# HIGHWAY 1416 AND RADAR HILL ROAD CORRIDOR ANALYSIS STUDY

Pennington County / Box Elder, SD

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# **Chapter 1 – EXISTING CONDITIONS**

# Introduction

Highway 1416 is an east/west corridor running parallel and to the south of I-90 through Box Elder, SD. Radar Hill Road runs north/south from its intersection with Highway 1416 to the north, to its intersection with SD 44 to the south. Expansion at the nearby Ellsworth Air Force Base is expected to occur and will lead to considerable development in the areas surrounding these roadways, leading to shifts in traffic patterns. A corridor analysis study was prepared to analyze these changes and provide recommendations to mitigate any deficiencies. This section of the corridor analysis study will address existing traffic conditions, including roadway characteristics, safety, operations, and capacity.

## Study Area

Key intersections were selected for detailed analysis within the corridor study. Intersections that were identified for analysis are listed below.

- » Highway 1416 & 151<sup>st</sup> Avenue
- » Highway 1416 & Liberty Boulevard/Spruce Drive
- » Highway 1416 & S Ellsworth Road
- » Highway 1416 & Radar Hill Road/Gumbo Drive
- » Radar Hill Road & Long View Road
- » Radar Hill Road & SD 44

At the start of the study, all intersections were two-way or all-way stop controlled. The intersection of Highway 1416 and Radar Hill Road/Gumbo Drive had additional stop-control in the eastbound direction on Highway 1416. Additional stop-control in the westbound direction on Highway 1416 existed at the intersections with Commercial Gate Road, S Ellsworth Road, and W Gate Road.

All northbound and southbound approaches along Highway 1416 (including the medians) were stopcontrolled, except at westbound Highway 1416 and S Ellsworth Road where the northbound approach was a free movement, and the southbound approach was yield controlled. The control noted at these four intersections were atypical designs and could result in driver confusion especially with those unfamiliar with the area.

The study area and labeled intersections are shown in Figure 1-1.

Figure 1-1 – Study Area



Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, Aerial from 2021

## **Objective**

The objective of this report is to collect, analyze, and document existing conditions along the Highway 1416 and Radar Hill Road corridors and present any deficiencies regarding safety, operations, and/or capacity. This section of the study will focus on the analysis of existing no-build conditions and present issues currently being experienced to be used for alternatives development and a basis of comparison for the analysis of the alternatives.

## **Previous Studies**

There have been several previous planning efforts and studies completed in Box Elder along the study segments. These documents provide important background information to support the development of this planning study.

## **RAPID CITY METROPOLITAN TRANSPORTATION PLAN (2020)**

The *Rapid City Metropolitan Transportation Plan (MTP)* is the Rapid City Area Metropolitan Planning Organization's (MPO) long range plan for the regional transportation system. Growth projections and the regional travel demand model generated as part of the MPO's planning process were used as primary components in establishing traffic projections for this corridor study. The MTP provides mid-term (2026-2030) recommendations to improve the Exit 63 interchange.

## **BOX ELDER COMPREHENSIVE PLAN (2014 REVISION)**

The *Box Elder Comprehensive Plan* provides a long-term vision for the city. The intersections of Highway 1416 and W Gate Road, Radar Hill Road, S Ellsworth Road, and Liberty Boulevard are identified as needing safety and mobility improvements. The discussion of future land use identifies Highway 1416 from Exit 63 to Liberty Boulevard and Radar Hill Road extending to Highway 1416 as potential locations for an entry corridor overlay. As a member agency of the Rapid City Area Metropolitan Planning Organization (RCAMPO), Box Elder would coordinate these future plans with the MPO in a local effort to carry out a continuing, cooperative and comprehensive performance-based multi-modal transportation planning process. This involves coordination with SDDOT and the consistent application of aesthetic standards and design elements. Natural drainages along Highway 1416 that contain floodway, and 100- and 500-year floodplain are recognized as constraints that will need to be addressed in new development. Elevated crash occurrence and traffic congestion along Highway 1416 is identified as a top-priority transportation issue.

## **BOX ELDER STRATEGIC TRANSPORTATION PLAN (2014)**

The *Box Elder Strategic Transportation Plan* was created to address a series of desired planning outcomes and transportation objectives, including the alignment of the built environment with regional and local goals, the enhancement of livability within the Box Elder community, and the identification of priorities among future transportation improvement projects. The existing traffic operations analysis includes five intersections along Highway 1416, at W Gate Road, Radar Hill Road, Commercial Gate Drive, S Ellsworth Road, and Liberty Boulevard. It is concluded that the intersection of westbound Highway 1416 with Ellsworth Road operates at LOS F during peak hours, with all other intersections operating at LOS C. Highway 1416 intersections with W Gate Road, Radar Hill Road, and S Ellsworth Road are anticipated to require signalized or roundabout control in order to operate at LOS C or better in the year 2035. The provision of a shared-use path from W Gate Road to S Ellsworth Road along Highway 1416 is identified as a high-priority pedestrian and bicycle project. The conversion of Highway 1416 from a four-lane divided highway to a two-lane undivided roadway with a center left turn lane is identified as a near-term priority included in the contemporaneous statewide transportation improvement plan (STIP). The construction of a side path along Radar Hill Road is identified as a low-priority pedestrian and bicycle project.

## HIGHWAY 1416 CORRIDOR STUDY (2010)

The *Highway 1416 Corridor Study* was commissioned by the Rapid City Area Metropolitan Planning Organization (RCAMPO) and the City of Box Elder in order to access existing traffic safety and operations along the corridor and develop recommendations for improvements. It was found that the current four-lane configuration of Highway 1416 has excess traffic-carrying capacity, providing an opportunity for reconfiguration into a non-divided city street that would improve accessibility, traffic circulation, and motorist safety. Several recommendations are made in this study, including the addition of right- and left-turn lanes at several intersections, widening of the northbound approach of the Radar Hill Road intersection, addition of pedestrian facilities where appropriate, and the development of a network model to allow for comparative analysis.

## **RAPID CITY AREA TRANSPORTATION IMPROVEMENT PROGRAM (2022)**

The *Rapid City Area Transportation Improvement Program* (TIP) for fiscal years 2023-2026 provides a priority listing and financial plan for highway and transit projects. This document includes the design and reconstruction of Radar Hill Road at Highway 1416 to a three-lane configuration. This project is not fiscally constrained in the TIP.

## **Known Issues**

## **CONGESTION AND INTERSECTION DELAY**

Recent and continuing development in the study area vicinity has shifted traffic patterns and resulted in erratic lane usage, congestion from turning movements, and intersection delay along the study corridors. Median storage can also become congested furthering delay by impeding movements upstream.

## **FUTURE DEVELOPMENT**

Ellsworth Airforce Base, a major economic driver in the Box Elder region, is anticipated to experience rapid growth in the coming years and will likely have an influence on travel patterns along and near Highway 1416 and Radar Hill Road. Two new schools are also anticipated to be constructed near the study area, as well as a public park south of Highway 1416.

#### **CRASH HISTORY**

As noted in the *Box Elder Strategic Transportation Plan*, multiple intersections along Highway 1416 are configured with a split between the eastbound and westbound directions, creating unusual intersection geometry and traffic control that is counter-intuitive. Five of the top nine high-crash intersections in Box Elder (2008-2012) are located along Highway 1416, with angle and rear-end crashes particularly prominent at these intersections.

### **CORRIDOR CONSTRAINTS**

Box Elder Road runs parallel to westbound Highway 1416 from east of S Ellsworth Road to west of W Gate Road. The median separating the two roadways is approximately 45 feet wide, considerably closer than the 120-foot-wide median separating eastbound and westbound Highway 1416. Box Elder Road is meant to operate as a frontage road to Highway 1416, providing access to businesses and homes. The narrow median has very limited storage, and though the northbound approaches onto Box Elder Road are uncontrolled, vehicles attempting to turn left onto Box Elder Road can cause queueing in the narrow median spilling over to the westbound approach of Highway 1416.

To the south, the Rapid City, Pierre, and Eastern railroad has a single railroad track that runs parallel to eastbound Highway 1416 throughout the study area, separated by a median ditch approximately 60 feet wide. The railroad restricts right-of-way along the south edge of the study area, as the railroad is unlikely to relinquish any right-of-way for highway purposes. Of the three study intersections that intersect at-grade with the railroad tracks (Liberty Boulevard, S Ellsworth Road, and Radar Hill Road), only the Radar Hill Road crossing has flashing-light signals and gate arms. The crossings at S Ellsworth Road and Liberty Boulevard are yield-controlled. The proximity of Highway 1416 to the railroad tracks leads to severe safety concerns regarding vehicle-rail collisions and can lead to operational concerns with queueing on Highway 1416. A crossing diagnostic inspection could be held to further investigate the safety conditions of the crossing.

## LACK OF PEDESTRIAN FACILITIES

No dedicated sidewalks, paths, or trails exist within the study area. There are also no dedicated or marked crossing locations on Highway 1416 or Radar Hill Road within the study area.

## LACK OF BICYCLE FACILITIES

As noted in the *Rapid City Area Bicycle and Pedestrian Master Plan*, very limited bicycle facilities exist in Box Elder. Major streets connecting the area to surrounding jurisdictions have high speeds and volumes that reduce safety for cycling.

## **Planned Improvements**

The City of Box Elder plans to complete an active transportation plan by the spring of 2024. A recent assessment of walking and biking routes was completed in conjunction with the USDOT Safe Streets and Roads for All (SS4A) grant.

The I-90 interchange connecting to Highway 1416 (Exit 63) is also planned to be reconstructed. The proposed design is a diverging diamond interchange, with construction expected to begin in 2027 (depending on federal funding availability). The interchange reconstruction was spurred by issues regarding safety, congestion, capacity, accessibility and connectivity, and a lack of pedestrian facilities. This project also recommends consolidating the Highway 1416 and W Gate Road intersection into one signalized intersection.

General road repairs are expected to take place during the summer of 2023 along Radar Hill Road between Highway 1416 and Long View Road. The repairs are expected to address issues of severe degradation and potholes along this section of the corridor. The City of Box Elder Active Transportation Recommendations document also provides the following recommendations within the study area:

- » Installing sidewalks along Highway 1416 from W Gate Road to Liberty Boulevard, and along Radar Hill Road from Highway 1416 to Box Elder city limits.
- » Implementing multimodal connection nodes on Highway 1416 at the I-90 interchange, Radar Hill Road, and Liberty Boulevard.
- » Converting the intersection of Highway 1416 and Liberty Boulevard to a roundabout and installing a traffic signal and dedicated crosswalks at Highway 1416 and S Ellsworth Road.
- » Creating a Farmers' Market or city park near the I-90 interchange.
- » Extending Cheyenne Road to connect to Radar Hill Road (with a connection point at the 228th Street intersection).

# **Existing Conditions**

## **Corridor Characteristics**

## **FUNCTIONAL CLASSIFICATIONS**

Highway 1416 is classified as an Urban Minor Arterial within the study area. Radar Hill Road is classified as an Urban Major Collector between Highway 1416 and Long View Road. From Long View Road to SD 44, Radar Hill Road is classified as a Rural Major Collector. The functional classifications for roadways within the study area are shown in **Figure 1-2**.

## LAND USE

Several land use categories are present adjacent to Highway 1416 and Radar Hill Road within the study area. The land along the north side of Highway 1416 is primarily industrial, high-density residential, and open space and park land. A large parcel north of Highway 1416 between Hillview Drive and Liberty Boulevard is classified as highway service land. The south side of Highway 1416 is bounded by the railroad.

Land surrounding Radar Hill Road is primarily low-, mid-, and high-density residential, as well as industrial and highway service. There are small parcels dedicated to industrial space near Mule Deer Trail, Fox Trail, and Plymouth Drive. The remaining area surrounding the study area is primarily agricultural.

Box Elder city limits end near Old Cavalry Road. The areas adjacent to Radar Hill Road between 229<sup>th</sup> Street and SD 44 are under Pennington County jurisdiction. This land is primarily residential and agricultural.

Land use is presented in **Figure 1-3**, using data provided by Pennington County.



Figure 1-2 – Road Functional Classifications

Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, SDDOT Traffic Data 2022, Aerial from 2021

#### Figure 1-3 – Land Use



Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, SDDOT Traffic Data 2022, Aerial from 2021

#### **RIGHT-OF-WAY (ROW)**

Right-of-way (ROW) is the available space owned by the County on which its roads and highways reside. ROW is often the constraining factor in developing alternatives, because acquiring additional ROW can be costly, increase project delivery deadlines, or stop a project altogether. The ROW of Highway 1416 directly adjacent to the Rapid City, Pierre, and Eastern railroad ROW. ROW widths vary along the corridor, depending on the location. ROW information will need to be verified through the project development, as the widths shown were obtained from publicly available GIS information. Cross-section widths along the corridor are shown in **Figure 1-4**.

#### Highway 1416

- » W Gate Road to Radar Hill Road Generally ranges from 300 to 320 ft.
- » From Radar Hill Road to S Ellsworth Road Generally ranges from 300 to 350 ft.
- » From S Ellsworth Road to End of divided roadway Generally ranges from 200 ft to 400 ft.
- » Start of undivided roadway to 151<sup>st</sup> Avenue Generally ranges from 90 ft to 120 ft.

#### Radar Hill Road

- » Highway 1416 to Creekside Drive Generally ranges from 70 to 120 ft.
- » Creekside Drive to 228<sup>th</sup> Street Generally ranges from 66 to 90 ft.
- » 228<sup>th</sup> Street to 229<sup>th</sup> Street Generally 100 ft
- » 229<sup>th</sup> Street to Long View Road Generally ranges from 85 ft to 110 ft.
- » Long View Road to SD 44 Generally ranges from 66 to 85 ft.

## <u>SPEED</u>

Figure 1-5 shows the posted speed limits in the study area.

#### Highway 1416

Highway 1416 has a posted speed limit of 65 miles per hour (mph) between 151<sup>st</sup> Avenue and east of Liberty Boulevard. Between Liberty Boulevard and S Ellsworth Road, the speed limit drops to 50 mph. West of S Ellsworth Road, the speed limit is 55 mph through the remainder of the study area to W Gate Road.

#### **Radar Hill Road**

Radar Hill Road has a posted speed limit of 45 mph between Highway 1416 and 229<sup>th</sup> Street. Between 229<sup>th</sup> Street and SD 44, Radar Hill Road has a posted speed limit of 50 mph.

#### Figure 1-4 – Cross-Sections



Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, SDDOT Traffic Data 2022, Aerial from 2021

#### Figure 1-5 – Speed Limit



Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, SDDOT Traffic Data 2022, Aerial from 2021

### ACCESS MANAGEMENT

Access management is the process of balancing the competing needs of mobility and land access. Access locations introduce conflict points into the traffic stream. Allowing dense, uncontrolled access spacing results in safety, operational, and aesthetic deficiencies.

SDDOT's *Road Design Manual* (Chapter 17 – Access Management) states the minimum desirable spacing of access points in both Urban Fringe and Rural areas is **five accesses per side per mile**. Along the Highway 1416 and Radar Hill Road study corridors, the number of intersection and driveway accesses along each side of the roadway were calculated. Highway 1416 was split into three distinct segments: the undivided segment between 151<sup>st</sup> Avenue and the directional split, westbound Highway 1416 to W Gate Road, and eastbound Highway 1416 to the directional split. Radar Hill Road was analyzed as a single segment. For each segment, the average number of accesses per side per mile was calculated and compared to the SDDOT threshold of five accesses per side per mile. Access management results are shown in **Table 1-1**.

Segment	Length (mi)	Side	Intersection Accesses	Driveway Accesses	Total Accesses	Total Accesses (per side per mile)	Intersection Accesses (per side per mile)
<b>Hwy 1416</b> 151 <sup>st</sup> Ave to	1 50	North	4	3	7	4.4	2.5
EB/WB split	1.58	South	3	2	5	3.2	1.9
WB Hwy 1416	2 5 4	North	8	0	8	3.1	3.1
EB/WB split to W Gate Rd	2.54	South	7	0	7	2.8	2.8
EB Hwy 1416	2 5 0	North	7	0	7	2.8	2.8
W Gate Rd to EB/WB split	2.50	South	5	0	5	2.0	2.0
Radar Hill Rd	F 42	West	17	17	34	6.3	3.1
Hwy 1416 to SD 44	5.43	East	15	31	46	8.5	2.8

Existing accesses along Highway 1416 meet SDDOT standards. Accesses along Radar Hill Road do not meet SDDOT standards, particularly on the east side of the roadway. Intersection access spacing does meet requirements along Radar Hill Road.

The southbound approach of EB Highway 1416 and S Ellsworth Road is also offset from the northbound approach. This intersection is classified as a negative offset, as defined by the SDDOT *Road Design Manual* (Chapter 17 – *Access Management*). This offset poses a safety risk for several movements, therefore geometric realignment should be considered.

## **LIGHTING**

#### Highway 1416

Roadway lighting is present at the following intersections along Highway 1416:

- » Trenton Lane single pole in the northeast corner of the intersection
- » Liberty Boulevard three poles illuminating the southbound, eastbound, and westbound approaches
- » S Ellsworth Road four poles illuminating the southbound, eastbound, and westbound approaches, as well as the median
- » Radar Hill Road four poles illuminating the southbound, eastbound, and westbound approaches, as well as the median
- » W Gate Road four poles illuminating the southbound, eastbound, and westbound approaches, as well as the median

No other intersections or segments along the Highway 1416 study corridor are lit.

#### Radar Hill Road

Roadway lighting is present at the following intersections along Radar Hill Road:

- » Highway 1416 four poles illuminating the southbound, eastbound, and westbound approaches, as well as the median
- » Wilo Drive single overhead light mounted on a telephone pole in the northeast corner of the intersection
- » Mule Deer Trail single pole in the southeast corner of the intersection
- » Fox Trail single pole in the northeast corner of the intersection
- » Flying Eagle Drive single overhead light mounted on a telephone pole in the northwest corner of the intersection
- » Radar Hills Drive single overhead light mounted on a telephone pole in the northeast corner of the intersection
- » 228<sup>th</sup> Street single pole in the southwest corner of the intersection
- » Old Cavalry Road single overhead light mounted on a telephone pole in the southeast corner of the intersection

No other intersections or segments along the Radar Hill Road study corridor are lit.

#### **ENVIRONMENTAL JUSTICE OVERVIEW**

The US Environmental Protection Agency's (EPA) Environmental Justice Screening and Mapping tool (EJSCREEN) was used to review the presence of readily identifiable low-income and minority populations by evaluating their percentages. The Environmental Justice (EJ) study area for this review included the project roadways: Highway 1416 and Radar Hill Road in Box Elder, Pennington County, South Dakota and a 0.25-mile buffer surrounding the roadways. Data obtained from EJSCREEN and US Census Bureau were used to determine percentages of low-income and minority populations within the EJ study area and the City of Box Elder. This limited analysis did not include investigating the presence of community facilities in the EJ study area that serve minority and low-income populations, or businesses in the EJ study area that are owned by, employ, and serve minority and low-income populations.

For the purposes of this review, the smallest unit of geography (i.e., city) was used for comparison with the EJ study area. An EJ population is identified when:

- 1. The minority or low-income population of a study area exceeds 50 percent, or
- 2. The minority or low-income population percentage is at least 10 percentage points higher than the city average.

As shown in **Table 1-2**, the minority and low-income populations in the entire study area do not exceed 50 percent and are not at least 10 percentage points higher than the average for the City of Box Elder. Therefore, an EJ population is not present in the EJ study area.

Demographic	Study Area	City of Box Elder
Minority Population	21%	22%
Low-Income Population	23%	28%

#### Table 1-2 – Minority and Low-Income Populations

### MULTIMODAL FACILITY

No dedicated sidewalks, paths, or trails exist within the study area. There are also no dedicated or marked crossing locations on Highway 1416 or Radar Hill Road within the study area.

The South Dakota Road Design Manual (Chapter 7 – Cross Sections; Chapter 16 – Miscellaneous) states that shoulders considered to be bikeable should be paved and a minimum of four feet in width. There is an unpaved shoulder along the north edge of westbound Highway 1416, between the median split near Cottonwood Drive and the I-90 on-ramp. This shoulder is a six-foot unpaved shoulder that does not meet design requirements for bikeability. There is no shoulder serving the eastbound direction of Highway 1416.

Radar Hill Road has a six-foot paved shoulder on the east and west sides of the roadway, between Wilo Drive and Creekside Drive. There is also a 10-foot paved shoulder on both sides of Radar Hill Road between 228<sup>th</sup> Street and 229<sup>th</sup> Street.

Though some existing shoulders within the Radar Hill Road corridor meet bicycle lane design requirements, there are sections of both the Highway 1416 corridor and the Radar Hill Road corridor that are not accessible via non-motorized modes of travel. Highway 1416 and Radar Hill Road are also high-speed corridors, with vehicular speed limits ranging from 45 to 65 miles per hour, which reduces safety for bicyclists and pedestrians utilizing the shoulders.

Pedestrian Level of Service (PLOS) and Bicycle Level of Service (BLOS) analyses were conducted and are discussed later in this report. Shoulder widths throughout the study area (paved and unpaved) are shown in **Figure 1-6**.

#### **ADJACENT FACILITIES**

There are parallel facilities on either side of Highway 1416. South of Highway 1416 is an active railroad line. The distance between the edge of roadway and the rail line can vary from 65 to 210 feet. In areas where the distance between facilities is lesser, as it is at the Radar Hill Road and Ellsworth Drive intersections, queueing in the northbound direction can cross the railroad creating a potential safety risk.

Box Elder Road runs parallel to Highway 1416 on the north side of the roadway. The roadways are separated by a 50-foot grass median. Due to the short distance between the roadways, southbound queues at the Highway 1416 intersections can create potential operational and safety deficiencies at the adjacent Box Elder Road intersections.

## **Traffic Volumes**

Traffic volumes were collected by KLJ at five of the six study intersections on Tuesday, May 9, 2023, and traffic volumes at Highway 1416 and 151<sup>st</sup> Avenue were collected on Tuesday, May 23, 2023. Volumes were collected for a 13-hour period and included pedestrian and bicycle movements.

The intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road/Gumbo Drive were modeled with the westbound and eastbound directions of Highway 1416 separately. There is a large median (approximately 120 feet) separating the eastbound and westbound directions, with additional stop control at the northbound and southbound approaches between the two highway movements. The volumes were collected with each eastbound and westbound intersection operating as one and were balanced appropriately as distinct eastbound and westbound intersections.

The 2022 Average Daily Traffic (ADT) volumes are shown in **Figure 1-7** and they were collected by Pennington County. The AM and PM peak turning movement counts are shown in **Table 1-3** and **Table 1-4**, respectively. Raw traffic volume counts can be found in **Appendix A**.



Figure 1-6 – Shoulder Width

Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, SDDOT Traffic Data 2022, Aerial from 2021



Figure 1-7 – 2022 Daily Traffic Volumes

Source: Penninstan County SD GIS Data SDGS LISGS ESRI SDDOT Traffic Data 2022 Aedial from 2021

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Highway 1416 and 151st Ave	-	-	-	5	-	34	7	38	-	-	94	8
Highway 1416 and Liberty Blvd	3	32	2	20	8	28	134	23	2	1	15	139
Highway 1416 and S Ellsworth Rd*	86	56	7	10	16	194	618	115	15	0	44	13
Highway 1416 and Radar Hill Rd*	167	1	236	8	9	16	4	527	55	79	334	5
Radar Hill Rd and Long View Rd	1	24	3	3	38	102	70	6	1	5	16	9
Radar Hill Rd and SD 44	4	0	1	19	2	10	15	217	5	2	207	17

### Table 1-3 – Turning Movement Counts (AM Peak)

\*Intersection split between eastbound and westbound Highway 1416. See split counts below.

NB - Northbound; SB - Southbound; EB - Eastbound; WB - Westbound

L – Left; T – Through; R – Right

#### Table 1-3a – Turning Movement Counts (AM Peak)

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
WB Highway 1416 and S Ellsworth Rd	86	674	-	-	26	194	-	-	-	0	44	13
EB Highway 1416 and S Ellsworth Rd	-	142	7	10	16	-	618	115	15	-	-	_
WB Highway 1416 and Radar Hill Rd	167	5	-	-	17	16	-	-	-	79	334	5
EB Highway 1416 and Radar Hill Rd	-	168	236	8	88	-	4	527	55	-	-	-

NB - Northbound; SB - Southbound; EB - Eastbound; WB - Westbound

L – Left; T – Through; R – Right

#### Table 1-4 – Turning Movement Counts (PM Peak)

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Highway 1416 and 151st Ave	-	-	-	3	-	15	36	84	-	-	50	1
Highway 1416 and Liberty Blvd	7	10	0	110	20	54	37	42	12	3	27	54
Highway 1416 and S Ellsworth Rd*	36	37	6	6	59	256	291	79	143	14	71	6
Highway 1416 and Radar Hill Rd*	112	9	116	4	9	10	19	401	193	184	531	3
Radar Hill Rd and Long View Rd	1	46	4	7	37	107	127	10	1	2	6	4
Radar Hill Rd and SD 44	6	1	0	23	7	24	39	132	12	1	221	24

\*Intersection split between eastbound and westbound Highway 1416. See split counts below.

NB – Northbound; SB – Southbound; EB – Eastbound; WB – Westbound

L – Left; T – Through; R – Right

Table 1-4a – Turning Movement Input	s for Operations Analysis (PM Peak)
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Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
WB Highway 1416 and S Ellsworth Rd	36	328	-	-	65	256	-	-	-	14	71	6
EB Highway 1416 and S Ellsworth Rd	-	73	6	6	73	-	291	79	143	-	-	-
WB Highway 1416 and Radar Hill Rd	112	28	-	-	13	10	-	-	-	184	531	3
EB Highway 1416 and Radar Hill Rd	-	121	116	4	193	-	19	401	193	-	-	-

NB - Northbound; SB - Southbound; EB - Eastbound; WB - Westbound

L – Left; T – Through; R – Right

## **Traffic Patterns**

13-hour counts were collected from 5:30 AM to 6:30 PM. The AM peak in vehicular volume was determined to begin at approximately 7:00 AM, and the PM peak begins at approximately 4:30 PM. The peak hours determined from KLJ's data collection and analysis was validated using StreetLight. The intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road experienced the highest volumes out of all study intersections. The AM and PM peak turning movement counts are shown in **Figure 1-8**.





## **Crash Analysis**

Reviewing historic crash information can help identify existing deficiencies that can be addressed through this study. Ten years of crash records from January 1, 2013, through December 31, 2022, were requested from SDDOT. There were 357 crashes reported during the analysis period in the study area. The density of vehicular crashes along the study area and the location of crash events are shown in **Figure 1-9**. There was a high number of crashes, particularly at the intersections of Highway 1416 with W Gate Road, Radar Hill Road, Commercial Gate Road, and S Ellsworth Road. The summary of crashes for study intersections only are shown in **Table 1-5**.

Intersection with Highway 1416	Incapacitating	Non- Incapacitating	Possible Injury	Non-Injury	TOTAL
151st Ave	-	-	1	1	2
Liberty Blvd / Spruce Dr	1	-	2	5	8
S Ellsworth Rd	1	1	6	17	25
Commercial Gate Rd*	-	4	3	19	26
Radar Hill Rd	7	23	18	53	101
W Gate Rd*	1	3	6	17	27
TOTAL	10	31	36	112	189
Intersection with Radar Hill Road	Incapacitating	Non- Incapacitating	Possible Injury	Non-Injury	тот
Long View Rd	-	-	-	-	0
SD 44	1	-	-	4	5
TOTAL	1	0	0	4	5

Table 1-5 – Crashes at Study Intersections

\*Not among the intersections for study but added for statistics and reporting purposes.

The corridor was divided into the following analysis segments based on engineering judgement and local knowledge:

- » Crash Segment A: Highway 1416 From 151<sup>st</sup> Avenue to west of Cottonwood Drive
- » Crash Segment B: Highway 1416 From west of Cottonwood Drive to Radar Hill Road
- » Crash Segment C: Highway 1416 From Radar Hill Road to W Gate Road
- » Crash Segment D: Radar Hill Road From Highway 1416 to 229<sup>th</sup> Street
- » Crash Segment E: Radar Hill Road From 229<sup>th</sup> Street to Long View Road
- » Crash Segment F: Radar Hill Road From Long View Road to SD 44

The summary of non-junction related crashes for crash segments are shown in **Table 1-6**.

Crash Segment ID	Fatal injury	Incapacitating	Non- incapacitating	Possible Injury	No injury	Wild animal hit	тот
Α	1	3	3	4	7	3	21
В	-	-	5	4	11	7	27
С	1	2	6	2	23	-	34
D	-	1	5	4	14	3	27
E	-	3	-	2	14	2	21
F	-		-	2	1	4	7
TOTAL	2	9	19	18	70	19	137

 Table 1-6 – Non-Junction Related Crashes

» There were 82 non-junction related crashes reported along Highway 1416 during the analysis period, which corresponds to 8.2 crashes per year.

» There were 55 non-junction related crashes reported along Radar Hill Road during the analysis period, which corresponds to 5.5 crashes per year.



*Figure 1-9 – Crash Density (Year 2013-2022)* 

Source: Pennington County SD GIS Data. SDGS. USGS. ESRI. Aerial from 2021

May 2023

#### **CRASH TRENDS AND PATTERNS**

The trend and pattern of corridor crashes by year and month were analyzed from crash records.

#### Highway 1416

There were 177 crashes reported in the Highway 1416 segments of the study area during the analysis period. This corresponds to 17.7 crashes per year. The ten-year crash summary at Highway 1416 roadway is shown in **Figure 1-10**.



Figure 1-10 – Highway 1416 Segment and Intersection Ten-Year Crash Summary (Year 2013-2022)

The number of crashes has varied during the analysis period. The total crashes peaked in 2014, and recently there has been a modest drop in crashes. This may be attributed to recent improvements made on the Highway 1416 corridor with stop signs added to the main line in a single direction at the intersections of West Gate Road, Radar Hill Road, and S Ellsworth Road. The number of fatal and incapacitating crashes have been highest in 2022, with two fatal and three incapacitating crashes.

The trends of crashes by months of the year are shown in **Figure 1-11**. Frequency of crashes were generally high from October through February. This timeframe coincides with the typical winter months and snowy/icy roadways.



#### Figure 1-11 – Highway 1416 Crashes by Month (Years 2013-2022)

#### Radar Hill Road

There were 180 crashes reported in the Radar Hill Road segment of the study area during the analysis period. This corresponds to 18 crashes per year. The ten-year crash summary at Radar Hill Road segment of the study is shown in **Figure 1-12**.





The number of crashes has varied during the analysis period. There were no fatal crashes reported during the analysis period on the Radar Hill Road corridor.

The trends of crashes by months of the year are shown in **Figure 1-13**. Frequency of crashes were generally high from September through January.





## FATAL CRASHES ON BOTH CORRIDORS

There were two (2) fatal and twenty (20) incapacitating injury crashes reported in the study area during the analysis period. The first fatal crash incident, which was reported in September 2014 took place at the intersection of Highway 1416 with Cottonwood Drive. The incident involved the collision of a motorist with an oncoming train. The railroad crossing at Cottonwood Drive near Highway 1416 is yield controlled. The second fatal crash incident, which was reported in February 2018 took place at the intersection of Eastbound Highway 1416 with Radar Hill Road. The incident involved a pedestrian and a motorist under the influence which occurred during dark conditions and the intersection was not well illuminated.

## **CRASHES INVOLVING PEDESTRIAN/BICYCLIST**

There was one pedestrian- and three bicyclist-involved crashes reported during the analysis period. The only pedestrian crash incident was a fatal crash that was described previously in the report.

The first crash involving a bicyclist was reported in July 2014 near the intersection of Radar Hill Road with 229<sup>th</sup> Street. The incident involved the collision of a bicyclist with a lightweight truck and occurred under dark conditions with no streetlight illumination. The bicyclist experienced an incapacitating injury.

The second crash involving a bicyclist was reported in September 2016 at the intersection of Highway 1416 and Radar Hill Road. The incident involved the collision of a bicyclist traveling northbound to cross

Highway 1416 with an oncoming vehicle traveling westbound. The bicyclist experienced an incapacitating injury.

The third crash involving a bicyclist was reported in November 2020 at the intersection of Highway 1416 with W Gate Road. The incident involved the collision of a bicyclist traveling southbound to cross Highway 1416 with an oncoming vehicle traveling westbound. The bicyclist experienced a possible injury.

## **CRASHES WITH TRAIN**

There were five crashes reported that involved collision of a vehicle with an oncoming train. There were three crashes reported for the intersection of Highway 1416 with Radar Hill Road, of which two resulted in non-incapacitating and one non-injury crashes. The major contributing factor for the crashes were failure to yield. The railroad crossing at Radar Hill Road is controlled by flashing lights and gates. There were two crashes reported at the railroad crossing with Cottonwood Drive, of which one resulted in a fatality and the other resulted in no injury. The major contributing factor for the crashes were failure to yield. The railroad crossing at 151<sup>st</sup> Avenue is controlled by a yield sign at each approach.

## **CRASH COLLISION TYPES**

Identifying crash types at roadways assists in developing countermeasures to mitigate or minimize the crash type. Angle (120 crashes) and rear-end (43 crashes) were the most typical crash types at the study intersections along Highway 1416. **Figure 1-14** on the following page shows the crashes by crash type at the study intersections during the analysis period. The larger the pie chart, the more crashes that occurred at the corresponding intersection.

Table 1-7 – Non-Junction Related Crashes by Collision Types									
Crash Crash									
Segment ID	Single- Vehicle	Rear- End	Angle	Head- On	Sideswipe	Wild Animal	Total		
Α	18	1		2			21		
В	21	3	1	1	1		27		
C	18	12	1		2	1	34		
D	15	9	1	1		1	27		
E	17	1		1	1	1	21		
F	6					1	7		
TOTAL	95	26	3	5	4	4	137		

The non-junction related crashes by collision types are summarized in Table 1-7.

- » Crash Segment A: Highway 1416 From 151<sup>st</sup> Avenue to west of Cottonwood Drive
- Crash Segment B: Highway 1416 From west of Cottonwood Drive to Radar Hill Road
- » Crash Segment C: Highway 1416 From Radar Hill Road to W Gate Road
- » Crash Segment D: Radar Hill Road From Highway 1416 to 229<sup>th</sup> Street
- Crash Segment E: Radar Hill Road From 229<sup>th</sup> Street to Long View Road
- » Crash Segment F: Radar Hill Road From Long View Road to SD 44.

Most (95 crashes, or 69 percent) of the non-junction related crashes involved a single-vehicle (i.e., run-off-road, rollover, etc.).



Figure 1-14 – Intersection Crashes by Collision Type (Ten-Year Crashes from 2013-2022)

Source: Pennington County, SD GIS Data, SDGS, USGS, ESRI, Aerial from 2021

### **CRASH HOTSPOTS**

Using the trends identified earlier, additional analysis and evaluation was completed in the study area for the intersections and segments that experienced a high frequency of crashes. This crash hotspot analysis is used to identify specific combinations of crash type and direction to further understand the specific issues at the study intersections and segments.

#### Highway 1416 and Radar Hill Road

The intersection of Highway 1416 and Radar Hill Road experienced the highest number of crashes during the analysis period with 102 crashes. Angle crashes were the most predominant type of crashes (77 crashes, or 75.5 percent) at the intersection. The intersection of Highway 1416 with Radar Hill Road is a divided intersection where the eastbound and westbound approaches of Highway 1416 operate as independent intersections with Radar Hill Road due to the large median (approximately 120 feet) between them.

The intersection of eastbound Highway 1416 and Radar Hill Road experienced 36 angle crashes during the ten-year analysis period. The intersection was converted to an all-way stop-control (AWSC) intersection in 2020. Prior to that, the intersection operated as a side-street stop-controlled intersection with stops on the northbound and southbound approaches. Between 2013 and 2019, the intersection experienced 30 angle crashes, which corresponds to 4.3 angle crashes per year. The major contributing factor to the angle crashes was failure to yield. The number of crashes involving eastbound- and northbound-traveling vehicles, and eastbound- and southbound-traveling vehicles were equal. The rate of angle crashes reduced between 2020 and 2022 (while operating as an AWSC intersection), with the intersection experiencing six angle crashes that corresponds to two angle crashes per year. However, the rate of rearend crashes went up from six crashes in seven years between 2013 and 2019 (0.9 rear-end crashes per year) to six crashes in three years between 2020 and 2022 (two rear-end crashes per year). Rear-end crashes generally occurred along the eastbound approach and northbound approach.

The intersection of westbound Highway 1416 and Radar Hill Road experienced 41 angle crashes. The major contributing factor to the angle crashes was failure to yield. The intersection operates as a side-street stop-controlled intersection with stops on the northbound and southbound approaches. Most of the angle crashes involved vehicles traveling northbound and westbound (20 crashes).

#### Highway 1416 and S Ellsworth Road

There were 25 crashes reported at the intersection of Highway 1416 and S Ellsworth Road during the analysis period. Angle crashes were the most prominent type of crashes (20 crashes, or 80-percent) at the intersection. The intersection of Highway 1416 with S Ellsworth Road is a divided intersection, with a median of approximately 150 feet. Due to the large median, the westbound and eastbound approaches of Highway 1416 are controlled as independent intersections with S Ellsworth Road.

The intersection of eastbound Highway 1416 and S Ellsworth Road experienced 12 crashes, with 10 angle crashes. The number of crashes involving eastbound- and northbound-traveling vehicles, and eastbound- and southbound-traveling vehicles were equal. The major contributing factors to the angle crashes were failure to yield. The northbound approach of the intersection has a negative offset which creates additional conflict points for motorists and increases the crash potential due to poor driver visual cognition of conflicting traffic.

The intersection of westbound Highway 1416 and S Ellsworth Road experienced 13 crashes, with 10 angle crashes. There were seven angle crashes involving northbound- and westbound-traveling vehicles. The intersection is controlled by side-street stop signs. The stop signs were moved from the S Ellsworth Rd approaches to the westbound approach of Highway 1416 in 2020. The northbound approach is uncontrolled, and the southbound approach is yield-controlled. The number of crashes were reduced from 10 crashes between 2013 and 2018 (1.4 crashes per year) to three crashes between 2020 to 2022 (one crash per year).

#### Segment Lighting

The segments of Highway 1416 and Radar Hill Road within the study area do not currently have continuous lighting. The non-junction related crashes by lighting conditions in the study area are summarized in **Table 1-8**.

Segment	Dark conditions with No street Lighting	Day conditions or dark conditions with some street lighting	Total
Α	12	9	21
В	12	15	27
С	13	21	34
D	7	20	27
E	10	11	21
F	5	2	7
TOTAL	59	78	137

 Table 1-8 – Non-Junction Related Crashes by Lighting Conditions

» Crash Segment A: Highway 1416 – From 151<sup>st</sup> Avenue to west of Cottonwood Drive

» Crash Segment B: Highway 1416 – From west of Cottonwood Drive to Radar Hill Road

» Crash Segment C: Highway 1416 – From Radar Hill Road to W Gate Road

» Crash Segment D: Radar Hill Road – From Highway 1416 to 229<sup>th</sup> Street

» Crash Segment E: Radar Hill Road – From 229<sup>th</sup> Street to Long View Road

» Crash Segment F: Radar Hill Road – From Long View Road to SD 44

There were 59, or 43-percent, non-junction related crashes reported during the analysis period that occurred under dark conditions with non-roadway lighting. There were 95 single-vehicle non-junction crashes reported for the study area during the analysis period (as shown **Table 1-7**). This includes 41, or 43 percent, single-vehicle non-junction related crashes that occurred during dark conditions where street lighting was non-existent.

## **Capacity Analysis and Demand**

## Intersection Capacity Analysis

Intersection capacity analysis was conducted using HCS 2023 software for each of the study intersections, using both AM and PM peak vehicular and pedestrian volumes. Intersection performance was measured based on delay and Level of Service (LOS). The methodology for vehicular and pedestrian LOS is described in the following sections.
#### VEHICULAR LEVEL OF SERVICE (VLOS)

Vehicular Level of Service (VLOS) is a function of average delay per vehicle. LOS "A" represents free-flow traffic, whereas LOS "F" represents unacceptable delay. LOS "D" or better is considered acceptable for Minor Arterials and Collectors, in accordance with SDDOT standards. LOS delay thresholds are presented in **Table 1-9**.

	Table 1-9 – Intersection Level of Sei	rvice Thresholds
	Average De	lay / Vehicle
Level of	Stop, Yield, and Roundabout	Signalized
Service	Intersections	Intersections
A	< 10 seconds	< 10 seconds
В	10 to 15 seconds	10 to 20 seconds
С	15 to 25 seconds	20 to 35 seconds
D	25 to 35 seconds	35 to 55 seconds
E	35 to 50 seconds	55 to 80 seconds
F	> 50 seconds	> 80 seconds

LOS for two-way stop controlled (TWSC) intersections is currently undefined by the Highway Capacity Manual (HCM). Major roadway through and right-turn movements generally experience no delay, as they are uncontrolled and do not need to yield to any conflicting movements. However, vehicles turning left or crossing the major street can experience significant delay. For this reason, LOS assigned to TWSC intersections in this study were determined based on the delay experienced by side street approaches and left-turning movements, weighted by movement volume. All-way stop controlled (AWSC) intersections are currently signalized or roundabout controlled.

The intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road were modeled as separate intersections due to large median separation between eastbound and westbound approaches, as well as differences in stop-control in each approach. The intersection delay and LOS were measured as a weighted average of all approaches experiencing delay by the volume of each approach.

Vehicular LOS results for each intersection are shown in **Table 1-10**. The intersection delay is presented based on methodology described above. The corresponding LOS value for the intersection delay is shown, as well as the LOS value for the worst approach. Detailed Vehicular Level of Service results can be found in **Appendix B**.

	AM Pea	ak	PM Pe	ak
Intersection	Delay (sec/veh)	LOS*	Delay (sec/veh)	LOS*
Highway 1416 and 151st Ave	9.1	A/A	8.0	A/A
Highway 1416 and Liberty Blvd	9.8	A/B	10.2	B / B
Highway 1416 and S Ellsworth Rd	677.2	F/F	13.5	B/E
Highway 1416 and Radar Hill Rd	26.9	D/E	32.8	D/F
Radar Hill Rd and Long View Rd	8.4	A/A	8.8	A/A
Radar Hill Rd and SD 44	10.5	B / B	2.6	A / B

Table 1-10 – Existing Intersection Vehicular Capacity Analysis

\*[Intersection LOS] / [Worst approach LOS]

#### AM Peak

During the AM peak, it was determined that the intersection of Highway 1416 and S Ellsworth Road experiences severely unacceptable delay and LOS, with both the intersection and worst approach reaching LOS F. The unacceptable conditions are primarily caused by a significant number of eastbound vehicles making a left turn at the intersection. On the recorded day, this uncontrolled movement had 618 vehicles during the peak hour. This equates to approximately one vehicle every 6 seconds for the entire hour leaving few gaps for all other movements.

The intersection of Highway 1416 and Radar Hill Road also experiences severely unacceptable delay and LOS, with the worst approach reaching LOS E. The worst approach at this intersection is the northbound approach of the eastbound portion of Highway 1416 (south of the median). The unacceptable delay at this approach is the result of the minimal storage space in the median separating eastbound and westbound Highway 1416 being exceeded by queueing vehicles, which causes queueing and delays for vehicles attempting to enter the median.

All other intersections operate under acceptable delay and LOS during the AM peak.

#### PM Peak

During the PM peak, it was determined that the intersection of Highway 1416 and S Ellsworth Road experiences unacceptable delay and LOS, with the worst approach reaching LOS E. The worst approach at this intersection is the southbound approach of the eastbound portion of Highway 1416 (south of the median). High eastbound volumes at this intersection make it difficult for drivers to find acceptable gaps to cross or merge onto the highway. This intersection also experiences higher southbound volumes during the PM peak as vehicles travel away from the Ellsworth Air Force Base.

The Highway 1416 and Radar Hill Road intersection also experiences severely unacceptable delay and LOS, with the worst approach reaching LOS F. The worst approaches at this intersection are the northbound and eastbound left/thru approaches of the eastbound portion of Highway 1416 (south of the median). Minimal median storage causes significant queueing and delays for vehicles attempting to enter the median.

All other intersections operate under acceptable delay and LOS during the PM peak.

#### PEDESTRIAN AND BICYCLE LEVEL OF SERVICE (PLOS/BLOS)

Pedestrian Level of Service (PLOS) and Bicycle Level of Service (BLOS) are measures of a segment's walkability and bikeability. The *Highway Capacity Manual* provides a PLOS and BLOS calculation for segments, incorporating roadway design, adjacent vehicular volume, presence of parking and other buffers, and existing pedestrian and bicycle facilities. The segments are scored with LOS A through F, with LOS A representing satisfactory facilities for bicycles and pedestrians, and LOS F representing a facility that is unsuitable for bicycles and pedestrians. A score value that corresponds to PLOS and BLOS characteristics within a given system is shown in **Table 1-11**.

Score Range	PLOS or BLOS
≤ 1.50	A
≥1.51 and ≤2.50	В
≥2.51 and ≤3.50	С
≥3.51 and ≤4.50	D
≥4.51 and ≤5.50	E
≥5.51	F

Table 1-11 – PLOS and BLOS Scoring Thresholds

The study area was split into eight segments for the PLOS and BLOS analysis, due to difference in directional ADT, speed limit changes, and the presence and width of shoulders. The segment descriptions and PLOS and BLOS results are shown in **Table 1-12**. Detailed PLOS and BLOS results can be found in **Appendix C**.

Cognost	PLC	)S	BLC	)S	
Segment	Score	LOS	Score	LOS	
<b>Highway 1416</b> 151st Ave to Liberty Blvd	4.92	E	4.20	D	
WB Highway 1416 Liberty Blvd to S Ellsworth Rd	4.08	D	4.08	D	
WB Highway 1416 S Ellsworth Rd to W Gate Rd	4.55	E	4.87	E	
<b>EB Highway 1416</b> Liberty Blvd to S Ellsworth Rd	4.06	D	4.89	E	
<b>EB Highway 1416</b> <i>S Ellsworth Rd to W Gate Rd</i>	4.57	E	4.90	E	
<b>Radar Hill Rd</b> Highway 1416 to 228th St	4.02	D	4.26	D	
<b>Radar Hill Rd</b> 228th St to 229th St	3.07	С	1.50	А	
<b>Radar Hill Rd</b> 229th St to SD 44	3.92	D	3.81	D	

Table 1-12 – Existing Pedestrian LOS (PLOS) and Bicycle LOS (BLOS) Results

PLOS and BLOS scores are generally unfavorable throughout the study area. This is primarily due to a lack of walkable and bikeable facilities. The Radar Hill Road segment from 228<sup>th</sup> Street to 229<sup>th</sup> Street has a ten-foot shoulder on both sides of the roadway, which contributes to the increased PLOS, and the satisfactory BLOS.

Providing adequate pedestrian and bicycle facilities along Highway 1416 and Radar Hill Road is expected to increase the PLOS and BLOS.

# Summary

### **Corridor Characteristics**

- » The access management analysis determined that Radar Hill Road exceeds SDDOT standards of five accesses per side per mile between Highway 1416 and SD 44, with an average of 6.3 and 8.5 accesses per mile, on the west and east sides, respectively.
- » A negative offset exists on S Ellsworth Road at the intersection with eastbound Highway 1416. Realignment of this intersection to remove the negative offset should be considered.
- The only existing multimodal facilities within the study area consists of a ten-foot shoulder on both sides of Radar Hill Road between 228<sup>th</sup> Street and 229<sup>th</sup> Street. No dedicated sidewalks or bike lanes exist within the study area.
- » Proximity to Box Elder Road to the north and the railroad tracks to the south limits available right-ofway for Highway 1416. The proximity also leads to safety and operational concerns at the intersections along Box Elder Road and the railroad.
- The northbound queues entering Highway 1416 at Radar Hill Road and Ellsworth Drive can extend to the railroad tracks causing safety concerns. Likewise, the southbound approaches onto Highway 1416 can extend across Box Elder Road causing delays and safety concerns with the intersections of the frontage road.
- » The atypical traffic control at Highway 1416's intersections with Radar Hill Road, Commercial Gate Road, and Ellsworth Drive could lead to driver confusion and become a potential safety hazard.

# Safety

- » There were 357 crashes reported during the 10-year analysis period in the study area.
- » There were 177 crashes reported in the Highway 1416 segments of the study area.
- » There were 180 crashes reported in the Radar Hill Road segment of the study area.
- » There were two (2) fatal and twenty (20) incapacitating injury crashes reported.
- » There was one pedestrian-related crash and three crashes involving bicyclists reported.
- » The frequency of crashes was generally high along the intersections of Highway 1416 with W Gate Road, Radar Hill Road, Commercial Gate Road, and S Ellsworth Road.
- » Angle (120 crashes) and rear-end (43 crashes) were the most typical crash types at the study intersections along Highway 1416.

- » Most (95 crashes, or 69 percent) of the non-junction related crashes were single-vehicle related, like run-off-road, roll over, etc. This includes 41, or 43 percent, single-vehicle non-junction related crashes that occurred during dark conditions where street lighting were minimum to non-existent.
- The intersection of Highway 1416 and Radar Hill Road experienced the highest number of crashes during the analysis period, with 102 crashes. Angle crashes were the most prominent type of crashes (77 crashes, or 75.5 percent) at the intersection.
- There were 25 crashes reported at the Highway 1416 and S Ellsworth Road intersection during the analysis period. Angle crashes were the most prominent type of crashes (20 crashes, or 80 percent) at the intersection.

# **Traffic Volumes**

- » KLJ collected traffic volumes at six study intersections on May 9 and May 23, 2023.
- » The AM peak was determined to be 7:00 AM, and the PM peak was determined to be 4:30 PM. These peak times were validated using StreetLight data.

# **Capacity Analysis**

- » Highway 1416 and S Ellsworth Road operates at LOS F during the AM peak, and LOS E during the PM peak.
- » Highway 1416 and Radar Hill Road operates at LOS E during the AM peak, and LOS F during the PM peak, brought on by queueing in the median.
- » All other study intersections operate under acceptable delay and LOS during the AM and PM peaks.
- The majority of the segments within the study area operate under unacceptable Pedestrian LOS (PLOS) and Bicycle LOS (BLOS), due to a lack of dedicated pedestrian and bicycle facilities.

# **Chapter 2 – FUTURE CONDITIONS**

# **Future Volumes**

Existing traffic counts were collected by KLJ in May of 2023 at the six study intersections. These volumes were projected to the 2030 and 2050 analysis years. The basis of the growth was derived from the Rapid City Area MPO regional model. However, the model does not currently account for some planned developments in the study area. The projection for the general background growth was adjusted to account for anticipated growth due to expansion of the Ellsworth Air Force Base. Annual growth rates were estimated using the Rapid City Area MPO regional model. Furthermore, additional traffic due to the development of two new schools and a multi-family housing development directly adjacent to the study area were also incorporated into the future volume counts. The methodology for the development of the volumes used in the analysis is included in this section.

#### Annual Growth Rate

Annual growth rates by movement at each of the study intersections were developed using Average Daily Traffic (ADT) values within the study area, and accounting for additional growth expected from the Ellsworth Air Force Base. ADTs for the years 2018 and 2045 were provided by the Rapid City Area MPO along the relevant segments of the Highway 1416 and Radar Hill Road corridors. The Ellsworth Air Force Base is expected to expand by approximately 4,000 people by the year 2030, which represents a population growth of 2.30% in the City of Box Elder. This growth rate was applied to the anticipated growth between the 2018 and 2045 ADTs to develop an annual growth rate using **Equation 1**.

Equation 1 – Annual Growth Rate

Annual Growth Rate =  $\left(\frac{ADT2045 * (1 + 2.30\%)}{ADT2018}\right)^{\frac{1}{2045 - 2018}} - 1$ 

This equation provided annual growth rate by approach, which was then averaged between relevant movements to determine annual growth rate by movement, as ADT is bi-directional (e.g., the annual growth rate applied to northbound left movements was an average of the *northbound* annual growth rate and the *eastbound* annual growth rate). The annual growth rates by movement are presented in **Table 2-1**.

	No	orthbou	nd	So	uthbou	nd	E	astboun	ıd	Westbound				
	L	Т	R	L	Т	R	L	Т	R	L	Т	R		
Highway 1416 and 151st Ave	-	-	-	0.61%	-	0.61%	0.61%	0.45%	-	-	0.45%	0.61%		
Highway 1416 and Liberty Blvd	0 30%	0.19%	0.30%	0.24%	0.19%	0.24%	0.24%	0.30%	0.30%	0.30%	0.30%	0.24%		
WB Highway 1416 and S Ellsworth Rd	0.61%	0.76%	-	-	0.76%	0.91%	-	-	-	0.75%	0.89%	0.90%		
EB Highway 1416 and S Ellsworth Rd	- 1	0.61%	0.89%	0.61%	0.61%	-	0.71%	0.81%	0.81%	-	-	-		
WB Highway 1416 and Radar Hill Rd	0.6/%	0.62%	-	-	0.62%	0.61%	-	-	-	0.69%	0.77%	0.77%		
EB Highway 1416 and Radar Hill Rd	- 1	0.62%	0.77%	0.62%	0.62%	-	0.69%	0.77%	0.77%	-	-	-		
Radar Hill Rd and Long View Rd	1.67%	1.01%	0.78%	0.92%	1.01%	1.82%	1.82%	1.58%	1.67%	0.78%	1.58%	0.92%		
Radar Hill Rd and SD 44	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%		
			1-16	eft: T –	Throug	h·R — F	Riaht							

Table 2-1 – Annual Growth Rate by Movement

L – Left; I – Through; R – Right

The annual growth rates were then applied to the existing (2023) volumes and projected to design years 2030 and 2050 for the AM and PM peaks.

#### Future Development

There have been two Traffic Impact Studies (TISs) completed that are expected to have measurable impact on the study intersections before the 2030 analysis year. One TIS discussed impacts from two different developments (Box Elder High School and Multi-Family Housing). These TISs were reviewed, and the additional trips expected due to the new developments were included in the projected traffic volumes for this study.

#### BOX ELDER HIGH SCHOOL (2021)

A new high school is proposed to be constructed on a 60-acre site between 151<sup>st</sup> Avenue and Liberty Boulevard, north of Highway 1416. This school is anticipated have 1,400 students and generate 728 trips during the AM school peak, and 196 trips during the PM school peak.

The additional volumes anticipated at each of the study intersections during the AM and PM peaks is shown in Table 2-2. The afternoon school peak (based on afternoon dismissal time) does not fall during the network PM peak; therefore, additional trips were added based on the PM peak of adjacent traffic. No additional trips are expected at the intersections of Radar Hill Road and Long View Drive, or Radar Hill Road and SD 44.

	Northbound			Soι	uthbou	und	Ea	stbou	nd	Westbound		
	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave				5 (1)		89 (36)	165 (32)	1			1	9 (2)
Highway 1416 and Liberty Blvd		17 (3)	7 (1)	37 (8)	8 (4)	89 (38)	182 (35)	121 (24)		4 (2)	59 (26)	24 (8)
WB Highway 1416 and S Ellsworth Rd					49 (9)					24 (10)	100 (43)	24 (10)
EB Highway 1416 and S Ellsworth Rd			49 (9)	49 (9)	24 (10)			205 (39)				
WB Highway 1416 and Radar Hill Rd										19 (11)	80 (32)	1
EB Highway 1416 and Radar Hill Rd			63 (9)	2				140 (30)				

#### Table 2-2 – Box Elder High School – Additional Trips

L – Left; T – Through; R – Right AM (PM)

## MULTI-FAMILY HOUSING

A new multi-family housing development is expected to be constructed before the 2030 analysis year. The additional trips generated by this development were included in the TIS for the Box Elder High School. The multi-family housing development is anticipated to be developed south of the High School, north of Highway 1416, and between Liberty Boulevard and 151<sup>st</sup> Avenue. The development is expected to have 200 dwelling units and generate 80 trips during the AM network peak, and 102 trips during the PM network Peak.

The additional volumes anticipated at each of the study intersections during the AM and PM peaks is shown in **Table 2-3**. No additional trips are expected at the intersections of Radar Hill Road and Long View Drive, or Radar Hill Road and SD 44.

	Northbound			Soι	ıthbou	ınd	Ea	stbou	nd	Westbound		
	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave				(1)		21	6					1
Highway 1416 and Liberty Blvd		1		(1) 2	2	(13) 23	(22) 7	5		1	15	(1) 5
		(2)	(1)	(5)	(1)	(14)	(24)	(16)		(1)	(10)	(3)
WB Highway 1416 and S Ellsworth Rd					2					6	26	6
					(6)					(4)	(16)	(4)
EB Highway 1416 and S Ellsworth Rd			2 (6)	2 (6)	6 (4)			8 (27)				
WB Highway 1416 and Radar Hill Rd										5	21	
5 7, 11 11										(4)	(12)	
EB Highway 1416 and Radar Hill Rd			2	1				5				
<b>5</b> , <b>1</b>			(6)					(21)				

Table 2-3 – Multi-Family Housing Development – Additional Trips

L – Left; T – Through; R – Right AM (PM)

#### **DOUGLAS SCHOOL DISTRICT (2022)**

A new elementary school is anticipated to be constructed on a site along Creekside Drive between Coyote Trail and Morgen Road. This school is anticipated have 600 students and generate 450 trips during the AM peak, and 96 trips during the PM peak.

The additional volumes anticipated at each of the study intersections during the AM and PM peaks is shown in **Table 2-4**. The afternoon school peak does not fall during the network PM peak; therefore, additional trips were added based on the PM peak of adjacent traffic. No additional trips are expected at the intersections of Radar Hill Road and Long View Drive, or Radar Hill Road and SD 44.

	North	nbound	ł	South	ound		East	bound		Westbound		
	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave												
Highway 1416 and Liberty Blvd												
WB Highway 1416 and S Ellsworth Rd		41 (10)			49 (9)							
EB Highway 1416 and S Ellsworth Rd		41 (10)			49 (9)							
WB Highway 1416 and Radar Hill Rd	4 (1)	22 (4)			19 (4)							
EB Highway 1416 and Radar Hill Rd		21 (5)			19 (4)				5 (1)			

Table 2-4 – Douglas School District Elementary School – Additional Trips

L – Left; T – Through; R – Right AM (PM)

## **Future Volumes**

The future volumes for the analysis years 2030 and 2050 were determined by applying the annual growth rates (**Table 2-1**) to the existing 2023 turning movement counts and adding the expected volumes due to the three new developments described above (**Table 2-2**, **Table 2-3**, and **Table 2-4**). The projected volumes for the AM and PM peaks of the build year 2030 are shown in **Table 2-5** and **Table 2-6**, respectively.

2030 No-Build Volumes	No	rthbou	ınd	So	uthbou	und	Ea	stbou	nd	Westbound		
AM Peak – 7:00	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave	-	-	-	11	-	146	179	41	-	-	99	19
Highway 1416 and Liberty Blvd	4	51	10	60	19	141	326	150	3	7	90	171
WB Highway 1416 and S Ellsworth Rd	90	752	-	-	128	207	-	-	-	30	173	44
EB Highway 1416 and S Ellsworth Rd	-	190	59	62	96	-	650	335	16	-	-	-
WB Highway 1416 and Radar Hill Rd	179	28	-	-	37	17	-	-	I	107	454	7
EB Highway 1416 and Radar Hill Rd	-	197	314	12	111	-	5	702	64	-	-	-
Radar Hill Rd and Long View Rd	2	26	4	4	41	116	80	7	2	6	18	10
Radar Hill Rd and SD 44	5	2	2	21	3	11	16	232	6	3	221	19

#### Table 2-5 – Projected Volumes – 2030 (AM Peak)

L – Left; T – Through; R – Right

#### Table 2-6 – Projected Volumes – 2030 (PM Peak)

2030 No-Build Volumes	No	rthbou	und	Sou	uthbou	und	Ea	stbou	nd	Westbound		
PM Peak – 16:30	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave	-	-	-	6	-	65	92	87	-	-	52	5
Highway 1416 and Liberty Blvd	8	16	2	125	26	107	97	83	13	7	64	66
WB Highway 1416 and S Ellsworth Rd	38	356	-	-	93	273	-	-	-	29	135	21
EB Highway 1416 and S Ellsworth Rd	-	87	22	22	100	-	306	150	152	-	-	-
WB Highway 1416 and Radar Hill Rd	118	34	-	-	18	11	-	-	-	209	605	4
EB Highway 1416 and Radar Hill Rd	-	132	138	5	206	-	20	475	205	-	-	-
Radar Hill Rd and Long View Rd	2	50	5	8	40	122	145	12	2	3	7	5
Radar Hill Rd and SD 44	7	2	2	25	8	26	42	141	13	2	236	26

L – Left; T – Through; R – Right

The projected volumes for the AM and PM peaks of the design year 2050 are shown in **Table 2-7** and **Table 2-8**, respectively.

#### Table 2-7 – Projected Volumes – 2050 (AM Peak)

2050 No-Build Volumes	No	rthbou	ind	So	uthbou	ind	Ea	stbou	nd	Westbound		
AM Peak – 7:00	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave	-	-	-	11	-	151	180	44	-	-	108	20
Highway 1416 and Liberty Blvd	4	52	10	61	19	142	333	151	3	7	91	178
WB Highway 1416 and S Ellsworth Rd	102	868	-	-	132	248	-	-	-	30	182	47
EB Highway 1416 and S Ellsworth Rd	-	209	60	63	98	-	748	356	19	-	-	-
WB Highway 1416 and Radar Hill Rd	202	28	-	-	40	19	-	-	-	120	512	8
EB Highway 1416 and Radar Hill Rd	-	220	356	13	123	-	5	794	73	-	-	-
Radar Hill Rd and Long View Rd	2	32	4	4	50	166	114	10	2	7	25	12
Radar Hill Rd and SD 44	6	2	2	25	3	13	20	278	7	3	265	22
	1 - 1	eft · T	– Thr	ouah	R - Ri	aht						

L – Left; T – Through; R – Right

2050 No-Build Volumes	No	rthbou	und	Sou	uthbou	und	Ea	stbou	nd	Westbound		
PM Peak – 16:30	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Highway 1416 and 151st Ave	-	-	-	6	-	67	97	95	-	-	57	5
Highway 1416 and Liberty Blvd	8	16	2	131	27	110	99	86	13	7	66	69
WB Highway 1416 and S Ellsworth Rd	43	413	-	-	104	327	-	-	-	32	150	22
EB Highway 1416 and S Ellsworth Rd	-	96	23	23	109	-	352	165	178	-	-	-
WB Highway 1416 and Radar Hill Rd	134	38	-	-	20	12	-	-	-	237	697	4
EB Highway 1416 and Radar Hill Rd	-	148	158	5	232	-	23	545	239	-	-	-
Radar Hill Rd and Long View Rd	2	61	5	9	49	174	207	16	2	3	10	6
Radar Hill Rd and SD 44	8	2	2	30	9	31	50	169	16	2	283	31
	1_1	ρft·T	– Thr	ough.	R _ Ri	aht						

#### Table 2-8 – Projected Volumes – 2050 (PM Peak)

L – Left; T – Through; R – Right

# **Capacity Analysis and Demand**

#### Intersection Capacity Analysis

Intersection capacity analysis was conducted using HCS 2023 software for each of the study intersections, using both AM and PM peak vehicular volumes. Intersection performance was measured based on delay and Level of Service (LOS). The vehicular Level of Service was determined using the methodology described in Existing Conditions. Detailed Vehicular Level of Service results can be found in **Appendix D**.

#### **LEVEL OF SERVICE RESULTS – 2030**

The LOS results under 2030 projected conditions are presented in **Table 2-9**.

#### Table 2-9 – Future Intersection Vehicular Capacity Analysis Results (2030)

	AM Pea	ak	PM Peak		
Intersection	Delay (sec/veh)	LOS*	Delay (sec/veh)	LOS*	
Highway 1416 and 151st Ave	9.0	A/B	6.5	A/A	
Highway 1416 and Liberty Blvd	116.5	F/F	12.7	B/C	
Highway 1416 and S Ellsworth Rd	4493.0	F/F	90.6	F/F	
Highway 1416 and Radar Hill Rd	66.5	F/F	68.7	F/F	
Radar Hill Rd and Long View Rd	8.6	A/A	9.1	A/A	
Radar Hill Rd and SD 44	11.0	B / B	2.8	A / B	

\*[Intersection LOS] / [Worst approach LOS]

#### AM Peak

During the AM peak under forecasted 2030 conditions, it was determined that the Intersection of Highway 1416 and Liberty Boulevard is expected to experience unacceptable delay and LOS, with both the intersection and worst approach reaching LOS F. The unacceptable conditions are due to northbound and southbound vehicles experiencing significant delay, as they are unable to find an acceptable gap in the high eastbound and westbound volumes.

The intersection of Highway 1416 and S Ellsworth Road is also expected to experience severely unacceptable delay and LOS during the AM peak in 2030, with both the intersection and worst approach reaching LOS F. These conditions were reached under existing conditions as well. The unacceptable conditions are primarily caused by a significant number of eastbound vehicles making a left turn, causing severe queueing in the median separating eastbound and westbound Highway 1416. The eastbound approach at this intersection is free flowing (i.e., there is no stop control at this approach). However, some delay is still experienced, as the high volume of left-turning vehicles exceeds the capacity of a single lane. This queueing causes spillback for eastbound movements, as well as northbound vehicles along S Ellsworth Road.

The intersection of Highway 1416 and Radar Hill Road is also expected to experience unacceptable delay and LOS during the AM peak in 2030, with both the intersection and worst approach reaching LOS F. These conditions were reached under existing conditions as well. The unacceptable conditions are primarily caused by a high northbound volume, and vehicles being unable to find an acceptable gap to cross or enter Highway 1416 due to high eastbound and westbound volumes. Minimal storage space in the median separating eastbound and westbound Highway 1416 also causes significant queuing and spillback affecting the northbound movements, as well as eastbound vehicles attempting to turn left.

All other study intersections are expected to operate under acceptable delay and LOS during the AM peak in 2030.

#### PM Peak

During the PM peak under projected 2030 conditions, it was determined that the intersection of Highway 1416 and S Ellsworth Road is expected to experience unacceptable delay and LOS, with the intersection reaching LOS C, and the worst approach reaching LOS F. The worst approach at this intersection during the PM peak is the southbound approach of the eastbound portion of Highway 1416 (south of the median). High eastbound volumes at this intersection make it difficult for southbound vehicles to find acceptable gaps to cross or enter Highway 1416, causing significant queueing and delay that impacts the southbound and westbound vehicles. This intersection also experiences higher southbound volumes during the PM peak as vehicles travel away from the Ellsworth Air Force Base.

The intersection of Highway 1416 and Radar Hill Road is also expected to experience unacceptable delay and LOS during the PM peak in 2030, with the intersection reaching LOS E and the worst approach reaching LOS F. The worst approaches at this intersection during the PM peak are the northbound and eastbound approaches of the eastbound portion of Highway 1416 (south of the median). Minimal storage space in the median and high eastbound left volumes cause significant queueing and delay that affects eastbound and northbound vehicles.

All other study intersections are expected to operate under acceptable delay and LOS during the PM peak in 2030.

#### LEVEL OF SERVICE RESULTS – 2050

The LOS results under 2050 projected conditions are presented in Table 2-10.

	AM Pea	ak	PM Peak		
Intersection	Delay (sec/veh)	LOS*	Delay (sec/veh)	LOS*	
Highway 1416 and 151st Ave	9.8	A/B	8.4	A/A	
Highway 1416 and Liberty Blvd	152.5	F/F	13.1	B/C	
Highway 1416 and S Ellsworth Rd	15432.5	F/F	166.1	F/F	
Highway 1416 and Radar Hill Rd	202.5	F/F	359.3	F/F	
Radar Hill Rd and Long View Rd	9.4	A/A	13.3	B/C	
Radar Hill Rd and SD 44	11.9	B / B	2.9	A / B	

Table 2-10 – Future Intersection Vehicular Capacity Analysis Results (2050)

#### AM Peak

During the AM peak under projected 2050 conditions, it was determined that the intersection of Highway 1416 and Liberty Boulevard is expected to experience unacceptable delay and LOS, with both the intersection and worst approach reaching LOS F. These conditions were met under 2030 conditions and are expected to worsen with continued growth in the surrounding network.

The intersection of Highway 1416 and S Ellsworth Road is also expected to experience severely unacceptable delay and LOS during the AM peak in 2050, with both the intersection and worst approach reaching LOS F. These conditions were reached under existing conditions, as well as projected 2030 conditions, and are expected to worsen with continued growth in the surrounding network.

The intersection of Highway 1416 and Radar Hill Road is also expected to experience severely unacceptable delay and LOS during the AM peak in 2050, with both the intersection and worst approach reaching LOS F. Unacceptable conditions were reached under existing conditions, as well as projected 2030 conditions, and are expected to worsen with continued growth in the surrounding network.

All other study intersections are expected to operate under acceptable delay and LOS during the AM peak in 2050.

#### PM Peak

During the PM peak under projected 2050 conditions, it was determined that the intersection of Highway 1416 and S Ellsworth Road is expected to experience unacceptable delay and LOS, with the intersection reaching LOS D, and the worst approach reaching LOS F. Unacceptable conditions were reached under existing conditions, as well as projected 2030 conditions, and are expected to worsen with continued growth in the surrounding network.

<sup>\*[</sup>Intersection LOS] / [Worst approach LOS]

The intersection of Highway 1416 and Radar Hill Road is also expected to experience severely unacceptable delay and LOS during the PM peak in 2050, with both the intersection and worst approach reaching LOS F. Unacceptable conditions were reached under existing conditions, as well as projected 2030 conditions, and are expected to worsen with continued growth in the surrounding network.

All other study intersections are expected to operate under acceptable delay and LOS during the PM peak in 2050.

## Signal Warrant Analysis

The *Manual on Uniform Traffic Control Devices* (MUTCD) provides guidance and standards for the installation of traffic control methods. Intersection control warrant analysis was conducted at the intersections of Highway 1416 and Liberty Boulevard, Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road. Warrants are met based on the number of hours volume criteria are met. The 13-hour volume was projected to 2030 and 2050 using the annual growth rates presented in Table 2-1, with additional volumes added during the AM and school peaks due to the anticipated school developments.

The most commonly analyzed signal warrants are the following:

- Warrant 1: Eight-Hour Vehicular Volume Specific volume thresholds must be met for at least eight hours of an average day.
  - Warrant 1a This warrant applies to locations where a large volume of intersecting traffic is the primary reason for installing a traffic signal.
  - Warrant 1b This warrant applies to locations where Warrant 1a is not met, and where volumes on the major road is so heavy that minor road traffic is unable to enter or cross the major road.
- Warrant 2: Four-Hour Vehicular Volume Specific volume thresholds must be met for at least four hours of an average day. This warrant applies to locations where the volume of intersecting traffic is the primary reason for installing a traffic signal.
- Warrant 3: Peak Hour Specific volume thresholds must be met during a peak hour of an average day. This warrant applies to locations that have higher-than-average volumes during peak hours, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.
- Warrant 7: Crash Experience Specific volume thresholds (similar to Warrants 1a and 1b) must be met for at least eight hours of an average day, and five or more reported crashes of types susceptible to correction by a traffic signal have occurred within one year.
- » MWSA: Multi-Way Stop Application This warrant is to determine if the implementation of a multiway stop control is warranted at an intersection. Specific volume thresholds must be met for at least eight hours of an average day, or five or more reported crashes of types susceptible to correction by a multi-way stop installation have occurred within one year. This warrant applies to locations where the volume of traffic on the intersecting roads is approximately equal.

The signal warrant analysis results for 2030 and 2050 are presented in **Table 2-11** and **Table 2-12**, respectively. Detailed Signal Warrant Analysis results can be found in **Appendix E**.

No-Build (2030)	1a	1b	2	3	7	MWSA
Highway 1416 and Liberty Blvd	1/8	1/8	1/4	0/1	1/8	4/8
Highway 1416 and S Ellsworth Rd	7/8	4/8	7/4	4/1	7/8	14 / 8
Highway 1416 and Radar Hill Rd	13 / 8	9/8	11 / 4	6/1	9/8	6/8

#### Table 2-11 – Signal Warrant Analysis Results (2030)

#### Table 2-12 – Signal Warrant Analysis Results (2050)

No-Build (2050)	1a	1b	2	3	7	MWSA
Highway 1416 and Liberty Blvd	1/8	1/8	1/4	0/1	1/8	4/8
Highway 1416 and S Ellsworth Rd	10 / 8	5/8	9/4	5/1	8/8	15 / 8
Highway 1416 and Radar Hill Rd	13 / 8	13 / 8	13 / 4	8/1	11/8	9/8

A signal is warranted at the intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road under 2030 and 2050 projected conditions.

Standard signal warrants are not met at the intersection of Highway 1416 and Liberty Boulevard. However, MUTCD **Signal Warrant 9: Intersection Near a Grade Crossing** is met at this intersection. This warrant is intended to apply to locations near an at-grade railroad crossing that is currently stop- or yield-controlled and is within 140 feet of the intersection stop line. Specific volume thresholds must be met during the highest traffic volume hour during which rail traffic uses the crossing, and the thresholds vary based on the railroad crossing distance from the intersection stop line. If a traffic signal is installed at an intersection due to this warrant, the MUTCD recommends that the signal shall have actuation on the minor street, preemption control shall be provided, and the railroad crossing shall have flashing-light signals. The intersection of Highway 1416 and Liberty Boulevard was also very close to meeting **Signal Warrant 3: Peak Hour** under projected 2050 no-build conditions. However, only meeting this warrant, does not typically merit the installation of a full-time operating signal. This intersection will have to be monitored and reevaluated periodically to determine if intersection control is warranted after the area around it continues to develop.

# Summary

#### **Traffic Volumes**

- » Traffic volumes collected in 2023 were projected to design years 2030 and 2050 using growth rates developed from ADT data provided by the Rapid City Area MPO, accounting for additional growth due to anticipated expansion of the Ellsworth Air Force Base.
- » Additional trips generated by three new developments near the study area were added to the projected AM and PM peak volumes. Two of the new developments are schools, and the afternoon peaks do not occur during the network PM peak, so additional trips were conservatively added based on the PM peak of adjacent traffic.

# **Capacity Analysis**

- » Highway 1416 and Liberty Boulevard is expected to operate at LOS F during the AM peak under 2030 and 2050 projected no-build conditions.
- » Highway 1416 and S Ellsworth Road is expected to operate at LOS F during both the AM and PM peak under 2030 and 2050 projected no-build conditions.
- » Highway 1416 and Radar Hill Road is expected to operate at LOS F during both the AM and PM peak under 2030 and 2050 projected no-build conditions.
- » Delay and LOS at these intersections are expected to worsen with continued growth in the surrounding network.
- » All other study intersections are expected to operate under acceptable delay and LOS during the AM and PM peaks under 2030 and 2050 projected no-build conditions.

## Signal Warrant Analysis

- » A signal is warranted at the intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road under 2030 and 2050 projected no-build conditions.
- The intersection of Highway 1416 and Liberty Boulevard meets the requirements of Signal Warrant 9 due to its proximity to an at-grade railroad crossing. This intersection was very close to meeting Signal Warrant 3 under projected 2050 no-build conditions.

# **Chapter 3 – ALTERNATIVES ANALYSIS**

# **Interim Alternatives**

Due to severe deficiencies in vehicular Level of Service found in the existing 2023 analysis, interim alternatives were analyzed to provide short-term relief as more permanent solutions continue to develop. The intersections of Highway 1416 and S Ellsworth Road and Highway 1416 and Radar Hill Road were analyzed assuming all-way stop control for the interim scenario. The results of this analysis, along with existing no-build results for comparison, are shown in **Table 3-1**.

		E	Existing - 2023 Future -			- 2030			
		AM P	eak	PM P	eak	AM P	eak	PM P	eak
Intersection	Scenario	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*
Highway 1416 and S	No-Build	598.3	F/F	10.1	B/E	4493.0	F/F	90.6	F/F
Ellsworth Rd	Interim	347.5	F	12.0	В	928.4	F	15.0	В
Highway 1416 and	No-Build	26.9	D/E	32.8	D/F	66.5	F/F	68.7	F/F
Radar Hill Rd	Interim	19.2	С	17.5	С	38.8	E	22.0	С

Table 3-1 – Interim Alternative Results

\*[Intersection LOS] / [Worst approach LOS] (for TWSC)

While all-way stop control at the intersections listed above is not expected to bring the intersections to acceptable operations, the delay and Level of Service is expected to improve significantly. At the time of this report, all-way stop control has been implemented as a short-term solution for the intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Drive, while more permanent and effective alternatives are analyzed, funded, and implemented.

# **Alternatives Development**

Based on Future Conditions results, it was determined that the intersections of Highway 1416 and 151<sup>st</sup> Avenue, and Radar Hill Road and Long View Road, and Radar Hill Road and SD 44 are expected to operate under acceptable conditions in the projected 2030 build year and 2050 design year, and therefore no intersection alternatives are proposed for these locations other than the TWLTL being added to the Radar Hill Road corridor.

Bicycle and Pedestrian Level of Service (LOS) was determined for segments along Highway 1416 and Radar Hill Road in the Existing Conditions Report for this study. Bicycle and Pedestrian LOS was determined to be inadequate for the majority of the segments along both corridors, aside from a portion of Radar Hill Road between 228<sup>th</sup> Street and 229<sup>th</sup> Street, where ten-foot shoulders are present on both sides of the roadway. Though no intersection alternatives are proposed along the Radar Hill Road corridor, the

implementation of a shared-use path along Highway 1416 and the city owned portion of Radar Hill Road as well as widened shoulders on the remainder of Radar Hill Road are expected to greatly improve the Bicycle and Pedestrian LOS.

The intersections of Highway 1416 and Liberty Boulevard, Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Road are expected to operate under unacceptable conditions for both the build year and design year. For this reason, alternative designs for each intersection were proposed to mitigate these deficiencies.

The Highway 1416 corridor is proposed to be converted to a urban corridor to remove the large median separating eastbound and westbound travel. The median area occupies otherwise developable land and the two-stage crossing required perpendicular to Highway 1416 causes severe deficiencies in queueing and delay. It is recommended that Highway 1416 be converted to a combination of a three-lane and five-lane urban corridor, with the centerline aligning more closely with the current westbound travel lanes of Highway 1416 to provide more distance from the adjacent railroad.

Due to existing travel patterns and volumes, all alternatives assume that Highway 1416 is a two-lane rural corridor from 151<sup>st</sup> Avenue to S Ellsworth Road with dedicated left-turn lanes at the Liberty Boulevard intersection. West of the intersection with S Ellsworth Road, Highway 1416 becomes a four-lane semi-urban corridor.

Conceptual designs for each alternative can be found in **Appendix F**. The development of alternatives for each intersection is discussed in the following paragraphs. While no roundabout warrant methodology currently exists, signal warrants have been generally accepted to apply to roundabouts as well. If signal warrants are met, it can be assumed that a roundabout alternative is warranted as well. Ultimate alternative selection will be based on the anticipated results presented in this report, as well as implementation cost, necessary right-of-way, and stakeholder involvement.

## Highway 1416 and Liberty Boulevard

As determined in the Future Conditions chapter of this study, the intersection of Highway 1416 and Liberty Boulevard did not meet signal warrant thresholds for the 2030 build year or 2050 design year. However, **Signal Warrant 9: Intersection Near a Grade Crossing** was met, due to high volumes and its proximity to a railroad crossing that is currently yield-controlled. The alternatives selected for this intersection included a traffic signal, and a single-lane roundabout. The Box Elder Comprehensive Plan (2014) also identifies this intersection as needing safety and mobility improvements.

Capacity analysis results showed that this intersection is expected to operate at LOS F during the AM peak by 2030 under no-build conditions. This is primarily due to significant queueing in the northbound and southbound approaches, as the eastbound and westbound movements experience high volumes and high speeds. Recent development near this intersection is also expected to generate additional trips traveling through this intersection. A traffic signal or roundabout can be reasonably expected to mitigate these deficiencies, if either is shown to be both warranted and feasible.

# Highway 1416 and S Ellsworth Road

The intersection of Highway 1416 and S Ellsworth Road met criteria for three signal warrants, as well as the multi-way stop application warrant, in both the build year and design year. This intersection experiences high volumes making eastbound left-turn movements, particularly during the AM peak, and high southbound right-turn movements, as vehicles travel to and from the Ellsworth Air Force Base north of the study area. Current roadway geometry requires eastbound left-turning movements to occur in two stages, with additional stopping and delay at the median separating eastbound and westbound travel along Highway 1416. This configuration paired with exceptionally high eastbound left-turn movements results in Level of Service failure during the AM and PM peaks. Intersection signalization was considered, with dual left-turn lanes at the eastbound approach to accommodate the high volumes, and a single eastbound through lane. A single-lane roundabout and hybrid roundabout were also analyzed. A fourth alternative was also developed for this intersection that includes a displaced left-turn at the eastbound approach, where eastbound left-turning vehicles cross conflicting westbound through traffic at a signalized crossing before making a left turn onto S Ellsworth Road.

All alternatives developed at the intersection of Highway 1416 and S Ellsworth Road assume that Highway 1416 is a three-lane corridor east of this intersection, and a five-lane corridor west of the intersection.

## Highway 1416 and Radar Hill Road

The intersection of Highway 1416 and Radar Hill Road met criteria for all signal warrants analyzed in both 2030 and 2050. This intersection experiences high volumes in the northbound approach. Minimal storage space in the median separating eastbound and westbound Highway 1416 causes significant queueing and spillback affecting the northbound movements, as well as eastbound vehicles attempting to turn left. A signalized alternative was analyzed, with dedicated left-turn lanes added to all approaches.

Multiple roundabout alternatives were also considered. The first roundabout alternative included a 2x1 design, with two lanes at the eastbound and westbound approaches, and single lanes at the northbound and southbound approaches. The second roundabout was a 2x1 design, with a channelized northbound right lane to accommodate high volumes making this movement during the AM and PM peaks. The third roundabout design included a two-lane westbound approach, and a single-lane eastbound approach, to better align with the off-ramp design of the I-90 interchange to the west. This design also includes a channelized northbound right.

## **Alternatives Summary**

The final alternatives selected for analysis for each of the study intersections are described below.

#### HIGHWAY 1416 AND LIBERTY BOULEVARD

- » No Build: TWSC This alternative includes the intersection remain a stop controlled on the Liberty Boulevard approaches for the time being with the addition of a dedicated left-turn lane for the westbound approach.
- » Alternative 1: Signalized Intersection This alternative includes the implementation of a traffic signal at the intersection, as well as the addition of dedicated left-turn lanes to all approaches.

» Alternative 2: Single-Lane Roundabout – This alternative includes the implementation of a single-lane roundabout.

#### HIGHWAY 1416 AND S ELLSWORTH ROAD

S Ellsworth Road is the intersection where Highway 1416 is proposed to transition from a three-lane to a five-lane urban corridor. All alternatives analyzed have a single-lane approach in each direction on the east side of the intersection, and a two-lane approach in each direction on the west side of the intersection. It should be noted that alternatives 2 and 3 do include a lane drop where an eastbound mainline-lane terminates as a left-turn lane. Typically, designs such as these are discouraged as they can create weaving conflicts near intersection. However, due to the high number of left-turning vehicles compared to through moving on the eastbound approach, it is not anticipated that such an issue will arise.

- » Alternative 1: Signalized Intersection This alternative includes the implementation of a traffic signal at the intersection, as well as the addition of dedicated left-turn lanes to all approaches, as well as dual eastbound left-turn lanes and a single eastbound through lane.
- » Alternative 2: Single-Lane Roundabout This alternative includes the implementation of a single-lane roundabout.
- Alternative 3: Hybrid Roundabout This alternative includes the implementation of a hybrid 2x1 roundabout. The roundabout has an additional dedicated eastbound left-turn lane to accommodate for high volumes, with two circulating lanes at the eastbound and northbound approaches. This design also includes a yield-controlled channelized southbound right-turn lane. Due to the high southbound right-turning volume, this alternative was developed to allow the volumes making this movement to pass by the roundabout without needing to circulate. An acceleration lane for this movement could be considered based on the results of this report, but the analysis was completed assuming this approach includes only a channelized right-turn lane, to remain cost conservative.
- » Alternative 4: Displaced Eastbound Left This alternative includes the implementation of a displaced eastbound left-turn movement. This alternative design includes the eastbound left-turn lane crossing the westbound through traffic at a signalized location west of the intersection with S Ellsworth Road. The eastbound left-turning traffic would then make the left-turning movement at another signal located at S Ellsworth Road.

#### HIGHWAY 1416 AND RADAR HILL ROAD

- » Alternative 1: Signalized Intersection This alternative includes the implementation of a traffic signal at the intersection, as well as the addition of dedicated left-turn lanes to all approaches.
- » Alternative 2: 2x1 Roundabout This alternative includes the implementation of a 2x1 roundabout, with two lanes in the eastbound and westbound directions, and one lane in the northbound and southbound directions.
- » Alternative 3: 2x1 Roundabout with Channelized NBR This alternative includes the implementation of a 2x1 roundabout with two lanes in the eastbound and westbound directions. The northbound approach includes a single lane for through and left-turning traffic, and a channelized right turn lane to accommodate high volumes. The southbound approach at Gumbo Drive is closed allowing for safer movement on Box Elder Road.

» Alternative 4: Hybrid Roundabout – This alternative includes the implementation of a roundabout with two lanes in westbound direction, and a single lane in the eastbound direction. The northbound approach includes a single lane for through and left-turning traffic, and a channelized right turn lane to accommodate high volumes. The southbound approach at Gumbo Drive is closed allowing for safer movement on Box Elder Road.

# **Crash Modification Factors**

Crash modification factors (CMFs) are an effective tool for analyzing alternative designs and estimating their respective safety benefit. CMFs are a multiplicative factor that indicates the proportion of crashes that would be expected after implementing a countermeasure. CMFs with a value less than 1.0 indicate a decrease in expected crashes, and CMFs greater than 1.0 indicate an increase in expected crashes. The Federal Highway Administration (FHWA)'s CMF Clearinghouse website provides a toolbox of CMF values determined through extensive research based on crash data. The CMF Clearinghouse presents each CMF, along with the quality (a measure of research reliability, rated on a scale of one (worst) to five (best)), as well as crash types, crash severities, and area types that the CMF can reasonably be applied to.

CMFs for each of the proposed intersection alternatives are shown in Table 3-2.

Countermeasure	CMF	Crash Type	Crash Severity	Area Type	Quality
Signalized Intersection	<b>0.95</b> (CMF ID: 322)	All	All	Urban	3/5
Install a traffic signal (major road speed limit at least 40	<b>0.33</b> (CMF ID: 323)	Angle	All	Urban	4/5
mph)	<b>2.43</b> (CMF ID: 324)	Rear-End	All	Urban	4/5
	<b>0.28</b> (CMF ID: 206)	All	All	Urban	4/5
Single-Lane Roundabout Conversion of stop-controlled	<b>0.42</b> (CMF ID: 207)	All	All	Rural	4/5
intersection into single-lane roundabout	<b>0.12</b> (CMF ID: 210)	All	А, В, С	Urban	4/5
	<b>0.18</b> (CMF ID: 211)	All	А, В, С	Rural	4/5
	<b>0.95</b> (CMF ID: 208)	All	All	Urban	4/5
<b>2x1 Roundabout</b> Conversion of stop-controlled	<b>0.004</b> (CMF ID: 6159)	All	К, А, В, С	Not specified	2/5
intersection into multi-lane roundabout	<b>2.073</b> (CMF ID: 6158)	All	All	Not specified	2/5
	<b>6.016</b> (CMF ID: 6160)	All	0	Not specified	2/5

 Table 3-2 – Highway 1416 Crash Modification Factors

Crash Severity: K – Fatality; A – Serious injury; B – Minor injury; C – Possible injury; O – Property damage only

Countermeasure	CMF	Crash Type	Crash Severity	Area Type	Quality
Channelized Bight Turn Long	<b>0.734</b> (CMF ID: 11154)	All	All	Not specified	3/5
Channelized Right-Turn Lane Provide Right Turn	<b>0.616</b> (CMF ID: 11152)	All	К, А, В, С	Not specified	3/5
Channelization	<b>0.786</b> (CMF ID: 11153)	All	0	Not specified	2/5
	<b>1.112</b> (CMF ID: 10889)	All	All	Urban and suburban	2/5
	<b>1.224</b> (CMF ID: 10890)	All	К, А, В, С	Urban and suburban	2/5
	<b>1.069</b> (CMF ID: 10891)	All	0	Urban and suburban	2/5
<b>Displaced Left</b> Convert intersection to a	<b>1.244</b> (CMF ID: 10894)	Angle	All	Urban and suburban	2/5
displaced left turn intersection	<b>0.946</b> (CMF ID: 10895)	Rear-end	All	Urban and suburban	2/5
	<b>0.713</b> (CMF ID: 10896)	Head-on	All	Urban and suburban	2/5
	<b>1.519</b> (CMF ID: 10892)	Single vehicle	All	Urban and suburban	2/5
	<b>0.612</b> (CMF ID: 10893)	Other	All	Urban and suburban	2/5

Crash Severity: K – Fatality; A – Serious injury; B – Minor injury; C – Possible injury; O – Property damage only

# **Capacity Analysis and Demand**

# Intersection Capacity Analysis

Intersection capacity analysis was conducted using HCS 2023 software for each of the alternatives described previously, using both AM and PM peak vehicular volumes under 2030 and 2050 scenarios. Intersection performance was measured based on delay and Level of Service (LOS). The methodology for vehicular LOS is described in the following section.

#### VEHICULAR LEVEL OF SERVICE (VLOS)

Vehicular Level of Service (VLOS) is a function of average delay per vehicle. LOS "A" represents free-flow traffic, whereas LOS "F" represents unacceptable delay. LOS "D" or better is considered acceptable for Minor Arterials and Collectors, in accordance with SDDOT standards. LOS delay thresholds are presented in **Table 3-3**.

	Average Delay / Vehicle							
Level of Service	Stop, Yield, and Roundabout Intersections	Signalized Intersections						
A	< 10 seconds	< 10 seconds						
В	10 to 15 seconds	10 to 20 seconds						
C	15 to 25 seconds	20 to 35 seconds						
D	25 to 35 seconds	35 to 55 seconds						
E	35 to 50 seconds	55 to 80 seconds						
F	> 50 seconds	> 80 seconds						

#### Table 3-3 – Intersection Level of Service Thresholds

Vehicular LOS results for each intersection are presented and discussed in the following section. The intersection delay is presented based on methodology described above. The corresponding LOS value for the intersection delay is shown, as well as the LOS value for the worst approach. Detailed Vehicular Level of Service results can be found in **Appendix G**.

## Highway 1416 and Liberty Boulevard

The LOS results for alternatives at Highway 1416 and Liberty Boulevard, under 2030 and 2050 conditions, are presented in **Table 3-4**.

		30	2050							
	AM Pea	ak	PM Peak		AM Peak		PM Peak			
Alternative	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*		
No-Build: TWSC	116.5	F/F	12.7	B/C	152.5	F/F	13.1	B/C		
Alt 1: Signal	17.0	В	8.8	A	17.4	В	9.8	A		
Alt 2: 1x1 RAB	8.2	А	5.3	А	8.4	А	5.4	Α		

Table 3-4 – Highway 1416 and Liberty Boulevard Alternatives Analysis Results

\*[Intersection LOS] / [Worst approach LOS] (for TWSC)

#### **ALTERNATIVE 1**

Delay and LOS results for Alternative 1: Signalized Intersection show that the implementation of a traffic signal at the intersection of Highway 1416 and Liberty Boulevard is expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under both 2030 and 2050 scenarios. The intersection is expected to operate at LOS C during the AM and PM peaks in 2030 and 2050 with the implementation of a traffic signal. Additional traffic timing optimization could further improve LOS results.

#### **ALTERNATIVE 2**

Delay and LOS results for Alternative 2: Single-Lane Roundabout show that the implementation of a singlelane roundabout at the intersection of Highway 1416 and Liberty Boulevard is expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under both 2030 and 2050 scenarios. The intersection is expected to operate at LOS A during the AM and PM peaks in 2030 and 2050 with the implementation of a single-lane roundabout.

# Highway 1416 and S Ellsworth Road

The LOS results for alternatives at Highway 1416 and S Ellsworth Road, under 2030 and 2050 conditions, are presented in **Table 3-5**.

		30		20	50			
	AM Peak		PM Peak		AM Peak		PM Peak	
Alternative	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*
No-Build: TWSC	4493.0	F/F	90.6	F/F	15432.5	F/F	166.1	F/F
Alt 1: Signal, dual EBL	19.9	В	17.5	В	39.4	D	20.1	C
Alt 2: 1x1 RAB	133.3	F	9.0	A	287.3	F	11.0	В
Alt 3: Hybrid RAB	11.8	В	5.7	Α	15.8	С	6.4	Α
Alt 4: Displaced EBL	13.6	В	7.4	А	12.0	В	7.9	Α

Table 3-5 – Highway 1416 and S Ellsworth Road Alternatives Analysis Results

\*[Intersection LOS] / [Worst approach LOS] (for TWSC)

#### **ALTERNATIVE 1**

Delay and LOS results for Alternative 1: Signalized Intersection show that the implementation of a traffic signal at the intersection of Highway 1416 and S Ellsworth Road is expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under both 2030 and 2050 scenarios. The intersection is expected to operate at LOS C during the AM and PM peaks in 2030 and the AM peak of 2050, and it is expected to operate at LOS D during the PM Peak in 2050, with the implementation of a traffic signal. Additional traffic timing optimization could further improve LOS results.

#### **ALTERNATIVE 2**

Delay and LOS results for Alternative 2: Single-Lane Roundabout show that the implementation of a singlelane roundabout at the intersection of Highway 1416 and S Ellsworth Road is not expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under 2030 and 2050 scenarios. The intersection is expected to operate at LOS F during the AM peak in 2030 and 2050 with the implementation of a single-lane roundabout. Based on this analysis, it was determined that a single-lane roundabout is not expected to have the capacity to support the high volumes traveling to the Ellsworth Air Force Base.

#### **ALTERNATIVE 3**

Delay and LOS results for Alternative 3: Hybrid Roundabout show that the implementation of a hybrid roundabout at the intersection of Highway 1416 and S Ellsworth Road, with additional capacity supporting

eastbound left-turning volumes, is expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under 2030 and 2050 scenarios. The intersection is expected to operate at LOS B during the AM peak in 2030 and 2050, and LOS A during the PM peak in 2030 and 2050 with the implementation of a hybrid roundabout.

#### **ALTERNATIVE 4**

Delay and LOS results for Alternative 4: Displaced Eastbound Left show that the implementation of a signalized displaced left-turn in the eastbound approach of Highway 1416 and S Ellsworth Road is expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under 2030 and 2050 scenarios. The intersection is expected to operate at LOS B during the AM peaks and LOS A during the PM peaks in both 2030 and 2050 with the implementation of a displaced eastbound left-turn lane.

### Highway 1416 and Radar Hill Road

The LOS results for alternatives at Highway 1416 and Radar Hill Road, under 2030 and 2050 conditions, are presented in **Table 3-6**.

		30		20	50			
	AM Pe	ak	PM Peak		AM Pe	ak	PM Peak	
Alternative	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*	Delay (s/veh)	LOS*
No-Build: TWSC	66.5	F/F	68.7	F/F	202.5	F/F	359.3	F/F
Alt 1: Signal	20.9	С	18.8	В	26.2	С	19.9	В
Alt 2: 2x1 RAB	16.4	С	7.0	А	63.8	F	8.1	А
Alt 3: 2x1 RAB (ch. NBR)	9.2	А	6.7	А	13.1	В	7.7	А
Alt 4: Hybrid RAB	14.0	В	10.4	В	24.2	С	16.1	С

\*[Intersection LOS] / [Worst approach LOS] (for TWSC)

#### **ALTERNATIVE 1**

Delay and LOS results for Alternative 1: Signalized Intersection show that the implementation of a traffic signal at the intersection of Highway 1416 and Radar Hill Road is expected to mitigate delay and LOS deficiencies expected during the AM and PM peaks, under 2030 and 2050 scenarios. The intersection is expected to operate at LOS C during the AM peaks and LOS B during the PM peaks in both 2030 and 2050 with the implementation of a traffic signal. Alternative 2

Delay and LOS results for Alternative 2: 2x1 Roundabout show that the implementation of a 2x1 roundabout at the intersection of Highway 1416 and Radar Hill Road, with two lanes in the eastbound and westbound directions, is expected to mitigate delay and LOS deficiencies during the AM and PM peaks under 2030 scenarios, but the intersection is expected to remain at LOS F during the AM peak in 2050. High northbound left and right volumes contribute significantly to this deficiency.

#### **ALTERNATIVE 3**

Delay and LOS results for Alternative 3: 2x1 Roundabout with Channelized NBR show that the implementation of a 2x1 roundabout, along with a channelized northbound right-turn lane at the intersection of Highway 1416 and Radar Hill Road is expected to mitigate delay and LOS deficiencies during the AM and PM peaks under 2030 and 2050 scenarios. The intersection is expected to operate at LOS A during the AM and PM peaks in 2030, at LOS B during the AM peak in 2050, and LOS A during the PM peak in 2050.

#### **ALTERNATIVE 4**

Delay and LOS results for Alternative 4: Hybrid Roundabout show that the implementation of a hybrid roundabout, with single lanes in the eastbound and southbound approaches, two lanes in the westbound approach, and a channelized northbound right-turn lane at the intersection of Highway 1416 and Radar Hill Road is expected to mitigate delay and LOS deficiencies during the AM and PM peaks, under 2030 and 2050 scenarios. The intersection is expected to operate at LOS B during the AM and PM peaks in 2030, and LOS C during the AM and PM peaks in 2050.

# Design

## **Right-of-Way Impacts**

Right-of-way was evaluated based on GIS data provided by the City of Rapid City and Pennington County. Based on this data, it is anticipated that this project would have minimal impact on the ROW. However, the data provided is not official, and land survey of property lines would need to be completed to confirm this.

Currently, the Radar Hill Road 3 lane alternative shows minimal property impacts at maximum of 4' based on available data. If those impacts are still present in preliminary design after a property survey is done, alignment tapering can be done to avoid the impacts to the properties if desired by the governing jurisdiction.

# **Anticipated Cost**

An anticipated preliminary cost comparison analysis was completed. The results are shown in **Table 3-7.** The cost estimates assumed 3% annual inflation, a 20% contingency, and an asphalt concrete depth of 8 inches on 14 inches of aggregate base. The city cost estimates shown on the Highway 1416 corridor stem from improvements to approaches on city owned roadways at study intersections. As shown, the lowest-cost alternative for Highway 1416 is Alternative 3 with roundabouts at the Radar Hill Road and S Ellsworth Road intersections. Traffic signals can be more expensive than roundabouts due primarily to the amount of grading and pavement widening necessary. Additionally, the cost of traffic signals was increased due to the lack of existing supporting infrastructure needed.

Preliminary estimates of engineering final design costs are shown in **Table 3-8**. This estimate includes 20% contingency, and does not include construction support, or right-of-way processes.

#### Table 3-7 – Preliminary Cost Estimates

« <sup>KL]</sup>		PRELIMINARY COST ESTIMATE SUMMARY														
HWY 1416/ RADAR HILL ROAD ALTERNATIVES	ALTERNATIVE COSTS	ESTIMATED COUNTY COST (A)	ESTIMATED CITY COST (R)	CURB & GUTTER OUTSIDE EDGES OF 1416 COST (C)	RECONSTRUCT FROM UBERTY BLVD TIE TO 1515T ST COST (2 LANE URBAN W/SIDEWALK) (D)	CONSTRUCTION ENGINEERING (A+B+C+O) * 8% = E	TOTAL CONSTRUCTION COST (A+B+C+D+E) = F	DESIGN ENGINEERING F*12%+G								
HWY 1416																
ALTERNATIVE 1 - SIGNALIZED INTERSECTIONS AT RADAR HILL	2023 CONSTRUCTION COST	\$ 16,537,466	\$ 2,993,825	\$ 1,180,080	\$ 2,950,500	\$ 1,892,950	\$ 25,554,821	\$ 3,066,579								
& ELLSWORTH, 3/4 AT COMMERCIAL GATE, 2 WAY STOP AT LIBERTY	2030 CONSTRUCTION COST	\$ 20,338,997	\$ 3,682,027	\$ 1,451,350	\$ 3,628,743	\$ 2,328,089	\$ 31,429,206	\$ 3,771,505								
ALTERNATIVE 2 - SIGNALIZED INTERSECTIONS AT RADAR HILL, DISPLACED LEFT AT ELLSWORTH, 3/4	2023 CONSTRUCTION COST	\$ 17,936,716	\$ 2,793,684	\$ 1,180,080	\$ 2,950,500	\$ 1,988,878	\$ 26,849,858	5 3,221,983								
AT COMMERCIAL GATE, 2 WAY STOP AT LIBERTY	2030 CONSTRUCTION COST	\$ 22,059,899	\$ 3,435,878	\$ 1,451,350	\$ 3,628,743	\$ 2,446,070	\$ 33,021,939	\$ 3,962,633								
ALTERNATIVE 3 - ROUNDABOUTS AT RADAR HILL &	2023 CONSTRUCTION COST	\$ 16,128,683	\$ 2,871,958	\$ 1,180,080	\$ 2,950,500	\$ 1,850,498	\$ 24,981,719	\$ 2,997,806								
ELLSORTH, 3/4 AT COMMERCIAL GATE, 2 WAY STOP AT LIBERTY	2030 CONSTRUCTION COST	\$ 19,836,246	\$ 3,532,146	\$ 1,451,350	\$ 3,628,743	\$ 2,275,879	\$ 30,724,363	\$ 3,686,924								
COST AT LIBERTY TO ADD A SIGNAL	2023 CONSTRUCTION COST	\$ 315,000	\$ 105,000	\$ 1,180,080	\$ 2,950,500	\$ 364,046	\$ 4,934,626	\$ 589,755								
(WHEN WARRANTS ARE MET)	2030 CONSTRUCTION COST	\$ 387,410	\$ 129,137	\$ 1,451,350	\$ 3,628,743	\$ 447,731	\$ 6,044,371	\$ 725,324								
RADAR HILL RD																
ALTERNATIVE 1 -	2023 CONSTRUCTION COST	\$ 7,351,400	\$ 5,253,409	s .	s -	5 1,008,385	\$ 13,613,194	\$ 1,633,583								
2 LANE URBAN WITH WALK	2030 CONSTRUCTION COST	\$ 9,041,295	\$ 6,461,031	s .	s -	5 1,240,186	\$ 16,742,511	\$ 2,009,101								
ALTERNATIVE 2 -	2023 CONSTRUCTION COST	\$ 7,365,795	\$ 5,849,960	s -	s -	\$ 1,057,260	\$ 14,273,016	\$ 1,712,762								
3 LANE URBAN WITH WALK	2030 CONSTRUCTION COST	\$ 9,058,999	\$ 7,194,713	\$ -	\$ -	\$ 1,300,297	\$ 17,554,009	\$ 2,106,481								
ALTERNATIVE 3 -	2023 CONSTRUCTION COST	\$ 6,091,419	\$ 2,220,434	s .	s -	\$ 664,947	\$ 8,976,780	\$ 1,077,214								
PAVEMENT RECONSTRUCTION	2030 CONSTRUCTION COST	\$ 7,491,677	\$ 2,730,829	s -	\$ -	\$ \$17,800	\$ 11,040,307	\$ 1,324,837								

NOTE: 2019 CONSTRUCTION COST ASSUMES 3% ANNUAL INFLATION ALL COSTS INCLUDE 20% CONTINGENCY PAVEMENT ASSUMPTION IS 8" OF ASPHALT CONCRETE ON 34" OF AGGREAGTE BASE A COST OF \$750,000 BIRDGE/ STRUCTURE REPLACEMENT IS INCLUDED WITH RADAR HEL ALTERNATIVES 1 & 2

≪ <sup>KL</sup>	J	PRELIMINARY ESTIMATE O	OF ENGIN	EERING FINAL D	ESIGN COST		
ITEM NO.		DESCRIPTION OF ITEM		City Line Item Subtotal	County Line Item Subtotal	Line Item Subtotal	
	1						
1		Project Management		\$182,433	\$140,707	\$293,140	
2		Quality Control		\$87,936	581,172	\$169,108	
<b>3</b> 10.000	Retuine	Public Gutreach		\$40,022	\$36,943	\$76,965	
Maria da Mar	95100550550550			\$86,561		\$166,464	
4		Suivey	22,600,660,000	586,561	\$79,903	51662484	
ς		Detailed Design Environmental		\$120.869	5111,571	\$232,440	
6	<b>.</b> 88408900980.	Hydraulics Engineering		528,260	526,086	\$54,346	
7		Utilities		\$47,715	\$44,044	\$91,759	
8		Structural Design		\$73,322	\$67,682	\$141,005	
q		Geotechnical Design		\$52,425	548,392	\$100.817	
-							
10.7		Special Provisions		530,042	527,731	557,773	
10.3		Engineers Cost Estimate		\$50,613	\$46,720	\$97,332	
10.5		Plan Review & Approval		\$95,930	588,551	\$184,481	
10.5.2		60% Plans		\$399,650	\$368,908	\$768,558	
10.5.3		90% Plans		\$415,732	\$383,752	\$799,484	
10.5.4		100% Plans		\$8,655	\$7.989	\$16,644.00	
10,5,5		Final Plans		\$2,513	\$2,319	54,832.00	
	I	I TOTAL CITY:	1				
		TOTAL COUNTY: 2023 Engineering Cest TOTAL			\$1,562,471 \$3,25	5.148	
		2030 Engineering Cost TOTAL:				16,646	

#### Table 3-8 – Preliminary Estimate of Engineering Final Design Cost

# Summary

### Interim Alternatives

» All-way stop control is recommended (and has been implemented) as a short-term solution for the intersections of Highway 1416 and S Ellsworth Road, and Highway 1416 and Radar Hill Drive, while more permanent and effective alternatives are analyzed, funded, and implemented.

## Alternatives

- » Alternatives developed and analyzed at **Highway 1416 and Liberty Boulevard** included the following:
  - Alternative 1 signalized intersection, with left-turn lanes at each approach
  - Alternative 2 single-lane roundabout
- » Alternatives developed and analyzed at Highway 1416 and S Ellsworth Road included the following:
  - Alternative 1 signalized intersection, with left-turn lanes at each approach, and a dual leftturn at the eastbound approach
  - Alternative 2 single-lane roundabout
  - Alternative 3 hybrid roundabout, with a dedicated eastbound left-turn lane
  - Alternative 4 displaced eastbound left, with signalization at the intersection, as well as the eastbound left crossing
- » Alternatives developed and analyzed at **Highway 1416 and Radar Hill Road** included the following:
  - Alternative 1 signalized intersection, with left-turn lanes at each approach
  - $\circ~$  Alternative 2 2x1 roundabout, with two travel lanes at the eastbound and westbound approaches
  - Alternative 3 2x1 roundabout, with two travel lanes at the eastbound and westbound approaches, and a channelized northbound right-turn lane
  - Alternative 4 hybrid roundabout, with a single-lane at the eastbound approach, two travel lanes in the westbound approach, and a channelized northbound right-turn lane
- » No alternatives were proposed or analyzed at the intersections of Highway 1416 and 151<sup>st</sup> Avenue, Radar Hill Road and Long View Drive, or Radar Hill Road and SD 44, as these intersections are expected to operate under acceptable conditions in 2050 with no geometric improvements.

# Capacity Analysis

- » The following alternatives are expected to operate under unacceptable delay and LOS in the projected scenarios:
  - Highway 1416 and S Ellsworth Road Alternative 2: 1x1 Roundabout is expected to operate at LOS F during the AM peaks in 2030 and 2050.
  - Highway 1416 and Radar Hill Road Alternative 2: 2x1 Roundabout is expected to operate at LOS F during the AM peak in 2050.
- » All other alternatives presented in this report are expected to operate under acceptable delay and LOS and are expected to improve delay and LOS conditions as compared to the no-build scenarios.

# Recommendations

Based on the capacity results discussed in this report, safety considerations analyzed for the Existing Conditions chapter, and preliminary cost estimates, the following recommendations were developed for each of the study intersections that require improvement:

- » Safety and capacity issues are present now, and they are expected to become worse as traffic increases. Efforts to correct these deficiencies should be undertaken as soon as adequate funding can be found.
- » Highway 1416 and Liberty Boulevard once warranted, the implementation of a traffic signal is recommended at this intersection, due to significant improvements in delay and LOS. Spatial constraints due to the proximity to the BNSF railroad, utilities, and wetlands made it difficult to implement the single-lane roundabout alternative.
- » Highway 1416 and S Ellsworth Road the implementation of a hybrid roundabout is recommended at this intersection, due to significant improvements in delay and LOS. High cost, spatial constraints, public opinion, and construction impacts made the displaced eastbound left-turn alternative a less desirable option. The hybrid roundabout alternative was also shown to be less expensive and expected to be more efficient and safer than the signalized alternative.
- » Highway 1416 and Radar Hill Road the implementation of a 2x1 roundabout with a channelized northbound right-turn lane is recommended at this intersection, due to significant improvements in delay and LOS. The roundabout alternative was also shown to be less expensive and expected to be safer than the signalized alternative.



# Appendix A: Raw Traffic Counts

Radar Hill - 1416 Corridor Study

Time	NB Utrn	NB Left	NB Thru	NB Right	EB Ped & Bikes	WB Ped & Bikes	SB Utrn	SB Left	SB Thru	SB Right	EB Ped & Bikes	WB Ped & Bikes	EB Utrn	EB Left	EB Thru	EB Right	NB Ped & Bikes	SB Ped & Bikes	WB Utrn	WB Left	WB Thru	WB Right	NB Ped & Bikes	SB Ped & Bikes
		NBL	NBT	NBR				SBL	SBT	SBR				EBL	EBT	EBR				WBL	WBT	WBR		
00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	0	0	0	0	0	0	1	0	11	0	0	0	4	4	0	0	0	0	0	12	0	0	0
06:00	0	0	0	0	0	0	0	5	0	22	0	0	0	4	8	0	0	0	0	0	56	1	0	0
07:00	0	0	0	0	0	0	0	5	0	34	0	0	0	7	38	0	0	0	0	0	94	8	0	0
08:00	0	0	0	0	0	0	0	2	0	16	0	0	0	15	30	0	0	0	0	0	40	3	0	0
09:00	0	0	0	0	0	0	0	2	0	16	0	0	0	7	21	0	0	0	0	0	41	3	0	0
10:00	0	0	0	0	0	0	0	3	0	13	0	0	0	12	35	0	0	0	1	0	30	1	0	0
11:00	0	0	0	0	0	0	0	2	0	16	0	0	0	13	36	0	0	0	0	0	34	2	0	0
12:00	0	0	0	0	0	0	0	3	0	23	0	0	0	24	41	0	0	0	0	0	31	2	0	0
13:00	0	0	0	0	0	0	0	4	0	13	0	0	0	16	32	0	0	0	1	0	31	3	0	0
14:00	0	0	0	0	0	0	0	4	0	12	0	0	0	19	45	0	0	0	0	0	33	4	0	0
15:00	0	0	0	0	0	0	0	2	0	10	0	0	0	12	59	0	0	0	0	0	27	3	0	0
16:00	0	0	0	0	0	0	0	3	0	14	0	0	1	33	82	0	0	0	0	0	34	1	0	0
17:00	0	0	0	0	0	0	0	2	0	19	0	0	0	30	75	0	0	0	0	0	55	2	0	0
18:00	0	0	0	0	0	0	0	3	0	8	0	0	0	15	24	0	0	0	0	0	16	2	0	0
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Time	NB Utrn	NB Left	NB Thru	NB Right	EB Ped & Bikes	WB Ped & Bikes	SB Utrn	SB Left	SB Thru	SB Right	EB Ped & Bikes	WB Ped & Bikes	EB Utrn	EB Left	EB Thru	EB Right	NB Ped & Bikes	SB Ped & Bikes	WB Utrn	WB Left	WB Thru	WB Right	NB Ped & Bikes	SB Ped & Bikes
		NBL	NBT	NBR				SBL	SBT	SBR				EBL	EBT	EBR				WBL	WBT	WBR		
00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	1	7	0	0	0	0	10	1	5	0	0	0	13	3	1	0	0	0	0	3	23	0	0
06:00	0	1	18	0	0	0	0	21	6	19	0	0	0	61	10	2	0	0	0	0	8	100	0	0
07:00	0	5	33	3	0	0	1	23	9	39	0	0	0	124	21	1	0	0	0	2	15	126	0	0
08:00	0	2	13	1	0	0	0	20	8	26	0	0	0	26	13	1	0	0	0	2	16	59	0	0
09:00	0	4	14	0	0	0	0	25	10	23	0	0	0	35	11	4	0	0	0	0	9	39	0	0
10:00	0	2	9	0	0	0	2	17	6	17	0	0	0	14	8	4	0	0	0	1	1	22	0	0
11:00	0	3	10	1	0	0	1	27	9	27	0	0	0	28	22	7	0	0	0	3	12	35	0	0
12:00	0	3	7	0	0	0	0	33	7	28	0	0	0	46	23	2	0	0	0	1	11	39	0	0
13:00	0	4	14	2	0	0	0	54	12	35	0	0	0	37	25	3	0	1	0	0	16	37	0	0
14:00	0	6	16	0	0	0	0	39	15	30	0	0	0	37	19	6	1	0	0	1	16	35	0	0
15:00	0	4	18	3	0	0	1	71	20	65	0	0	0	46	33	2	0	0	0	1	14	51	0	0
16:00	0	0	15	1	0	0	0	82	22	49	0	0	0	44	42	12	0	0	0	3	19	47	0	0
17:00	0	8	15	1	0	0	2	92	24	51	0	0	0	39	46	9	0	2	0	4	25	51	0	0
18:00	0	0	11	1	0	0	0	26	8	13	0	0	0	13	18	3	2	0	0	1	4	17	0	0
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Time	NB Utrn	NB Left	NB Thru	NB Right	EB Ped & Bikes	WB Ped & Bikes	SB Utrn	SB Left	SB Thru	SB Right	EB Ped & Bikes	WB Ped & Bikes	EB Utrn	EB Left	EB Thru	EB Right	NB Ped & Bikes	SB Ped & Bikes	WB Utrn	WB Left	WB Thru	WB Right	NB Ped & Bikes	SB Ped & Bikes
		NBL	NBT	NBR				SBL	SBT	SBR				EBL	EBT	EBR				WBL	WBT	WBR		
00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	16	7	2	0	0	0	1	1	31	0	0	0	154	15	2	0	0	0	0	10	0	0	0
06:00	0	46	35	7	0	0	0	3	3	85	0	0	0	621	66	8	0	0	0	2	16	7	0	0
07:00	0	86	56	7	0	0	0	10	16	194	0	0	0	618	115	15	0	0	0	0	44	13	0	0
08:00	0	36	15	5	0	0	0	4	9	130	0	0	1	263	29	10	0	0	0	4	33	7	0	0
09:00	0	24	18	2	0	0	0	8	14	134	0	0	0	212	39	16	0	0	0	2	24	8	0	0
10:00	0	21	11	4	0	0	0	10	14	138	0	0	0	197	42	15	0	0	0	6	36	6	0	0
11:00	0	23	9	2	0	0	0	5	18	156	0	0	0	217	50	26	0	0	0	0	37	3	0	0
12:00	0	22	15	7	0	0	0	13	25	175	0	0	0	279	55	35	0	0	0	3	38	10	0	0
13:00	0	27	19	7	0	0	0	3	10	150	0	0	0	252	62	18	0	0	0	5	40	7	1	0
14:00	0	23	20	3	0	0	0	4	23	170	0	0	0	280	58	32	0	0	0	1	49	13	0	0
15:00	0	28	21	7	0	0	0	9	47	334	0	0	0	263	61	48	0	0	0	6	62	13	0	0
16:00	0	30	26	6	0	0	0	9	45	300	0	0	0	286	78	75	0	1	0	6	63	7	1	1
17:00	0	42	32	4	0	0	0	7	72	237	0	0	1	257	82	152	0	1	0	17	65	3	0	0
18:00	0	25	8	0	0	0	0	0	13	111	0	0	0	85	31	43	0	0	0	2	14	1	0	0
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Time	NB Utrn	NB Left	NB Thru	NB Right	EB Ped & Bikes	WB Ped & Bikes	SB Utrn	SB Left	SB Thru	SB Right	EB Ped & Bikes	WB Ped & Bikes	EB Utrn	EB Left	EB Thru	EB Right	NB Ped & Bikes	SB Ped & Bikes	WB Utrn	WB Left	WB Thru	WB Right	NB Ped & Bikes	SB Ped & Bikes
		NBL	NBT	NBR				SBL	SBT	SBR				EBL	EBT	EBR				WBL	WBT	WBR		
00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	47	1	36	0	0	0	1	2	8	0	0	0	1	143	11	0	0	0	13	48	1	0	0
06:00	0	116	0	170	0	0	0	2	2	14	0	0	0	2	524	32	0	0	0	32	137	5	0	0
07:00	0	167	1	236	0	0	0	8	9	16	0	0	0	4	527	55	0	0	0	79	334	5	0	0
08:00	0	81	7	56	0	0	0	3	9	26	0	0	2	7	243	49	0	0	0	51	202	7	0	0
09:00	0	68	8	59	0	0	0	6	4	10	0	0	1	15	223	46	0	0	0	46	196	2	0	0
10:00	0	64	3	62	0	0	0	3	2	9	0	0	1	9	201	55	0	0	0	55	234	3	0	0
11:00	0	57	3	50	0	0	0	2	3	12	0	0	0	16	250	69	0	0	0	76	295	3	0	0
12:00	0	56	9	88	0	0	0	5	5	20	0	0	0	12	294	75	0	0	0	66	227	2	0	0
13:00	0	68	6	61	0	0	0	1	8	18	0	0	1	16	288	73	0	0	0	65	230	4	0	0
14:00	0	66	2	87	0	0	0	5	9	16	0	0	0	23	292	87	0	0	0	74	316	8	0	0
15:00	0	69	7	82	0	0	0	3	3	10	0	0	0	17	291	104	0	0	0	195	509	5	0	0
16:00	0	89	9	101	0	0	0	5	5	11	0	0	0	19	357	162	0	0	0	182	627	7	0	0
17:00	0	117	8	125	0	0	0	3	8	9	0	0	0	25	377	185	0	0	0	136	437	2	0	0
18:00	0	31	3	26	0	0	0	1	4	6	0	0	0	7	131	70	0	0	0	29	124	4	0	0
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Time	NB Utm	NB Left	NB Thru	NB Right	EB Ped & Bikes	WB Ped & Bikes	SB Utrn	SB Left	SB Thru	SB Right	EB Ped & Bikes	WB Ped & Bikes	EB Utm	EB Left	EB Thru	EB Right	NB Ped & Bikes	SB Ped & Bikes	WB Utrn	WB Left	WB Thru	WB Right	NB Ped & Bikes	SB Ped & Bikes
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		NBL	NBT	NBR				SBL	SBT	SBR				EBL	EBT	EBR				WBL	WBT	WBR		
00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	0	11	3	0	0	0	0	12	21	0	0	0	14	0	1	0	0	0	0	1	1	0	0
06:00	0	0	32	2	0	0	0	3	30	73	0	0	0	64	2	2	0	0	0	3	8	6	0	0
07:00	0	1	16	3	0	0	0	4	42	105	0	0	0	65	5	0	0	0	0	3	16	8	0	0
08:00	0	0	11	6	0	0	0	7	27	55	0	0	0	46	7	1	0	0	0	7	8	8	0	0
09:00	0	2	23	7	0	0	0	6	27	49	0	0	0	40	11	4	0	0	0	8	10	6	0	0
10:00	0	1	27	5	0	0	0	6	26	53	0	0	0	32	7	0	0	0	0	4	9	7	0	0
11:00	0	1	23	5	0	0	0	8	32	48	0	0	0	50	6	3	0	0	0	6	7	6	0	0
12:00	1	1	30	6	0	0	0	6	23	47	0	0	0	57	5	4	0	0	0	5	5	8	0	0
13:00	0	0	20	4	0	0	0	7	20	59	0	0	0	49	4	0	0	0	0	6	9	8	0	0
14:00	0	0	26	6	0	0	0	9	29	72	0	0	0	47	3	1	0	0	0	7	4	6	0	0
15:00	0	2	34	7	0	0	0	4	40	87	0	0	0	80	8	0	0	0	0	4	5	8	0	0
16:00	0	1	44	7	0	0	0	8	40	94	0	0	0	118	8	1	0	0	0	4	9	5	0	0
17:00	0	3	43	2	0	0	0	6	36	93	0	0	0	102	9	1	0	0	0	1	4	3	0	0
18:00	0	2	13	1	0	0	0	3	14	22	0	0	0	43	3	2	0	0	0	1	1	1	0	0
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Time	NB Utrn	NB Left	NB Thru	NB Right	EB Ped & Bikes	WB Ped & Bikes	SB Utrn	SB Left	SB Thru	SB Right	EB Ped & Bikes	WB Ped & Bikes	EB Utm	EB Left	EB Thru	EB Right	NB Ped & Bikes	SB Ped & Bikes	WB Utrn	WB Left	WB Thru	WB Right	NB Ped & Bikes	SB Ped & Bikes
		NBL	NBT	NBR				SBL	SBT	SBR				EBL	EBT	EBR				WBL	WBT	WBR		
00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	1	1	1	0	0	0	7	3	3	0	0	0	7	60	0	0	0	0	0	42	6	0	0
06:00	0	5	6	3	0	0	0	11	5	17	0	0	0	12	159	3	0	0	0	0	107	12	0	0
07:00	0	11	1	2	0	0	0	9	5	25	0	0	0	15	170	4	0	0	0	2	150	4	0	0
08:00	0	6	4	3	0	0	0	16	0	20	0	0	0	15	147	3	0	0	0	3	103	2	0	0
09:00	0	2	2	1	0	0	0	17	3	23	0	0	0	17	177	5	0	0	0	5	135	16	0	0
10:00	0	4	0	3	0	0	0	20	2	10	0	0	0	15	202	8	0	0	0	2	228	15	0	0
11:00	0	7	0	2	0	0	0	21	2	17	0	0	0	24	164	2	0	0	0	4	192	10	0	0
12:00	0	5	3	2	0	0	0	15	6	21	0	0	0	21	168	7	0	0	0	3	253	14	0	0
13:00	0	1	2	5	0	0	0	6	4	14	0	0	0	20	121	4	0	0	0	0	155	6	0	0
14:00	0	8	2	1	0	0	0	10	8	22	0	0	0	18	145	3	0	0	0	1	138	11	0	0
15:00	0	5	1	3	0	0	0	15	6	24	0	0	0	32	170	7	0	0	0	0	193	12	0	0
16:00	0	7	2	0	0	0	0	19	6	24	0	0	0	38	127	11	0	0	0	2	179	18	0	0
17:00	0	7	4	2	0	0	0	12	3	25	0	0	0	29	153	7	0	0	0	2	171	13	0	0
18:00	0	1	1	0	0	0	0	3	4	5	0	0	0	7	68	4	0	0	0	0	62	5	0	0
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

# Appendix B: Vehicular Level of Service (VLOS) Results – Existing

Radar Hill - 1416 Corridor Study

		ŀ	ICS 1	ſwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			Highv	vay 1416	5 and 15	1st Ave		
Agency/Co.							Jurisc	liction			Box E	lder SD				
Date Performed	6/2/2	023					East/	West Stre	eet		Highv	vay 1416	5			
Analysis Year	2023						North	n/South S	Street		151st	Ave				
Time Analyzed	AM p	eak					Peak	Hour Fac	ctor		0.76					
Intersection Orientation	East-\	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Radar	r Hill 141	6 Corrid	or Study												
Lanes																
					Majo	or Street: Ea	st-West									
Vehicle Volumes and Adj	justme	nts														
Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume (veh/h)		7	38				94	8						5		34
Percent Heavy Vehicles (%)		9												16		16
Proportion Time Blocked																
Percent Grade (%)															0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
<b>Critical and Follow-up H</b>	eadwa	ys														
Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.19												6.56		6.36
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.28												3.64		3.44
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)	T	9													51	<u> </u>
Capacity, c (veh/h)		1409													866	
v/c Ratio		0.01													0.06	
95% Queue Length, Q <sub>95</sub> (veh)		0.0													0.2	
Control Delay (s/veh)		7.6	0.1												9.4	
Level of Service (LOS)		A	Α												A	
Approach Delay (s/veh)		1	.2											9	.4	
Approach LOS			4												A	

		ŀ	ICS 1	Гwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage		_	_	Inters	ection	_	_	Highv	vay 1416	5 and 15	1st Ave		
Agency/Co.		-					Jurisc	liction			-	lder SD				
Date Performed	6/2/2	023					East/	West Stre	eet		Highv	vay 1416	5			
Analysis Year	2023						North	/South S	Street		151st	Ave				
Time Analyzed	PM Pe	eak					Peak	Hour Fac	tor		0.83					
Intersection Orientation	East-\	Nest					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Radar	· Hill 141	6 Corrid	or Study	,											
Lanes																
Vehicle Volumes and Adj	justme	nts			Majo	or Street: Ea	st-West									
Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume (veh/h)		36	84				50	1						3		15
Percent Heavy Vehicles (%)		9												16		16
Proportion Time Blocked																
Percent Grade (%)															0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
<b>Critical and Follow-up H</b>	eadwa	ys														
Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.19												6.56		6.36
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.28												3.64		3.44
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		43													22	
Capacity, c (veh/h)		1498													905	
v/c Ratio		0.03													0.02	
95% Queue Length, Q <sub>95</sub> (veh)		0.1													0.1	
Control Delay (s/veh)		7.5	0.2												9.1	
Level of Service (LOS)		Α	Α												Α	
Approach Delay (s/veh)		2	.4											9	.1	
Approach LOS		ŀ	4												Ą	

		ŀ	ICS 1	ſwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			High	way 1416	5 and Lik	erty Blv	d	
Agency/Co.		-					Jurisc	liction			-	lder SD				
Date Performed	6/2/2	023					East/	Nest Stre	eet		High	way 1416	5			
Analysis Year	2023						North	/South S	Street		Liber	ty Blvd				
Time Analyzed	AM P	eak					Peak	Hour Fac	tor		0.84					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	or Study	,											
Lanes																
			_	_				_	_	_			_	_	_	
					Maj	or Street: Ea	st-West									
Vehicle Volumes and Adj	ustme	nts														
Approach			ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	1	0		0	1	1
Configuration		L		TR			LTR				LTR			LT		R
Volume (veh/h)		134	23	2		1	15	139		3	32	2		20	8	28
Percent Heavy Vehicles (%)		8				7				2	2	2		9	9	9
Proportion Time Blocked																
Percent Grade (%)											0				0	
Right Turn Channelized														Y	es	
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)	T	4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.18				4.17				7.12	6.52	6.22		7.19	6.59	6.29
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.27				2.26				3.52	4.02	3.32		3.58	4.08	3.38
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		160				1					44			33		33
Capacity, c (veh/h)		1356				1551					414			406		936
v/c Ratio		0.12				0.00					0.11			0.08		0.04
95% Queue Length, Q <sub>95</sub> (veh)		0.4				0.0					0.4			0.3		0.1
Control Delay (s/veh)		8.0	0.1	0.1		7.3	0.0	0.0			14.7			14.7		9.0
Level of Service (LOS)		A	A	A		A	A	A			В			В		A
Approach Delay (s/veh)		6					.1	I		14	4.7				l 1.8	
Approach LOS			4				4				В				B	

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		H	ICS 7	ſwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			High	way 1416	and Lib	erty Blv	b	
Agency/Co.		-					Jurisc	liction			-	lder SD				
Date Performed	6/2/2	023					East/	Nest Stre	eet		High	way 1416	5			
Analysis Year	2023						North	/South S	Street		Liber	ty Blvd				
Time Analyzed	PM P	eak					Peak	Hour Fac	tor		0.84					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	or Study												
Lanes																
					Majo	or Street: Ea	st-West									
Vehicle Volumes and Adj	justme	nts														
Approach			ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	1	0		0	1	1
Configuration		L		TR			LTR				LTR			LT		R
Volume (veh/h)		37	42	12		3	27	54		7	10	0		110	20	54
Percent Heavy Vehicles (%)		8				7				2	2	2		9	9	9
Proportion Time Blocked																
Percent Grade (%)							•				0				0	
Right Turn Channelized														Y	es	
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.18				4.17				7.12	6.52	6.22		7.19	6.59	6.29
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.27				2.26				3.52	4.02	3.32		3.58	4.08	3.38
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)	T	44				4					20			155		64
Capacity, c (veh/h)		1460				1507					620			676		981
v/c Ratio		0.03				0.00					0.03			0.23		0.07
95% Queue Length, Q <sub>95</sub> (veh)		0.1				0.0					0.1			0.9		0.2
Control Delay (s/veh)		7.5	0.1	0.1		7.4	0.0	0.0			11.0			11.9		8.9
Level of Service (LOS)		Α	A	A		Α	A	A			В			В		A
Approach Delay (s/veh)		3	.1			0	.3			1	1.0			1	1.0	
Approach LOS			4				4				В				В	

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		ŀ	102	WO-	way	Stop	-Cor	ntrol	керс	ort						
General Information							Site	Inform	natio	n						
Analyst	Emm	a Myers-	Verhage				Inters	ection			WB H	ighway	1416 and	d S Ellsw	orth Rd	
Agency/Co.							Jurisd	liction			Box E	lder SD				
Date Performed	6/12/	2023					East/\	Nest Stre	eet		WB H	lighway	1416			
Analysis Year	2023						North	/South S	Street		S Ellsv	worth Ro	ł			
Time Analyzed	AM P	eak					Peak	Hour Fac	ctor		0.84					
Intersection Orientation	North	n-South					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	16 Corrid	or Study	,											
Lanes																
					Majoi	Street: Nor	th-South									
Vehicle Volumes and Adj	ustme	nts														
Approach		1	bound				bound				bound				bound	
Movement	U	L	T	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	2	0	0	0	1	0	0	0	1	1
Configuration						LT		TR		LT					Т	R
Volume (veh/h)						0	44	13		86	674				26	194
Percent Heavy Vehicles (%)						10	10	10		1						
Proportion Time Blocked																
Percent Grade (%)						(	0									
Right Turn Channelized														Y	′es	
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						7.20	6.60	6.30		4.11						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.59	4.09	3.39		2.21						
Delay, Queue Length, an	d Leve	l of S	ervice													
Flow Rate, v (veh/h)	T					26		42		102						Τ
Capacity, c (veh/h)						197		239		1588						
v/c Ratio						0.13		0.17		0.06						
95% Queue Length, Q <sub>95</sub> (veh)						0.5		0.6		0.2						
	-					26.1		23.3		7.4	0.9					
Control Delay (s/veh)								-								
						D		С		Α	Α					
Control Delay (s/veh)							4.4	С			A .6					

								ntrol								
General Information							Site	Inform	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			WB H	lighway	1416 an	d S Ellsw	orth Rd	
Agency/Co.							Jurisd	liction			Box E	lder SD				
Date Performed	6/12/	2023					East/\	Nest Stre	eet		WB H	lighway	1416			
Analysis Year	2023						North	/South S	Street		S Ells	worth Ro	I			
Time Analyzed	PM P	eak					Peak	Hour Fac	tor		0.90					
Intersection Orientation	North	n-South					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	or Study	,											
Lanes																
																_
				_				_								
				_				_								
					Majo	r Street: Nor	th-South									
Vehicle Volumes and Adj	ustme	nts														
Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	2	0	0	0	1	0	0	0	1	1
Configuration						LT		TR		LT					Т	R
Volume (veh/h)						14	71	6		36	328				65	25
Percent Heavy Vehicles (%)						10	10	10		1						
Proportion Time Blocked																
Percent Grade (%)			-			(	0				-				-	
Right Turn Channelized														Ŷ	′es	
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)	T					7.1	6.5	6.2		4.1						Γ
Critical Headway (sec)						7.20	6.60	6.30		4.11						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.59	4.09	3.39		2.21						
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)	T					55		46		40						
Capacity, c (veh/h)						438		459		1534						
v/c Ratio						0.13		0.10		0.03						
95% Queue Length, Q <sub>95</sub> (veh)						0.4		0.3		0.1						
Control Delay (s/veh)						14.4		13.7		7.4	0.2					
Level of Service (LOS)						В		В		A	A					
Approach Delay (s/veh)						14	1 1	1			.0	1				1
							T. I				.0					

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		ŀ	ICS 1	ſwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			EB Hi	ghway 1	416 and	S Ellswo	orth Rd	
Agency/Co.							Jurisc	liction			Box E	lder SD				
Date Performed	6/4/2	023					East/	West Stre	eet		EB Hi	ghway 1	416			
Analysis Year	2023						North	n/South	Street		S Ells	worth Rc	1			
Time Analyzed	AM P	eak					Peak	Hour Fac	ctor		0.84					
Intersection Orientation	East-	West					Analy	sis Time	Period (	(hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	or Study	,											
Lanes																
					Maju	or Street: Ea	st-West									
Vehicle Volumes and Adj	ustme	nts														
Approach	Τ	Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume (veh/h)		618	115	15							142	7		10	16	
Percent Heavy Vehicles (%)		4									1	1		5	5	
Proportion Time Blocked																
Percent Grade (%)											0				0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		5.3									6.5	6.9		7.5	6.5	
Critical Headway (sec)		5.38									6.52	6.92		7.60	6.60	
Base Follow-Up Headway (sec)		3.1									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		3.14									4.01	3.31		3.55	4.05	
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		736										177		31		
Capacity, c (veh/h)		1146										36		34		
v/c Ratio		0.64										4.98		0.92		
95% Queue Length, Q <sub>95</sub> (veh)		5.2										74.4		6.2		
Control Delay (s/veh)		13.7	0.8									7390.1		468.7		
Level of Service (LOS)		В	A									F		F		
Approach Delay (s/veh)		11								73	90.1			46	8.7	
			3								F				F	

		F	ICS <sup>-</sup>	Гwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emm	a Myers-	Verhage	2			Inters	ection			EB Hi	ghway 1	416 and	S Ellswo	orth Rd	
Agency/Co.							Jurisc	liction				lder SD				
Date Performed	6/4/2	023					East/	West Stre	eet		EB Hi	ghway 1	416			
Analysis Year	2023						North	n/South :	Street			worth Ro				
Time Analyzed	PM P	eak					Peak	Hour Fac	ctor		0.90					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	lor Study	,											
Lanes																
					Maj	or Street: Ea	st-West									
Vehicle Volumes and Adj	ustme	nts														
Approach	T	Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume (veh/h)		291	79	143							73	6		6	73	
Percent Heavy Vehicles (%)		4									1	1		5	5	
Proportion Time Blocked																
Percent Grade (%)											0				0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)	Τ	5.3									6.5	6.9		7.5	6.5	
Critical Headway (sec)		5.38									6.52	6.92		7.60	6.60	
Base Follow-Up Headway (sec)		3.1									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		3.14									4.01	3.31		3.55	4.05	
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)	1	323										88		88		
Capacity, c (veh/h)		1146										231		184		
v/c Ratio		0.28										0.38		0.48		
95% Queue Length, Q <sub>95</sub> (veh)		1.2										1.8		2.6		
Control Delay (s/veh)		9.4	0.3									30.0		42.0		
Level of Service (LOS)		A	A									D		E		
Approach Delay (s/veh)		5	.4							3(	0.0			42	2.0	
Approach LOS			4								D				E	

									Repo							
General Information							Site	Inform	natio	n						
Analyst	Emm	a Myers	-Verhage	2			Inters	ection			WB H	ighway	1416 an	d Radar	Hill Rd	
Agency/Co.							Jurisd	iction			Box E	lder SD				
Date Performed	6/4/2	023					East/\	Nest Stre	eet		WB H	ighway	1416			
Analysis Year	2023						North	/South S	Street		Radai	· Hill Rd				
Time Analyzed	AM P	eak					Peak	Hour Fac	ctor		0.88					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 14'	16 Corrid	lor Study	,											
Lanes																
Vehicle Volumes and Adj		nto			Maj	or Street: Ea	st-West									
Approach			oound		1	Wost	oound			North	bound		1	South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6	0	7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration			-	-		LT	-	TR		LT		-				TR
Volume (veh/h)						79	334	5		167	5				17	16
Percent Heavy Vehicles (%)						5	551			4	4				3	3
Proportion Time Blocked										· ·	· ·				3	
Percent Grade (%)											0				0	
Right Turn Channelized															<u> </u>	
Median Type   Storage	-			Undi	vided											
Critical and Follow-up H	eadwa	vs														
Base Critical Headway (sec)		J-				5.3				7.5	6.5				6.5	6.9
Critical Headway (sec)						5.40				7.58	6.58				6.56	6.9
Base Follow-Up Headway (sec)	-					3.1				3.5	4.0				4.0	3.3
Follow-Up Headway (sec)						3.15				3.54	4.04				4.03	3.3
Delay, Queue Length, an	d Lovo		orvico		<u> </u>		<u> </u>									
Flow Rate, v (veh/h)				1	I	90		_	_	195	1	_	1	1		38
	-					1143				462						52
Capacity, c (veh/h) v/c Ratio						0.08				462 0.42						0.0
95% Queue Length, Q <sub>95</sub> (veh)						0.08				2.2						0.0
Control Delay (s/veh)	-					0.3 8.4	0.5			2.2 18.5		_				12
Level of Service (LOS)						0.4 A	0.5 A			10.5 C						12. B
	-						A .0				8.5			1	2.4	
Approach Delay (s/veh)						2	.0			10	J.J		1	1	<b>∠.</b> ↔	

									Repo							
General Information							Site	Inform	natio	n						
Analyst	Emm	a Myers	Verhage				Inters	ection			WB H	ighway	1416 an	d Radar	Hill Rd	
Agency/Co.							Jurisd	iction			Box E	lder SD				
Date Performed	6/4/2	023					East/\	Nest Stre	eet		WB H	ighway	1416			
Analysis Year	2023						North	/South S	Street		Rada	· Hill Rd				
Time Analyzed	PM P	eak					Peak	Hour Fac	ctor		0.94					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 14	l6 Corrid	or Study												
Lanes																
				_				_								
							_									
					Majo	or Street: Ea	st-West									
Vehicle Volumes and Adj	ustme	nts														
Approach	T	Eastk	ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration						LT		TR		LT						TR
Volume (veh/h)						184	531	3		112	28				13	10
Percent Heavy Vehicles (%)						5				4	4				3	3
Proportion Time Blocked																
Percent Grade (%)						1					0			1	0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)	T					5.3				7.5	6.5				6.5	6.9
Critical Headway (sec)						5.40				7.58	6.58				6.56	6.96
Base Follow-Up Headway (sec)						3.1				3.5	4.0				4.0	3.3
Follow-Up Headway (sec)	+					3.15				3.54	4.04				4.03	3.33
Delay, Queue Length, an	d I ovo		ervice													
Flow Rate, v (veh/h)						196				149	1				1	24
	-					1143				235						293
Capacity, c (veh/h) v/c Ratio	-					0.17				0.63						0.08
						0.17				4.7						0.08
95% Queue Length, Q <sub>95</sub> (veh)	-			_		0.6 8.8	1.1			4.7		_				
Control Delay (s/veh)							1.1 A									18.4
			1			A	A			E						C
Level of Service (LOS) Approach Delay (s/veh)							.0			· · ·	5.8			-	8.4	

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	/lyers-Verh	age									
Agency/Co.					1							
Date Performed	6/4/202	3			1							
Analysis Year	2023				1							
Analysis Time Period (hrs)	1.00				1							
Time Analyzed	AM Pea	k			1							
Project Description	Radar H	ill 1416 Co	rridor Stud	у	1							
Intersection	EB High	way 1416 a	and Radar I	Hill Rd	1							
Jurisdiction	Box Elde	er SD			1							
East/West Street	EB High	way 1416			1							
North/South Street	Radar H	ill Rd			1							
Peak Hour Factor	0.88				1							
Turning Movement Dema	n <mark>d Volu</mark> m	nes										
Approach		Eastbound	1		Westbound	k	1	Northboun	d	S	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	4	527	55					168	236	8	88	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjus	tments											
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	S	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	304	362					459			109		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.270	0.322					0.408			0.097		
Final Departure Headway, hd (s)	6.19	6.06					5.39			6.36		
Final Degree of Utilization, x	0.523	0.609					0.688			0.193		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.89	3.76					3.39			4.36		
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1		Westbound	k	1	Northboun	d	5	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	304	362					459			109		
Capacity (veh/h)	582	594					667			566		
95% Queue Length, Q <sub>95</sub> (veh)	3.2	4.5					6.2			0.7		
Control Delay (s/veh)	15.6	18.1					20.0			10.9		
Level of Service, LOS	С	С					С			В		
Approach Delay (s/veh)   LOS	17.0		C				20.0		С	10.9		В
Intersection Delay (s/veh)   LOS			17	7.6					(	C		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informatio	n				Lanes							
Analyst	Emma N	lyers-Verh	age									
Agency/Co.												
Date Performed	6/4/202	3			1							
Analysis Year	2023				1							
Analysis Time Period (hrs)	1.00				1							
Time Analyzed	PM Peal	K			1							
Project Description	Radar H	ill 1416 Co	rridor Stud	у	1							
Intersection	EB High	way 1416 a	and Radar I	Hill Rd	1							
Jurisdiction	Box Elde	er SD			1							
East/West Street	EB High	way 1416			1							
North/South Street	Radar H	ill Rd			1							
Peak Hour Factor	0.94				1							
Turning Movement Demand	d Volum	ies										
Approach		Eastbound			Westbound	1	١	Northboun	d	S	outhboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	19	401	193					121	116	4	193	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjustn	nents											
Approach		Eastbound	1		Westbound	1	١	Northboun	d	S	outhboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	234	419					252			210		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.208	0.372					0.224			0.186		
Final Departure Headway, hd (s)	5.94	5.55					5.57			5.91		
Final Degree of Utilization, x	0.385	0.645					0.390			0.344		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.64	3.25					3.57			3.91		
Capacity, Delay and Level of	f Servic	e										
Approach		Eastbound	1		Westbound	1	٩	Northboun	d	S	outhboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	234	419					252			210		
Capacity (veh/h)	606	649					646			609		
95% Queue Length, Q <sub>95</sub> (veh)	1.9	5.2					1.9			1.6		
Control Delay (s/veh)	12.3	18.2					12.1			12.0		
Level of Service, LOS	В	С					В			В		
Approach Delay (s/veh)   LOS	16.1		С				12.1		В	12.0		В
	1							0				

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informati	on				Lanes							
Analyst	Emma N	/lyers-Verh	age									
Agency/Co.					1							
Date Performed	6/4/202	3			1							
Analysis Year	2023											
Analysis Time Period (hrs)	1.00				1							
Time Analyzed	AM Pea	k										
Project Description	Radar H	lill 1416 Co	rridor Stud	у	1							
Intersection	Radar H	lill Rd and I	ong View	Rd	1							
Jurisdiction	Box Eld	er SD			1							
East/West Street	Long Vi	ew Rd			1							
North/South Street	Radar H	lill Rd			]							
Peak Hour Factor	0.90											
Turning Movement Deman	d Volum	nes										
Approach		Eastbound	l		Westbound	b	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	70	6	1	5	16	9	1	24	3	3	38	102
% Thrus in Shared Lane												
Lane Flow Rate and Adjust	ments											
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	78	8		6	28		1	30		3	156	
Percent Heavy Vehicles	3	3		49	49		14	14		5	5	
Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.069	0.007		0.005	0.025		0.001	0.027		0.003	0.138	
Final Departure Headway, hd (s)	5.52	4.92		6.35	5.60		5.69	5.11		5.44	4.43	
Final Degree of Utilization, x	0.119	0.011		0.010	0.043		0.002	0.043		0.005	0.191	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, t <sub>s</sub> (s)	3.22	2.62		4.05	3.30		3.39	2.81		3.14	2.13	
Capacity, Delay and Level of	of Servic	e										
Approach		Eastbound			Westbound	b	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	78	8		6	28		1	30		3	156	
Capacity (veh/h)	652	732		567	643		633	705		662	812	
95% Queue Length, $Q_{95}$ (veh)	0.4	0.0		0.0	0.1		0.0	0.1		0.0	0.7	
Control Delay (s/veh)	9.0	7.7		9.1	8.6		8.4	8.0		8.2	8.2	
Level of Service, LOS	А	А		А	А		А	А		А	А	
Approach Delay (s/veh)   LOS	8.8		A	8.6		A	8.0		A	8.2		A
Intersection Delay (s/veh)   LOS			8	.4					/	4		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	/lyers-Verh	age									
Agency/Co.					1							
Date Performed	6/4/202	3			1							
Analysis Year	2023				1							
Analysis Time Period (hrs)	1.00				1							
Time Analyzed	PM Pea	k			1							
Project Description	Radar H	lill 1416 Co	rridor Stud	ly	1							
Intersection	Radar H	lill Rd and I	ong View	Rd								
Jurisdiction	Box Elde	er SD			]							
East/West Street	Long Vi	ew Rd									_	
North/South Street	Radar H	lill Rd			]							
Peak Hour Factor	0.95											
Turning Movement Demai	nd Volum	nes										
Approach		Eastbound			Westbound	b	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	127	10	1	2	6	4	1	46	4	7	37	107
% Thrus in Shared Lane												
Lane Flow Rate and Adjust	ments											
Approach		Eastbound	1		Westbound	b	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	134	12		2	11		1	53		7	152	
Percent Heavy Vehicles	3	3		49	49		14	14		5	5	
Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.119	0.010		0.002	0.009		0.001	0.047		0.007	0.135	
Final Departure Headway, hd (s)	5.57	5.00		6.48	5.70		5.81	5.25		5.57	4.55	
Final Degree of Utilization, x	0.207	0.016		0.004	0.017		0.002	0.077		0.011	0.192	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, t <sub>s</sub> (s)	3.27	2.70		4.18	3.40		3.51	2.95		3.27	2.25	
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	134	12		2	11		1	53		7	152	
Capacity (veh/h)	647	719		555	631		620	686		646	790	
95% Queue Length, Q <sub>95</sub> (veh)	0.8	0.0		0.0	0.1		0.0	0.2		0.0	0.7	
Control Delay (s/veh)	9.7	7.8		9.2	8.5		8.5	8.4		8.3	8.3	
Level of Service, LOS	А	А		A	А		А	А		А	А	
Approach Delay (s/veh)   LOS	9.6		A	8.6		A	8.4		А	8.3		A
Intersection Delay (s/veh)   LOS			8	5.8						Ą		

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		ŀ	ICS 1	ſwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site Information									
Analyst	Emma	a Myers-	Verhage				Intersection Radar Hill Ro				r Hill Rd	l and Highway 44				
Agency/Co.							Jurisd	liction			Box E	lder SD				
Date Performed	6/4/2	023					East/\	West Stre	eet		Highv	way 44				
Analysis Year	2023						North	n/South S	Street		Radai	r Hill Rd				
Time Analyzed	AM P	eak					Peak	Hour Fac	ctor		0.86					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	Radar Hill 1416 Corridor Study														
Lanes																
					Maj	or Street: Ea	st-West									
Vehicle Volumes and Adj	ustme	nts														
Approach	Eastbound We					West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	Т	TR		L	Т	TR			LTR				LTR	
Volume (veh/h)	0	15	217	5	0	2	207	17		4	0	1		19	2	10
Percent Heavy Vehicles (%)	5	5			3	3				6	6	6		10	10	10
Proportion Time Blocked																
Percent Grade (%)								0 0					0			
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.16				7.62	6.62	7.02		7.70	6.70	7.10
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.23				3.56	4.06	3.36		3.60	4.10	3.40
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)	T	17				2					6				36	
Capacity, c (veh/h)		1279				1296					534				564	
v/c Ratio		0.01				0.00					0.01				0.06	
95% Queue Length, Q <sub>95</sub> (veh)	0.0 0.					0.0					0.0				0.2	
Control Delay (s/veh)		7.9				7.8					11.8				11.8	
Level of Service (LOS)	A A					А					В				В	
Approach Delay (s/veh)		0	.5			0	.1			1.	1.8			1'	1.8	
Approach LOS			۹.			,	4				В В					

		ŀ	ICS 1	WO-	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inform	natio	n						
Analyst	Emm	a Myers-	Verhage				Inters	ection			Radar	· Hill Rd a	d and Highway 44			
Agency/Co.							Jurisd	liction			Box E	lder SD				
Date Performed	6/4/2	023					East/\	Nest Stre	eet		Highv	vay 44				
Analysis Year	2023						North	/South S	Street		Radar	· Hill Rd				
Time Analyzed	PM P	eak					Peak	Hour Fac	tor		0.85					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	or Study												
Lanes																
					Mai	or Street: Ea										
Vakiele Valumes and Adi					IVIAJ	JI Street. Ea	st-west									
Vehicle Volumes and Adj	ustme													<b>6</b>		
Approach		1	ound	5		West					bound	5			bound	
Movement	U	L	T	R	U	L	Т	R	U	L	Т	R	U	L	T	R
Priority Number of Lanes	10	1	2	3	40	4	5	6		7	8	9 0		10	11	12 0
	0	1	2 T	0 TR	0	1	2 T	0 TR		0	1	0		0	1 LTR	
Configuration	0	L	T		0	L	T			6	LTR	0		22	7 LIR	
Volume (veh/h)	0	39	132	12	0	1	221	24		6	1	-		23		24
Percent Heavy Vehicles (%)	5	5			3	3	<u> </u>			6	6	6		10	10	10
Proportion Time Blocked											0				0	
Percent Grade (%)	-							0 0					0			
Right Turn Channelized				Undi	با م ام											
Median Type   Storage	<u> </u>			Undi	vided											
Critical and Follow-up H	eadwa	-									1				1	_
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.16				7.62	6.62	7.02		7.70	6.70	7.1
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.23				3.56	4.06	3.36		3.60	4.10	3.4
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		46				1					8				64	
Capacity, c (veh/h)		1249				1398					467				564	
v/c Ratio		0.04				0.00					0.02				0.11	
95% Queue Length, Q <sub>95</sub> (veh)		0.1				0.0					0.1				0.4	
Control Delay (s/veh)		8.0				7.6					12.9				12.2	
Level of Service (LOS)	A A									В				В		
Approach Delay (s/veh)		1	.7			0	.0			12	2.9			12	2.2	
Approach LOS			4				4				В	В				

# Appendix C: Pedestrian Level of Service (PLOS) and Bicycle Level of Service (BLOS) Results

Lanes per direction:	2
Outside lane width:	12 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	3943 (veh/day)
Posted speed limit:	65 mph
Heavy vehicle percentage:	3%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	4.2	D (3.51-4.50)	Moderately Low
PLOS:	4.92	E (4.51-5.50)	Very Low

Highway 1416 151st Avenue to Liberty Blvd

Lanes per direction:	2
Outside lane width:	12 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	1469 (veh/day)
Posted speed limit:	50 mph
Heavy vehicle percentage:	5%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	4.08	D (3.51-4.50)	Moderately Low
PLOS:	4.08	D (3.51-4.50)	Moderately Low

WB Highway 1416 Liberty Blvd to S Ellsworth Rd

Lanes per direction:	2
Outside lane width:	12 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	5878 (veh/day)
Posted speed limit:	55 mph
Heavy vehicle percentage:	5%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	4.87	E (4.51-5.50)	Very Low
PLOS:	4.55	E (4.51-5.50)	Very Low

WB Highway 1416 S Ellsworth Rd to W Gate Rd

Lanes per direction:	2
Outside lane width:	12 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	1080 (veh/day)
Posted speed limit:	50 mph
Heavy vehicle percentage:	8%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	4.89	E (4.51-5.50)	Very Low
PLOS:	4.06	D (3.51-4.50)	Moderately Low

<u>EB Highway 1416</u> Liberty Blvd to S Ellsworth Rd

Lanes per direction:	2
Outside lane width:	12 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	6290 (veh/day)
Posted speed limit:	55 mph
Heavy vehicle percentage:	5%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	4.9	E (4.51-5.50)	Very Low
PLOS:	4.57	E (4.51-5.50)	Very Low

EB Highway 1416 S Ellsworth Rd to W Gate Rd

Lanes per direction:	2
Outside lane width:	13 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	5385 (veh/day)
Posted speed limit:	45 mph
Heavy vehicle percentage:	4%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	4.26	D (3.51-4.50)	Moderately Low
PLOS:	4.02	D (3.51-4.50)	Moderately Low

<u>Radar Hill Rd</u> Highway 1416 to 228th St

Lanes per direction:	2
Outside lane width:	13 ft
Paved shoulder/bike lane/marked parking width:	10 ft
Bidirectional ADT traffic volume:	1052 (veh/day)
Posted speed limit:	45 mph
Heavy vehicle percentage:	12%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%

	Score	Level-of-service	Compatibility Level
BLOS:	1.5	A (below 1.50)	Extremely High
PLOS:	3.07	C (2.51-3.50)	Moderately High

Radar Hill Rd 228th St to 229th St

Lanes per direction:	2
Outside lane width:	13 ft
Paved shoulder/bike lane/marked parking width:	0 ft
Bidirectional ADT traffic volume:	320 (veh/day)
Posted speed limit:	50 mph
Heavy vehicle percentage:	7%
FHWA's pavement condition rating:	3
% of segment with occupied parking:	0%
% of segment with sidewalks:	0%
Score Level-of-service	Compatibility Level

	Score	Level-of-service	Compatibility Lev
BLOS:	3.81	D (3.51-4.50)	Moderately Low
PLOS:	3.92	D (3.51-4.50)	Moderately Low

Radar Hill Rd 229th St to Highway 44

# Appendix D: Vehicular Level of Service (VLOS) Results - Future No-Build

Movement   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   I   R   U   L   T   R   U   I   T   R   U   I   T   R   U   I   I   R   U   I   I   R   U   I   I   I   R   U   I   I   I   R   U   I<			
Agency/Co. Jurisdiction Box Elder, SD   Date Performed 7/28/2023 East/West Street Highway 1416   Analysis Year 2030 North/South Street 151st Ave   Time Analyzed AM Peak Peak Hour Factor 0.76   Intersection Orientation East-West Analysis Time Period (hrs) 1.00   Project Description Radar Hill 1416 Corridor Study Intersection Christian Study Intersection Christian Study   Lanes   Vehicle Volumes and Adjustments   Westbound North/South Street   North/South Street Study   Device Volumes and Adjustments   Approach Eastbound Westbound North-bound S   Movement U L T R U L T R U I   Priority 1U 1 2 3 4U 4 5 6 7 8 9 I I			
Jate Performed   7/28/2023   East/West Street   Highway 1416     Analysis Year   2030   North/South Street   151st Ave     Time Analyzed   AM Peak   Peak Hour Factor   0.76     Intersection Orientation   East-West   Analysis Time Period (hrs)   1.00     Project Description   Radar Hill 1416 Corridor Study   Lanes   Verify Corrigor Study     North Corrigor Study	t Ave		
Analysis Year 2030 North/South Street 151st Ave   Time Analyzed AM Peak Peak Hour Factor 0.76   Intersection Orientation East-West Analysis Time Period (hrs) 1.00   Project Description Radar Hill 1416 Corridor Study Analysis Time Period (hrs) 1.00   Lanes Vest			
Time Analyzed AM Peak Peak Hour Factor 0.76   Intersection Orientation East-West Analysis Time Period (hrs) 1.00   Project Description Radar Hill 1416 Corridor Study Lanes Lanes Lanes Vestor Northout Vestor Northout Northout Sector			
Intersection Orientation East-West Analysis Time Period (hrs) 1.00   Project Description Radar Hill 1416 Corrido Study   Lanes Image:			
Project Description Radar Hill 1416 Corridor Study   Lanes Image: State Sta			
Lanes   Image: State of the stat			
Verifie Volumes and Adjustmette   Approach Verifie Verifie Verifie Northourd O   Approach Verifie Verifie Northourd O   Movement U L T R U C Priority Northourd C Priority Northourd C Priority Northourd C Priority Northourd C Priority C Priority C Priority C Priority Priority Priority Pri			
A Colspan="6">A Colspan="6" A Colspan="6">A Colspan="6" A			
Approach   Eastburd   Image: Weight with with with with with with with wi			
Movement   U   L   T   R   U   L<			
Priority 1U 1 2 3 4U 4 5 6 7 8 9 6   Number of Lanes 0 0 11 0 0 0 10 0 0 10 10 0 0 10 10 0	South	bound	
Number of Lanes   0   0   1   0   0   1   0   0   1   0	L	Т	R
	10	11	12
	0	1	0
		LR	
Volume (veh/h)   179   41   99   19   99   19   90   10 <th10< th="">   10   10</th10<>	11		14

Percent Grade (%)											0			
Right Turn Channelized														
Median Type   Storage			Undi	vided										
Critical and Follow-up H	eadways													
Base Critical Headway (sec)	4.1												7.1	
Critical Headway (sec)	4.19												6.56	
Base Follow-Up Headway (sec)	2.2												3.5	
Follow-Up Headway (sec)	2.28												3.64	
Delay, Queue Length, and Level of Service			•											
Flow Rate, v (veh/h)	236													207
Capacity, c (veh/h)	1383													780
v/c Ratio	0.17													0.26
95% Queue Length, Q <sub>95</sub> (veh)	0.6													1.1
Control Delay (s/veh)	8.1	1.4												11.3
Level of Service (LOS)	A	Α												В
Approach Delay (s/veh)		6.9							11.3					
Approach LOS	A							В						

9

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Percent Heavy Vehicles (%)

Proportion Time Blocked

16

16

6.2 6.36 3.3 3.44

		ŀ	ICS <sup>-</sup>	Гwo-	Way	Stop	-Cor	ntrol	Repo	ort							
General Information	_	_	_	_	_	_	Site	Inforr	natio	n	_	_	_	_	_	_	
Analyst	Emma Myers-Verhage												6 and 151st Ave				
Agency/Co.								liction				lder, SD					
Date Performed	7/28/	2023						West Stre	eet		1	way 1416	5				
Analysis Year	2030							n/South			151st	-					
Time Analyzed	PM P	eak						Hour Fac			0.83						
Intersection Orientation	East-	West						vsis Time		hrs)	1.00						
Project Description		r Hill 141	6 Corrid	lor Study	,					-/	•						
Lanes	-																
				J 4 1 7 4 4 7 4		아 Street: Ea		241X4400									
Vehicle Volumes and Adj	ustme	nts															
Approach		Eastb	ound			West	oound			North	bound			South	bound		
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R	
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12	
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0	
Configuration	1	LT						TR							LR		
Volume (veh/h)	1	92	87				52	5						6		65	
Percent Heavy Vehicles (%)	1	9												16		16	
Proportion Time Blocked	1																
Percent Grade (%)	1														0		
Right Turn Channelized	1																
Median Type   Storage	1			Undi	vided												
Critical and Follow-up He	eadwa	ys															
Base Critical Headway (sec)	1	4.1												7.1		6.2	
Critical Headway (sec)	1	4.19												6.56		6.36	
Base Follow-Up Headway (sec)	1	2.2												3.5		3.3	
Follow-Up Headway (sec)	1	2.28												3.64		3.44	
Delay, Queue Length, and	d Leve	l of Se	ervice														
Flow Rate, v (veh/h)	1	111													86		
Capacity, c (veh/h)	-	1489													901		
v/c Ratio		0.07				_									0.09		
95% Queue Length, Q <sub>95</sub> (veh)		0.07													0.09		
Control Delay (s/veh)		7.6	0.6												0.3 9.4		
Level of Service (LOS)		7.6 A	0.6 A												9.4 A		
Approach Delay (s/veh)			.2												.4		
	4																
Approach LOS		1	Ą												4		

HCS Two-Way Stop-Control Report											
General Information		Site Information									
Analyst	Emma Myers-Verhage	Intersection	Highway 1416 and Liberty Blvd								
Agency/Co.		Jurisdiction	Box Elder, SD								
Date Performed	7/28/2023	East/West Street	Highway 1416								
Analysis Year	2030	North/South Street	Liberty Blvd								
Time Analyzed	AM Peak	Peak Hour Factor	0.84								
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00								
Project Description	Radar Hill 1416 Corridor Study										
Lanes											



### Approach Eastbound Westbound Northbound Southbound U U L т R U т R U L Т R L Movement L Т 1U Priority 1 2 3 4U 4 5 6 7 8 9 10 11 Number of Lanes 0 1 1 0 0 0 1 0 0 1 0 0 1 LTR Configuration L TR LTR LT 326 3 7 171 10 Volume (veh/h) 150 90 4 51 60 19 7 Percent Heavy Vehicles (%) 8 2 2 2 9 9 **Proportion Time Blocked** 0 0 Percent Grade (%) **Right Turn Channelized** Yes Median Type | Storage Undivided Critical and Follow-up Headways Base Critical Headway (sec) 4.1 4.1 7.1 6.5 6.2 7.1 6.5 Critical Headway (sec) 4.18 4.17 7.12 6.52 6.22 7.19 6.59 2.2 2.2 3.5 3.3 4.0 Base Follow-Up Headway (sec) 4.0 3.5 Follow-Up Headway (sec) 2.27 2.26 3.52 4.02 3.32 3.58 4.08 Delay, Queue Length, and Level of Service Flow Rate, v (veh/h) 388 94 8 77 Capacity, c (veh/h) 1216 1363 123 65 v/c Ratio 0.32 0.01 0.63 1.46 1.4 0.0 4.3 21.3 95% Queue Length, $Q_{95}$ (veh) 9.3 81.0 1032.9 Control Delay (s/veh) 7.7 0.1 0.1 F F Level of Service (LOS) А А А А Approach Delay (s/veh) 6.4 0.3 81.0 377.7 Approach LOS А F F А

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**Vehicle Volumes and Adjustments** 

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6.2

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3.3

3.38

168

814 0.21

0.8

10.6

В

HCS Two-Way Stop-Control Report										
General Information		Site Information								
Analyst	Emma Myers-Verhage	Intersection	Highway 1416 and Liberty Blvd							
Agency/Co.		Jurisdiction	Box Elder, SD							
Date Performed	7/28/2023	East/West Street	Highway 1416							
Analysis Year	2030	North/South Street	Liberty Blvd							
Time Analyzed	PM Peak	Peak Hour Factor	0.84							
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00							
Project Description	Radar Hill 1416 Corridor Study									
.anes										
	J	4 1 7 4 7 1 F								



# **Vehicle Volumes and Adjustments**

Approach		Eastb	ound			West	oound		Northbound				Southbound			
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	1	0		0	1	1
Configuration		L		TR			LTR				LTR			LT		R
Volume (veh/h)		97	83	13		7	64	66		8	16	2		125	26	107
Percent Heavy Vehicles (%)		8				7				2	2	2		9	9	9
Proportion Time Blocked																
Percent Grade (%)										(	0			(	)	
Right Turn Channelized													Yes			
Median Type   Storage				Undi	vided								<u>.</u>			
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.18				4.17				7.12	6.52	6.22		7.19	6.59	6.29
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.27				2.26				3.52	4.02	3.32		3.58	4.08	3.38
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		115				8					31			180		127
Capacity, c (veh/h)		1390				1444					405			424		918
v/c Ratio		0.08				0.01					0.08			0.42		0.14
95% Queue Length, Q <sub>95</sub> (veh)		0.3				0.0					0.2			2.2		0.5
Control Delay (s/veh)		7.8				7.5	0.0	0.0			14.6			19.7		9.6
Level of Service (LOS)		A				A	А	A			В			С		A
Approach Delay (s/veh)		3	.9	2		0	.4	2	14.6				15.5			
Approach LOS		1	4				4			I	В			(	2	

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### HCS Two-Way Stop-Control Report

General Information		Site Information	Site Information						
Analyst	Emma Myers-Verhage	Intersection	WB Highway 1416 and S Ellsworth Rd						
Agency/Co.		Jurisdiction	Box Elder, SD						
Date Performed	7/28/2023	East/West Street	WB Highway 1416						
Analysis Year	2030	North/South Street	S Ellsworth Rd						
Time Analyzed	AM Peak	Peak Hour Factor	0.84						
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00						
Project Description	Radar Hill 1416 Corridor Study								

### Lanes



### **Vehicle Volumes and Adjustments** Approach Eastbound Westbound Northbound Southbound U R U U L Т L т R U L Т R L т R Movement 12 7 1U 2 4U Priority 10 11 8 9 1 3 4 5 6 Number of Lanes 0 0 0 0 2 0 0 0 1 0 0 0 1 1 TR Configuration LT LT Т R 90 128 207 Volume (veh/h) 30 173 44 752 Percent Heavy Vehicles (%) 10 10 10 1 **Proportion Time Blocked** 0 Percent Grade (%) **Right Turn Channelized** Yes Median Type | Storage Undivided **Critical and Follow-up Headways** Base Critical Headway (sec) 7.1 6.5 6.2 4.1 Critical Headway (sec) 7.20 6.60 6.30 4.11 3.5 4.0 3.3 2.2 Base Follow-Up Headway (sec) Follow-Up Headway (sec) 3.59 4.09 3.39 2.21 Delay, Queue Length, and Level of Service Flow Rate, v (veh/h) 139 155 107 Capacity, c (veh/h) 133 172 1434 v/c Ratio 1.04 0.90 0.07 15.8 11.6 0.2 95% Queue Length, Q<sub>95</sub> (veh) Control Delay (s/veh) 295.8 141.5 1.2 7.7 F F Level of Service (LOS) А А Approach Delay (s/veh) 214.3 1.9

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Approach LOS

HCS™ TWSC Version 2023 WBHwy1416-EllsworthRd\_AMPeak2030.xtw А

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### HCS Two-Way Stop-Control Report

Thes two-way stop-control Report									
	Site Information								
Emma Myers-Verhage	Intersection	WB Highway 1416 and S Ellsworth Rd							
	Jurisdiction	Box Elder, SD							
7/28/2023	East/West Street	WB Highway 1416							
2030	North/South Street	S Ellsworth Rd							
PM Peak	Peak Hour Factor	0.84							
North-South	Analysis Time Period (hrs)	1.00							
Radar Hill 1416 Corridor Study									
	7/28/2023 2030 PM Peak North-South	Emma Myers-VerhageIntersectionJurisdictionJurisdiction7/28/2023East/West Street2030North/South StreetPM PeakPeak Hour FactorNorth-SouthAnalysis Time Period (hrs)							

### Lanes



### **Vehicle Volumes and Adjustments** Approach Eastbound Westbound Northbound Southbound U R U U L Т L т R U L Т R L т R Movement 12 7 1U 2 4U Priority 10 11 8 9 1 3 4 5 6 Number of Lanes 0 0 0 0 2 0 0 0 1 0 0 0 1 1 TR Configuration LT LT Т R 93 273 Volume (veh/h) 29 135 21 38 356 Percent Heavy Vehicles (%) 10 10 10 1 **Proportion Time Blocked** 0 Percent Grade (%) **Right Turn Channelized** Yes Median Type | Storage Undivided **Critical and Follow-up Headways** Base Critical Headway (sec) 7.1 6.5 6.2 4.1 Critical Headway (sec) 7.20 6.60 6.30 4.11 3.5 4.0 3.3 2.2 Base Follow-Up Headway (sec) Follow-Up Headway (sec) 3.59 4.09 3.39 2.21 Delay, Queue Length, and Level of Service Flow Rate, v (veh/h) 105 115 45 Capacity, c (veh/h) 374 413 1486 0.25 v/c Ratio 0.31 0.03 1.3 1.0 0.1 95% Queue Length, Q<sub>95</sub> (veh) Control Delay (s/veh) 18.9 16.7 7.5 0.3 С С Level of Service (LOS) А А Approach Delay (s/veh) 17.8 1.0

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Approach LOS

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А

General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	EB Highway 1416 and S Ellsworth Rd
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/28/2023	East/West Street	EB Highway 1416
Analysis Year	2030	North/South Street	S Ellsworth Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.84
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	Radar Hill 1416 Corridor Study		·
Lanes			
	2 4 2 7 4	↓ 人 本 ト し ト 	



# Vehicle Volumes and Adjustments

Vennele Volumes and Adj																
Approach		Eastb	ound			West	oound			North	bound		Southbound			
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume (veh/h)		650	335	16							190	59		62	96	
Percent Heavy Vehicles (%)		4									1	1		5	5	
Proportion Time Blocked																
Percent Grade (%)										(	D		0			
Right Turn Channelized																
Median Type   Storage		Undivided														
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		5.3									6.5	6.9		7.5	6.5	
Critical Headway (sec)		5.38									6.52	6.92		7.60	6.60	
Base Follow-Up Headway (sec)		3.1									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		3.14									4.01	3.31		3.55	4.05	
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		774										296		188		
Capacity, c (veh/h)		1146										19		13		
v/c Ratio		0.67										15.26		14.20		
95% Queue Length, Q <sub>95</sub> (veh)		6.0										141.6		90.5		
Control Delay (s/veh)		14.6	2.3									26052. 6		24320. 7		
Level of Service (LOS)		В	А									F		F		
Approach Delay (s/veh)		1(	).2					-	26052.6				24320.7			
Approach LOS		l	В								F			l	F	

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					vvay	Stop		ntrol	repo	ort						
General Information	_	_	_	_	_		Site	Inforr	natio	1	_	_	_	_	_	
Analyst	Emma	Myers-	Verhage					ection		-	EB Hid	nhway 1	416 and	S Ellswo	rth Rd	
Agency/Co.	Ennine	- myers	vernage					liction				lder, SD		5 Elistro		
Date Performed	7/28/2	2023						West Stre	eet			ghway 1	416			
Analysis Year	2030							/South S				worth Rc				
Time Analyzed	PM Pe	eak						Hour Fac			0.84					
Intersection Orientation	East-V	Vest						sis Time		hrs)	1.00					
Project Description	Radar	Hill 141	6 Corrid	or Study	,		<u> </u>									
Lanes																
						۲ ۲ or Street: Ea	t-West	4 1 7 4 4 7 1 1								
Vehicle Volumes and Adju	stme	nts														
Approach		Eastb	ound			West	oound			North	bound		Southbound			
Movement	U	L	Т	R	U	L	Т	R	U	L	T	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume (veh/h)		306	150	152							87	22		22	100	
Percent Heavy Vehicles (%)		4									1	1		5	5	
Proportion Time Blocked																
Percent Grade (%)										(	)			(	)	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up Hea	adway	ys														
Base Critical Headway (sec)		5.3									6.5	6.9		7.5	6.5	
Critical Headway (sec)		5.38									6.52	6.92		7.60	6.60	
Base Follow-Up Headway (sec)		3.1									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		3.14									4.01	3.31		3.55	4.05	
Delay, Queue Length, and	Leve	of Se	ervice													
Flow Rate, v (veh/h)		364										130		145		
Capacity, c (veh/h)		1146										189		109		
v/c Ratio		0.32										0.69		1.33		
95% Queue Length, Q <sub>95</sub> (veh)		1.4										5.6		26.4		
Control Delay (s/veh)		9.6	0.7									63.5		747.2		
Level of Service (LOS)		А	A									F		F		
Approach Delay (s/veh)	5.0									63	8.5			74	7.2	
	5.0 A										3.5 747.2 F F					

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HCS Two-Way Stop-Control Report												
General Information		Site Information										
Analyst	Emma Myers-Verhage	Intersection	WB Highway 1416 and Radar Hill Rd									
Agency/Co.		Jurisdiction	Box Elder, SD									
Date Performed	7/28/2023	East/West Street	WB Highway 1416									
Analysis Year	2030	North/South Street	Radar Hill Rd									
Time Analyzed	AM Peak	Peak Hour Factor	0.88									
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00									
Project Description Radar Hill 1416 Corridor Study												

### Lanes



## Vehicle Volumes and Adjustments

Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration						LT		TR		LT						TR
Volume (veh/h)						107	454	7		179	28				37	17
Percent Heavy Vehicles (%)						5				4	4				3	3
Proportion Time Blocked																
Percent Grade (%)										(	)				0	
Right Turn Channelized																
Median Type   Storage		Undivided														
Critical and Follow-up He	low-up Headways															
Base Critical Headway (sec)						5.3				7.5	6.5				6.5	6.9
Critical Headway (sec)						5.40				7.58	6.58				6.56	6.96
Base Follow-Up Headway (sec)						3.1				3.5	4.0				4.0	3.3
Follow-Up Headway (sec)						3.15				3.54	4.04				4.03	3.33
Delay, Queue Length, and	l Leve	l of Se	ervice													
Flow Rate, v (veh/h)						122				235						61
Capacity, c (veh/h)						1143				314						358
v/c Ratio						0.11				0.75						0.17
95% Queue Length, Q <sub>95</sub> (veh)						0.4				7.5						0.6
Control Delay (s/veh)						8.5	0.7			48.4						17.2
Level of Service (LOS)						A	А			E						С
Approach Delay (s/veh)					2.2			48.4				17.2				
Approach LOS					A				E				С			

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		ł	HCS <sup>-</sup>	Гwo-	Way	Stop	-Cor	ntrol	Repo	ort						
General Information	_	Site	Inforr	natio	n	_	_	_	_	_						
Analyst	Emma	a Myers	-Verhage	2				ection			WB H	lighway	1416 an	d Radar	Hill Rd	
Agency/Co.							Jurisd	iction			Box E	lder, SD				
Date Performed	7/28/	2023					East/	Nest Stre	eet		WB H	lighway	1416			
Analysis Year	2030						North	/South S	Street		Radai	r Hill Rd				
Time Analyzed	PM P	eak					Peak	Hour Fac	ctor		0.94					
Intersection Orientation	East-	Nest					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	· Hill 14	16 Corric	lor Study	<i>,</i>						1					
Lanes																
				24 1 Y 4 P 7 A		م م Street: Ea		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1								
Vehicle Volumes and Adj	ustme	nts														
Approach						West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration	1					LT		TR		LT						TR
Volume (veh/h)	]					209	605	4		118	34				18	11
Percent Heavy Vehicles (%)						5				4	4				3	3
Proportion Time Blocked	1															
Percent Grade (%)	]									(	0				0	
Right Turn Channelized																
Median Type   Storage	1			Undi	vided											
Critical and Follow-up He	eadwa	ys														
Base Critical Headway (sec)						5.3				7.5	6.5				6.5	6.9
Critical Headway (sec)						5.40				7.58	6.58				6.56	6.96
Base Follow-Up Headway (sec)						3.1				3.5	4.0				4.0	3.3
Follow-Up Headway (sec)	1					3.15				3.54	4.04				4.03	3.33
Delay, Queue Length, and	d Leve	l of S	ervice													
Flow Rate, v (veh/h)	1					222				162						31
Capacity, c (veh/h)	1					1143				184						227
v/c Ratio	1					0.19				0.88						0.14
95% Queue Length, Q <sub>95</sub> (veh)						0.7				11.0						0.5
Control Delay (s/veh)	1					8.9	1.3			123.8						23.4
Level of Service (LOS)						A	A			F						C
Approach Delay (s/veh)	1	1	1				.2				3.8			2	3.4	
Approach LOS	1						. <u> </u>				F				C	
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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informati	on				Lanes							
Analyst	Emma N	/lyers-Verh	age				_					
Agency/Co.					1			*+ + *	L da b	د ل <u>ه</u>		
Date Performed	7/28/20	23			1							
Analysis Year	2030				1	_*					K	
Analysis Time Period (hrs)	1.00				1						<u> </u>	
Time Analyzed	AM Pea	k			1	*	4				<b>↑</b> 74	
Project Description	Radar H	ill 1416 Co	rridor Stud	у	1	<u> </u>	<b>-x</b>					
Intersection	EB High	way 1416 a	and Radar I	Hill Rd	1						¥ ★	
Jurisdiction	Box Elde	er, SD			1	7 7					<u>≁</u>	
East/West Street	EB High	way 1416			1	•			<b>b</b>			
North/South Street	Radar H	ill Rd			1		ካ	<u>+</u> ++	∣ ╱╴╋╴╊	- C		
Peak Hour Factor	0.88				1							
Turning Movement Deman	d Volum	nes										
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	5	702	64					197	314	12	111	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	ments											
Approach		Eastbound	ł		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	405	472					581			140		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.360	0.419					0.516			0.124		
Final Departure Headway, hd (s)	6.73	6.61					5.79			7.02		
Final Degree of Utilization, x	0.756	0.866					0.934			0.273		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, ts (s)	4.43	4.31					3.79			5.02		
Capacity, Delay and Level o	of Servic	e		-	-					<u> </u>	<u> </u>	
Approach		Eastbound	l		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	405	472					581			140		
Capacity (veh/h)	535	544					622			513		
95% Queue Length, Q <sub>95</sub> (veh)	8.3	14.0					20.9			1.1		
Control Delay (s/veh)	29.4	46.4					64.3			12.7		
Level of Service, LOS	D	E					F			В		
Approach Delay (s/veh)   LOS	38.6		E			-	64.3		F	12.7		В
Intersection Delay (s/veh)   LOS			45	5.7						E		

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General and Site Informat	ion				Lanes							
	-	A			Lanes							
Analyst	Emma	/lyers-Verh	age		-		J		L III III	L		
Agency/Co.	7/20/20	22			-		Ē	200355335				
Date Performed	7/28/20	23			-	_*					<u>الا ــــ</u>	
Analysis Year	2030				-	_ <b>_</b> ,					4	
Analysis Time Period (hrs)	1.00				-	4					←	
Time Analyzed	PM Pea		a dalara Cira d		-	$\overline{\prec}$					4444	
Project Description	_		rridor Stud	-	-	<b>→</b>	শ				*	
Intersection			and Radar I	Hill Rd	-	*					**	
Jurisdiction	Box Elde				-	<b>_</b> *					K-	
East/West Street	-	way 1416			-				1			
North/South Street	Radar H	III Rd					ኘ	1 1 1	11	<u>۲</u>		
Peak Hour Factor	0.94											
Turning Movement Demai	nd Volum	nes										
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	20	475	205					132	138	5	206	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	tments											
Approach		Eastbound	1		Westbound	k	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	274	471					287			224		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.243	0.418					0.255			0.200		
Final Departure Headway, hd (s)	6.12	5.75					5.79			6.18		
Final Degree of Utilization, x	0.466	0.752					0.462			0.385		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, ts (s)	3.82	3.45					3.79			4.18		
Capacity, Delay and Level	of Servic	e										
Approach	T	Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	274	471					287			224		
Capacity (veh/h)	588	626					622			582		
95% Queue Length, Q <sub>95</sub> (veh)	2.6	8.2					2.5			1.9		
Control Delay (s/veh)	14.1	25.3					13.7			13.0		
Level of Service, LOS	В	D					В			В		
Approach Delay (s/veh)   LOS	21.2		С		-		13.7		В	13.0		В

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Ayers-Verh	age									
Agency/Co.							<u>_</u>	* + + *	└┓┢	L.		
Date Performed	7/28/20	23						4	Ļ			
Analysis Year	2030					_*					K	
Analysis Time Period (hrs)	1.00					_ <b>*</b>					<u> </u>	
Time Analyzed	AM Pea	k				**	_1			4	<b>←</b> x	
Project Description	Radar H	lill 1416 Co	rridor Stud	у		$\rightarrow$	7			<b>K</b> -	)/	
Intersection	Radar H	lill Rd and I	ong View	Dr	1						- - - - - 	
Jurisdiction	Box Eld	er, SD				7 7						
East/West Street	Radar H	lill Rd				٩		ካ	t.			
North/South Street	Long Vi	ew Dr					ኻ	<u>م</u> الم	╵ ╱│╋│╊			
Peak Hour Factor	0.90											
Turning Movement Demai	nd Volum	nes										
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	80	7	2	6	18	10	2	26	4	4	41	116
% Thrus in Shared Lane												
Lane Flow Rate and Adjust	tments		,				,					
Approach	T	Eastbound	ł		Westbound	d	n I	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	89	10		7	31		2	33		4	174	
Percent Heavy Vehicles	3	3		49	49		14	14		5	5	
Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.079	0.009		0.006	0.028		0.002	0.030		0.004	0.155	
Final Departure Headway, hd (s)	5.59	4.93		6.43	5.68		5.76	5.16		5.50	4.48	
Final Degree of Utilization, x	0.138	0.014		0.012	0.049		0.004	0.048		0.007	0.217	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, ts (s)	3.29	2.63		4.13	3.38		3.46	2.86		3.20	2.18	
Capacity, Delay and Level	of Servic	е				<u>.</u>				<u>.</u>		
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	89	10		7	31		2	33		4	174	
Capacity (veh/h)	644	730		560	634		625	697		655	803	
95% Queue Length, Q <sub>95</sub> (veh)	0.5	0.0		0.0	0.2		0.0	0.2		0.0	0.8	
Control Delay (s/veh)	9.2	7.7		9.2	8.7		8.5	8.1		8.2	8.4	
Level of Service, LOS	A	A		А	A		A	А		A	A	
Approach Delay (s/veh)   LOS	9.0		A	8.8		A	8.1		A	8.4		A
Intersection Delay (s/veh)   LOS			8	.6						A		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	on				Lanes							
Analyst	Emma N	Ayers-Verh	age									
Agency/Co.							<u>_</u>	* + *	└┓┢	L.		
Date Performed	7/28/20	23						4	Ļ			
Analysis Year	2030					_*					K	
Analysis Time Period (hrs)	1.00					_ <b>*</b>					<u> </u>	
Time Analyzed	PM Pea	k				**	1			4	<b>←</b> x	
Project Description	Radar H	lill 1416 Co	rridor Stud	у		$\rightarrow$	7			<b>K</b> -	)/	
Intersection	Radar H	lill Rd and I	ong View	Dr	1						- - - - - 	
Jurisdiction	Box Eld	er, SD				7 7						
East/West Street	Radar H	lill Rd				٩		ካ	t.			
North/South Street	Long Vi	ew Dr					ኻ	<u>م م</u> م ا	╵ ╱│╋│╊			
Peak Hour Factor	0.95											
Turning Movement Demai	nd Volum	nes										
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	145	12	2	3	7	5	2	50	5	8	40	122
% Thrus in Shared Lane												
Lane Flow Rate and Adjust	ments											
Approach	T	Eastbound	ł		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	153	15		3	13		2	58		8	171	
Percent Heavy Vehicles	3	3		49	49		14	14		5	5	
Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.136	0.013		0.003	0.011		0.002	0.051		0.007	0.152	
Final Departure Headway, hd (s)	5.64	5.04		6.58	5.79		5.91	5.34		5.66	4.63	
Final Degree of Utilization, x	0.239	0.021		0.006	0.020		0.003	0.086		0.013	0.219	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, t <sub>s</sub> (s)	3.34	2.74		4.28	3.49		3.61	3.04		3.36	2.33	
Capacity, Delay and Level	of Servic	e				<u>.</u>				<u>.</u>		
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	153	15		3	13		2	58		8	171	
Capacity (veh/h)	638	714		547	622		610	674		636	777	
95% Queue Length, Q <sub>95</sub> (veh)	0.9	0.1		0.0	0.1		0.0	0.3		0.0	0.8	
Control Delay (s/veh)	10.1	7.8		9.3	8.6		8.6	8.5		8.4	8.6	
Level of Service, LOS	В	A		А	A		А	А		A	A	
Approach Delay (s/veh)   LOS	9.9		A	8.8		A	8.5		A	8.6		A
Intersection Delay (s/veh)   LOS			9	.1						A		

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General Information Site Information											
Analyst	Emma Myers-Verhage	Intersection	Radar Hill Rd and Highway 44								
Agency/Co.		Jurisdiction	Box Elder, SD								
Date Performed	7/28/2023	East/West Street	Highway 44								
Analysis Year	2030	North/South Street	Radar Hill Rd								
Time Analyzed	AM Peak	Peak Hour Factor	0.86								
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00								
Project Description	Radar Hill 1416 Corridor Study	^									
Lanes											
	م لي	4 4 4 4 4 4									



## Vehicle Volumes and Adjustments

Approach		Eastb	ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	Т	TR		L	Т	TR			LTR				LTR	
Volume (veh/h)	0	16	232	6	0	3	221	19		5	2	2		21	3	11
Percent Heavy Vehicles (%)	5	5			3	3				6	6	6		10	10	10
Proportion Time Blocked																
Percent Grade (%)										(	0			. (	0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.16				7.62	6.62	7.02		7.70	6.70	7.10
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.23				3.56	4.06	3.36		3.60	4.10	3.40
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		19				3					10				41	
Capacity, c (veh/h)		1259				1276					494				531	
v/c Ratio		0.01				0.00					0.02				0.08	
95% Queue Length, Q <sub>95</sub> (veh)		0.0				0.0					0.1				0.2	
Control Delay (s/veh)		7.9				7.8					12.5				12.3	
Level of Service (LOS)		A				A					В				В	
Approach Delay (s/veh)		0	.5			0	.1		12.5				12.3			
Approach LOS			4		A					I	В		В			

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HCS 11 TWSC Version 2023 RadarHillRd-Hwy44\_AMPeak2030.xtw

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	HCS Two-Way Stop-Control Report												
General Information		Site Information											
Analyst	Emma Myers-Verhage	Intersection	Radar Hill Rd and Highway 44										
Agency/Co.		Jurisdiction	Box Elder, SD										
Date Performed	7/28/2023	East/West Street	Highway 44										
Analysis Year	2030	North/South Street	Radar Hill Rd										
Time Analyzed	PM Peak	Peak Hour Factor	0.85										
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00										
Project Description	Radar Hill 1416 Corridor Study												
Lanes													

\* 
 Major Street: East-West

Westbound

L

L

4

т

5

R

6

U

Northbound

L

7

т

8

R

9

0

2

6

6.9

7.02

3.3

3.36

0.1

12.7

В

12.7

В

U

Thomy		1 '	L _	5	40		5	0	'	U U	i
Number of Lanes	0	1	2	0	0	1	2	0	0	1	
Configuration		L	Т	TR		L	Т	TR		LTR	ľ
Volume (veh/h)	0	42	141	13	0	2	236	26	7	2	ĺ
Percent Heavy Vehicles (%)	5	5			3	3			6	6	ĺ
Proportion Time Blocked											ĺ
Percent Grade (%)									(	0	Î
Right Turn Channelized											
Median Type   Storage				Undi	vided						
Critical and Follow-up H	eadwa	ys									
Base Critical Headway (sec)		4.1				4.1			7.5	6.5	ĺ
Critical Headway (sec)		4.20				4.16			7.62	6.62	ĺ
Base Follow-Up Headway (sec)		2.2				2.2			3.5	4.0	ĺ
Follow-Up Headway (sec)		2.25				2.23			3.56	4.06	ĺ
Delay, Queue Length, an	d Leve	l of Se	ervice								I
Flow Rate, v (veh/h)		49				2				13	ľ
Capacity, c (veh/h)		1228				1384				481	ſ
v/c Ratio		0.04				0.00				0.03	ĺ

4Υ↑

R

3

U

4U

Eastbound

L

1

0.1

8.1

А

1.7

Т

2

U

1U

#### Approach LOS А

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95% Queue Length, Q<sub>95</sub> (veh)

Control Delay (s/veh)

Level of Service (LOS)

Approach Delay (s/veh)

**Vehicle Volumes and Adjustments** 

Approach

Movement Priority

HCSTM TWSC Version 2023 RadarHillRd-Hwy44\_PMPeak2030.xtw

0.1

А

0.0

7.6

А

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12.8

Southbound

Т

11

1

LTR

8

10

6.5

6.70

4.0

4.10

69 534 0.13

0.4

12.8

В

R

12

0

26

10

6.9

7.10

3.3

3.40

L

10

0

25

10

7.5

7.70

3.5

3.60

		ŀ	ICS 1	Гwo-	Way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			Highv	way 1416	6 and 15	1st Ave		
Agency/Co.							Jurisc	liction			Box E	lder, SD				
Date Performed	7/30/	2023					East/	West Str	eet		High	way 1416	5			
Analysis Year	2050						North	n/South :	Street		151st	Ave				
Time Analyzed	AM P	eak					Peak	Hour Fac	ctor		0.76					
Intersection Orientation	East-	Vest					Analy	sis Time	Period (	hrs)	1.00					
Project Description																
Lanes																
				$J \neq J \neq h \downarrow h$	ন শ	↓ or Street: Ea	t P C	141X4400								
Vehicle Volumes and Ad	justme	nts														
Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
					4U		5				8			10	11	

,																
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	0	1	0		
Configuration		LT						TR					LR			
Volume (veh/h)		180	44				108	20				11		151		
Percent Heavy Vehicles (%)		9										16		16		
Proportion Time Blocked																
Percent Grade (%)												(	0			
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up He	adwa	ys														
Base Critical Headway (sec)		4.1										7.1		6.2		
Critical Headway (sec)		4.19										6.56		6.36		
Base Follow-Up Headway (sec)		2.2										3.5		3.3		
Follow-Up Headway (sec)		2.28										3.64		3.44		
Delay, Queue Length, and	l Leve	l of Se	ervice									6.56       3.5				
Flow Rate, v (veh/h)		237											213			
Capacity, c (veh/h)		1368											769			
v/c Ratio		0.17											0.28			
95% Queue Length, Q <sub>95</sub> (veh)		0.6											1.1			
Control Delay (s/veh)		8.2	1.5										11.5			
Level of Service (LOS)		Α	A										В			
Approach Delay (s/veh)		6	.9									11	1.5			
Approach LOS		/	4									I	В			

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		ŀ	ICS	WO-	way	Stop	-Cor	ntrol	Repo	ort						
General Information							Site	Inforr	natio	n						
Analyst	Emma	a Myers-	Verhage				Inters	ection			Highv	way 1416	5 and 15	1st Ave		
Agency/Co.							Jurisc	liction			Box E	lder, SD				
Date Performed	7/30/	2023					East/	West Str	eet		Highv	way 1416	5			
Analysis Year	2050						North	n/South	Street		151st	Ave				
Time Analyzed	PM Pe	eak					Peak	Hour Fac	ctor		0.83					
Intersection Orientation	East-\	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Radar	Hill 141	6 Corrid	or Study	,											
Lanes																
				<u> </u>		or Street: Ea		074471P								
Vehicle Volumes and A	djustme	nts														
Approach		Eastb	ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	1
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	C
Configuration		LT						TR							LR	
Volume (veh/h)		97	95				57	5						6		6
Percent Heavy Vehicles (%)		9												16		1
Proportion Time Blocked																
													1		 ז	-

, , ,												1
Proportion Time Blocked												
Percent Grade (%)										(	0	
Right Turn Channelized												
Median Type   Storage				Undi	vided							
Critical and Follow-up He	eadwa	ys										
Base Critical Headway (sec)		4.1								7.1		6.2
Critical Headway (sec)		4.19								6.56		6.36
Base Follow-Up Headway (sec)		2.2								3.5		3.3
Follow-Up Headway (sec)		2.28								3.64		3.44
Delay, Queue Length, and	d Leve	l of Se	ervice	l .								
Flow Rate, v (veh/h)		117									88	
Capacity, c (veh/h)		1481									891	
v/c Ratio		0.08									0.10	
95% Queue Length, Q <sub>95</sub> (veh)		0.3									0.3	
Control Delay (s/veh)		7.6	0.6								9.5	
Level of Service (LOS)		A	A								А	
Approach Delay (s/veh)		4	.2							9	.5	
	1				1				1			

А

Approach LOS

	HCS Two-Way Stop	-Control Report	
General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	Highway 1416 and Liberty Blvd
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/30/2023	East/West Street	Highway 1416
Analysis Year	2050	North/South Street	Liberty Blvd
Time Analyzed	AM Peak	Peak Hour Factor	0.84
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	Radar Hill 1416 Corridor Study	· · · · · · · · · · · · · · · · · · ·	
Lanes			
	14174		



# **Vehicle Volumes and Adjustments**

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I I L

Approach		Eastb	ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	1	0		0	1	1
Configuration		L		TR			LTR				LTR			LT		R
Volume (veh/h)		333	151	3		7	91	178		4	52	10		61	19	142
Percent Heavy Vehicles (%)		8				7				2	2	2		9	9	9
Proportion Time Blocked																
Percent Grade (%)										(	C			(	)	
Right Turn Channelized														Ye	es	
Median Type   Storage				Undi	vided											
Critical and Follow-up He	Undivided															
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.18				4.17				7.12	6.52	6.22		7.19	6.59	6.29
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.27				2.26				3.52	4.02	3.32		3.58	4.08	3.38
Delay, Queue Length, and	Image       Image <t< td=""><td></td><td></td></t<>															
Flow Rate, v (veh/h)		396				8					79			95		169
Capacity, c (veh/h)		1207				1362					116			58		808
v/c Ratio		0.33				0.01					0.67			1.65		0.21
95% Queue Length, Q <sub>95</sub> (veh)		1.5				0.0					4.9			24.6		0.8
Control Delay (s/veh)		9.4				7.7	0.1	0.1			94.3			1387.3		10.6
Level of Service (LOS)		А				A	А	А			F			F		В
Approach Delay (s/veh)		6	.5			0	.3			94	4.3			50	6.7	
Approach LOS		/	4				4				F			I	=	

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	HCS Two-Way Stop	o-Control Report	
General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	Highway 1416 and Liberty Blvd
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/30/2023	East/West Street	Highway 1416
Analysis Year	2050	North/South Street	Liberty Blvd
Time Analyzed	PM Peak	Peak Hour Factor	0.84
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	Radar Hill 1416 Corridor Study	•	
Lanes			



# Vehicle Volumes and Adjustments

Approach		Eastb	ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	1	0		0	1	1
Configuration		L		TR			LTR				LTR			LT		R
Volume (veh/h)		99	86	13		7	66	69		8	16	2		131	27	110
Percent Heavy Vehicles (%)		8				7				2	2	2		9	9	9
Proportion Time Blocked																
Percent Grade (%)										(	D				0	
Right Turn Channelized														Y	es	
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa															
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.18				4.17				7.12	6.52	6.22		7.19	6.59	6.29
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.27				2.26				3.52	4.02	3.32		3.58	4.08	3.38
Delay, Queue Length, and	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		118				8					31			188		131
Capacity, c (veh/h)		1383				1440					395			415		913
v/c Ratio		0.09				0.01					0.08			0.45		0.14
95% Queue Length, Q <sub>95</sub> (veh)		0.3				0.0					0.3			2.4		0.5
Control Delay (s/veh)		7.8				7.5	0.0	0.0			14.9			20.8		9.6
Level of Service (LOS)		Α				A	Α	Α			В			С		A
Approach Delay (s/veh)		3	.9			0	.4			14	1.9			16	5.2	
Approach LOS		1	4				4			I	В				С	

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### HCS Two-Way Stop-Control Report

	1103 100 008	ly stop control report	
General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	WB Highway 1416 and S Ellsworth Rd
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/30/2023	East/West Street	WB Highway 1416
Analysis Year	2050	North/South Street	S Ellsworth Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.84
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	Radar Hill 1416 Corridor Study		
_			

### Lanes



Vehicle Volumes and Ad	justme	nts														
Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	2	0	0	0	1	0	0	0	1	1
Configuration						LT		TR		LT					Т	R
Volume (veh/h)						30	182	47		102	868				132	248
Percent Heavy Vehicles (%)						10	10	10		1						
Proportion Time Blocked																
Percent Grade (%)							0									
Right Turn Channelized														Y	'es	
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						7.20	6.60	6.30		4.11						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.59	4.09	3.39		2.21						
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)						144		164		121						
Capacity, c (veh/h)						97		130		1429						
v/c Ratio						1.48		1.27		0.08						
95% Queue Length, Q <sub>95</sub> (veh)						30.5		26.6		0.3						
Control Delay (s/veh)						1010.7		620.4		7.8	1.6					
Level of Service (LOS)						F		F		A	A					
Approach Delay (s/veh)		-	-			80	2.8	-		2	.3			-	-	-
Approach LOS							F			,	۹.					

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		ł	HCS <sup>-</sup>	Two-	Way	Stop	-Cor	ntrol	Repo	ort						
General Information	_	_	_	_		-			natio		_	_	_	_		
Analyst	- Emm	a Mvers	-Verhage	<u>ــــــــــــــــــــــــــــــــــــ</u>				ection			WBH	lighway	1416 an	d S Ellsw	orth Rd	
Agency/Co.			remage					liction				lder, SD				
Date Performed	7/30/	/2023						West Stre	eet			lighway	1416			
Analysis Year	2050							n/South S				worth Rc				
Time Analyzed	PM P							Hour Fac			0.90					
Intersection Orientation	Nort	h-South							Period (	hrs)	1.00					
Project Description	Rada	r Hill 14	16 Corric	lor Study	/					,	1					
Lanes																
				744747		치 치 다 Y r Street: Nor		14444								
Vehicle Volumes and Ad	justme				1				1							
Approach		1		л			bound			L	bound				bound	
Movement		Eastbound ULTR				L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	10	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	2	0	0	0	1	0	0	0	1	1
Configuration	╡──					LT	450	TR	<u> </u>	LT					T	R
Volume (veh/h)		<u> </u>	<u> </u>			32	150	22		43	413				104	327
Percent Heavy Vehicles (%)	╡──				<u> </u>	10	10	10		1				<u> </u>	<u> </u>	<u> </u>
Proportion Time Blocked Percent Grade (%)							0									
Right Turn Channelized	╡──						0		<u> </u>						′es	
Median Type   Storage				Undi	vided									1		
Critical and Follow-up H	_  eadwa	VS			viueu											
Base Critical Headway (sec)	1		1			7.1	6.5	6.2		4.1				<u> </u>		
Critical Headway (sec)						7.20	6.60	6.30		4.11						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2					<u> </u>	
Follow-Up Headway (sec)	1					3.59	4.09	3.39		2.21						
Delay, Queue Length, an	d Leve	el of S	ervice													
Flow Rate, v (veh/h)	1					119		108		48						
Capacity, c (veh/h)						350		387		1480						
v/c Ratio	1					0.34		0.28		0.03						
95% Queue Length, Q <sub>95</sub> (veh)	1					1.5		1.1		0.1						
Control Delay (s/veh)	1					20.6		17.9		7.5	0.3					
	_	+													<u> </u>	<b></b>

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Level of Service (LOS)

Approach LOS

Approach Delay (s/veh)

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С

С

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А

С

		ŀ	HCS 1	Гwo-	Way	Stop	-Cor	ntrol	Repo	ort						
General Information	_	_	_	_	_	_	Site	Inforn	natio	n	_	_	_	_	_	_
Analyst	Emm	a Myers-	Verhage					ection			EB Hi	ighway 1	416 and	S Ellswo	rth Rd	
Agency/Co.		- <b>)</b>	5-					liction				Elder, SD				
Date Performed	7/30/	/2023						West Stre	eet		1	ighway 1	416			
Analysis Year	2050							n/South S				worth Rc				
Time Analyzed	AM P	eak					Peak	Hour Fac	ctor		0.84					
Intersection Orientation	East-	West					Analy	sis Time	Period (	hrs)	1.00					
Project Description	Rada	r Hill 141	16 Corrid	or Study	/											
Lanes																
				<u> 1 4 1 人本 4 5 8</u> - 4 5		t t or Street: Ea		414410								
Vehicle Volumes and Adju	ustme	nts														
Approach		Eastb	ound		İ 📃	West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration	1	LT		TR								TR		LT		
Volume (veh/h)	1	748	356	19							209	60		63	98	
Percent Heavy Vehicles (%)	1	4									1	1		5	5	
Proportion Time Blocked	1															
Percent Grade (%)	1										0			(	)	
Right Turn Channelized	1															
Median Type   Storage	1			Undi	vided											
Critical and Follow-up He	adwa	ys														
Base Critical Headway (sec)	1	5.3									6.5	6.9		7.5	6.5	
Critical Headway (sec)	1	5.38									6.52	6.92		7.60	6.60	
Base Follow-Up Headway (sec)		3.1									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		3.14									4.01	3.31		3.55	4.05	
Delay, Queue Length, and	l Leve	l of Se	ervice													
Flow Rate, v (veh/h)	1	890										320		192		
Capacity, c (veh/h)		1146										6		4		
v/c Ratio	1	0.78										51.91		50.64		
95% Queue Length, Q <sub>95</sub> (veh)	1	9.7										160.0		96.9		
p370 Queue Length, Q95 (Ven)	1	18.8	3.2									92815.		91259.		
Control Delay (s/veh)				L								6		1		
		C	A									6 F		1 F		
Control Delay (s/veh)	   	С								928	15.6				59.1	

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		ŀ	ICS 1	Гwo-'	Way	Stop	-Cor	ntrol	Repo	ort						
General Information	_	_	_	_	_	_	Site	Inforr	natio	า	_	_	_	_	_	
Analyst	Emm	a Myers-	Verhage					section		-	EB Hi	ahway 1	416 and	S Ellswo	rth Rd	
Agency/Co.			vernage					liction			-	lder, SD		SENSIVO		
Date Performed	7/30/	2023						West Stre	eet		1	ghway 1	416			
Analysis Year	2050							n/South S				worth Ro				
Time Analyzed	PM P	eak						Hour Fac			0.90					
Intersection Orientation	East-	West						sis Time		hrs)	1.00					
Project Description	Rada	r Hill 141	6 Corrid	or Study	,						•					
Lanes																
				<u>ן 4 ↓ ↓ ♦ ↓ ↓ 0</u>		۲ مربع or Street: Ea	t t T	1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4								
Vehicle Volumes and Adju	ustme	nts														
Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration	1	LT		TR								TR		LT		
Volume (veh/h)	1	352	165	178							96	23		23	109	
Percent Heavy Vehicles (%)	1	4									1	1		5	5	
Proportion Time Blocked	1															
Percent Grade (%)	1									(	0			(	)	
Right Turn Channelized	1															
Median Type   Storage				Undi	vided											
Critical and Follow-up He	adwa	ys														
Base Critical Headway (sec)	1	5.3									6.5	6.9		7.5	6.5	
Critical Headway (sec)	i	5.38									6.52	6.92		7.60	6.60	
Base Follow-Up Headway (sec)	i	3.1									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		3.14									4.01	3.31		3.55	4.05	
Delay, Queue Length, and	l Leve	l of Se	ervice													
Flow Rate, v (veh/h)	1	391										132		147		
Capacity, c (veh/h)	1	1146										164		83		
v/c Ratio	1	0.34										0.81		1.76		
95% Queue Length, Q <sub>95</sub> (veh)	1	1.5										8.2		37.6		
Control Delay (s/veh)	1	9.8	0.7									102.1		1513.9		
Level of Service (LOS)	1	A	A									F		F		
Approach Delay (s/veh)	1	5								10	2.1			151	3.9	
Approach LOS	1		4								F				=	
Conversion of Clarida	1						CVaraia		1				Conorate			

HCSTM TWSC Version 2023 EBHwy1416-EllsworthRd\_PMPeak2050.xtw

	Site Information
HCS Two-Way Stop	-Control Report

General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	WB Highway 1416 and Radar Hill Rd
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/30/2023	East/West Street	WB Highway 1416
Analysis Year	2050	North/South Street	Radar Hill Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.88
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	Radar Hill 1416 Corridor Study		

### Lanes



## Vehicle Volumes and Adjustments

veniere volumes and Auj	Jotine															
Approach		Eastb	ound			West	oound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration						LT		TR		LT						TR
Volume (veh/h)						120	512	8		202	28				40	19
Percent Heavy Vehicles (%)						5				4	4				3	3
Proportion Time Blocked																
Percent Grade (%)										(	)				0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up He	adwa	ys														
Base Critical Headway (sec)						5.3				7.5	6.5				6.5	6.9
Critical Headway (sec)						5.40				7.58	6.58				6.56	6.96
Base Follow-Up Headway (sec)						3.1				3.5	4.0				4.0	3.3
Follow-Up Headway (sec)						3.15				3.54	4.04				4.03	3.33
Delay, Queue Length, and	l Leve	l of Se	ervice													
Flow Rate, v (veh/h)						136				261						67
Capacity, c (veh/h)						1143				266						314
v/c Ratio						0.12				0.98						0.21
95% Queue Length, Q <sub>95</sub> (veh)						0.4				18.6						0.8
Control Delay (s/veh)						8.6	0.8			158.0						19.6
Level of Service (LOS)						А	А			F						C
Approach Delay (s/veh)						2	.3			15	8.0			19	9.6	
Approach LOS	A							F				С				

	HCS Two-Way Stop	-Control Report	
General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	WB Highway 1416 and Radar Hill Rd
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/30/2023	East/West Street	WB Highway 1416
Analysis Year	2050	North/South Street	Radar Hill Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.94

Analysis Time Period (hrs)

1.00

### Lanes

Intersection Orientation

**Project Description** 



### Vehicle Volumes and Adjustments

East-West

Radar Hill 1416 Corridor Study

Approach	Eastbound Westbound									North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration						LT		TR		LT						TR
Volume (veh/h)						237	697	4		134	38				20	12
Percent Heavy Vehicles (%)						5				4	4				3	3
Proportion Time Blocked																
Percent Grade (%)										(	)				0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up He	eadwa	ys														
Base Critical Headway (sec)						5.3				7.5	6.5				6.5	6.9
Critical Headway (sec)						5.40				7.58	6.58				6.56	6.96
Base Follow-Up Headway (sec)						3.1				3.5	4.0				4.0	3.3
Follow-Up Headway (sec)						3.15				3.54	4.04				4.03	3.33
Delay, Queue Length, and	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)						252				183						34
Capacity, c (veh/h)						1143				138						176
v/c Ratio						0.22				1.32						0.19
95% Queue Length, Q <sub>95</sub> (veh)						0.8				31.1						0.7
Control Delay (s/veh)						9.0	1.5			703.8						30.4
Level of Service (LOS)						A	A			F						D
Approach Delay (s/veh)						3	.4			70	3.8			30	).4	
Approach LOS	A							F				D				

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General and Site Informat	ion				p Con							
					Lanes							
Analyst	Emma N	Ayers-Verh	age		-		J		Laha ba	L.		
Agency/Co.					-			100356658				
Date Performed	7/30/20	23			-	_*					1 K	
Analysis Year	2050				-						*	
Analysis Time Period (hrs)	1.00				-	*					-	
Time Analyzed	AM Pea				-	$\overline{\prec}$					444	
Project Description	_		rridor Stud	-	-	-	7				÷	
Intersection			and Radar I	Hill Rd	-	*					*	
Jurisdiction	Box Elde				-	7					K-	
East/West Street		way 1416			-				1			
North/South Street	Radar H	lill Rd					ኘ	* **	11	<u>۲</u>		
Peak Hour Factor	0.86											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound			Westbound	k	1	Northboun	d	5	Southboun	d
Movement	L	Т	R	L	т	R	L	Т	R	L	Т	R
Volume (veh/h)	5	794	73					220	356	13	123	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	tments											
Approach		Eastbound			Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	467	547					670			158		
Percent Heavy Vehicles	3	3					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.416	0.486					0.595			0.141		
Final Departure Headway, hd (s)	6.81	6.69					5.83			7.04		
Final Degree of Utilization, x	0.884	1.016					1.084			0.309		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	4.51	4.39					3.83			5.04		
Capacity, Delay and Level	of Servic	е										
Approach		Eastbound			Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	467	547					670			158		
Capacity (veh/h)	529	538					618			511		
95% Queue Length, Q <sub>95</sub> (veh)	15.2	30.8					47.3			1.3		
Control Delay (s/veh)	52.4	135.1					215.6			13.2		
Level of Service, LOS	F	F					F			В		
												1

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informati	on				Lanes							
Analyst	Emma N	/lyers-Verh	age				_					
Agency/Co.					1			* + *		L.		
Date Performed	7/30/20	23			1				•			
Analysis Year	2050				1	_*					K	
Analysis Time Period (hrs)	1.00				1	_ <b>*</b>					444	
Time Analyzed	PM Pea	<			1	÷.	4				<b>←</b>	
Project Description	Radar H	ill 1416 Co	orridor Stud	у	1	$\prec$	7					
Intersection	EB High	way 1416 a	and Radar I	Hill Rd	1	-						
Jurisdiction	Box Elde	er, SD			1	<b>T</b>					<u>∽</u>	
East/West Street	EB High	way 1416			1	4			t <del>a</del>		••	
North/South Street	Radar H	ill Rd			1		5	<u>+</u> ++	∣ ╱┤╋│╋			
Peak Hour Factor	0.85				1			1				
Turning Movement Demar	d Volum	nes										
Approach	T	Eastbound	ł		Westbound	ł	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	23	545	239					148	158	5	232	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	ments								<u> </u>			
Approach	T	Eastbound	ł		Westbound	k	n l	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	348	602					360			279		
Percent Heavy Vehicles	3	3					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.309	0.535					0.320			0.248		
Final Departure Headway, hd (s)	6.58	6.21					6.14			6.57		
Final Degree of Utilization, x	0.636	1.038					0.614			0.509		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t₅ (s)	4.28	3.91					4.14			4.57		
Capacity, Delay and Level of	of Servic	e							1			
Approach	T	Eastbound	ł		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	348	602					360			279		
Capacity (veh/h)	547	579					586			548		
95% Queue Length, Q <sub>95</sub> (veh)	5.0	36.1					4.6			3.0		
Control Delay (s/veh)	20.6	156.7					18.8			16.3		
Level of Service, LOS	С	F					С			С		
Approach Delay (s/veh)   LOS	106.9	<u> </u>	F				18.8		С	16.3		С
Intersection Delay (s/veh)   LOS				1.0						F		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Ayers-Verh	age									
Agency/Co.							<u>_</u>	* + + *	└┓┢	L.		
Date Performed	7/30/20	23						4	Ļ			
Analysis Year	2050					_*					K	
Analysis Time Period (hrs)	1.00					_ <b>*</b>					<u> </u>	
Time Analyzed	AM Pea	k				**	1			4	<b>←</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	у		$\rightarrow$	7			<b>K</b> -	)/	
Intersection	Radar H	lill Rd and I	ong View	Dr	1							
Jurisdiction	Box Eld	er, SD				7 7						
East/West Street	Long Vi	ew Dr				٩		ካ	t.			
North/South Street	Radar H	lill Rd					ኻ	<u>م</u> الم	╵ ╱│╋│╊			
Peak Hour Factor	0.90				1							
Turning Movement Demai	nd Volum	nes										
Approach		Eastbound			Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	114	10	2	7	25	12	2	32	4	4	50	166
% Thrus in Shared Lane												
Lane Flow Rate and Adjust	ments											
Approach	T	Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	127	13		8	41		2	40		4	240	
Percent Heavy Vehicles	3	3		49	49		14	14		5	5	
Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.113	0.012		0.007	0.037		0.002	0.036		0.004	0.213	
Final Departure Headway, hd (s)	5.79	5.17		6.67	5.94		5.99	5.41		5.67	4.63	
Final Degree of Utilization, x	0.204	0.019		0.014	0.068		0.004	0.060		0.007	0.309	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, t <sub>s</sub> (s)	3.49	2.87		4.37	3.64		3.69	3.11		3.37	2.33	
Capacity, Delay and Level	of Servic	e				<u>.</u>				<u>.</u>		
Approach		Eastbound			Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	127	13		8	41		2	40		4	240	
Capacity (veh/h)	622	696		540	606		601	665		635	778	
95% Queue Length, Q <sub>95</sub> (veh)	0.8	0.1		0.0	0.2		0.0	0.2		0.0	1.3	
Control Delay (s/veh)	10.0	8.0		9.5	9.1		8.7	8.5		8.4	9.4	
Level of Service, LOS	A	A		А	A		А	А		A	A	
Approach Delay (s/veh)   LOS	9.8		A	9.1		A	8.5		A	9.4		A
Intersection Delay (s/veh)   LOS			9	.4						A		

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		HCS	All-W	ay Sto	p Con	itrol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	/lyers-Verh	age				_					
Agency/Co.								* + + *		L <u>.</u>		
Date Performed	7/30/20	23						4	Ļ			
Analysis Year	2050					_*					×	
Analysis Time Period (hrs)	1.00					*					<u> </u>	
Time Analyzed	PM Pea	ĸ				***	1			4	<b>←</b>	
Project Description	Radar H	ill 1416 Co	rridor Stud	у		$\rightarrow$	7			<b>K</b> -	*	
Intersection	Radar H	ill Rd and I	Long View	Dr							*	
Jurisdiction	Box Elde	er, SD				7						
East/West Street	Long Vi	ew Dr				٩		5	t.		-	
North/South Street	Radar H	ill Rd					5	ৰ ক^	╵ ╱╵╋╵╊			
Peak Hour Factor	0.85							1				
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound	1	Westbound	d	1	Northboun	d	9	Southboun	d	
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	50	169	16	2	283	31	8	2	2	30	9	31
% Thrus in Shared Lane												
Lane Flow Rate and Adjus	tments											
Approach	1	Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	59	218		2	369		9	5		35	47	
Percent Heavy Vehicles	3	3		49	49		14	14		5	5	
Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.052	0.193		0.002	0.328		0.008	0.004		0.031	0.042	
Final Departure Headway, hd (s)	5.70	5.14		6.38	5.81		7.01	6.16		6.74	5.70	
Final Degree of Utilization, x	0.093	0.311		0.004	0.596		0.018	0.008		0.066	0.074	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, ts (s)	3.40	2.84		4.08	3.51		4.71	3.86		4.44	3.40	
Capacity, Delay and Level	of Servic	e										
Approach	T	Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	59	218		2	369		9	5		35	47	
Capacity (veh/h)	632	701		565	620		513	584		534	632	
95% Queue Length, Q <sub>95</sub> (veh)	0.3	1.3		0.0	4.3		0.1	0.0		0.2	0.2	
Control Delay (s/veh)	9.0	10.1		9.1	17.0		9.8	8.9		9.9	8.9	
Level of Service, LOS	A	В		A	С		A	A		A	A	
Approach Delay (s/veh)   LOS	9.9		A	16.9		С	9.5		A	9.3		A
Intersection Delay (s/veh)   LOS				3.3						B		

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General Information		Site Information	
Analyst	Emma Myers-Verhage	Intersection	Radar Hill Rd and Highway 44
Agency/Co.		Jurisdiction	Box Elder, SD
Date Performed	7/30/2023	East/West Street	Highway 44
Analysis Year	2050	North/South Street	Radar Hill Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.86
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	Radar Hill 1416 Corridor Study	· · ·	
.anes			



## Vehicle Volumes and Adjustments

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I I L

Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	Т	TR		L	Т	TR			LTR				LTR	
Volume (veh/h)	0	20	278	7	0	3	265	22		6	2	2		25	3	13
Percent Heavy Vehicles (%)	5	5			3	3				6	6	6		10	10	10
Proportion Time Blocked																
Percent Grade (%)										(	D			(	0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up H	eadwa	ys														
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.16				7.62	6.62	7.02		7.70	6.70	7.10
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.23				3.56	4.06	3.36		3.60	4.10	3.40
Delay, Queue Length, an	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		23				3					12				48	
Capacity, c (veh/h)		1201				1218					422				465	
v/c Ratio		0.02				0.00					0.03				0.10	
95% Queue Length, Q <sub>95</sub> (veh)		0.1				0.0					0.1				0.3	
Control Delay (s/veh)		8.1				8.0					13.8				13.6	
Level of Service (LOS)		A				Α					В				В	
Approach Delay (s/veh)		0	.5			0	.1			13	3.8			13	3.6	
Approach LOS		1	4				4			E	В				В	

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Generated: 7/30/2023 3:26:04 PM

General Information		Site Information							
Analyst	Emma Myers-Verhage	Intersection	Radar Hill Rd and Highway 44						
Agency/Co.		Jurisdiction	Box Elder, SD						
Date Performed	7/30/2023	East/West Street	Highway 44						
Analysis Year	2050	North/South Street	Radar Hill Rd						
Time Analyzed	PM Peak	Peak Hour Factor	0.85						
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00						
Project Description	Radar Hill 1416 Corridor Study		-						
Lanes	· ·								
_J & ↓ Å & ▶ \									



# Vehicle Volumes and Adjustments

Approach		Eastb	ound			West	bound			North	bound			South	bound	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	Т	TR		L	Т	TR			LTR				LTR	
Volume (veh/h)	0	50	169	16	0	2	283	31		8	2	2		30	9	31
Percent Heavy Vehicles (%)	5	5			3	3				6	6	6		10	10	10
Proportion Time Blocked																
Percent Grade (%)										(	0			. (	0	
Right Turn Channelized																
Median Type   Storage				Undi	vided											
Critical and Follow-up He	eadwa	ys														
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.16				7.62	6.62	7.02		7.70	6.70	7.10
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.23				3.56	4.06	3.36		3.60	4.10	3.40
Delay, Queue Length, and	d Leve	l of Se	ervice													
Flow Rate, v (veh/h)		59				2					14				82	
Capacity, c (veh/h)		1164				1342					409				466	
v/c Ratio		0.05				0.00					0.03				0.18	
95% Queue Length, Q <sub>95</sub> (veh)		0.2				0.0					0.1				0.6	
Control Delay (s/veh)		8.3				7.7					14.1				14.4	
Level of Service (LOS)		A				A					В				В	
Approach Delay (s/veh)		1	.8			0	.0			14	4.1			14	1.4	
Approach LOS		/	4			/	4				В				В	

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# Appendix E: Signal Warrant Analysis Results

Radar Hill - 1416 Corridor Study



City/County: Box Elder, SD Intersection: Hwy 1416 and Liberty Blvd

g	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dat	Population < 10,000:	No	Major 1: EB Highway 1416	50	2	100%
7	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
pn	0.70 Factor Used:	Yes	Minor 2: NB Liberty Blvd	25	1	100%
St	0.80 Factor Used:	No	Minor 4: SB Liberty Blvd	45	2	100%

	Time of Day	Major #1	Major #3	Total 1+3	Major 1A/1B 420/630	Minor #2	Minor #2 1A/1B 140/070	Minor #4	Minor #4 1A/1B 140/070	Both Met 1A/1B	Crash Warrant	MWSA Warrant
	6:00 - 7:00	89	117	206	/	20	/	50	/	/		
	7:00 - 8:00	485	247	732	X/X	68	/	213	X/X	X/X	х	х
	8:00 - 9:00	66	89	155	/	17	/	60	/	/		
Analysis	9:00 - 10:00	70	57	127	/	19	/	63	/	/		
al	10:00 - 11:00	46	33	79	/	12	/	47	/	/		
An A	11:00 - 12:00	82	62	144	/	15	/	70	/	/		
ts /	12:00 - 1:00	100	64	164	/	12	/	74	/X	/		
Warrants	1:00 - 2:00	91	65	156	/	21	/	108	/X	/		
Ë	2:00 - 3:00	94	66	160	/	24	/	92	/X	/		
N N	3:00 - 4:00	177	119	296	/	31	/	217	X/X	/		х
-	4:00 - 5:00	134	85	219	/	18	/	163	X/X	/		х
	5:00 - 6:00	132	96	228	/	26	/	179	X/X	/		х
	6:00 - 7:00	63	34	97	/	14	/	53	/	/		
	7:00 - 8:00	66	52	118	/	14	/	60	/	/		
	8:00 - 9:00	48	37	85	/	10	/	43	/	/		
	9:00 - 10:00	31	24	55	/	7	/	28	/	/		

	Criteria	Hours Met	Hours Required	Warrants Met
ts	Warrant 1a: Minimum Vehicular Volume	1	8	Not Met
븜	Warrant 1b: Interruption of Continuous Traffic	1	8	Not Met
Resul	Warrant 2: Four-Hour Vehicular Volume	1	4	Not Met
8	Warrant 7: Crash Experience	1	8	Not Met
	Multi-way Stop Applications (MWSA)	4	8	Not Met
dar Hill 1416 (	Corridor Study			No-Build (2030) ///KL
City/Cou	unty: Box Elder, SD			
Intersec	tion: Hwy 1416 and Liberty Blyd			

### Radar Hill 1416 Corridor Study

City/County: Box Elder, SD Intersection: Hwy 1416 and Liberty Blvd

ta	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Oai	Population < 10,000:	No	Major 1: EB Highway 1416	50	2	100%
2	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
n	0.70 Factor Used:	Yes	Minor 2: NB Liberty Blvd	25	1	100%
St	0.80 Factor Used:	No	Minor 4: SB Liberty Blvd	45	2	100%



	Criteria	Hours Met	Hours Required	Warrants Met
Results	Warrant 2: Four-Hour Vehicular Volume	1	4	Not Met
	Warrant 3: Peak Hour	0	1	Not Met



City/County: Box Elder, SD Intersection: Hwy 1416 and Liberty Blvd

g	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dat	Population < 10,000:	No	Major 1: EB Highway 1416	50	2	100%
<u>&gt;</u>	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
pn	0.70 Factor Used:	Yes	Minor 2: NB Liberty Blvd	25	1	100%
St	0.80 Factor Used:	No	Minor 4: SB Liberty Blvd	45	2	100%

	Time of Day	Major #1	Major #3	Total 1+3	Major 1A/1B 420/630	Minor #2	Minor #2 1A/1B 140/070	Minor #4	Minor #4 1A/1B 140/070	Both Met 1A/1B	Crash Warrant	MWSA Warrant
	6:00 - 7:00	93	123	216	/	21	/	52	/	/		
	7:00 - 8:00	493	254	747	X/X	70	/	217	X/X	X/X	х	х
	8:00 - 9:00	68	94	162	/	18	/	63	/	1		
Analysis	9:00 - 10:00	73	59	132	/	20	/	66	/	1		
a	10:00 - 11:00	48	35	83	/	13	/	49	/	1		
An	11:00 - 12:00	85	65	150	/	16	/	74	/X	1		
S	12:00 - 1:00	104	67	171	/	13	/	78	/X	1		
Warrants	1:00 - 2:00	95	68	163	/	22	/	113	/X	1		
Ľ.	2:00 - 3:00	97	69	166	/	26	/	96	/X	1		
Š	3:00 - 4:00	182	123	305	/	33	/	225	X/X	1		х
-	4:00 - 5:00	139	89	228	/	19	/	171	X/X	1		х
	5:00 - 6:00	137	101	238	/	28	/	188	X/X	1		х
	6:00 - 7:00	64	36	100	/	15	/	55	/	/		
	7:00 - 8:00	68	55	123	/	14	/	63	/	1		
	8:00 - 9:00	49	39	88	/	11	/	45	/	1		
	9:00 - 10:00	33	25	58	/	7	/	30	/	1		

	Criteria	Hours Met	Hours Required	Warrants Met
ts	Warrant 1a: Minimum Vehicular Volume	1	8	Not Met
븜	Warrant 1b: Interruption of Continuous Traffic	1	8	Not Met
Resul	Warrant 2: Four-Hour Vehicular Volume	1	4	Not Met
8	Warrant 7: Crash Experience	1	8	Not Met
	Multi-way Stop Applications (MWSA)	4	8	Not Met
dar Hill 1416 (	Corridor Study			No-Build (2050) /// KL
City/Cou	unty: Box Elder, SD			
Intersec	tion: Hwy 1416 and Liberty Blyd			

### Radar Hill 1416 Corridor Study

City/County: Box Elder, SD Intersection: Hwy 1416 and Liberty Blvd

ta	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dai	Population < 10,000:	No	Major 1: EB Highway 1416	50	2	100%
∠	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
	0.70 Factor Used:	Yes	Minor 2: NB Liberty Blvd	25	1	100%
St	0.80 Factor Used:	No	Minor 4: SB Liberty Blvd	45	2	100%



	Criteria	Hours Met	Hours Required	Warrants Met
Results	Warrant 2: Four-Hour Vehicular Volume	1	4	Not Met
	Warrant 3: Peak Hour	0	1	Not Met



City/County: Box Elder, SD Intersection: Hwy 1416 and S Ellsworth Rd

2	g	Date:	8/25/2023	Approach	Speed	Lanes	RT %
	Jat	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
	2	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
	n	0.70 Factor Used:	Yes	Minor 2: NB S Ellsworth Rd	25	1	100%
ť	5	0.80 Factor Used:	No	Minor 4: SB S Ellsworth Rd	35	1	100%

					Major		Minor #2		Minor #4	Both Met	Crash	MWSA
	Time of Day	Major #1	Major #3	Total 1+3	1A/1B 420/630	Minor #2	1A/1B 105/053	Minor #4	1A/1B 105/053	1A/1B	Warrant	Warrant
	6:00 - 7:00	741	39	780	X/X	93	/X	101	/X	/x	х	х
										-		
ts Analysis	7:00 - 8:00	1013	236	1249	X/X	247	X/X	364	X/X	X/X	X	X
	8:00 - 9:00	336	67	403	/	59	/X	158	X/X	/		Х
	9:00 - 10:00	294	52	346	/	46	/	170	X/X	1		х
	10:00 - 11:00	281	67	348	/	38	/	177	X/X	1		х
	11:00 - 12:00	324	62	386	/	36	/	196	X/X	1		х
	12:00 - 1:00	407	78	485	X/	46	/	233	X/X	X/	х	х
Warrants	1:00 - 2:00	366	76	442	X/	56	/X	179	X/X	X/		х
L L	2:00 - 3:00	410	92	502	X/	48	/	217	X/X	X/	х	х
Š	3:00 - 4:00	454	178	632	X/X	78	/X	450	X/X	X/X	х	х
-	4:00 - 5:00	484	109	593	X/	65	/X	383	X/X	X/	х	х
	5:00 - 6:00	541	119	660	X/X	82	/X	343	X/X	X/X	х	х
	6:00 - 7:00	186	41	227	/	35	/	139	X/X	1		х
	7:00 - 8:00	285	52	337	/	41	/	148	X/X	1		х
	8:00 - 9:00	204	37	241	/	30	/	106	X/X	1		
	9:00 - 10:00	134	25	159	/	19	/	69	/X	1		

	Criteria	Hours Met	Hours Required	Warrants Met		
ts	Warrant 1a: Minimum Vehicular Volume	7	8	Not Met		
	Warrant 1b: Interruption of Continuous Traffic	4	8	Not Met		
Resu	Warrant 2: Four-Hour Vehicular Volume	7	7 4			
8	Warrant 7: Crash Experience	7	8	Not Met		
	Multi-way Stop Applications (MWSA)	14	8	Met		
Radar Hill 1416	Corridor Study			No-Build (2030)		
City/Co	unty: Box Elder, SD					
Intersec	tion: Hwy 1416 and S Ellsworth Rd					

### Radar Hill 1416 Corridor Study

City/County: Box Elder, SD Intersection: Hwy 1416 and S Ellsworth Rd

ata	Date:	8/25/2023	Approach	Speed	Lanes	RT %
)a	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
l <u>≻</u>	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
on	0.70 Factor Used:	Yes	Minor 2: NB S Ellsworth Rd	25	1	100%
st	0.80 Factor Used:	No	Minor 4: SB S Ellsworth Rd	35	1	100%



	Criteria	Hours Met	Hours Required	Warrants Met
Results	Warrant 2: Four-Hour Vehicular Volume	7	4	Met
	Warrant 3: Peak Hour	4	1	Met



City/County: Box Elder, SD Intersection: Hwy 1416 and S Ellsworth Rd

, a	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dat	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
<u>^</u>	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
pn	0.70 Factor Used:	Yes	Minor 2: NB S Ellsworth Rd	25	1	100%
St	0.80 Factor Used:	No	Minor 4: SB S Ellsworth Rd	35	1	100%

	Time of Day	Major #1	Major #3	Total 1+3	Major 1A/1B 420/630	Minor #2	Minor #2 1A/1B 105/053	Minor #4	Minor #4 1A/1B 105/053	Both Met 1A/1B	Crash Warrant	MWSA Warrant
	6:00 - 7:00	853	43	896	X/X	107	X/X	115	X/X	X/X	х	Х
ý	7:00 - 8:00	1134	245	1379	X/X	271	X/X	400	X/X	X/X	х	х
	8:00 - 9:00	384	74	458	X/	68	/X	181	X/X	X/		х
sis	9:00 - 10:00	337	57	394	/	53	/	195	X/X	/		х
a	10:00 - 11:00	322	75	397	/	44	/	203	X/X	/		х
Analysis	11:00 - 12:00	371	68	439	X/	41	/	225	X/X	X/		х
	12:00 - 1:00	466	86	552	X/	53	/	267	X/X	X/	х	х
Warrants	1:00 - 2:00	419	84	503	X/	64	/X	206	X/X	X/	х	х
E E	2:00 - 3:00	470	102	572	X/	56	/X	249	X/X	X/	х	х
Š	3:00 - 4:00	514	191	705	X/X	87	/X	513	X/X	X/X	х	х
-	4:00 - 5:00	555	121	676	X/X	75	/X	440	X/X	X/X	х	х
	5:00 - 6:00	620	133	753	X/X	95	/X	394	X/X	X/X	х	х
	6:00 - 7:00	212	44	256	/	40	/	159	X/X	/		X
	7:00 - 8:00	327	58	385	/	48	/	170	X/X	/		Х
	8:00 - 9:00	233	41	274	/	34	/	121	X/X	/		Х
	9:00 - 10:00	154	27	181	/	22	/	79	/X	/		

	Criteria	Hours Met	Hours Required	Warrants Met		
s	Warrant 1a: Minimum Vehicular Volume	10	8	Met		
Results	Warrant 1b: Interruption of Continuous Traffic	5	8	Not Met		
es	Warrant 2: Four-Hour Vehicular Volume	9	4	Met		
8	Warrant 7: Crash Experience	8	8	Met - Check Crash Rate		
	Multi-way Stop Applications (MWSA)	15	8	Met		
dar Hill 1416 (	Corridor Study			No-Build (2050) ///KL		
City/Cou	unty: Box Elder, SD					
Intersec	tion: Hwy 1416 and S Ellsworth Rd					

### Radar Hill 1416 Corridor Study

City/County: Box Elder, SD Intersection: Hwy 1416 and S Ellsworth Rd

Г	ta	Date:	8/25/2023	Approach	Speed	Lanes	RT %
	Dai	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
	>	Existing Signal:	No	Major 3: WB Highway 1416	50	2	100%
	nd	0.70 Factor Used:	Yes	Minor 2: NB S Ellsworth Rd	25	1	100%
	St	0.80 Factor Used:	No	Minor 4: SB S Ellsworth Rd	35	1	100%



	Criteria	Hours Met	Hours Required	Warrants Met
Results	Warrant 2: Four-Hour Vehicular Volume	9	4	Met
	Warrant 3: Peak Hour	5	1	Met



City/County: Box Elder, SD Intersection: Hwy 1416 and Radar Hill Rd

a.	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dat	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
<u>&gt;</u>	Existing Signal:	No	Major 3: WB Highway 1416	55	2	100%
pn	0.70 Factor Used:	Yes	Minor 2: NB Radar Hill Rd	45	1	100%
st	0.80 Factor Used:	No	Minor 4: SB Gumbo Dr	25	1	100%

					Major		Minor #2		Minor #4	Both Met	Crash	MWSA
	Time of Day	Major #1	Major #3	Total 1+3	1A/1B 420/630	Minor #2	1A/1B 105/053	Minor #4	1A/1B 105/053	1A/1B	Warrant	Warrant
	6:00 - 7:00	591	192	783	X/X	299	X/X	19	/	X/X	Х	Х
	7:00 - 8:00	774	560	1334	X/X	512	X/X	56	/X	X/X	х	х
	8:00 - 9:00	328	289	617	X/	151	X/X	40	/	X/		х
sis	9:00 - 10:00	307	268	575	X/	141	X/X	21	/	X/		
al	10:00 - 11:00	288	320	608	X/	135	X/X	15	/	X/		
ts Analysis	11:00 - 12:00	363	407	770	X/X	115	X/X	18	/	X/X	х	
	12:00 - 1:00	413	328	741	X/X	160	X/X	31	/	X/X	х	
Warrants	1:00 - 2:00	408	330	738	X/X	141	X/X	28	/	X/X	х	
L L	2:00 - 3:00	436	438	874	X/X	162	X/X	31	/	X/X	х	
Š	3:00 - 4:00	480	809	1289	X/X	179	X/X	21	/	X/X	х	х
-	4:00 - 5:00	580	877	1457	X/X	208	X/X	22	/	X/X	х	х
	5:00 - 6:00	631	626	1257	X/X	262	X/X	21	/	X/X	х	х
	6:00 - 7:00	232	183	415	/	63	/X	12	/	/		
	7:00 - 8:00	287	274	561	X/	123	X/X	16	/	X/		
	8:00 - 9:00	205	196	401	/	88	/X	11	/	1		
	9:00 - 10:00	135	128	263	/	58	/X	7	/	1		

Resu	Warrant 1b: Interruption of Continuous Traffic Warrant 2: Four-Hour Vehicular Volume	11	4	Met Met	
Ľ.	Warrant 7: Crash Experience	9	8	Met - Check Crash Rate	
	Multi-way Stop Applications (MWSA)	6	8	Not Met	

### Radar Hill 1416 Corridor Study

City/County: Box Elder, SD Intersection: Hwy 1416 and Radar Hill Rd

ta	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dai	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
	Existing Signal:	No	Major 3: WB Highway 1416	55	2	100%
on	0.70 Factor Used:	Yes	Minor 2: NB Radar Hill Rd	45	1	100%
St	0.80 Factor Used:	No	Minor 4: SB Gumbo Dr	25	1	100%



	Criteria	Hours Met	Hours Required	Warrants Met
Results	Warrant 2: Four-Hour Vehicular Volume	11	4	Met
	Warrant 3: Peak Hour	6	1	Met



City/County: Box Elder, SD Intersection: Hwy 1416 and Radar Hill Rd

a	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Dat	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
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	Time of Day	Major #1	Major #3	Total 1+3	Major 1A/1B 420/630	Minor #2	Minor #2 1A/1B 105/053	Minor #4	Minor #4 1A/1B 105/053	Both Met 1A/1B	Crash Warrant	MWSA Warrant
	6:00 - 7:00	672	217	889	X/X	341	X/X	21	/	X/X	Х	Х
	7:00 - 8:00	860	620	1480	X/X	571	X/X	60	/X	X/X	х	х
	8:00 - 9:00	372	327	699	X/X	172	X/X	45	/	X/X	х	х
Analysis	9:00 - 10:00	349	304	653	X/X	161	X/X	24	/	X/X	х	
aly	10:00 - 11:00	327	362	689	X/X	154	X/X	17	/	X/X		
An	11:00 - 12:00	411	462	873	X/X	131	X/X	20	/	X/X	х	
	12:00 - 1:00	468	371	839	X/X	182	X/X	36	/	X/X	х	х
au	1:00 - 2:00	463	374	837	X/X	161	X/X	32	/	X/X	х	
Warrants	2:00 - 3:00	494	496	990	X/X	185	X/X	36	/	X/X	х	х
Š	3:00 - 4:00	540	912	1452	X/X	202	X/X	23	/	X/X	х	х
-	4:00 - 5:00	658	996	1654	X/X	237	X/X	25	/	X/X	х	х
	5:00 - 6:00	717	710	1427	X/X	298	X/X	24	/	X/X	х	х
	6:00 - 7:00	262	206	468	X/	72	/X	13	/	/		
	7:00 - 8:00	325	310	635	X/X	140	X/X	18	/	X/X		х
	8:00 - 9:00	232	222	454	X/	100	/X	13	/	/		
	9:00 - 10:00	153	145	298	/	66	/X	8	/	/		

	Criteria	Hours Met	Hours Required	Warrants Met	
ts	Warrant 1a: Minimum Vehicular Volume	13	8	Met	
5	Warrant 1b: Interruption of Continuous Traffic	13	8	Met	
Resi	Warrant 2: Four-Hour Vehicular Volume	13	4	Met	
*	Warrant 7: Crash Experience	11	8	Met - Check Crash Rate	
	Multi-way Stop Applications (MWSA)	9	8	Met	
adar Hill 1416 (	Corridor Study			No-Build (2050) ///KL]	
City/Cou	unty: Box Elder, SD			(V ·	
Intersec	tion: Hwy 1416 and Radar Hill Rd				

### Radar Hill 1416 Corridor Study

City/County: Box Elder, SD Intersection: Hwy 1416 and Radar Hill Rd

ata	Date:	8/25/2023	Approach	Speed	Lanes	RT %
Da	Population < 10,000:	No	Major 1: EB Highway 1416	55	2	100%
l <u>≻</u>	Existing Signal:	No	Major 3: WB Highway 1416	55	2	100%
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St	0.80 Factor Used:	No	Minor 4: SB Gumbo Dr	25	1	100%



	Criteria	Hours Met	Hours Required	Warrants Met
Results	Warrant 2: Four-Hour Vehicular Volume	13	4	Met
	Warrant 3: Peak Hour	8	1	Met

# **Appendix F: Alternative Concepts**

Radar Hill - 1416 Corridor Study










RADAR HILL ROAD 3 LANE SECTION ALTERNATIVE







HWY 1416 & RADAR HILL ROAD CORRIDOR STUDY









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RADAR HILL ROAD 3 LANE SECTION ALTERNATIVE







# Appendix G: Vehicular Level of Service (VLOS) Results – Alternatives

Radar Hill - 1416 Corridor Study

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informati	on				Lanes							
Analyst	Emma N	Myers-Verh	age									
Agency/Co.							<u>_</u>	* + + *	└┙┿╸┝	L.		
Date Performed	6/26/20	)23						2	Ļ			
Analysis Year	2023					_*					K	
Analysis Time Period (hrs)	1.00					<u>_</u>					<u> </u>	
Time Analyzed	AM Pea	k				*				4	<b>←</b> x	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim						4	↓ ◆	
Intersection	WB Hig	hway 1416	and S Ellsv	vorth Road							¥ +	
Jurisdiction	Box Eld	er, SD										
East/West Street	WB Hig	hway 1416				•						
North/South Street	S Ellswo	orth Rd					ካ	<u>م</u> الم ا	/ / † 1x			
Peak Hour Factor	0.84											
Turning Movement Deman	d Volun	nes										
Approach		Eastbound	1		Westbound	b	1	Northboun	d		Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				0	44	13	86	674			26	194
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	ments											
Approach	T	Eastbound	1	· ·	Westbound		, i	Northboun	d		Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			т	R	
Flow Rate, v (veh/h)				26	42		905			31	231	
Percent Heavy Vehicles				10	10		1			5	5	
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20	3.20	
Initial Degree of Utilization, x	1			0.023	0.037		0.804			0.028	0.205	
Final Departure Headway, hd (s)				6.94	6.68		4.86			5.39	4.69	
Final Degree of Utilization, x				0.050	0.077		1.222			0.046	0.301	
Move-Up Time, m (s)				2.3	2.3		2.0			2.3	2.3	
Service Time, t <sub>s</sub> (s)				4.64	4.38		2.86			3.09	2.39	
Capacity, Delay and Level o	of Servic	е			-			-	-	-		
Approach		Eastbound	1		Westbound	d	1	Northboun	d		Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			т	R	
Flow Rate, v (veh/h)				26	42		905			31	231	
Capacity (veh/h)				519	539		740			668	767	
95% Queue Length, Q <sub>95</sub> (veh)				0.2	0.3		96.3			0.1	1.3	
Control Delay (s/veh)				10.0	9.9		432.7			8.4	9.4	
Level of Service, LOS				В	А		F			Α	А	
Approach Delay (s/veh)   LOS		_		10.0		A	432.7		F	9.3		A
Intersection Delay (s/veh)   LOS			31	9.7						F		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informati	on				Lanes							
Analyst	Emma N	Myers-Verh	age									
Agency/Co.							<u>_</u>	* + + *	└┙┝	L.		
Date Performed	6/26/20	)23						2	Ļ			
Analysis Year	2023					_*					K	
Analysis Time Period (hrs)	1.00					_ <b>*</b>					<u> </u>	
Time Analyzed	PM Pea	k				**				4	<b>←</b> x	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		$\rightarrow$				4	*	
Intersection	WB Hig	hway 1416	and S Ellsv	vorth Rd							₹ +	
Jurisdiction	Box Eld	er, SD				*						
East/West Street	WB Hig	hway 1416				٩						
North/South Street	S Ellswo	orth Rd					ካ	<u>م</u> الم ا	▎ ╱╵╋╵╊	· ~		
Peak Hour Factor	0.90											
Turning Movement Demar	nd Volun	nes										
Approach		Eastbound	1		Westboun	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				14	71	6	36	328			65	256
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	ments											
Approach	T	Eastbound	1		Westboun	d	1	Northboun	d		Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			Т	R	
Flow Rate, v (veh/h)				55	46		404			72	284	
Percent Heavy Vehicles				10	10		1			5	5	
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20	3.20	
Initial Degree of Utilization, x				0.049	0.041		0.360			0.064	0.253	
Final Departure Headway, hd (s)				6.55	6.30		5.04			5.29	4.58	
Final Degree of Utilization, x				0.100	0.081		0.566			0.106	0.362	
Move-Up Time, m (s)				2.3	2.3		2.0			2.3	2.3	
Service Time, t <sub>s</sub> (s)				4.25	4.00		3.04			2.99	2.28	
Capacity, Delay and Level	of Servic	е										
Approach		Eastbound	1		Westboun	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			т	R	
Flow Rate, v (veh/h)				55	46		404			72	284	
Capacity (veh/h)				550	571		714			681	785	
95% Queue Length, Q <sub>95</sub> (veh)				0.3	0.3		3.8			0.4	1.7	
Control Delay (s/veh)				10.0	9.6		14.6			8.6	9.9	
Level of Service, LOS				A	A		В			A	A	
Approach Delay (s/veh)   LOS			-	9.8		A	14.6		В	9.6		A
Intersection Delay (s/veh)   LOS			12	2.0						В		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Information	on				Lanes							
Analyst	Emma I	Myers-Verh	age									
Agency/Co.							<u>_</u>	* + + *	└┿┝	L.		
Date Performed	6/26/20	)23						L.	Ļ			
Analysis Year	2030					_*					K	
Analysis Time Period (hrs)	1.00					*					<u> </u>	
Time Analyzed	AM Pea	k				*				4	<b>←</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		$\prec$				4	*	
Intersection	WB Hig	hway 1416	and S Ellsv	vorth Road							₹ €	
Jurisdiction	Box Eld	er, SD				<b>★</b>						
East/West Street	WB Hig	hway 1416				٩					-	
North/South Street	S Ellswo	orth Rd					5	<u>+</u> ++	 ∕* <del>†</del> †a	10		
Peak Hour Factor	0.84							<u>1</u>				
Turning Movement Deman	d Volun	nes										
Approach	T	Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				30	173	44	90	752			128	207
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	ments											
Approach	T	Eastbound	ł		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	1			LT	TR		LT			Т	R	
Flow Rate, v (veh/h)				139	155		1002			152	246	
Percent Heavy Vehicles				10	10		1			5	5	
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20	3.20	
Initial Degree of Utilization, x				0.123	0.138		0.891			0.135	0.219	
Final Departure Headway, hd (s)				7.34	6.98		5.87			6.37	5.67	
Final Degree of Utilization, x				0.283	0.301		1.633			0.270	0.388	
Move-Up Time, m (s)				2.3	2.3		2.0			2.3	2.3	
Service Time, t <sub>s</sub> (s)				5.04	4.68		3.87			4.07	3.37	
Capacity, Delay and Level o	of Servic	е				<u> </u>						
Approach		Eastbound	ł		Westbound	d	1	Northboun	d	5	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			т	R	
Flow Rate, v (veh/h)				139	155		1002			152	246	
Capacity (veh/h)				490	516		614			565	635	
95% Queue Length, Q <sub>95</sub> (veh)				1.2	1.3		201.8			1.1	1.9	
Control Delay (s/veh)				12.9	12.7		1163.9			11.4	12.0	
Level of Service, LOS				В	В		F			В	В	
Approach Delay (s/veh)   LOS				12.8		В	1163.	9	F	11.8		В
Intersection Delay (s/veh)   LOS			69	3.2					I	F		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informati	on				Lanes							
Analyst	Emma N	Ayers-Verh	age									
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Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		¥ †				4		
Intersection	WB Hig	hway 1416	and S Ellsv	vorth Rd							*	
Jurisdiction	Box Eld	er, SD				*						
East/West Street	WB Hig	hway 1416				•		*				
North/South Street	S Ellswo	orth Rd					ካ	ৰ ক	╵ ⋎ <sup>┩</sup> ╴╋			
Peak Hour Factor	0.90											
Turning Movement Demar	d Volum	nes										
Approach		Eastbound	l		Westbound	d	, I	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				29	135	21	38	356			93	273
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	ments											
Approach	Τ	Eastbound	l		Westbound	d	· ·	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			Т	R	
Flow Rate, v (veh/h)				107	98		438			103	303	
Percent Heavy Vehicles				10	10		1			5	5	
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20	3.20	
Initial Degree of Utilization, x				0.095	0.087		0.389			0.092	0.270	
Final Departure Headway, hd (s)				6.90	6.58		5.51			5.80	5.09	
Final Degree of Utilization, x				0.205	0.180		0.670			0.167	0.429	
Move-Up Time, m (s)				2.3	2.3		2.0			2.3	2.3	
Service Time, t <sub>s</sub> (s)				4.60	4.28		3.51			3.50	2.79	
Capacity, Delay and Level of	of Servic	e										
Approach		Eastbound	1		Westbound	d	· ·	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			Т	R	
Flow Rate, v (veh/h)				107	98		438			103	303	
Capacity (veh/h)				522	547		653			620	707	
95% Queue Length, $Q_{95}$ (veh)				0.8	0.7		5.8			0.6	2.2	
Control Delay (s/veh)				11.4	10.7		19.5			9.7	11.6	
Level of Service, LOS				В	В		С			A	В	
Approach Delay (s/veh)   LOS				11.1		В	19.5		С	11.1		В
Intersection Delay (s/veh)   LOS			14	4.6						В		

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General and Site Informat					Lanes							
Analyst	Emma N	/lyers-Verh	age						L da b			
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Analysis Year	2023					_^ 						
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Project Description	Radar H	ill 1416 Co	rridor Stud	y - Interim		_ →	7				Å.	
Intersection	EB High	way 1416 a	and S Ellsw	orth Rd		<b>_</b>					**	
Jurisdiction	Box Elde	er, SD				<b>_</b>					κ <sup></sup>	
East/West Street	EB High	way 1416							1			
North/South Street	S Ellswo	rth Rd					ኻ	* **	r † †	· [*		
Peak Hour Factor	0.84											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound	1		Westbound	1	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	618	115	15					142	7	10	16	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjus	tments											
Approach		Eastbound	1		Westbound	1	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	804	86					177			31		
Percent Heavy Vehicles	4	4					1			5		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.715	0.077					0.158			0.028		
Final Departure Headway, hd (s)	5.67	5.07					5.80			6.26		
Final Degree of Utilization, x	1.267	0.121					0.286			0.054		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, ts (s)	3.37	2.77					3.80			4.26		
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1		Westbound	1	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	804	86					177			31		
Capacity (veh/h)	635	711					621			575		
95% Queue Length, Q <sub>95</sub> (veh)	97.1	0.4					1.2			0.2		
Control Delay (s/veh)	514.0	8.5					11.1			9.6		
Level of Service, LOS	F	A					В			А		
		)	F				11.1		В	9.6		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	/lyers-Verh	age									
Agency/Co.								10035555	└ da b	⊾ L <u>a</u>		
Date Performed	6/26/20	23				_			•		_	
Analysis Year	2023					_*						
Analysis Time Period (hrs)	1.00										<u> ↔</u>	
Time Analyzed	PM Pea	k				*	4				4 4 4	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim			7				<u>∦</u> 2	
Intersection	EB High	way 1416 a	and S Ellsw	orth Rd	1						*	
Jurisdiction	Box Elde	er, SD				7					₹ √	
East/West Street	EB High	way 1416							1			
North/South Street	S Ellswo	orth Rd					ኻ	*	'  *			
Peak Hour Factor	0.90											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound	1		Westbound	k	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	291	79	143					73	6	6	73	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjus	tments											
Approach	T	Eastbound	ł		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	367	203					88			88		
Percent Heavy Vehicles	4	4					1			5		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.326	0.180					0.078			0.078		
Final Departure Headway, hd (s)	5.50	4.51					5.30			5.42		
Final Degree of Utilization, x	0.561	0.254					0.129			0.132		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.20	2.21					3.30			3.42		
Capacity, Delay and Level	of Servic	e	,						,			
Approach	T	Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	367	203					88			88		
Capacity (veh/h)	655	799					680			664		
95% Queue Length, Q <sub>95</sub> (veh)	3.7	1.0					0.4			0.5		
Control Delay (s/veh)	15.2	8.7					9.1			9.2		
Level of Service, LOS	С	A					A			A		
Approach Delay (s/veh)   LOS	12.9	<u> </u>	В				9.1		A	9.2		A
Intersection Delay (s/veh)   LOS				2.0						B		

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General and Site Informat	ion				p Con Lanes							
	-				Lanes							
Analyst	Emma N	lyers-Verh	age				J	~     _ ×		L.		
Agency/Co.								10035555	-  -			
Date Performed	6/26/20	23				_*						
Analysis Year	2030										~	
Analysis Time Period (hrs)	1.00					*					←	
Time Analyzed	AM Pea					$\neg$	-4				4 4 4 4	
Project Description	_		rridor Stud	-		$\rightarrow$	7				₽	
Intersection			and S Ellsw	orth Rd		*					**	
Jurisdiction	Box Elde					<b>~</b> *					<b>_</b>	
East/West Street	-	way 1416							7			
North/South Street	S Ellswo	rth Rd					ኘ	* **	1 1	<u>۲</u>		
Peak Hour Factor	0.84											
Turning Movement Dema	nd Volum	les										
Approach		Eastbound	l		Westbound	k	1	Northboun	d	5	Southbound	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	650	335	16					190	59	62	96	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	tments											
Approach		Eastbound	I		Westbound	k	1	Northboun	d	9	Southbound	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	973	218					296			188		
Percent Heavy Vehicles	4	4					1			5		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.865	0.194					0.263			0.167		
Final Departure Headway, hd (s)	6.47	6.01					6.04			6.52		
Final Degree of Utilization, x	1.750	0.365					0.497			0.341		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, ts (s)	4.17	3.71					4.04			4.52		
Capacity, Delay and Level	of Servic	e										
Approach	T	Eastbound	1		Westbound	ł	1	Northboun	d	9	Southbound	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	973	218					296			188		
Capacity (veh/h)	556	599					596			552		
95% Queue Length, Q <sub>95</sub> (veh)	215.4	1.7					2.9			1.5		
Control Delay (s/veh)	1374.5	12.2					15.0			12.9		
Level of Service, LOS	F	В					В			В		
											4	

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	/lyers-Verh	age									
Agency/Co.								* + + *	51.000	L <u>L</u>		
Date Performed	6/26/20	23				_			•		_	
Analysis Year	2030					_*					×	
Analysis Time Period (hrs)	1.00					<u>→</u>					<u>←</u>	
Time Analyzed	PM Pea	ĸ				*	4				4444	
Project Description	Radar H	ill 1416 Co	rridor Stud	y - Interim			7				k ≹	
Intersection	EB High	way 1416 a	and S Ellsw	orth Rd							*	
Jurisdiction	Box Elde	er, SD				<u>↓</u>					*	
East/West Street	EB High	way 1416			1				•			
North/South Street	S Ellswo	rth Rd			1		ካ	<u>م</u> الم	' ↗✦☆	· ~		
Peak Hour Factor	0.90											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound	1		Westbound	k	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	306	150	152					87	22	22	100	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	tments											
Approach	T	Eastbound	ł		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	423	252					121			136		
Percent Heavy Vehicles	4	4					1			5		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.376	0.224					0.108			0.120		
Final Departure Headway, hd (s)	5.71	4.84					5.53			5.72		
Final Degree of Utilization, x	0.672	0.339					0.186			0.216		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.41	2.54					3.53			3.72		
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	423	252					121			136		
Capacity (veh/h)	630	744					651			629		
95% Queue Length, Q <sub>95</sub> (veh)	5.8	1.5					0.7			0.8		
Control Delay (s/veh)	19.9	10.0					9.8			10.3		
Level of Service, LOS	С	В					Α			В		
Approach Delay (s/veh)   LOS	16.2		С				9.8		A	10.3		В
Intersection Delay (s/veh)   LOS			14	4.5						в В		

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HCSTM AWSC Version 2023 EB1416-Ellsworth\_Interim\_PMPeak2030.xaw Generated: 8/23/2023 11:11:18 AM

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	on				Lanes							
Analyst	Emma N	Myers-Verh	age									
Agency/Co.								* + + *	└┙┢	L.		
Date Performed	6/26/20	)23										
Analysis Year	2023					_*					×	
Analysis Time Period (hrs)	1.00					*					*	
Time Analyzed	AM Pea	k				*				4	<b>←</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		$\prec$				4	}_ ✦	
Intersection	WB Hig	hway 1416	and Radar	Hill Rd							*	
Jurisdiction	Box Eld	er, SD				1 1						
East/West Street	WB Hig	hway 1416				•					- •	
North/South Street	Radar H	lill Rd					5	<del>م</del> الم	▎ ╱╵╋╵ <sub>╄╸</sub>			
Peak Hour Factor	0.88				1			1 1	r r r			
Turning Movement Demai	nd Volum	nes										
Approach	Τ	Eastbound	1		Westbound	d	, I	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				79	334	5	167	5			17	16
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	ments											
Approach	T	Eastbound	1		Westbound	d	· ·	Northboun	d	5	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				280	195		195			38		
Percent Heavy Vehicles				5	5		4			3		
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20		
Initial Degree of Utilization, x				0.248	0.174		0.174			0.033		
Final Departure Headway, hd (s)				5.39	5.21		5.33			5.08		
Final Degree of Utilization, x				0.419	0.283		0.289			0.053		
Move-Up Time, m (s)				2.3	2.3		2.0			2.0		
Service Time, ts (s)				3.09	2.91		3.33			3.08		
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1	-	Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				280	195		195			38		
Capacity (veh/h)				668	691		676			709		
95% Queue Length, Q <sub>95</sub> (veh)				2.1	1.2		1.2			0.2		
Control Delay (s/veh)				12.0	10.0		10.5			8.4		
Level of Service, LOS				В	А		В			А		
Approach Delay (s/veh)   LOS		· · · ·		11.1		В	10.5		В	8.4		A
Intersection Delay (s/veh)   LOS			1(	).8						B		

HCS TM AWSC Version 2023 WB1416-RadarHill\_Interim\_AMPeak2023.xaw Generated: 8/23/2023 10:55:00 AM

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Myers-Verh	age									
Agency/Co.								* + + *	└┉┢	L.		
Date Performed	6/26/20	)23						×.				
Analysis Year	2023					_*					₹	
Analysis Time Period (hrs)	1.00					4					*	
Time Analyzed	PM Pea	k				*				4	<b>←</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		$\rightarrow$				<del>ن</del> ې ا	}_ ✦	
Intersection	WB Hig	hway 1416	and Radar	Hill Rd							¥ ★	
Jurisdiction	Box Eld	er, SD				- -						
East/West Street	WB Hig	hway 1416				•					-	
North/South Street	Radar H	lill Rd			1		5	<del>م</del> الم	/ <b>*   ↑</b>   ∱,			
Peak Hour Factor	0.94				1			1 T				
Turning Movement Dema	nd Volun	nes										
Approach		Eastbound	1	· ·	Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				184	531	3	112	28			13	10
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	tments		,	,			,			,		
Approach	T	Eastbound	1		Westbound	d	· ·	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				478	286		149			24		
Percent Heavy Vehicles				5	5		4			3		
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20		
Initial Degree of Utilization, x				0.425	0.254		0.132			0.022		
Final Departure Headway, hd (s)				5.31	5.10		5.74			5.54		
Final Degree of Utilization, x				0.705	0.404		0.237			0.038		
Move-Up Time, m (s)				2.3	2.3		2.0			2.0		
Service Time, t <sub>s</sub> (s)				3.01	2.80		3.74			3.54		
Capacity, Delay and Level	of Servic	е										
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				478	286		149			24		
Capacity (veh/h)				678	706		627			650		
95% Queue Length, Q <sub>95</sub> (veh)				6.7	2.0		0.9			0.1		
Control Delay (s/veh)				20.4	11.2		10.5			8.8		
Level of Service, LOS				С	В		В			А		
Approach Delay (s/veh)   LOS				17.0		C	10.5		В	8.8		A
Intersection Delay (s/veh)   LOS			1!	5.8					(	C		

HCS M AWSC Version 2023 WB1416-RadarHill\_Interim\_PMPeak2023.xaw

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Myers-Verh	age									
Agency/Co.							<u>_</u>	* + *	└┓┢	L.		
Date Performed	6/26/20	)23										
Analysis Year	2030					_*					K	
Analysis Time Period (hrs)	1.00					_ <b>*</b>					*	
Time Analyzed	AM Pea	k				*				4	<b>←</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		<u> </u>				<del>ن</del> ې ا	<u>}-</u>	
Intersection	WB Hig	hway 1416	and Radar	Hill Rd							<b>▼</b>	
Jurisdiction	Box Eld	er, SD										
East/West Street	WB Hig	hway 1416				٩						
North/South Street	Radar H	lill Rd					5	<u>+</u> ++	▎ ╱╴╋╴╏ <sub>┲</sub>	17		
Peak Hour Factor	0.88				1			1 T				
Turning Movement Demai	nd Volun	nes										
Approach		Eastbound	1		Westbound	d	· ·	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				107	454	7	179	28			37	17
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjust	tments											
Approach	T	Eastbound	1		Westbound	d	, i	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				380	266		235			61		
Percent Heavy Vehicles				5	5		4			3		
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20		
Initial Degree of Utilization, x				0.337	0.236		0.209			0.055		
Final Departure Headway, hd (s)				5.61	5.43		5.68			5.63		
Final Degree of Utilization, x				0.592	0.401		0.371			0.096		
Move-Up Time, m (s)				2.3	2.3		2.0			2.0		
Service Time, ts (s)				3.31	3.13		3.68			3.63		
Capacity, Delay and Level	of Servic	e										
Approach	1	Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				380	266		235			61		
Capacity (veh/h)				641	663		633			640		
95% Queue Length, Q <sub>95</sub> (veh)				4.2	2.0		1.8			0.3		
Control Delay (s/veh)				16.4	11.8		12.0			9.2		
Level of Service, LOS				С	В		В			А		
Approach Delay (s/veh)   LOS				14.5		В	12.0		В	9.2		A
Intersection Delay (s/veh)   LOS			13	3.5						B		

HCS TM AWSC Version 2023 WB1416-RadarHill\_Interim\_AMPeak2030.xaw Generated: 8/23/2023 12:32:19 PM

		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Myers-Verh	age									
Agency/Co.								* + + *	Lata b	L.		
Date Performed	6/26/20	)23						×.				
Analysis Year	2030					_*					K	
Analysis Time Period (hrs)	1.00					-*					*	
Time Analyzed	PM Pea	k				4				4	<b>←</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim	1	$\prec$				4	*	
Intersection	WB Hig	hway 1416	and Radar	Hill Rd							*	
Jurisdiction	Box Eld	er, SD			1	1 1						
East/West Street	WB Hig	hway 1416				4					ι κ	
North/South Street	Radar H						5	*	/ <b>/ ↑</b>			
Peak Hour Factor	0.94							1 4	r T ľ			
Turning Movement Dema	nd Volun	nes										
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)				209	605	4	118	34			18	11
% Thrus in Shared Lane				50		50						
Lane Flow Rate and Adjus	tments											
Approach	T	Eastbound	1		Westbound	d	l i	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				544	326		162			31		
Percent Heavy Vehicles				5	5		4			3		
Initial Departure Headway, hd (s)				3.20	3.20		3.20			3.20		
Initial Degree of Utilization, x				0.484	0.290		0.144			0.027		
Final Departure Headway, hd (s)				5.38	5.17		5.90			5.76		
Final Degree of Utilization, x				0.814	0.468		0.265			0.049		
Move-Up Time, m (s)				2.3	2.3		2.0			2.0		
Service Time, t₅ (s)				3.08	2.87		3.90			3.76		
Capacity, Delay and Level	of Servic	e										
Approach	1	Eastbound	l		Westbound	d	-	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LT	TR		LT			TR		
Flow Rate, v (veh/h)				544	326		162			31		
Capacity (veh/h)				669	697		611			625		
95% Queue Length, Q <sub>95</sub> (veh)				11.1	2.6		1.1			0.2		
Control Delay (s/veh)				30.1	12.4		11.0			9.1		
Level of Service, LOS				D	В		В			A		
Approach Delay (s/veh)   LOS		<u> </u>		23.5		C	11.0		В	9.1		A
Intersection Delay (s/veh)   LOS			2'	1.2					(	C		

HCS M AWSC Version 2023 WB1416-RadarHill\_Interim\_PMPeak2030.xaw

		TICS		ay Sto	p Con		port					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Ayers-Verh	age									
Agency/Co.								10035555	⊾₄ ♪	<u>ل</u>		
Date Performed	6/26/20	23							•			
Analysis Year	2023					_*					×	
Analysis Time Period (hrs)	1.00										4444	
Time Analyzed	AM Pea	k					4					
Project Description	Radar H	lill 1416 Co	rridor Stud	y -Interim		$\rightarrow$	*				× ₹	
Intersection	EB High	way 1416 a	and Radar I	Hill Rd							▲	
Jurisdiction	Box Elde	er, SD									* ~	
East/West Street	EB High	way 1416							1			
North/South Street	Radar H	lill Rd					ካ	*	, 1 † †	· /*		
Peak Hour Factor	0.88											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound			Westbound	ł	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	4	527	55					168	236	8	88	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	tments											
Approach	T	Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	304	362					459			109		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.270	0.322					0.408			0.097		
Final Departure Headway, hd (s)	6.19	6.06					5.39			6.36		
Final Degree of Utilization, x	0.523	0.609					0.688			0.193		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.89	3.76					3.39			4.36		
Capacity, Delay and Level	of Servic	e		-	-	-	-	-			-	
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	5	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	304	362					459			109		
Capacity (veh/h)	582	594					667			566		
95% Queue Length, Q <sub>95</sub> (veh)	3.2	4.5					6.2			0.7		
Control Delay (s/veh)	15.6	18.1					20.0			10.9		
Level of Service, LOS	С	С					С			В		
Approach Delay (s/veh)   LOS	17.0		С		<u> </u>		20.0		С	10.9		В
Intersection Delay (s/veh)   LOS			17	7.6						C		

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HCSTM AWSC Version 2023 EB1416-RadarHill\_Interim\_AMPeak2023.xaw Generated: 8/23/2023 10:15:57 AM

	_	HCS	All-W	ay Sto		troi Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Ayers-Verh	age									
Agency/Co.								200355335	└ ┿ ┝	La la		
Date Performed	6/26/20	23							•			
Analysis Year	2023					_* _*					×	
Analysis Time Period (hrs)	1.00										4 4 7 4 4	
Time Analyzed	PM Pea	k					4					
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim			7				k ≹	
Intersection	EB High	way 1416 a	and Radar I	Hill Rd							*	
Jurisdiction	Box Eld	er, SD				<b>T</b>						
East/West Street	EB High	way 1416			1				•			
North/South Street	Radar H	lill Rd					ካ	ন্য কাল স	'  *  <b>†</b>  *	· ~		
Peak Hour Factor	0.94											
Turning Movement Dema	nd Volun	nes										
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	19	401	193					121	116	4	193	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjus	tments		,			,	,		,	,		
Approach	T	Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	234	419					252			210		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.208	0.372					0.224			0.186		
Final Departure Headway, hd (s)	5.94	5.55					5.57			5.91		
Final Degree of Utilization, x	0.385	0.645					0.390			0.344		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.64	3.25					3.57			3.91		
Capacity, Delay and Level	of Servic	e										<u> </u>
Approach		Eastbound	1		Westbound	d	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	234	419					252			210		
Capacity (veh/h)	606	649					646			609		
95% Queue Length, Q <sub>95</sub> (veh)	1.9	5.2					1.9			1.6		
Control Delay (s/veh)	12.3	18.2					12.1			12.0		
Level of Service, LOS	В	С					В			В		
Approach Delay (s/veh)   LOS	16.1	<u> </u>	С				12.1		B	12.0		B
Intersection Delay (s/veh)   LOS	1			I 1.4						B		

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General and Site Informat	ion				Lanes							
Analyst	Emma N	Ayers-Verh	age									
Agency/Co.								CONTRACTOR OF	⊾₄≱ I			
Date Performed	6/26/20	23										
Analysis Year	2030										~ .X	
Analysis Time Period (hrs)	1.00					-4						
Time Analyzed	AM Pea	k					4				3	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim		$\rightarrow$	*				4 4 7 4 4	
Intersection	EB High	way 1416 a	and Radar I	Hill Rd							÷	
Jurisdiction	Box Elde	er, SD									κ Γ	
East/West Street	EB High	way 1416							1			
North/South Street	Radar H	lill Rd					ግ	*	, r † †	· /*		
Peak Hour Factor	0.88											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	5	702	64					197	314	12	111	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjus	tments		<u>.</u>		-		-	-	-		-	
Approach	T	Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	405	472					581			140		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.360	0.419					0.516			0.124		
Final Departure Headway, hd (s)	6.73	6.61					5.79			7.02		
Final Degree of Utilization, x	0.756	0.866					0.934			0.273		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, ts (s)	4.43	4.31					3.79			5.02		
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	405	472					581			140		
Capacity (veh/h)	535	544					622			513		
95% Queue Length, Q <sub>95</sub> (veh)	8.3	14.0					20.9			1.1		
Control Delay (s/veh)	29.4	46.4					64.3			12.7		
Level of Service, LOS	D	E					F			В		
Approach Delay (s/veh)   LOS	38.6		E				64.3		F	12.7		В
Intersection Delay (s/veh)   LOS			45	5.7						E		

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		HCS	All-W	ay Sto	p Con	trol Re	eport					
General and Site Informat	ion				Lanes							
Analyst	Emma N	Ayers-Verh	age				_					
Agency/Co.								* + + *	└ da b	د ل <u>د</u>		
Date Performed	6/26/20	23				_			•		_	
Analysis Year	2030										<u>k</u>	
Analysis Time Period (hrs)	1.00					*					4 4 7 4 4	
Time Analyzed	PM Pea	k				*	4				<b>↓</b>	
Project Description	Radar H	lill 1416 Co	rridor Stud	y - Interim			7					
Intersection	EB High	way 1416 a	and Radar I	Hill Rd							¥ +	
Jurisdiction	Box Eld	er, SD			1	<b>T</b>						
East/West Street	EB High	way 1416							1			
North/South Street	Radar H	lill Rd					ኻ	ন্দ কাল স	י ר 1 זי	· ~		
Peak Hour Factor	0.94											
Turning Movement Dema	nd Volum	nes										
Approach		Eastbound	1		Westbound	k	1	Northboun	d	9	Southboun	d
Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Volume (veh/h)	20	475	205					132	138	5	206	
% Thrus in Shared Lane	50		50									
Lane Flow Rate and Adjust	tments											
Approach	1	Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	274	471					287			224		
Percent Heavy Vehicles	4	4					4			3		
Initial Departure Headway, hd (s)	3.20	3.20					3.20			3.20		
Initial Degree of Utilization, x	0.243	0.418					0.255			0.200		
Final Departure Headway, hd (s)	6.12	5.75					5.79			6.18		
Final Degree of Utilization, x	0.466	0.752					0.462			0.385		
Move-Up Time, m (s)	2.3	2.3					2.0			2.0		
Service Time, t <sub>s</sub> (s)	3.82	3.45					3.79			4.18		
Capacity, Delay and Level	of Servic	e										
Approach		Eastbound	1		Westbound	ł	1	Northboun	d	9	Southboun	d
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LT	TR					TR			LT		
Flow Rate, v (veh/h)	274	471					287			224		
Capacity (veh/h)	588	626					622			582		
95% Queue Length, Q <sub>95</sub> (veh)	2.6	8.2					2.5			1.9		
Control Delay (s/veh)	14.1	25.3					13.7			13.0		
Level of Service, LOS	В	D					В			В		
Approach Delay (s/veh)   LOS	21.2		С				13.7		В	13.0		В
Intersection Delay (s/veh)   LOS			18	3.0					(	C		

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	HCS	s Sigr	nalize	a inte	ersect	ION R	esu	ts Sun	nmary	/				
General Information								Intersec	tion Inf	ormatic	<u></u>			
								Duration		1.000			44	
Agency Analyst	Emma Myora Varba		Analy	nia Dat	0/1//	0000				Other				
	Emma Myers-Verha	age	1		e 8/14/2			Area Typ	e				.ï.	
Jurisdiction	Box Elder, SD		Time F		AM P	еак		PHF	Devia	1.00	20		l.	← 33 ~~~ @
Urban Street	Alternative 1				r 2030	110 5		Analysis		1> 7:0				
Intersection	Hwy 1416 and Rad		File Na	ame	Hwy1	416-Rad	darHil	_Alt1_AN	/IPeak20	J30.xus		_	<u> </u>	01/21
Project Description	Radar Hill 1416 Co	rridor St	tudy									3		<b>17</b> 181
Demand Information				EB			W	В		NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), veh/h			5	697	64	102	43	3 7	179	18	312	11	26	17
														<u> </u>
Signal Information		r		1	_ 6		<u> </u>	5	- 20	2		_	ĸ	$\mathbf{A}$
Cycle, s 61.1	Reference Phase	2		<b></b>		'R '		S S	r s	17 4	1		3	4
Offset, s 0	Reference Point	End	Green		3.7	15.0	0.9		18.9			5		
Uncoordinated Yes	Simult. Gap E/W	On	Yellow	/ 3.5	0.0	3.5	3.5	5 0.0	3.5				$\mathbf{Y}$	- <b>V</b>
Force Mode Fixed	Simult. Gap N/S	On	Red	1.0	0.0	1.0	1.0	0.0	1.0		5	6	7	8
Timor Besults					EPT				ND		NDT	0.01		CDT
Timer Results			EBI		EBT	WB 1		WBT	NBI 2		NBT	SBI 7	-	SBT
Assigned Phase			5		2	1		6	3		8	7		4
Case Number			1.1		3.0	1.1		3.0	1.1		4.0	1.1		4.0
Phase Duration, s	```		4.9		19.5	8.6		23.2	9.6		27.6	5.4		23.4
Change Period, (Y+R	•		4.5		4.5	4.5	_	4.5	4.5		4.5	4.5		4.5
Max Allow Headway (	,		2.9		2.9	2.9		2.9	3.0		3.3	3.3		3.3
Queue Clearance Time			2.1		14.2	4.7		8.3	6.3		12.8	2.3		3.1
Green Extension Time	(ge), s		0.0		0.8	0.0		2.1	0.0		0.5	0.0		0.7
Phase Call Probability			80.0		1.00	0.82		1.00	0.95		1.00	0.17		1.00
Max Out Probability			1.00	J	0.70	1.00	)	0.08	1.00	)	0.14	1.00	)	0.00
Movement Group Res	sults			EB	_		WE	3		NB			SB	_
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement			5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate ( v	′), veh/h		5	697	64	102	433	7	179	330		11	43	
Adjusted Saturation Flo	ow Rate ( s ), veh/h/l	n	1667	1666	1483	1667	166	5 1483	1667	1495		1667	1634	
Queue Service Time (	g s ), s		0.1	12.2	2.1	2.7	6.3	0.2	4.3	10.8		0.3	1.1	
Cycle Queue Clearanc	- /		0.1	12.2	2.1	2.7	6.3	0.2	4.3	10.8		0.3	1.1	
Green Ratio(g/C)			0.25	0.25	0.25	0.33	0.31	0.31	0.42	0.38		0.32	0.31	
Capacity ( c ), veh/h			294	819	365	265	102	1 455	659	566		322	505	
Volume-to-Capacity Ra	atio (X)		0.017	0.851	0.176	0.385	0.42	4 0.015	0.272	0.583		0.034	0.085	
Back of Queue ( Q ), f			2	200.7	26.8	36.8	87.5	5 2.5	57.1	164.5		4.5	20.1	
Back of Queue ( Q ), v		,	0.1	8.0	1.1	1.5	3.5		2.3	6.6		0.2	0.8	
Queue Storage Ratio (		tile)	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay ( <i>d</i> 1 ), s			17.3	22.0	18.2	16.2	16.9		11.6	15.2		14.7	15.0	
Incremental Delay ( d 2	·		0.0	5.7	0.1	0.3	0.1	0.0	0.1	4.4		0.0	0.3	
Initial Queue Delay ( d	,		0.0	0.0	0.0	0.0	0.0	_	0.0	0.0		0.0	0.0	
Control Delay ( d ), s/v			17.3	27.7	18.3	16.5	17.0	) 14.8	11.6	19.6		14.7	15.3	
Level of Service (LOS)			В	С	В	В	В	В	В	В		В	В	
Approach Delay, s/veh	/LOS		26.9	9	С	16.9	)	В	16.8	3	В	15.2	2	В
Intersection Delay, s/ve	eh / LOS				20	0.9						С		
Multimodal Results	// 00			EB	<b>P</b>		WE			NB	<b>D</b>		SB	
Pedestrian LOS Score			1.91		B	1.91	_	B	2.41	_	B	2.42		B
Bicycle LOS Score / LO	5		1.12		A	0.93		A	1.33		A	0.58		A

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		HCS	s Sigr	alize	a inte	ersect	ION R	esui	ts Sun	nmary	/				
General Informat	tion								Intersec	tion Inf	ormotic				MA
	lion										1.000			44	
Agency				Analyz	in Dat	0/47/5	000		Duration	•	_		-		
Analyst		Emma Myers-Verha	ige	1		8/17/2			Area Typ	be	Other	-		-ï.	
Jurisdiction		Box Elder, SD		Time F		AM P	зак		PHF	<b>D</b> : 1	1.00	20		.i.	
Urban Street		Alternative 1				· 2050		1	Analysis		1> 7:(				
Intersection		Hwy 1416 and Rada		File Na	ame	Hwy1	416-Rad	darHill	_Alt1_AN	/IPeak20	050.xus		_	<u> </u>	
Project Description	n	Radar Hill 1416 Cor	ridor St	udy									3		<b>H</b> 40
Demand Informa	tion				EB			W	B		NB			SB	
Approach Movem	ent			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), veh	ı/h			5	789	73	115	49	1 8	202	18	354	12	28	19
							5			-					
Signal Informatio	1r	Deference Dhees	0	-		- 3	<b>H</b> ? }		5  26	9			~	5	$\mathbf{V}$
	6.6	Reference Phase	2				R'	~ <b></b>	ì l S	121		1	<b>\$</b> 2	3	4
Offset, s	0	Reference Point	End	Green		4.2	18.5	5.1				_	<u>.</u>		
	Yes	Simult. Gap E/W	On	Yellow	-	0.0	3.5	3.5		0.0			Y	7	Ŷ
Force Mode F	ixed	Simult. Gap N/S	On	Red	1.0	0.0	1.0	1.0	1.0	0.0		5	6	7	8
Timer Results				EBI		EBT	WB		WBT	NB		NBT	SBI		SBT
Assigned Phase				5		2	1	-	6	3	-	8	7		4
Case Number				1.1		3.0	1.1		3.0	1.1		4.0	1.1		4.0
Phase Duration, s	3			4.9		23.0	9.1		27.2	9.6		25.0	9.5		24.9
Change Period, (		: ). s		4.5		4.5	4.5		4.5	4.5		4.5	4.5		4.5
Max Allow Headw		,		2.9	_	2.9	2.9		2.9	3.0		3.3	3.3		3.3
Queue Clearance		,		2.1		17.6	5.2		10.0	7.1		17.9	2.3		3.4
	en Extension Time ( $g e$ ), s					0.9	0.0		2.6	0.0		0.3	0.0		0.8
	en Extension Time ( g e ), s se Call Probability					1.00	0.88		1.00	0.98		1.00	1.00		1.00
Max Out Probabili	-			0.09		0.71	1.00		0.06	1.00		1.00	1.00		0.00
Movement Group	n Poc	ulte			EB			WB			NB			SB	
Approach Movem	-	uits			T	R	L	T	R	L	T	R	1	T	R
Assigned Moveme				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rat		) vob/b		5	2 789	73	115	491		202	372	10	12	4	14
-		w Rate ( <i>s</i> ), veh/h/l	n		-			-						<u> </u>	
Queue Service Tir			n	1615	1614	1437	1602	160 <sup>-</sup> 8.0		1615 5.1	1447		1628	1593	
Cycle Queue Clea				0.1	15.6	2.6	3.2 3.2				15.9		0.3	1.4 1.4	
Green Ratio ( g/C		e fille (g c), s		0.1 0.28	15.6 0.28	2.6 0.28	3.2 0.37	8.0 0.34	0.2	5.1 0.38	15.9 0.31		0.3	0.31	
Capacity ( c ), veh	,			289	896	399	249	1090	_	613	445		269	488	
Volume-to-Capaci		tio(X)		0.017	0.880	0.183	0.463	0.45		0.330			0.045	0.096	
	-	/In (95 th percentile	)	2.2	253.9	33.8	45.6	111.8		85.1	292.8		6	25.2	
<u>`</u>		h/In (95 th percenti	·	0.1	9.8	1.3	1.8	4.3		3.3	11.3		0.2	1.0	
		RQ) (95 th percent		0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay ( d				17.4	23.0	18.3	16.8	17.1	_	14.7	21.5		15.3	16.5	
Incremental Delay	,			0.0	7.9	0.1	0.5	0.1	0.0	0.1	19.2		0.3	0.4	
Initial Queue Dela				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay ( d )				17.4	30.9	18.4	17.3	17.2		14.8	40.7		15.6	16.9	
Level of Service (I	,			В	С	В	В	В	В	В	D		В	В	
Approach Delay, s		LOS		29.7	7	С	17.2	2	В	31.6	3	С	16.6	3	В
Intersection Delay						26	6.2						С		
Multimodal Resu					EB			WB			NB			SB	
Pedestrian LOS S				1.91		В	1.90		В	2.42		В	2.42		В
Bicycle LOS Score	e / LO	S		1.20	)	Α	0.99	9	А	1.43	3	А	0.58	3	А

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HCS<sup>™</sup> Streets Version 2023

Jurisdiction Box Elder, SD Time	Peric rsis Y lame E 4	ear B T 24	8/14/2 AM Pe 2030 Hwy14 R 204	eak	       	R	h e Period	1.000 Other 1.00 1> 16	:45			
AgencyImage: Second secon	Peric vsis Y lame E 4 4 v 3.5	ear B T 24	AM Pe 2030 Hwy12 R	eak 116-Rac	larHill_ WB	Duration, Area Typ PHF Analysis _Alt1_PM	h e Period	1.000 Other 1.00 1> 16 030.xus	:45		.↓ ( 	
AnalystEmma Myers-VerhageAnalyJurisdictionBox Elder, SDTimeUrban StreetAlternative 1AnalyIntersectionHwy 1416 and Radar HilFile NProject DescriptionRadar Hill 1416 Corridor StudyDemand InformationApproach MovementLDemand ( $v$ ), ver/h20Signal InformationCycle, s57.8Reference Phase2Offset, s0Reference PointEndUncoordinatedYesSimult. Gap E/WOnYellow	Peric vsis Y lame E 4 4 v 3.5	ear B T 24	AM Pe 2030 Hwy12 R	eak 116-Rac	/ F // larHill_ WB	Area Typ PHF Analysis _Alt1_PM	e Period	Other 1.00 1> 16 030.xus NB	:45		SB	
JurisdictionBox Elder, SDTimeUrban StreetAlternative 1AnalyIntersectionHwy 1416 and Radar HilFile NProject DescriptionRadar Hill 1416 Corridor StudyFile NDemand InformationApproach MovementLDemand ( $v$ ), veh/h20Signal InformationCycle, s57.8Reference Phase2Offset, s0Reference PointEndUncoordinatedYesSimult. Gap E/WOnYellow	Peric vsis Y lame E 4 4 v 3.5	ear B T 24	AM Pe 2030 Hwy12 R	eak 116-Rac	IarHill_ WB	PHF Analysis Alt1_PM	Period	1.00 1> 16 030.xus NB	:45		SB	k
Alternative 1AnalyIntersectionHwy 1416 and Radar HilFile NProject DescriptionRadar Hill 1416 Corridor StudyDemand InformationApproach MovementLDemand ( $v$ ), veh/h20Signal InformationCycle, s57.8Reference Phase2Offset, s0Reference PointEndUncoordinatedYesSimult. Gap E/WOnYellow	rsis Y lame E 4 4	ear B T 24	2030 Hwy14 R	116-Rac	larHill_ WB	Analysis Alt1_PM		1> 16 030.xus NB			SB	k
IntersectionHwy 1416 and Radar HilFile NProject DescriptionRadar Hill 1416 Corridor StudyDemand InformationApproach Movement $L$ Demand ( $v$ ), $veh/h$ 20Signal InformationCycle, s57.8Reference Phase2Offset, s0Reference PointEndUncoordinatedYesSimult. Gap E/WOnYellow	E E 4 1.4 1.4 v 3.5	EB T 24	Hwy14	L	larHill_ WB	Alt1_PM		030.xus NB			SB	k
Project DescriptionRadar Hill 1416 Corridor StudyDemand InformationIApproach MovementIDemand ( $v$ ), $v$ + / h20Signal InformationCycle, s57.8Reference Phase2Offset, s0Reference PointEndGreetUncoordinatedYesSimult. Gap E/WOnYellow	E 4 - 7 n 1.4 v 3.8	EB T 24	R	L	WB	R	IPeak20	NB			SB	k
Demand Information     Approach Movement   L     Demand (v), veh/h   20     Signal Information   20     Cycle, s   57.8   Reference Phase   2     Offset, s   0   Reference Point   End     Uncoordinated   Yes   Simult. Gap E/W   On   Yellow	4 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7	T 24			Т	R	L		R		SB	k
Approach Movement   L     Demand ( v ), veh/h   20     Signal Information     Cycle, s   57.8     Reference Phase   2     Offset, s   0   Reference Point   End     Uncoordinated   Yes   Simult. Gap E/W   On   Yellow	4 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7	T 24			Т	R	L		R		10	
Approach Movement   L     Demand ( v ), veh/h   20     Signal Information     Cycle, s     57.8   Reference Phase   2     Offset, s   0   Reference Point   End     Uncoordinated   Yes   Simult. Gap E/W   On   Yellow	4 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7	T 24			Т	R	L		R	+	10	1
Demand (v), veh/h   20     Signal Information     Cycle, s   57.8   Reference Phase   2     Offset, s   0   Reference Point   End   Green     Uncoordinated   Yes   Simult. Gap E/W   On   Yellow	4 	24				_		1 .				R
Signal InformationCycle, s57.8Reference Phase2Offset, s0Reference PointEndUncoordinatedYesSimult. Gap E/WOnYellow	n 1.4 v 3.5	e-	201	- 10 I	001		117	10	123	5	9	11
Cycle, s57.8Reference Phase2Offset, s0Reference PointEndUncoordinatedYesSimult. Gap E/WOnYellow	v 3.	<u>ا</u>	Ę	F			111	10	120	Ū		
Offset, s     0     Reference Point     End     Green       Uncoordinated     Yes     Simult. Gap E/W     On     Yellow	v 3.	1	. 5	= _ 2	_		20.				_	L
Uncoordinated Yes Simult. Gap E/W On Yellov	v 3.	1	6	₽₩₽₽		51				<b>A</b>	<u>``</u> !"	<u>с</u> рі
Uncoordinated Yes Simult. Gap E/W On Yellov	v 3.		4.1	11.6	0.4	3.9	18.5		1	<b>Y</b> <sup>2</sup>	3	4
			0.0	3.5	3.5	0.0	3.5			$\rightarrow$		KT2
			0.0	1.0	1.0	0.0	1.0		5	6	7	8
Timer Results EE	_		BT	WBI	-	WBT	NBL	-	NBT	SBL	-	SBT
Assigned Phase 5			2	1		6	3		8	7		4
Case Number 1.			3.0	1.1		3.0	1.1		4.0	1.1	$\rightarrow$	4.0
Phase Duration, s 5.	_		6.1	10.0		20.2	8.7		26.9	4.9		23.0
Change Period, (Y+R c), s 4.			1.5	4.5		4.5	4.5		4.5	4.5		4.5
Max Allow Headway ( <i>MAH</i> ), s 2.9	_		2.9	2.9	$\rightarrow$	2.9	3.0	_	3.3	3.3	$\rightarrow$	3.3
Queue Clearance Time ( $g_s$ ), s 2.0			9.7	7.4		10.9	4.6		5.6	2.1		2.5
Green Extension Time (g e), s 0.0	_		2.0	0.0	$\rightarrow$	1.9	0.0		0.2	0.0	$\rightarrow$	0.2
Phase Call Probability 0.2			.00	0.96		1.00	0.85		1.00	0.08		1.00
Max Out Probability 1.0	0	0.	.14	1.00		0.18	1.00		0.00	1.00		0.00
Movement Group Results	Е	В			WB			NB			SB	
Approach Movement L	1	г	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement 5	2	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h 20	42	24	204	194	561	4	117	133		5	20	
Adjusted Saturation Flow Rate (s), veh/h/ln 1615	_		1437	1602	1601	1425	1615	1453		1628	1555	
Queue Service Time $(g_s)$ , s 0.6	7.	.0	7.7	5.4	8.9	0.1	2.6	3.6		0.1	0.5	
Cycle Queue Clearance Time ( $g_c$ ), s 0.6	7.	.0	7.7	5.4	8.9	0.1	2.6	3.6		0.1	0.5	
Green Ratio (g/C) 0.22	0.2	20	0.20	0.32	0.27	0.27	0.42	0.39		0.33	0.32	
Capacity ( c ), veh/h 232	64	18	288	352	871	388	669	562		497	497	
Volume-to-Capacity Ratio (X) 0.086	0.6	55 (	0.708	0.551	0.644	0.010	0.175	0.237		0.010	0.040	
Back of Queue (Q), ft/In (95 th percentile) 8.1	10	1.9 <sup>·</sup>	101.6	75.4	126.1	1.5	34.4	49.7		1.9	8.7	
Back of Queue (Q), veh/ln (95 th percentile) 0.3	3.	.9	3.9	2.9	4.8	0.1	1.3	1.9		0.1	0.3	
Queue Storage Ratio ( <i>RQ</i> ) (95 th percentile) 0.00	0.0	00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay ( d 1 ), s/veh 18.0	21	.3	21.5	15.9	18.6	15.4	10.7	12.0		13.2	13.6	
Incremental Delay ( d 2 ), s/veh 0.1	0.	.4	1.2	1.1	0.6	0.0	0.0	1.0		0.0	0.2	
Initial Queue Delay ( <i>d</i> <sub>3</sub> ), s/veh 0.0	0.	.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay ( d ), s/veh 18.1	21		22.7	17.0	19.2	15.4	10.7	13.0		13.2	13.7	
Level of Service (LOS) B	(	;	С	В	В	В	В	В		В	В	
Approach Delay, s/veh / LOS 21.	9		С	18.6		В	11.9		В	13.6		В
Intersection Delay, s/veh / LOS			18	8.8						В		
Multimodal Results		В			WB			NB	_		SB	
Pedestrian LOS Score / LOS 1.9			B	1.91		B	2.41		B	2.41	_	B
Bicycle LOS Score / LOS 1.0	2		A	1.11		A	0.90		A	0.53		A

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			s sigr	ialize	umt	ersect	ION R	esu	its Sun	imary	/				
General Inform	ation							1	Interco	tion Inf	ormatic			un da na sur	
	ation								Intersec		V			4	
Agency				A	:- D-4	0/47/0	000		Duration		1.000		- 8		
Analyst		Emma Myers-Verha	age			e 8/17/2			Area Typ	e	Other	-		-Ť.	×_ ←
Jurisdiction		Box Elder, SD		Time F		PM P	eak		PHF	<u>.</u>	1.00			.1.	
Urban Street		Alternative 1				r 2050			Analysis		1> 16				
Intersection		Hwy 1416 and Rad		File Na	ame	Hwy1	416-Rad	darHil	I_Alt1_PN	/Peak20	)50.xus			<u> </u>	
Project Descript	tion	Radar Hill 1416 Co	rridor St	udy									3	NET STATES	97 A.V.
Demand Inform	nation				EB			W	В		NB			SB	
Approach Move	ement			L	Т	R	L	Г	R	L	Т	R	L	Т	R
Demand ( v ), v	eh/h			23	494	238	222	65	3 4	133	10	143	5	11	12
					1			1							
Signal Informa				-	2	_ 5		4	5	- 20	2			π	
Cycle, s	60.0	Reference Phase	2		Γ.		TR "		s I s	rzi s	17 4	1	€₂	з	<b>▲↓</b> <i>■</i>
Offset, s	0	Reference Point	End	Green	1.6	4.3	13.3	0.4	4.2	18.1	1		<u> </u>		
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.5	0.0	3.5	3.5	5 0.0	3.5			Y	$\mathbf{Y}$	~ <b>**</b>
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	0.0	1.0	1.0	0.0	1.0		5	6	7	8
Timer Dev II				- CD		EDT				NE		NDT	0.51		ODT
Timer Results				EBI	-	EBT	WB		WBT	NBI		NBT	SBI		SBT
Assigned Phase	J			5		2	1		6	3		8	7		4
Case Number				1.1	$\rightarrow$	3.0	1.1	_	3.0	1.1		4.0	1.1		4.0
Phase Duration		<b>`</b>		6.1	$\rightarrow$	17.8	10.4		22.1	9.1		26.8	4.9		22.6
Change Period,	•	,		4.5		4.5	4.5		4.5	4.5		4.5	4.5		4.5
Max Allow Head	<b>2</b> (	·		2.9 2.7		2.9 11.3	2.9 7.9		2.9 12.8	3.0 5.2		3.3 6.4	3.3 2.1		3.3 2.6
	ue Clearance Time ( g s ), s n Extension Time ( g e ), s					2.1		_	2.0						0.3
						1.00	0.0			0.0		0.3	0.0		1.00
	se Call Probability Out Probability					0.31	0.98	_	1.00 0.38			1.00	0.08		
	onity			1.00	,	0.31	1.00	,	0.30	1.00	, <sub> </sub>	0.00	1.00	,	0.00
Movement Gro	oup Res	sults			EB			WE	3		NB			SB	
Approach Move	ement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Move	ment			5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow F	Rate ( v	), veh/h		23	494	238	222	653	4	133	153		5	23	
Adjusted Satura	ation Flo	w Rate ( <i>s</i> ), veh/h/l	n	1615	1614	1437	1602	160	1 1425	1615	1451		1628	1562	
Queue Service	Time ( g	g s ), S		0.7	8.4	9.3	5.9	10.8	3 0.1	3.2	4.4		0.1	0.6	
Cycle Queue Cl	learance	e Time ( <i>g c</i> ), s		0.7	8.4	9.3	5.9	10.8	3 0.1	3.2	4.4		0.1	0.6	
Green Ratio ( g	/C)			0.25	0.22	0.22	0.35	0.29	0.29	0.41	0.37		0.31	0.30	
Capacity ( c ), v	/eh/h			224	718	320	350	942	419	643	540		455	472	
Volume-to-Capa		. ,		0.102	0.688	0.745	0.634	0.69	3 0.010	0.207	0.283		0.011	0.049	
	. ,	/In ( 95 th percentile		9.4	123.6	129.7	94.9	157.	8 1.5	42.7	63.8		2.1	10.8	
		eh/In ( 95 th percenti		0.4	4.8	5.0	3.7	6.1		1.7	2.5		0.1	0.4	
Queue Storage	Ratio (	RQ) (95 th percent	tile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (	(d1), s/	/veh		17.8	21.4	21.7	16.3	18.8	3 15.0	11.5	13.2		14.4	14.8	
Incremental Del	2 ,	•		0.1	0.5	2.9	2.9	1.5	0.0	0.1	1.3		0.0	0.2	
Initial Queue De		,		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (				17.9	21.9	24.6	19.3	20.3	3 15.0	11.6	14.5		14.4	15.0	
Level of Service	. ,			В	С	С	В	С	В	В	В		В	В	
Approach Delay	oproach Delay, s/veh / LOS					С	20.0	)	В	13.1	1	В	14.9	)	В
Intersection Del	ersection Delay, s/veh / LOS					19	9.9						В		
Multimodal Re		// 00			EB			WE			NB	_		SB	_
Pedestrian LOS				1.91		B	1.91		B	2.41		B	2.42		B
Bicycle LOS Sc	ore / LC	13		1.11		А	1.21		A	0.96		A	0.53	>	A

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HCS™ Streets Version 2023

				H	CS Ro	unda	abou	its R	ер	ort								
General Information		_	_			_	Site	e Inf	orn	natior	ı			_		_	_	
Analyst	Emma	Myers-	-Verhag	je		4				Inters	ection			н	ighway	1416	and R	adar Hil
Agency or Co.		-	-			1	+ 			E/W S	Street Na	me		н	ighway	1416		
Date Performed	8/17/2	023							4	N/S S	treet Na	me		Ra	adar Hil	l Rd		
Analysis Year	2030				<b>≰</b> ⊥		Ð	1	×	Analy	sis Time	Period,	hrs	1.	.00			
Time Analyzed	AM Pe	ak			*			1		Peak	Hour Fac	tor		0.	.88			
Project Description	Radar Study	Hill 141	16 Corri	idor			→ → ▼◆	1		Jurisd	liction			В	ox Elder	, SD		
Volume Adjustments	and S	te Cl	narac	teristi	cs									-				
Approach		E	EB			Ņ	WB				N	В				S	В	
Movement	U	L	Т	R	U	L	Т	F	ł	U	L	Т	R	ι	J	L	Т	R
Number of Lanes (N)	0	0	2	0	0	0	2	(	)	0	0	1	0	(	5	0	1	0
Lane Assignment		-		TR	L	.T		TR				Ľ	ΓR					LTR
Volume (V), veh/h	0	5	702	64	0	107	454	+ <del>-</del>	,	0	179	18	314	0	о <sup>,</sup>	12	25	17
Percent Heavy Vehicles, %	4	4	4	4	5	5	5		;	4	4	4	4	3	3	3	3	3
Flow Rate (VPCE), pc/h	0	6	830	76	0	128	542	2 8	3	0	212	21	371	(	) <sup>,</sup>	14	29	20
Right-Turn Bypass	<u>                                     </u>	No	one			N	one	_			Nc	one				No	ne	
Conflicting Lanes			1				1				ź	2				2	2	
Pedestrians Crossing, p/h			0				0				(	)				C	)	
Proportion of CAVs									C	)								
Critical and Follow-U	p Head	dway	Adju	ıstme	nt													
Approach	-	-	EB		T	,	WB				N	B				S	B	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Вура	ss	Left	Ric	ght	Bypass	l	Left	Rig	jht	Bypass
Critical Headway, s	4.5436	4.5	436		4.543	5 4.	5436				4.3	276				4.32	276	
Follow-Up Headway, s	2.5352	2.5	352		2.535	2 2.	5352				2.5	352				2.53	352	
Flow Computations,		tv an	d v/d	Ratio	s	_					_				1			
Approach	· ·	-	EB		1	,	WB				N	B				S	B	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Вура	ss	Left	Ric	ght	Bypass	L	Left	Rig	iht	Bypass
Entry Flow (v₀), pc/h	429		83		319		359				60					6		
Entry Volume, veh/h	412	4	65		303		342				58	31				6	1	
Circulating Flow (vc), pc/h		1	71			2	239				85	50				88	32	
Exiting Flow (vex), pc/h		12	215			-	774				3	5				23	33	
Capacity (cpce), pc/h	1215	12	215		1142	1	142				68	39				67	71	
Capacity (c), veh/h	1169		169		1088		088				66	53				65	51	
v/c Ratio (x)	0.35	_	.40		0.28		).31				_	88				0.0		
Delay and Level of Se	ervice																	
Approach				EB				WB				NB					SB	
Lane			Left	Righ		iss l	.eft	Right	E	Bypass	Left	Righ	t Byp	ass	Left	_	Right	Bypass
Lane Control Delay (d), s/veh			6.5	7.1			6.0	6.4	1			43.2					6.6	
Lane LOS			A	A			A	A	+			E				+	A	
95% Queue, veh			1.6	2.0		+	1.2	1.4	+			15.4				+	0.3	
Approach Delay, s/veh   LOS			6.	_	A		6.2			Ą	43.2	<u> </u>	E		6.			A

HCSTM Roundabouts Version 2023 Hwy1416-RadarHill\_Alt2\_AMPeak2030.xro

				Н	CS Rc	ound	dabc	out	s Rep	oort								
General Information		_	_			_	_	_	_	matio	n	_	_	_	_	_	_	
Analyst	Emma	Myers	-Verhag	ge		F	<u>ل</u>	B.		Inters	section			Hi	ighway	1416	and F	Radar Hil
Agency or Co.				-	-	1	+	1		E/W S	Street Na	ime			ighway			
Date Performed	8/17/2	2023			-17	1			1	N/S S	Street Na	me		Rá	adar Hil	l Rd		
Analysis Year	2050				<b>∦</b> 1				1 🎽	Analy	/sis Time	Period,	nrs	1.	.00			
Time Analyzed	AM Pe	ak			*		-		L	Peak	Hour Fac	tor		0.	.88			
Project Description	Radar Study	Hill 14'	16 Corr	idor				¥-1		Juriso	diction			Во	ox Elder	; SD		
Volume Adjustments	and S	ite Cl	narao	terist	ics													
Approach		I	EB				WB				Ν	IB				S	В	
Movement	U	L	Т	R	U	L	-	Т	R	U	L	Т	R	ι	J	L	Т	R
Number of Lanes (N)	0	0	2	0	0	C	)	2	0	0	0	1	0	C	)	0	1	0
Lane Assignment		Г		TR		LT		Т	R			Ľ	ſR					LTR
Volume (V), veh/h	0	5	794	73	0	12	20 5	12	8	0	202	18	356	C	) .	13	27	19
Percent Heavy Vehicles, %	4	4	4	4	5	5	5	5	5	4	4	4	4	3	3	3	3	3
Flow Rate (VPCE), pc/h	0	6	938	86	0	14	43 6	11	10	0	239	21	421	C	) .	15	32	22
Right-Turn Bypass	<u> </u>	N	one	_		-	None				No	one				No	one	_
Conflicting Lanes			1				1					2				ĩ	2	
Pedestrians Crossing, p/h		0					0					)				(	)	
Proportion of CAVs										0								
Critical and Follow-U	p Head	dway	Adju	ustme	nt													
Approach		-	EB		1		WB	_		T	N	IB				S	B	
Lane	Left	Ri	ght	Bypass	Lef	t	Right		Bypass	Left	Rie	ght	Bypass	L	Left	Ric	ght	Bypass
Critical Headway, s	4.5436	-	436		4.543	36	4.5436	_		<u> </u>	_	276	<u>, , , , , , , , , , , , , , , , , , , </u>	-			, 276	
Follow-Up Headway, s	2.5352	2.5	352		2.53	52	2.5352	+			2.5	352				2.5	352	
Flow Computations,	Capaci	tv an	d v/	c Rati	DS			_										
Approach		-	EB				WB			1	N	IB				5	B	
Lane	Left	_	ght	Bypass	Lef	+	Right		Bypass	Left	_		Bypass	-	Left		ght	Bypass
Entry Flow (v <sub>e</sub> ), pc/h	484	_	46	Буразз	359		405	+	599833			31	Буразз		Len		9	Буразз
Entry Volume, veh/h	465	_	25		342		386	+		-		55					7	
Circulating Flow (vc), pc/h	405		90		542	-	266					59					93 93	
Exiting Flow (vex), pc/h			374				872					7					51	
Capacity (cpce), pc/h	1195		195		111	5	1115					28		-			11	
Capacity (cpce), pc/m Capacity (c), veh/h	1149	_	149		106		1062	+			_	)4					93	
v/c Ratio (x)	0.41	_	.46		0.32	_	0.36	+			_	08				0.1	_	
Delay and Level of Se			.40		0.57	-	0.50									0.	···	
-	ervice										_			_			6.0	
Approach				EE		_		_	WB			NB					SB	
Lane			Left			ass	Left	-		Bypass	Left	Righ		ass	Left	_	Right	Bypass
Lane Control Delay (d), s/veh			7.3	8.0			6.6		7.1			217.	′				7.4	
Lane LOS			A	A	_		A	-	A			F	_			-	A	
95% Queue, veh			2.0	2.5			1.4	_	1.7			46.4					0.4	
Approach Delay, s/veh   LOS			7	.7	A		6.9	)		А	217	.7	F		7.	4		A
Intersection Delay, s/veh   LO Copyright © 2023 University of			_			63.				ion 2023				F		0 <i>(</i> 0 ·	000-	4:27:59 PN

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			H	CS Ro	unda	abou	its R	ер	ort									
	_	_			_		_	_	_	ı	_	_	_	_	_	_		
Emma	Myers-	Verhag	je		4		1		Inters	ection			н	lighway	1416	5 and F	adar Hil	
	-				1	† †			E/W S	Street Na	me		н	lighway	1416	5		
8/17/2	2023							4	N/S S	treet Na	me		R	adar Hi	ll Rd			
2030				K +		t)	1	×	Analy	sis Time	Period,	hrs	1	.00				
PM Pe	ak			*			1		Peak	Hour Fac	tor		0	.94				
Radar Study	Hill 141	6 Corri	idor			, , ,	1		Jurisd	liction			В	ox Elde	r, SD			
and S	ite Cł	narac	terist	cs														
	E	B				WB				N	B		Γ		S	B		
U	L	Т	R	U	L	Т	F	2	U	L	Т	R		U	L	Т	R	
0	0	2	0	0	0	2	(	)	0	0	1	0		0	0	1	0	
Ľ	г		TR		.т		TR				Ľ	TR					LTR	
0	20	475	205	0	209	605	5 4		0	118	14	138		0	5	13	11	
4	4	4	4	5	5	5	5	;	4	4	4	4		3	3	3	3	
0	22	526	227	0	233	676	5 4		0	131	15	153		0	5	14	12	
	N	one			N	lone				Nc	one				No	one		
		1				1				ź	2				2	2		
		0				0				(	)				(	0		
				-				C	)									
p Hea	dway	Adjı	ıstme	nt														
	E	B		T		WB	_			N	B		Γ		S	B		
Left	Ri	ght	Bypass	Left	R	ight	Вура	ss	Left	Rig	ght	Bypass		Left	Rig	ght	Bypass	
4.5436	4.5	436		4.543	6 4.	5436				4.3	276				4.3	276		
2.5352	2.5	352		2.535	2 2.	5352				2.5	352				2.5	352		
Capaci	ty an	d v/c	Ratio	os									-					
	-			T		WB				N	B		Г		S	B		
Left	Ri	ght	Bypass	Left	R	ight	Вура	ss	Left	Ric	ght	Bypass		Left	Rio	ght	Bypass	
364	-	-		429	_	-										-		
350	3	95		409		461				28	38				3	0		
	2	52				168				55	53				10	40		
	6	84				319				4	1				4	74		
1129	1	29		1219	1	219				88	37				58	87		
1086				1161	_					8	53				5	70		
0.32				0.35	(	).40				0.	34				0.	05		
rvice				1														
			EB				WB				NB					SB		
		Left	_		ass	_eft		E	Bypass	Left	-	_	ass	Left			Bypass	
		6.5	-	_	_		7.1	$\uparrow$			8.0				+	6.9		
		A				A	A				A				+	A		
		1.4			+		2.0	+			1.5				+	0.2		
			<u> </u>	A		6.9			Ą	8.0	<u> </u>	A		6	.9		A	
n i i i i i i i i i i i i i i i i i i i			Image: Second se	Image with the set of the s	SiteEmma Wyers-VerhageJate8/17/2023Uat2030UatPM PeakVatRadar Hill 1416 Corridor StudyStat <td col<="" td=""><td>Site InfoEmma Myers-VerhageImage: Site Info8/17/2023Image: Site Info2030Image: Site Info2030Image: Site InfoPM PalkImage: Site InfoRadar Hill 1416 CorrisonImage: Site InfoRadar Hill 1416 CorrisonImage: Site InfoSite InfoImage: Site InfoPM PalkImage: Site InfoRadar Hill 1416 CorrisonImage: Site InfoSite InfoImage: Site Info</td><td>Site Information of the set /td><td>Emma Wers-Verkage Intersection   8/17/2023 Intersection   8/17/2023 Intersection   2030 Intersection   2031 Intersection   Radar Hill 1416 Intersection   Study   PM Peak   Radar Hill 1416   Study   Intersection   Study   Intersection   Study   Intersection   Intersection<td>Site InferrectionEmma yers-VerbageIntersection8/17/2023Intersection2030UIntersectionPM PeakIntersectionRadar HII 1416 CorrigoIntersectionRadar HII 1416 CorrigoIntersectionRadar HII 1416 CorrigoIntersectionRadar HII 1416 CorrigoIntersectionIntersectionIntersectionRadar HII 1416 CorrigoIntersectionIntersectionIntersectionRadar HII 1416 CorrigoIntersection<td><th colspa<="" td=""><td>Site InfermationEmma Myers VerbageIntersectorIntersector8/17/2023UIntersectorIntersector2030UUIntersectorN/S Street NorPM PeakUUUVN/S Street NorPM PeakUUUUVN/S Street NorRaday Hill Atta ConstructionVVUUNNStudyULTRULTRULTRULTRULR002000200010ULTRULTRULR0204752050209605401181413844455554444022526270236740131151531TTTTTTT153154153153153153153154153153153153153154154153153154154153153153154<t< td=""><td>Site Infermention     Intersection     <th col<="" td=""><td>Site InformationEmma Myers-VerhageIntersectionIntersectionHighwayB/17/2023UIntersectionE/W Struet 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T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   <th< td=""></th<></td></t<></td>	Site InformationEmma Myers-VerhageIntersectionIntersectionHighwayB/17/2023UIntersectionE/W Struet NameHighwayB/17/2023UUUIntersectionHighwayB/17/2023UUUUIntersectionHighwayB/17/2023UUUUVHighwayHighwayB/17/2023UUUVVIntersectionHighwayB/17/2023UUUVVVHighwayHighwayB/17/2023UUUVVVVHighwayB/17/2023UUUVVVNNB/18/11/11/11/11/11/11/11/11/11/11/11/11/	Site Infermation   Intersection   Radar Hill 1416 Corridor   State Intersection   State Intersection   O O O   O O O   O O O   O O O   O O O   O O <t< td=""><td>Site Information     Emma Myers-Verbage   Highway 1416 aur F     B/17/2023   Highway 1416 aur F     B/17/2023   Highway 1416 aur F     B/17/2023   F     Colspan="4"&gt;Colspan="4"&gt;Colspan="4"&gt;Radar Hill Aur F   Radar Hill Aur F   Highway 1416 aur F     B/17/2023   Colspan="4"&gt;Set Colspan="4"&gt;Set Colspan="4"&gt;Set Colspan="4"&gt;Set Colspan="4"&gt;Set Colspan="4"     Colspan="4"&gt;Colspan="4"&gt;Set Colspan="4"&gt;Set Colspan="4"   Radar Hill Aur F   Radar Hill Aur F   Radar Hill Aur F   Set Colspan="4"   Set Colspan="4"     U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   <th< td=""></th<></td></t<>	Site Information     Emma Myers-Verbage   Highway 1416 aur F     B/17/2023   Highway 1416 aur F     B/17/2023   Highway 1416 aur F     B/17/2023   F     Colspan="4">Colspan="4">Colspan="4">Radar Hill Aur F   Radar Hill Aur F   Highway 1416 aur F     B/17/2023   Colspan="4">Set Colspan="4">Set Colspan="4">Set Colspan="4">Set Colspan="4">Set Colspan="4"     Colspan="4">Colspan="4">Set Colspan="4">Set Colspan="4"   Radar Hill Aur F   Radar Hill Aur F   Radar Hill Aur F   Set Colspan="4"   Set Colspan="4"     U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R   U   L   T   R <th< td=""></th<>

HCSTM Roundabouts Version 2023 Hwy1416-RadarHill\_Alt2\_PMPeak2030.xro

				HC	S Rou	ında	bou	ts Re	port							
General Information		_	_				Site	e Infor	matio	n			_			
Analyst	Emma	Myers-	-Verhag	je		4			Inte	rsection			Hig	ghway 14	416 and	Radar Hil
Agency or Co.				-		-	_		E/W	Street Na	ame		Hic	ghway 14	416	
Date Performed	8/17/2	2023							N/S	Street Na	me		Ra	dar Hill I	Rd	
Analysis Year	2050				<b>K</b> ⊥		D	) †≯		ysis Time	Period,	hrs	1.0	0		
Time Analyzed	PM Pe	ak			*			1	Peal	Hour Fa	ctor		0.9	4		
Project Description	Radar Study	Hill 14	16 Corr	idor					Juris	diction			Bo	x Elder, S	SD	
Volume Adjustments	and S	ite Cl	narac	teristi	cs											
Approach			EB			W	/B			1	١B				SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	2	0	0	0	2	0	0	0	1	0	0	0	1	0
Lane Assignment	Ľ	Г		TR	LT			TR			Ľ	TR				LTR
Volume (V), veh/h	0	23	545	239	0	237	697	4	0	134	14	158	0	5	15	12
Percent Heavy Vehicles, %	4	4	4	4	5	5	5	5	4	4	4	4	3	3	3	3
Flow Rate (VPCE), pc/h	0	25	603	264	0	265	779	4	0	148	15	175	0	5	16	13
Right-Turn Bypass		N	one			Nc	one			N	one			_	None	_
Conflicting Lanes			1				1				2				2	
Pedestrians Crossing, p/h			0			(	)				0				0	
Proportion of CAVs									0							
Critical and Follow-U	p Hea	dway	Adju	ustmer	nt											
Approach		-	EB			W	/B			1	NB				SB	
Lane	Left	Ri	ght	Bypass	Left	Ric	ght	Bypass	Let	t Ri	ght	Bypass	Le	eft	Right	Bypass
Critical Headway, s	4.5436	6 4.5	436		4.5436	4.5	436			4.3	276				4.3276	
Follow-Up Headway, s	2.5352	2.5	352		2.5352	2.5	352			2.5	352				2.5352	
Flow Computations,	Capaci	tv an	d v/e	c Ratio	s	_										
Approach		-	EB			w	/B		1	1	1B	_			SB	
Lane	Left	_	ght	Bypass	Left	_	ght	Bypass	Let			Bypass	le	eft	Right	Bypass
Entry Flow (ve), pc/h	419	-	73	2)pass	493	-	55	Jpass			38	5)pass			34	Jpuss
Entry Volume, veh/h	403	_	55		469		29		-		25				33	
Circulating Flow (vc), pc/h			86				38		-		33				1192	
Exiting Flow (vex), pc/h			83				40		-		14				545	
Capacity (cpce), pc/h	1095	_	095		1197		97		-		29				516	
Capacity (c), veh/h	1053	_	053		1140		40				97				501	
v/c Ratio (x)	0.38	_	.43		0.41	-	40				41				0.07	
Delay and Level of Se	<u> </u>						-									
Approach				EB		_		WB		1	NB				SB	
Lane			Left	Right	: Bypas	s Ir	eft	Right	Bypass	Left	Righ	_	155	Left	Right	Bypass
Lane Control Delay (d), s/veh			7.5	8.2	. bypas	5 Le	_	8.2	53 pass	Len	9.7			Left	8.0	- Sypass
Lane LOS			7.5 A	0.2			.4 A	0.2 A			9.7 A	_	+		8.0 A	
95% Queue, veh			A 1.9	2.3		2	_	A 2.6			2.0		+		0.2	
Approach Delay, s/veh   LOS				.8	A		7.8	2.0	A	9.1	<u> </u>	A	+	8.0	0.2	A
Intersection Delay, s/ven   LOS	<u> </u>				~	8.1	7.0		A	9.1		~	A	0.0		Λ
Intersection Delay, s/ven   LOS Copyright © 2023 University of		l Riahts	Reserv	red	НС		undah	outs Ver	sion 202	3				rated: 8/	23/2023	0.31.33

HCS T Roundabouts Version 2023 Hwy1416-RadarHill\_Alt2\_PMPeak2050.xro

				H	CS Rc	un	dabo	uts	s Rep	ort										
General Information		_	_			_	Si	te l	nforr	natio	n	_			_	_	_			
Analyst	Emma Myers-Verhage					L	<u>له م</u>		Inters	Intersection					Highway 1416 and Radar Hil					
Agency or Co.					-	E/V					W Street Name				Highway 1416					
Date Performed	8/17/2023										/S Street Name				Radar Hill Rd					
Analysis Year	2030	I I I						alysis Time Period, hrs				1.00								
Time Analyzed	AM Pe	*						Peak Hour Factor					0.88							
Project Description	Radar Study							Jurisdiction					Box Elder, SD							
Volume Adjustments	and S	te Cl	narac	terist	ics															
Approach		E	B			WB					NB					SB				
Movement	U	L	T R		U		L ·	Г	R	U	L	Т	Τ	R	U	L	Т	R		
Number of Lanes (N)	0	0	2	0	0	(	o i	2	0	0	0	1	T	0	0	0	1	0		
Lane Assignment		-		TR		LT		T	R				LT				LTR			
Volume (V), veh/h	0	5	702	64	0	1(	07 4	54	7	0	179	18		314	0	12	25	17		
Percent Heavy Vehicles, %	4	4	4	4	5		5 !	5	5	4	4	4	t	4	3	3	3	3		
Flow Rate (VPCE), pc/h	0	6	830	76	0	12	28 54	42	8	0	212	21		371	0	14	29	20		
Right-Turn Bypass	None			+	None					Yielding					None					
Conflicting Lanes			1					2					2							
Pedestrians Crossing, p/h	0					0					0					0				
Proportion of CAVs										0										
Critical and Follow-U	p Head	dway	Adju	ıstme	nt															
Approach	i i		B		T		WB				NB				SB					
Lane	Left	Ri			Bypass Lef		Right		Sypass	Left	t Right		Bypass		Left	Left Rig		Bypass		
Critical Headway, s	4.5436	-	436		4.543	36	4.5436				4.3276			763	<u> </u>		3276			
Follow-Up Headway, s	2.5352				2.53		2.5352					.5352 2.		087	2.535					
Flow Computations,	Capaci	tv an	d v/c	: Ratio	)S						_					-				
Approach		-	B				WB				N	IB		- T			SB			
Lane	Left	_	ght	Bypass	Lef	eft Right		F	Sypass	left	Left Rig		Bvr	ass	Left		ight	Bypass		
Entry Flow (ve), pc/h	429		83	bypuss	319		359		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Len		33		71	Len		63	bypuss		
Entry Volume, veh/h	412		465		303		342					24 357					61			
Circulating Flow (vc), pc/h			171		500		239				50			882						
Exiting Flow (vex), pc/h			44		+	774					5			233						
Capacity (Cpce), pc/h	1215		1215		114	1142		Т			-	689		583		67				
Capacity (c), veh/h	1169		169		108		1142 1088	┢				663 561					651			
v/c Ratio (x)	0.35				0.28	-	0.31				_	34	0.64				.09			
Delay and Level of Se					0.20		5.51						5.							
Approach				EB				1	NB			NB	3				SB			
Lane			Left Right			ass	Left	_		Bypass	Left	Righ	_	Bypass	Le	ft	Right	Bypass		
Lane Control Delay (d), s/veh			6.5	7.1			6.0	-	6.4	51		9.9	-	20.6			6.6	51.000		
Lane LOS			0.5 A	A			A		A			A	_	C			0.0 A			
95% Queue, veh			1.6	2.0	_		1.2		1.4			1.5		5.0	-		0.3			
Approach Delay, s/veh   LOS			6.8		A		6.2			A	16.!	<u> </u>		C		6.6	0.0	A		
			0.	-	~		0.2				10	-		-		0.0				

HCS T Roundabouts Version 2023 Hwy1416-RadarHill\_Alt3\_AMPeak2030.xro

				Н	CS R	our	ndab	out	s Rep	oort										
General Information		_	_	_	_	_	_	_	_	matio	n		_	_	_	_	_			
Analyst	Emma Myers-Verhage						* 🔺			Inter	section	Hi	Highway 1416 and Radar Hil							
Agency or Co.						E/W					W Street Name				Highway 1416					
Date Performed	8/17/2	$\Box$	N/S					Street Name				Radar Hill Rd								
Analysis Year	2050	I						ysis Time Period, hrs				1.00								
Time Analyzed	AM Pe	*						ak Hour Factor				0.88								
Project Description	Radar Study							Jurisdiction					Box Elder, SD							
Volume Adjustments	and S	ite Cl	narao	terist	ics															
Approach		I	EB			WB					NB					SB				
Movement	U	L	L T R		U	Т	L	Т	R	U	L	Т	R	U		L	Т	R		
Number of Lanes (N)	0	0	2	0	0		0	2	0	0	0	1	0	0	(	0	1	0		
Lane Assignment		Г		TR	1	LT			TR			L	Т		LTR		LTR			
Volume (V), veh/h	0	5	794	73	0	<b>·</b>	120	512	8	0	202	202 18 35		0	1	13 2		.7 19		
Percent Heavy Vehicles, %	4	4	4	4	5	+	5	5	5	4	4	4	4	3		3	3	3		
Flow Rate (VPCE), pc/h	0	6	938	86	0		143	611	10	0	239	21	421	0	1	5	32	22		
Right-Turn Bypass	None			-	None					Yielding					None					
Conflicting Lanes	1				-	1						2								
Pedestrians Crossing, p/h		0				0					0					0				
Proportion of CAVs										0										
Critical and Follow-U	p Head	dway	Adju	ustme	ent															
Approach	·	EB WB								1	NB SB									
Lane	Left	Ri	Right Byp		Le	Left		Right Bypass		Left	t Right		Bypass		Left Righ		nt	Bypass		
Critical Headway, s	4.5436	-	4.5436		-	4.5436		36		-	_	-	4.9763			4.327				
Follow-Up Headway, s	2.5352				2.5	2.5352		2.5352			2.5	2.5352			2.53		52			
Flow Computations,	Capaci	tv an	d v/	c Rati	os		<u> </u>							<u> </u>						
Approach		-	EB				WB	3		1	N	IB				SB				
Lane	Left F		Right By			eft	Righ	_	Bypass	Left	_		Bypass		eft	Righ	_	Bypass		
Entry Flow (v <sub>e</sub> ), pc/h	484	-		Bypus	35		405		Dypuss	Len		60	421			69		Dypuss		
Entry Volume, veh/h	465			525		342		386				50	405		67		-			
Circulating Flow (vc), pc/h			190			72		266				io 405 i9			993					
Exiting Flow (vex), pc/h			53			872					37					261				
Capacity (cpce), pc/h	1195		1195		11	1115		_				28	522		6		_			
Capacity (c), veh/h	1149	_	1149				1115 1062			-		04					593			
v/c Ratio (x)	0.41	_	0.46		_	1062 0.32					_	41 0.81			0.11		-			
Delay and Level of Se			. +0		0	52	0.36	-			0.	••	5.01			0.1	•			
-	ervice				)				WB			NID		_			D			
Approach			EB Left Right			Bypass				Durr	1.0	NB	D		1	SB eft Right		D		
Lane						pass	Left	_	Right	Bypass	Left	Right			Left		-	Bypass		
Lane Control Delay (d), s/veh	elay (d), s/veh		7.3				6.6		7.1			12.2	38.	-			7.4			
Lane LOS			A	_	_		A	-	A			B	E			-	A			
95% Queue, veh			2.0	2.			1.4		1.7			2.1	10. D	.3			).4			
Approach Delay, s/veh   LOS			7	.7	A	A 6.9					28.	7.4 A								
Intersection Delay, s/veh   LO Copyright © 2023 University of			Det				3.1	- 1 - 1		sion 2023				B		122 12	000.0	:52:33 AN		

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				Н	CS F	Rour	ndab	out	s Rep	oort								
General Information		_	_	_	_	_	_	_		matio	n	_	_	_	_	_	_	
Analyst	Emma	Myers-	Verhag	je			*			Inters	section			F	lighway	1416	5 and F	Radar Hil
Agency or Co.		,				1	++			E/W S	Street Na	ime		_	lighway			
Date Performed	8/17/2	2023				7			4	N/S S	Street Na	me		R	adar Hi	ll Rd		
Analysis Year	2030					1	W		t 🎽	Analy	/sis Time	Period,	nrs	1	.00			
Time Analyzed	PM Pe	ak			7	$\left( \right)$	-		1		Hour Fac			0	.94			
Project Description	Radar Study	Hill 141	l6 Corr	idor			$\vec{\cdot}$	1	1	Jurisc	diction			В	ox Elde	r, SD		
Volume Adjustments	and Si	ite Cl	narac	terist	ics													
Approach	T	E	EB		T	_	WB	_			N	IB	_	Т		S	БВ	
Movement	U	L	Т	R	ι	J	L	Т	R	U	L	Т	R		U	L	Т	R
Number of Lanes (N)	0	0	2	0	(	0	0	2	0	0	0	1	0		0	0	1	0
Lane Assignment		Г		TR	+	LT	-	1	ГR			l		+				LTR
Volume (V), veh/h	0	20	475	205	(	0	209	605	4	0	118	14	138	+	0	5	13	11
Percent Heavy Vehicles, %	4	4	4	4		5	5	5	5	4	4	4	4	+	3	3	3	3
Flow Rate (VPCE), pc/h	0	22	526	227	. (	0	233	676	4	0	131	15	153		0	5	14	12
Right-Turn Bypass	<u> </u>	N	one	_			None	e			Yiel	ding		+		No	one	_
Conflicting Lanes			1				1					2					2	
Pedestrians Crossing, p/h			0				0				(	)		+			0	
Proportion of CAVs	0																	
Critical and Follow-U	p Head	dway	Adju	ustme	ent													
Approach	<u> </u>	E	B		T	_	WB	_		<u> </u>	N	IB	_	Т		S	БB	
Lane	Left	Ri	ght	Bypass	;	Left	Righ	t	Bypass	Left	Rig	ght	Bypass	+	Left	Rig	ght	Bypass
Critical Headway, s	4.5436	4.5	436		4.	5436	4.543	6			4.3	276	4.9763			4.3	276	
Follow-Up Headway, s	2.5352	2.5	352		2.	5352	2.535	2			2.5	352	2.6087	+		2.5	352	
Flow Computations,	Capaci	ty an	d v/e	c Rati	os													
Approach		-	B	_	T		WB		_		N	IB		Т		S	SB	
Lane	Left	Ri	ght	Bypass	; I	Left	Righ	t	Bypass	Left	Rig	ght	Bypass		Left	Rig	ght	Bypass
Entry Flow (ve), pc/h	364	4	11		4	429	484				1.	46	153			3	31	
Entry Volume, veh/h	350	3	95		4	409	461				1.	40	147	+		3	80	
Circulating Flow (v <sub>c</sub> ), pc/h		2	52				168				5	53				10	)40	
Exiting Flow (vex), pc/h		5	31				819				4	.1				4	74	
Capacity (c <sub>pce</sub> ), pc/h	1129	1'	129		1	1219	1219	Э			8	37	803			5	87	
Capacity (c), veh/h	1086	1(	086		1	1161	1161	1			8	53	772			5	70	
v/c Ratio (x)	0.32	0.	.36		(	0.35	0.40	)			0.	16	0.19			0.	05	
Delay and Level of Se	ervice																	
Approach				E	3				WB			NB					SB	
Lane			Left	Rig	ht E	Bypass	Left		Right	Bypass	Left	Righ	t By	pass	Left	Right	Bypass	
Lane Control Delay (d), s/veh			6.5	7.	0		6.5		7.1			5.9	(	6.7		T	6.9	
Lane LOS			А	A			А		A			А		A		T	А	
95% Queue, veh			1.4	1.	7		1.6		2.0			0.6	(	0.7		T	0.2	
Approach Delay, s/veh   LOS			6	.8	,	A	6	5.9	T '	A	6.3		A		6.	.9		A
Intersection Delay, s/veh   LO	5						6.7								ـــــــــــــــــــــــــــــــــــــ		-	

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				НС	S Roi	unda	bοι	uts l	Rep	ort												
General Information	_	_	_	_	_	_	-	_	_	natio	n	_	_	_	_	_	_	_				
Analyst	Emma	Myers	-Verhad	je		4		1		Inters	ection			F	lighway	1416	5 and F	Radar Hil				
Agency or Co.				, 			+++			E/W S	Street Na	me			lighway							
Date Performed	8/17/2	2023			$\overline{1}$				1	N/S S	itreet Na	me		_	adar H							
Analysis Year	2050				<b>X</b> ⊥		t I	) †	×	Analy	sis Time	Period, l	nrs	1 1	.00							
Time Analyzed	PM Pe	ak			*				/	Peak	Hour Fac	tor		0	.94							
Project Description	Radar Study	Hill 14'	16 Corr	idor			, , , ,	1	7	Jurisc	liction			В	ox Elde	r, SD						
Volume Adjustments	and S	ite Cl	narac	teristi	cs																	
Approach		[	EB			V	VB				N	В		Т		S	БВ					
Movement	U	L	Т	R	U	L	Т		R	U	L	Т	R		U	L	Т	R				
Number of Lanes (N)	0	0	2	0	0	0	2		0	0	0	1	0		0	0	1	0				
Lane Assignment	Ľ	г		TR	Ľ	Т		TR				L	.T					LTR				
Volume (V), veh/h	0	23	545	239	0	237	69	7	4	0	134	14	158		0	5	15	12				
Percent Heavy Vehicles, %	4	4	4	4	5	5	5	+	5	4	4	4	4		3	3	3	3				
Flow Rate (VPCE), pc/h	0	25	603	264	0	265	779	9	4	0	148	15	175		0	5	16	13				
Right-Turn Bypass		N	one			N	one				Yiel	ding				No	one	_				
Conflicting Lanes			1				1				2	2					2					
Pedestrians Crossing, p/h			0				0				(	)					0					
Proportion of CAVs					1				(	)												
Critical and Follow-U	p Hea	dway	Adju	ustmer	nt																	
Approach	i i	-	EB		1	v	VB				N	В		Т		S	B					
Lane	Left	Ri	ght	Bypass	Left	Ri	ght	Bvc	oass	Left	Rio	ght I	Bypass		Left	Ri	ght	Bypass				
Critical Headway, s	4.5436	-	436		4.5436	-	5436				4.3		4.9763				276					
Follow-Up Headway, s	2.5352	_	352		2.5352	_	5352				2.5		2.6087				352					
Flow Computations,	Capaci	tv an	d v/e	Ratio	s			<u> </u>		<u> </u>	_											
Approach		-	EB			V	VB				N	B		<b>—</b>			B					
Lane	Left	_	ght	Bypass	Left	_	ght	Byr	oass	Left			Bypass	+	Left		ght	Bypass				
Entry Flow (v <sub>e</sub> ), pc/h	419		73	Буразз	493		55	Бур	5833	Len	-	53	175		Len		34	Буразз				
Entry Volume, veh/h	403	_	55		469	_	29				_	57	168	+			33					
Circulating Flow (vc), pc/h	405		86		405		88					33	100	+			92					
Exiting Flow (vex), pc/h			08				40					4		+			45					
Capacity (cpce), pc/h	1095		00		1197	_	197	<u> </u>			-	29	742	+			16					
Capacity (cp:a), pc/n Capacity (c), veh/h	1095	_	053		1140	_	197					97	742	+-			01					
v/c Ratio (x)	0.38		.43		0.41	_	.46				_	20	0.24	+-			07					
	<u> </u>		. +.,		0.41		.+0				0.	-~	0.24			0.	51					
Delay and Level of Se	ervice	_				-											a=					
Approach				EB		_		WE				NB	_		SB pass Left Right Byr							
Lane			Left	Righ	t Bypa	_	eft	Rigł	-	Bypass	Left	Righ	-	pass	Left	Bypass						
Lane Control Delay (d), s/veh			7.5	8.2			7.4	8.2				6.6	_	7.8		+	8.0					
Lane LOS			A	A	_	_	A	A				A	_	A		+	A					
95% Queue, veh			1.9	2.3		2	2.1	2.6				0.7		0.9			0.2					
Approach Delay, s/veh   LOS			7	.8	A		7.8			A	7.2		A			.0		A				
Intersection Delay, s/veh   LOS Copyright © 2023 University of I			Det	l		7.7		h c - 1	. \/- '	on 2023					4 	0./22	(2022.5	9:33:59 AN				

HCSTM Roundabouts Version 2023 Hwy1416-RadarHill\_Alt3\_PMPeak2050.xro

				H	CS Ro	und	aboı	uts	Rep	ort								
General Information			_			_	Sit	e Ir	nforn	natio	n		_		_	_	_	
Analyst	Emma	a Myers	Verha	ge		4		L		Inters	ection			F	lighway	/ 141	6 and F	Radar Hil.
Agency or Co.						1	† †			E/W S	Street Na	me			lighway	/ 1410	5	
Date Performed	8/17/	2023							1	N/S S	treet Na	me		R	Radar H	ill Rd		
Analysis Year	2030				∢ +				† 🎽	Analy	sis Time	Period, l	hrs	1	.00			
Time Analyzed	AM P	eak			*				1	Peak	Hour Fac	tor		0	.88			
Project Description	Radar Study	Hill 14	16 Cori	ridor			, Ţ√	1		Jurisd	liction			В	Box Elde	er, SD		
Volume Adjustments	and S	ite Cl	nara	cterist	ics													
Approach			EB				WB				N	B				S	SB	
Movement	U	L	Т	R	U	L	Т	Т	R	U	L	Т	R	2	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	2	T	0	0	0	1	0	)	0	0	1	0
Lane Assignment				LTR		.T		TR				L	.т					LTR
Volume (V), veh/h	0	5	702	64	0	107	45	4	7	0	179	18	31	4	0	12	25	17
Percent Heavy Vehicles, %	4	4	4	4	5	5	5	$\uparrow$	5	4	4	4	4	1	3	3	3	3
Flow Rate (VPCE), pc/h	0	6	830	76	0	128	54	2	8	0	212	21	37	71	0	14	29	20
Right-Turn Bypass		N	one	_			None				Yiel	ding				N	one	
Conflicting Lanes			1				1				ź	2					2	
Pedestrians Crossing, p/h			0				0				(	)					0	
Proportion of CAVs									(	)								
Critical and Follow-U	lp Hea	dwav	Adi	ustme	nt													
Approach	•		EB				WB				N	В					SB	
Lane	Left	_	ght	Bypass	Left		Right	By	/pass	Left	_		Bypas	55	Left		ght	Bypass
Critical Headway, s			763	-)	4.543		.5436	-,	1		4.3		4.976				276	-)
Follow-Up Headway, s		_	6087		2.535	_	.5352				_		2.608				352	
Flow Computations,	Canaci	itv an	d v/	c Ratio	5	_												
Approach			EB				WB				N	B					SB	
Lane	Left	_	ght	Bypass	Left		Right	By	/pass	Left	_		Bypas		Left		ght	Bypass
Entry Flow (ve), pc/h	Leit		12	Буразз	319		359	by	pass	Len	23	-	371	_	Len		53	Буразз
Entry Volume, veh/h			77		303	+	342				_	24	357				51	
Circulating Flow (vc), pc/h			71		505		239					50	551				82	
Exiting Flow (vex), pc/h			44		-		774				3						33	
Capacity (Cpce), pc/h			44 159		1142		1142					39	583	,			71	
		_			1088		1088				_		561				51	
Capacity (c), veh/h			115		+	_					_	53						
v/c Ratio (x)		0	.79		0.28		0.31				0	34	0.64	*		0	.09	
Delay and Level of Se	ervice					-												
Approach				EB	_			W				NB					SB	
Lane			Left			ass	Left			Bypass	Left	Righ	t E	Bypass	Left	-	Right	Bypass
Lane Control Delay (d), s/veh				18.			6.0		.4			9.9		20.6			6.6	
Lane LOS				С			A		4			A		С			А	
95% Queue, veh				10.			1.2	1.	.4			1.5		5.0			0.3	
Approach Delay, s/veh   LOS			1	8.7	С		6.2			A	16.5	5	(	С	6	.6		А
Intersection Delay, s/veh   LO opyright © 2023 University of						14.0				on 2023					В			8:54:45 A

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				H	CS Ro	unda	abou	uts R	lep	ort								
General Information			_			_	Sit	e Inf	orn	natio	n		_	_	_	_	_	
Analyst	Emma	a Myers	Verha	ge		4		L		Inters	ection			н	lighway	1416	5 and F	Radar Hil.
Agency or Co.							+			E/W S	Street Na	me		н	lighway	, 1416	5	
Date Performed	8/17/	2023			$\Gamma/$				4	N/S S	itreet Na	me		R	adar H	ill Rd		
Analysis Year	2050				$\prec$ $\perp$			1	×	Analy	sis Time	Period, I	nrs	1.	.00			
Time Analyzed	AM P	eak			*			1		Peak	Hour Fac	tor		0	.88			
Project Description	Radar Study	Hill 14	16 Corr	idor			<b>,</b>	1	1	Jurisd	liction			В	ox Elde	r, SD		
Volume Adjustments	and S	ite Cl	narao	teristi	cs													
Approach			EB				WB				N	B				S	SB	
Movement	U	L	Т	R	U	L	Т		र	U	L	Т	R	l	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	2		)	0	0	1	0	(	0	0	1	0
Lane Assignment				LTR	L	.T		TR				L	т					LTR
Volume (V), veh/h	0	5	794	73	0	120	512	2	3	0	202	18	356	(	0	13	27	19
Percent Heavy Vehicles, %	4	4	4	4	5	5	5		5	4	4	4	4	:	3	3	3	3
Flow Rate (VPCE), pc/h	0	6	938	86	0	143	61	1 1	0	0	239	21	421	(	0	15	32	22
Right-Turn Bypass		N	one			Ν	lone	_			Yiel	ding				No	one	
Conflicting Lanes			1				1				:	2					2	
Pedestrians Crossing, p/h			0				0				(	)					0	
Proportion of CAVs					_				(	)								
Critical and Follow-U	p Hea	dwav	Adj	ustme	nt													
Approach	·		EB		T		WB				N	В		Т		5	B	
Lane	Left	_	ght	Bypass	Left	_	light	Вура	ss	Left			Bypass		Left		ght	Bypass
Critical Headway, s			9 763		4.543	-	5436	51			_		4.9763				276	
Follow-Up Headway, s		_	6087		2.535		5352						2.6087	-			352	
Flow Computations,	Capaci	itv an	d v/	r Ratic										-				
Approach			EB				WB				N	B		1			B	
Lane	Left	_	ght	Bypass	Left		Right	Вура		Left			Bypass		Left		ght	Bypass
Entry Flow (ve), pc/h	Leit		030	Буразз	359	_	405	Бура	33	Len		50	421	-	Leit		59	вуразз
Entry Volume, veh/h		_	90		342	_	386		_		_	50	405	-			57	
Circulating Flow (vc), pc/h			90		542		266					59	403	-			93	
Exiting Flow (vex), pc/h			53				872		_			7		-			61	
Capacity (Cpce), pc/h			137		1115		115					28	522	-			11	
						_			_			_		-				
Capacity (c), veh/h v/c Ratio (x)			.91		1062 0.32	_	062					04 41	502 0.81	+			93 11	
· · · · ·	<u> </u>		וע.		0.52		0.00				0.	<b>T</b>	0.01			0.	11	
Delay and Level of Se	ervice					-												
Approach				EB	_		_	WB	_			NB	_			_	SB	
Lane			Left				Left	Right	E	Bypass	Left	Right	_	bass	Left		Right	Bypass
Lane Control Delay (d), s/veh				35.7			6.6	7.1				12.2	_	3.9			7.4	
Lane LOS				E			А	A				В		E			A	
95% Queue, veh				20.6			1.4	1.7				2.1		).3			0.4	
Approach Delay, s/veh   LOS			3	5.1	E		6.9			A	28.	7	D			.4		А
Intersection Delay, s/veh   LO						24.2				on 2023					С			8:56:17 A

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				HC	S Roi	Indal	bou	ts Rep	oort								
General Information			_				Site	Infor	matio	n			_		_	_	
Analyst	Emma	a Myers-	Verha	ge		-			Inter	section			Hi	ghway '	1416 a	and R	adar Hil.
Agency or Co.						+	-		E/W	Street Na	ime		Hi	ghway '	1416		
Date Performed	8/17/	2023						4	N/S S	Street Na	me		Ra	adar Hill	Rd		
Analysis Year	2030				$\triangleleft$			) †≯	Analy	/sis Time	Period, l	nrs	1.0	00			
Time Analyzed	PM P	eak			*			1	Peak	Hour Fac	tor		0.9	94			
Project Description	Radai Study	Hill 141	l6 Cori	idor				6	Juriso	diction			Bc	ox Elder,	SD		
Volume Adjustments	and S	ite Cl	narae	teristi	cs												
Approach		E	B			W	'B			N	IB				SB		
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	J   I	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	2	0	0	0	1	0	0	) (	0	1	0
Lane Assignment				LTR	LT			TR			L	.T					LTR
Volume (V), veh/h	0	20	475	205	0	209	605	4	0	118	14	138	0		5	13	11
Percent Heavy Vehicles, %	4	4	4	4	5	5	5	5	4	4	4	4	3		3	3	3
Flow Rate (VPCE), pc/h	0	22	526	227	0	233	676	4	0	131	15	153	0		5	14	12
Right-Turn Bypass		N	one			No	ne	_		Yiel	ding				Non	ie	1
Conflicting Lanes			1			1			<u> </u>		2				2		
Pedestrians Crossing, p/h			0			0	)				)				0		
Proportion of CAVs									0								
Critical and Follow-U	b Hea	dwav	Adi	ustmer	nt												
Approach		-	B			w	′B		T	N	IB				SB		
Lane	Left	_	ght	Bypass	Left	Rig		Bypass	Left	_		Bypass	L	.eft	Righ	_	Bypass
Critical Headway, s		-	763	71	4.5436	4.54		71			-	4.9763			4.327		71
Follow-Up Headway, s		_	087		2.5352	2.53	-					2.6087			2.535	-	
Flow Computations,	Capac	itv an	d v/	c Ratio	<b>c</b>				<u> </u>								
Approach		-	EB		<b>5</b>	W	′B		1	N	IB		1		SB		
Lane	Left	_	ght	Bypass	Left	Rig	_	Bypass	Left			Bypass		.eft	Righ		Bypass
Entry Flow (ve), pc/h	Leit		75	Буразз	429	48		Буразз	Len		46	153		en	31	-	Буразз
Entry Volume, veh/h	-		45		429	40	-			_	40	147		_	30		
-			45 52		409	16					53	147			104		
Circulating Flow (v <sub>c</sub> ), pc/h	-		31			81					.1				474		
Exiting Flow (vex), pc/h			5 I 067		1219	12					37	803			587	-	
Capacity (cpce), pc/h	-													_			
Capacity (c), veh/h v/c Ratio (x)		_	.73		0.35	0.4				_	53 16	772 0.19			570 0.05	-	
		0.	.15		0.35	0.2	+0		1	0.	10	0.19			0.05		
Delay and Level of Se	ervice												_				
Approach				EB				WB			NB				_	SB	
Lane			Left					Right	Bypass	Left	Righ		-	Left		ght	Bypass
Lane Control Delay (d), s/veh				16.3	_	6.		7.1			5.9	6.	-		-	5.9	
Lane LOS				С		Δ		A			A	A	-		-	A	
95% Queue, veh				7.6		1.		2.0			0.6	0.	7			).2	
Approach Delay, s/veh   LOS			1	5.3	С		6.9		А	6.3		A		6.9	)		А
Intersection Delay, s/ven   LOS Intersection Delay, s/veh   LOS Copyright © 2023 University of		ll Rights				10.4		oouts Vers					B Gene			023 8	

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				HC	S Rol	Indal	oou	ts Rep	oort							
General Information							Site	Infor	matio	n						
Analyst	Emma	a Myers-	Verha	ge					Inter	section			Highw	ay 141	6 and I	Radar Hil.
Agency or Co.						+	-		E/W	Street Na	ime		Highw	ay 141	6	
Date Performed	8/17/	2023			$\Box$			14	N/S S	Street Na	me		Radar	Hill Rd		
Analysis Year	2050				$\triangleleft$			†  ¥	Analy	/sis Time	Period, h	rs	1.00			
Time Analyzed	PM P	eak			*			/	Peak	Hour Fac	tor		0.94			
Project Description	Radai Study	Hill 141	6 Corr	idor			1	6	Juriso	diction			Box Ele	der, SD	I	
Volume Adjustments	and S	ite Cl	narao	teristi	cs											
Approach		E	B			W	В			N	IB			:	SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	2	0	0	0	1	0	0	0	1	0
Lane Assignment				LTR				TR			LI	.				LTR
Volume (V), veh/h	0	23	545	239	0	237	697	4	0	134	14	158	0	5	15	12
Percent Heavy Vehicles, %	4	4	4	4	5	5	5	5	4	4	4	4	3	3	3	3
Flow Rate (VPCE), pc/h	0	25	603	264	0	265	779	4	0	148	15	175	0	5	16	13
Right-Turn Bypass		N	one			No	ne	-		Yiel	ding			N	one	
Conflicting Lanes			1			1					2				2	
Pedestrians Crossing, p/h			0			0	)				)				0	
Proportion of CAVs									0							
Critical and Follow-U	b Hea	dwav	Adi	ustmer	nt											
Approach		-	B			w	B		T	N	IB				SB	
Lane	Left	_	ght	Bypass	Left	Rig		Bypass	Left	_		ypass	Left		ight	Bypass
Critical Headway, s		-	763		4.5436	-	-				-	.9763		-	3 3276	
Follow-Up Headway, s		_	087		2.5352		-					.6087		-	5352	
Flow Computations,	Capac	itv an	d v/	r Ratio	<b>c</b>				<u> </u>							
Approach	Capac	-	B		<b>5</b>	w	'B		1	N	IB				SB	
Lane	Left	_	ght	Bypass	Left	Rig		Bypass	Left			ypass	Left		ight	Bypass
Entry Flow (ve), pc/h	Leit		92	вуразз	493	55		вуразз	Len		-	175	Leit		34	Буразз
Entry Volume, veh/h			92 58		495	52	-			_				-	33	
-					469						57	168				
Circulating Flow (v <sub>c</sub> ), pc/h			86			18			-		33				192	
Exiting Flow (vex), pc/h			08		1197	94					4 29	742		-	545 1.C	
Capacity (cpce), pc/h			031			119				_					516	
Capacity (c), veh/h			91 97		1140	114	-			_		714			501 07	
v/c Ratio (x)	•	0.	87		0.41	0.4	+0		1	0.	20	0.24		0	.07	
Delay and Level of Se	ervice												_			
Approach				EB				WB			NB				SB	
Lane			Left					Right	Bypass	Left	Right	Bypas	s Le	ft	Right	Bypass
Lane Control Delay (d), s/veh				29.4		7.	4	8.2			6.6	7.8			8.0	
Lane LOS				D		A		A			A	A			А	
95% Queue, veh				15.6		2.	1	2.6			0.7	0.9			0.2	
Approach Delay, s/veh   LOS			29	9.4	D		7.8		А	7.2		А		8.0		А
Intersection Delay, s/veh   LO opyright © 2023 University of						16.1							С			

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			s Sigi	anze		ersect		esu	1.5	Sum	innary	,				
General Inform	nation								Inte	ersect	tion Inf	ormatio	n			
Agency	lation									ration,		1.000			44	
Analyst		Emma Myers-Verha	200	Analys	ie Date	e Aug 8	2023			a Typ		Other				いたの
Jurisdiction			age	Time F		AM P			PHI	• •	<u> </u>	1.00			~#c	÷-
Urban Street		Alternative 1		Analys		_	can				Period	1> 7:0	10			
Intersection		Hwy 1416 and S El	lewor	File Na			416-Ells	worth		•						
Project Descrip	tion	Radar Hill 1416 Co			ame		410-Ells	woru	IRU_		AIVIFEA	K2030.X	lus		`¶ Instantan	
Project Descrip	lion			ludy												D MA
Demand Inform	nation				EB			W	В			NB			SB	
Approach Move	ement			L	Т	R	L	Т	-	R	L	Т	R	L	Т	R
Demand ( v ), v	eh/h			650	327	16	24	14	7	38	90	100	57	60	66	207
Signal Informa					2		3 5	<u> </u>	2	1215	- 203	2		_	R.	$\mathbf{A}$
Cycle, s	61.1	Reference Phase	2		ΓĽ	R		5 0	ŝ		5	17	1		3	4
Offset, s	0	Reference Point	End	Green	1.7	4.3	9.1	3.9	)	1.1	18.5			<u> </u>	1	
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	-	3.5	3.5	3.5		0.0	3.5		∧			- <b>V</b>
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.0	1.0	)	0.0	1.0		5	6	7	8
Timer Results				EBI		EBT	WB		\\\/	BT	NBI		NBT	SBI		SBT
Assigned Phase	0			5		2	1		6		3	-	8	7		4
Case Number				1.1		4.0	1.1		4.	-	1.1		4.0	1.1		4.0
Phase Duration				15.0	<u>,                                     </u>	22.4	6.2	_	4. 13		8.4		23.0	9.5		4.0 24.1
Change Period				4.5		4.5	4.5		4.		4.5		4.5	9.5		4.5
Max Allow Head		,		2.9		2.9	2.9		4. 2.		2.9		3.1	2.9		3.1
		·		11.9		12.6	2.9		2. 8.		4.2		6.5	3.4		10.9
	ue Clearance Time ( <i>g</i> <sub>s</sub> ), s en Extension Time ( <i>g</i> <sub>e</sub> ), s			0.0		0.7	0.0	_	0.		0.0		0.7	0.0		0.5
				1.00		1.00	0.0	_	1.0		0.0		1.00	1.00		1.00
Max Out Proba	se Call Probability			1.00		0.01	1.00		0.0		1.00		0.00	1.00		0.05
Max Out 1105a	onity			1.00	, ∥	0.01	1.00	<b>,</b>	0.0	01	1.00	,	0.00	1.00		0.00
Movement Gro	oup Res	ults			EB			WE	3			NB			SB	
Approach Move	ement			L	Т	R	L	Т		R	L	Т	R	L	Т	R
Assigned Move	ment			5	2	12	1	6		16	3	8	18	7	4	14
Adjusted Flow I	Rate( <i>v</i>	), veh/h		650	343		24	185	;		90	157		60	273	
Adjusted Satura	ation Flo	ow Rate ( <i>s</i> ), veh/h/l	n	1618	1735		1667	168	8		1667	1643		1667	1540	
Queue Service	Time ( g	g s ), S		9.9	10.6		0.7	6.4			2.2	4.5		1.4	8.9	
Cycle Queue C	learance	e Time ( <i>g c</i> ), s		9.9	10.6		0.7	6.4	Τ		2.2	4.5		1.4	8.9	
Green Ratio ( g	/C)			0.35	0.29		0.18	0.15	5		0.37	0.30		0.38	0.32	
Capacity ( c ), v	/eh/h			899	509		255	251			384	498		541	494	
Volume-to-Cap	acity Ra	itio(X)		0.723	0.674		0.094	0.73	7		0.235	0.316		0.111	0.553	
Back of Queue	(Q), ft	/In ( 95 th percentile	e)	141.1	158		11.1	102.	4		29.2	71.2		20.7	139.6	
Back of Queue	( Q ), ve	eh/In ( 95 th percent	ile)	5.6	6.3		0.4	4.1			1.2	2.8		0.8	5.6	
Queue Storage	Ratio (	RQ) (95 th percent	tile)	0.00	0.00		0.00	0.00	)		0.00	0.00		0.00	0.00	
Uniform Delay	( d 1 ), s	/veh		16.8	19.0		21.2	24.9	)		13.8	16.4		12.2	17.1	
Incremental De	lay ( <i>d</i> 2	), s/veh		2.5	0.8		0.1	1.6			0.1	1.7		0.4	4.5	
Initial Queue De	elay ( <i>d</i>	з ), s/veh		0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0	
Control Delay (	d ), s/ve	eh		19.3	19.8		21.2	26.5	5		13.9	18.1		12.6	21.6	
Level of Service	e (LOS)			В	В		С	С			В	В		В	С	
Approach Delay	y, s/veh	/LOS		19.5	5	В	25.9	9	C	2	16.6	6	В	20.0	)	В
Intersection De	lay, s/ve	h / LOS				19	9.9							В		
Multimodal Re					EB			WE				NB			SB	
Pedestrian LOS				1.91		В	2.11			3	1.91		B	2.09		В
Bicycle LOS Sc	ore / LC	DS		2.13	3	В	0.83	3	Α	۹	0.90	)	Α	1.04	1	А

		5 Sigi	anze	u mite	-13 <del>-</del> 01		esui	is Sun	iiiiai y	,				
General Information								Intersec	tion Inf	ormatio	on			814
Agency								Duration		1.000			44	
Analyst	Emma Myers-Verh	200	Analys	eie Date	e Aug 8	2023		Area Typ		Other				
-	-	aye	Time F		AM Pe					1.00			~Ťe	*
Jurisdiction	Box Elder, SD					еак			Daviad	1> 7:0	20			4 <sup></sup> 88
Urban Street	Alternative 1			sis Year				Analysis						
Intersection	Hwy 1416 and S E		File Na	ame	Hwy14	416-Ells	worth	Rd_Alt1_	_AMPea	K2050.X	us	_	<u></u>	6.17
Project Description	Radar Hill 1416 Co	rridor St	udy											20 20
Demand Information	1			EB			W	3		NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), veh/h			748	348	19	24	15	6 41	102	107	58	61	69	248
													1	-11.
Signal Information								. 2K	2				_	T
Cycle, s 83.4	Reference Phase	2		Ρe	ТÉ –				12			<b>A</b>	<b>``</b>  '	<u>стя</u>
Offset, s 0	Reference Point	End	Green	21	11.1	11.7	18.				1	<b>Y</b> <sup>2</sup>	3	4
Uncoordinated Yes	Simult. Gap E/W	On	Yellow		3.5	3.5	3.5		0.0			$\rightarrow$		KT2
Force Mode Fixed	I Simult. Gap N/S	On	Red	1.0	1.0	1.0	1.0		0.0		5	6	7	8
Timer Results			EBI	_	EBT	WB	L	WBT	NB	L	NBT	SBI	-	SBT
Assigned Phase			5		2	1		6	3		8	7		4
Case Number			1.1		4.0	1.1		4.0	1.1		4.0	1.1		4.0
Phase Duration, s			22.2	2	31.8	6.6		16.2	22.5	5	22.5	22.5	5	22.5
Change Period, (Y+F	R c ), S		4.5		4.5	4.5		4.5	4.5		4.5	4.5		4.5
Max Allow Headway (	<i>MAH</i> ), s		2.9		2.9	2.9		2.9	2.9		3.1	2.9		3.1
Queue Clearance Tim	e Clearance Time ( $g_s$ ), s			3	17.1	3.0		11.5	5.1		9.3	3.8		19.0
Green Extension Time	Extension Time ( g e ), s				0.1	0.0		0.2	0.1		0.7	0.1		0.0
Phase Call Probability				)	1.00	0.43	3	1.00	1.00	)	1.00	1.00	)	1.00
Max Out Probability			1.00	)	1.00	0.00	)	0.10	0.00	)	0.03	0.00	)	1.00
Movement Group Re	sults			EB			WB			NB			SB	
Approach Movement	.50115			Т	R	L	Т	R	L	T	R		T	R
Assigned Movement			5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (	v) veh/h		748	367	12	24	197	10	102	165	10	61	317	
Adjusted Saturation F		In	1618	1734		1667	1687	·	1667	1646		1667	1534	
Queue Service Time (	. ,		15.6	15.1		1.0	9.5		3.1	7.3		1.8	17.0	
Cycle Queue Clearan	. = ,		15.6	15.1		1.0	9.5		3.1	7.3		1.8	17.0	
Green Ratio ( $g/C$ )	oo nino ( g c ), s		0.38	0.33		0.17	0.14		0.43	0.22		0.43	0.22	-
Capacity ( <i>c</i> ), veh/h			924	567		255	236		446	355		575	331	
Volume-to-Capacity R	Patio (X)		924 0.809	0.647		0.094	0.833	_	0.229	0.465		0.106	0.958	
Back of Queue (Q),	· · ·	2)	241	240.8		17	176.8		51.4	136.2		28.7	433.7	
Back of Queue (Q), Back of Queue (Q),		<i>,</i>	9.6	240.8 9.6		0.7	7.1	,	2.1	5.4		1.1	433.7	
Queue Storage Ratio	· ·	,	9.6	9.6		0.7	0.00		0.00	0.00		0.00	0.00	
	<u>, , , , , , , , , , , , , , , , , , , </u>												32.3	
Uniform Delay ( <i>d</i> 1),			22.1	24.0		29.5	34.9	-	16.3	28.5		14.5	<u> </u>	
Incremental Delay ( d			5.1	2.0		0.1	5.8		1.2	4.4		0.4	66.0	
Initial Queue Delay (			0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay ( d ), s/			27.2	26.0		29.5	40.7		17.5 P	32.9		14.9	98.4	
Level of Service (LOS	•		C	C		C	- D		B	C		B	F	
Approach Delay, s/vel			26.8	5	C	39.5	0	D	27.0	J	С	84.9	)	F
intersection Delay s/v	ersection Delay, s/veh / LOS				39	9.4						D		
	imadal Dagulta													
Multimodal Results	odal Results			EB			WB			NB			SB	
	e/LOS		1.92		В	2.13		В	1.93	1	В	2.12	1	В

		5 Sigi	Tanze	ume	ersect		esu	13 3	bum	innary	, 				
General Information							1	Inter	rsect	tion Infe	ormatic	n			
Agency								Dura			1.000			44	
Analyst	Emma Myers-Verha	200	Analys	eie Date	e Aug 8	2023		Area			Other				<b>與</b>
Jurisdiction	Box Elder, SD	age	Time F		PM P			PHF		6	1.00			~Ĭ1	*
Urban Street	Alternative 1				r 2030	ean				Period	1> 16	.15			<b>-</b>
		lowor					worth		•						
Intersection Project Description	Hwy 1416 and S El Radar Hill 1416 Co			ame	wy i	416-Ells	swortn	Ru_P	<u> </u>	PiviPea	KZU3U.X	us		ì∤ Kanaan	
Project Description			luay										123	s i care su e l'atter sate le	10 492
Demand Information	1			EB			W	В			NB			SB	
Approach Movement			L	Т	R	L	Т	-	R	L	Т	R	L	Т	R
Demand ( v ), veh/h			306	84	152	15	7	6	7	38	39	7	7	62	273
															<u> </u>
Signal Information	- W			2	7	2 6	<u> </u>	5	Ж	20.	3		_	ĸ	
Cycle, s 52.4	Reference Phase	2		P e	TŘ –		з <b>п</b> .,	s I		5.	17 <b>×</b>		€ , L	<b>```</b> ''	ктя
Offset, s 0	Reference Point	End	Green	1.0	4.1	5.8	2.1		2.9	18.5			<b>X</b>		
Uncoordinated Yes	Simult. Gap E/W	On	Yellow		0.0	3.5	3.5		0.0	3.5		▶			<b>K1</b> 2
Force Mode Fixed	Simult. Gap N/S	On	Red	1.0	0.0	1.0	1.0	)	0.0	1.0		5	6	7	8
								1.4.44	-						
Timer Results			EBI	-	EBT	WB	L	WB	1	NBL	-	NBT	SBI	-	SBT
Assigned Phase			5		2	1	_	6		3	$\rightarrow$	8	7	_	4
Case Number			1.1		4.0	1.1		4.0	_	1.1		4.0	1.1	_	4.0
Phase Duration, s			9.6		14.4	5.5		10.3		6.6		23.0	9.5		25.9
Change Period, (Y+F			4.5		4.5	4.5		4.5	_	4.5		4.5	4.5		4.5
Max Allow Headway	· · ·		2.9 6.2		3.0	3.0		3.0		3.3		3.4	3.3		3.4
	ue Clearance Time ( $g_s$ ), s en Extension Time ( $g_e$ ), s				9.5	2.4	_	4.4	_	2.7		2.9	2.1		10.7
	n Extension Time ( <i>g</i> <sub>e</sub> ), s				0.4	0.0		0.5		0.0		0.8	0.0		0.6
	e Call Probability			)	1.00	0.20		0.99	_	0.42		1.00	1.00		1.00
Max Out Probability			1.00	)	0.01	1.00	)	0.00	0	1.00	)	0.00	1.00	)	0.07
Movement Group Ro	esults			EB			WE	3			NB			SB	
Approach Movement			L	Т	R	L	Т	17	R	L	Т	R	L	Т	R
Assigned Movement			5	2	12	1	6	1	16	3	8	18	7	4	14
Adjusted Flow Rate (	<i>v</i> ), veh/h		306	236	<u> </u>	15	83			38	46		7	335	
Adjusted Saturation F	,	In	1618	1568		1667	172	4		1667	1703		1667	1526	
Queue Service Time			4.2	7.5	<u> </u>	0.4	2.4	_		0.7	0.9		0.1	8.7	
Cycle Queue Clearan	, = ,		4.2	7.5		0.4	2.4			0.7	0.9		0.1	8.7	
Green Ratio ( g/C )			0.24	0.19	1	0.13	0.11	_		0.39	0.35		0.46	0.41	
Capacity ( c ), veh/h			766	297		178	191	_		421	601		759	622	
Volume-to-Capacity F	Ratio (X)		0.399	0.795		0.084	0.43			0.090	0.077		0.009	0.538	
Back of Queue (Q),	,	e)	54.2	104		6.2	37.3			10.9	16.2		1.9	141.3	
Back of Queue (Q),		,	2.2	4.2		0.2	1.5	_		0.4	0.6		0.1	5.7	
Queue Storage Ratio	· ·		0.00	0.00		0.00	0.00			0.00	0.00		0.00	0.00	
Uniform Delay ( <i>d</i> 1),	, ,, .	,	16.9	20.3	<u> </u>	20.3	21.8	_		10.5	11.3		7.8	11.8	
Incremental Delay ( a			0.1	1.9		0.1	0.6	_		0.0	0.2		0.0	3.4	
Initial Queue Delay (			0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0	
Control Delay ( d ), s/	•		17.1	22.1		20.4	22.3	_		10.5	11.5		7.8	15.1	
Level of Service (LOS			В	С		C	C			B	В		A	В	
Approach Delay, s/ve	'		19.3		В	22.0		С		11.1		В	15.0		В
Intersection Delay, s/						7.5							В		
<b>Multimodal Results</b>				EB			WE	3			NB			SB	
Pedestrian LOS Scor	e / LOS		1.91	1	В	2.11	1	В		1.89	)	В	2.08	3	В
Bicycle LOS Score / L	OS		1.38	3	А	0.65	5	Α		0.63	3	А	1.05	5	А

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HCS<sup>™</sup> Streets Version 2023

			Joigi	Ialize		13000		esu	113	oun	innary					
General Inform	nation								Inte	ersect	tion Infe	ormatio	on			
Agency	ation								<u> </u>	ration,		1.000			44	
Analyst		Emma Myers-Verha	200	Apolyc	vic Dote	e Aug 1	0 2023			a Typ		Other				
Jurisdiction		Box Elder, SD	aye	Time F		PM P			PH		e	1.00				*
Urban Street		Alternative 1				· 2050	eak			-	Period	1> 16	.15			iii
Intersection			0 51	File Na				worth	L	-						
	tion	Highway 1416 and Radar Hill 1416 Co			ame	Hwy	416-Ells	swortr	iRa_		PiviPeal	<2050.X	us	_	) (* Normalia	CHINE .
Project Descrip	lion			ludy											( ())) ()) ()) ()) ()) ()) ()) () () ()	10 49
Demand Inform	nation				EB			W	/B			NB			SB	
Approach Move	ment			L	Т	R	L	1	Г	R	L	Т	R	L	Т	R
Demand ( v ), v	eh/h			352	99	178	18	9	1	8	43	43	8	8	72	327
												<u> </u>				<u> </u>
Signal Informa	tion				2	2	2 6	4	6	1216	- 20.	1		_	ĸ	$\mathbf{A}$
Cycle, s	54.6	Reference Phase	2		F e	TŘ –		. 7	S		5	rz 🖌	1	€ ,		к <b>1</b> ж
Offset, s	0	Reference Point	End	Green	1.2	3.9	8.0	2.4	4	2.6	18.5			<u> </u>		~
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		0.0	3.5	3.5		0.0	3.5		▶	$\mathbf{\mathbf{b}}$	5	~ <b>*1</b> 2*
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	0.0	1.0	1.0	)	0.0	1.0		5	6	7	8
Timer Day If						EDT			14.0	DT	NIDI		NDT	0.51		ODT
Timer Results	2			EBI 5	-	EBT 2	WB		6	BT	NBL	-	NBT 8	SBI 7	-	SBT
Assigned Phase	5								-		3		-			4
Case Number				1.1	_	4.0	1.1		4.	_	1.1		4.0	1.1		4.0
Phase Duration		\ \		9.6		16.5	5.7	_	12	_	6.9		23.0	9.5		25.6
Change Period,		,		4.5		4.5	4.5	_	4.	_	4.5		4.5	4.5		4.5
Max Allow Head		,		2.9		3.0	3.0	_	3.		3.3	_	3.4	3.3		3.4
	eue Clearance Time ( <i>g</i> <sub>s</sub> ), s en Extension Time ( <i>g</i> <sub>e</sub> ), s			7.1		11.5	2.5		5.	_	2.9		3.1	2.2		14.5
				0.0		0.4	0.0		0.	_	0.0		1.0	0.0		0.5
Max Out Proba	se Call Probability			1.00		1.00 0.05	0.24	_	1.0 0.0	_	0.48		1.00 0.00	1.00		1.00 0.75
Max Out Floba	Jiiity			1.00	,	0.05	1.00	,	0.0	00	1.00		0.00	1.00	,	0.75
Movement Gro	up Res	ults			EB			WE	3			NB			SB	
Approach Move	ment			L	Т	R	L	Т		R	L	Т	R	L	Т	R
Assigned Move	ment			5	2	12	1	6		16	3	8	18	7	4	14
Adjusted Flow F	Rate( <i>v</i>	), veh/h		352	277		18	99			43	51		8	399	
Adjusted Satura	ation Flo	w Rate ( <i>s</i> ), veh/h/l	n	1568	1520		1537	159	0		1654	1689		1602	1466	
Queue Service		. ,		5.1	9.5		0.5	3.1			0.9	1.1		0.2	12.5	
Cycle Queue C	learance	e Time ( <i>g c</i> ), s		5.1	9.5		0.5	3.1			0.9	1.1		0.2	12.5	
Green Ratio ( g	/C )			0.27	0.22		0.17	0.1	5		0.38	0.34		0.43	0.39	
Capacity ( c ), v	eh/h			788	332		174	234	1		323	572		698	566	
Volume-to-Capa	•	· · ·		0.447	0.833		0.104	0.42	3		0.133	0.089		0.011	0.705	
Back of Queue	(Q), ft	/In ( 95 th percentile	:)	66.1	140.6		8	48.3	3		13.7	19.8		2.5	219.1	
Back of Queue	( Q ), ve	eh/In ( 95 th percenti	ile)	2.6	5.4		0.3	1.8			0.5	0.8		0.1	8.4	
Queue Storage	Ratio (	RQ) (95 th percent	tile)	0.00	0.00		0.00	0.00	0		0.00	0.00		0.00	0.00	
Uniform Delay (	d 1 ), s	/veh		16.8	20.4		19.6	21.2	2		12.1	12.3		8.9	14.1	
Incremental De	lay ( <i>d</i> 2	), s/veh		0.1	4.0		0.1	0.5	;		0.1	0.3		0.0	7.5	
Initial Queue De	elay(d	3 ), s/veh		0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0	
Control Delay (	d ), s/ve	eh		16.9	24.4		19.7	21.6	6		12.1	12.6		8.9	21.6	
Level of Service	e (LOS)			В	С		В	С			В	В		А	С	
Approach Delay	/, s/veh	/LOS		20.2	2	С	21.3	3	C	2	12.4	-	В	21.4	1	С
Intersection De	ay, s/ve	h / LOS				20	).1							С		
Multimodal Re					EB			WE				NB			SB	
Pedestrian LOS				1.91		В	2.11			3	1.90		В	2.08		В
Bicycle LOS Sc	ore / LC	)S		1.53	3	В	0.68	3	Α	4	0.64		А	1.16	5	A

Agency or Co.     Imagency or Co.	Highway 1416 and S Ellswo         F/W Street Name       Highway 1416 and S Ellswo         E/W Street Name       S Ellsworth Rd         N/S Street Name       S Ellsworth Rd         N/S Street Name       S Ellsworth Rd         Analysis Time Period, hrs       1.00         Peak Hour Factor       0.84         Jurisdiction       SB         VB       SB         U       L       T       R       U       L       T       R         0       0       1       0       0       1       0       1       0         LTR       LTR       LTR       LTR	
<th colst<="" th=""><th>Intersection       Inighted yith outropy througe cluster         E/W Street Name       Highway 1416         N/S Street Name       S Ellsworth Rd         Analysis Time Period, hrs       1.00         Peak Hour Factor       0.84         Jurisdiction       Box Elder, SD         WB       NB         V       L       T       R         0       0       1       0       0       1         LTR       LTR       LTR       LTR       LTR</th></th>	<th>Intersection       Inighted yith outropy througe cluster         E/W Street Name       Highway 1416         N/S Street Name       S Ellsworth Rd         Analysis Time Period, hrs       1.00         Peak Hour Factor       0.84         Jurisdiction       Box Elder, SD         WB       NB         V       L       T       R         0       0       1       0       0       1         LTR       LTR       LTR       LTR       LTR</th>	Intersection       Inighted yith outropy througe cluster         E/W Street Name       Highway 1416         N/S Street Name       S Ellsworth Rd         Analysis Time Period, hrs       1.00         Peak Hour Factor       0.84         Jurisdiction       Box Elder, SD         WB       NB         V       L       T       R         0       0       1       0       0       1         LTR       LTR       LTR       LTR       LTR
Agency or Co.EVN Street NameHighway 146Date Performed2030VSEIN<	E/W Street Name       Highway 1416         N/S Street Name       S Ellsworth Rd         Analysis Time Period, hrs       1.00         Peak Hour Factor       0.84         Jurisdiction       Box Elder, SD         V       L       T       R       U       L       T       R         0       0       1       0       0       1       0       1       0         LTR       LTR       LTR       LTR       LTR       LTR       LTR       LTR       LTR	
Analysis Year     203     Image and all analyses     Analysis Year     Anal	Malysis Time Period, hrs       1.00         Peak Hour Factor       0.84         Jurisdiction       Box Elder, SD         V       L       T       R       U       L       T       R         0       0       1       0       0       1       0       1       0         LTR       LTR       LTR       LTR       LTR       LTR       LTR       LTR	
Time Analyzed       AM Peak       Image: The Analyzed in the Alternation of the Alternatination of the Alternatination of the Alternation of the Alternat	Peak Hour Factor         0.84           Jurisdiction         Box Elder, SD           WB         V           V         L           T         R           U         L           T         R           U         L           LTR         0           LTR         LTR	
Time AnalyzedAM PeakImage: Peak Hour PactorPeak Hour PactorPeak Hour PactorOBAProject DescriptionAlt=""At Image: Peak Hour PactorImage: Peak Hour Pactor <td>Peak Hour Factor         0.84           Jurisdiction         Box Elder, SD           WB         SB           U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         U         L         T         R         U         L         T         R         U         L         T         R         U         L         R         U         L         R         U         L         R<!--</td--></td>	Peak Hour Factor         0.84           Jurisdiction         Box Elder, SD           WB         SB           U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         U         L         T         R         U         L         T         R         U         L         T         R         U         L         R         U         L         R         U         L         R </td	
And AdjustmentsImage: Section of the section o	WB     NB     SB       U     L     T     R     U     L     T     R     U     L     T     R       0     0     1     0     0     1     0     0     1     0       L     LTR     LTR     LTR     LTR     LTR     LTR     LTR     LTR	
ApproachULTRULTRULTRULMovementULTRUITRUIIRUINumber of Lanes (N)OOIII	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
Movement         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         L         T         R         U         U         I<	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
Number of Lanes (N)OII <thi< th="">III<!--</td--><td><math display="block">\begin{array}{c ccccccccccccccccccccccccccccccccccc</math></td></thi<>	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
Lane AssignmentIII	LTR LTR LTR	
Volume (V), veh/h       0       650       335       16       0       30       173       44       0       90       100       59       0       62         Percent Heavy Vehicles, %       4       4       4       10       10       10       10       10       11       1       1       1       15       5         Flow Rate (vec.), pc/h       0       0       805       415       20       0       39       227       58       0       108       12       1       55       55         Right-Turn Bypass       Image: Condition Lanes       Image: Condition Lan		
Percent Heavy Vehicles, %4444101010101111155Flow Rate (wca), pc/n08054152003922758010812071078Right-Turn Bypass $\square$ <	0 30 173 44 0 90 100 59 0 62 66 20	
Flow Rate (wea), pc/h08054152003922758010812071078Right-Turn Bypass $\longrightarrow$ <		
Right-Turn BypassNoneN	10 10 10 10 1 1 1 1 5 5 5 5	
Conflicting Lanes111 <th c<="" td=""><td>0 39 227 58 0 108 120 71 0 78 82 25</td></th>	<td>0 39 227 58 0 108 120 71 0 78 82 25</td>	0 39 227 58 0 108 120 71 0 78 82 25
Pedestrians Crossing, p/h0000000Proportion of CAVs $\mathbf{C}$ <td< td=""><td>None None None</td></td<>	None None None	
Critical and Follow-UP Headway. sEBWBNBSApproachLeftRightBypassLeftRightBypassLeftRightBypassLeftRightBypassLeftRightSIaneLeftRightSLeftRightSLeftRightBypassLeftRightBypassLeftRightSFollow-Up Headway, sLeftRightSLeftRightSLeftRightBypassLeftRightBypassLeftRightSFollow-Up Headway, sLeftRightBypassLeftRightSLeftRightBypassLeftRightSFollow-Up Headway, sLeftRightBypassLeftRightBypassLeftRightSSFollow-Up Headway, sLeftRightBypassLeftRightBypassLeftRightSSLaneLeftRightBypassLeftRightBypassLeftRightBypassLeftRightIaneLeftRightBypassLeftRightBypassLeftRightBypassLeftRightIaneLeftRightBypass	1 1 1	
Critical and Follow-U Headways Structure           Approach $\mathbb{EB}$ $\mathbb{WB}$ $\mathbb{WB}$ $\mathbb{R}$ <t< td=""><td>0 0 0</td></t<>	0 0 0	
ApproachImage: Constraint of the term of the term of	0	
LaneLeftRightBypassLeftRightBypassLeftRightBypassLeftRightBypassLeftRightBypassLeftRightCritical Headway, s4.97634.97634.97634.97634.97634.97634.97634.976314.976314.9763Follow-Up Headway, s2.60872.60872.608712.6087 <td></td>		
Critical Headway, s4.9763	WB NB SB	
Follow-Up Headway, s2.60872.60872.60872.60872.60872.608702.608702.608702.608702.608702.608702.608702.608702.608702.608702.6087002.6087002.6087000 <th0< td=""><td>Left Right Bypass Left Right Bypass Left Right Bypass</td></th0<>	Left Right Bypass Left Right Bypass Left Right Bypass	
Flow Computations, Capacity and v/c Ratios         Approach       EB       WB       WB       NB       NB       Image: State of the state of th	4.9763 4.9763 4.9763	
Approach $\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	2.6087 2.6087 2.6087	
LaneLeftRightBypass		
Entry Flow (ve), pc/h       1240       324       324       299       41         Entry Volume, veh/h       1192       295       296       296       327         Circulating Flow (ve), pc/h       199       1033       1298       337         Exiting Flow (ves), pc/h       564       594       983       14         Capacity (cpre), pc/h       1126       481       367       94         Capacity (c), veh/h       1083       437       4364       484       437	WB NB SB	
Entry Volume, veh/h       1192       295       296       983       395         Circulating Flow (vc), pc/h $199$ $1033$ $1298$ $1298$ $1298$ $1298$ $1298$ $1298$ $1298$ $1298$ $1298$ $1126$ $1126$ $1126$ $481$ $367$ $1126$ $942$ Capacity (c), veh/h       1083 $108$ $1437$ $108$	Left Right Bypass Left Right Bypass Left Right Bypass	
Circulating Flow (vc), pc/h       199       1033       1298       37         Exiting Flow (vex), pc/h       564       594       983       14         Capacity (cpce), pc/h       1126       481       367       94         Capacity (c), veh/h       1083       437       364       85	324 299 419	
Exiting Flow (vex), pc/h     564     594     983     124       Capacity (cpce), pc/h     1126     481     367     94       Capacity (c), veh/h     1083     437     364     88	295 296 399	
Capacity (cpre), pc/h         1126         481         367         94           Capacity (c), veh/h         1083         437         364         88	1033 1298 374	
Capacity (c), veh/h         1083         437         364         89	594 983 141	
	481 367 942	
y(c Patio (v) 110 0.67 0.01	437 364 897	
v/c Ratio (x) 1.10 0.67 0.81 0.4	0.67 0.81 0.44	
Delay and Level of Service		
Approach EB WB NB	WB NB SB	
Lane Left Right Bypass Left Right Bypass Left Right Bypass Left Right Bypass Left Right Left Right Left Left Right		
Lane Control Delay (d), s/veh         220.7         28.1         52.9         52.9	Bypass Left Right Bypass Left Right Bypass Left Right Bypa	
Lane LOS F D D F C C C C C C C C C C C C C C C C		
95% Queue, veh 77.6 5.7 10.1 0	28.1     52.9     9.4	
Approach Delay, s/veh   LOS         220.7         F         28.1         D         52.9         F         9.4	28.1     52.9     9.4       D     F     A	
Intersection Delay, s/veh   LOS 133.3 F	28.1       52.9       9.4         D       F       A         5.7       10.1       2.4	

				H	CS	Rour	ndal	pout	ts Rep	oort							
General Information			_		_			Site	Infor	matio	n			_	_		
Analyst	Emma	a Myers-	Verhag	je	Т		*			Inter	section			Highw	ay 14'	16 and S	Ellswor
Agency or Co.						1	+			E/W	Street Na	ime		Highw	ay 14	16	
Date Performed	8/7/2	023				7			4	N/S S	Street Na	me		S Ellsw	orth F	Rd	
Analysis Year	2050					$(\pm ($			_ † ≯	Analy	/sis Time	Period, hi	rs	1.00			
Time Analyzed	AM P	eak			4	7			L	Peak	Hour Fac	tor		0.84			
Project Description	Alterr	ative 2					-	_ [		Juriso	diction			Box El	der, SI	)	
Volume Adjustments	and S	ite Cł	narao	terist	ics												
Approach		E	B				W	В			Ν	IB				SB	
Movement	U	L	Т	R	Ť	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	Τ	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment				LTR				l	TR			LTF	2				LTR
Volume (V), veh/h	0	748	356	19	Ť	0	30	182	47	0	102	107	60	0	63	69	248
Percent Heavy Vehicles, %	4	4	4	4	T	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	926	441	24	T	0	39	238	62	0	123	129	72	0	79	86	310
Right-Turn Bypass		No	one				No	ne			No	one			Ν	lone	
Conflicting Lanes			1				1					1				1	
Pedestrians Crossing, p/h			0				0	)				0				0	
Proportion of CAVs	0																
Critical and Follow-U	p Hea	dway	Adju	ıstme	nt												
Approach		E	B				W	В			N	IB				SB	
Lane	Left	Rig	ght	Bypass		Left	Rig	Iht	Bypass	Left	Ri	ght By	/pass	Left	F	Right	Bypass
Critical Headway, s		4.9	763				4.97	763			4.9	763			4.	9763	
Follow-Up Headway, s		2.6	087				2.60	087			2.6	087			2.	6087	
Flow Computations,	Capaci	ity an	d v/o	: Ratio	os												
Approach		E	B		Τ		W	B			Ν	IB				SB	
Lane	Left	Rig	ght	Bypass		Left	Rig	ht	Bypass	Left	Ri	ght By	/pass	Left	F	Right	Bypass
Entry Flow (ve), pc/h		13	91				33	9			3	24				475	
Entry Volume, veh/h		13	38				30	8			3	21				452	
Circulating Flow (vc), pc/h		2	04				11	78			14	46				400	
Exiting Flow (vex), pc/h		5	92				67	'1			11	17				149	
Capacity (कृल्), pc/h		11	21				41	5			3	16				918	
Capacity (c), veh/h		10	)78				37	7			3	13				874	
v/c Ratio (x)		1.	24				0.8	32			1.	03			(	0.52	
Delay and Level of Se	ervice																
Approach				EB	;				WB			NB				SB	
Lane			Left	Rigl	ht	Bypass	Le	ft	Right	Bypass	Left	Right	Bypas	s Le	eft	Right	Bypass
Lane Control Delay (d), s/veh				458	.9				51.8			187.8				11.1	
Lane LOS				F					F			F				В	
95% Queue, veh				143	.9				10.3			24.1				3.2	
Approach Delay, s/veh   LOS			45	8.9		F		51.8		F	187	.8	F		11.1		В
Intersection Delay, s/veh   LOS	5					28	37.3							F			

				HC	CS Roi	unda	bou	ts Rep	port							
<b>General Information</b>							Site	Infor	matio	n						
Analyst	Emma	a Myers-	Verhag	je		4			Inte	section			High	way 14 <sup>-</sup>	16 and S	Ellswor
Agency or Co.						1	+		E/W	Street Na	ame		High	way 14 <sup>-</sup>	16	
Date Performed	8/7/2	023						+	N/S	Street Na	me		S Ellsv	worth F	Rd	
Analysis Year	2030				$\prec$ $\perp$			† ≯	Ana	ysis Time	Period, h	rs	1.00			
Time Analyzed	PM Pe	eak			÷			L	Peak	Hour Fa	ctor		0.90			
Project Description	Alterr	native 2							Juris	diction			Box E	lder, SI	D	
Volume Adjustments	and S	ite Cł	narac	teristi	cs											
Approach		E	B			١	VВ			١	1B				SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment				LTR				LTR			LTI	२			1	LTR
Volume (V), veh/h	0	306	150	152	0	29	135	21	0	38	49	22	0	22	71	273
Percent Heavy Vehicles, %	4	4	4	4	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	354	173	176	0	35	165	26	0	43	55	25	0	26	83	318
Right-Turn Bypass		No	one			N	one			N	one			١	None	_
Conflicting Lanes			1				1				1				1	
Pedestrians Crossing, p/h			0				0				0		0			
Proportion of CAVs									0							
Critical and Follow-U	p Hea	dway	Adju	ustmer	nt											
Approach		E	B			١	WB		T	٩	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Lef	t Ri	ght B	ypass	Left	F	Right	Bypass
Critical Headway, s		4.9	763			4.9	9763			4.9	763			4.	.9763	
Follow-Up Headway, s		2.6	087			2.0	5087			2.6	087			2.	.6087	
Flow Computations,	Capaci	ity an	d v/d	: Ratio	s											
Approach		E	B			١	VВ		T	١	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Lef	t Ri	ght B	ypass	Left	F	Right	Bypass
Entry Flow (ve), pc/h		7	03			Ĩ	26			1	23				427	
Entry Volume, veh/h		6	76			Ĩ	205			1	22				407	
Circulating Flow (v <sub>c</sub> ), pc/h		1	44				52			5	53				243	
Exiting Flow (v <sub>ex</sub> ), pc/h		2	24			Ę	26			4	35				294	
Capacity (c <sub>pce</sub> ), pc/h		11	91			8	370			7	85			i	1077	
Capacity (c), veh/h		11	46			7	'91			7	77			i	1026	
v/c Ratio (x)		0.	59			C	.26			0	16				0.40	
Delay and Level of Se	ervice															
Approach				EB		Т		WB			NB		Т		SB	
Lane			Left	Righ	t Bypa	ss L	.eft	Right	Bypass	Left	Right	Bypas	s L	eft	Right	Bypass
Lane Control Delay (d), s/veh				10.6				7.4			6.3				7.8	
Lane LOS				В				А			A		+	+	А	
95% Queue, veh				4.2				1.0			0.6				2.0	
Approach Delay, s/veh   LOS			10	.6	В		7.4		А	6.3	3	A	+	7.8		A
Intersection Delay, s/veh   LOS	5					9.0							A			
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				HC	S Rou	inda	bou	ts Rej	port							
General Information							Site	Infor	matio	n						
Analyst	Emma	a Myers-	Verhag	je		4			Inter	section		Т	Highwa	y 141	6 and S	Ellswor
Agency or Co.							+		E/W	Street Na	ime		Highwa	y 141	6	
Date Performed	8/7/2	023						4	N/S S	Street Na	me		S Ellswo	orth R	d	
Analysis Year	2050				$\triangleleft$			† >	Analy	ysis Time	Period, hi	s	1.00			
Time Analyzed	PM Pe	eak			*			1	Peak	Hour Fac	ctor		0.90			
Project Description	Alterr	native 2							Juriso	diction			Box Eld	er, SD		
Volume Adjustments	and S	ite Cł	narao	teristi	cs											
Approach		E	B			١	VВ			Ν	IB			:	SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment				LTR	<u> </u>			LTR			LTF	R I				LTR
Volume (V), veh/h	0	352	165	178	0	32	150	22	0	43	53	23	0	23	81	327
Percent Heavy Vehicles, %	4	4	4	4	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	407	191	206	0	39	183	27	0	48	59	26	0	27	94	382
Right-Turn Bypass		No	one		<u> </u>	N	one			No	one			N	one	
Conflicting Lanes			1				1				1				1	
Pedestrians Crossing, p/h			0				0			(	0		0			
Proportion of CAVs									0							
Critical and Follow-U	p Hea	dway	Adju	ustmer	nt											
Approach	<u> </u>	E	B			١	VB			N	IB			:	SB	
Lane	Left	Ri	ght	Bypass	Left	Ri	ight	Bypass	Left	Rig	ght By	/pass	Left	Ri	ght	Bypass
Critical Headway, s		4.9	763			4.9	9763			4.9	763			4.9	9763	
Follow-Up Headway, s		2.6	087			2.6	5087		1	2.6	087			2.6	5087	
Flow Computations,	Capaci	ity an	d v/	c Ratio	s											
Approach	· ·	-	B			\ \	NB			N	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	Ri	ight	Bypass	Left	Rio	ght By	/pass	Left	Ri	ght	Bypass
Entry Flow (v <sub>e</sub> ), pc/h	-		04			-	49			_	33	-		-	03	
Entry Volume, veh/h		7	73			2	26		-	1	32			4	79	
Circulating Flow (v <sub>c</sub> ), pc/h	-	1	60			5	514			6	25			2	.70	
Exiting Flow (vex), pc/h		2	44			6	513			4	93			3	39	
Capacity (cpce), pc/h			72			-	817				29			_	048	
Capacity (c), veh/h			27				43				22			-	98	
v/c Ratio (x)	-	_	69				.30		-	_	18			-	.48	
Delay and Level of Se	ervice				I						-					
Approach				EB				WB			NB		T		SB	
Lane			Left	_	: Bypas	s I	.eft	Right	Bypass	Left	Right	Bypass	i Lef	t	Right	Bypass
Lane Control Delay (d), s/veh			2011	13.5				8.5	-,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		7.0	5, 5435		+	9.3	
Lane LOS				В		+		A			7.0 A		-	+	9.5 A	
95% Queue, veh				6.3		+-	+	1.3			0.7		-	+	2.7	
Approach Delay, s/veh   LOS			13	8.5	B	+	8.5		A	7.0		A		9.3	,	A
, pprouch Delay, 3/Vell   LUS			1.		U		0.5		~	1.0		~		J.J		A

HCS TM Roundabouts Version 2023 Hwy1416-EllsworthRd\_Alt2\_PMPeak2050.xro

				HC	S Roi	unda	abou	its Rej	port							
<b>General Information</b>							Site	e Infor	matio	n						
Analyst	Emma	Myers-	Verha	ge	<b>1</b>	1.			Inter	section			Hwy 1	1416 ar	nd S Ells	worth Rd
Agency or Co.					1./	V	+ )		E/W	Street Na	ime		Highv	vay 141	6	
Date Performed	8/4/2	023			17				N/S	Street Na	me		S Ellsv	worth R	d	
Analysis Year	2030				<b>K</b> †.			) † †≽	Anal	/sis Time	Period, h	rs	1.00			
Time Analyzed	AM P	eak			÷			1	Peak	Hour Fac	ctor		0.84			
Project Description	Altern	ative 3							Juris	diction			Box E	lder, SE	)	
Volume Adjustments	and S	ite Cł	narao	teristi	cs											
Approach		E	B			١	WB			Ν	IB				SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment	1	-		LTR				LTR			LTI	र				LT
Volume (V), veh/h	0	650	335	16	0	30	173	44	0	90	100	59	0	62	66	207
Percent Heavy Vehicles, %	4	4	4	4	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	805	415	20	0	39	227	58	0	108	120	71	0	78	82	259
Right-Turn Bypass		No	one			N	lone			No	one			Yie	elding	
Conflicting Lanes			1				2				2				1	
Pedestrians Crossing, p/h			0				0				0					
Proportion of CAVs									1							
Critical and Follow-U	p Hea	dway	Adj	ustmer	nt											
Approach		E	B			١	WB			Ν	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Left	Ri	ght B	ypass	Left	R	light	Bypass
Critical Headway, s	4.5436	5 4.5	436			4.3	3276			4.3	276			4.	9763	4.9763
Follow-Up Headway, s	2.5352	2 2.5	352			2.	5352			2.5	352			2.	6087	2.6087
Flow Computations,	Capaci	ity an	d v/	c Ratio	s											
Approach		E	B			١	WB			Ν	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Left	Ri	ght B	ypass	Left	R	light	Bypass
Entry Flow (v <sub>e</sub> ), pc/h	657	5	83			3	324			2	99				160	259
Entry Volume, veh/h	632	5	60			ź	295			2	96				152	247
Circulating Flow (v <sub>c</sub> ), pc/h		1	99			1	033			12	98			:	374	
Exiting Flow (v <sub>ex</sub> ), pc/h		5	64			3	335			9	83				141	
Capacity (c <sub>adj,pce</sub> ), pc/h	1187	11	87			<u></u>	591			4	72				944	981
Capacity (c), veh/h	1142	11	42				537			4	67			1	899	934
v/c Ratio (x)	0.55	0.	49			C	).55			0.	63			(	).17	0.26
Delay and Level of Se	ervice															
Approach				EB				WB			NB				SB	
Lane			Left	Righ	t Bypa	ss L	.eft	Right	Bypass	Left	Right	Bypas	s L	eft	Right	Bypass
Lane Control Delay (d), s/veh			9.8	8.6				17.5			23.9				5.7	6.6
Lane LOS			А	А				С			С				А	А
95% Queue, veh			3.7	2.9				3.5			4.9				0.6	1.1
Approach Delay, s/veh   LOS			9	.3	А		17.5		С	23.	9	С		6.2		А
Intersection Delay, s/veh   LO	S					11.8							В			

HCS T Roundabouts Version 2023 Hwy1416-EllsworthRd\_Alt3\_AMPeak2030.xro

				HC	S Roi	unda	abou	its Rej	port							
<b>General Information</b>							Site	e Infor	matio	n						
Analyst	Emma	Myers-	Verhag	je		1.			Inter	section			Hwy 1	416 an	d S Ells	worth Rd
Agency or Co.					1./	V	+ )		E/W	Street Na	ime		Highw	vay 141	6	
Date Performed	8/4/2	023			17				N/S	Street Na	me		S Ellsv	vorth R	d	
Analysis Year	2050				5(+)			) † †≽	Anal	ysis Time	Period, h	rs	1.00			
Time Analyzed	AM Pe	eak			÷			1	Peak	Hour Fac	ctor		0.84			
Project Description	Altern	ative 3					 		Juris	diction			Box El	der, SD	)	
Volume Adjustments	and S	ite Cł	narac	teristi	cs	-										
Approach		E	B			١	WB			Ν	IB				SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment	L	-		LTR				LTR			LTF	٢				LT
Volume (V), veh/h	0	748	356	19	0	30	182	47	0	102	107	60	0	63	69	248
Percent Heavy Vehicles, %	4	4	4	4	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	926	441	24	0	39	238	62	0	123	129	72	0	79	86	310
Right-Turn Bypass		No	one			N	lone			No	one			Yie	lding	
Conflicting Lanes			1				2				2				1	
Pedestrians Crossing, p/h			0				0				0				0	
Proportion of CAVs									1							
Critical and Follow-U	p Hea	dway	Adju	ustmer	nt											
Approach		E	B			١	WB			Ν	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Left	Ri	ght B	pass	Left	R	ight	Bypass
Critical Headway, s	4.5436	5 4.5	436			4.3	3276			4.3	276			4.9	9763	4.9763
Follow-Up Headway, s	2.5352	2 2.5	352			2.	5352			2.5	352			2.6	6087	2.6087
Flow Computations,	Capaci	ity an	d v/o	: Ratio	s											
Approach		E	B			١	WB			Ν	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Left	Ri	ght B	pass	Left	R	ight	Bypass
Entry Flow (v <sub>e</sub> ), pc/h	737	6	54			3	339			3	24			1	65	310
Entry Volume, veh/h	709	6	29			3	308			3	21			1	57	295
Circulating Flow (v <sub>c</sub> ), pc/h		2	04			1	178			14	46			2	100	
Exiting Flow (v <sub>ex</sub> ), pc/h		5	92			3	361			11	17			1	49	
Capacity (c <sub>adj,pce</sub> ), pc/h	1182	11	82			Ę	523			4	16			9	920	955
Capacity (c), veh/h	1137	11	37			4	475			4	12			8	376	909
v/c Ratio (x)	0.62	0.	55			C	).65			0.	78			C	.18	0.32
Delay and Level of Se	ervice															
Approach				EB				WB			NB				SB	
Lane			Left	Right	t Bypa	ss L	.eft	Right	Bypass	Left	Right	Bypass	s Le	eft	Right	Bypass
Lane Control Delay (d), s/veh			11.5	9.8				24.5			41.3				5.9	7.5
Lane LOS			В	А				С			E				А	А
95% Queue, veh			4.9	3.7				5.2			8.8				0.7	1.4
Approach Delay, s/veh   LOS			10	).7	В		24.5		C	41.	3	E		6.9		А
Intersection Delay, s/veh   LO	S					15.8							С			

				HC	S Rou	unda	abou <sup>-</sup>	ts Rep	oort							
General Information		_	_			_	_	Infor		n			_	_	_	
Analyst	Emma	a Myers-	Verhag	je					Inters	ection			Hwy 1	416 an	id S Ells	worth Rd
Agency or Co.						V	+		E/W S	Street Na	ime		Highw	ay 141	6	
Date Performed	8/4/2	023			17			+	N/S S	itreet Na	me		S Ellsw	orth R	d	
Analysis Year	2030				K, ⊢		ŧ)	† † <b>≽</b>	Analy	sis Time	Period, h	rs	1.00			
Time Analyzed	PM Pe	eak			Į.			L	Peak	Hour Fac	ctor		0.90			
Project Description	Alterr	ative 3					→ → √		Jurisc	liction			Box Ele	der, SD	)	
Volume Adjustments	and S	ite Cł	narac	teristic	s											
Approach		E	B			Ŋ	WB			N	IB				SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment		_		LTR				LTR			LTI	२				LT
Volume (V), veh/h	0	306	150	152	0	29	135	21	0	38	49	22	0	22	71	273
Percent Heavy Vehicles, %	4	4	4	4	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	354	173	176	0	35	165	26	0	43	55	25	0	26	83	318
Right-Turn Bypass		No	one			N	lone			No	one			Yie	lding	
Conflicting Lanes			1				2				2				1	
Pedestrians Crossing, p/h			0				0			(	0				0	
Proportion of CAVs									1							
Critical and Follow-U	p Hea	dway	Adju	ustmen	nt											
Approach		E	B			Ņ	WB			N	IB				SB	
Lane	Left	Rig	ght	Bypass	Left	R	ight	Bypass	Left	Rig	ght B	ypass	Left	R	ight	Bypass
Critical Headway, s	4.5436	6 4.5	436			4.	3276			4.3	276			4.	9763	4.9763
Follow-Up Headway, s	2.5352	2 2.5	352			2.	5352			2.5	352			2.	6087	2.6087
Flow Computations,	Capaci	ity an	d v/o	: Ratio	s											
Approach		E	B			Ņ	WB			N	IB				SB	
Lane	Left	Rig	ght	Bypass	Left	R	ight	Bypass	Left	Rig	ght B	ypass	Left	R	ight	Bypass
Entry Flow (ve), pc/h	373	3	30			Ĩ	226			12	23				109	318
Entry Volume, veh/h	358	3	18			Ĩ	205			12	22				104	303
Circulating Flow (vc), pc/h		1	44			2	452			5	53			ĩ	243	
Exiting Flow (v <sub>ex</sub> ), pc/h		2	24			ź	208			43	35			ź	294	
Capacity (dadj,pce), pc/h	1248	12	48			9	968			88	89			1	079	1116
Capacity (c), veh/h	1200	12	200			8	380			88	80			1	028	1063
v/c Ratio (x)	0.30	0.	26			0	).23			0.	14			(	).10	0.28
Delay and Level of Se	ervice															
Approach				EB				WB			NB				SB	
Lane			Left	Right	Bypas	ss l	_eft	Right	Bypass	Left	Right	Bypas	s Le	ft	Right	Bypass
Lane Control Delay (d), s/veh			5.8	5.4				6.5			5.4				4.4	6.2
Lane LOS			А	А				А			А				А	А
Lane LOS																
95% Queue, veh			1.3	1.1				0.9			0.5				0.3	1.2
			1.3 5.		A		6.5	0.9	A	5.4	<u> </u>	A	$\vdash$	5.7	0.3	1.2 A

				HC	S Roi	unda	ibou	ts Re	port							
General Information			_			_	Site	Infor	matio	n			_	_		
Analyst	Emma	a Myers-	Verhag	e		I			Inter	section			Hwy	1416 a	nd S Ells	worth Rd
Agency or Co.						r	+		E/W	Street Na	ame		High	way 14	16	
Date Performed	8/4/2	023			17				N/S S	Street Na	me		S Ellsv	worth I	۶d	
Analysis Year	2050				K, ⊥		ŧ)	)††≽	Analy	/sis Time	Period, h	rs	1.00			
Time Analyzed	PM Pe	eak						L	Peak	Hour Fac	ctor		0.90			
Project Description	Alterr	native 3							Juriso	diction			Box E	lder, Sl	C	
Volume Adjustments	and S	ite Cł	narac	teristi	cs											
Approach		E	B			١	VB			Ν	IB				SB	
Movement	U	L	Т	R	U	L	Т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment		L		LTR				LTR			LTI	२				LT
Volume (V), veh/h	0	352	165	178	0	32	150	22	0	43	53	23	0	23	81	327
Percent Heavy Vehicles, %	4	4	4	4	10	10	10	10	1	1	1	1	5	5	5	5
Flow Rate (VPCE), pc/h	0	407	191	206	0	39	183	27	0	48	59	26	0	27	94	382
Right-Turn Bypass		No	one			N	one			No	one			Yi	elding	
Conflicting Lanes			1				2				2				1	
Pedestrians Crossing, p/h			0				0				0				0	
Proportion of CAVs									1							
Critical and Follow-U	lp Hea	dway	Adju	ıstmen	nt											
Approach		E	B			١	VB			Ν	1B				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Left	Ri	ght B	ypass	Left	F	Right	Bypass
Critical Headway, s	4.5436	5 4.5	436			4.3	3276			4.3	276			4	.9763	4.9763
Follow-Up Headway, s	2.5352	2 2.5	352			2.	5352			2.5	352			2	.6087	2.6087
Flow Computations,	Capac	ity an	d v/o	: Ratio	S											
Approach		E	B			١	VB			Ν	1B				SB	
Lane	Left	Ri	ght	Bypass	Left	R	ight	Bypass	Left	Ri	ght B	ypass	Left	F	Right	Bypass
Entry Flow (ve), pc/h	426	3	78			2	49			1	33				121	382
Entry Volume, veh/h	410	3	63			ź	26			1	32				115	364
Circulating Flow (vc), pc/h		1	60				514			6	25				270	
Exiting Flow (vex), pc/h		2	44			ź	.31			4	93				339	
Capacity (cadj,pce), pc/h	1230	12	30			9	19			8	36				1050	1090
Capacity (c), veh/h	1183	11	83			8	35			8	28	Í			1000	1038
v/c Ratio (x)	0.35	0.	31			C	.27			0.	16				0.12	0.35
Delay and Level of Se	ervice															
Approach				EB				WB			NB				SB	
Lane			Left	Right	t Bypa	ss L	.eft	Right	Bypass	Left	Right	Bypas	s L	eft	Right	Bypass
Lane Control Delay (d), s/veh			6.4	5.9				7.3			6.0				4.6	7.1
Lane LOS			А	A				А			А				А	A
95% Queue, veh			1.6	1.3				1.1			0.6				0.4	1.6
Approach Delay, s/veh   LOS			6.	2	A		7.3		А	6.0	)	A		6.5		A
Intersection Delay, s/veh   LO	S		Reserv			6.4							А			

	пса	s sigi	Idlize		ersect		esui	ເຣັວເ	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	la y					
General Information							_	Inters	ectio	n Info	ormatio	on		14144	<b>4</b> 56
Agency								Durati			1.000				
	Emma Myers-Verha	ane	Analys	sis Dat	e 8/16/2	023		Area T			Other				
	Box Elder, SD	age	Time F		AM Pe			PHF	урс		1.00	1			↓
	Alternative 4.1 - no	EBI			r 2030	Jan		Analys	cie De	ariod	1> 7:	00			
	Hwy 1416 Displace		File Na			416-Ells	1								
	Radar Hill 1416 Co			ame	TIVYYI	+10-Ells	worth		.4.1 <u>/</u>	HINFE	arzusi	J.XUS	-		5765 BR
			luuy										10		
Demand Information				EB			W	3			NB			SE	3
Approach Movement			L	Т	R	L	Т	F	R	L	Т	R	L	Т	R
Demand ( <i>v</i> ), veh/h			650	343			23	7							
			li.												
Signal Information			_	2		_									
Cycle, s 30.5	Reference Phase	2		⊨≍	$\rightarrow$							1	$\rightarrow$ 2		3 4
Offset, s 0	Reference Point	End	Green	14.2	7.4	0.0	0.0	0.	.0	0.0					
Uncoordinated Yes	Simult. Gap E/W	On	Yellow	3.5	3.5	0.0	0.0	0.	.0	0.0					
Force Mode Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.	.0	0.0		5	6		7 8
<b>T D H</b>					FRT	10.000		14/5-				NET			0.57
Timer Results			EBI	-	EBT	WB		WBT		NBL		NBT	SB	<b></b>	SBT
Assigned Phase			5		2			6	_		_		<u> </u>	$\rightarrow$	
Case Number			2.0		4.0			8.3	_					$\rightarrow$	
Phase Duration, s			18.7		30.5		-+	11.9	_		_		<u> </u>	$\rightarrow$	
Change Period, (Y+R a			4.5		4.5			4.5	_					$\rightarrow$	
Max Allow Headway ( M	·		2.9		2.8		$\rightarrow$	2.8	_		_		<u> </u>	$\rightarrow$	
Queue Clearance Time	, = ,		13.0		2.5			5.9					<u> </u>	$\rightarrow$	
Green Extension Time	(ge), s		1.2		1.6			1.4	_				<u> </u>	$\rightarrow$	
Phase Call Probability			1.00		1.00			1.00						$\rightarrow$	
Max Out Probability			0.00	)	0.00			0.00							_
Movement Group Res	ults			EB			WB		Т		NB			SE	}
Approach Movement			L	Т	R	L	Т	R		L	Т	R	L	Т	R
Assigned Movement			5	2			6								
Adjusted Flow Rate (v	), veh/h		650	343			444								1
Adjusted Saturation Flo		In	1615	1614			1536	;							
Queue Service Time ( g			11.0	0.5			3.9								1
Cycle Queue Clearance	,		11.0	0.5			3.9								
Green Ratio ( g/C )			0.46	0.85			0.24								1
Capacity ( <i>c</i> ), veh/h			750	2753			740								
Volume-to-Capacity Ra	tio(X)		0.866	0.125			0.600	_							
Back of Queue (Q), ft		e)	38.8	0.1			32.3								
Back of Queue ( Q ), ve		,	1.5	0.0			1.2								
Queue Storage Ratio (	· ·	,	0.00	0.00			0.00								
Uniform Delay ( <i>d</i> 1 ), s/	,, ,		7.3	0.4			10.3								
Incremental Delay ( d 2			1.2	0.0			0.3								
Initial Queue Delay ( d :			0.0	0.0			0.0								
Control Delay ( d ), s/ve	•		8.6	0.4			10.6								
Level of Service (LOS)			Α	Α			В								
Approach Delay, s/veh	/ LOS		5.7		A	10.6	6	В		0.0			0.0		
Intersection Delay, s/ve					7	.2					-		A		
Multimodal Results				EB			WB				NB			SE	}
Pedestrian LOS Score			0.60	)	А	1.37	7	А		2.10		В	2.2	7	В
Bicycle LOS Score / LO		1.31		А	0.68	2	Α								

	HUS	s sigr	alize	a inte	ersect		esur	ts Sur	nmary	/				_
General Information							_	Intorood	tion Inf	ormoti				
										1.000		- 1		
Agency	Muana Manha		Analyz	in Dat	0/40/0	0000		Duration		_				
	Myers-Verha	age			e 8/16/2			Area Ty	be	Other	[			↓
Jurisdiction Box Eld		501	Time F		AM Pe	еак		PHF	<b>D</b> : 1	1.00				
	tive 4.1 - no				r 2050			Analysis		1> 7:				
	16 Displace		File Na	ame	Hwy1	416-Ells	worth	Rd_Alt4.	1_AMPe	eak2050	J.xus	_	SPOT STATISTICS	
Project Description Radar H	Hill 1416 Co	rridor St	ludy											1991 3 10
Demand Information				EB			W	3		NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), veh/h			748	367			25	8						
									_					
Signal Information		1		2		_								
	nce Phase	2		⊨≍	⊢						1		3	4
· · · · · · · · · · · · · · · · · · ·	nce Point	End	Green	18.4	8.2	0.0	0.0	0.0	0.0					
	Gap E/W	On	Yellow	3.5	3.5	0.0	0.0	0.0	0.0					
Force Mode Fixed Simult.	Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
Time Dec. If					EDT				A 100 1		NET	0.51		0.0.7
Timer Results			EBI		EBT	WB	L	WBT	NBI		NBT	SBI		SBT
Assigned Phase			5		2		_	6	-					
Case Number			2.0		4.0		+	8.3		_			_	
Phase Duration, s			22.9		35.6	<u> </u>	$\rightarrow$	12.7	<u> </u>			<u> </u>	$\rightarrow$	
Change Period, $(Y+R_c)$ , s			4.5		4.5	<u> </u>	_	4.5		_				
Max Allow Headway ( <i>MAH</i> ), s			2.9		2.8		+	2.8	<u> </u>	+		<u> </u>	$\rightarrow$	
Queue Clearance Time ( $g_s$ ), s			16.9		2.6		$\rightarrow$	6.7		_			_	
Green Extension Time ( $g_e$ ), s			1.5		1.7	<u> </u>	_	1.5	<u> </u>			<u> </u>	$\rightarrow$	
Phase Call Probability			1.00		1.00	<u> </u>		1.00	<u> </u>			<u> </u>		
Max Out Probability			0.00	)	0.00			0.01						
Movement Group Results				EB			WB			NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement			5	2			6							
Adjusted Flow Rate (v), veh/h			748	367			453	<u> </u>						1
Adjusted Saturation Flow Rate		n	1615	1614			1536							1
Queue Service Time ( $g_s$ ), s			14.9	0.6			4.7	1						1
Cycle Queue Clearance Time (	g c ), s		14.9	0.6			4.7							
Green Ratio ( $g/C$ )	- //		0.52	0.87			0.23							
Capacity ( c ), veh/h			834	2821			710							
Volume-to-Capacity Ratio $(X)$			0.897	0.130			0.638							
Back of Queue (Q), ft/In (95 t	th percentile	e)	68	0.1			48.4							
Back of Queue (Q), veh/ln (95	-	,	2.6	0.0			1.8							1
Queue Storage Ratio (RQ) (9	-	,	0.00	0.00			0.00							
Uniform Delay ( <i>d</i> 1), s/veh		,	7.8	0.3			12.4	_						1
Incremental Delay ( d 2 ), s/veh			1.5	0.0			0.3							
Initial Queue Delay ( d 3 ), s/vel			0.0	0.0			0.0	-						
Control Delay ( <i>d</i> ), s/veh			9.3	0.3			12.7							
			A	A			B							
· · · ·			6.3		A	12.7	L	B	0.0			0.0		
Level of Service (LOS)			1		••			-	0.0					
Level of Service (LOS) Approach Delay, s/veh / LOS			0.0		8	2						Α		
Level of Service (LOS)			0.0		8	.2						A		
Level of Service (LOS) Approach Delay, s/veh / LOS			0.0	EB	8	.2	WB			NB		A	SB	
Level of Service (LOS) Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS			0.60	-	8 	1.38	1	A	2.1(	1	В	A 2.27		В

		HUS	s Sigr	alize		erseci		esui	ts S	sum	mary				_		
O	4!							1	1							eterne	_
General Informa	ition										on Info			- i		April (1997) (2018)	
Agency					·	0.4.0.4				tion, I		1.000					影
Analyst		Emma Myers-Verha	age			e 8/16/2				Туре		Othe	r				
Jurisdiction		Box Elder, SD	==:	Time F		PM P	eak		PHF			1.00				+	- 197 E
Urban Street		Alternative 4.1 - no				r 2030				•	Period	1> 16					
Intersection		Hwy 1416 Displace		File Na	ame	Hwy1	416-Ells	sworth	Rd_A	\lt4.1_	_PMPe	ak2030	).xus				
Project Description	on	Radar Hill 1416 Co	rridor St	udy										3	111111	20,22,32	
Demand Informa	ation				EB			W	B			NB			SE	3	
Approach Moverr	nent			L	Т	R	L	Т		R	L	Т	R	L	Т	R	2
Demand ( v ), vel	h/h			306	236			11	4								
Signal Information	10			-	1		_										
	18.5	Reference Phase	2	-	₽.	$\rightarrow$							1			3	4
Offset, s	0	Reference Point	End	Green	4.5	5.1	0.0	0.0	, ,	0.0	0.0						
	Yes	Simult. Gap E/W	On	Yellow	3.5	3.5	0.0	0.0	) (	0.0	0.0						
Force Mode F	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0		0.0	0.0		5	6		7	8
Timer Descrite				- CDI		CDT				T I	ND		NDT			0.07	
Timer Results				EBL		EBT	WB		WB		NBL		NBT	SBI		SBT	
Assigned Phase				5	$\rightarrow$	2	<u> </u>	-	6	_		$\rightarrow$			$\rightarrow$		_
Case Number	_			2.0		4.0	<u> </u>		8.3	_				<u> </u>	-		
Phase Duration, s		<b>`</b>		9.0		18.5	<u> </u>		9.6					<u> </u>	$\rightarrow$		_
Change Period, (		,		4.5		4.5		-	4.5	_					$\rightarrow$		
Max Allow Headw Queue Clearance		,		2.9 5.3		2.8 2.4		-	2.8 3.9	-				<u> </u>	$\rightarrow$		_
Green Extension		· = /		0.3		1.2		-	3.9 1.1	_				<u> </u>	-+-		_
Phase Call Proba		( <i>g</i> e), s		0.3		1.00	<u> </u>	-	1.00					<u> </u>	$\rightarrow$		_
Max Out Probabil				0.02		0.00			0.00	_					-+-		_
	шу			0.02	-	0.00			0.00	0							
Movement Grou	p Res	ults			EB			WB	;			NB			SE	3	
Approach Movem	nent			L	Т	R	L	Т	F	R	L	Т	R	L	Т	R	ł
Assigned Movem	nent			5	2			6									
Adjusted Flow Ra	ate ( v	), veh/h		306	236			387									
Adjusted Saturati	ion Flo	w Rate ( <i>s</i> ), veh/h/l	n	1615	1614			1536	3								
Queue Service Ti	ime ( g	1 s ), S		3.3	0.4			1.9									
Cycle Queue Cle	arance	e Time ( <i>g c</i> ), s		3.3	0.4			1.9									
Green Ratio ( g/C	C)			0.24	0.76			0.27	'								
Capacity ( c ), vel	h/h			389	2445			842									
Volume-to-Capac	city Ra	tio ( <i>X</i> )		0.786	0.097			0.46	0								
Back of Queue (	Q ), ft	/In ( 95 th percentile	)	6.8	0.1			0.8									
Back of Queue (	Q ), ve	h/In ( 95 th percenti	le)	0.3	0.0			0.0									
Queue Storage R	Ratio (	RQ)(95 th percent	tile)	0.00	0.00			0.00									
Uniform Delay ( a	d 1 ), s/	veh		6.6	0.6			5.6									
Incremental Delay	y ( d 2	), s/veh		1.4	0.0			0.1									
Initial Queue Dela	ay ( <i>d</i> :	), s/veh		0.0	0.0			0.0									
Control Delay ( d	), s/ve	h		8.0	0.6			5.7									
Level of Service (	(LOS)			Α	Α			A									
Approach Delay,	s/veh	LOS		4.8		А	5.7		Α		0.0			0.0			
Intersection Delay	y, s/ve	h/LOS				5	5.2							A			
Multimodal Resu					EB			WB				NB			SE		
Pedestrian LOS				0.60		A	1.34		A		2.08		В	2.25	,	В	_
Bicycle LOS Scor	re / LO	5		0.93	5	А	0.5	5	Α								

General Inform	nation								Intersec	tion Inf	ormatio	on	2	P P P T	
Agency									Duration,		1.000				
Analyst		Emma Myers-Verha	ade	Analys	sis Date	e 8/16/2	023		Area Typ		Other				
Jurisdiction		Box Elder, SD	.90	Time F		PM Pe			PHF	•	1.00	·		~#E	+
Urban Street		Alternative 4.1 - no	FBI			· 2050	Jui		Analysis	Period	1> 16	8.45	¥→		
Intersection		Hwy 1416 Displace		File Na			416-Ells		Rd Alt4.1						
Project Descrip	tion	Radar Hill 1416 Co				1100 y 1-		worun	<u>(d_/ (i(+.</u> )			5.745	-		167 (G
T TOJECT Descrip				luuy											
Demand Inform	nation				EB			WE	3		NB			SB	
Approach Move	ement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), v	eh/h			352	277			134	4						
Signal Informa		(	1		2	€	_								
Cycle, s	20.7	Reference Phase	2		F	$\rightarrow$						1	→ <sub>2</sub>	3	4
Offset, s	0	Reference Point	End	Green	5.8	5.9	0.0	0.0	0.0	0.0					
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		3.5	0.0	0.0	0.0	0.0		►			
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.0	0.0	_	5	6	7	8
						FRT			MOT			NET	0.7	ļ	0.57
Timer Results				EBL	-	EBT	WBI	-	WBT	NBI	-	NBT	SBL	-	SBT
Assigned Phas	e			5		2			6						
Case Number				2.0		4.0			8.3						
Phase Duration	•			10.3		20.7		-+	10.4					$\rightarrow$	
Change Period		,		4.5		4.5			4.5						
Max Allow Hea	<b>2</b> 1	,		2.9		2.8			2.8					_	
Queue Clearan		1 = 1		6.2		2.4			4.6						
Green Extensio		(ge), s		0.5		1.5			1.4				<u> </u>	_	
Phase Call Pro	-			0.87		1.00			0.99						
Max Out Proba	bility			0.00	·	0.00			0.00						
Movement Gro	oup Res	ults			EB			WB			NB			SB	
Approach Move	-			L	T	R	L	T	R	L	T	R		T	R
Assigned Move				5	2			6							-
Adjusted Flow		) yeh/h		352	277			461	-			<u> </u>			1
-		), ven/n													
	ation Flo	•	n		1614	1 1		1536				1			
-		w Rate ( <i>s</i> ), veh/h/l	n	1615	1614 04			1536 2.6							-
Queue Service	Time ( g	ow Rate(s), veh/h/l g s ), s	n	1615 4.2	0.4			2.6							
Queue Service Cycle Queue C	Time(g learance	ow Rate(s), veh/h/l g s ), s	'n	1615 4.2 4.2	0.4 0.4			2.6 2.6							
Queue Service Cycle Queue C Green Ratio ( g	Time(g learance I/C)	ow Rate(s), veh/h/l g s ), s	n	1615 4.2 4.2 0.28	0.4 0.4 0.78			2.6 2.6 0.29							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v	Time(g learance I/C) veh/h	w Rate(s), veh/h/l g s ), s e Time(g c ), s	İn	1615 4.2 4.2 0.28 451	0.4 0.4 0.78 2525			2.6 2.6 0.29 876							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap	Time(g learance i/C) veh/h acity Ra	w Rate ( <i>s</i> ), veh/h/l g <sub>s</sub> ), s e Time ( g <sub>c</sub> ), s tio ( <i>X</i> )		1615 4.2 4.2 0.28 451 0.780	0.4 0.4 0.78 2525 0.110			2.6 2.6 0.29 876 0.526							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue	Time ( <u>c</u> learance //C ) /eh/h acity Ra ( Q ), ft	w Rate ( <i>s</i> ), veh/h/l g s ), s e Time ( g c ), s tio ( <i>X</i> ) /In (] 95 th percentile	:)	1615 4.2 4.2 0.28 451 0.780 8.9	0.4 0.4 2525 0.110 0.1			2.6 2.6 0.29 876 0.526 1.9							
Queue Service Cycle Queue C Green Ratio (g Capacity (c), v Volume-to-Cap Back of Queue Back of Queue	Time ( <u>c</u> learance //C ) /eh/h acity Ra ( Q ), ft ( Q ), ve	w Rate ( <i>s</i> ), veh/h/l g <sub>s</sub> ), s e Time ( <i>g</i> <sub>c</sub> ), s tio ( <i>X</i> ) /In (] 95 th percentile eh/ln ( 95 th percentile	e) ile)	1615 4.2 4.2 0.28 451 0.780 8.9 0.3	0.4 0.78 2525 0.110 0.1 0.0			2.6 2.6 0.29 876 0.526 1.9 0.1							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage	Time ( <u>c</u> learance //C ) /eh/h acity Ra ( Q ), ft ( Q ), ve Ratio (	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) <u>/In (</u> 95 th percentile eh/ln (95 th percenti RQ) (95 th percent	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.3	0.4 0.78 2525 0.110 0.1 0.0 0.00			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00							
Queue Service Cycle Queue C Green Ratio (g Capacity (c), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay	Time ( <u>g</u> learance //C ) /eh/h acity Ra ( Q ), ft ( Q ), ve Ratio ( ( d 1 ), s/	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) <u>/In (95 th percentile</u> eh/ln (95 th percenti RQ) (95 th percent	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De	Time ( <u>c</u> learance //C ) /eh/h acity Ra ( Q ), ft ( Q ), ve Ratio ( ( d 1 ), s/ lay ( d 2	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /In (95 th percentile eh/ln (95 th percenti RQ) (95 th percent /veh ), s/veh	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9 1.1	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.2							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D	Time ( <u>c</u> learance //C ) /eh/h acity Ra ( Q ), ft ( Q ), ve Ratio ( ( d 1 ), s/ lay ( d 2 elay ( d	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /In (95 th percentile eh/ln (95 th percenti RQ) (95 th percent /veh ), s/veh 3), s/veh	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9 1.1 0.0	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0 0.0			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.2 0.2							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D Control Delay (	Time ( <u>c</u> learance //C ) /eh/h acity Ra ( Q ), ft ( Q ), ve Ratio ( ( d 1 ), s/ lay ( d 2 elay ( d 2 d ), s/ve	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /In (95 th percentile eh/ln (95 th percenti RQ) (95 th percent /veh ), s/veh 3), s/veh	e) ile)	1615           4.2           0.28           451           0.780           8.9           0.3           0.00           6.9           1.1           0.0           8.9	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0 0.0 0.0			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.2 0.0 6.4							
Queue Service Cycle Queue C Green Ratio (g Capacity (c), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D Control Delay ( Level of Service	Time ( $\underline{c}$ learance $\sqrt{C}$ ) veh/h acity Ra ( $Q$ ), ve Ratio ( ( $d_1$ ), sy lay ( $d_2$ elay ( $d_2$ elay ( $d_3$ ), s/ve $\underline{c}$ (LOS)	bw Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /In (95 th percentile eh/ln (95 th percenti RQ) (95 th percent /veh ), s/veh 3), s/veh eh	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9 1.1 0.0 8.0 8.0 A	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0 0.5 A			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.2 0.2							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D Control Delay ( Level of Service Approach Delay	Time ( $\underline{c}$ learance $\sqrt{C}$ ) $\sqrt{eh/h}$ acity Ra (Q), ft ( $Q$ ), ve Ratio ( $(d_1), s_{\ell}$ lay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ ) solutions ( $d_2$ ) elay ( $d_2$ )	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /in (95 th percentile eh/ln (95 th percenti RQ) (95 th percenti /veh ), s/veh $_3$ ), s/veh eh	e) ile)	1615           4.2           0.28           451           0.780           8.9           0.3           0.00           6.9           1.1           0.0           8.9	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0 0.5 A	A	6.4	2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.2 0.0 6.4							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D Control Delay ( Level of Service	Time ( $\underline{c}$ learance $\sqrt{C}$ ) $\sqrt{eh/h}$ acity Ra (Q), ft ( $Q$ ), ve Ratio ( $(d_1), s_{\ell}$ lay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ ) solutions ( $d_2$ ) elay ( $d_2$ )	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /in (95 th percentile eh/ln (95 th percenti RQ) (95 th percenti /veh ), s/veh $_3$ ), s/veh eh	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9 1.1 0.0 8.0 8.0 A	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0 0.5 A		6.4	2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.2 0.0 6.4					0.0		
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D Control Delay ( Level of Service Approach Delay	Time ( $\underline{c}$ learance $\sqrt{C}$ ) reh/h acity Ra ( $Q$ ), ref ( $Q$ ), ve Ratio ( ( $d_1$ ), s/ lay ( $d_2$ elay ( $d_3$ ), s/ve e (LOS) y, s/veh lay, s/veh	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /in (95 th percentile eh/ln (95 th percenti RQ) (95 th percenti /veh ), s/veh $_3$ ), s/veh eh	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9 1.1 0.0 8.0 8.0 A	0.4 0.78 2525 0.110 0.1 0.0 0.00 0.5 0.0 0.5 A			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.0 6.4 A							
Queue Service Cycle Queue C Green Ratio ( g Capacity ( c ), v Volume-to-Cap Back of Queue Back of Queue Queue Storage Uniform Delay Incremental De Initial Queue D Control Delay ( Level of Service Approach Delay	Time ( $\underline{c}$ learance $\sqrt{C}$ ) reh/h acity Ra ( $Q$ ), ref ( $Q$ ), ve Ratio ( ( $d_1$ ), s/ lay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_2$ elay ( $d_3$ , s/ve e (LOS) y, s/veh lay, s/ve	w Rate ( $s$ ), veh/h/l $g_s$ ), s e Time ( $g_c$ ), s tio ( $X$ ) /In (95 th percentile eh/ln (95 th percenti RQ) (95 th percenti /veh ), s/veh 3), s/veh eh / LOS th / LOS	e) ile)	1615 4.2 0.28 451 0.780 8.9 0.3 0.00 6.9 1.1 0.0 8.0 8.0 A	0.4 0.78 2525 0.110 0.1 0.0 0.5 0.0 0.5 A 0.5 A EB			2.6 2.6 0.29 876 0.526 1.9 0.1 0.00 6.2 0.0 6.4 A WB			NB	B		SB	B

HCS Sig	nalize	ainte	ersect	ION R	esun	s Sun	imary	,				
General Information						ntersect	tion Inf	ormatic	20			
								1.000			4 4	
Agency	Analys	in Dete	0/4 0/5	000		Duration,						· · · · · · · · · · · · · · · · · · ·
Analyst Emma Myers-Verhage			8/16/2			Area Typ	e	Other	-		"Ĭs	
Jurisdiction Box Elder, SD	Time F		AM Pe	зак		PHF		1.00	20		. i.	
Urban Street Alternative 4.1 - no EBL	-	sis Year				Analysis		1> 7:0				
Intersection Hwy 1416 and S Ellswor		ame	Hwy1	416-Ells	worth	Rd_Alt4.1	_AMPe	eak2030	).xus	_	*	
Project Description Radar Hill 1416 Corridor S	tudy									3		<b>时</b> 间到
Demand Information		EB			WE	}		NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), veh/h		327	16	24	147	7 38	90	100	57	60	66	207
												i in the second
Signal Information		2	_21.5									
Cycle, s 19.5 Reference Phase 2		R °		2					1	$\mathbf{c}$	2	к†ж
Offset, s 0 Reference Point End	Green	5.0	5.5	0.0	0.0	0.0	0.0	_		x		
Uncoordinated Yes Simult. Gap E/W On	Yellow		3.5	0.0	0.0	0.0	0.0			$\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{$		512
Force Mode Fixed Simult. Gap N/S On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
							_					
Timer Results	EBI	-	EBT	WB	L	WBT	NBI		NBT	SBI		SBT
Assigned Phase			2			6			8		$\rightarrow$	4
Case Number			7.0			5.0			8.0			7.0
Phase Duration, s			9.5			9.5			10.0			10.0
Change Period, ( Y+R c ), s			4.5			4.5			4.5			4.5
Max Allow Headway ( MAH ), s			2.9			2.9			3.3		$\rightarrow$	3.3
Queue Clearance Time ( g s ), s			3.6			4.0			4.6			4.4
Green Extension Time ( g e ), s			1.0			1.0			1.1			1.1
Phase Call Probability			1.00			1.00			0.96			0.96
Max Out Probability			0.00			0.00			0.01			0.01
Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement		2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h		327	16	24	147	38		247			126	207
Adjusted Saturation Flow Rate ( s ), veh/h/ln		1614	1437	986	1536	1367		1546			1495	
Queue Service Time ( $g_s$ ), s		1.6	0.2	0.4	0.7	0.4		1.4			0.0	
Cycle Queue Clearance Time ( $g_c$ ), s		1.6	0.2	2.0	0.7	0.4		2.6			1.1	
Green Ratio (g/C)		0.26	0.26	0.26	0.26	0.26		0.28			0.28	
Capacity ( <i>c</i> ), veh/h		833	371	541	793	353		685			691	
Volume-to-Capacity Ratio ( <i>X</i> )		0.392	0.043	0.044	0.185			0.361			0.182	
Back of Queue (Q), ft/In (95 th percentile)	l –	0.8	0.1	0.9	1.1	0.7		5.7			8.3	
Back of Queue (Q), veh/ln (95 th percentile)		0.0	0.0	0.0	0.0	0.0		0.2			0.3	
Queue Storage Ratio ( <i>RQ</i> ) (95 th percentile)		0.00	0.00	0.00	0.00	0.00		0.00			0.00	
Uniform Delay ( $d_1$ ), s/veh		6.0	5.4	6.8	5.6	5.5		6.0			5.5	
Incremental Delay ( $d_2$ ), s/veh		0.1	0.0	0.0	0.0	0.0		0.1			0.0	
Initial Queue Delay ( d 3 ), s/veh		0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay ( <i>d</i> ), s/veh		6.1	5.4	6.8	5.7	5.6		6.1			5.5	0.0
Level of Service (LOS)		A	A	A	A	A		A			A	A
Approach Delay, s/veh / LOS	6.0		A	5.8		A	6.1		A	2.1		A
Intersection Delay, s/veh / LOS				.8						A		
			, International	-						-		
Multimodal Results		EB			WB			NB			SB	
mattinouu nooulto					1				-			-
Pedestrian LOS Score / LOS	1.64	1	В	1.86	5	В	2.38	3	В	2.22	2	В

		пса	s sigi	ialize	a inte	ersect	ION R	esun	s Sum	imary	,				_
Concernel Inform										lan laf			8		94834
General Inform	hation								Intersect		W		- 1		97 73k
Agency						011010			Duration,		1.000		- 3		巍
Analyst		Emma Myers-Verha	age			8/16/2			Area Typ	e	Other				<ul> <li>&lt;</li> <li></li> /ul>
Jurisdiction		Box Elder, SD		Time F		AM P	eak		PHF		1.00			"it	
Urban Street		Alternative 4.1 - no		-		2050			Analysis		1> 7:(		_		
Intersection		Hwy 1416 and S El		File Na	ame	Hwy1	416-Ells	worth	Rd_Alt4.1	_AMPe	eak2050	).xus		*	
Project Descrip	tion	Radar Hill 1416 Co	rridor St	tudy									8	a in the sec	37 N N
Demand Inform	nation				EB			WE	}		NB			SB	
Approach Move	ement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), v					348	19	24	156	_	90	100	57	60	66	207
								1.1.1			1				
Signal Informa	tion				2	215									I
Cycle, s	19.8	Reference Phase	2		l ⇒ ĕ		2						$\rightarrow$	3	<u>дъ</u>
Offset, s	0	Reference Point	End	Green	53	5.5	0.0	0.0	0.0	0.0		1	<b>Y</b> 2	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		3.5	0.0	0.0	0.0	0.0			$\rightarrow$		<b>K†</b> 2
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
			<del>.</del>												
Timer Results				EBI	-	EBT	WB	L	WBT	NB		NBT	SBI	-	SBT
Assigned Phase	e					2			6			8			4
Case Number						7.0			5.0			8.0			7.0
Phase Duration	i, S					9.8			9.8			10.0			10.0
Change Period,	nge Period, (Y+R c), s					4.5			4.5			4.5			4.5
Max Allow Head	Allow Headway ( MAH ), s					2.9			2.9			3.3			3.3
Queue Clearan	ce Time	( <b>g</b> s ), s				3.8			4.2			4.6			4.4
Green Extensio	n Time	(g e ), s				1.1			1.1			1.1			1.1
Phase Call Prol	bability					1.00			1.00			0.96			0.96
Max Out Proba	bility					0.00			0.00			0.01			0.01
Movement Gro	oup Res	ults			EB			WB			NB			SB	
Approach Move	-			L	Т	R	L	Т	R	L	T	R	1	T	R
Assigned Move				_	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow F		) veh/h			348	19	24	156	41		247			126	207
		w Rate ( <i>s</i> ), veh/h/l	n		1614	1437	967	1536			1546			1495	201
Queue Service					1.8	0.2	0.4	0.8	0.4		1.5			0.0	
Cycle Queue C		· /			1.8	0.2	2.2	0.8	0.4		2.6			1.2	
Green Ratio ( g		<b>u</b> inite ( <b>g u</b> ), <b>u</b>			0.27	0.27	0.27	0.27	0.27		0.28			0.28	
Capacity ( c ), v	,				860	383	535	818	364		679			685	
Volume-to-Capa		tio $(X)$			0.405	0.050	0.045	0.191			0.364			0.184	
		/In (95 th percentile	)		0.9	0.000	0.040	1.2	0.113		6			8.6	
	<u>, ,</u>	eh/In ( 95 th percentie			0.0	0.0	0.0	0.0	0.0		0.2			0.3	
	. ,	RQ) ( 95 th percent			0.00	0.00	0.00	0.00	0.00		0.2			0.00	
Uniform Delay (		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			6.0	5.4	6.9	5.6	5.5		6.1			5.6	
Incremental De	· ,				0.0	0.0	0.9	0.0	0.1		0.1			0.0	
Initial Queue De					0.1	0.0	0.0	0.0	0.1	_	0.1			0.0	
Control Delay (		•			6.1	5.4	6.9	5.6	5.5		6.2			5.6	0.0
		211			A	- 3.4 A	A	3.0 A	3.3 A		0.2 A			3.0 A	0.0 A
	evel of Service (LOS)					A	A 5.8		A	6.2		A	2.1	L	A
	pproach Delay, s/veh / LOS						.9		А	0.2					~
Intersection De	tersection Delay, s/veh / LOS					4	.9						A		
Multimodal Re	ltimodal Results				EB			WB			NB			SB	
Pedestrian LOS		/LOS		1.64	1	В	1.86	3	В	2.38		В	2.22		В
Bicycle LOS Sc	ore / LC	)S		0.79	_	А	0.67		А	0.90	)	А	1.04	Ļ 🔰	А
			_												

		HUS	s Sigr	alize	a inte	rsect		esuit	s Sum	imary	,				
O										Van Inf					F48 23
General Inform	hation								ntersect				- 1	J	17 120
Agency		<b>E M N</b> ( )				0.40.0			Duration,		1.000		- 85		
Analyst		Emma Myers-Verha	age			8/16/2			Area Typ	e	Other				
Jurisdiction		Box Elder, SD		Time F		PM Pe	eak		PHF		1.00			411	← 33 ∠ 88
Urban Street		Alternative 4.1 - no			sis Year				Analysis		1> 16				
Intersection		Hwy 1416 and S El		File Na	ame	Hwy1	416-Ells	worthF	Rd_Alt4.1	_PMPe	eak2030	).xus		*	
Project Descrip	tion	Radar Hill 1416 Co	rridor St	udy									3		
Demand Inform	nation				EB			WE	;		NB			SB	
Approach Move				L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( v ), v					84	152	15	76	7	38	39	7	7	62	273
Signal Informa	tion				2	215									$\mathbf{L}$
Cycle, s	19.5	Reference Phase	2		l⇒ ĕ	" ™≊∿	2						ᠸ	1	кtх Г
Offset, s	0	Reference Point	End	Green	5.0	5.5	0.0	0.0	0.0	0.0		1	X Z	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		3.5	0.0	0.0	0.0	0.0			$\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{$		KT2
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
Timer Results				EBI	-	EBT	WB	L	WBT	NBL	-	NBT	SBI		SBT
Assigned Phase	e					2			6			8			4
Case Number						7.0			5.0			8.0			7.0
Phase Duration	•					9.5			9.5			10.0			10.0
Change Period,	, ( Y+R )	c ), S				4.5			4.5			4.5			4.5
Max Allow Head	<b>2</b> 1	·				3.0			3.0			3.4			3.4
Queue Clearan	ueue Clearance Time ( $g_s$ ), s					3.7			2.6			2.7			5.3
Green Extensio	reen Extension Time ( g e ), s					0.6			0.6			0.9			0.8
Phase Call Prol	bability					1.00			1.00			0.90			0.90
Max Out Proba	bility					0.00			0.00			0.00			0.00
Movement Gro	oup Res	ults			EB			WB			NB			SB	
Approach Move	-		_	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Move					2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow F		), veh/h			84	152	15	76	7	_	84			69	273
		w Rate ( <i>s</i> ), veh/h/l	n		1614	1437	1231	1536	1367		1586			1662	
Queue Service					0.4	1.7	0.2	0.4	0.1		0.0			0.0	
Cycle Queue C		· ·			0.4	1.7	0.6	0.4	0.1		0.7			0.6	
Green Ratio ( g					0.26	0.26	0.26	0.26	0.26		0.28			0.28	
Capacity ( c ), v					826	368	659	786	350		717			674	
Volume-to-Capa		tio (X)			0.102	0.413	0.023	0.097			0.117			0.102	
		/In (95 th percentile	.)		0.102	1.5	0.3	0.6	0.020		1.5			4.3	
	<u>, ,</u>	eh/In ( 95 th percenti	·		0.0	0.1	0.0	0.0	0.0		0.1			0.2	
		RQ) ( 95 th percent			0.00	0.00	0.00	0.00	0.00		0.00			0.00	
		,, ,			5.6	6.0	5.8	5.5	5.4		5.3			5.2	
	niform Delay ( <i>d</i> 1 ), s/veh ncremental Delay ( <i>d</i> 2 ), s/veh					0.0	0.0	0.0	0.0		0.0			0.0	
Initial Queue De		•			0.0	0.0	0.0	0.0	0.0		0.0		<u> </u>	0.0	
Control Delay (					5.6	6.3	5.8	5.6	5.4		5.3			5.3	0.0
Level of Service		211			3.0 A	0.3 A	A	3.0 A	A		3.3 A			A	0.0 A
Approach Delay		/1.05		6.1		A	5.6		A	5.3		A	1.1		A
Intersection Delay	-			0.1			5.0 .7		~	5.5					~
	ay, s/ve					3	. 1						A		
Multimodal Re	sults				EB			WB			NB			SB	
Pedestrian LOS		/ LOS		1.64		В	1.87		В	2.37	1	В	2.22	11	В
Bicycle LOS Sc				0.68	_	A	0.57		A	0.63		A	1.05		A
,	•														

HCS SIG	nanze	u mite	13001		esun	is Sull	innary					
General Information						Intersec	tion Inf	ormatic	n		11.4.5 ()	
								1.000			4 4	
Agency	Anabu	ie Dete	0/40/5	000		Duration,						
Analyst Emma Myers-Verhage			e 8/16/2			Area Typ	e	Other			~	
Jurisdiction Box Elder, SD	Time I		PM P	еак		PHF	<b>D</b> : 1	1.00	45			
Urban Street Alternative 4.1 - no EBL		sis Year				Analysis		1> 16				
Intersection Hwy 1416 and S Ellswor.		ame	Hwy1	416-Ells	worth	Rd_Alt4.1	I_PMPe	eak2050	).xus		**	
Project Description Radar Hill 1416 Corridor	Study									3		8 W
Demand Information		EB			WE	3		NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand ( <i>v</i> ), veh/h		99	178	18	91	8	43	43	8	8	72	327
	- 1											
Signal Information		2	_215									
Cycle, s 20.8 Reference Phase 2		₿ <sup>è</sup>	″L ≌∩	2					1	$\mathbf{\nabla}$	3	кt»
Offset, s 0 Reference Point End	Green	50	6.8	0.0	0.0	0.0	0.0	_		x	5	4
Uncoordinated Yes Simult. Gap E/W On	Yellow		3.5	0.0	0.0	0.0	0.0					572
Force Mode Fixed Simult. Gap N/S On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
Timer Results	EB		EBT	WB		WBT	NBI	-	NBT	SBI	-	SBT
Assigned Phase	-		2		$\rightarrow$	6			8		_	4
Case Number	-		7.0			5.0			8.0			7.0
Phase Duration, s	$\vdash$		9.5			9.5	<u> </u>		11.3			11.3
Change Period, ( Y+ <i>R</i> c ), s			4.5			4.5			4.5			4.5
Max Allow Headway ( MAH ), s	-		3.0		$\rightarrow$	3.0			3.4		_	3.4
Queue Clearance Time ( $g s$ ), s	$\vdash$		4.2			2.7			2.8			6.2
Green Extension Time ( g e ), s	$\vdash$		0.7		$\rightarrow$	0.7			1.1			1.0
Phase Call Probability			1.00			1.00			0.94			0.94
Max Out Probability			0.00			0.00			0.00			0.01
Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement		2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate ( v ), veh/h		99	178	18	91	8		94			80	327
Adjusted Saturation Flow Rate (s), veh/h/ln		1614	1437	1214	1536	1367		1570			1664	
Queue Service Time ( $g_s$ ), s		0.5	2.2	0.2	0.5	0.1		0.0			0.0	
Cycle Queue Clearance Time ( $g c$ ), s		0.5	2.2	0.7	0.5	0.1		0.8			0.7	
Green Ratio (g/C)		0.24	0.24	0.24	0.24	0.24		0.33			0.33	
Capacity ( <i>c</i> ), veh/h		778	346	611	740	329		764			733	
Volume-to-Capacity Ratio (X)		0.127	0.514	0.029	0.123			0.123			0.109	
Back of Queue ( Q ), ft/In ( 95 th percentile)	1	1	5.2	0.7	1.4	0.3		1.7			5.1	
Back of Queue ( Q ), veh/ln ( 95 th percentile)		0.0	0.2	0.0	0.1	0.0		0.1			0.2	
Queue Storage Ratio ( <i>RQ</i> ) (95 th percentile)		0.00	0.00	0.00	0.00	0.00		0.00			0.00	
Uniform Delay ( <i>d</i> 1 ), s/veh		6.2	6.8	6.5	6.2	6.0		5.0			5.0	
Incremental Delay ( <i>d</i> <sub>2</sub> ), s/veh		0.0	0.4	0.0	0.0	0.0		0.0			0.0	
Initial Queue Delay ( d ₃ ), s/veh		0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay ( <i>d</i> ), s/veh		6.2	7.3	6.5	6.2	6.0		5.0			5.0	0.0
Level of Service (LOS)		Α	Α	Α	Α	Α		Α			Α	Α
Approach Delay, s/veh / LOS	6.9		А	6.2		А	5.0		A	1.0		A
Intersection Delay, s/veh / LOS				.9						A		
Multimodal Results		EB			WB			NB			SB	
Pedestrian LOS Score / LOS	1.64	1	В	1.87	7	В	2.37	7	В	2.22	2	В
Bicycle LOS Score / LOS	0.72	2	А	0.58	3	А	0.64		А	1.16	;	Α

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HCS™ Streets Version 2023

		пса	o olyi	Ialize	ume	ersect		esu	115 3	um	mary					
General Inform	nation								Inter	sorti	ion Inf	ormatio	n			蘇艦
Agency	lation								Durat			1.000			7 1	
Analyst		Emma Myers-Verha	200	Apolyc	vic Dot	e 8/16/2	0023		Area			Other				
Jurisdiction		Box Elder, SD	aye	Time F		AM P			PHF	туре	<del>,</del>	1.00			~Į1	<u> </u>
Urban Street		Alternative 4.2 - no				· 2030	Jak				Period	1> 7:0	0			
		L						wort	1 -							
Intersection	tion	Hwy 1416 and S El Radar Hill 1416 Co		1	ame	wy i	416-Ells	woru	nku_A	114.Z		akzusu	.xus	_	Ý Kalinijska	CHER.
Project Descrip	tion	Radar Hill 1416 Co	rridor Si	ludy										22	2001210212	10 202
Demand Inform	nation				EB			V	√B			NB			SB	
Approach Move	ement			L	Т	R	L	· ·	T	R	L	Т	R	L	Т	R
Demand ( v ), v	eh/h			650	327	16	24			38	90	100	57	60	66	207
															in a second	i and
Signal Informa	tion				7	-25								_		Y
Cycle, s	49.8	Reference Phase	2		н Н С	- 1 - SA	2							€ .		стя Г
Offset, s	0	Reference Point	End	Green	22.3	18.5	0.0	0.	0 0	0.0	0.0		1	X Z	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		3.5	0.0	0.		0.0 0.0	0.0					512
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.	0 0	0.0	0.0		5	6	7	8
				_												
Timer Results				EBI	-	EBT	WB	L	WB	Г	NBL	-	NBT	SBI		SBT
Assigned Phase	e					2		_	6	_			8			4
Case Number						5.0			5.0	_			8.0			7.0
Phase Duration						26.8			26.8	3			23.0			23.0
Change Period,		,				4.5			4.5				4.5			4.5
Max Allow Head	<b>2</b> 1	,				2.9			2.9				3.3			3.3
Queue Clearan	ueue Clearance Time ( $g_s$ ), s					20.5			5.9				7.7			7.3
Green Extensio	reen Extension Time ( g e ), s					1.8			2.0				1.0			1.0
Phase Call Prol	nase Call Probability					1.00			1.00	)			1.00			1.00
Max Out Proba	bility					0.03			0.00	)			0.02			0.02
Movement Gro	oup Res	aults			EB			W	B			NB			SB	
Approach Move	-			L	Т	R	L	Т		र	L	T	R	L	T	R
Assigned Move				5	2	12	1		1	_	3	8	18	7	4	14
Adjusted Flow F		), veh/h		650	327	16	24		3	_	-	247			126	207
		w Rate ( <i>s</i> ), veh/h/l	n	1615	1614	1437	986		13	_		1542			1444	
Queue Service				18.5	3.1	0.3	0.8		0.	_		2.3			0.0	
Cycle Queue C		- , 		18.5	3.1	0.3	3.9		0.	_		5.7			2.6	
Green Ratio ( g		<b>u</b> inite ( <b>g u</b> ), <b>u</b>		0.45	0.45	0.45	0.45		0.4	_		0.37			0.37	
Capacity ( c ), v				868	1446	644	525		61	_		671			643	
Volume-to-Capa		tio $(X)$		0.749	<u> </u>		0.046		0.0			0.368			0.196	<u> </u>
	-	/In ( 95 th percentile	)	193.8	30.6	2.8	5.7		7.	_		80.7			44.2	
-		eh/In ( 95 th percentie		7.5	1.2	0.1	0.2		0.	_		3.2			1.7	
		RQ) (95 th percent	,	0.00	0.00	0.00	0.2		0.0	_		0.00			0.00	
				12.7	8.4	7.7	9.6	-	7.	_		11.6			10.6	
	niform Delay ( <i>d</i> 1 ), s/veh cremental Delay ( <i>d</i> 2 ), s/veh					0.0	9.0		0.	_		1.6			0.7	
	itial Queue Delay ( $d_3$ ), s/veh					0.0	0.0		0.	_		0.0			0.0	
Control Delay (		•		0.0	0.0 8.5	7.7	9.6		7.	_		13.1			11.3	0.0
Level of Service		<i>.</i>		B	8.5 A	A	9.0 A		/ . 	_		-13.1 B			B	0.0 A
		/1.05		11.9		B	A 8.5		A	•	13.1		В	4.3		A
	Approach Delay, s/veh / LOS ntersection Delay, s/veh / LOS						8.5 ).4		A		13.1					~
mersection De	iay, s/ve					10	.4							В		
Multimodal Re	sults				EB			W	B			NB			SB	
Pedestrian LOS		/ LOS		1.65		В	1.88		В		2.08		В	2.25		В
Bicycle LOS Sc				1.31		A	1.00		F		0.90		A	1.04		A
2.0,00 200 00	5,57 LC	-		1.0							0.00			1.0-		

	noc	Joigi	Tanze	a mite	13000		csu	its Sun	innary	/				
General Information								Intersec	tion Inf	ormatio	on	2		S HE
Agency								Duration		1.000			2 k	
	Emma Myers-Verha	nde	Analys	sis Date	e 8/16/2	2023		Area Typ		Other		,		
-	Box Elder, SD	igo	Time F		AM P			PHF		1.00			~#E	<u> </u>
	Alternative 4.2 - no	WRT			2050	can		Analysis	Period	1> 7:0	00			4
	Hwy 1416 and S Ell					416-Ells	wortl	nRd_Alt4.				- <sup>23</sup>		
	Radar Hill 1416 Cor			ame	TIVYYI	+10-LII3	wort				7.AU3		Na ana amb	
Troject Description			luuy											
Demand Information				EB			V	/B		NB			SB	
Approach Movement			L	Т	R	L	-	T R	L	Т	R	L	Т	R
Demand ( v ), veh/h			748	348	19	27		41	102	107	58	61	69	248
									-					
Signal Information			-	3	126.							_		$\mathbf{k}$
Cycle, s 38.9	Reference Phase	2		R	§∩	2					1	€₂	3	4
Offset, s 0	Reference Point	End	Green	20.4	9.5	0.0	0.	0.0	0.0			<u>×</u>		
Uncoordinated Yes	Simult. Gap E/W	On	Yellow	3.5	3.5	0.0	0.	0.0	0.0					- V
Force Mode Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.	0 0.0	0.0		5	6	7	8
Timer Results			EBI		EBT	WB		WBT	NB		NBT	SBI		SBT
Assigned Phase			EDI	-	2		-+	6			8	301	-	4
Case Number					5.0			5.0			o 8.0			7.0
Phase Duration, s					24.9		-	24.9			0.0 14.0			14.0
Change Period, (Y+R					4.5		$\rightarrow$	4.5			4.5			4.5
Max Allow Headway ( A	•				2.9	<u> </u>	$\rightarrow$	2.9	-		3.3			3.3
	ueue Clearance Time ( $g s$ ), s						$\rightarrow$	4.7			8.1	<u> </u>		8.2
	reen Extension Time ( $g_e$ ), s					<u> </u>	-	2.3	-		1.3	<u> </u>		1.3
Phase Call Probability							$\rightarrow$	1.00			1.00			1.00
Max Out Probability					1.00		-	0.00			0.01			0.01
Max Out Probability					0.00			0.00			0.01			0.01
Movement Group Res	ults			EB			W	В		NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement			5	2	12	1		16	3	8	18	7	4	14
Adjusted Flow Rate (v	), veh/h		748	348	19	27		41		267			130	248
Adjusted Saturation Flo	w Rate ( <i>s</i> ), veh/h/l	n	1615	1614	1437	967		1367		1543			1471	
Queue Service Time ( g	g s ), S		16.0	2.2	0.2	0.6		0.6		3.6			0.0	
Cycle Queue Clearance	e Time ( <i>g c</i> ), s		16.0	2.2	0.2	2.7		0.6		6.1			2.5	
Green Ratio ( g/C )			0.52	0.52	0.52	0.52		0.52		0.24			0.24	
Capacity ( <i>c</i> ), veh/h			1031	1693	753	640		717		505			496	
Volume-to-Capacity Ra			0.725			0.042		0.057		0.528			0.262	
Back of Queue ( Q ), ft			79.2	10.6	1.1	2.7		2.9		69.3			37	
Back of Queue (Q), ve	· ·	,	3.1	0.4	0.0	0.1		0.1		2.7			1.4	
Queue Storage Ratio (		ile)	0.00	0.00	0.00	0.00		0.00		0.00			0.00	
	niform Delay ( d 1 ), s/veh					5.6		4.5		13.3			12.1	
Incremental Delay ( d 2			0.4	0.0	0.0	0.0		0.0		0.3			0.1	
Initial Queue Delay ( d	·		0.0	0.0	0.0	0.0		0.0		0.0			0.0	
Control Delay ( d ), s/ve	eh		8.6	5.0	4.5	5.6		4.6		13.7			12.2	0.0
Level of Service (LOS)			Α	A	A	Α		A		В			В	A
Approach Delay, s/veh			7.4		А	5.0		А	13.	7	В	4.2		А
Intersection Delay, s/ve	h / LOS				7	.6						A		
													05	
Multimodal Results	11.00		4.04	EB	<b>D</b>	4.00	W		0.0	NB	_	0.01	SB	<b>D</b>
Pedestrian LOS Score			1.63		B	1.86	)	В	2.0		B	2.25		B
Bicycle LOS Score / LC	10		1.41		А			F	0.93	0	A	1.11		A

HCS Sig	nanze	umte	rsect		esu	its Sun	innary	/				_
General Information						Intersec	tion Inf	ormatio	<u></u>			
Agency						Duration		1.000			1	
Analyst Emma Myers-Verhage	Apoly	sie Date	e 8/16/2	0023		Area Typ		Other				
Jurisdiction Box Elder, SD	Time		PM P			PHF		1.00			~Ĭ1	~
Urban Street Alternative 4.2 - no WBT			_	еак			Dariad	1> 16				4 <sup></sup> 12
			· 2030		worth	Analysis						
Intersection Hwy 1416 and S Ellswor		ame	Hwy	410-Elis	woru	hRd_Alt4.	2_PMP6	eak2030	J.xus		NG BUNG Jack	
Project Description Radar Hill 1416 Corridor S	study									123	의 50 대원 H 전 대원 H 전	2012131
Demand Information		EB			W	/B		NB			SB	
Approach Movement	L	Т	R	L	•	T R	L	Т	R	L	Т	R
Demand ( v ), veh/h	306	84	142	15		7	38	39	7	7	62	273
											in second	in a second
Signal Information		7 5	-215							_		
Cycle, s 21.3 Reference Phase 2		₩°	" _≊∰	2						<del>Q</del> l		ктя
Offset, s 0 Reference Point End	Green	6.3	5.9	0.0	0.	0 0.0	0.0	_		X Z	3	4
Uncoordinated Yes Simult. Gap E/W On	Yellow		3.5	0.0	0.		0.0					×17
Force Mode Fixed Simult. Gap N/S On	Red	1.0	1.0	0.0	0.	0 0.0	0.0		5	6	7	8
							1					
Timer Results	EBI	-	EBT	WBI		WBT	NB		NBT	SBL	-	SBT
Assigned Phase			2			6			8			4
Case Number			5.0		_	5.0		_	8.0			7.0
Phase Duration, s	<u> </u>		10.8		_	10.8			10.4			10.4
Change Period, ( Y+R c ), s			4.5			4.5			4.5			4.5
Max Allow Headway ( <i>MAH</i> ), s	<u> </u>		2.9		_	2.9			3.4		$\rightarrow$	3.4
Queue Clearance Time ( g s ), s			5.5			2.6			2.8			5.6
Green Extension Time ( $g_e$ ), s			0.8			0.9			0.9			0.8
Phase Call Probability			1.00			1.00			0.92			0.92
Max Out Probability			0.00			0.00			0.00			0.00
Movement Group Results		EB			W	В		NB			SB	
Approach Movement	L	Т	R		Т		L	Т	R	L	Т	R
Assigned Movement	5	2	12	1		16	3	8	18	7	4	14
Adjusted Flow Rate ( v ), veh/h	306	84	142	15		7		84			69	273
Adjusted Saturation Flow Rate (s), veh/h/ln	1615	1614	1437	1231		1231		1583			1663	
Queue Service Time ( $g_s$ ), s	3.5	0.4	1.6	0.2		0.1		0.0			0.0	
Cycle Queue Clearance Time ( $g_c$ ), s	3.5	0.4	1.6	0.6		0.1		0.8			0.7	
Green Ratio ( g/C )	0.30	0.30	0.30	0.30		0.30		0.28			0.28	<u> </u>
Capacity ( <i>c</i> ), veh/h	820	963	428	683		367		688			651	
Volume-to-Capacity Ratio ( <i>X</i> )	0.373		0.331	0.022		0.019		0.122			0.106	1
Back of Queue ( Q ), ft/In ( 95 th percentile)	3.5	0.4	1.8	0.4		0.2		3			5.6	
Back of Queue (Q), veh/ln (95 th percentile)	0.1	0.0	0.1	0.0		0.0		0.1			0.2	1
Queue Storage Ratio ( $RQ$ ) (95 th percentile)	0.00	0.00	0.00	0.00		0.00		0.00			0.00	
Uniform Delay ( $d_1$ ), s/veh	6.5	5.4	5.8	5.6		5.3		5.8			5.8	1
Incremental Delay ( $d_2$ ), s/veh	0.1	0.0	0.2	0.0		0.0		0.0			0.0	
Initial Queue Delay ( d 3 ), s/veh	0.0	0.0	0.0	0.0		0.0		0.0			0.0	1
Control Delay ( <i>d</i> ), s/veh	6.6	5.4	6.0	5.6		5.3		5.8			5.8	0.0
Level of Service (LOS)	A	A	A	A		A		A			A	A
Approach Delay, s/veh / LOS	6.2		A	5.5		A	5.8		A	1.2		A
Intersection Delay, s/veh / LOS				.4			0.0			A		
	1		, International									
						2		NID			0.5	
Multimodal Results		EB			W	В		NB			SB	
Multimodal Results Pedestrian LOS Score / LOS	1.64		В	1.86		B	2.06	1	В	2.23		В

		пса	o olyi	Ialize	umu	ersect		esu	its Su		IУ					
General Inform	nation								Interse	ction	nfor	rmatio	n		a a su	
Agency	lation								Duratio		10	1.000	/11		7 1	
Analyst		Emma Myers-Verha	200	Apoly	vic Dat	e 8/16/2	0022		Area Ty	•		Other				
Jurisdiction		Box Elder, SD	aye	Time F		PM P			PHF	he		1.00			~Į.	×
Urban Street		Alternative 4.2 - no				r 2050	eak		Analysi	o Dorid		1> 7:0	0			
								wort						- ×		
Intersection	tion	Hwy 1416 and S El Radar Hill 1416 Co		1	ame		410-EllS	woru	hRd_Alt4	Z_PIV	Pea	K2050	.xus		Y Kanadan	
Project Descrip	uon	Radar Hill 1416 Co	maor Si	ludy										128		0.82
Demand Inform	nation				EB			V	VB			NB			SB	
Approach Move	ment			L	Т	R	L	<b>—</b>	T R		L	Т	R	L	Т	R
Demand ( v ), v	eh/h			352	99	178	18		8	4	3	43	8	8	72	327
					1											
Signal Informa	tion				7									_		Y
Cycle, s	24.3	Reference Phase	2		₩°	7 sa	2							<b>4</b>		sta 1
Offset, s	0	Reference Point	End	Green	77	7.7	0.0	0.	0 0.0		.0	_	1	X Z	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		3.5	0.0	0.			.0			$\mathbf{\Sigma}$		stz.
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.			.0		5	6	7	8
Timer Results				EBI	-	EBT	WB	L	WBT	1	IBL		NBT	SBI	-	SBT
Assigned Phase	e					2			6				8			4
Case Number						5.0			5.0				8.0			7.0
Phase Duration						12.2			12.2			_	12.2			12.2
Change Period,	(Y+R	c ), S				4.5			4.5				4.5			4.5
Max Allow Head	dway(A	<i>MAH</i> ), s				3.0			3.0				3.4			3.4
Queue Clearan	ueue Clearance Time ( $g_s$ ), s					6.6			2.8				3.0			7.0
Green Extensio	reen Extension Time ( <i>g</i> <sub>e</sub> ), s					1.0			1.1				1.1			1.0
Phase Call Prol	nase Call Probability					1.00			1.00				0.97			0.97
Max Out Proba	bility					0.01			0.00			(	0.00			0.02
Movement Gro	un Res	aults			EB			W	B			NB			SB	
Approach Move	-			L	Т	R	L	Т		ΤL		T	R	L	T	R
Assigned Move				5	2	12	1		16	3		8	18	7	4	14
Adjusted Flow F		), veh/h		352	99	178	18		8			94			80	327
		ow Rate ( <i>s</i> ), veh/h/l	n	1615	1614		1214		1367	,	-	1565			1666	
Queue Service				4.6	0.5	2.4	0.3		0.1			0.0			0.0	
Cycle Queue C		- /		4.6	0.5	2.4	0.8		0.1	-		1.0			0.8	
Green Ratio ( g		5 mile ( <b>9</b> c ), c		0.31	0.31	0.31	0.31		0.31			0.31			0.31	
Capacity ( c ), v	,			805	1017	453	653		431			709			688	
Volume-to-Capa		tio (X)		0.438	<u> </u>	0.393	0.028		0.019			).133			0.116	
		/In ( 95 th percentile	)	14.2	1.5	6.9	0.020		0.4	-	+	5			7.9	
		eh/In ( 95 th percentie		0.5	0.1	0.3	0.0		0.0			0.2			0.3	
	· /	RQ) ( 95 th percent	,	0.00	0.00	0.00	0.00		0.00			0.2			0.00	
-				7.3	5.9	6.5	6.1	-	5.7			6.0			6.0	
	niform Delay ( <i>d</i> 1 ), s/veh cremental Delay ( <i>d</i> 2 ), s/veh					0.2	0.0		0.0			0.0			0.0	
	itial Queue Delay ( $d_3$ ), s/veh					0.2	0.0	_	0.0	-		0.0			0.0	
Control Delay (		·		0.0 7.4	0.0 5.9	6.7	6.2		5.7	-		6.1			6.0	0.0
Level of Service				7.4 A	3.9 A	0.7 A	0.2 A		A		-	0.1 A			0.0 A	0.0 A
	. ,			7.0		A	A 6.0		A		5.1		A	1.2		A
	pproach Delay, s/veh / LOS ntersection Delay, s/veh / LOS								A	-	J. I					~
mersection De	ay, s/ve	an / LUS 				4	.9							A		
Multimodal Re	sults				EB			W	B			NB			SB	
Pedestrian LOS		/105		1.64		В	1.87		B	2	.06		В	2.23		В
Bicycle LOS Sc				1.01		A	1.07		F	_	.64	+	A	1.16		A
210,010 200 00				1.0	•	~								1.10		

Signal Information         Cycle, s         60         Reference Phase         2           Offset, s         0         Reference Phase         2           Offset, s         0         Reference Phase         2           Cycle, s         0         Reference Phase         2           Timer Results         Reference Phase         5         12.5         22.6         0.0         0.0         0.0         0.0           Timer Results         Red         1.0         1.0         1.0         0.0         7.0         Phase Duration, s         14.0         3.0         0.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0         3.0 </th <th></th> <th></th> <th>пса</th> <th>s sigr</th> <th>anze</th> <th>ainte</th> <th>ersect</th> <th>ION R</th> <th>esu</th> <th>its</th> <th>Sum</th> <th>mary</th> <th>'</th> <th></th> <th></th> <th></th> <th></th>			пса	s sigr	anze	ainte	ersect	ION R	esu	its	Sum	mary	'					
Approach         Invasion	Concerct Inform								1	lint		la in limf			E E	NIM THE RIM MET KI	1483	
Analysis         Emma Myers-Vurlage         Analysis Date         Aug 8, 2023         Area Type         Other         Other         Aut         State         The Pariod         Analysis Year         C230         Analysis Year         C300         C300 <thc300< th="">         C300         C300         &lt;</thc300<>		nation											N.		- 1	1 4	97 -7a.	
Jurisdiction         Dox Elder, Sd         Time Period         AM Period         Prof.         100           Urban Sitest         Alternative 1         Analysis Year         2030         Analysis Period         11> 7:00         11> 7:00           Internaction         Hwy 1416 and Lborty Bivd         File Name         Hwy 1416-Lborty Bivd         File Name         File Name<															- 8			
Outban Stream         Anternative 1         Analysis Year         2030         Analysis Period         To 7.00           Intersection         Hwy 1416 and Liberty Blvd         File Name         Hwy 1416-Liberty, Alt1_AMPeak2030.xus         Image 110         To 0           Project Description         Radar Hill 1416 Corridor Study         Image 110         T         R         L         T         R         R         R	-		-	age								3						
Intersection         Hwy 1416 and Liberty Bivd         File Name         Hwy1416-Liberty_Alt1_AMPeak2030.us         Image: Control of Study           Demand Information         EB         VB         NB         L         T         R         L <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>eak</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>"†r</td> <td>100 T</td>								eak								"†r	100 T	
Project Description         Radar Hill 1418 Conidor Study         EB         WB         NB         SB           Approach Movement         L         T         R         L         T <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>00</td><td></td><td></td><td></td></td<>														00				
Demand Information         L         T         R			<u> </u>		.н	ame	Hwy1	416-Lib	erty_/	Alt1_	_AMPe	ak2030	).xus			tr		
Approach Movement       L       T       R	Project Descrip	tion	Radar Hill 1416 Co	rridor St	tudy										3	ि सी भी लिये हैं है।	<b>新</b> 派	
Approach Movement       L       T       R	Demand Inform	nation				FB			W	/B			NB			SB		
Demand ( v ), velvh         326         150         3         7         90         171         4         51         10         60         19         141           Signal Information           Cycle, s         58.0         Reference Print         End         2         10         60         10         10         10         0.0					L	1	R	ΤL	ii.	1	R	L	ii.	R	L	1	R	
Signal Information           Cycle, s         60         Reference Phase         2           Offset, s         0         Reference Phase         2           Offset, s         0 <th colspan<="" td=""><td></td><td></td><td></td><td></td><td>326</td><td>-</td><td>_</td><td>7</td><td>9</td><td>0</td><td></td><td>4</td><td>51</td><td>_</td><td></td><td></td><td>141</td></th>	<td></td> <td></td> <td></td> <td></td> <td>326</td> <td>-</td> <td>_</td> <td>7</td> <td>9</td> <td>0</td> <td></td> <td>4</td> <td>51</td> <td>_</td> <td></td> <td></td> <td>141</td>					326	-	_	7	9	0		4	51	_			141
Cycle, s         68.0         Reference Paise         2         C         2         C         2         C         2         C         2         C         2         C         2         C         2         C         2         C         2         C         2         C         2         C <thc< th=""> <thc< td="" tr<=""><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></thc<></thc<>							-											
Offset         o         Reference Point         End         Green         9.5         12.5         22.5         0.0	Signal Informa	tion															•	
Offset         o         Reference Point         End         Green         9.5         12.5         22.5         0.0	Cycle, s	58.0	Reference Phase	2		K.	- ₩°	сі Ф. В.Ф.	2						<b>A</b>		Ŷ	
Uncoordinated         Yea         Simult. Gap E/V         On         Yealow         3.5         3.5         0.0         0.0         0.0         √            Force Mode         Fixed         Simult. Gap I/S         On         Ref         1.0         1.0         1.0         0.0         0.0         0.0         √          √          √         √           Timer Results          5         2         1         6          4          8.8         SBT           Assigned Phase          1.1         4.0         0.0         14.0         8.0         7.0           Change Period. (Y+Rc.).s         14.0         3.10         0.0         17.0         27.0         27.0         27.0           Change Period. (Y+Rc.).s         3.0         3.0         0.0         3.0         0.0         3.0         0.0         3.0         0.0         1.00 </td <td>Offset, s</td> <td>0</td> <td>Reference Point</td> <td>End</td> <td>Green</td> <td></td> <td></td> <td>22.5</td> <td></td> <td><u></u></td> <td>0.0</td> <td>0.0</td> <td></td> <td>1</td> <td>Y 2</td> <td>3</td> <td>4</td>	Offset, s	0	Reference Point	End	Green			22.5		<u></u>	0.0	0.0		1	Y 2	3	4	
Force Mode       Fixed       Simult. Gap N/S       On       Red       1.0       1.0       1.0       0.0 <th< td=""><td>Uncoordinated</td><td>Yes</td><td>Simult. Gap E/W</td><td>On</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td><math>\rightarrow</math></td><td></td><td><math>\Phi</math></td></th<>	Uncoordinated	Yes	Simult. Gap E/W	On											$\rightarrow$		$\Phi$	
Assigned Phase       6       2       1       6       4       8         Case Number       1.1       4.0       0.0       14.0       31.0       0.0       17.0       27.0       27.0       27.0         Phase Duration, s       14.0       31.0       0.0       17.0       27.0       27.0       27.0       27.0         Change Peried, (Y#R c), s       4.5       3.5       4.5       3.5       4.5       4.5       3.2       3	Force Mode	Fixed	Simult. Gap N/S	On										5	6	7	8	
Assigned Phase       6       2       1       6       4       8         Case Number       1.1       4.0       0.0       14.0       31.0       0.0       17.0       27.0       27.0       27.0         Phase Duration, s       14.0       31.0       0.0       17.0       27.0       27.0       27.0       27.0         Change Peried, (Y#R c), s       4.5       3.5       4.5       3.5       4.5       4.5       3.2       3																		
Case Number       1.1       4.0       0.0       14.0       31.0       0.0       14.0       37.0       7.0         Phase Duration, s       14.0       31.0       0.0       17.0       2						_			L			NBI	-		SB			
Phase Duration, s       14.0       31.0       0.0       17.0       Z       27.0       Z       27.0         Change Period, (YHR c), s       4.5       4.5       3.5       4.5       3.5       4.5       4.5       3.2       3		e			· · · ·			1			· .						-	
Change Period. (Y+R c). s       4.5       4.5       3.5       4.5       3.5       4.5       3.2       <					1.1			0.0						8.0			7.0	
Max Allow Headway (MAH).s       3.0       3.0       0.0       3.0       <		•					31.0							27.0			27.0	
Queue Clearance Time ( $g \pm$ ), s       10.6       5.1       11.8       3.5       5.8         Green Extension Time ( $g \pm$ ), s       0.0       0.7       0.0       0.7       0.0       0.7       0.0       0.7       0.0       0.7       0.0       0.7       0.0       0.7       0.0       0.0       1.00       1.00       1.00       1.00       1.00       1.00       0.00	-	· ·	,		4.5			3.5						4.5			4.5	
Green Extension Time ( $g \in i$ , s         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0         0.7         0.0		2 1	·		3.0			0.0						3.2			3.2	
Phase Call Probability       0.99       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       0.00       1.00       0.00       1.00       0.00      <		· - ·												3.5			5.8	
Max Out Probability1.000.00 <th< td=""><td></td><td colspan="5">reen Extension Time ( g e ), s</td><td></td><td>0.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.5</td></th<>		reen Extension Time ( g e ), s						0.0									0.5	
Movement Group ResultsLTRLT <t< td=""><td>Phase Call Pro</td><td>bability</td><td></td><td></td><td>0.99</td><td>)</td><td>1.00</td><td></td><td></td><td>1.</td><td>00</td><td></td><td></td><td>1.00</td><td></td><td></td><td>1.00</td></t<>	Phase Call Pro	bability			0.99	)	1.00			1.	00			1.00			1.00	
Approach MovementLTRLTRLTRLTRLTRLTRLTRLTRAsigned Movement5212161674143818Adjusted Flow Rate (v), veh/h326153C268C65C79141Adjusted Saturation Flow Rate (s), veh/h/ln16151689C1508C65C14141448Queue Service Time (g c), s8.63.1C9.8C1.5CC0.0C38Green Ratio (g/C)0.410.46C0.22C0.39C3.3C3.3C0.33C0.33C0.33C0.33C0.33C0.33C0.410.460.6290.092C0.1200.53.866Volume-to-Capacity Ratio (X)0.7420.198C0.6290.092C0.1200.55.353535353540.120.553535353541.11.12.10.000	Max Out Proba	bility			1.00		0.00			0.	00			0.00			0.00	
Approach MovementLTRLTRLTRLTRLTRLTRLTRLTRAsigned Movement5212161674143818Adjusted Flow Rate (v), veh/h326153C268C65C79141Adjusted Saturation Flow Rate (s), veh/h/ln16151689C1508C65C14141448Queue Service Time (g c), s8.63.1C9.8C1.5CC0.0C38Green Ratio (g/C)0.410.46C0.22C0.39C3.3C3.3C0.33C0.33C0.33C0.33C0.33C0.33C0.410.460.6290.092C0.1200.53.866Volume-to-Capacity Ratio (X)0.7420.198C0.6290.092C0.1200.55.353535353540.120.553535353541.11.12.10.000	Movement Gro	oup Res	aults			FB			WF	3			NB			SB		
Assigned Movement       5       2       12       1       6       16       7       4       14       3       8       18         Adjusted Flow Rate (v), veh/h       326       153       0       268       0       65       0       79       141         Adjusted Saturation Flow Rate (s), veh/h/ln       1615       1689       0       1508       0       1643       0       1414       1448         Queue Service Time (g s), s       8.6       3.1       0       9.8       0.0       0.0       0.5       3.8         Cycle Queue Clearance Time (g c), s       8.6       3.1       0       9.8       0.22       0.39       0.039       0.39       0.33         Capacity (c), veh/h       0.41       0.46       0.22       0.39       0       0.39       0.35         Back of Queue (Q), veh/n       0.742       0.198       0.629       0.092       0.120       0.25         Back of Queue (Q), veh/n (95 th percentile)       1414       39.1       137.3       10       0       11.1       2.1         Queue Storage Ratio (RQ) (95 th percentile)       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00					1		R		1		R	1		R	1	ir	R	
Adjusted Flow Rate (v), veh/h       326       153       M       268       M       65       M       79       141         Adjusted Saturation Flow Rate (s), veh/h/ln       1615       1689       1508       1643       1643       1414       1444         Queue Service Time (gs), s       8.6       3.1       9.8       0.0       0.0       0.5       3.8         Cycle Queue Clearance Time (gc), s       8.6       3.1       9.8       703       0.55       3.8         Capacity (c), veh/h       440       772       426       703       0.558       562         Volume-to-Capacity Ratio (X)       0.742       0.198       0.629       0.092       0.120       0.25         Back of Queue (Q), th/ln (95 th percentile)       1414       39.1       137.3       25       27.3       53         Back of Queue (Q), veh/ln (95 th percentile)       55       5.5       5.3       1.0       0.0       1.1       2.1         Queue Storage Ratio (RQ) (95 th percentile)       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00					5					+					3			
Adjusted Saturation Flow Rate (s), veh/h/ln       1615       1689       Image: Second Seco			) veh/h		-			· ·		3						-		
Queue Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       8.6       3.1       Image: Service Time (g s), s       3.8       3.8       1.5       3.8				n		<u> </u>				_								
Cycle Queue Clearance Time (g c), s8.63.19.81.52.03.8Green Ratio (g/C)0.410.460.220.220.390.590.590.590.55						<u> </u>	-		<u> </u>		_							
Green Ratio (g/C)0.410.46I0.22I0.39I0.390.55<			. ,						<u> </u>									
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			5 mile ( <b>9</b> c ), c				-				_							
Volume-to-Capacity Ratio (X)0.7420.198Image: Constraint or Constraint						<u> </u>											562	
Back of Queue (Q), ft/in (95 th percentile)141.439.1Image: 137.3137.312.525.51.5137.3137.312.525.51.5137.3			tio (X)			<u> </u>				_							0.251	
Back of Queue (Q), veh/ln (95 th percentile)5.51.5I5.3I1.0I1.12.1Queue Storage Ratio (RQ) (95 th percentile)0.0011.30.00.00 <td></td> <td></td> <td></td> <td>:)</td> <td></td> <td></td> <td></td> <td></td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>				:)					<u> </u>									
Queue Storage Ratio ( RQ ) ( 95 th percentile)0.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.0111.30.000.0111.412.00Incremental Delay ( d 2 ), s/veh6.10.0 <td></td> <td><u>, ,</u></td> <td></td> <td>,</td> <td></td> <td><u> </u></td> <td></td> <td></td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		<u>, ,</u>		,		<u> </u>			<u> </u>									
Uniform Delay (d 1), s/veh14.19.4Image: Constraint of the constraint of the		, ,	, .	,		<u> </u>			<u> </u>								0.00	
Incremental Delay (d 2), s/veh6.1 $0.0$ $o.$				,													12.0	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	. ,				<u> </u>			<u> </u>									
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		2 1	•			<u> </u>			<u> </u>									
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		• •	,						<u> </u>								13.1	
Approach Delay, s/veh / LOS       16.8       B       22.3       C       11.6       B       12.7       B         Intersection Delay, s/veh / LOS       17.0       B       12.7       B         Multimodal Results       EB       WB       NB       SB         Pedestrian LOS Score / LOS       1.66       B       1.91       B       1.67       B       1.89       B																		
Intersection Delay, s/veh / LOS         17.0         B           Multimodal Results         EB         WB         NB         SB           Pedestrian LOS Score / LOS         1.66         B         1.91         B         1.67         B         1.89         B		· /					В	22.3		(	С	11.6		В	12.7			
Multimodal Results         EB         WB         NB         SB           Pedestrian LOS Score / LOS         1.66         B         1.91         B         1.67         B         1.89         B		-																
Pedestrian LOS Score / LOS         1.66         B         1.91         B         1.67         B         1.89         B		., ., .,						-										
	Multimodal Re	sults				EB			WE	3			NB			SB		
Bicvcle LOS Score / LOS 1.28 A 0.93 A 0.59 A 0.85 A	Pedestrian LOS	S Score	/LOS		1.66	3	В	1.91	1	E	В	1.67	/	В	1.89	9	В	
	Bicycle LOS Sc	ore / LC	DS		1.28	3	А	0.93	3	/	A	0.59	)	А	0.85	5	А	

		HCS	s Sigr	alize	d Int	ersec	tion F	kesul	ts S	um	mary	'			_	
General Inform	action							_	Intor	ooti	on Inf	ormatic				1988 B
	nation											ormatio			_	
Agency					·				Durat			1.000				
Analyst		Emma Myers-Verha	age	-		e Aug 8			Area	Туре	•	Other			-#s	÷
Jurisdiction		Box Elder, SD		Time F		AM F			PHF		<u></u>	1.00				
Urban Street		Alternative 1		Analys					Analy			1> 7:(	00	X		
Intersection		Hwy 1416 and Libe		R	ame	[Hwy1	416-Lik	perty_A	lt1_AI	MPea	ak2050	).xus		_	*	
Project Descrip	tion	Radar Hill 1416 Co	rridor St	udy										3		
Demand Inform	nation				EB			W	B			NB			SB	
Approach Move	ement			L	Т	R	L	Т	·	R	L	Т	R	L	Т	R
Demand ( v ), v	/eh/h			326	146	3 3	6	76	3 1	173	4	51	10	59	17	119
				1												
Signal Informa	1				La .	.3	빌세								R I	$\mathbf{Y}$
Cycle, s	60.9	Reference Phase	2		R		é – N	[7]					1		3	4
Offset, s	0	Reference Point	End	Green	9.9	18.1	19.4	0.0	) C	0.0	0.0			<u> </u>		
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	_	3.5	3.5	0.0		0.0	0.0			Y	>	- V
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.0	0.0	)   C	0.0	0.0		5	6	7	8
Timer Results				EBI		EBT	WE	31	WBT	г	NBI		NBT	SB		SBT
Assigned Phas	•			5	-	2	1		6	-	3	-	8	7		4
Case Number	0			1.1		4.0	0.0		14.0		11.0		14.2	14.0		13.3
Phase Duration				14.4	1	37.0	0.0		22.6	_	0.0		23.9	0.0		23.9
Change Period				4.5		4.5	4.0		4.5	-	4.0		4.5	4.5		4.5
Max Allow Hea		,		3.0		3.0	0.0	_	3.0		0.0		3.2	0.0		3.2
Queue Clearan	- 1	·		9.5		4.7	0	-	20.1		0.0	+	3.7	0.0		8.2
Green Extensio		, = ,		0.4		0.6	0.0	)	0.0	_	0.0		0.1	0.0		0.3
Phase Call Pro		(3 * )/		1.00		1.00			1.00				1.00			1.00
Max Out Proba	bility			0.00	)	0.00			1.00	)			0.00			0.00
Mayamant Cr					EB				<b>`</b>						SB	
Movement Gro	-	Suits			ED T	R	L	WB	,   F	,	L	NB T	R	L	T	R
Assigned Move				5	2	12	1	6	10	_	3	8	18	7	4	14
Adjusted Flow		) yoh/h		326	149	12	<u> </u>	255		0	5	65	10	- '	76	119
-			n	1667	1744		-	757		-		1698		<u> </u>	508	119
Queue Service		w Rate ( s ), veh/h/l		7.5	2.7			5.0		-+		1.7		<u> </u>	0.0	
Cycle Queue C		- /		7.5	2.7		-	18.1	_	-		1.7		<u> </u>	6.2	
Green Ratio ( g		e fille ( <i>g c</i> ), s		0.49	0.53		-	0.30		-		0.32		<u> </u>	0.2	
Capacity ( c ), v	,			389	931		-	313		-		615			267	
Volume-to-Cap		tio (X)		0.837	0.160	)	-	0.81	_	-		0.106			0.285	
	-	/In (95 th percentile	)	96	30.3			173.		-		29.4			39.9	
	, ,	eh/In ( 95 th percentie	,	3.8	1.2			7.0	_			1.2			1.6	
	, ,	RQ) (95 th percent	,	0.00	0.00			0.00				0.00			0.00	
Uniform Delay			)	13.1	7.2			18.7	_			14.7			15.8	
Incremental De	. ,			1.9	0.0			16.1	_	+		0.3			2.7	
Initial Queue D	2 1	•		0.0	0.0			0.0	_			0.0			0.0	
Control Delay (		,		15.0	7.3			34.8	_			15.0			18.5	0.0
Level of Service				В	A			C				В			В	A
Approach Dela		/ LOS		12.5	5	В	34.	8	С		15.0	)	В	7.2		A
Intersection De	-					1	7.4							В		
Multimodal Re					EB			WB	5			NB			SB	
Pedestrian LOS				1.65		В	1.9	1	В		1.71		В	1.90	)	В
	ore / LC	NO.		1.27	7	А	0.9	1	Α		0.59	)	А	0.8		А

		HCS	s Sigr	nalize	d Inte	ersect	ion R	esul	ts Su	mma	ary					
General Inform	action								Intoro	otion	Infe	rmotic		B	1241	P4114
	nation	γ									Into	ormatic		- i	1	
Agency					·		0000		Duratio			1.000				
Analyst		Emma Myers-Verha	age			e Aug 8			Area T	уре		Other			"Ĭı	
Jurisdiction		Box Elder, SD		Time F		PM P	eak		PHF			1.00		55 55 55 55 55 55 55 55 55 55 55 55 55	.ir	÷
Urban Street		Alternative 1		Analys					Analys			1> 16	:30			
Intersection		Hwy 1416 and Libe	-		ame	Hwy1	416-Libe	erty_A	lt1_PN	Peak2	2030	.xus			<b>*</b>	
Project Descrip	tion	Radar Hill 1416 Cor	rridor St	udy										3	11 (1 <b>1</b> 7 (1	<b>1</b> 10
Demand Inform	nation				EB			W	B			NB			SB	
Approach Move	ement			L	Т	R	L	Т	F	2	L	Т	R	L	Т	R
Demand ( v ), v	/eh/h			38	43	13	4	28	3 5	5	8	11	2	112	21	55
															<u> </u>	
Signal Informa	Ir		1	-	a	3 4	그래도							_	<b>K</b>	$\mathbf{A}$
Cycle, s	37.5	Reference Phase	2		R		1 50	2					1	$\left\{ \begin{array}{c} \mathbf{e} \\ \mathbf{e} \end{array} \right\}$	3	к <b>т</b> и
Offset, s	0	Reference Point	End	Green	1.6	3.9	18.5	0.0	0.	0 (	0.0			<u>۲</u>		
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.5	3.5	3.5	0.0	0.	0 (	0.0		<b>&gt;</b>		$\mathbf{V}$	- V
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.0	0.0	0.	0 (	0.0		5	6	7	T a
Timer Results				EBI		EBT	WB		WBT		NBL		NBT	SBI		SBT
Assigned Phas	2			5	-	2	1		6	-	3	-	8	7	-	4
Case Number	G			5 1.1	_	4.0	0.0		14.0	+	3 11.0		8	14.0		4
Phase Duration				6.1		4.0	0.0		8.4		0.0		23.0	0.0		23.0
Change Period		- ) C		4.5		4.5	4.5		4.5		4.5		4.5	4.5		4.5
Max Allow Hea		,		3.0		3.1	0.0	_	3.1		4.5 0.0		3.2	0.0		3.0
	ueue Clearance Time (g s), s					2.9	0.0		4.0		0.0		2.2	0.0		5.2
Green Extensio				2.7 0.0		0.2	0.0		0.2		0.0		0.0	0.0		0.2
Phase Call Pro		(9,0), 3		0.33		0.85	0.0	-	0.77		0.0		1.00	0.0		1.00
Max Out Proba				1.00		0.00		-	0.00				0.00			0.00
	2t <i>j</i>				-	0.00			0.00							0100
Movement Gro	-	sults			EB			WB	1			NB			SB	
Approach Move				L	Т	R	L	Т	R		-	Т	R	L	Т	R
Assigned Move	ment			5	2	12	1	6	16	3	3	8	18	7	4	14
Adjusted Flow	Rate( <i>v</i>	), veh/h		38	56			87				21			133	55
Adjusted Satura	ation Flo	ow Rate ( <i>s</i> ), veh/h/l	n	1667	1680			1571				1605			831	
Queue Service	Time ( g	g s ), S		0.7	0.9			2.0				0.2			0.0	
Cycle Queue C	learanc	e Time ( <i>g c</i> ), s		0.7	0.9			2.0				0.2			3.2	
Green Ratio ( g	ı∕C)			0.20	0.27			0.10				0.49			0.49	
Capacity ( c ), v				333	448			281				926			587	
Volume-to-Cap				0.114				0.31	_			0.023			0.227	
Back of Queue	(Q), f	/In ( 95 th percentile	e)	8.1	10.3			23.6	;			3			18.2	
Back of Queue	(Q), ve	eh/In ( 95 th percenti	ile)	0.3	0.4			0.9				0.1			0.7	
Queue Storage	Ratio (	RQ) (95 th percent	tile)	0.00	0.00			0.00				0.00			0.00	
Uniform Delay	(d1), s	/veh		12.5	10.4			16.0				4.9			5.5	
Incremental De	lay ( <i>d</i> 2	), s/veh		0.1	0.0			0.2				0.0			0.9	
Initial Queue D	elay ( <i>d</i>	з ), s/veh		0.0	0.0			0.0				0.0			0.0	
Control Delay (	d ), s/ve	eh		12.5	10.5			16.2	2			4.9			6.4	0.0
Level of Service	e (LOS)			В	В			В				А			Α	Α
Approach Dela	y, s/veh	/LOS		11.3	3	В	16.2	2	В		4.9		А	4.6		A
Intersection De	lay, s/ve	eh / LOS				8	.8							A		
Multimodal Re					EB			WB				NB	_		SB	
Pedestrian LOS				1.66		B	1.91		B		1.69		В	1.86	_	В
Bicycle LOS So	core / LC	DS		0.64	ł	Α	0.63	3	A		0.52		A	0.80	)	A

	HCS	s Sigr	nalize	d Int	ersect	tion R	lesu	ts S	um	mary	7				_
General Informatio	<u> </u>							Intor	ooti	ion Inf	ormatio		- B		rate:
											1.000			4 4	
Agency			Analys					Durat			_				
Analyst	Emma Myers-Verha	age			te Aug 8			Area	туре	<del>)</del>	Other			a į	÷-
Jurisdiction	Box Elder, SD		Time F			еак		PHF		<b>.</b>	1.00	20			
Urban Street	Alternative 1		1		ar 2050	440.1.1				Period	1> 7:(	50			
Intersection	Hwy 1416 and Libe	-		ame	Hwy1	416-Lib	erty_/	Nt1_P	мРе	ak2050	).xus		_	*	
Project Description	Radar Hill 1416 Co	rridor St	udy												10
Demand Information	n			EB			W	В			NB			SB	
Approach Movemen	t		L	Т	R	L	Т	-	R	L	Т	R	L	Т	R
Demand ( v ), veh/h			40	46	13	4	3	0	58	8	11	2	118	22	58
			lir.												
Signal Information			-	La		빌세4							*	~ .	$\mathbf{A}$
Cycle, s 42.		2		R		°   N	7					1	<b>\$</b> 2	3	4
Offset, s 0	Reference Point	End	Green		4.2	23.0			0.0	0.0			<u> </u>		
Uncoordinated Yes		On	Yellow		3.5	3.5	0.0		0.0	0.0			Y	$\mathbf{Y}$	· V
Force Mode Fixe	ed Simult. Gap N/S	On	Red	1.0	1.0	1.0	0.0	) [(	0.0	0.0		5	6	7	8
Timer Results			EBI		EBT	WE	BL I	WB	т	NBI		NBT	SBI		SBT
Assigned Phase			5	-	2	1	-	6	-	3		8	7		4
Case Number			1.1		4.0	0.0	)	14.0	)	11.0	)	14.2	0.0		13.3
Phase Duration, s			6.4		15.0	0.0		8.7	_	0.0		27.5	0.0		27.5
Change Period, ( Y+	·R c ). s		4.5		4.5	4.5		4.5	_	4.5		4.5	4.5		4.5
Max Allow Headway			3.0		3.1	0.0	)	3.1		0.0		3.2	0.0		3.0
Queue Clearance Ti	ueue Clearance Time ( $g$ s), s							4.4				2.2			5.7
Green Extension Tin	ireen Extension Time ( $g e$ ), s					0.0	)	0.2		0.0		0.0	0.0		0.3
Phase Call Probabili	ty		0.38	3	0.90			0.83	3			1.00			1.00
Max Out Probability			1.00	)	0.00			0.00	)			0.00			0.00
Movement Group F	Results			EB			WE	}			NB			SB	
Approach Movemen		_	L	T	R	L	T	1	२	L	T	R	L	T	R
Assigned Movement			5	2	12	1	6	1	_	3	8	18	7	4	14
Adjusted Flow Rate			40	59	-		92	-			21			140	58
-	Flow Rate ( s ), veh/h/l	n	1667	1683	3		157	2			1600			794	
Queue Service Time			0.8	1.2	-		2.4				0.2			0.0	<u> </u>
Cycle Queue Cleara	, = ,		0.8	1.2			2.4	_			0.2			3.7	
Green Ratio ( g/C )			0.19	0.25			0.10	)			0.54			0.54	
Capacity ( c ), veh/h			299	417	_		259				984			585	
Volume-to-Capacity			0.134	0.14 <sup>-</sup>	1		0.35	5			0.021			0.239	
Back of Queue (Q)	, ft/In (95 th percentile	e)	10.9	14.3			31				3.1			20.2	
Back of Queue (Q)	, veh/ln ( 95 th percent	ile)	0.4	0.6			1.2				0.1			0.8	
Queue Storage Rati	o(RQ)( 95 th percent	tile)	0.00	0.00			0.00	)			0.00			0.00	
Uniform Delay ( d 1 )	, s/veh		14.6	12.5			18.4	ł			4.5			5.2	
Incremental Delay (	<i>d</i> <sub>2</sub> ), s/veh		0.1	0.1			0.3				0.0			1.0	
Initial Queue Delay (	· · ·		0.0	0.0			0.0	_			0.0			0.0	
Control Delay ( d ), s			14.6	12.5			18.7	7			4.6			6.2	0.0
Level of Service (LC	'		В	В			В				Α			Α	Α
Approach Delay, s/v			13.4	4	В	18.	7	В		4.6		А	4.4		А
Intersection Delay, s	/veh / LOS				ç	9.8							A		
Multimedia							14/5	<b>,</b>						0.0	
Multimodal Results Pedestrian LOS Sco			1.67	EB	P	1.9	WE 1	BB		1.69	NB	В	1.0/	SB	В
Bicycle LOS Score /			0.65		B A	0.6	_	A	$\rightarrow$	0.52		A	1.86 0.81		A
Dicycle LOG GCOIE /	200		0.00		~		4			0.52	-	Л		0000 0.00	

				H	CS Ro	und	labo	uts	Rep	ort							
General Information							Sit	te Ir	nform	natio	n						
Analyst	Emma	a Myers-	Verha	ge		Þ		L.		Inters	ection			Highv	vay 14	16 and l	.iberty Bl.
Agency or Co.						1	+			E/W S	Street Na	me		Highv	vay 14	16	
Date Performed	8/3/2	023			$\Gamma/$		-		1+	N/S S	itreet Na	me		Libert	y Blvd		
Analysis Year	2030				<b>K</b> 1				†≯	Analy	sis Time	Period, hr	s	1.00			
Time Analyzed	AM P	eak			*		-		1	Peak	Hour Fac	tor		0.84			
Project Description	Alterr	native 1					→ ▼∳	1		Jurisc	liction			Box E	lder, S	D	
Volume Adjustments	and S	ite Cl	narao	teristi	cs												
Approach		E	EB				WB				N	В				SB	
Movement	U	L	Т	R	U	L	Т		R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	1		0	0	0	1	0	0	0	1	0
Lane Assignment				LTR				LTF	ł			LTR	:				LTR
Volume (V), veh/h	0	326	150	3	0	7	9	0	171	0	4	51	10	0	60	19	141
Percent Heavy Vehicles, %	8	8	8	8	7	7	7	,	7	2	2	2	2	9	9	9	9
Flow Rate (VPCE), pc/h	0	419	193	4	0	9	11	15	218	0	5	62	12	0	78	25	183
Right-Turn Bypass		No	one				None				No	one			I	None	
Conflicting Lanes			1				1					1				1	
Pedestrians Crossing, p/h			0				0				(	)				0	
Proportion of CAVs									(	0							
Proportion of CAVs 0 Critical and Follow-Up Headway Adjustment																	
Approach		-	EB		T	_	WB	_	-		N	B		_	_	SB	
Lane	Left	Ri	ght	Bypass	Left		Right	Ву	/pass	Left	Rig	ght By	/pass	Left		Right	Bypass
Critical Headway, s		4.9	763			4	4.9763				4.9	763			4	.9763	
Follow-Up Headway, s		2.6	087			1	2.6087				2.6	087			2	.6087	
Flow Computations,	Capac	ity an	d v/	c Ratio	s												
Approach		E	B			_	WB		-		N	B		_	_	SB	
Lane	Left	Ri	ght	Bypass	Left		Right	Ву	/pass	Left	Rig	ght By	/pass	Left		Right	Bypass
Entry Flow (ve), pc/h		6	16				342				7	9				286	
Entry Volume, veh/h		5	70				320				7	7				262	
Circulating Flow (v <sub>c</sub> ), pc/h		1	12				486				69	90				129	
Exiting Flow (vex), pc/h		2	83				303				69	99				38	
Capacity (cpce), pc/h		12	231			Т	841				68	33				1210	
Capacity (c), veh/h		1	140			+	786	$\vdash$			6	59				1110	
v/c Ratio (x)		0.	.50				0.41				0.	12				0.24	
Delay and Level of Se	ervice																
Approach			_	EB		Т	_	W	/B			NB		Т	_	SB	
Lane			Left	Righ	it Bypa	ass	Left	Rig	ght I	Bypass	Left	Right	Bypas	s L	eft	Right	Bypass
Lane Control Delay (d), s/veh				8.8				-	.8			6.7				5.4	
Lane LOS				A		+			4			А		+		А	
95% Queue, veh				3.0				2	.0			0.4				0.9	
Approach Delay, s/veh   LOS			8	.8	A		9.8	1		A	6.7		A	+	5.4		A
Intersection Delay, s/veh   LOS	5					8.2								A			
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				HC	S Ro	unc	dabo	outs	s Rep	oort							
General Information			_			_	Si	te l	nfor	matio	n			_	_	_	
Analyst	Emma	a Myers-	Verhag	je						Inters	ection			Highwa	y 141	6 and L	iberty Bl
Agency or Co.						1	+	1		E/W S	Street Na	ime		Highwa	y 141	6	
Date Performed	8/3/2	023			$\Box$	1	-		+	N/S S	Street Na	me		Liberty	Blvd		
Analysis Year	2050				<b>₹</b> ⊥		Ð		1≯	Analy	vsis Time	Period, hr	s	1.00			
Time Analyzed	AM P	eak			ŧ.		-		L	Peak	Hour Fac	tor		0.84			
Project Description	Alterr	ative 1						1		Juriso	liction			Box Eld	er, SD		
Volume Adjustments	and S	ite Cł	narac	teristi	cs	_											
Approach		E	B				WB				N	IB			9	SB	
Movement	U	L	Т	R	U	L		т	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0		1	0	0	0	1	0	0	0	1	0
Lane Assignment				LTR				LT	R			LTR					LTR
Volume (V), veh/h	0	333	151	3	0	7	9	91	178	0	4	52	10	0	61	19	142
Percent Heavy Vehicles, %	8	8	8	8	7	7		7	7	2	2	2	2	9	9	9	9
Flow Rate (VPCE), pc/h	0	428	194	4	0	9	1	16	227	0	5	63	12	0	79	25	184
Right-Turn Bypass		No	one				None				No	one			N	one	
Conflicting Lanes			1				1					1				1	
Pedestrians Crossing, p/h			0				0				(	)				0	
Proportion of CAVs										0							
Critical and Follow-U	p Hea	dway	Adju	ustmer	nt												
Approach		E	B				WB				N	IB			9	SB	
Lane	Left	Rig	ght	Bypass	Left		Right	E	Bypass	Left	Rig	ght By	pass	Left	Ri	ght	Bypass
Critical Headway, s		4.9	763				4.9763				4.9	763			4.9	9763	
Follow-Up Headway, s		2.6	087				2.6087				2.6	087			2.6	5087	
Flow Computations,	Capaci	ity an	d v/o	c Ratio	s												
Approach		-	B		T		WB			T	N	IB			9	SB	
Lane	Left	Rig	ght	Bypass	Left		Right	E	Bypass	Left	Rig	ght By	pass	Left	Ri	ght	Bypass
Entry Flow (ve), pc/h		6	26				352	T			8	0			2	88	
Entry Volume, veh/h		5	80				329				7	8			2	.64	
Circulating Flow (v <sub>c</sub> ), pc/h		1	13				496				7(	01			1	30	
Exiting Flow (v <sub>ex</sub> ), pc/h		2	85				305				7	18			ŝ	38	
Capacity (cpce), pc/h		12	30			Т	832	Τ			6	75			12	209	
Capacity (c), veh/h		11	39			+	778				6	52			1	109	
v/c Ratio (x)		0.	51			1	0.42				0.	12			0	.24	
Delay and Level of Se	rvice	1									1						
Approach				EB		Τ		1	WB			NB				SB	
Lane			Left	Righ	t Bypa	iss	Left	R	ight	Bypass	Left	Right	Bypass	Lef	t	Right	Bypass
Lane Control Delay (d), s/veh				9.0	_			1	0.1			6.8				5.5	
Lane LOS				A		+		$\square$	В			А				А	
95% Queue, veh				3.1		+			2.2			0.4				0.9	
Approach Delay, s/veh   LOS			9.	.0	A		10.	1		В	6.8		A		5.5		A
Intersection Delay, s/veh   LOS						8.4								A			
				H	CS Ro	unc	labo	uts	s Rep	oort							
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<b>General Information</b>			_			_	_	_		matio	n			_	_	_	
Analyst	Emma	a Myers-	Verha	ge				A		Inters	ection		<b>—</b>	Highw	/ay 141	6 and L	iberty Bl
Agency or Co.				E,				E/W S	Street Na		Highway 1416						
Date Performed	8/3/2023							N/S S	N/S Street Name				Liberty Blvd				
Analysis Year	2030	2030								Analy	vsis Time	Period, hr	s	1.00			
Time Analyzed	PM Pe	PM Peak			Pe				Peak	Hour Fac	0.84						
Project Description	· · ·			J.					Jurisc	liction	Box Elder, SD						
Volume Adjustments	and S	ite Cl	narao	teristi	cs	_											
Approach		E	EB				WB				N	IB		SB			
Movement	U	L	Т	R	U	L		г	R	U	L	Т	R	U	L	Т	R
Number of Lanes (N)	0	0	1	0	0	0	-	1	0	0	0	1	0	0	0	1	0
Lane Assignment				LTR				LT	R			LTR					LTR
Volume (V), veh/h	0	97	83	13	0	7	6	4	66	0	8	16	2	0	125	26	107
Percent Heavy Vehicles, %	8	8	8	8	7	7	-	7	7	2	2	2	2	9	9	9	9
Flow Rate (VPCE), pc/h	0	125	107	17	0	9	8	2	84	0	10	19	2	0	162	34	139
Right-Turn Bypass		No	one				None				No	one			N	one	
Conflicting Lanes		1 1 1 1															
Pedestrians Crossing, p/h		0			0					0				0			
Proportion of CAVs 0																	
Critical and Follow-U	p Hea	dway	Adj	ustme	nt												
Approach		E	B				WB			NB						SB	
Lane	Left	Ri	ght	Bypass	Left		Right	В	ypass	Left	Rig	ght By	/pass	Left	R	ight	Bypass
Critical Headway, s		4.9	763				4.9763				4.9763			4.9763		9763	
Follow-Up Headway, s		2.6087				2.6087			2.6087			2.6087					
Flow Computations,	Capaci	ity an	d v/	c Ratic	s												
Approach	<u> </u>	E	B				WB	_			N	IB				SB	
Lane	Left	Ri	ght	Bypass	Left	Left Right		В	ypass	Left	eft Right By		pass	Left R		ight	Bypass
Entry Flow (ve), pc/h		2	49				175	T			3	1			3	35	
Entry Volume, veh/h		2	31				164	$\top$			3	0			3	807	
Circulating Flow (v <sub>c</sub> ), pc/h		205 154 394 10						01									
Exiting Flow (v <sub>ex</sub> ), pc/h		271 231 228 60															
Capacity (c <sub>pce</sub> ), pc/h		11	120		1179 923					23			1	1245			
Capacity (c), veh/h		1(	)37			1102				905			1142				
v/c Ratio (x)		0.	.22				0.15	T			0.	03			C	.27	
Delay and Level of Se	ervice										1						
Approach				EB		Т		V	NB			NB		Т		SB	
Lane			Left	Righ	t Bypa	iss	Left	Ri	ight	Bypass	Left	Right	Bypass	: Le	eft	Right	Bypass
Lane Control Delay (d), s/veh				5.6				4	4.6			4.3		T		5.7	
Lane LOS				A					A			А				А	
95% Queue, veh				0.9				(	0.5			0.1				1.1	
Approach Delay, s/veh   LOS			5	.6	A		4.6			A	4.3		A	$\square$	5.7		A
Intersection Delay, s/veh   LOS	S					5.3								A			
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				Н	CS	Rou	ndal	bou	ts Re	port									
General Information								_	Infor	_	on								
Analyst	Emma	Myers-	Verha	ge	Т		4			Inte	rsectio	n			Highw	ay 14	16 and L	iberty Bl	
Agency or Co.					- E/				E/V	E/W Street Name					Highway 1416				
Date Performed	8/3/2023									N/S Street Name				Liberty Blvd					
Analysis Year	2050	2050									Analysis Time Period, hrs				1.00				
Time Analyzed	PM Pe	PM Peak				Pei				Peak Hour Factor				0.84					
Project Description	Altern	ative 1				Ju					Jurisdiction				Box Elder, SD				
Volume Adjustments	and S	ite Cl	narae	terist	ics														
Approach		E	ΕB		Т	WB					NB					SB			
Movement	U	L	Т	R	Т	U	L	Т	R	U	L		Т	R	U	L	Т	R	
Number of Lanes (N)	0	0	1	0	Т	0	0	1	0	0	0		1	0	0	0	1	0	
Lane Assignment				LTR	Τ				LTR				LTR		LTR			LTR	
Volume (V), veh/h	0	99	86	13	Т	0	7	66	69	0	8		16	2	0	131	27	110	
Percent Heavy Vehicles, %	8	8	8	8	Т	7	7	7	7	2	2		2	2	9	9	9	9	
Flow Rate (VPCE), pc/h	0	127	111	17	Т	0	9	84	88	0	10	,	19	2	0	170	35	143	
Right-Turn Bypass		No	one		Т		No	one				No	ne			١	None		
Conflicting Lanes	1 1 1 1																		
Pedestrians Crossing, p/h	0			Τ	0					0				0					
Proportion of CAVs 0																			
<b>Critical and Follow-U</b>	p Hea	dway	Adj	ustme	ent														
Approach		E	EB		Τ	WB				NB				SB					
Lane	Left	Ri	ght	Bypass	5	Left	Rig	ght	Bypass	Le	ft	Rig	jht By	pass	Left	F	Right	Bypass	
Critical Headway, s		4.9	763		Т			4.9763				4.9763				4.9763			
Follow-Up Headway, s	2.6087		Τ	2.6087					2.6087				2.6087						
Flow Computations,	Capaci	ity an	d v/	c Rati	os														
Approach		E	B		Т		W	/B				Ν	В				SB		
Lane	Left	Ri	ght	Bypass	;	Left Right		ght	Bypass	Le	ft	Rig	jht By	pass	Left	Left Right		Bypass	
Entry Flow (v <sub>e</sub> ), pc/h		2	55		Т		18	31				3	1				348		
Entry Volume, veh/h		2	36		Т		16	59				3	0				319		
Circulating Flow (vc), pc/h		2	214 156						408					103					
Exiting Flow (v <sub>ex</sub> ), pc/h		283 237 234							61										
Capacity (c <sub>pce</sub> ), pc/h		11	109		Τ	1177				910				1242					
Capacity (c), veh/h		1(	)27			1100				892			1140						
v/c Ratio (x)		0.	.23		Τ		0.1	15				0.0	03				0.28		
Delay and Level of Se	rvice																		
Approach				EI	3				WB				NB		Τ		SB		
Lane			Left	Rig	ht	Bypass	Le	eft	Right	Bypass	Le	ft	Right	Bypass	i Le	ft	Right	Bypass	
Lane Control Delay (d), s/veh				5.	7				4.6				4.3				5.8		
Lane LOS	A						А				А				А				
95% Queue, veh				0.	9				0.5				0.1				1.2		
Approach Delay, s/veh   LOS			5	.7		А		4.6		А		4.3		A		5.8		A	
Intersection Delay, s/veh   LOS							5.4								A				

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HCSTM Roundabouts Version 2023 Hwy1416-Liberty\_Alt2\_PMPeak2050.xro

# Appendix H: Public Input Meeting Summaries

Radar Hill - 1416 Corridor Study



Radar Hill Road & Highway 1416 Corridor Study Public Input Meeting #1 Box Elder Community Center June 20, 2023 5:30 - 8:00 P.M. MST

## **Meeting Discussion Points**

#### Meeting Attendees

See attached

#### • Welcome & Presentation

- Steve Grabill welcomed attendees to the meeting.
- Steve Grabill provided a PowerPoint presentation that included bullets and graphics highlighting the corridor study area, as well as data that had been collected and analyzed to date.
- Steve Grabill reviewed the schedule for the project, noting that another public meeting is scheduled for September to present preliminary design concepts intended to address corridor needs. This meeting will receive further input on needs and public response to the design concepts. He also noted that a Study Advisory Team comprised of FHWA, State, Metropolitan Planning Organization (MPO), Pennington County and Box Elder officials and staff were providing key direction for the study.
- The presentation covered study objectives, known issues, currently planned improvements, traffic volume and crash data, existing conditions traffic operations and pedestrian/bicycle analysis results.
- Attendees were asked to provide comments verbally, through a printed comments sheet, via email, and through the website.
- Public Comments
  - An open house opportunity was offered prior to and after the formal presentation.
     Board displays and roll plots of the two corridors were available for viewing and discussion. Staff were available to discuss specific concerns attendees had during, prior to and after the formal presentation.
  - Following the presentation, Steve Grabill led a discussion of corridor needs and issues.
  - Attendee comment: How is the study being paid for? Mr. Grabill responded that it was paid with approximately 80% federal dollars through the MPO, with the local match split between Pennington County and Box Elder.

NATIONAL PERIPECTIVE ESCIENCE EXTERNES TRUETED ADVICE



- Attendee comment: Concern was raised regarding overall traffic capacity of the corridors.
- $\circ$   $% \left( Attendee \ comment: \ Some \ crashes \ are \ not \ reported, \ so \ actual \ safety \ issue \ could \ be \ worse. \label{eq:some constant}$
- Attendee comment: Concern with detours during Exit 63 construction.
- Attendee comment: I prefer Hwy 1416 and Box Elder Road be combined into a 5-lane and removing the divided highway. Highway 1416 turn movements are not intuitive.
- Attendee comment: Coordination needs to happen between the Hwy 1416 improvements and the Exit 63 project.
- Attendee comment: Traffic control along Hwy 1416 is confusing. Non-intuitive turns where yield for one direction and not the opposite direction.
- Attendee comment: Comments were made that Hwy 1416 was originally built to facilitate Ellsworth Air Base traffic more than traffic for local use.
- Attendee comment: Radar Hill Road is not safe for use by pedestrians or bicyclists.
- Attendee comment: Crash analysis should investigate run-off-the-road crashes. This is particularly a problem in winter with icy conditions along Hwy 1416.
- Attendee comment: Truck traffic has increased and is causing excessive road damage and requires wider turns.
- Attendee comment: Corridor improvements need to take into account growth, impacts to rural residents. Impacts to agricultural land and irrigation should be considered.
   Urban development occurring in rural areas needs to be better planned and the impacts need to be better considered.
- Attendee comment: High speeds have been observed along Radar Hill Road. Corridor improvements should include pull-offs for law enforcement.
- Attendee comment: Access to Box Elder parks should be provided for pedestrians and bicyclists.
- Attendee comment: The traffic peak for Ellsworth Air Base occurs at 6:30 and not 7:00. Mr. Grabill responded that the 7:00 traffic peak came from actual collected data, but that he would verify that there was not a mistake.
- Attendee comment: A stop sign or signal on westbound Hwy 1416 should be added to promote use of Liberty Boulevard by Air Base traffic.
- Attendee comment: Add an acceleration lane on Hwy 1416 for traffic heading east from Radar Hill Road.
- Attendee comment: Add a stop sign to Hwy 1416 as a short-term improvement at Ellsworth Road. The Ellsworth intersection should be a 4 way stop.
- Attendee comment: Concern about runoff along Hwy 1416 during a large storm event. This was also a problem on Radar Hill Road where they had to detour traffic so they couldn't drive on Radar Hill Road.
- Attendee comment: Concern about irrigation ditches being used for runoff.
- Attendee comment: Are Twilight Drive and Cheyenne Boulevard being studied as part of this project?



- Attendee comment: Are new schools considered as part of this project? Mr. Miller responded that the study area was extended further east to account for the new school at Liberty Boulevard. Mr. Grabill said the new school along Creekside Drive was being considered as well.
- Attendee comment: Roundabouts should be considered as a viable traffic control alternative along Hwy 1416.
- Attendee comment: Unique solutions used in other states (such as Colorado) should be considered to address traffic problems here.
- Attendee comment: Disappointment was expressed that more people didn't attend the meeting. Other methods to advertise the next public meeting should be undertaken.

After the formal presentation was completed, members of the public joined staff and informally discussed the project. The meeting adjourned at 8:00 p.m.

ATTENDANCE LIST	<b>KL</b> J
Tuesday, June 20, 2023 Box Elder, SD	
Pennington C Highway 1416	ounty 5 and Radar Hill Road
NAME	ORGANIZATION/BUSINESS ADDRESS/EMAIL
Jay Schwizerbach	315 Ruhe LN, BOX ELLON
Travis Luseter	Penn. Lo. Boc.
JASON MUSUNISSOM	POWN. CO. PEANNENG
Miké Guera	CITY OF BOX ELDER CIMERSet By a house
Tomillain	Realtor - Homeowne Anderson B

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	<b>K</b> LJ
ATTENDANCE LIST Tuescoy, June 20, 2023 Box Bdes, 50	
Pennington C Highway 141	6 and Radar Hill Road
Steve Grabill	KLI
Dana Forman	Kerst
Mini Dieback Ray+ Stacy Campbell	wazoo29 Chotmail.com
Jin HAYWARD	7860 Long View Rd
Jay Wickhan	14791 Martight Drive catholic day 73700000
Tim Trucklood	torvideland (2) 791. Com
Marie Trueblood	october@gri.net.
Tim Rk	SEDOT
Then MULTURY SMENN'E NUTTER JOE MALER	DIET 35 STATE REPRESENTATIVE 6600 Long View 12d/Hunutter@MASh.com 950000 Hogy

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Radar Hill Road & Highway 1416 Corridor Study Public Input Meeting #2 Box Elder Community Center September 19, 2023 5:30 - 8:00 P.M. MST

## **Meeting Discussion Points**

#### Meeting Attendees

• See attached

#### • Welcome & Presentation

- Steve Grabill welcomed attendees to the meeting. He said that the Study was being completed on behalf of the SDDOT, Metropolitan Planning Organization (MPO), Pennington County and Box Elder.
- Steve Grabill provided a PowerPoint presentation that included bullets and graphics highlighting the study process and schedule, future conditions, interim corridor options and analysis, and conceptual corridor design options and analysis.
- Steve Grabill noted that a concept to build Highway 1416 in the current location of Box Elder Road was eliminated due to the many accesses along Box Elder Road, noise, safety, and traffic engineering reasons.
- A variety of intersection improvement concepts were shown for the Radar Hill Road and Ellsworth intersections along Highway 1416. Radar Hill Road Concept 1(Signals) & Concept 3 (Roundabout) were compared, with most staff support for the roundabout concept. This concept included cross arms to prevent cars from stopping on the railroad tracks. Since a roundabout splitter island would cut off through traffic from using Box Elder Road, this concept eliminated access to Gumbo (north extension of Radar Hill Road. All concepts improved pedestrian/bicycle crossings across Highway 1416.
- Steve Grabill noted that another public meeting is tentatively scheduled for March 2024 to present the draft Corridor Study Report. Attendees were asked to provide comments verbally, through a printed comments sheet, via email, and through the website. Attendees were also encouraged to offer feedback during the presentation.

#### • Public Comments

An open house opportunity was offered prior to and after the formal presentation.
 Board displays and roll plots of the design options for Highway 1416 and Radar Hill

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Road were available for viewing and discussion. Staff were available to discuss specific concerns attendees had during, prior to and after the formal presentation.

- Attendee comment: Joe Miller said for the interim stop signs that they plan on rubble strips, message boards, control signs for the intersections, but waiting to see the input from this public meeting. He also said it may take some time to implement the interim improvements.
- Attendee comment: Roundabouts may create problems for trucks. A tow truck driver said he can be towing a full semi with trailer, and he didn't think the roundabouts would allow him to pass through. Joe Miller noted that the severity of impact and number of conflict points are less in roundabout alternatives.
- Attendee comment: Concern in ability of roundabouts to handle trucks (with triples) turning, consider emergency response times and consult with the fire department.
- Attendee comment: Concern was raised that some semi-trucks are triples from freight company Old Dominion. Skyburg also has centipede trucks.
- Attendee comment: There is potential for a railroad crossing being added at West Gate Drive.
- Attendee comment: Ellsworth Road should have stop signs at Box Elder Road. Also, signing and striping should prohibit vehicles from blocking Box Elder Road.
- Attendee comment: Property owners along Radar Hill Road were concerned about their property being acquired for the wider road and sidewalk. Mr. Grabill said he didn't think additional property would be acquired along Radar Hill Road but that he would need to confirm that.
- Attendee comment: Concern was raised about how trucks would be accommodated if Box Elder Road does not connect directly onto Ellsworth Road.
- Attendee comment: Concerns were raised regarding the Displaced Left Turn option. Statements were received that it wouldn't work well if pavement markings are covered by snow. Also, there was concern if signals were not properly coordinated. A comment was also made that the option would be confusing to drive through.
- Attendee comment: A comment was made that trucks on Liberty find out they are going the wrong way and end up making a U-turn at the Highway 1416 intersection. Perhaps some signing can provide better direction or other accommodations can be made.
- Attendee comment: What will be the speed limit along Highway 1416? Mr. Grabill responded that the speed limit has not been determined yet. He added that if roundabouts are chosen as a preferred option, they generally have an impact of slowing traffic down. Joe Miller added that enforcement is important. The county tries to stay within 85% of the present corridor speeds.
- Attendee comment: Concern was raised regarding fire department access with roundabouts.
- Attendee comment: Comments both for sidewalks and against sidewalks were received. A resident was concerned about undesirable situations on a sidewalk that would be abutting his property. Another attendee responded that life safety is



important, he was in favor of sidewalks and added that street lighting would be another important improvement.

- Attendee comment: What improvements will be made at Commercial Gate Drive? Mr. Grabill responded that the current layout shows southbound left turns being prohibited. However, he said that he hadn't met with Ellsworth Air Force Base yet, and they would likely have project needs that have not yet been considered.
- Attendee comment: There needs to be coordination with the Exit 63 project.
- Attendee comment: Questions were raised concerning how quickly improvements might be made, and what locations might be prioritized first. County staff said interim options could be implemented soon, but that would depend on availability of contractors, especially for rumble strip installations. Mr. Grabill said that other, more expensive improvements are needed now, but implementation will be subject to available funding.

After the formal presentation and joint comment period was completed, members of the public joined staff and informally discussed the project. Attendees were told they could continue to comment through the website, and that another meeting was tentatively scheduled for March 2024 to present the draft corridor study report. The meeting adjourned at 8:00 p.m.



Radar Hill Road & Highway 1416 Corridor Study Public Input Meeting #3 Box Elder Community Center February 29, 2024 5:30 - 7:00 P.M. MST

## **Meeting Discussion Points**

#### Meeting Attendees

See attached

#### • Welcome & Presentation

- Steve Grabill welcomed attendees to the meeting. He said that the Study was being completed on behalf of the SDDOT, FHWA, Metropolitan Planning Organization (MPO), Pennington County and Box Elder.
- Steve Grabill provided a PowerPoint presentation that included bullets and graphics highlighting the study process and schedule, recommended corridor and intersection alternatives, and next steps in the report approval process.
- Estimated costs for the recommended alternatives were included as a table in the PowerPoint presentation.
- Copies of the draft Corridor Study Report were available at the meeting. Attendees were asked to provide comments verbally, through a printed comments sheet, via email, and through the website. Attendees were also encouraged to offer feedback during the presentation.

#### • Public Comments

- Concern was raised that the project eliminates access onto 1416 and no left turns off 1416 will affect fire truck access.
- Roundabouts to function as turnaround "U-turn"? Mr. Grabill responded that was correct.
- How are traffic crossings for pedestrians handled and questions about whether signal lights can address pedestrian crossings. Mr. Grabill showed on the displays how pedestrian crossings along 1416 were being addressed. He said it is possible, especially for pedestrian crossings across a multi-lane roundabout, to signalize the crossing. These decisions would be made during design.
- A traffic signal at Gumbo Drive is better. Still close Gumbo but install Signal.
- After questions were raised about corridor speed, Mr. Grabill said the design speed on each roundabout is 20 mph and on 1416 is 45 mph.



- Are you planning an Asphalt or Concrete Road surface? Mr. Grabill said asphalt.
- Question About removing people from floodplain. Mr. Grabill said the expectation is that no additional fill material would be placed in the floodplain, and perhaps some can be removed. He didn't know whether the result could be that some people would be removed from the floodplain.
- More discussion about fire department access @ Commercial Gate. City staff responded that the fire department would be involved in reviewing design proposals.
- There was general discussion about U-turns for semi-trucks at 1416 & Liberty.
- A comment was received about the proposed 151<sup>st</sup> Ave left turn lane. Mr. Grabill said the project would also hopefully straighten out the intersection skew.
- Roundabout at Commercial Gate? Can a roundabout be added? Mr. Grabill responded that it may be possible but was not evaluated.
- Thank you for Stop Signs that were added.
- Concerns controlling the speed down in the roundabouts.
- Concerns about turning left or right in the roundabout. Mr. Grabill said the curvilinear design helps to facilitate proper use of the roundabouts.
- Sidewalks safe in the roundabouts, pedestrians push button cross. Mr. Grabill said crossing one lane, not multiple lanes for pedestrians helps pedestrian safety in the roundabouts.
- Close off Gumbo Road concern, why can't you put signals. Mr. Grabill said the roundabouts were a safer alternative from a crash severity standpoint.

After the formal presentation and joint comment period was completed, members of the public joined staff and informally discussed the project. Attendees were told they could continue to comment through the website. The meeting adjourned at 7:00 p.m.



ATTENDANCE LIST	KL]
Thursday, February 29, 2024 Box Elder, SD	
Pennington ( Highway 141	County 6 and Radar Hill Road
NAME	ORGANIZATION/ADDRESS/EMAIL (Dptional)
Steve Grabill	KLJ / Plapid City
Eleen Menzla	BoxElder,5D.
Jae Mrysee	PESANCO
Hany & Amith	Radan Hills Dr
Jory Jarson	City of BE
Est Fruis Arthins	Bay Elder Rd, Bay Elder
Rich Holzer	
Whe striends Bran	11 /
ingr. Amondo Schonzon bac	Box Eldo
Just Taplor	BEPD
Dan Baun	Dap Ada Redon Hills Rd.
Gary Walton	301 Crocus Ct, Bexeldy

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ATTENDANCE LIST	KL]
Thursday, February 29, 2024 Box Elder, SD	
Pennington C Highway 1416	ounty 5 and Radar Hill Road
NAME	ORGANIZATION/ADDRESS/EMAIL (Optional)
CARMLYN ZIERRE	234 MOCKING BIRD OR 605430-6323 Suc. a. 22 @ Yakusi con
Lucille Smith	BOXEIdar
Curt & Sander Mein	128 Box Flder all a) Box Elder
Mott Schoot !	word Row Electric
Dustin Hall	10718 NEIL YOUR Red Regard C. 44. 50
Jerald Maine	607 W Sunnydale Rd. Sop Elda
Dana Frances	DGR 1313 E. St At St.
Matt Corcora	KLJ
SARAH GILKERSON	SDDOT
Julic Ruston	KUJ
Tin Hortman	k UT
Timthompson	

Матюнах навочастна Варнома, ватотая Пелатор аруара



ATTENDANCE LIST	<b>KL</b> J
Thursday, February 29, 2024 Box Elder, SD	
Pennington Co Highway 1416	and Radar Hill Road
NAME	ORGANIZATION/ADDRESS/EMAIL (Optional)
Kohina Breekland	ADDAT MODE Broadway Pine, 4P 57511
Tara Sirles	308 Sox Elder Ed W. B.E. 57719
Brenda Degen - Whiting	4000 N. Ele Vale Rd RC SD 57701

Матюна, наконстича Варнома, вотектая Тилитер аруара



18 East Main Street, STE. 229 Rapid City, SD 57701-2949 605-721-5553 KLJENG.COM

## Memorandum

Date: 4/5/24

To: Hwy 1416/Radar Hill Project Team (Joe Miller, Sarah Gilkerson, Doug Curry, Cassie Furchner, Mike Carlson, Michael Gubka, Jennica Wilcox, Kip Harrington, Eric Radke) Copy to: Steve Grabill, PE, PTOE From: Mark Powers, PE, PTOE RE: Hwy 1416 Connection to W Gate Rd

### Introduction

This memo was created in support of the Highway 1416/Radar Hill Road corridor study. In the public comment period following the Public Input Meeting on February 29, 2024, the project manager received an email from a citizen of Box Elder, SD. The citizen stated that they lived on Box Elder Road near the Yesway convenience store. Their expressed concern was that the proposed layout for Highway 1416 as part of this project, combined with the layout currently in development for the Exit 63/Highway 1416 and I-94 interchange project, limits the mobility for them and other citizens and businesses in the area.

## Project Background

The Highway 1416/Radar Hill Road study spans from just east of the W Gate Road Intersection to 151<sup>st</sup> Avenue on Highway 1416. The design for the W Gate Road intersection is part of the Highway 1416 and I-94 interchange reconstruction project which is currently in its design phase. The current plans for the W Gate Road intersection are shown in **Figure 1**. As shown, the planned design will close access from Box Elder Road to W Gate Road to improve safety by eliminating the tight spacing between the intersections. The Yesway convenience store will have a private access on Highway 1416 that will be Right-In Right-Out (RIRO), but it will not connect to Box Elder Road.

Currently, there are two full access intersections on Highway 1416 between W Gate Road and Radar Hill Road. Radar Hill Road, Commercial Drive, and Ellsworth Road intersections are all currently full access as well. Study recommendations for the Highway 1416/Radar Hill Road project also include making the two full access intersections west of Radar Hill Road RIRO with median separation on Highway 1416. The proposed plan also recommends making the Radar Hill Road intersection a roundabout and eliminating the north leg of the intersection. The Commercial Drive intersection is proposed to be ¾ access where vehicles can enter Commercial Drive from both directions of Highway 1416 but can only exit heading westbound. The intersection at Ellsworth Drive is proposed to be a full access roundabout.



Figure 1 - West Gate Road Intersection Design



## Citizen's Concern

The citizen along Box Elder, SD which contacted the Project Manager currently lives on Box Elder Road east of the Yesway convenience store. The concern raised by the citizen was that the design and concept of the two projects make traveling east on Highway 1416 or south on Radar Hill Road difficult for residents and businesses north of Highway 1416 on the west side of town.

#### Travel to East on Highway 1416

With the two project plans there are two ways to complete this movement:

- All vehicles can travel east on Box Elder Road to Ellsworth Road and use the roundabout at Ellsworth Drive and Highway 1416 to continue east. This route is expected to add about 1-2 minutes in travel time to what drivers are currently experiencing along the corridor.
- Personal vehicles can also use one of the RIRO intersections to travel west on Highway 1416 and make a U-turn at the W Gate Road signal to continue east. This route is expected to add 0.6-1.5 minutes in travel time to what drivers are currently experiencing on the corridor. With a 6-foot



median and two lanes of eastbound travel at the W Gate Road intersection, passenger cars are expected to be capable of making this maneuver, but larger vehicles are not expected to be able to make the tight turn.

#### Travel to South on Radar Hill Road

With the two project plans there are two ways to complete this movement:

- All vehicles can travel east on Box Elder Road to Commercial Gate and use the RIRO intersection to travel west on Highway 1416 to Radar Hill Road. Based on travel speed and distance, this route is expected to add 1.5 minutes in travel time to what drivers are currently experiencing on the corridor.
- Passenger car vehicles can also use one of the RIRO intersections to travel west on Highway 1416 and make a U-turn at the W Gate Road signal to continue east to Radar Hill Road. Based on travel speed and distance, this route is expected to add 0.6-1.5 minutes in travel time to what drivers are currently experiencing on the corridor. With a 6-foot median and two lanes of eastbound travel at the W Gate Road intersection personal vehicles are expected to be capable of making this maneuver, but heavy vehicles of any size are not expected to be able to make the tight turn.

## **Alternative Solutions**

The Study Advisory Team (SAT) held a meeting on March 13, 2024 specifically to address this issue. The SAT discussed numerous potential changes to the proposed concepts that could address the concern raised. Ultimately, all the potential changes were eliminated from consideration. The discussion on conceptual solutions is summarized in **Table 1**.

Alternative Solutions	Reasons for Consideration/Elimination
Move the Radar Hill roundabout 75' to the south in order to fit a north leg	<ul> <li>Moving the roundabout would put it closer to the train tracks and create a potential conflict with the northbound queues and oncoming trains.</li> <li>Adding a north leg with minimal distance between Box Elder Rd and Hwy 1416 would have a similar safety risk as it currently does.</li> </ul>
Change the planned traffic control for W Gate Rd at Hwy 1416 to a roundabout	<ul> <li>With the planned additions of roundabouts on Hwy 1416 at Radar Hill Rd and Ellsworth Dr on this study, installing a roundabout at W Gate Road would create a homogenous network of intersection control on the corridor.</li> <li>The roundabout control type was evaluated by the SDDOT but rejected due to operational concerns and poor level of Service.</li> </ul>

#### Table 1 - SAT Discussion Summary



Create a full access intersection on Hwy 1416 between W Gate Rd and Radar Hill Rd	<ul> <li>There are safety concerns with creating a full access intersection similar to the current issues. These issues would likely be made worse by anticipated increasing traffic volumes.</li> </ul>
Create a limited access intersection on Hwy 1416	<ul> <li>Historically, drivers in this area have had</li></ul>
between W Gate Rd and Radar Hill Rd with an	difficulty understanding an intersection
acceleration lane for southbound left-turning	like this and they have led to additional
vehicles to give them added time to merge	safety concerns.

## **Final Recommendation**

After considering all the described alternatives listed in **Table 1**, the SAT ultimately decided to maintain the currently planned roadway designs and intersection concepts. The W Gate intersection is wide enough for personal vehicles to make a west-east U-turn movement. Travel times for all displaced vehicle trips are not expected to be increased by more than 2 minutes.