

**Appendix D:
Traffic and Transportation Technical Memorandum for
the Deer Creek Station Project**

Basin Electric Deer Creek Station Project

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**TRAFFIC & TRANSPORTATION
TECHNICAL REPORT**

DEER CREEK STATION PROJECT

prepared for

Basin Electric Power Cooperative

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Project No. 51236

prepared by

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1.0 GENERAL INFORMATION

This report presents the findings of a study of the local transportation infrastructure that will serve the construction and operations of a new 300-megawatt natural gas generation facility proposed by Basin Electric Power Cooperative in Brookings County, South Dakota. The project is referred to as the Deer Creek Station Project, and is located approximately 10 miles northeast of the city of Brookings. Two sites were originally considered by Basin Electric for the proposed facility. This study is primarily focused on White Site 1 in the northeast quarter of Section 25, of Township 111N, Range 48W study area (Figure 2-1).

* * * * *

2.0 EXISTING CONDITIONS

Interstate I-29 is the major regional transportation element in the study area and is located approximately 11 miles west of the Deer Creek Station Project Site. The primary east-west highways in the study area are South Dakota (SD) Highway 30 about 2.5 miles north of the site, and US Highway 14 about six miles to the south. The site is locally served by a well defined system of low volume paved and gravel roadways, essentially located on the grid line defined by the land section lines. The roadways and pavement types in the vicinity of the site are displayed in Figure 2-1. The roads adjacent to and leading to the site are gravel roads as are many of the unmarked roads in Figure 2-1. The gravel and paved roads identified in Figure 2-1 are anticipated to be those used to access the proposed site, White Site 1 or alternate site, White Site 2.

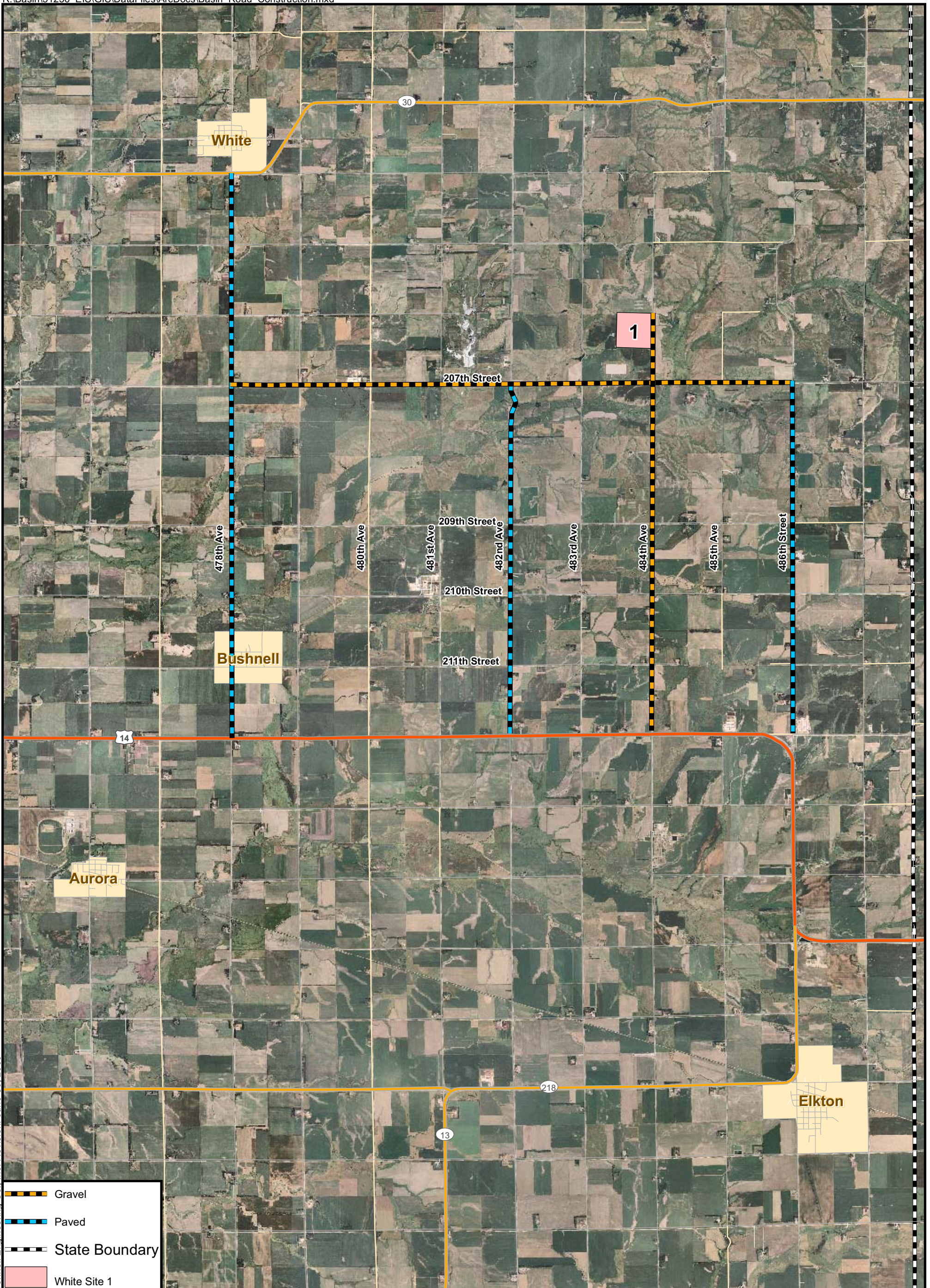
2.1 TRAFFIC VOLUMES





Average daily traffic volumes (ADT) published on the 2008 South Dakota Traffic Flow map indicate the following volumes for the highways that are anticipated to carry the majority of the project construction traffic to White Site 1 (Table 2-1).

Table 2-1: 2008 Average Daily Traffic Volumes

Route	Average Daily Traffic	% Trucks
I-29 South of Brookings	11,420	18%
US Highway 14 approximately 1 mile east of Brookings	4,625	10%
US Highway 14 near 482 nd Avenue	1,710	15%
SD Highway 30 near White	700	5%

Application of a peak hour-to-daily ratio (referred to as ‘k-factor’) of 10% for a typical rural environment, and a 60% / 40% directional split yields peak hour volumes per lane that are well below the capacity of the roadways. In general, two lane roads such as US Highway 14 and SD Highway 30 can carry approximately 16,000 vehicles per day per lane, or 32,000 ADT without causing congestion. This correlates to general observations of free traffic flow conditions along these routes during peak periods. The county and gravel roads are considered low volume roads which are defined as roads that carry less than 400 ADT, and subsequently carry traffic at adequate service levels.



	Gravel
	Paved
	State Boundary
	White Site 1

Source: USDA/FSA- Aerial Photography
Field Office; ESRI; Basin Electric Power Cooperative

0 1 2 4 Miles



Figure 2-1
Deer Creek Station
Pavement Types
Basin Electric Power Cooperative
Brookings County, SD

2.2 PAVEMENT TYPES AND BRIDGES

2.2.1 Interstate 1-29

Approximately 10 miles of I-29, from mile road marker (MRM) 133 near Brookings (located between exit 132 and exit 133) north to MRM 143 (approximately two miles north of exit 140) , fall within the study area. I-29 within the study area carries a concrete surface with an asphalt overlay from MRM 133 to MRM 139 and a concrete surface from MRM 139 to MRM 143 that was completely rebuilt in 2007 and 2008.

There are three bridges on I-29 within the Project Area, two located at MRM 134.94 and one located at MRM 141.45, and all with functional adequacy and in good condition, as indicated by the federal sufficiency ratings, which are based on a 100 point maximum.(Table 2-2).

Table 2-2: I-29 Bridges in Study Area

Structure Number*	MRM	ADT	Federal Sufficiency Rating
06184074	141.45	3565	96.5
06184139	134.94	4355	96.5
06185139	134.94	4355	96.5

*Source: SDDOT State Owned Structures Report, 2008

2.2.2 US Highway 14

Approximately 18 miles of US Highway 14, from I-29 exit 132 at Brookings east to the South Dakota/Minnesota border, fall within the study area. US Highway 14 from I-29 east for two and a half miles to 475th Avenue carries an asphalt surface (Photo 2-1) and the remainder, from 475th Avenue east to the South Dakota/Minnesota border, carries a concrete surface. Detailed surface information can be found on page 7 of the South Dakota Department of Transportation Surfacing Log. There are three bridges, located at MRM 422.54, MRM 423.53, and MRM 423.85, on US Highway 14 between I-29 and Aurora, all with adequate federal sufficiency ratings (Table 2-3).

Photo 2-1: US Highway 14



Table 2-3: US Highway 14 Bridges in Study Area

Structure Number	MRM	ADT	Federal Sufficiency Rating
06194160	422.54	4635	97
06201160	423.53	4055	97.8
06204160	423.85	4055	97.8

*Source: SDDOT State Owned Structures Report, 2008

2.2.3 South Dakota Highway 30

Approximately 16 miles of SD Highway 30 (Photo 2-2), from approximately a mile and a half west of I-29 exit 140 to the South Dakota/Minnesota border, fall within the study area. All of SD Highway 30 within the study area carries an asphalt surface.

Photo 2-2: SD Highway 30



There are three bridges, located at MRM 358.53, MRM 357.71, and MRM 361.95, on SD Highway 30 within the study area, all with adequate federal sufficiency ratings (Table 2-4).

Table 2-4: SD State Highway 30 Bridges in Study Area

Structure Number*	MRM	ADT	Federal Sufficiency Rating
06185080	358.53	801	99
06178080	357.71	555	88.2
062190800	361.95	740	90.4

*Source: SDDOT State Owned Structures Report, 2008

2.3 COUNTY AND TOWNSHIP ROADS AND BRIDGES

Local roadways that are likely to carry project generated traffic are generally located along the legal land section lines, and fall within the jurisdiction of Brookings County, Richland Township, or Sherman Township as indicated in Table 2-5. Photo 2-3 is illustrative of the typical gravel roads in the area.

Photo 2-3: 207th and 484th Intersection – Looking West Along 207th



Table 2-5: County and Township Roadways

Roadway	Jurisdiction	Surface
207 th Street – 478 th Ave to 482 nd Ave	Brookings County	Gravel
207 th Street – 482 nd Ave to 484 th Ave	Sherman Township	Gravel
207 th Street – 484 th Ave to MN state line	Brookings County	Gravel
482 nd Ave – US 14 to 207 th Street	Brookings County	Asphalt
482 nd Ave – 207 th Street to SD 30	Brookings County	Gravel
484 th Ave – US 14 to 207 th Street	Richland Township	Gravel
486 th Ave – US 14 to 207 th Street	Brookings County	Asphalt
478 th Ave – SD 30 to US 14	Brookings County	Asphalt

Source: SDDOT State Owned Structures Report, 2008

There are several bridge span structures crossing Deer Creek or its tributaries with posted load restrictions in the immediate project area at the following locations (Table 2-6).

Table 2-6: County and Township Bridges in Study Area

Location	Jurisdiction	Posted Limits
207 th Street – 0.5 miles east of 484 th	Brookings County	17T/28T/32T
207 th Street – 0.2 miles east of 484 th	Brookings County	No Posted Limits-
484 th Ave – 0.2 miles south of 207 th	Richland Township	9T/14T/ 16T

Source: SDDOT State Owned Structures Report, 2008

In addition, there are several creek crossings on the county and township road system consisting of single and multi-culvert combinations, comprised of either corrugated metal or reinforced concrete pipe.

Routine maintenance of the Brookings County roads and bridges are generally maintained by county staff. The townships contract for their respective maintenance activities.

* * * * *

3.0 CONSTRUCTION IMPACTS

3.1 TRAFFIC GENERATION AND DISTRIBUTION

The Deer Creek Station project is expected to require up to 360 workers on site at the peak of construction. The majority of the workers are expected to originate from Brookings with others to be in adjacent communities. The distribution of the 360 project-generated trips is tabulated below, based upon the assumption that 250 workers will live within the 12-mile area defined by the Public Utility Commission (PUC) for this Project. The other 110 workers are anticipated to originate from outside of the study area. Worker distribution estimates were made based upon the existing available housing stock within each municipality (Table 3-1) and to present a worst case scenario, no car-pooling is projected.

Table 3-1: Geographic Distribution of Construction Work Force

City/Town	Workers
*Astoria	3
*Aurora	9
*Brookings	218
*Bushnell	1
*Elkton	12
*White	7
Clear Lake	1
DeSmet	2
Flandreau	3
Lake Benton, MN	1
Lake Norden	1
Madison	4
Pipestone, MN	6
Sioux Falls	64
Watertown	28
Total	360

* Municipality within the PUC 12-mile defined study area

Based on the assumed anticipated geographic distribution of the construction work force, traffic is conservatively estimated to increase on the regional roadway network noted in Table 3-2. These values are based on single vehicular occupancy for all workers, and no consideration for regular absenteeism. This provides a worst case scenario for traffic flow on local roads. As noted later in the Capacity Analysis section, even with the addition of the construction traffic all intersections will remain in good operating condition.

Table 3-2: Projected Roadway Assignment of Construction Traffic

Route	Traffic Increase (One-Way Trips)
I-29 north of Brookings	29
I-29 south of Brookings	71
US Highway 14 east of I-29	221
US Highway 14 east of 484 th Avenue	19
US Highway 14 at Aurora	9
SD Highway 30 from I-29 east	11
Total	360

3.2 EQUIPMENT AND MATERIALS SHIPMENT

Construction materials and equipment will be shipped and delivered to the site by either rail or truck. Rail shipments will be offloaded in Aurora and trucked over the roadway network to the project site. Shipments trucked directly will travel on Interstate I-29, US Highway 14 and the local gravel road network. Shipments coming from both north and south will likely travel over I-29 prior to leaving the interstate at Exit 132 to travel east on US Highway 14 prior to entering the local road network.

3.3 TRAFFIC ASSIGNMENT AND ROUTING

The vast majority of the traffic increase will be noticed on US Highway 14 from I-29 east to the project site turnoff road. An estimated 330 construction workers will travel to the project site on US Highway 14 east of Brookings, 19 will come from Elkton and points east in Minnesota and 11 will come from the north over SD Highway 30.

Construction traffic will be routed to the site via signage from US Highway 14 south of the site and SD Highway 30 to the north (Figure 3-1). From the east and west along US Highway 14, traffic will be routed north along 482nd Avenue, east to 207th Street, and north on 484th Avenue to the site. This will keep north-south traffic on the 482nd Avenue paved surface, and minimize traffic on the load posted Deer Creek bridges on 207th Street east of 484th Avenue. Where traffic turns northbound onto 484th Avenue from eastbound 207th Street, there is a “Y” intersection where westbound traffic on 207th turns northbound on 484th by cutting the corner. Those entering onto northbound 484th from westbound 207th currently have the priority movement, as the northbound traffic on 484th has a stop sign (see Photo 3-1). During construction at White Site 1 it would be advisable to place a yield sign for the traffic moving from

westbound 207th onto northbound 484th and remove the stop sign on 484th. This would be a new traffic control situation at this intersection so the following actions would need to occur:

- Remove the stop sign on northbound 484th Avenue at the 207th Street intersection
- Install a yield sign for westbound 207th Street traffic at 484th Avenue
- Install a changeable message board on westbound 207th Street approximately 100 yards prior to 484th Avenue intersection for a period of 60 days to advise motorists of the new intersection traffic controls
- Install a new construction traffic warning sign along westbound 207th at the intersection with 484th Street

Photo 3-1: 207th and 484th Intersection – Looking North on 484th



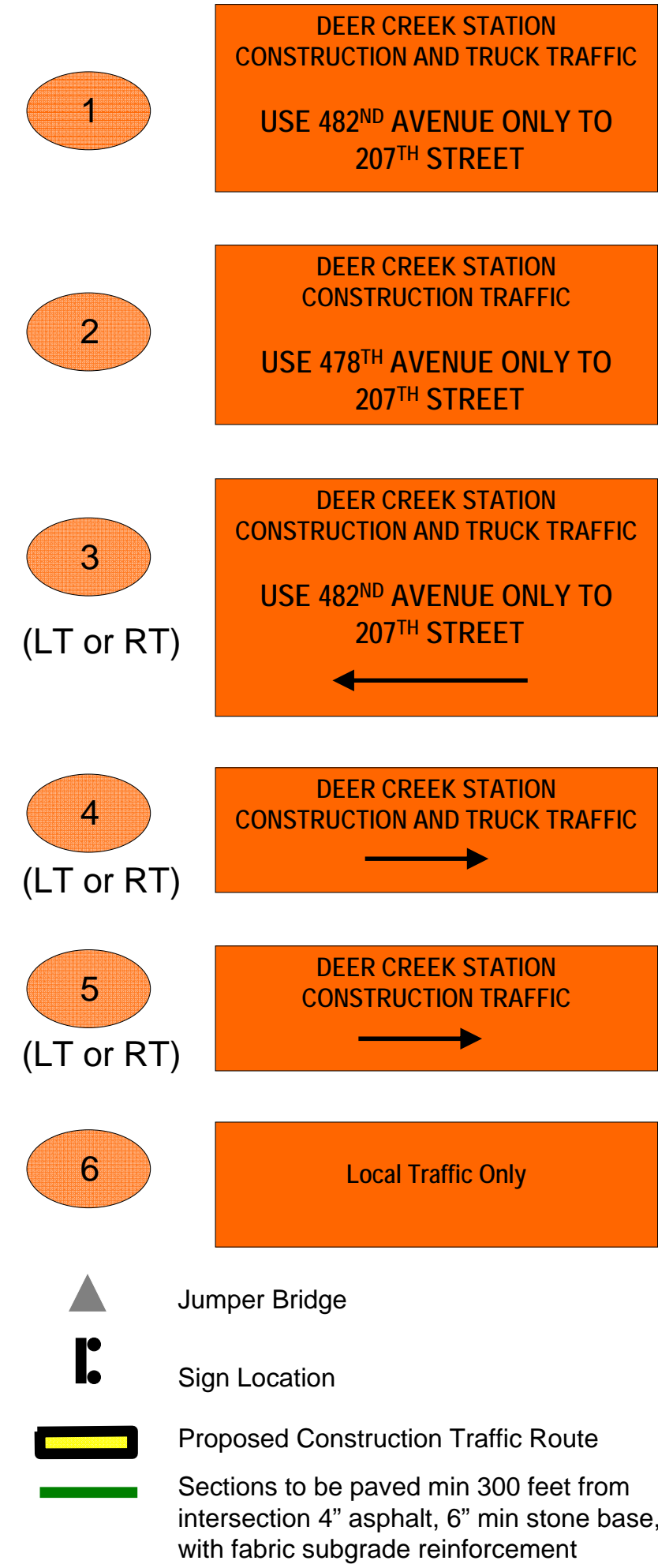
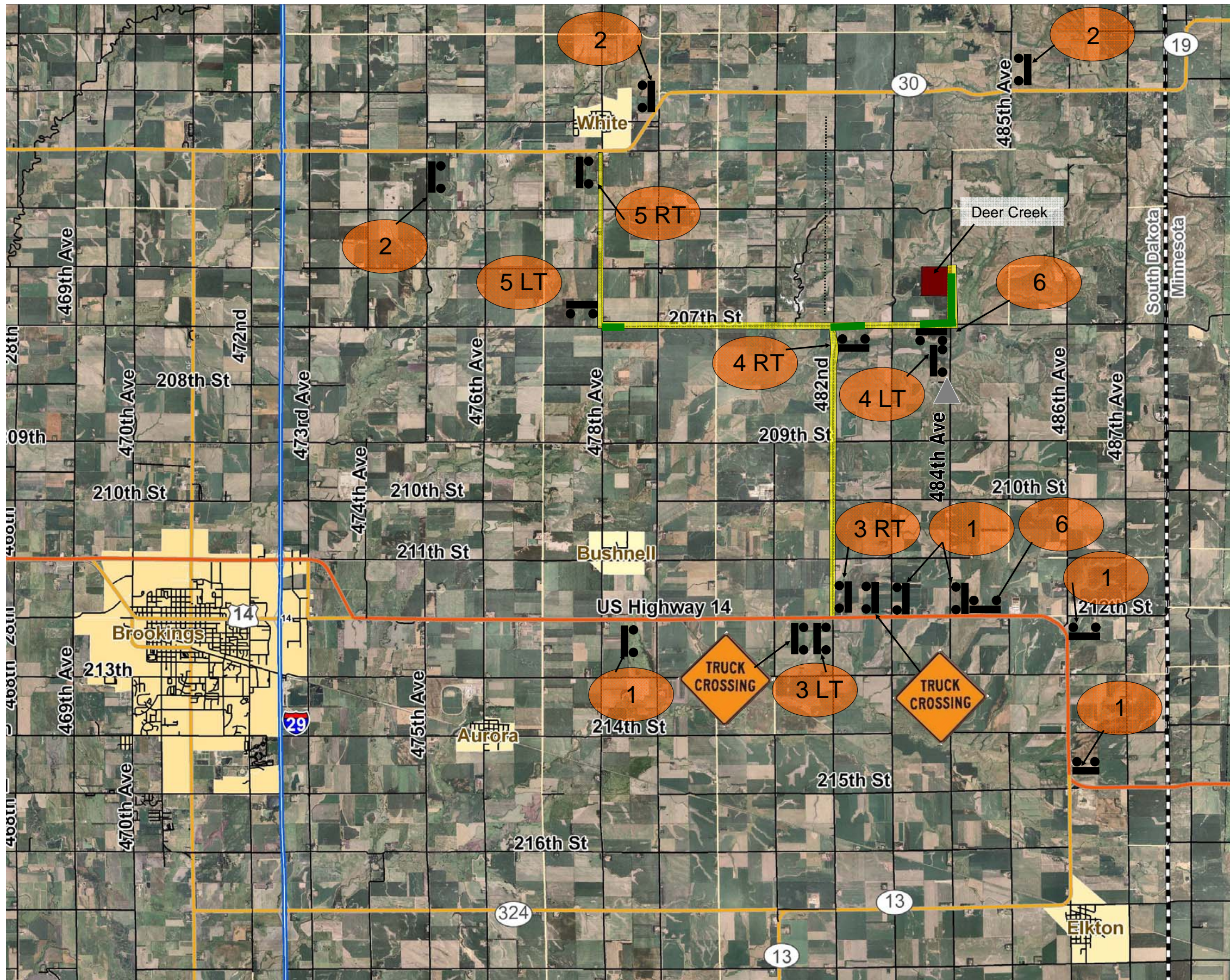
From the north, along SD Highway 30, traffic will be routed down 478th Avenue to 207th Street east to 484th Avenue, and north to the site.

In addition to daily construction traffic, the project is expected to receive approximately 1,000 truck deliveries during the course of the project which may include semi-trailer combinations. Delivery traffic will be routed similarly to regular construction traffic, to minimize traffic on the gravel surface of 484th Avenue south of 207th Street and over the Deer Creek bridges on 207th Street and 484th Avenue.

In addition to construction of the energy conversion facility there will be a crew working to build the necessary gas pipeline between White Site 1 and north of SD Highway 30, primarily along 485th Avenue. The gas pipeline will be built between July and September 2010 and the construction crew will consist of an estimated 70 workers. These workers will be in the area for approximately three months and should finish construction of the gas pipeline several months prior to peak construction of the power generation plan. It is reasonable to assume that all 70 of these workers will travel to the project site from the north via SD Highway 30 beginning at I-29 exit 140, as the existing gas line they are tapping into is approximately 12 miles north of the project site. None of the gas pipeline construction is scheduled to occur south of the project site.

3.4 HEAVY HAUL

Construction of the project is expected to require between 20-to-25 heavy haul loads delivered to the site, which will require transportation equipment of gross weights and dimensional characteristics in excess of standard over-the-road units. Basin Electric has initiated discussion of the heavy equipment deliveries with a specialty hauling firm to ascertain the loads and potential routes to the site. The firm has delivered transformers to proximate facilities using 483rd Avenue and turning onto 207th Street. However, for this project, they expressed their preference for not using this route due to the turn and grades. Instead, it was decided to use 484th Avenue directly from US Highway 14 and placing a temporary 'jumper' bridge (Figure 3-1) over the Deer Creek bridge structure, which may require some minor grading at the approaches.



**Figure 3-1 Recommended Signing and Pavement Improvements
Deer Creek Station Project**

3.5 CAPACITY ANALYSIS

Capacity as defined in the *Highway Capacity Manual* is the maximum rate of flow for a roadway segment or intersection under prevailing conditions. A volume to capacity ratio (v/c) greater than 1.0 is an indication of congestion and increased potential accident rates at the location in question. By observation, the local roadway grid network provides adequate capacity to meet current and projected traffic demands resulting from the Deer Creek Station project.

Approximately 90% of the work force is expected to access the site from US Highway 14 to 482nd Avenue. Capacity at this intersection was evaluated under current base conditions, and with projected peak construction traffic. Base condition peak hour traffic on US Highway 14 in the proximity to the intersection was developed from the 2008 South Dakota traffic flow maps. Additional construction traffic was then added based on the volume and geographic distribution as previously discussed

Intersection traffic operations are evaluated using levels of service (LOS), which are established in the Highway Capacity Manual as ranges of average delay per vehicle entering the intersection within a 15-minute analysis period. Ranges in delay, in terms of seconds/vehicle for each LOS are listed in Table 3-3 below:

Table 3-3: LOS Criteria for Stop Controlled Intersections

LOS	Average Delay (sec/veh)
A	< 10
B	10 - 20
C	20 - 35
D	35 - 55
E	55 - 80
F	> 80

Traffic at the intersection during the morning peak period was calculated to operate at acceptable LOS A under the base year condition and will remain at LOS A with the additive construction traffic. Capacity utilization (or volume/capacity) at the intersection is projected to increase from about 16% under the No-Build condition to about 44% with the additive construction traffic.

* * * * *

4.0 RECOMMENDATIONS

Certain signage and roadway improvements are recommended to provide an adequate roadway network to serve the transportation needs for the Deer Creek Station project during its construction, and ultimate operational life.

4.1 SIGNAGE PROGRAM

A comprehensive signing plan, as depicted in Figure 3-1, is recommended to route construction and truck delivery traffic along the desired street system as previously discussed and coordinated between Basin Electric and Brookings County.

Other recommendations to signage in the area include:

- Standard graphic two-way traffic signs along the designated segments of 207th Street and 482nd Avenue to heighten expectations of encountering oncoming traffic since these roads currently carry light volumes of traffic.



- At approaches to intersections that are part of the designated construction route, a warning sign to advise drivers approaching the intersection from other directions to increase awareness of higher traffic volumes than would regularly be expected at these locations. Typical locations would be at all of the approaches to 482nd Avenue between 207th Street and US Highway 14 and 207th Street between 278th Avenue and 484th Avenue.



- Post **TRUCKS ENTERING ROAD** signs along 484th Street at the approaches to the project site entrance.



4.2 PAVEMENT AND SURFACE TREATMENT PROGRAM

Gravel surfaces at approaches to intersections along the designated access routes (Figure 3-1) are recommended to be paved for a minimum distance of 300 feet to eliminate washboarding and rutting that occur from deceleration, acceleration, and turning movements. The intersection segments should be paved to the extent necessary to provide the adequate tapers and radii for semi-trailer movements, which may require local ditch grading and location adjustment. The one-mile segment of 484th Avenue from 207th Street north to the project entrance is recommended to be paved, as this roadway will serve not only all construction traffic, but the traffic generated by regular operations of the plant following its completion.

The recommended improved paved roadway section should consist of four inches of asphalt surface course on a minimum of six inches of aggregate base underlain by a reinforcement fabric separator. The existing gravel surface could be used as the aggregate base course, but should be inspected and measured to assure the minimum six inches is available, or if additional base will be required. If necessary, the gravel areas may be over-excavated to accommodate the minimum base requirements prior to placement of the reinforcement fabric. In addition to its primary function as a separator, the fabric also provides strength if placed properly.

In an effort to control dust along the gravel section of 207th Street an appropriate treatment program will be developed in coordination with the county and township.

Since the local roadways and bridge structures that will be used fall under several different jurisdictions (Brookings County, Sherman Township, and Richland Township), a multi-party agreement is recommended which clearly defines limits of maintenance responsibility throughout the project.

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