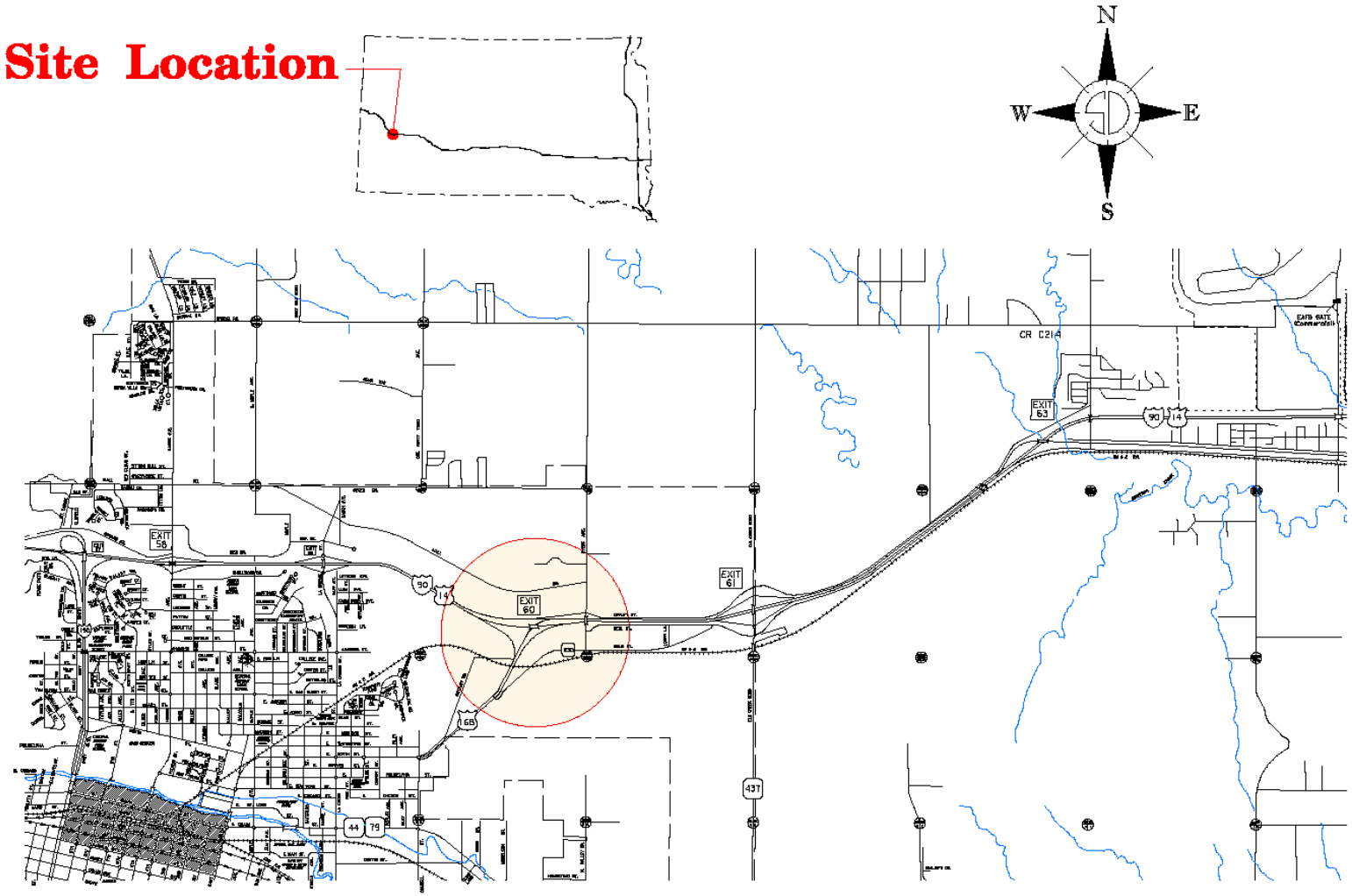


FIGURE 2

Existing Configuration

I-90 - Exit 60 - Rapid City, S. D.

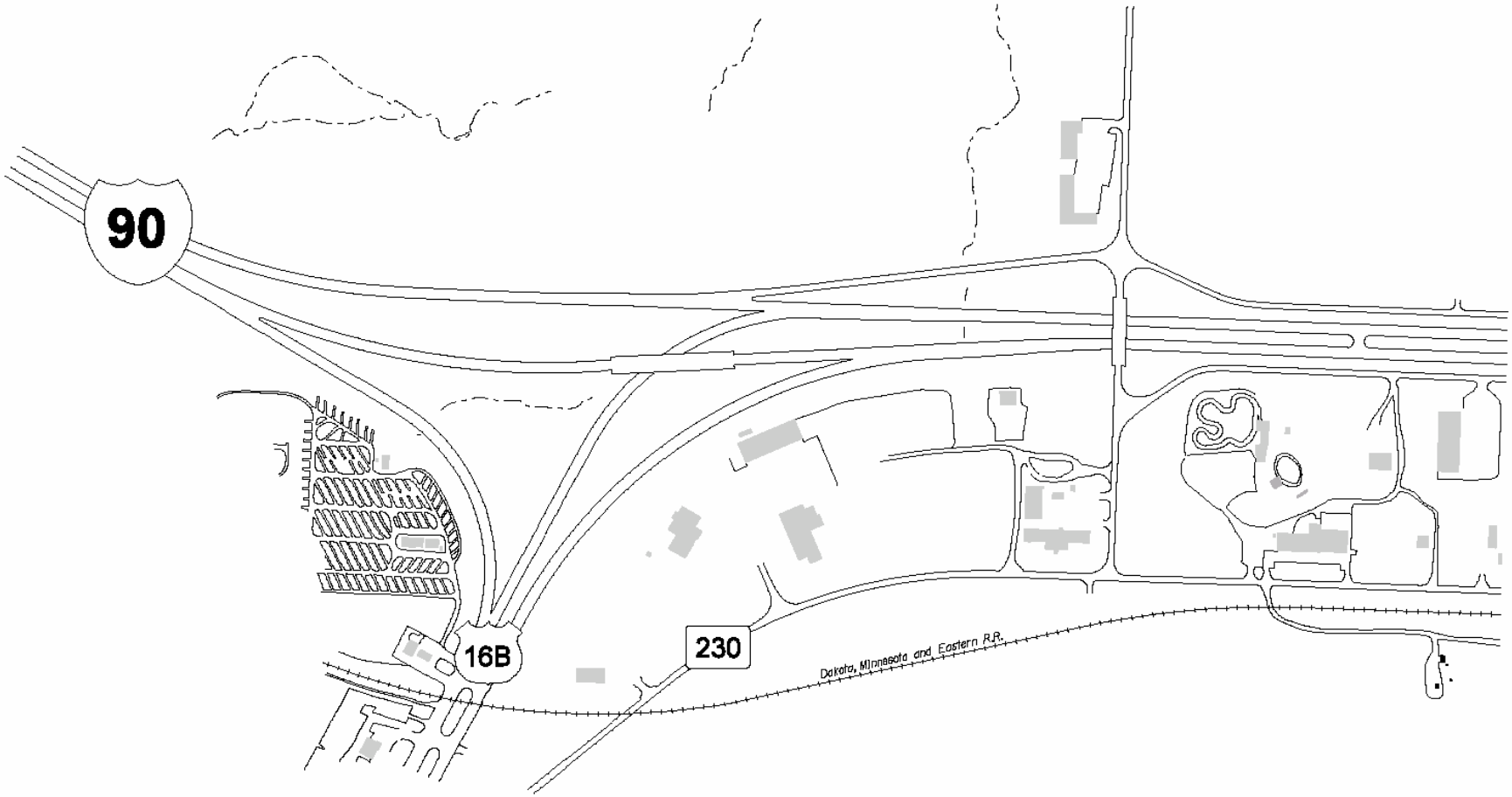
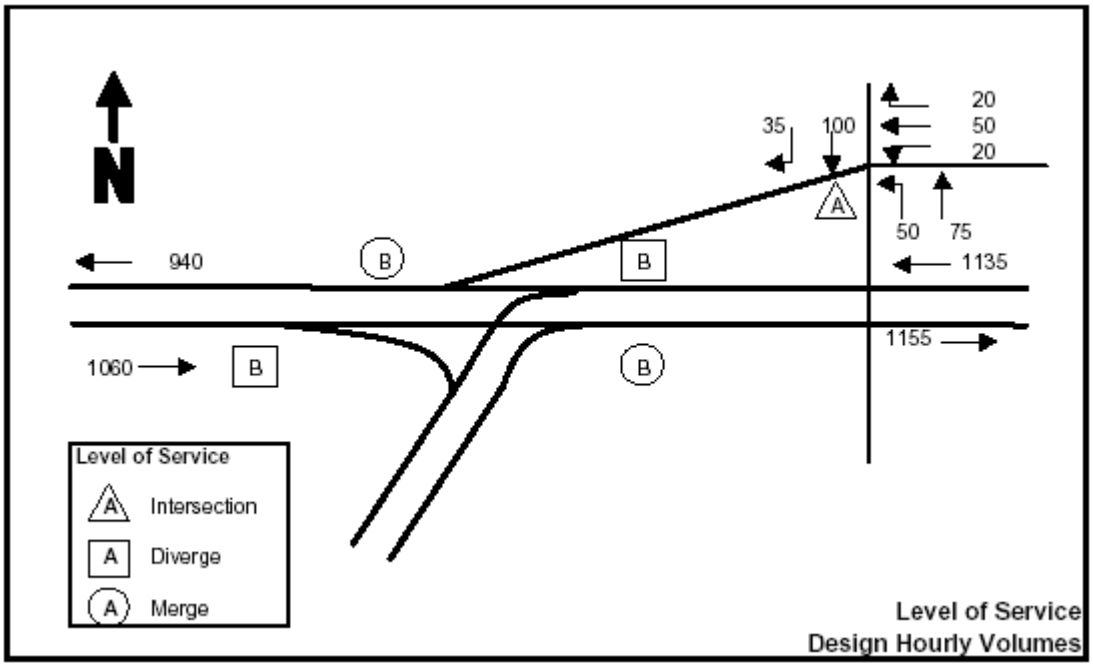
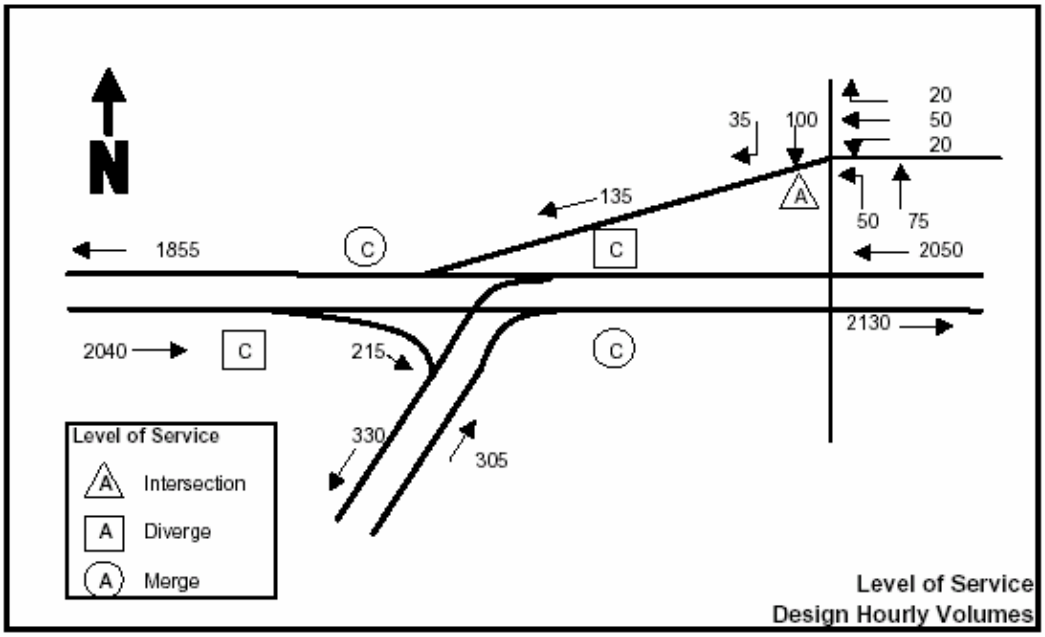


Figure 3 - Existing



It is expected that the projected traffic volumes at this interchange would be accommodated by the current interchange configuration but the safety concerns and the need to accommodate a full range of movements would remain unaddressed. No improvements are necessary based on capacity requirements. Figure 4 shows the capacity analysis for the projected 2020 traffic volumes.

Figure 4 – Projected 2020



The proposed interchange modification will provide full movement interchange, safety improvements and provide a north connection to the interchange.

2. **All reasonable alternatives for design options, location and transportation system management type improvements (such as ramp metering, mass transit, and HOV facilities) have been assessed and provided for if currently justified, or provisions are included for accommodating such facilities if a future need is identified.**

Based on safety issues and to enhance access to the north of I-90, three interchange alternatives were developed to replace the existing interchange configuration; a standard diamond configuration, a partial cloverleaf configuration, and a single-point interchange. Each interchange configuration provides access to the north of Interstate 90, which is not currently provided at Exit 60. The north access is expected to shift travel patterns.

Standard Diamond Interchange Alternative

Figure 5 shows the standard diamond configuration alternative considered. Under this alternative the alignment of the westbound I-90 lanes are proposed to remain at their present location. The alignment of the eastbound lanes would be moved so they parallel the westbound alignment. All of the existing ramps would be removed and replaced. The south ramp terminal intersection is only 500 feet from the proposed new intersection between Eglin Street and East North Street. This is a concern with this design.

A standard diamond interchange would represent a significant improvement over the existing traffic safety conditions at Exit 60 by eliminating the existing eastbound I-90 Bridge over East North Street, which had been the location of several crashes during wet and slippery driving conditions.

Projected Year 2010 and Year 2020 capacity analysis of the standard diamond interchange design were preformed using the Synchro software tool, which is capable of analyzing roadway networks as a system of coordinated signalized intersections. The analyzed roadway network for this alternative included the ramp terminal intersections and the proposed East North Street / Eglin Street intersection. The projected LOS in 2010 for this alternative is shown in Figure 6. Figure 7 shows the LOS for 2020. In 2020 the north ramp intersection will be operating at a LOS D all other movements will operate at a LOS C.

FIGURE 5

Standard Diamond Alternative

I-90 - Exit 60 - Rapid City, S. D.

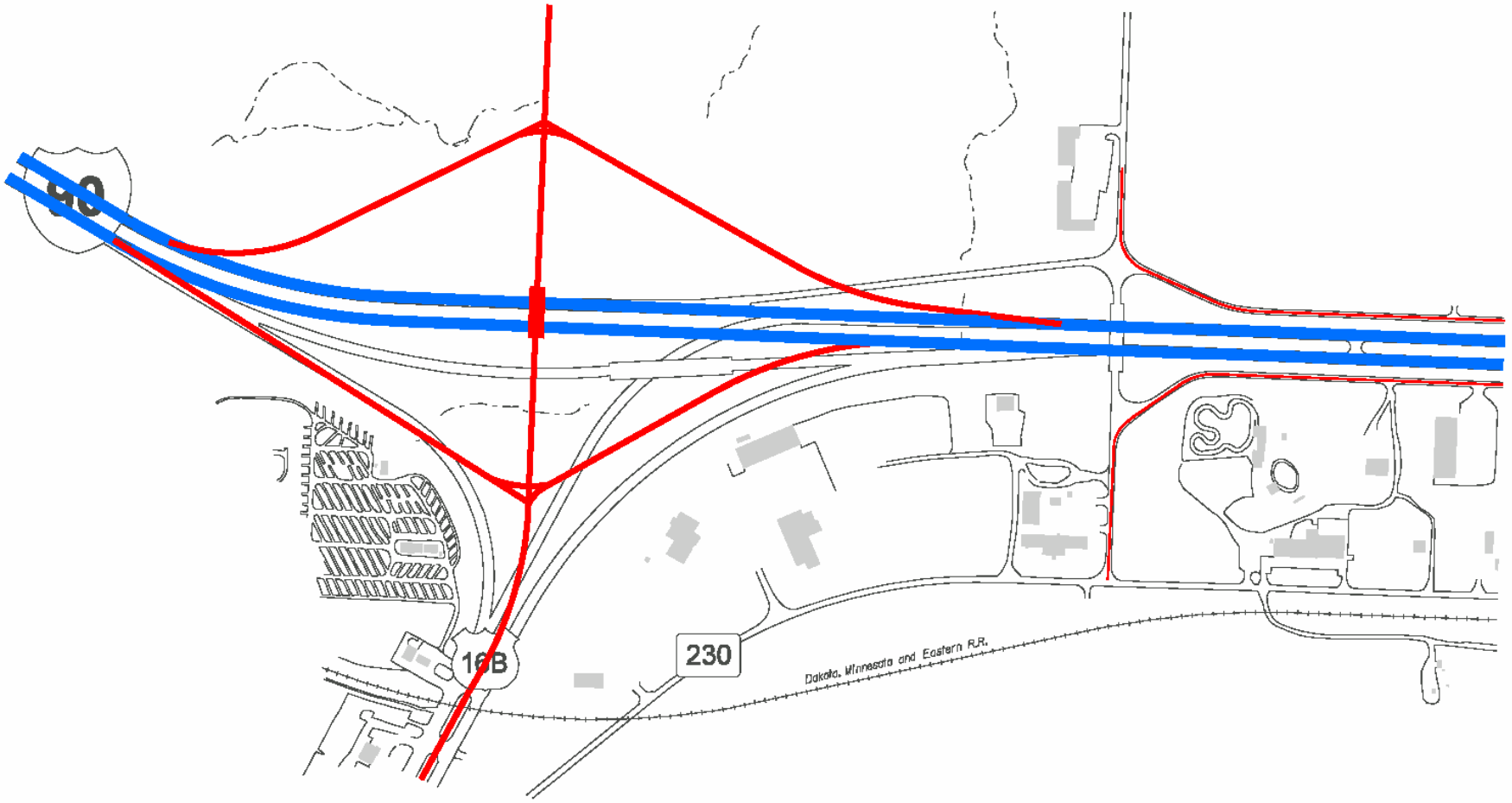


Figure 6 – Projected 2010

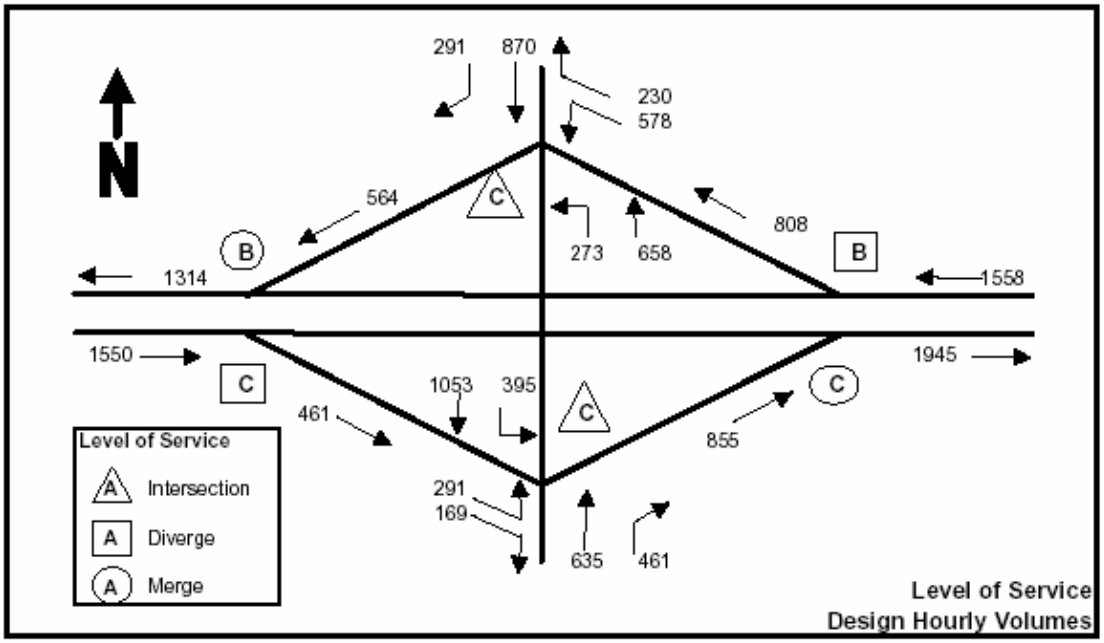
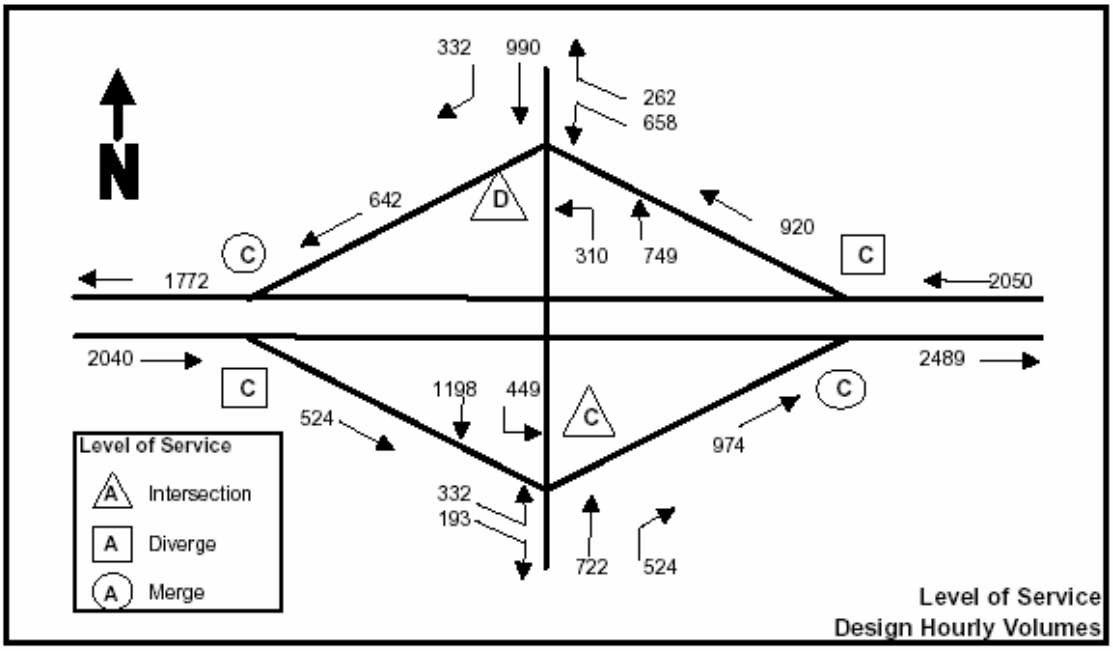


Figure 7 – Projected 2020



Partial Cloverleaf Design Alternative

Figure 8 shows the partial cloverleaf design alternative considered. This design is a partial cloverleaf with loop ramps on the north side of I-90 and a standard diamond configuration on the south side of I-90.

The Partial Cloverleaf north of the interchange is serviced by a collector/distributor (C/D) road along westbound I-90. The loop ramps adjacent to the C/D road have a 35 mph design speed. Both of the loop ramps would be single lane ramps that would use a parallel type taper to merge to and from East North Street. The East North Street Bridge section over I-90 would consist of four through lanes. The south ramp terminal intersection would be signalized with dual southbound left-turn lanes. The south ramp terminal intersection is only 500 feet from the proposed new intersection between Eglin Street and East North Street. This is a concern with this design.

Heightened crash rates are often associated with Partial Cloverleaf interchanges. These incidents often occur within the mainline weave portion of a cloverleaf interchange. In the proposed Alternative, the weaving vehicles would be accommodated by a C/D road configuration, allowing the weaving movements to occur at a lower speed than if the weaving was performed along mainline I-90, enhancing traffic safety. This is likely to make this alternative somewhat safer than a partial cloverleaf interchange with a mainline weaving section.

The capacity of the partial cloverleaf alternative based on projected Year 2010 and Year 2020 traffic volumes was analyzed. Based on this analysis, the signalized south ramp terminal intersection is projected to operate at LOS A by the Year 2010 and remain at LOS A by the Year 2020. Vehicles traversing the directional cloverleaf ramps north of I-90 would encounter minimal delay. The Eglin Street / North Street intersection is projected to operate at LOS A based on Year 2010 traffic volume projections and LOS B based on projected Year 2020 traffic conditions. Figure 9 shows the LOS in 2010 for this alternative. Figure 10 shows the LOS in 2020.

The advantage of this design is safer weaving of traffic with separated road configuration on I-90. The disadvantages are the large amount of right-of-way required and the south ramp terminal intersection is close to the intersection between Eglin Street and East North Street.

FIGURE 8

Partial Cloverleaf Alternative

I-90 - Exit 60 - Rapid City, S. D.

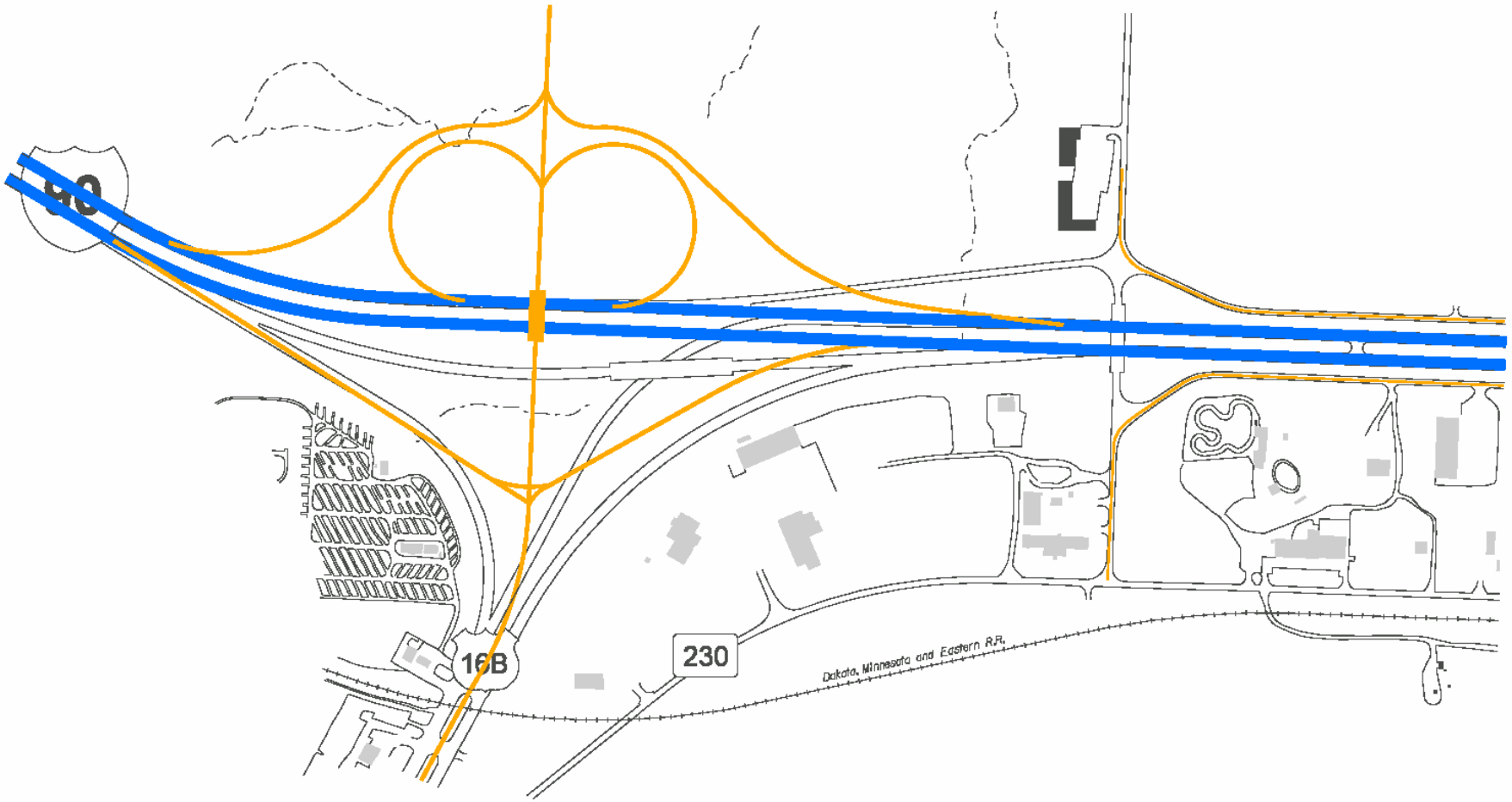


Figure 9 – Projected 2010

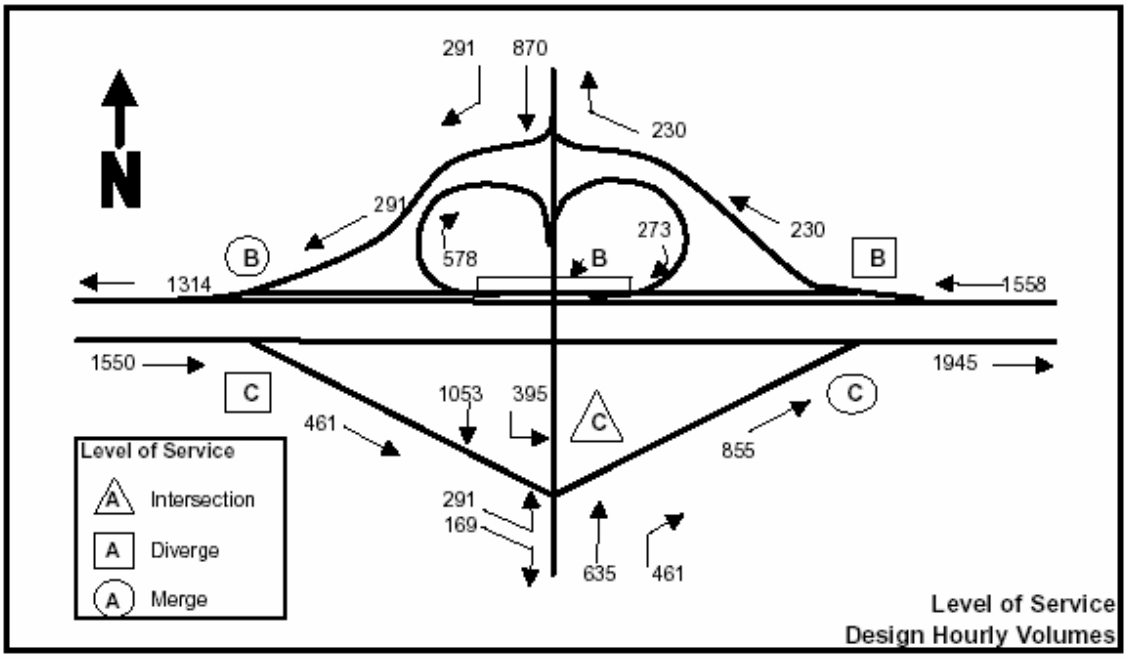
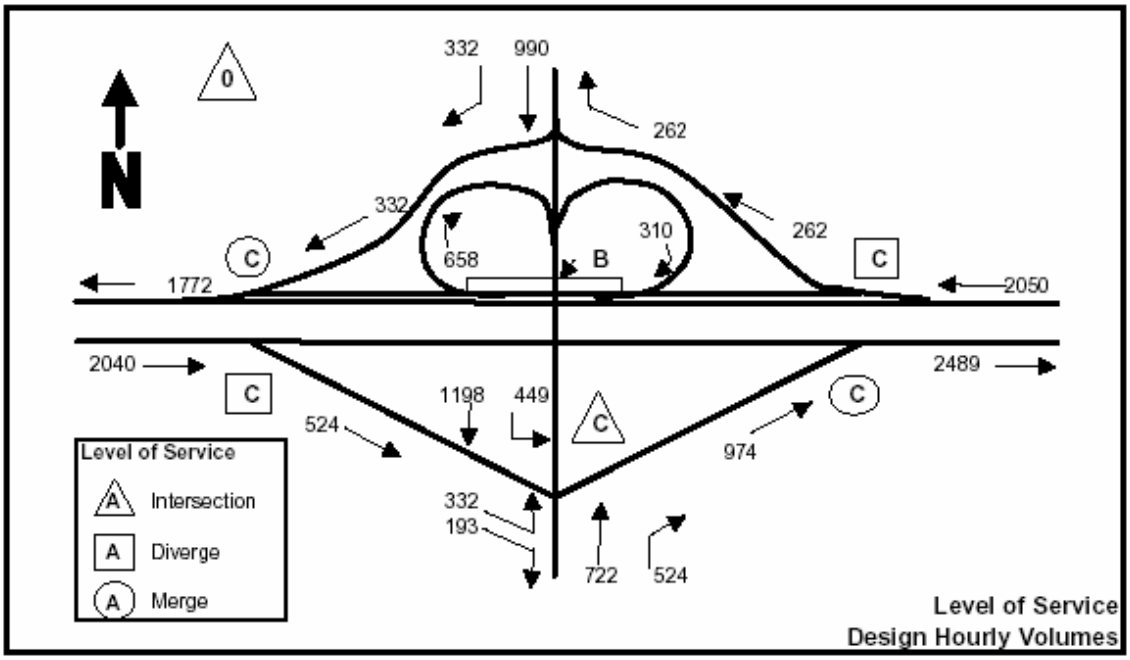


Figure 10 – Projected 2020



Single Point Design Alternative (Preferred)

Figure 11 shows the preferred design of a single point interchange. The interstate mainline would be over the interchange. The overpass and westbound on-ramp at Dyess Avenue would be removed. The single point interchange concept consolidates all interchange turning movements into a single intersection, as shown on Figure 11..

The installation of a single point interchange at Exit 60 would represent a departure from the typical I-90 interchange. Initial unfamiliarity with the interchange configuration may cause increased accident rates at the interchange. However, as drivers become familiar with the layout, traffic safety will likely improve. Another single point interchange already exists at Exit 58 (Haines Avenue) in Rapid City

The intersection LOS results are shown for the years 2010 and 2020 in Figures 12 and 13.

Figure 12 – Projected 2010

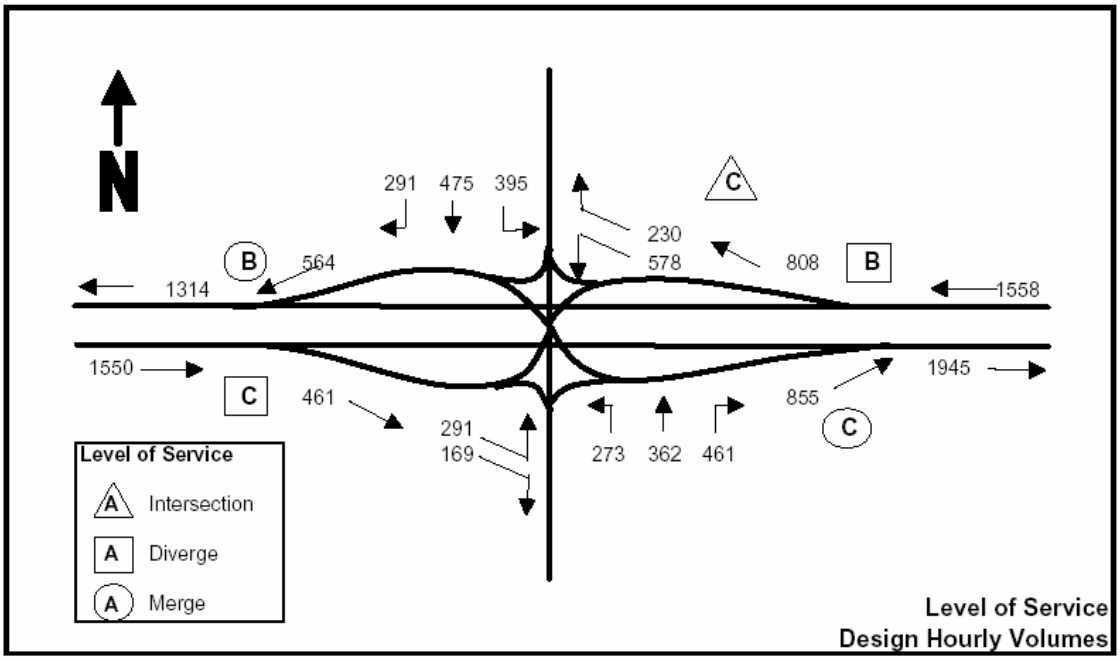


FIGURE 11

Single Point Alternative

I-90 - Exit 60 - Rapid City, S. D.

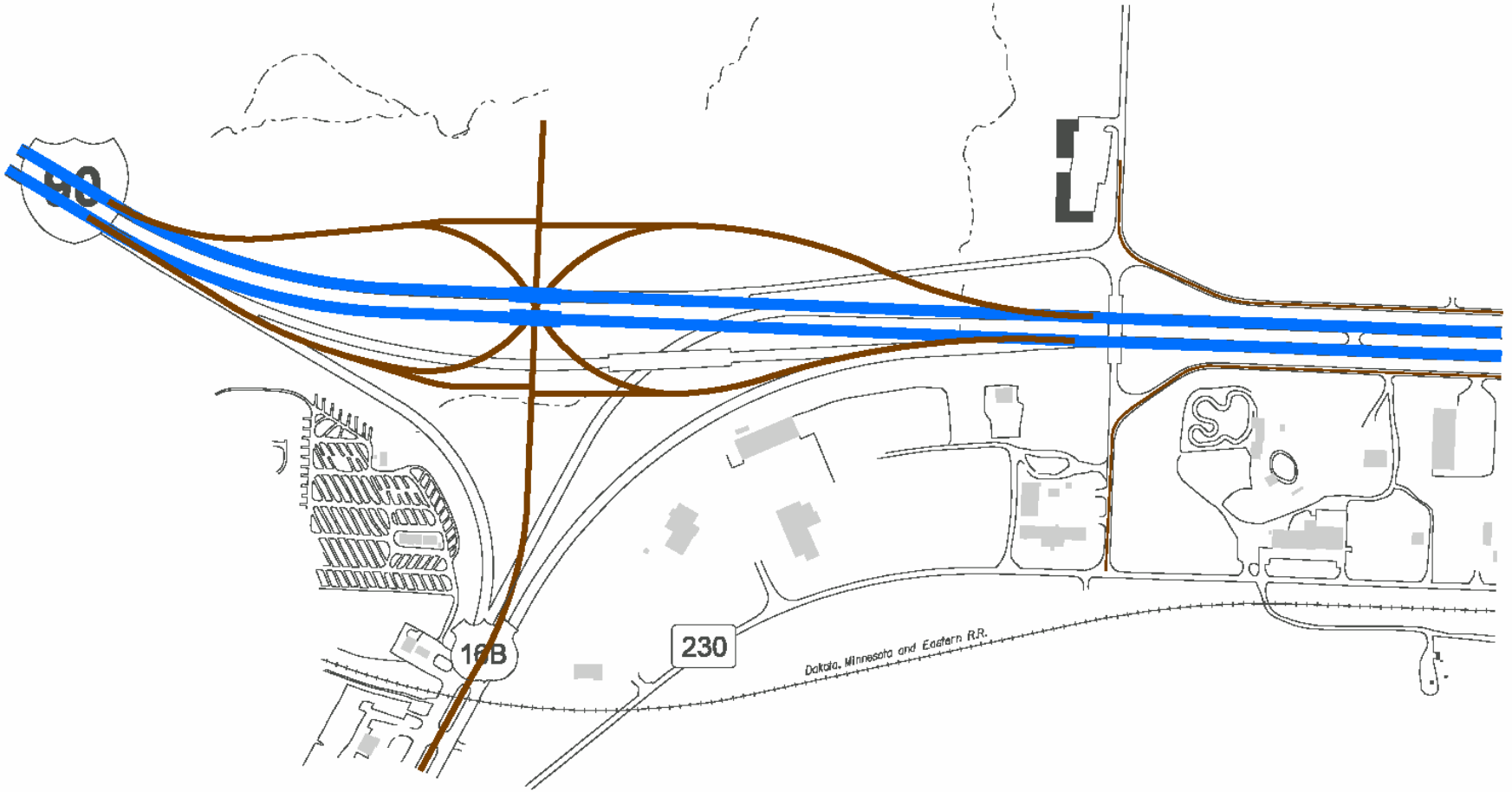
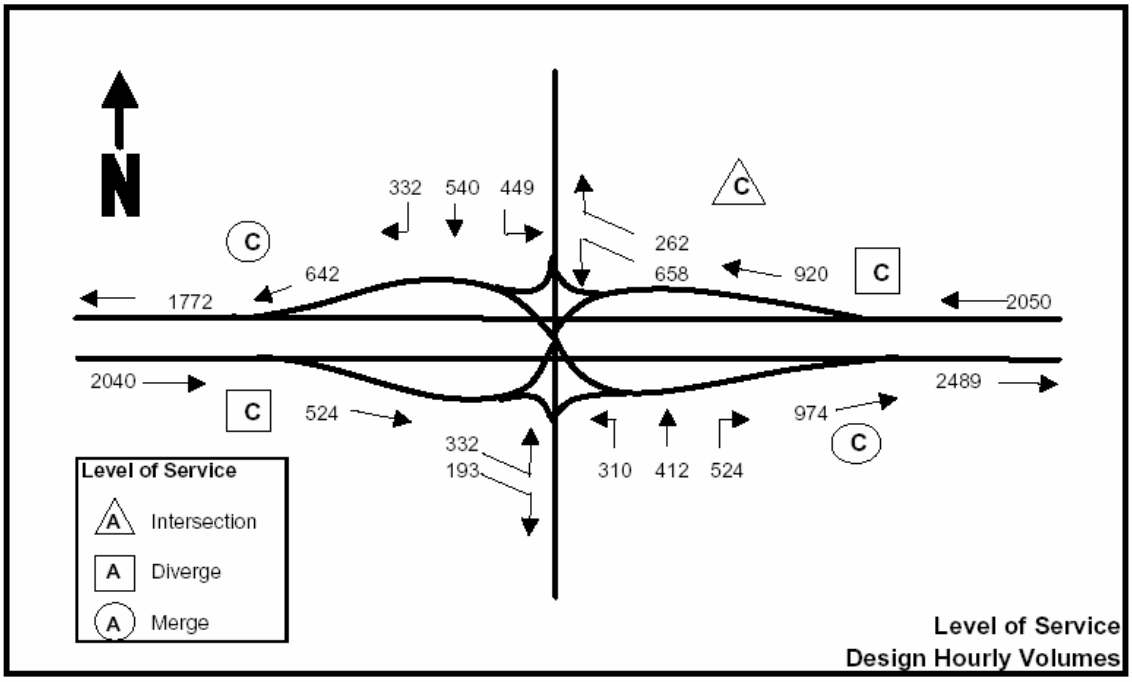


Figure 13 – Projected 2020



The single point interchange concept was selected because less right-of-way would be required with this design compared to the diamond and partial cloverleaf designs. Also the space between the southern ramp intersection and the Eglin St. and East North Street was greater than the other designs. The increase in distance between the intersections improves the operation of both intersections.

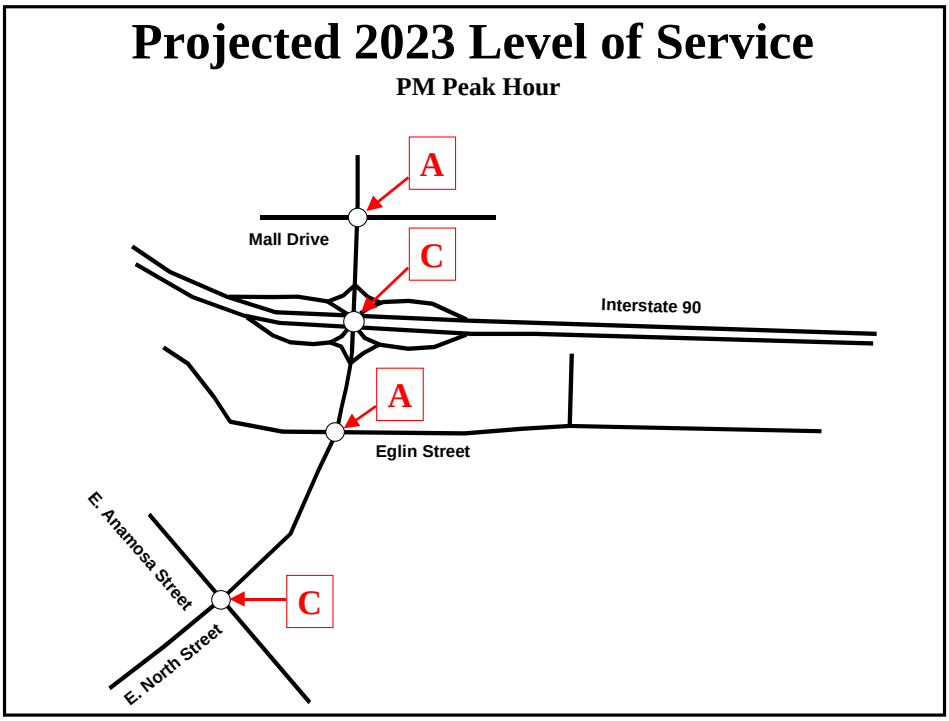
3. **The proposed access point does not have a significant adverse impact on the safety and operation of the Interstate facility based on an analysis of current and future traffic. The operational analysis for existing conditions shall, particularly in urbanized areas, include an analysis of sections of Interstate to and including at least the first adjacent existing or proposed interchange on either side. Crossroads and other roads and streets shall be included in the analysis to the extent necessary to assure their ability to collect and distribute traffic to and from the interchange with new or revised access points.**

An analysis of the impact of the proposed interchange modification at Exit 60 to the interstate revealed that the interchange will improve access to the interstate and would not adversely impact the adjacent interchanges. The ramp intersections a I-90 at Exit 59 (LaCrosse St.) are currently operating at LOS A. In 2023, with a new interchange at Exit 60, the they will still be operating at LOS C or better.

The Exit 61 interchange (I-90 & Elk Vale Road) is currently operating at a LOS of B. It is projected that this interchange will operate at LOS F by 2010. Exit 61 is the connecting interchange for the Heartland Expressway, currently under construction. The South Dakota Department of Transportation has programmed the reconstruction of this interchange for FY 2007. The reconstruction of this interchange will improve the operation of the interchange and the interstate system.

The traffic analysis of the crossroad (E. North Street) was conducted as part of the Eglin Street Corridor Study. Since the current design of Exit 60 does not have a crossroad, the analysis looked at the future traffic operation in 2023 following the completion of the interchange reconstruction and the extension of E. North Street to Mall Drive. Figure 14 shows that all of the intersections studied will be operating at LOS C or better.

Figure 14



4. **The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" for special purpose access for transit vehicles, or HOV's or into park and ride lots may be considered on a case by case basis. The proposed access will be designated to meet or exceed current standards for Federal-aid projects on the Interstate system.**

   The access improvement connects to a public road only and will replace the current partial interchange with a full interchange which will provide for all traffic movements. The improvement will meet or exceed current standards for Federal-aid projects on the Interstate system.

5. **The proposal considers and is consistent with local and regional land use and transportation plans. Prior to final approval, all requests for new or revised access must be consistent with the metropolitan and/or statewide transportation**

plan, as appropriate, the applicable provisions of 23 CFR part 450 and the transportation conformity requirements of 40 CFR parts 51 and 93.

The proposed interchange improvement is consistent with the STIP and local planning.

6. **In areas where the potential exists for future multiple interchange additions, all requests for new or revised access are supported by a comprehensive Interstate network study with recommendations that address all proposed and desired access within the context of a long-term plan.**

   The South Dakota Interstate Corridor Study completed in February 2001 indicated that there is no potential for future interchange additions along this segment of Interstate.

7. **The request for a new or revised access generated by new or expanded development demonstrates appropriate coordination between the development and related or otherwise required transportation system improvements.**

   The proposed interchange modification is not the result of new or expanded development. The interchange is being reconstructed to provide a full access interchange and to address identified safety concerns. The City of Rapid City is also requesting a full interchange to help stimulate development north of the interchange.

8. **The request for new or revised access contains information relative to the planning requirements and the status of the environmental processing of the proposal.**

   The proposed revised access is included in the STIP and the status of the environmental processing is a separate part of this request for the revised access.