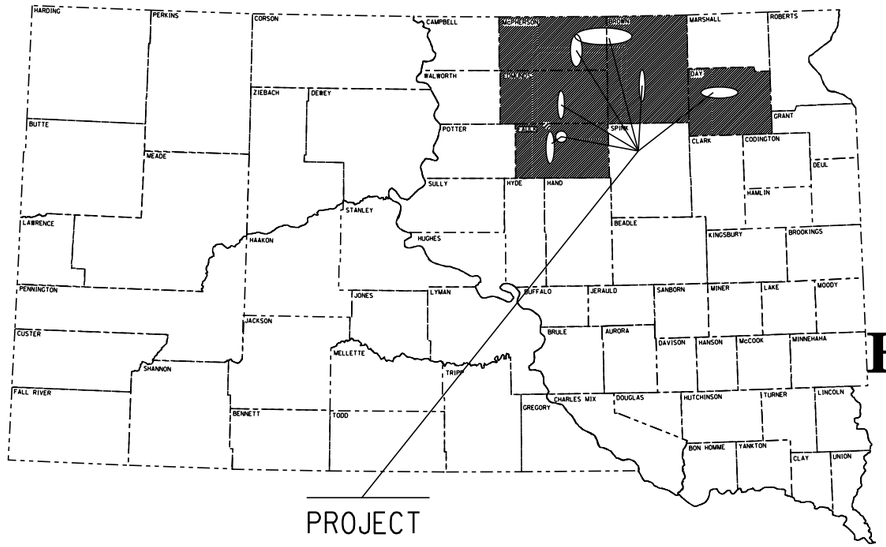


STATE OF SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION
PLANS FOR PROPOSED

PROJECT NH-P0011(83)
SD HIGHWAYS 10, 45, 47
US HIGHWAYS 12, 212, 281
BROWN, DAY, EDMUNDS, FAULK, McPHERSON COUNTIES

Asphalt Surface Treatment (Chip Seal)

PCN 047F

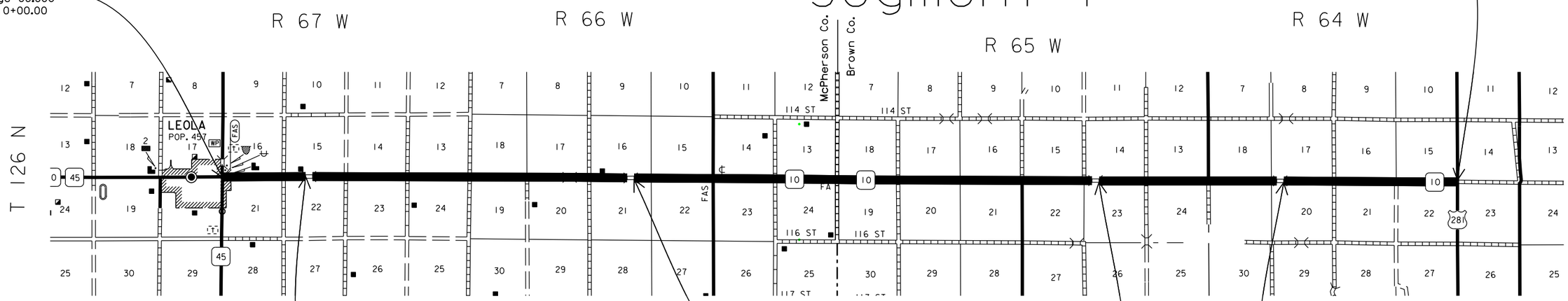
STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	1	33
Plotting Date: 01/06/2015			

INDEX OF SHEETS

Segment 1

Begin Segment 1
MRM 259.32+0.000
Mileage 66.800
Sta. 0+00.00

End Segment 1
MRM 279.29+0.000
Mileage 86.725
Sta. 1052+04.00



St. No 45-394-150
ContinuousConcrete Bridge
74'00"=0.014 Miles
MRM 260.74

St. No 45-447-150
Continuous Concrete Bridge
117'00"=0.022 Miles
MRM 265.94

St. No 07-041-150
Continuous Concrete Bridge
133'6"=0.025 Miles
MRM 273.44

St. No 07-071-150
Continuous Concrete Bridge
238'6"=0.045 Miles
MRM 276.45

DESIGN DESIGNATION

ADT (2013)	626
ADT (2033)	820
DHV	89.3
D	50
T DHV	10.3%
T ADT	22.6%
V	70 mph

STORM WATER PERMIT

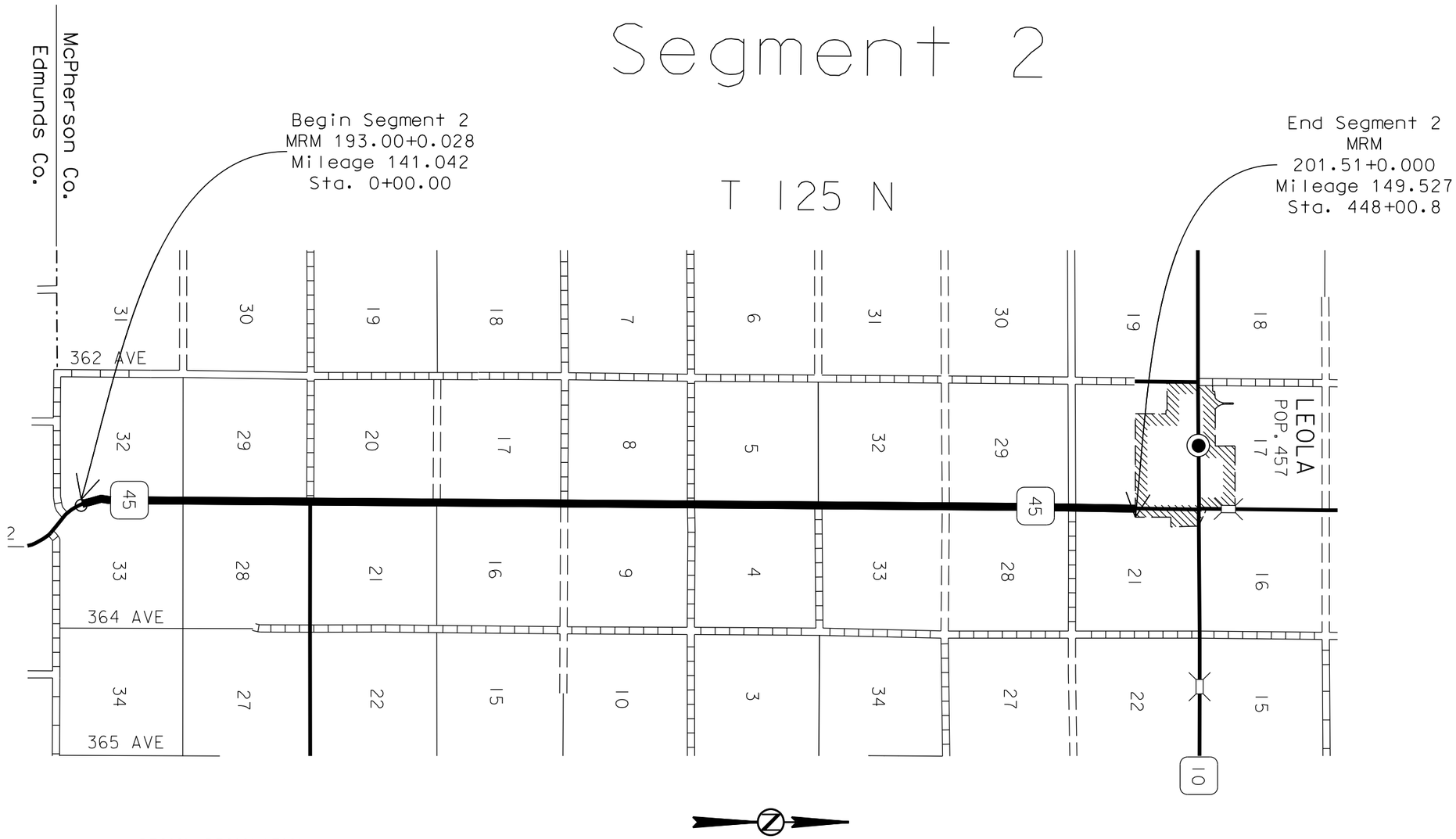
(NONE REQUIRED)

GROSS LENGTH	105204.00 FEET	19.925MILES
LENGTH OF EXCEPTIONS	563.00 FEET	0.107MILES
NET LENGTH	104641.00 FEET	19.818MILES

4

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	2	33

Segment 2



DESIGN DESIGNATION

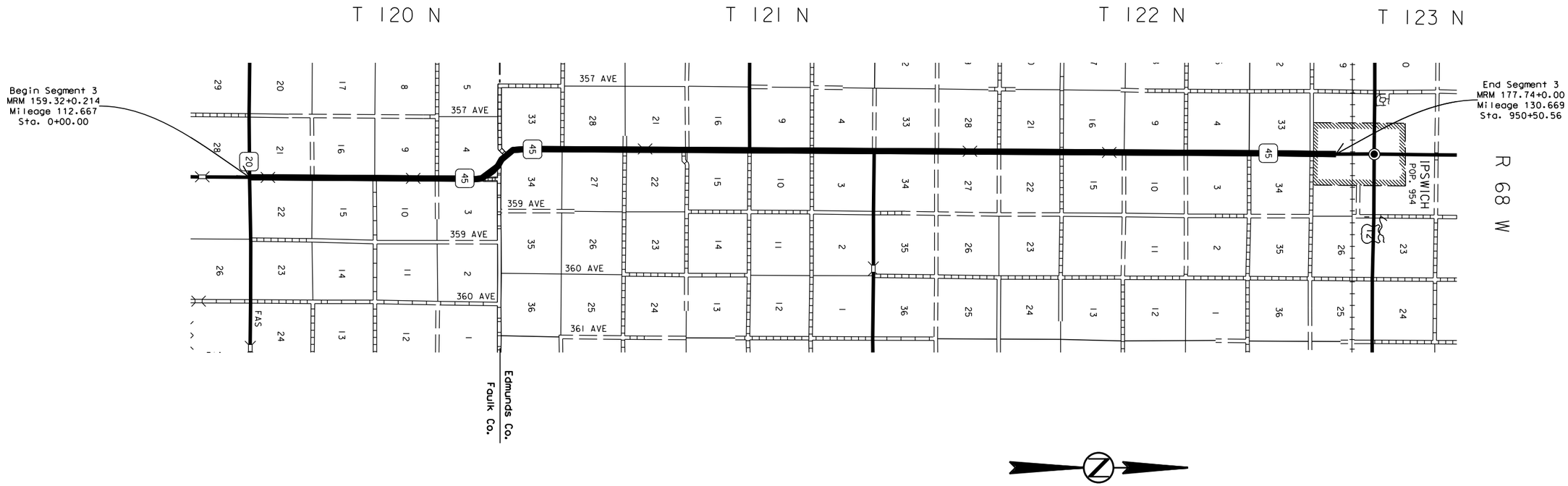
ADT (2013)	369
ADT (2033)	485
DHV	52.9
D	50
T DHV	16.8
T ADT	36.9%
V	70 mph

NET LENGTH 44800.8 FEET 8.485 MILES

PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	3	33

Segment 3 SD 45



DESIGN DESIGNATION

ADT (2013)	756
ADT (2033)	595
DHV	136.9
D	50
T DHV	14.5
T ADT	31.9%
V	70 mph

NET LENGTH 95050.56 FEET 18.002 MILES

PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	4	33

Segement 4 Faulkton

T118N

R69W

DESIGN DESIGNATION

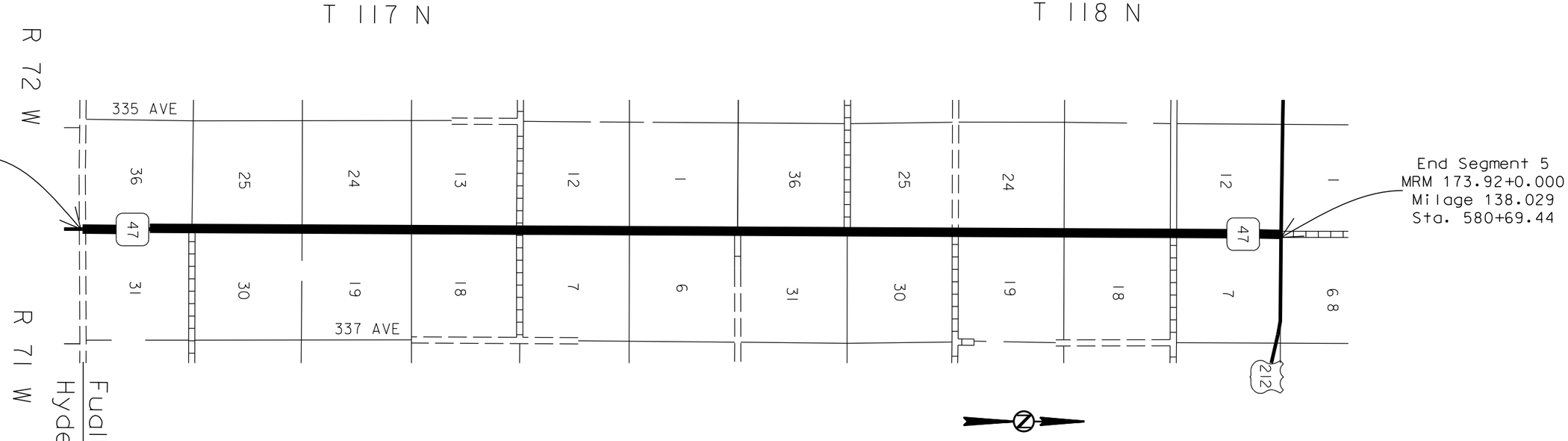
ADT (2013)	1255
ADT (2033)	1566
DHV	195.8
D	50
T DHV	6.9
T ADT	15.2
V	40 mph

NET LENGTH 4287.36 FEET 0.812 MILES

PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	5	33

Segment 5 SD 47



DESIGN DESIGNATION

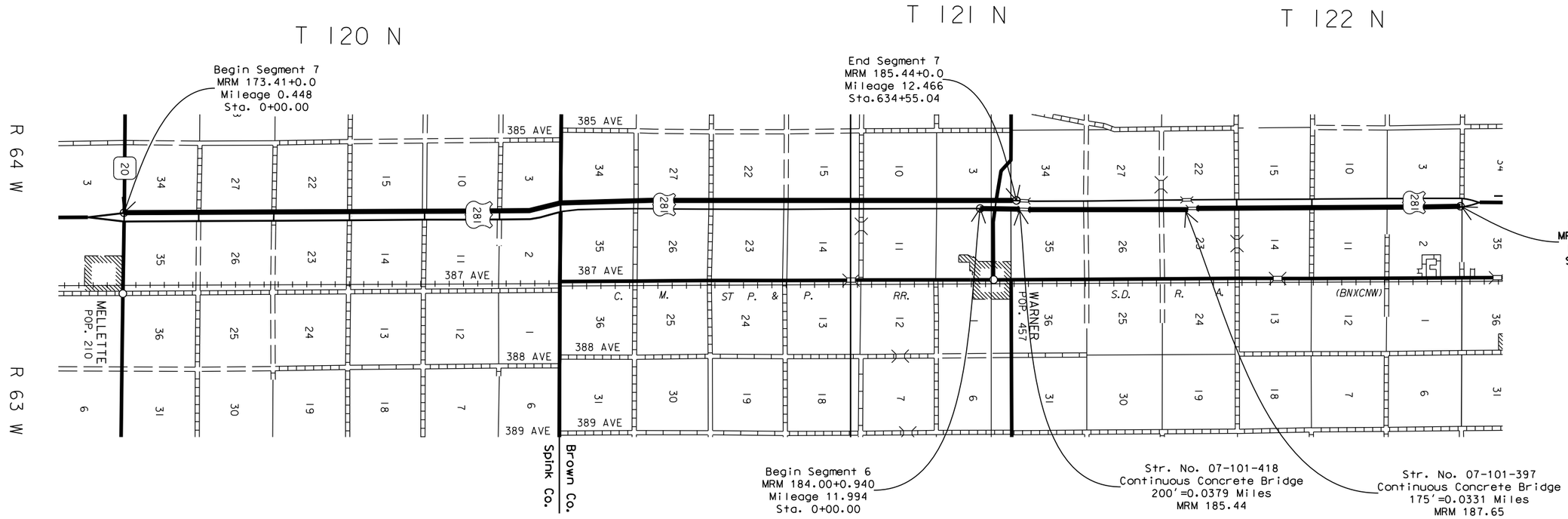
ADT (2013)	266
ADT (2033)	332
DHV	41.5
D	50
T DHV	13.5
T ADT	29.7%
V	70 mph

NET LENGTH 58069.44 FEET 10.998 MILES

PLOTTED FROM - TRAB1NT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	6	33

Segment 6 US 281N
Segment 7 US 281S



Segment 7

NET LENGTH	63455.04 FEET	12.018 MILES

DESIGN DESIGNATION

ADT (2013)	1475
ADT (2033)	1808
DHV	219.5
D	48
T DHV	13.5
T ADT	20.5%
V	70 mph

Segment 6

GROSS LENGTH	34457.28 FEET	6.526 MILES
LENGTH OF EXCEPTIONS	375.00 FEET	0.071 MILES
NET LENGTH	34082.28 FEET	6.455 MILES

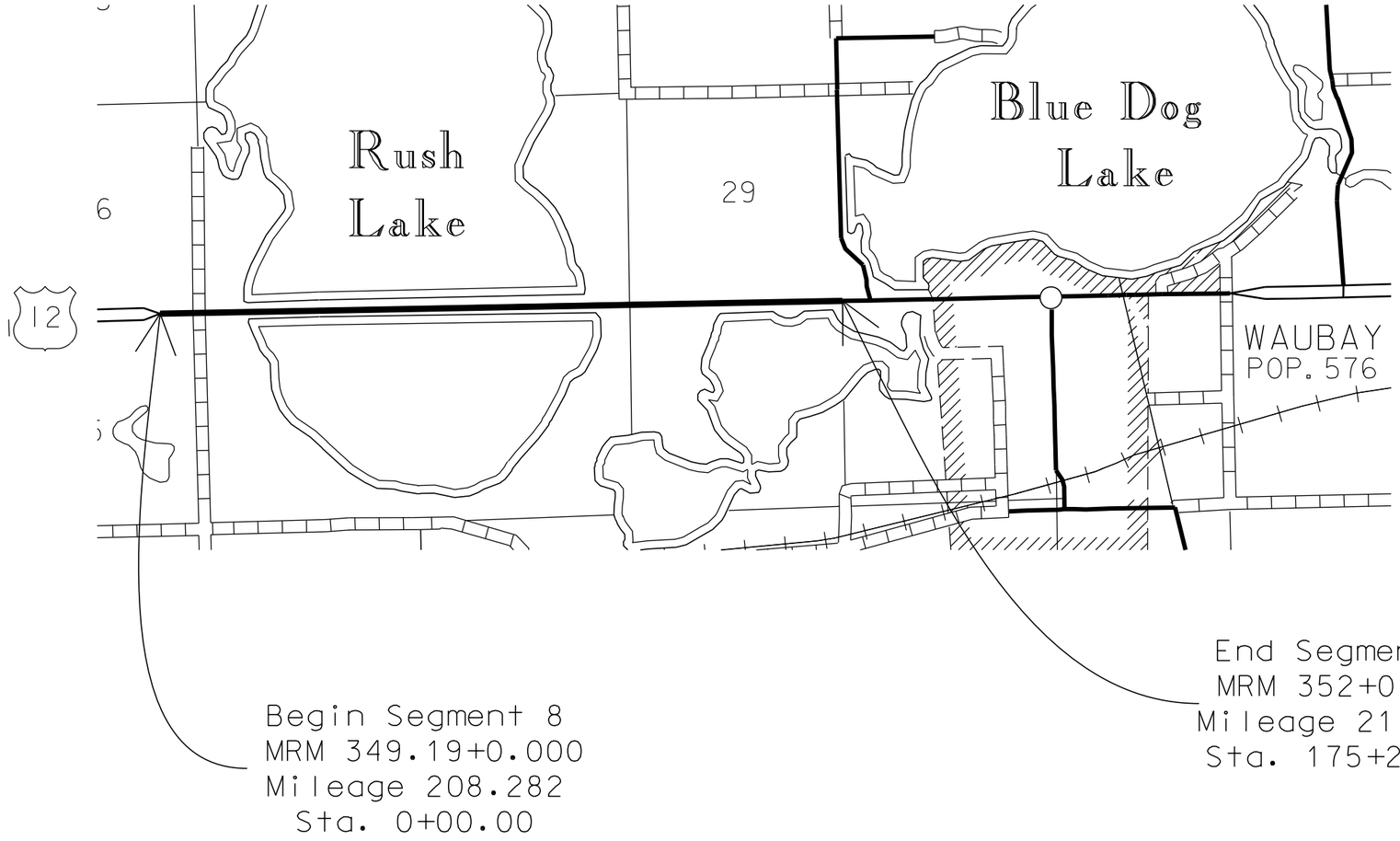
DESIGN DESIGNATION

ADT (2013)	1682
ADT (2033)	2168
DHV	270.9
D	50
T DHV	9
T ADT	19.7%
V	70 mph

PLOTTED FROM - TRAB1NT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	7	33

Segment 8 US 12



DESIGN DESIGNATION

ADT (2013)	2665
ADT (2033)	3627
DHV	399.0
D	50
T DHV	15.4
T ADT	33.8%
V	70 mph

NET LENGTH 17524.32 FEET 3.319 MILES

PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	8	33

Revised 1/13/15 B.S.

Estimate of Quantities

Bid Item Number	Item	Quantity	Unit
009E0010	Mobilization	Lump Sum	LS
330E0300	SS-1h or CSS-1h Asphalt for Fog Seal	487.4	Ton
330E3000	Sand for Fog Seal	200.0	Ton
360E0042	CRS-2P Asphalt for Surface Treatment	2,235.8	Ton
360E1200	Modified Cover Aggregate	4,092.4	Ton
360E1200	Modified Cover Aggregate	1,752.2	Ton
360E1200	Modified Cover Aggregate	2,999.8	Ton
360E1200	Modified Cover Aggregate	273.6	Ton
360E1200	Modified Cover Aggregate	1,774.0	Ton
360E1200	Modified Cover Aggregate	1,041.2	Ton
360E1200	Modified Cover Aggregate	1,938.5	Ton
360E1200	Modified Cover Aggregate	1,070.7	Ton
633E1300	Pavement Marking Paint, White	3,316.2	Gal
633E1305	Pavement Marking Paint, Yellow	1,313.4	Gal
633E6020	Pavement Marking Masking, 25"	448	Ft
633E6025	Pavement Marking Masking, Area	180	SqFt
633E6030	Pavement Marking Masking, Arrow	15	Each
633E6045	Pavement Marking Masking, Railroad Crossing	2	Each
634E0010	Flagging	1,598	Hour
634E0020	Pilot Car	573	Hour
634E0100	Traffic Control	6,314	Unit
634E0120	Traffic Control, Miscellaneous	Lump Sum	LS
634E0420	Type C Advance Warning Arrow Panel	6	Each
634E0630	Temporary Pavement Marking	160.1	Mile
998E0100	Railroad Protective Insurance	Lump Sum	LS

SPECIFICATIONS

Standard Specifications for Roads and Bridges, 2004 Edition and Required Provisions, Supplemental Specifications and Special Provisions as included in the Proposal.

ENVIRONMENTAL COMMITMENTS

An Environmental Commitment is a measure that SDDOT commits to implement in order to avoid, minimize, and/or mitigate a real or potential environmental impact. Environmental commitments to various agencies and the public have been made to secure approval of this project. An agency mentioned below with permitting authority can influence a project if perceived environmental impacts have not been adequately addressed. Unless otherwise designated, the Contractor's primary contact regarding matters associated with these commitments will be the Project Engineer. These environmental commitments are not subject to change without prior written approval from the SDDOT Environmental Office. The environmental commitments associated with this project are as follows:

COMMITMENT B: FEDERALLY THREATENED, ENDANGERED, AND PROTECTED SPECIES

COMMITMENT B2: WHOOPING CRANE

The Whooping Crane is a spring and fall migratory bird in South Dakota that is about 5 feet tall and typically stops on wetlands, rivers, and agricultural lands along their migration route. An adult Whooping Crane is white with a red crown and a long, dark, pointed bill. Immature Whooping Cranes are cinnamon brown. While in flight, their long necks are kept straight and their long dark legs trail behind. Adult Whooping Cranes' black wing tips are visible during flight.

Action Taken/Required:

Harassment or other measures to cause the Whooping Crane to leave the site is a violation of the Endangered Species Act. If a Whooping Crane is sighted roosting in the vicinity of the project, borrow pit, or staging site associated with the project, cease construction activities in the affected area until the Whooping Crane departs and contact the Project Engineer. The Project Engineer will contact the Environmental Office so that the sighting can be reported to USFWS.

COMMITMENT B4: BALD EAGLE

Bald eagles are known to occur in this area.

Action Taken/Required:

If a nest is observed within one mile of the project site, notify the Project Engineer immediately so that he/she can consult with the Environmental Office for an appropriate course of action.

COMMITMENT C: WATER SOURCE

The Contractor shall not withdraw water with equipment previously used outside the State of South Dakota without prior approval from the SDDOT Environmental Office. Thoroughly wash all construction equipment before entering South Dakota to reduce the risk of invasive species introduction into the project vicinity.

The Contractor shall not withdraw water directly from streams of the James, Big Sioux, and Vermillion watersheds without prior approval from the SDDOT Environmental Office.

Action Taken/Required:

The Contractor shall obtain the necessary permits from the regulatory agencies such as the Department of Environment and Natural Resources (DENR) and the United States Army Corps of Engineers (COE) prior to executing water extraction activities.

COMMITMENT E: STORM WATER

Construction activities constitute less than 1 acre of disturbance.

Action Taken/Required:

At a minimum and regardless of project size, appropriate erosion and sediment control measures must be installed to control the discharge of pollutants from the construction site.

COMMITMENT H: WASTE DISPOSAL SITE

The Contractor shall furnish a site(s) for the disposal of construction and/or demolition debris generated by this project.

Action Taken/Required:

The waste disposal site(s) shall be managed and reclaimed in accordance with the following from the General Permit for Highway, Road, and Railway Construction/Demolition Debris Disposal Under the South Dakota Waste Management Program issued by the Department of Environment and Natural Resources.

The waste disposal site(s) shall not be located in a wetland, within 200 feet of surface water, or in an area that adversely affects wildlife, recreation, aesthetic value of an area, or any threatened or endangered species, as approved by the Project Engineer.

If the waste disposal site(s) is located such that it is within view of any ROW, the following additional requirements shall apply:

1. Construction and/or demolition debris consisting of concrete, asphalt concrete, or other similar materials shall be buried in a trench completely separate from wood debris. The final cover over the construction and/or demolition debris shall consist of a minimum of 1 foot of soil capable of supporting vegetation. Waste disposal sites provided outside of the State ROW shall be seeded in accordance with Natural Resources Conservation Service recommendations. The seeding recommendations may be obtained through the appropriate County NRCS Office. The Contractor shall control the access to waste disposal sites not within the State ROW through the use of fences, gates, and placement of a sign or signs at the entrance to the site stating "No Dumping Allowed".

2. Concrete and asphalt concrete debris may be stockpiled within view of the ROW for a period of time not to exceed the duration of the project. Prior to project completion, the waste shall be removed from view of the ROW or buried and the waste disposal site reclaimed as noted above.

The above requirements will not apply to waste disposal sites that are covered by an individual solid waste permit as specified in SDCL 34A-6-58, SDCL 34A-6-1.13, and ARSD 74:27:10:06.

Failure to comply with the requirements stated above may result in civil penalties in accordance with South Dakota Solid Waste Law, SDCL 34A-6-1.31.

All costs associated with furnishing waste disposal site(s), disposing of waste, maintaining control of access (fence, gates, and signs), and reclamation of the waste disposal site(s) shall be incidental to the various contract items.

COMMITMENT I: HISTORICAL PRESERVATION OFFICE CLEARANCES

The SDDOT has obtained concurrence with the State Historical Preservation Office (SHPO or THPO) for all work included within the project limits and all designated option borrow sites provided within the plans.

Action Taken/Required:

All earth disturbing activities not designated within the plans require review of cultural resources impacts. This work includes, but is not limited to: staging areas, borrow sites, waste disposal sites, and all material processing sites.

The Contractor shall arrange and pay for a cultural resource survey and/or records search. The Contractor has the option to contact the state Archaeological Research Center (ARC) at 605-394-1936 or another qualified archaeologist, to obtain either a records search or a cultural resources survey. A record search might be sufficient for review; however, a cultural resources survey may need to be conducted by a qualified archaeologist.

The Contractor shall provide ARC with the following: a topographical map or aerial view on which the site is clearly outlined, site dimensions, project number, and PCN. If applicable, provide evidence that the site has been previously disturbed by farming, mining, or construction activities with a landowner statement that artifacts have not been found on the site.

The Contractor shall submit the records search or cultural resources survey report and if the location of the site is within the current geographical or historic boundaries of any South Dakota reservation to SDDOT Environmental Engineer, 700 East Broadway Avenue, Pierre, SD 57501-2586 (605-773-3180). SDDOT will submit the information to the appropriate SHPO/THPO. Allow **30 Days** from the date this information is submitted to the Environmental Engineer for SHPO/THPO review.

If evidence for cultural resources is uncovered during project construction activities, then such activities shall cease and the Project Engineer shall be immediately notified. The Project Engineer will contact the SDDOT Environmental Engineer in order to determine an appropriate course of action.

SHPO/THPO review does not relieve the Contractor of the responsibility for obtaining any additional permits and clearances for staging areas, borrow sites, waste disposal sites, or material processing sites that affect wetlands, threatened and endangered species, or waterways. The Contractor shall provide the required permits and clearances to the Project Engineer at the preconstruction meeting.

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	11	33

Table of Quantities (for information only)

	Length (Miles) Gross	19.925					6.526				
	Length (Miles) Net	19.818	8.485	18.002	0.812	10.998	6.455	12.018	3.319		
Bid Item No.	**Bid Item Description**	**Segment 1 SD 10**	**Segment 2 SD 45**	**Segment 3 SD 45**	**Segment 4 US 212**	**Segment 5 SD 47**	**Segment 6 US 281N**	**Segment 7 US 281S**	**Segment 8 US 12**	**Total Quantity**	**UNITS**
009E0010	Mobilization	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LS
330E0300	SS-1h or CSS-1h Asphalt for Fog Seal	111.0	47.5	105.4	7.4	53.9	40.7	75.7	45.8	487.4	Ton
330E3000	Sand for Fog Seal	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	200.0	Ton
360E0042	CRS-2P Asphalt for Surface Treatment	600.5	257.1	482.9	40.2	260.7	153.0	284.8	156.7	2235.8	Ton
360E1200	Modified Cover Aggregate	4092.4	-	-	-	-	-	-	-	4092.4	Ton
360E1200	Modified Cover Aggregate	-	1752.2	-	-	-	-	-	-	1752.2	Ton
360E1200	Modified Cover Aggregate	-	-	2999.8	-	-	-	-	-	2999.8	Ton
360E1200	Modified Cover Aggregate	-	-	-	273.6	-	-	-	-	273.6	Ton
360E1200	Modified Cover Aggregate	-	-	-	-	1774.0	-	-	-	1774.0	Ton
360E1200	Modified Cover Aggregate	-	-	-	-	-	1041.2	-	-	1041.2	Ton
360E1200	Modified Cover Aggregate	-	-	-	-	-	-	1938.5	-	1938.5	Ton
360E1200	Modified Cover Aggregate	-	-	-	-	-	-	-	1070.7	1070.7	Ton
633E1300	Pavement Marking Paint, White	896.6	381.8	810.1	10.1	494.9	187.3	344.9	190.5	3316.2	Gal
633E1305	Pavement Marking Paint, Yellow	199.7	57.6	218.0	36.5	85.5	146.8	270.4	298.7	1313.4	Gal
633E6020	Pavement Marking Masking, 25"	-	-	72	96	-	-	-	280	448	Ft
633E6025	Pavement Marking Masking, Area	-	-	-	-	-	-	-	180	180	SqFt
633E6030	Pavement Marking Masking, Arrow	-	-	-	-	-	-	-	15	15	Each
633E6045	Pavement Marking Masking, Railroad Crossing	-	-	2	-	-	-	-	-	2	Each
634E0010	Flagging	396	170	360	16	220	129	240	66	1598	Hour
634E0020	Pilot Car	198	85	180	-	110	-	-	-	573	Hour
634E0100	Traffic Control	1026	751	1060	612	827	646	866	526	6314	Unit
634E0120	Traffic Control, Miscellaneous	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LUMP SUM	LS
634E0420	Type C Advance Warning Arrow Panel	-	-	-	2	-	1	1	2	6	Each
634E0630	Temporary Pavement Marking	39.9	17.0	36.0	1.6	22.0	13.1	24.0	6.6	160.1	Mile
998E0100	Railroad Protective Insurance	-	-	LUMP SUM	-	-	-	-	-	LUMP SUM	LS

RATE OF MATERIALS

The Estimate of Quantities is based on the following quantities of materials per mile.

ASPHALT SURFACE TREATMENT:

SEGMENT	ROUTE	STATION	to	STATION
1	SD 10	00+00.00		1052+04.00

CRS-2P Asphalt for Surface Treatment at the rate of 30.3 tons applied 32 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 206.5 tons applied 32 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.6 tons applied 32 feet wide.
(Rate = 0.07 Gal./S.Y.)

SEGMENT	ROUTE	STATION	to	STATION
2	SD 45	00+00.00		448+00.8

CRS-2P Asphalt for Surface Treatment at the rate of 30.3 tons applied 32 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 206.5 tons applied 32 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.6 tons applied 32 feet wide.
(Rate = 0.07 Gal./S.Y.)

SEGMENT	ROUTE	STATION	to	STATION
3	SD 45	0+00.00		890+68.32

CRS-2P Asphalt for Surface Treatment at the rate of 26.2 tons applied 25 feet wide. (Rate =0.42 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.8 tons applied 33 feet wide.
(Rate = 0.07 Gal./S.Y.)

SEGMENT	ROUTE	STATION	to	STATION
4	US 212	25+45.59		37+21.6

CRS-2P Asphalt for Surface Treatment at the rate of 60.6 tons applied 64 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 413.0 tons applied 64 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 11.2 tons applied 64 feet wide.
(Rate = 0.07 Gal./S.Y.)

SEGMENT	ROUTE	STATION	to	STATION
3	SD 45	890+68.32		938+20.32
4	US 212	0+00.00		25+45.59
4	US 212	37+21.6		42+87.36

CRS-2P Asphalt for Surface Treatment at the rate of 45.5 tons applied 48 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 309.8 tons applied 48 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 8.4 tons applied 48 feet wide.
(Rate = 0.07 Gal./S.Y.)

SEGMENT	ROUTE	STATION	to	STATION
5	SD 47	0+00.00		580+69.44

CRS-2P Asphalt for Surface Treatment at the rate of 23.7 tons applied 25 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 4.9 tons applied 28 feet wide.
(Rate = 0.07 Gal./S.Y.).

SEGMENT	ROUTE	STATION	to	STATION
6	US 281N	0+00.00		344+30.88
7	US 281S	0+00.00		637+24.32

CRS-2P Asphalt for Surface Treatment at the rate of 23.7 tons applied 25 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 6.3 tons applied 36 feet wide.
(Rate = 0.07 Gal./S.Y.).

SEGMENT	ROUTE	STATION	to	STATION
8	US 12	0+00.00		175+24.32

CRS-2P Asphalt for Surface Treatment at the rate of 47.2 tons applied 50 feet wide. (Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 322.6 tons applied 50 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 13.8 tons applied 79 feet wide.
(Rate = 0.07 Gal./S.Y.).

Application rate of CRS-2P, Modified Cover Aggregate, and Fog Seal shall be as indicated in the Rates of Materials for the appropriate segment, or as directed by the Engineer in the field.

SEQUENCE OF OPERATIONS

The following Sequence of Operations shall be used for this project. The Contractor may submit an alternate Sequence of Operations for consideration by the Area Engineer. An alternate Sequence of Operations shall be submitted to the Area Engineer a minimum of 2 weeks prior to the preconstruction meeting.

1. Install Construction Signing
2. Install Pavement Marking Masking
3. Install Temporary Pavement Markings
4. Apply Asphalt Surface Treatment
5. Apply Fog Seal
6. Apply Permanent Pavement Markings
7. Project Cleanup and Removal of Construction Signing

TRAFFIC CONTROL FOR ASPHALT SURFACE TREATMENT

Removing, relocating, covering, salvaging and resetting of existing traffic control devices, including delineation, shall be the responsibility of the Contractor. Cost of this work shall be incidental to the various contract bid items unless otherwise specified in the plans. Delineators and signs damaged or lost shall be replaced by the Contractor at no cost to the State.

Storage of vehicles and equipment shall be as near the right-of-way as possible. Contractor's employees should mobilize at a location off the right-of-way and arrive at the work sites in a minimum number of vehicles necessary to perform the work. Indiscriminate driving and parking of vehicles within the right-of-way will not be permitted. Any damage to the vegetation, surfacing, embankment, delineators and existing signs resulting from such indiscriminate use shall be repaired and/or restored by the Contractor, at no expense to the State, and to the satisfaction of the Engineer.

The Contractor shall provide documentation that all breakaway sign supports comply with FHWA NCHRP Report 350 or MASH crash-worthy requirements. The Contractor shall provide installation details at the preconstruction meeting for all breakaway sign support assemblies.

Work activities during non-daylight hours are subject to prior approval.

Traffic approaching the project from intersecting roadways, streets, and approaches must be adequately accommodated. Major intersections or large commercial entrances may require additional signing, flaggers, and channelizing devices on a temporary basis until work activities pass these areas.

"ROAD WORK NEXT XX MILES", "LOOSE GRAVEL", and "END ROAD WORK" signs are the only signs that need to be mounted on Fixed Location Breakaway Sign Supports. "ROAD WORK AHEAD", "FLAGGER", "ONE LANE ROAD AHEAD" and any other signs may be mounted on portable supports. The bottom of signs on portable or temporary supports shall not be less than seven feet above the pavement in urban areas, and one foot above the pavement in rural areas. The signs mounted on portable supports shall be moved as necessary to keep current with the work activities.

Traffic Control units, as shown in the Estimate of Quantities, are estimates. Contractor's operation may require adjustments in quantities, either more or less. Payment will be for those signs actually ordered by the Engineer and used. Traffic Control units will be paid for separately for each segment.

The Contractor shall furnish, install and maintain "LOOSE GRAVEL" signs with "40 MPH" advisory speed plates signs upon start of surface treatment operations at each end of the segment. In addition, "LOOSE GRAVEL" signs with "40 MPH" advisory speed plates shall be installed at 3 mile intervals throughout each segment and at other location(s) determined in the field by the Engineer. The aforementioned signs shall be removed after the fog sealing has been completed.

Until initial brooming is completed, additional flagger(s) and FLAGGER symbol sign(s) shall be provided to alert the traveling public entering completed portions of the project to the potential of airborne chips. The flagger(s) shall provide each motorist with a printed notice on the Contractor's letterhead similar to the one shown. Cost of the notice shall be incidental to other contract bid items. The flagger(s) shall remain in place until initial brooming has been completed. A flagger shall be in place at the beginning and end of each segment providing this notice on the 2 lanes highways.

"CONTRACTORS LETTERHEAD"

THIS HIGHWAY IS BEING RESURFACED WITH A CHIP SEAL COAT.

THIS TYPE OF CONSTRUCTION HAS THE POTENTIAL OF CAUSING VEHICLE DAMAGE SUCH AS CHIPPED WINDSHIELDS AND BROKEN HEADLIGHTS DUE TO ROCKS BEING THROWN BY HIGH SPEED ONCOMING OR PASSING TRAFFIC.

YOU MAY WISH TO CONSIDER TAKING AN ALTERNATE ROUTE. IF YOU PROCEED, KEEP TO THE RIGHT AND DRIVE 40 MPH OR LESS. ANOTHER FLAGGER AND A PILOT CAR WILL BE ESCORTING YOU AROUND THE SEAL COAT APPLICATION AREA.

THANK YOU.

The Contractor shall be required to use a pick up broom having a self-contained storage unit in the towns of Ipswich & Faulkton (Segments 3 & 4). Removed material shall be disposed of at sites provided by the Contractor and approved by the Engineer.

HAUL ROAD

The Contractor shall be responsible for any haul roads used to transport material to the project site. The State will not participate in the cost of restoration of any haul roads used by the Contractor.

BRIDGES, APPROACH SLABS, CONCRETE ADN UTILITY ENTRANCES

Asphalt Surface Treatment shall not be placed on any of the bridges, approach slabs or any other type of concrete, manholes/water valves and rail road crossings on these segments. The Contractor shall be required to remove any AST applied to these areas by approved non-destructive methods as approved by the Engineer.

ESTIMATED QUANTITIES

The quantities of asphalt for surface treatment and cover aggregate are based off the rates shown in the Rates of Materials. This is only an estimate. The actual application rates of materials will be determined in the field during construction based upon the surface condition, aggregate type, aggregate gradation and flakiness index. The contract unit prices for the Asphalt Surface Treatment contract items shall be nonnegotiable regardless of changes in contract quantities.

ASPHALT SURFACE TREATMENT

The Contractor shall not overlap asphalt application at centerline, but shall construct a neat butt joint with aggregate applied completely out to the joint.

MODIFIED COVER AGGREGATE

Quality tests on the Cover Aggregate are required by specification. The Contractor shall notify the Area Office prior to sampling and a representative from the Area Office shall witness all sampling of aggregates to be submitted to the Central Testing Laboratory.

After the aggregate stockpile has been produced, a sample shall be submitted to the Asphalt Supplier a minimum of 14 days prior to starting the project to allow time to evaluate the compatibility and design of the surface treatment. A copy of the test results from the Asphalt Supplier shall be submitted to the Engineer and Bituminous Engineer prior to starting the surface treatment.

Cover Aggregate shall be screened over a 1 inch screen immediately prior to application. Failure to operate the screen shall be cause for immediate shutdown of all roadway operations.

Cover Aggregate shall conform to the following gradation requirements:

Sieve Size	Percent Passing
3/8 inch	100
¼ inch	25 - 70
No. 4	0 - 25
No. 8	0 – 5
No. 200	0 – 1.3

The Flakiness Index shall not exceed 30%. Non-processed natural aggregate shall be subject to flakiness testing at a frequency of one test minimum per aggregate source.

MODIFIED COVER AGGREGATE CONTINUED

Application of the Modified Cover Aggregate shall be maintained within 500 feet or have a time limit of 1 minute between the application of the CRS-2P for Asphalt Surface Treatment and the application of the cover aggregate, whichever amounts to the shorter period of time.

All other requirements for Type 1B Cover Aggregate shall apply.

A failure on the #200 sieve will cause all operations to cease immediately and the Engineer will determine correction, if necessary, needed prior to restarting operations.

FOG SEAL

The fog seal shall be placed following the completion of the chip seal. Prior to the application of the fog seal the Contractor will be required to broom the chip seal. A CSS-1h or SS-1h emulsion shall be used for the fog seal application. A water-to-emulsion rate of 1:1 should be used for the binder application.

Blotting Sand for Fog Seal shall conform to the Specifications Section 879.1B.

Prior to hauling, Blotting Sand shall be screened to minimize segregation, eliminate oversize and effectively breakup or discard material bonded into chunks.

The Contractor shall maintain traffic control on the fog sealing area until the fog seal is cured enough to prevent pickup on vehicles. Blotting sand shall be applied at locations such as intersections, as directed by the Engineer.

TEMPORARY PAVEMENT MARKINGS

Temporary road markers with double covers shall be used to mark dashed centerline, No Passing Zones and applicable lane lines. **Paint will not be allowed for Temporary Pavement Marking.**

No passing zones shall be marked using tabs on US 12 across Rush Lake (segment 8, two double yellows) and US 212 thru Faulkton (segment 4, one double yellow). The yellow edge line shall be marked using tabs on US 281 (segments 6 and 7).

The cost of the Temporary Road Markers used on this project will be incidental to the contract unit price per mile for Temporary Pavement Marking.

The temporary road markers shall have secure double covers. The Contractor will be required to remove the covers manually after completion of the chip seal and once again after completion of the fog seal. Any markers that are non-reflective will be cleaned. Cleaning of road markers will be incidental to the contract unit price per mile for Temporary Pavement Marking. Petroleum products shall not be used to clean markers.

The Contractor is allowed to use DO NOT PASS and PASS WITH CARE signs for a period of 2 weeks to mark no passing zones on roads with an average daily traffic of 2500 vehicles or less. It is estimated that 34 DO NOT PASS and 35 PASS WITH CARE signs will be required to mark the no passing zones, should the Contractor elect to use these signs.

Cost for furnishing, installing and removing the DO NOT PASS and PASS WITH CARE signs shall be incidental to the contract unit price per mile for Temporary Pavement Marking.

The total length of no passing zone on this project is as follows:

Segment	Route	Length of No Passing Zones	Do Not Pass	Pass With Care
1	SD 37	3.1 Miles	18	19
2	SD 45	.1 Miles	2	2
3	SD 45	4.5 Miles	9	9
5	SD 47	0.6 Miles	5	5
		Total	**34**	**35**

PERMANENT PAVEMENT MARKINGS

The Contractor shall advise the Engineer a minimum of 2 weeks prior to the application of the permanent pavement marking to allow the State to check and mark the location of no passing zones. All materials shall be applied as per manufacturer's recommendations.

The Contractor shall be required to repaint all existing pavement markings including centerline, edge line, lane lines, gore areas, stop bars, etc. The Contractor will be required to inventory and mark, with appropriately colored tabs, the extent and location of the existing word messages, turn arrows, stop bars, railroad crossings, pedestrian crossings, gore areas etc. before the markings are obliterated. The Engineer shall be provided a copy of the pavement marking inventory. Additional quantities are included in the estimate of quantities for these areas. The cost of the tabs shall be incidental to the contract unit prices for the various items.

Permanent pavement markings shall be furnished and applied by the Contractor in accordance with Section 633 of the Specifications and the details in these plans. **The rate of application of glass beads shall be 8 lbs per gallon of paint**.

The application of Permanent Pavement Marking Paint shall not begin until 72 Hours following completion of fog sealing and shall be completed within 14 calendar days following completion of the fog seal.

For each working day the application of permanent pavement marking paint remains uncompleted after the previously stated time requirements, the Contractor will be assessed liquidated damages at the rate of $250.00 per day.

This provision applies up to the Contract Completion Date, as extended. After the completion date, liquidated damages will be assessed in accordance with section 8.7, until the Permanent Pavement Marking is completed, even though the project may be open to traffic.

PAVEMENT MARKING MASKING

Immediately prior to Asphalt Surface Treatment application and fog sealing, durable markings, as listed below, shall be covered with an approved pavement marking masking. All cost for furnishing, installing, removing, and disposing of masking shall be incidental to the various contract unit prices for Pavement Marking Masking. Pavement Marking Masking will be paid for each application with a limit of two times.

The following items shall be masked:

ITEM	LOCATION	QUANTITY
25" Masking	US 12 Gore Areas	280 Ft
25" Masking	US 212 Cross Walk in Faulkton	96 Ft
RR Crossing Masking	SD 45 In City of Ipswich, SD	2 Each
Turn Arrow Masking	US 12	15 Each

-Note: Install all cold applied pavement marking masking prior to placing Asphalt Surface Treatment.

EXISTING PAVEMENT CONDITIONS & TRAFFIC VOLUMES

The existing pavement conditions have been checked for each project and factored into the rates of materials. Actual rates will be adjusted in the field during construction by the Engineer.

The traffic volumes are shown on the title sheets.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN

After the aggregate stockpiles have been produced, the Contractor shall submit samples of the aggregates to the asphalt supplier, prior to construction, to determine a mix design and verify compatibility of the aggregate and asphalt.

The asphalt surface treatment will be designed in accordance with the Modified McLeod Design Procedure found in Volume II of Appendix C of the Preventive Maintenance Surface Treatments Report. The asphalt surface treatment design will be prepared by qualified personnel experienced in asphalt surface treatment design.

The surface design will be based on the traffic volume(s) and pavement conditions contained in the plans. The final application rate for the asphalt binder and cover aggregate will be determined after the source of the material is known and field adjustments are made. The design will include the following information:

1) Aggregate gradation.
2) Bulk specific gravity of the aggregate.
3) Loose unit weight of the aggregate.
4) Asphalt type and rate of application.
5) Aggregate rate of application.

In addition to the above data, the Contractor will submit with the design of the asphalt surface treatment a sample of each aggregate and emulsion for use by the Engineer for verifying the test results. The design may be verified by the Department.

The mix design shall be submitted to the Engineer at least one week prior to the start of construction.

Appendix C Volume II. Guidelines for Design of Chip Seals are reproduced below:

Volume II. Guidelines for Design of Chip Seals

Introduction

This volume presents the guidelines for the design of chip seals. The guidelines first cover some general information regarding the aggregate chips and the asphalt emulsion. The guidelines then address the specific material properties that are used in the recommended design procedure. Finally, the design equations for the aggregate and emulsion application rates are presented. An example design problem, illustrating the design procedure in a step-by-step manner, is also presented.

Aggregate Chips

Aggregate Type

Three aggregate types–quartzite, limestone and natural aggregates– are commonly used throughout the state. Quartzite is more common in the eastern part of the state, whereas limestone is more common in the western part of the state. Natural aggregates are found in the central as well as the northeast portion of the state. Other aggregate types, such as river gravel and granite, have been used for chip seals but are not common.

The selection of the aggregate type should be based on the availability and cost of aggregates in the area. The performance of chip seals with specific aggregate types should also be considered in the selection. On specialized applications, such as for high-volume roadways, additional considerations may need to be taken into account. For example, crushed aggregate can provide improved retention and durability characteristics.

Aggregate Shape

The ideal shape for aggregate chips is cubical and angular, as opposed to flat and rounded. Flat particles tend to orient on their flattest side under traffic loadings and can become completely covered with emulsion and create a bleeding problem. In addition, these completely embedded chips prevent proper embedment of chips that lie on top of the embedded chips, resulting in continued chip loss. With cubical aggregates, the chip height is essentially the same regardless of its orientation, resulting in more uniform chip embedment.

Angular or crushed aggregate particles are preferred over rounded particles. Rounded aggregates are more susceptible to rolling and displacement under traffic, especially in locations of stopping or turning traffic. Angular particles tend to lock together and provide better long-term retention and stability.

Aggregate Gradation

The aggregate gradation plays a key role in the design, construction and performance of chip seals. The gradation requirements shown in this Design Procedure are for information only and Modified Cover Aggregate is specified in the plans. The ideal gradation comprises the following characteristics:

- The aggregate chips should be similarly sized. A one-size aggregate provides a more uniform thickness and a more consistent and proper embedment of the chips, which improves the retention and performance of the chip seal. Similarly sized chips also help improve the surface friction and drainage capabilities of the chip seal.
- The aggregate bands should not be too wide. Allowing a wide range of aggregate retained on a particular sieve will result in widely varying gradations and differing performance. A tight gradation band ensures consistency and uniformity of the chip seal.
- The gradation should limit the amount of fines (material passing the 0.075 mm [No. 200] sieve). Fine materials create dust and can be a safety hazard for passing vehicles. Furthermore, fine materials absorb emulsion and can affect the bonding characteristics and performance of the chip seal.

To better account for these ideal properties, the aggregate gradations in Table II-1 are recommended for all roadways. The maximum aggregate size is 9.52 mm (⅜ in). The gradation also forces the majority of the aggregate to a small range to create a more uniform chip seal. The gradation also addresses the amount of fines by limiting the material passing the 0.075 mm (No. 200) sieve to one percent. The recommended gradation for sections using a second choke stone layer is also provided in the table.

Table II-1. Aggregate gradations for chip seal designs.

Sieve Size	Percent Passing	
	Aggregate Chips	Choke Stone
12.7 mm (½ in)	100	100
9.52 mm (⅜ in)	90 – 100	100
6.35 mm (¼ in)	40 – 70	100
4.75 mm (No. 4)	0 – 25	85 – 100
2.36 mm (No. 8)	0 – 5	10 – 40
1.18 mm (No. 16)	–	0 – 10
0.300 mm (No. 50)	–	0 – 5
0.075 mm (No. 200)	0 – 1	0 – 1

Flat and Elongated Particles (Flakiness Index)

Like small particles, flat and elongated particles can become completely embedded in the emulsion and thus prevent larger aggregate particles from achieving proper embedment. The flakiness index – determined in accordance with the Central Federal Lands Highway Division (CFLHD) DFT-508, *Standard Method of Determining the Flakiness Index and Average Least Dimension of Aggregates* – should be performed to limit the amount of flat and elongated particles. The Flakiness Index is a measure of the percentage, by weight, of flat particles. For most applications, the Flakiness Index should be limited to 30 percent (i.e., the weight of flat and elongated particles should not exceed 30 percent of the total aggregate weight). For special applications such as high-volume roadways, the limit should be tightened to 20 or 25 percent.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Asphalt Emulsion

Emulsification is a process in which two otherwise incompatible materials are blended together. In the case of asphalt emulsion, the two incompatible materials are asphalt and water. An asphalt emulsion consists of asphalt particles dispersed in water, which is stabilized using a chemical solution (also know as an emulsifier). Upon application, the water and asphalt separate, a process referred to as "breaking" of the emulsion. The water then evaporates leaving the asphalt as the bonding agent.

Emulsion Classification

Asphalt emulsions are classified into three categories – anionic, cationic and nonionic – referring to the electrical charge of the emulsifier surrounding the asphalt particles. Anionic emulsions have a negative electrical charge surrounding the asphalt particles, and cationic emulsions have a positive charge.
Because opposite electrical charges attract, anionic emulsions should be used with aggregates that have a positive charge (such as limestone and natural aggregates). Likewise, cationic emulsions should be used with aggregates that have a negative charge (such as quartzite).

Emulsions are further identified based on how quickly they revert back to asphalt cement. The following terms are used to classify the emulsion grades:

- Rapid-setting (RS)
- Medium-setting (MS)
- Slow-setting (SS)
- Quick-setting (QS)

The grades indicate the speed at which the emulsion will become unstable and "break" coming into contact with the aggregate. An RS emulsion breaks very quickly and has little or no ability to mix with an aggregate. An MS emulsion will mix with coarse aggregate but not fine aggregate. SS and QS emulsions are designed to mix with fine aggregates.

High-float emulsions (designated as HF) allow a thicker film of asphalt material on the aggregate, which enhances the bonding and retention. They are designated as such because they pass the Float Test (ASTM D139 or AASHTO T50). High-float emulsions are recommended for use with dusty aggregates (greater than 2 percent fines).

Numbers are used in the classification to indicate the relative viscosity of the emulsion. Lower numbers indicate a lower viscosity or more fluid material (i.e., an MS-2 is more viscous than an MS-1). Letters are also sometimes used following the designation: "h" indicates a harder base asphalt, "s" indicates a softer base asphalt and "p" indicates a polymer-modified asphalt.

Table II-2 shows the classifications for asphalt emulsion. Standard specifications are available for anionic asphalt emulsions (ASTM D977 or AASHTO M140) and for cationic asphalt emulsions (ASTM D2397 or AASHTO M208).

Table II-2. Classifications of asphalt emulsions.

Anionic Asphalt Emulsions	Cationic Asphalt Emulsions
RS-1	CRS-1
RS-2	CRS-2
HFRS-2	–
MS-1	–
MS-2	CMS-2
MS-2h	CMS-2h
HFMS-1	–
HFMS-2	–
HFMS-2h	–
HFMS-2s	–
SS-1	CSS-1
SS-1h	CSS-1h

Chip Seal Design

Chip seals should be designed so that the proposed materials are of sufficient quality and have the desired properties to provide the expected performance. Proper design also ensures that the proper application rates are being used. The design procedure presented herein is a modified version of the McLeod design procedure (McLeod 1969) and is currently being used by the Minnesota Department of Transportation (Janisch and Gaillard 1998).

The procedure is based on two basic principles:

- The aggregate application rate is designed to provide a chip seal that is one stone thick (i.e., there should be a single layer of uniformly sized chips) with minimal excess.

- The voids in the aggregate are designed to be 70 percent filled with asphalt cement for good performance (i.e., the chips should be 70 percent embedded).

Emulsion Properties

Residual Asphalt Content

A portion of an asphalt emulsion consists of water, which evaporates as the binder breaks. The amount of asphalt cement that remains after breaking is referred to as the residual asphalt content. It is important to consider the residual asphalt content because it represents the amount of material that is available for bonding to the aggregate. In general, the residual asphalt content is about 65 to 70 percent (i.e., 65 to 70 percent of an asphalt emulsion consists of asphalt cement).

As mentioned, the objective of this design procedure is to achieve 70 percent embedment of the average-sized aggregate. To accomplish this, the emulsion must be at the top of the average-sized aggregate before curing. If only 70 percent of the aggregate is covered initially, the asphalt height will be about 30 percent too low after curing.

Aggregate Properties

Median Particle Size

The median particle size is the theoretical size through which 50 percent of the material passes. It is determined from the gradation chart using the following sieve sizes: 25.0 mm (1 in), 19.0 mm (¾ in), 12.5 mm (½ in), 9.5 mm (⅜ in), 6.3 mm (¼ in), 4.75 mm (No. 4), 2.36 mm (No. 8), 1.18 mm (No. 16), 0.300 mm (No. 50) and 0.075 mm (No. 200).

Flakiness Index

The Flakiness Index is a measure of the percentage, by weight, of flat particles. It is determined by testing a sample of aggregate particles for their ability to fit through a slotted plate. The test is conducted in accordance with the Central Federal Lands Highway Division (CFLHD) DFT-508, *Standard Method of Determining the Flakiness Index and Average Least Dimension of Aggregates.* The weight of the material passing the slots is divided by the total weight of the aggregate sample to determine the percent of flat particles or Flakiness Index.

Average Least Dimension

The average least dimension represents a reduction of the median particle size after accounting for the amount of flat particles. It represents the chip seal thickness in the wheel path after traffic has reoriented the chips on their flattest side. It is determined from the median particle size and flakiness index using the following equation:

$$H = \frac{M}{1.139285 + 0.011506FI} \qquad \text{(Eq. II-1)}$$

where:

H = Average Least dimension, in.
M = Median particle size, in.
FI = Flakiness index, percent.

Loose Unit Weight

The loose unit weight is required in order to determine the voids in the aggregate in a loose condition. The voids represent the available space for the asphalt binder after placement and rolling. The loose unit weight

is a function of the gradation, shape and specific gravity of the aggregate. It should be determined in accordance with ASTM C29.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Bulk Specific Gravity

Bulk specific gravity represents the weight of aggregate as compared to the weight of water. Different aggregate types have different unit weights or specific gravities. This factor affects the application rate of the aggregate chips because a heavier aggregate will require more weight of chips (or a higher application rate) than a lighter aggregate to cover the same area. Bulk specific gravities for aggregates typically range from 2.40 to 3.00. Natural aggregates are generally about 2.40 and quartzite and limestone aggregates are generally around 2.60.

Voids in Loose Aggregate

The voids in the loose aggregate represent the voids after the aggregate chips are placed on the pavement. It is based on the loose unit weight and can be determined using the following equation:

$$V = 1 - \frac{W}{62.4G} \qquad \text{(Eq. II-2)}$$

where:

V = Voids in the loose aggregate.
W = Loose unit weight of the aggregate chips, lb/ft^3.
G = Bulk specific gravity of the aggregate.

For one-sized chips, this factor will typically be around 50 percent. Rolling will reduce the amount of voids, typically to around 30 percent. Traffic will further reduce the amount of voids to around 20 percent.

Aggregate Absorption

Aggregates, especially porous aggregates, will absorb a portion of the asphalt emulsion. This will affect the amount of asphalt binder that is available for bonding with the aggregate chips. To ensure that enough binder remains, this factor must be taken into account when designing the emulsion application rate. An absorption correction factor of 0.09 l/m^2 (0.02 gal/yd^2) is recommended for aggregates with absorption greater than 1.5 percent. Quartzite is generally not too absorptive and will not require an adjustment. Some limestone and natural aggregates, however, may require an adjustment to the emulsion application rate.

Other Design Properties

Traffic Volume

The traffic volume will influence the amount of asphalt binder that is required to provide sufficient embedment of the aggregate chips. All other factors equal, roadways with higher traffic volumes will require less asphalt binder. This may appear to be the opposite of what is typically expected. However, consider that traffic causes a reorientation of the chips until they eventually lie on their flattest side.

More traffic thus results in a greater probability that the chips will be laying on their flattest side and will result in a thinner chip seal. Less traffic will result in a thicker chip seal and will thus require more asphalt binder to achieve sufficient embedment. Table II-3 provides the recommended traffic correction factor to be used in determining the emulsion application rate. Failure to account for this factor will result in bleeding in the wheel paths.

Table II-3. Recommended traffic correction factor.

Traffic (ADT)	Traffic Factor
< 100	0.85
100 – 500	0.75
500 – 1000	0.70
1000 – 2000	0.65
> 2000	0.60

Traffic Whip-Off

A portion of the aggregate chips will get thrown off the roadway before final curing and embedment under traffic has occurred. This is accounted for in the procedure using a traffic whip-off factor. The factor is based on the traffic volume and traffic speed of the roadway. Low-volume, residential streets will have about a 5 percent loss, whereas the loss on high-volume, high-speed roadways will be around 10 percent. The factor can be computed using the following equation:

$$E = 1 + \frac{P}{100} \qquad \text{(Eq. II-3)}$$

where:

E = Traffic whip-off factor.
P = Expected loss of aggregate chips, percent.

Thus, an expected loss of 10 percent results in a traffic whip-off factor of 1.10.

Existing Pavement Condition

The surface condition of the existing pavement will greatly influence the amount of asphalt emulsion that is required. A dry, porous pavement will absorb a tremendous amount of asphalt binder and thus affect the emulsion application rate. Conversely, a new pavement (or a pavement with bleeding on the surface) will absorb much less binder. The varying condition is accounted for in the design procedure by the surface correction factor. The recommended value, based on the pavement surface texture, is provided in Table II-4.

The same application rate cannot be used for all roadways with varying conditions. Similarly, the surface condition should be monitored during placement, and the application rate adjusted as needed to address areas of differing condition

Table II-4. Recommended surface correction factors.

Existing Pavement Surface Texture	Surface Correction Factor, gal/yd^2
Black, flushed asphalt	-0.01 to -0.06
Smooth, non-porous	0.00
Slightly porous and oxidized	+0.03
Slightly pocked, porous and oxidized	+0.06
Badly pocked, porous and oxidized	+0.09

Design Equations

Once the inputs are determined, the application rates can be calculated using the McLeod design equations. The equations for aggregate and emulsion application rates are presented below.

Aggregate Application Rate

The following equation is used to determine the aggregate application rate:

$$C = 46.8(1 - 0.4V) \times H \times G \times E \qquad \text{(Eq. II-4)}$$

where:

C = Chip application rate, lbs/yd^2.
V = Voids in loose aggregate.
H = Average Least dimension, in.
G = Bulk specific gravity.
E = Traffic whip-off factor.

Emulsion Application Rate

The emulsion application rate is determined using the following equation:

$$B = \frac{2.244 \times H \times T \times V + S + A}{R} \qquad \text{(Eq. II-5)}$$

where:

B = Binder application rate, gal/yd^2.
H = Average Least dimension, in.
T = Traffic correction factor.

V = Voids in loose aggregate.
S = Surface correction factor.
A = Aggregate absorption factor, gal/yd^2.
R = Residual asphalt content of binder.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED

Minnesota performs an additional calculation of the emulsion application rate to account for snowplow damage (Janisch and Gaillard 1998). The emulsion application rate is recalculated using the median particle size instead of the average least dimension. This new emulsion rate provides the required rate if the chips are not reoriented, and thus is more representative of the rate required outside the wheel path. The average of the two rates is then used as the starting point in the field. Minnesota has found that if this additional calculation is not performed, insufficient binder is applied in non-traffic areas, and snow plows shave off the chips (Janisch and Gaillard 1998).

Example Design Problem

A 68 kg (150 lb) sample of quartzite aggregate has been submitted for design. The roadway has traffic levels of 2,125 vehicles per day. The pavement surface is slightly pocked, porous and oxidized. A CRS-2 emulsion with a residual asphalt content of 66.5 percent will be used as the binder. Determine the emulsion and aggregate application rates for this project.

Step 1. Determine the aggregate gradation, bulk specific gravity and percent absorption.

Laboratory testing of the aggregate revealed the gradation as shown in Table II-5. Testing in accordance with AASHTO T 84-94 indicates a bulk specific gravity of the aggregate of 2.61. The aggregate absorption based on AASHTO T 84-94 is 0.55 percent, so no correction is needed.

Table II-5. Gradation results for design project.

Sieve Size	Percent Passing
12.7 mm (½ in)	100
9.52 mm (⅜ in)	95
6.35 mm (¼ in)	62
4.75 mm (No. 4)	12
2.36 mm (No. 8)	3.2
0.075 mm (No. 200)	1.3

Step 2. Determine the mean particle size.

The median particle size (M) is determined by plotting the gradation results and reading off the size at which 50 percent of the particles pass. The median particle size represents the theoretical size at which half the stones are larger and half are smaller. For the given gradation, the median particle size is determined to be 5.8 mm (0.23 in).

Step 3. Determine the flakiness index.

To determine the flakiness index, the aggregate particles are fitted through slots. The results of this testing is shown in Table II-6.

Table II-6. Results of flakiness index test.

Size Fraction	Weight Retained on Slot, grams	Weight Passing Slot, grams
12.5 to 9.5 mm (½ to ⅜ in)	54.2	12.3
9.5 to 6.3 mm (⅜ to ¼ in)	123.3	43.5
6.3 to 4.75 mm (¼ in to No. 4)	184.4	89.5
Total	**361.9**	**145.3**

Using these results, the flakiness index (FI) is determined as follows:

$$FI = \frac{Weight\ of\ Flat\ Chips}{Weight\ of\ Sample} = \frac{145.3}{361.9 + 145.3} = 0.286 = 28.6\ percent$$

Step 4. Determine the average least dimension.

The average least dimension (H) is the expected thickness of the chip seal after the chips have been reoriented on their flattest side from traffic. It is determined using Equation II-2 as follows:

$$H = \frac{M}{1.139285 + 0.011506FI} = \frac{0.23\ in}{1.139285 + (0.011506 \times 28.6)} = 0.157\ in$$

Step 5. Determine the loose weight of the aggregate.

A metal cylinder with a volume of 0.014 m^3 (0.50 ft^3) was loosely filled with aggregate and weighed. This process was repeated three times, the results of which are shown in Table II-7.

Table II-7. Results of loose unit weight testing.

Test Number	Weight of Aggregate, kg (lbs)
1	20.57 (45.25)
2	20.60 (45.32)
3	20.59 (45.29)
Average	**20.59 (45.29)**

The loose unit weight (W) is then determined as follows:

$$W = \frac{Weight\ of\ Aggregate}{Weight\ of\ Cylinder} = \frac{45.29\ lbs}{0.50\ ft^3} = 90.58\ lbs/ft^3$$

Step 6. Determine the voids in the loose aggregate.

The voids in the loose aggregate (V) is determined using Equation II-2 as follows:

$$V = 1 - \frac{W}{62.4\,G} = 1 - \frac{90.58\ lbs/ft^3}{62.4\ lbs/ft^3 \times 2.61} = 0.44$$

Step 7. Determine the aggregate application rate.

With the inputs determined above, Equation II-4 is used to determine the aggregate application rate (C):

$$C = 46.8(1 - (0.4V)) \times H \times G \times E$$
$$= 46.8(1 - (0.4 \times 0.44)) \times 0.157 \times 2.61 \times 1.10 = 17.3\ lbs/yd^2$$

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED

Step 8. Determine the emulsion application rate.

The emulsion application rate is determined using Equation II-5. The calculation is performed twice – once for the wheel path areas (using the average least dimension) and again for the non-wheel path areas (using the median particle size). These calculations are shown below:

$$B = \frac{2.244 \times H \times T \times V + S + A}{R}$$
$$= \frac{2.244 \times 0.157 \times 0.60 \times 0.44 + 0.06 + 0.00}{0.665} = 0.23\ gal.yd^2$$

$$B = \frac{2.244 \times M \times T \times V + S + A}{R}$$
$$= \frac{2.244 \times 0.23 \times 0.60 \times 0.44 + 0.06 + 0.00}{0.665} = 0.30\ gal.yd^2$$

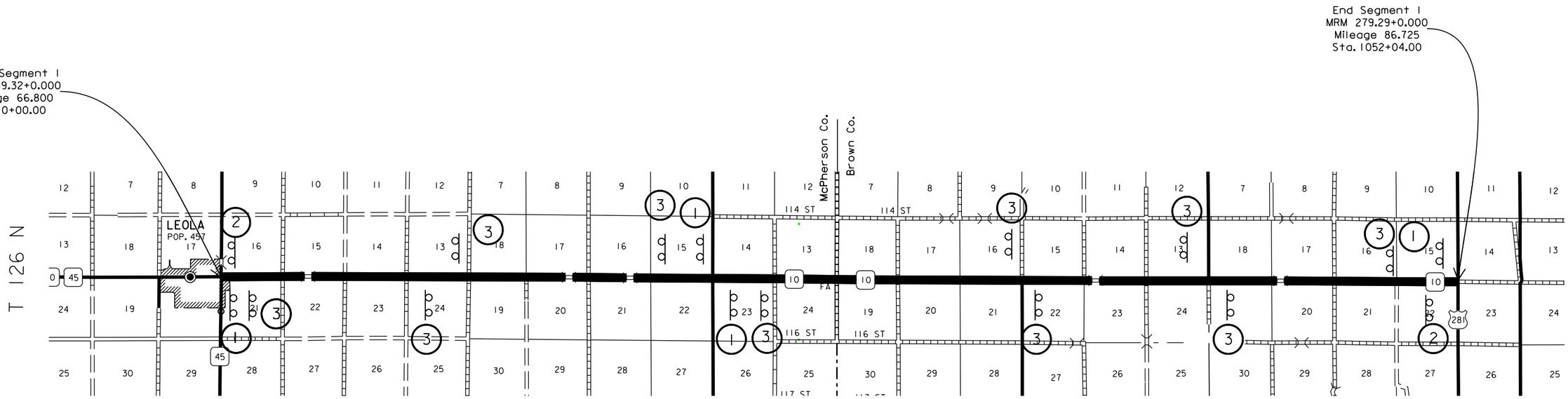
The average of the two results (0.27 gal/yd^2) is used as the starting point in the field.

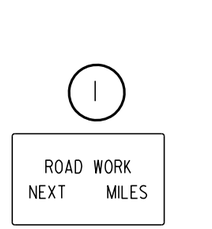
STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	19	33
Plotting Date: 01/06/2015			

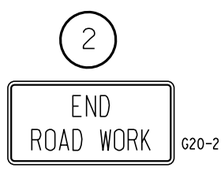
Revised 1/13/15 B.S.

Segment 1

FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)







W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

PLOT NAME - 8

FILE - ...\SEGMENT 1 SD 10 LEOLA - TC.DGN

PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	20	33

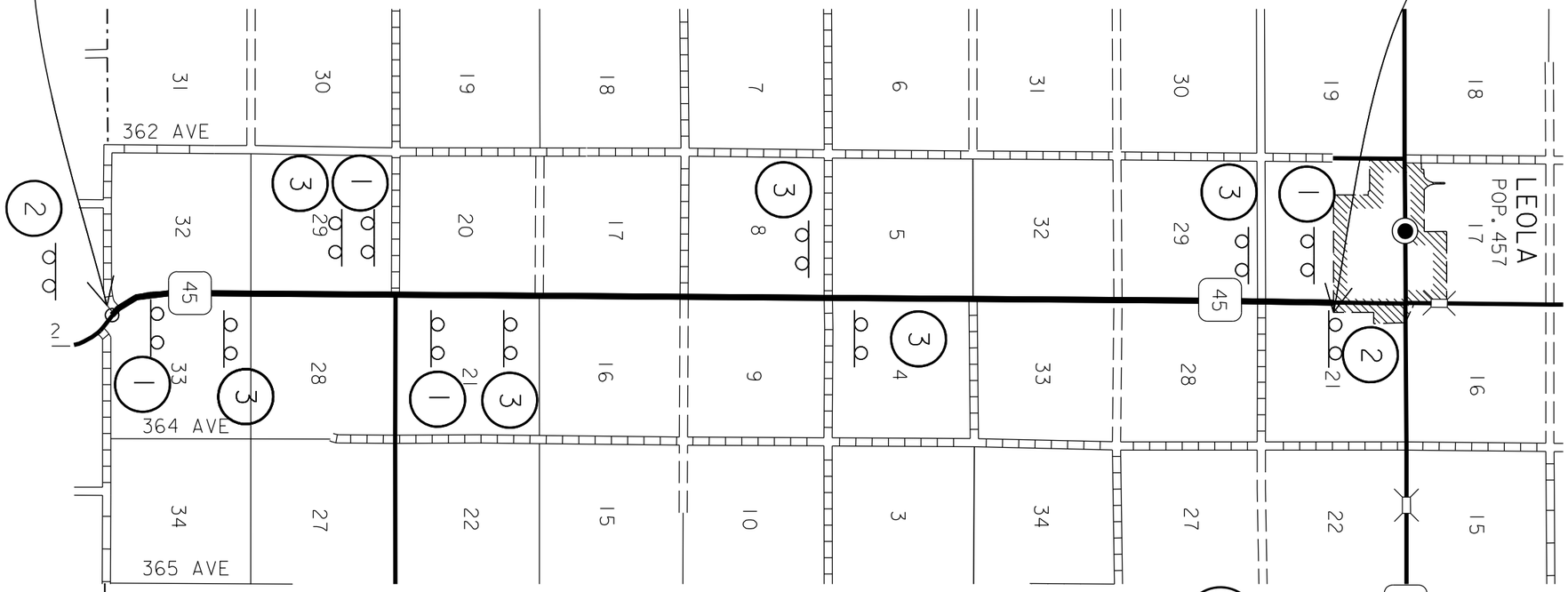
Revised 1/13/15 B.S.

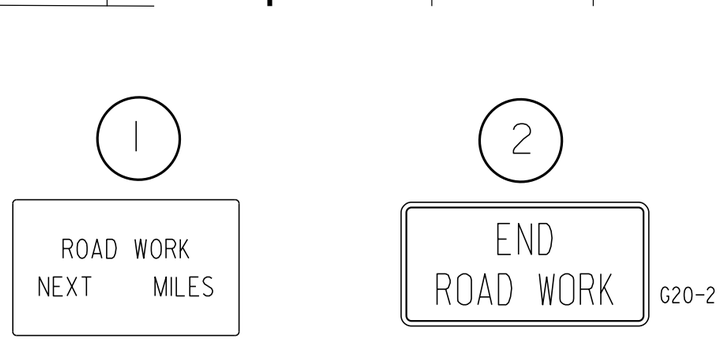
Segment 2

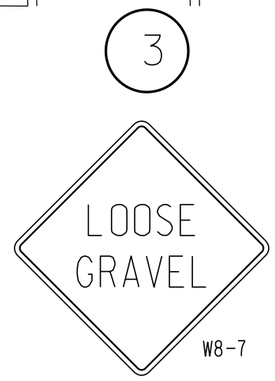
FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)

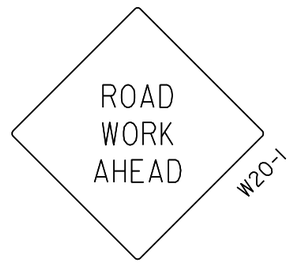
Begin Segment 2
MRM 193.00+0.028
Mileage 141.042
Sta. 0+00.00

End Segment 2
MRM
201.51+0.000
Mileage 149.527
Sta. 448+00.8









W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

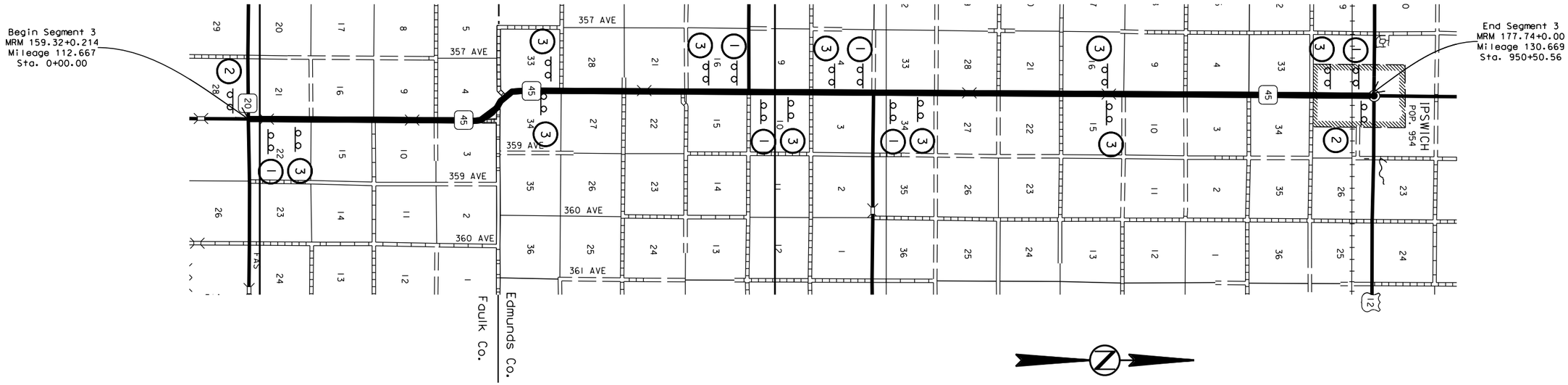
PLOTTED FROM - TRABINT01

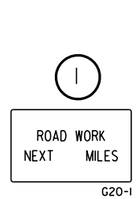
STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	21	33

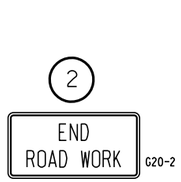
Revised 1/13/15 B.S.

Segment 3 SD 45

FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)







W20-1ROAD WORK AHEAD signs shallbe mounted on portable supports and shallbe placed on intersecting roadways as directed by the Engineer.ROAD WORK AHEAD shallbe moved as necessary to keep current with work activities.

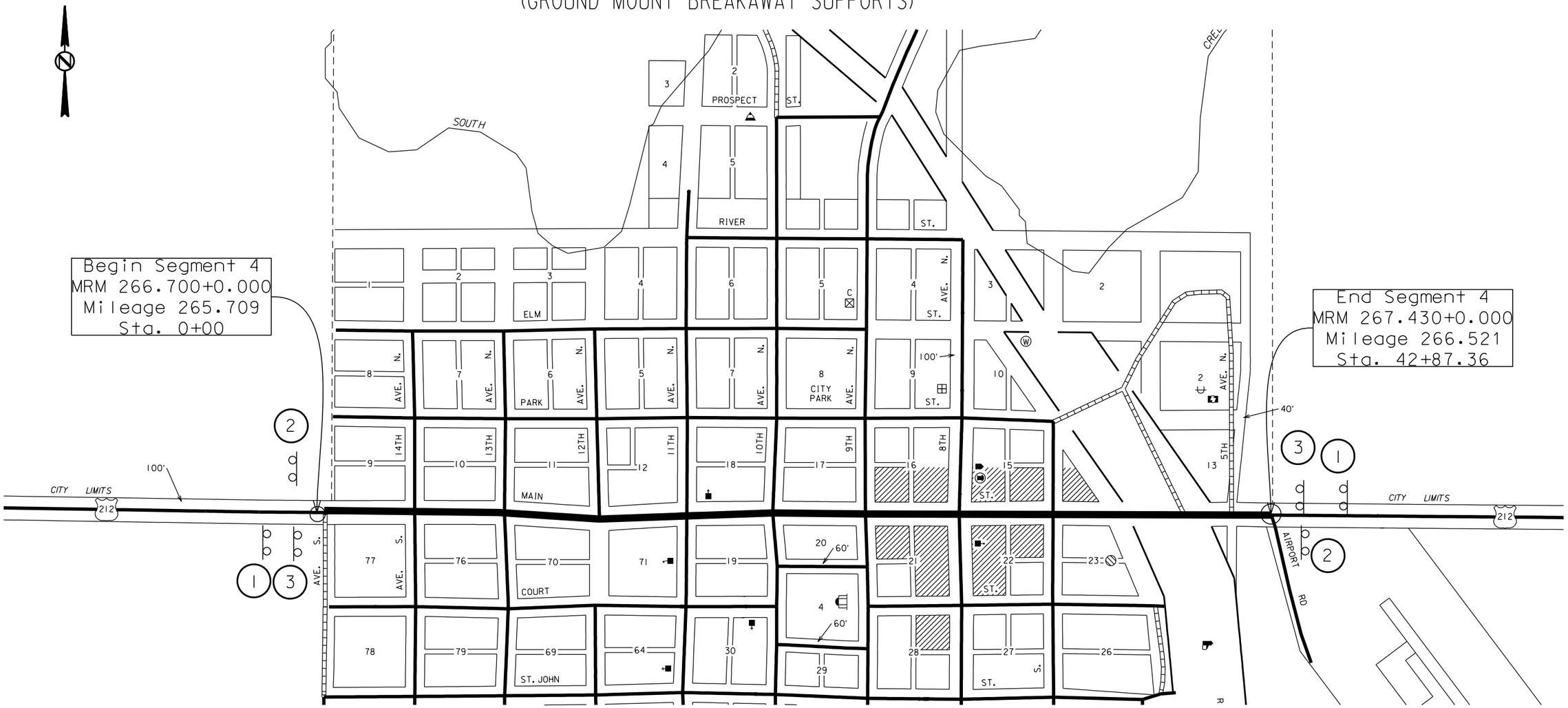
PLOTTED FROM - TRAB1NT01

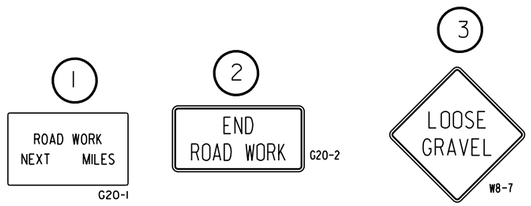
STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	22	33

Segement 4 Faulkton

FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)

Revised 1/13/15 B.S.





W20-1ROAD WORK AHEAD signs shallbe mounted on portable supports and shallbe placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shallbe moved as necessary to keep current with work activities.

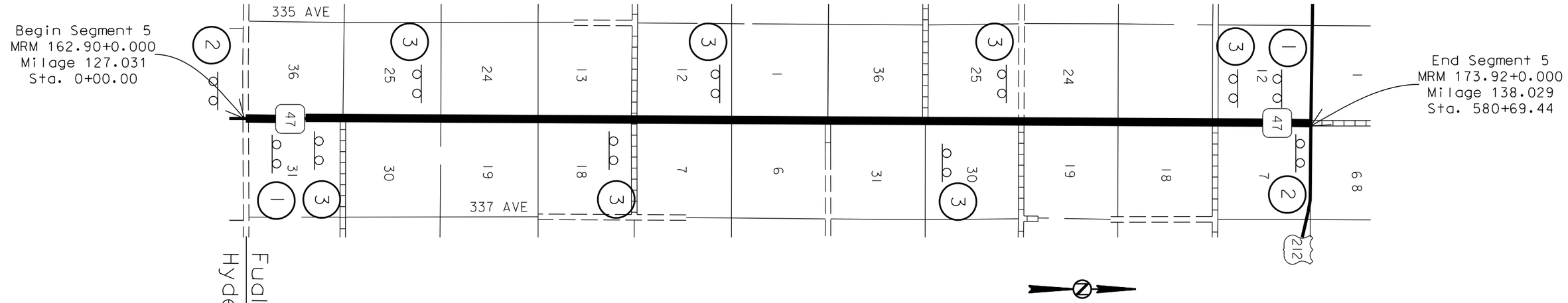
PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	23	33

Revised 1/13/15 B.S.

Segment 5 SD 47

FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)



1

ROAD WORK
NEXT MILES

G20-1

2

END
ROAD WORK

G20-2

3

LOOSE
GRAVEL

W8-7

40
M.P.H.

W13-1

ROAD
WORK
AHEAD

W20-1

W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

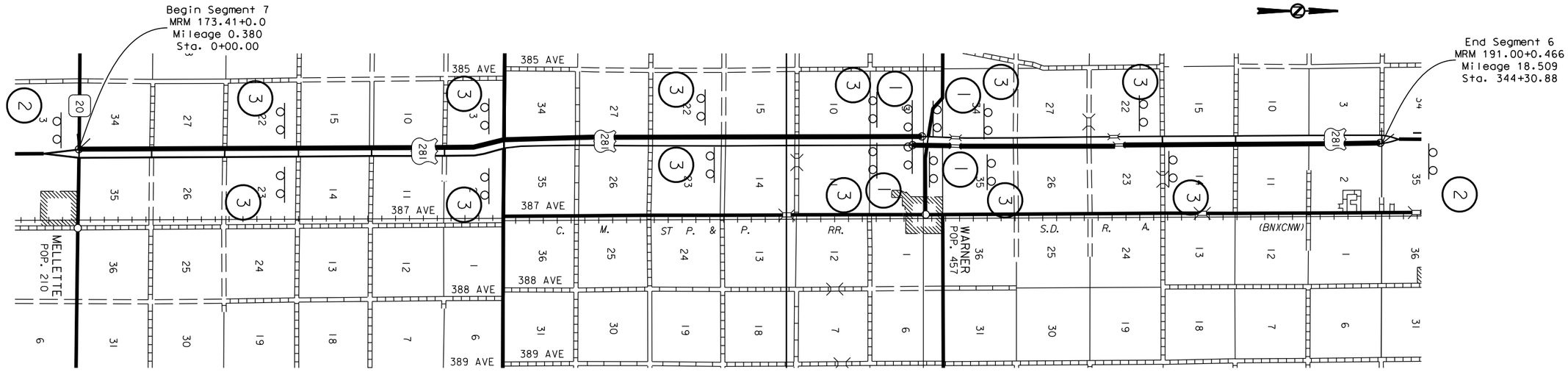
PLOTTED FROM - TRAB1NT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	24	33

Revised 1/13/15 B.S.

Segment 6 US 281N
Segment 7 US 281S

FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)



1

ROAD WORK
NEXT MILES

G20-1

2

END
ROAD WORK

G20-2

3

LOOSE
GRAVEL

W8-7

40
M.P.H.

W13-1

ROAD
WORK
AHEAD

W20-1

W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

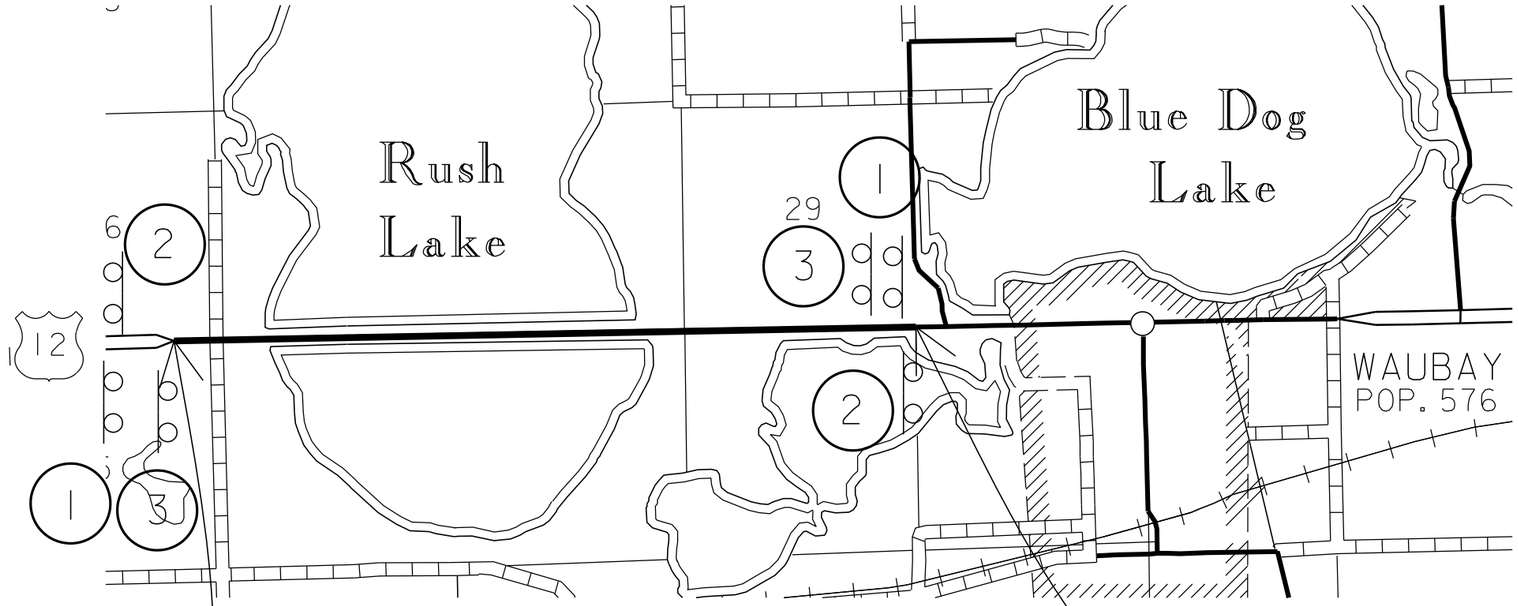
PLOTTED FROM - TRAB1NT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	25	33

Revised 1/13/15 B.S.

Segment 8 US 12

FIXED LOCATION SIGNS
(GROUND MOUNT BREAKAWAY SUPPORTS)



Begin Segment 8
MRM 349.19+0.000
Mileage 208.282
Sta. 0+00.00

End Segment 8
MRM 352+0.511
Mileage 211.601
Sta. 175+24.32

1

ROAD WORK
NEXT MILES

G20-1

2

END
ROAD WORK

G20-2

3

LOOSE
GRAVEL

W8-7

40
M.P.H.

W13-1

ROAD
WORK
AHEAD

W20-1

W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

PLOTTED FROM - TRABINT01

The signs illustrated are not required if the work space is behind a barrier, more than 2 feet behind the curb, or 15 feet or more from the edge of any roadway.

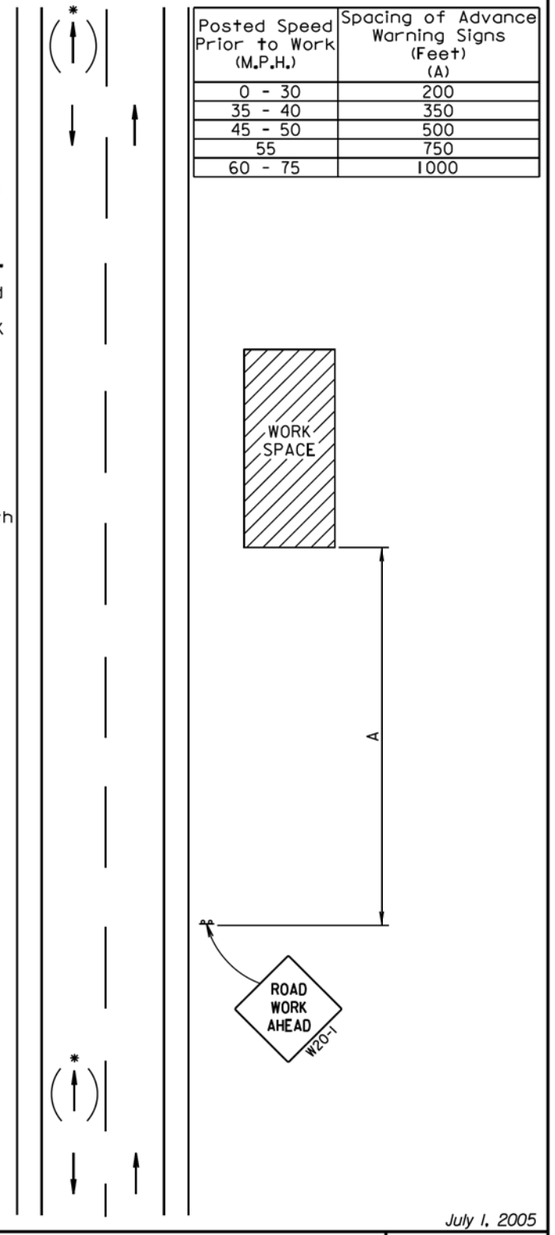
The signs illustrated shall be used where there are distracting situations; such as: vehicles parked on shoulder, vehicles accessing the work site via the highway, and equipment traveling on or crossing the roadway to perform work operations.

The ROAD WORK AHEAD sign may be replaced with other appropriate signs, such as the SHOULDER WORK sign. The SHOULDER WORK sign may be used for work adjacent to the shoulder.

* If the work space is on a divided highway, an advance warning sign should also be placed on the left side of the directional roadway.

For short term, short duration, or mobile operations, all signs and channelizing devices may be eliminated if a vehicle with an activated flashing or revolving yellow light is used.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 75	1000



July 1, 2005

Published Date: 4th Qtr. 2014	SDDOT	GUIDES FOR TRAFFIC CONTROL DEVICES WORK BEYOND THE SHOULDER	PLATE NUMBER 634.01
			Sheet 1 of 1

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	200	25
35 - 40	350	25
45 - 50	500	50
55	750	50
60 - 65	1000	50

Flagger

Channelizing Device

For low-volume traffic situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions, a single flagger may be used.

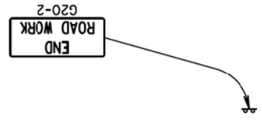
The ROAD WORK AHEAD and the END ROAD WORK signs may be omitted for short duration operations (1 hour or less).

For tack and/or flush seal operations, when flaggers are not being used, the FRESH OIL sign (W21-2) shall be displayed in advance of the liquid asphalt areas.

Flashing warning lights and/or flags may be used to call attention to the advance warning signs.

The channelizing devices shall be drums or 42" cones.

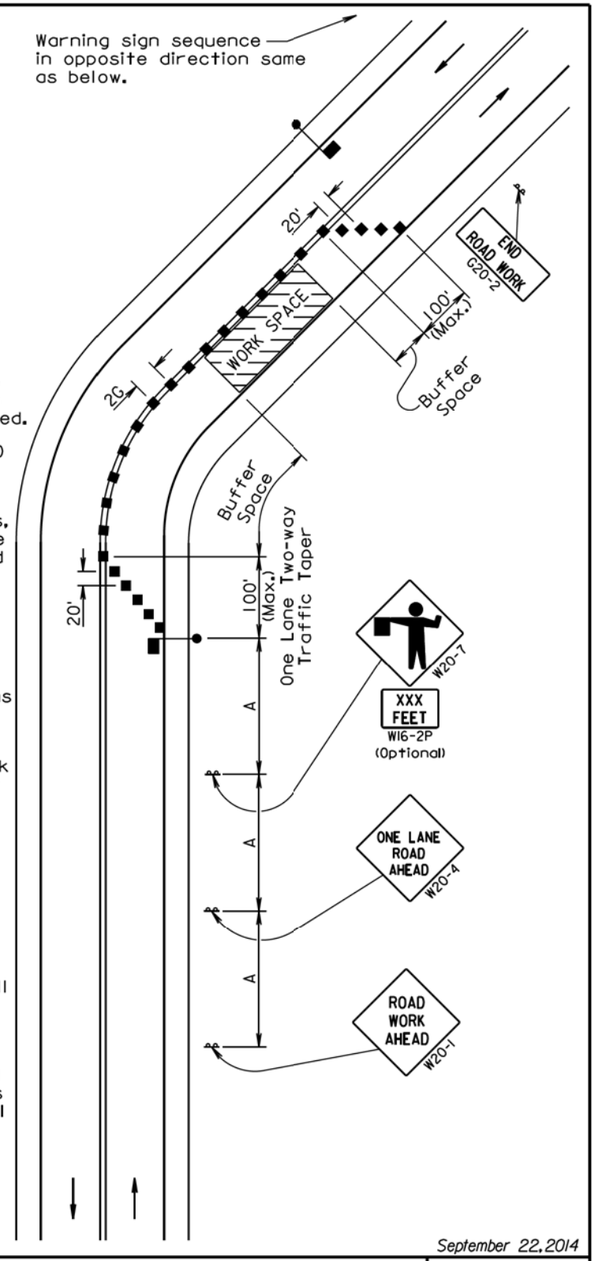
Channelizing devices are not required along the centerline adjacent to work area when pilot cars are utilized for escorting traffic through the work area.



Channelizing devices and flaggers shall be used at intersecting roads to control intersecting road traffic as required.

The buffer space should be extended so that the two-way traffic taper is placed before a horizontal or vertical curve to provide adequate sight distance for the flagger and queue of stopped vehicles.

The length of A may be adjusted to fit field conditions.



September 22, 2014

Published Date: 4th Qtr. 2014	SDDOT	GUIDES FOR TRAFFIC CONTROL DEVICES LANE CLOSURE WITH FLAGGER PROVIDED	PLATE NUMBER 634.23
			Sheet 1 of 1

PLOT SCALE - 1:200

PLOT NAME - 2

FILE - ...\634.01 & 634.23.DGN

-PLOTTED FROM - TRAB1NT01

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A) (B) (C)	Taper Length (Feet) (L)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	200	180	25
35 - 40	350	320	25
45 - 50	500	600	50 *
55	750	660	50 *
60 - 65	1000	780	50 *

* Spacing to be every 40' for 42" cones.

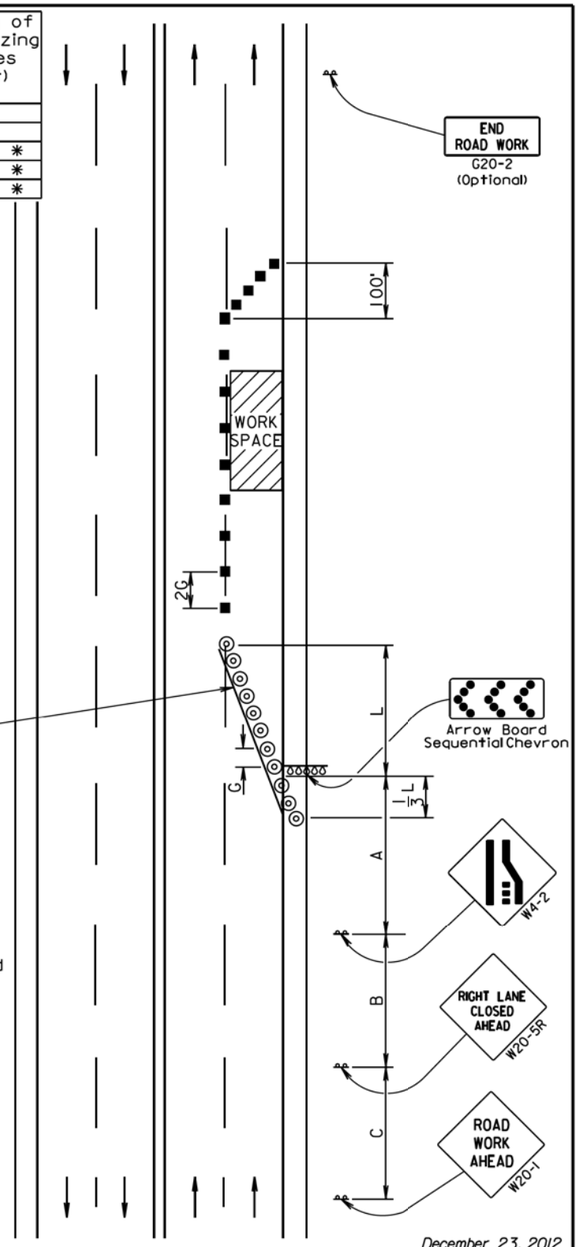
◎ Reflectorized Drum

■ Channelizing Device shall be 42" cones or drums

42" cones may be used in place of the drums shown in the taper if setup will not be used during any night time hours.

4" white temporary pavement marking shall be used for overnight and long term operations.

Longitudinal dimensions may be adjusted to fit project conditions such as horizontal curves, vertical curves, and other site restrictions.



December 23, 2012

Published Date: 4th Qtr. 2014	SDDOT	GUIDES FOR TRAFFIC CONTROL DEVICES 4-LANE UNDIVIDED, RIGHT LANE CLOSED	PLATE NUMBER 634.47 Sheet 1 of 1

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A) (B) (C)	Taper Length (Feet) (L)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	200	180	25
35 - 40	350	320	25
45 - 50	500	600	50 *
55	750	660	50 *
60 - 65	1000	780	50 *

* Spacing to be every 40' for 42" cones.

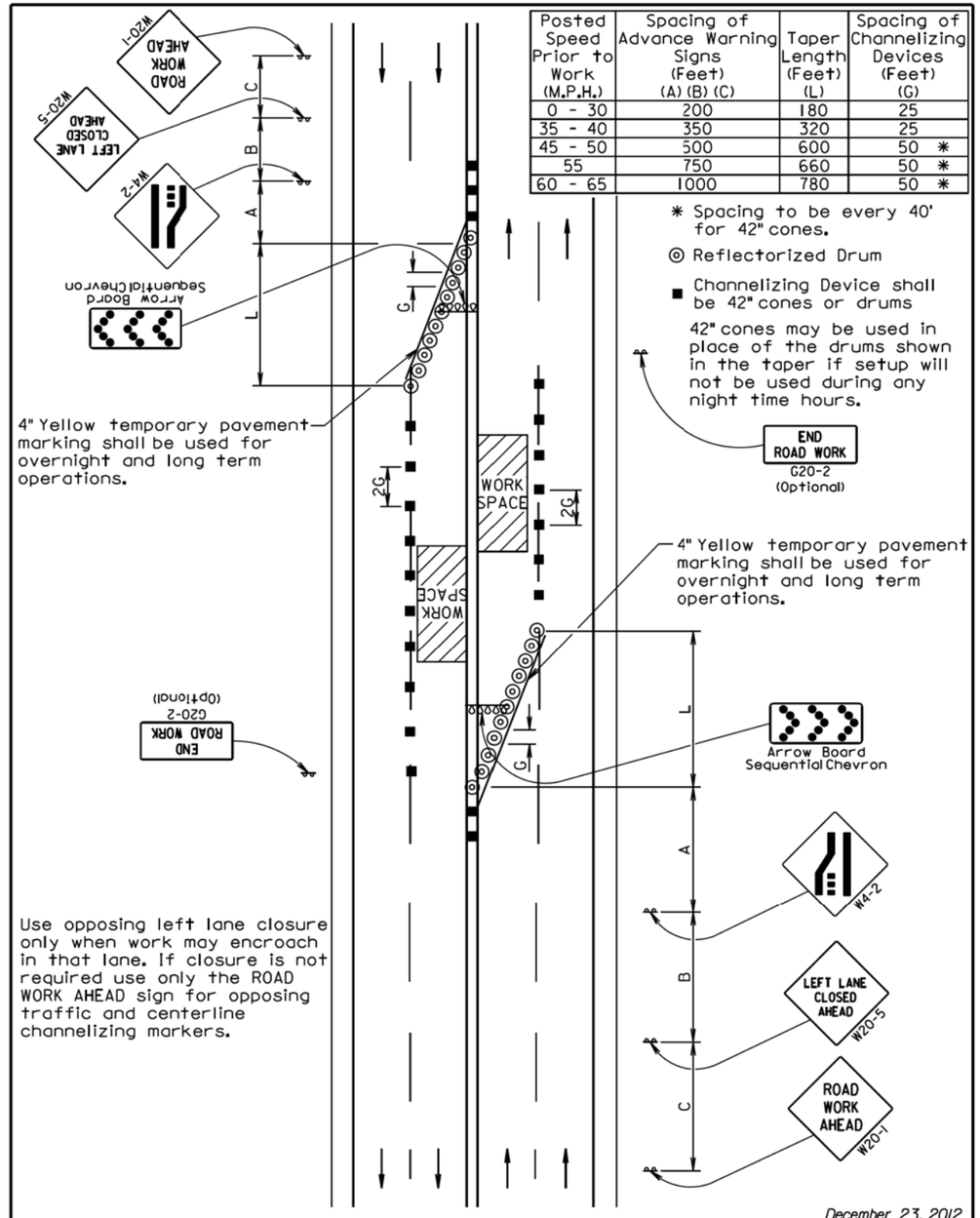
◎ Reflectorized Drum

■ Channelizing Device shall be 42" cones or drums

42" cones may be used in place of the drums shown in the taper if setup will not be used during any night time hours.

4" Yellow temporary pavement marking shall be used for overnight and long term operations.

Use opposing left lane closure only when work may encroach in that lane. If closure is not required use only the ROAD WORK AHEAD sign for opposing traffic and centerline channelizing markers.

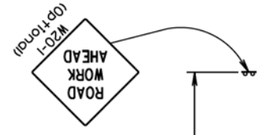


December 23, 2012

Published Date: 4th Qtr. 2014	SDDOT	GUIDES FOR TRAFFIC CONTROL DEVICES 4-LANE UNDIVIDED, LEFT LANE CLOSED	PLATE NUMBER 634.48 Sheet 1 of 1

WITHOUT BARRIER

** Shall be used for overnight and long term operations.



Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A) (B) (C)	Taper Length (Feet) (L)
0 - 30	200	180
35 - 40	350	320
45 - 50	500	600
55	750	660
60 - 65	1000	780
	(A) (B) (C)	
70 - 75	1000 1600 2600	900

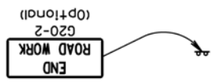
Posted Speed Prior to Work (M.P.H.)	Length of Longitudinal Buffer Space (Feet)
20	35
25	55
30	85
35	120
40	170
45	220
50	280
55	335
60	415
65	485
70	535
75	585

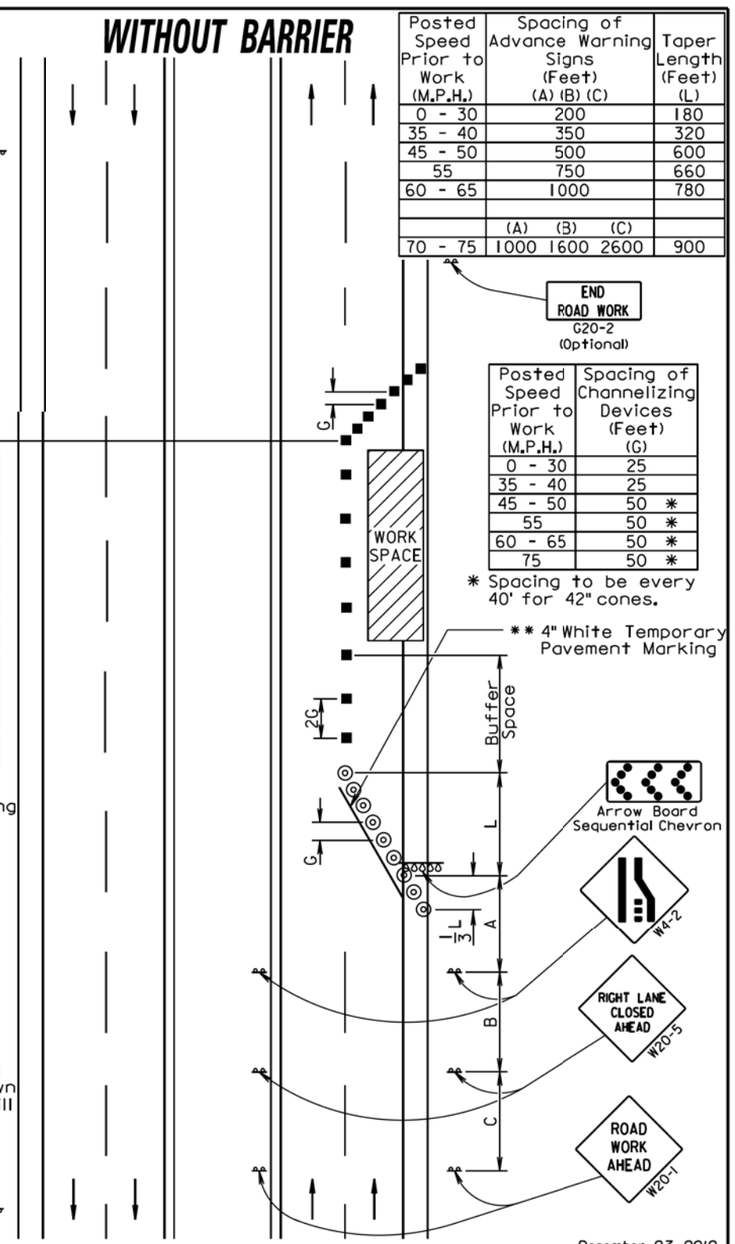
This procedure also applies when work is being performed in the lane adjacent to the median on a divided highway. Under these conditions, LEFT LANE CLOSED signs and the corresponding LANE REDUCTION symbol signs shall be used.

◎ Reflectorized Drum

■ Channelizing Device shall be 42" cones or drums

42" cones may be used in place of the drums shown in the taper if setup will not be used during any night time hours.



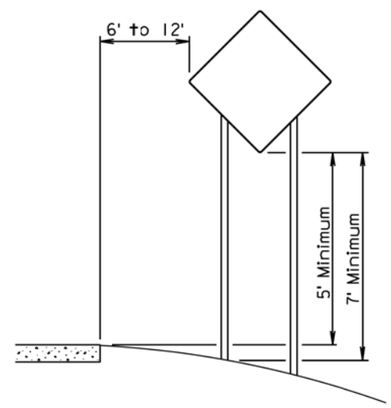


Posted Speed Prior to Work (M.P.H.)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	25
35 - 40	25
45 - 50	50 *
55	50 *
60 - 65	50 *
75	50 *

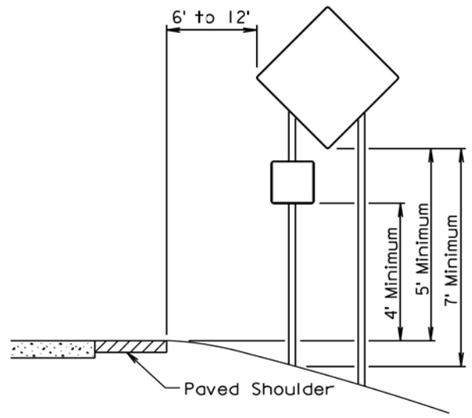
* Spacing to be every 40' for 42" cones.

December 23, 2012

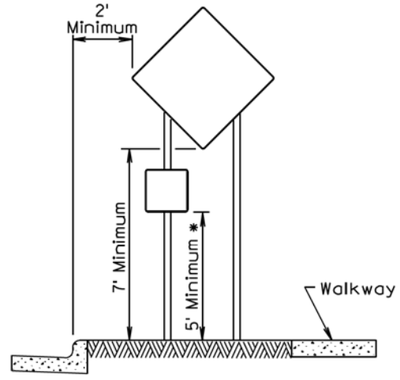
Published Date: 4th Qtr. 2014	SDDOT	GUIDES FOR TRAFFIC CONTROL DEVICES LANE CLOSURE WITHOUT BARRIER	PLATE NUMBER 634.64 Sheet 1 of 1



RURAL DISTRICT

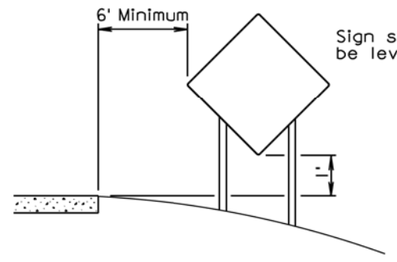


RURAL DISTRICT WITH SUPPLEMENTAL PLATE



URBAN DISTRICT

* If the bottom of supplemental plate is mounted lower than 7 feet above a pedestrian walkway, the supplemental plate should not project more than 4" into the pedestrian facility.



RURAL DISTRICT
3 DAY MAXIMUM
(Not applicable to regulatory signs)

September 22, 2014

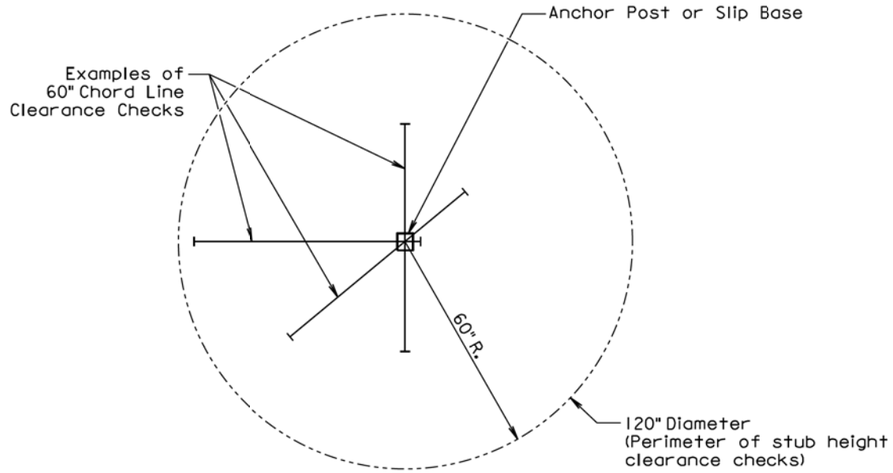
Published Date: 4th Qtr. 2014	SDDOT	CRASHWORTHY SIGN SUPPORTS (Typical Construction Signing)	PLATE NUMBER 634.85 Sheet 1 of 1

PLOT SCALE - 1:200

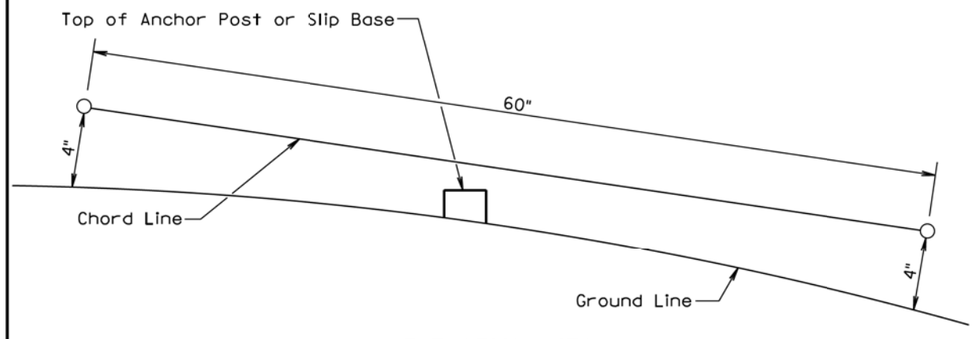
PLOT NAME - 4

FILE - ...\634.648634.85.DGN

-PLOTTED FROM - TRABINT01



PLAN VIEW
(Examples of stub height clearance checks)



ELEVATION VIEW

GENERAL NOTES:

The top of anchor posts and slip bases SHALL NOT extend above a 60" chord line within a 120" diameter circle around the post with ends 4" above the ground.

At locations where there is curb and gutter adjacent to the breakaway sign support, the stub height shall be a maximum of 4" above the ground line at the localized area adjacent to the breakaway support stub.

The 4" stub height clearance is not necessary for U-channel lap splices where the support is designed to yield (bend) at the base.

July 1, 2005

Published Date: 4th Qtr. 2014	SDDOT	***BREAKAWAY SUPPORT STUB CLEARANCE***	*PLATE NUMBER* 634.99
			Sheet 1 of 1

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	30	33

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 1 SD 10

SIGN CODE	DESCRIPTION	CONVENTIONAL ROAD NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W8-7	LOOSE GRAVEL	10	48" x 48"	34	340
W13-1P	ADVISORY SPEED (plaque)	10	30" x 30"	21	210
W20-1	ROAD WORK AHEAD	4	48" x 48"	34	136
W20-4	ONE LANE ROAD AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	4	48" x 48"	34	136
G20-1	ROAD WORK NEXT __ MILES	4	36" x 18"	17	68
G20-2	END ROAD WORK	4	36" x 18"	17	68
				TOTAL UNITS	1026

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 2 SD 45

SIGN CODE	DESCRIPTION	CONVENTIONAL ROAD NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W8-7	LOOSE GRAVEL	5	48" x 48"	34	170
W13-1P	ADVISORY SPEED (plaque)	5	30" x 30"	21	105
W20-1	ROAD WORK AHEAD	4	48" x 48"	34	136
W20-4	ONE LANE ROAD AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	4	48" x 48"	34	136
G20-1	ROAD WORK NEXT __ MILES	4	36" x 18"	17	68
G20-2	END ROAD WORK	4	36" x 18"	17	68
				TOTAL UNITS	751

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 3 SD 45

SIGN CODE	DESCRIPTION	CONVENTIONAL ROAD NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W8-7	LOOSE GRAVEL	10	48" x 48"	34	340
W13-1P	ADVISORY SPEED (plaque)	10	30" x 30"	21	210
W20-1	ROAD WORK AHEAD	4	48" x 48"	34	136
W20-4	ONE LANE ROAD AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	4	48" x 48"	34	136
G20-1	ROAD WORK NEXT __ MILES	6	36" x 18"	17	102
G20-2	END ROAD WORK	4	36" x 18"	17	68
				TOTAL UNITS	1060

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 4 US 212

SIGN CODE	DESCRIPTION	CONVENTIONAL ROAD NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W4-2	LEFT or RIGHT LANE ENDS (symbol)	2	48" x 48"	34	68
W8-7	LOOSE GRAVEL	2	48" x 48"	34	68
W20-1	ROAD WORK AHEAD	8	48" x 48"	34	272
W20-5	LEFT or RIGHT LANE CLOSED AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	2	48" x 48"	34	68
G20-1	ROAD WORK NEXT __ MILES	2	36" x 18"	17	34
G20-2	END ROAD WORK	2	36" x 18"	17	34
				TOTAL UNITS	612

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 5 SD 47

SIGN CODE	DESCRIPTION	CONVENTIONAL ROAD NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W8-7	LOOSE GRAVEL	7	48" x 48"	34	238
W13-1P	ADVISORY SPEED (plaque)	7	30" x 30"	21	147
W20-1	ROAD WORK AHEAD	4	48" x 48"	34	136
W20-4	ONE LANE ROAD AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	4	48" x 48"	34	136
G20-1	ROAD WORK NEXT __ MILES	2	36" x 18"	17	34
G20-2	END ROAD WORK	4	36" x 18"	17	68
				TOTAL UNITS	827

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 6 US 281N

SIGN CODE	DESCRIPTION	EXPRESSWAY / INTERSTATE NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W4-2	LEFT or RIGHT LANE ENDS (symbol)	2	48" x 48"	34	68
W8-7	LOOSE GRAVEL	4	48" x 48"	34	136
W13-1P	ADVISORY SPEED (plaque)	4	30" x 30"	21	84
W20-1	ROAD WORK AHEAD	3	48" x 48"	34	102
W20-5	LEFT or RIGHT LANE CLOSED AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	2	48" x 48"	34	68
G20-1	ROAD WORK NEXT __ MILES	2	48" x 24"	24	48
G20-2	END ROAD WORK	3	48" x 24"	24	72
				TOTAL UNITS	646

ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 7 US 281S

SIGN CODE	DESCRIPTION	EXPRESSWAY / INTERSTATE NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W4-2	LEFT or RIGHT LANE ENDS (symbol)	2	48" x 48"	34	68
W8-7	LOOSE GRAVEL	8	48" x 48"	34	272
W13-1P	ADVISORY SPEED (plaque)	8	30" x 30"	21	168
W20-1	ROAD WORK AHEAD	3	48" x 48"	34	102
W20-5	LEFT or RIGHT LANE CLOSED AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	2	48" x 48"	34	68
G20-1	ROAD WORK NEXT __ MILES	2	48" x 24"	24	48
G20-2	END ROAD WORK	3	48" x 24"	24	72
				TOTAL UNITS	866

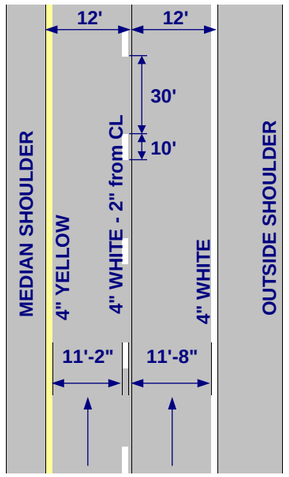
ITEMIZED LIST FOR TRAFFIC CONTROL SEGMENT 8 US 12

SIGN CODE	DESCRIPTION	EXPRESSWAY / INTERSTATE NUMBER	SIGN SIZE	UNITS PER SIGN	UNITS
W4-2	LEFT or RIGHT LANE ENDS (symbol)	2	48" x 48"	34	68
W8-7	LOOSE GRAVEL	2	48" x 48"	34	68
W13-1P	ADVISORY SPEED (plaque)	2	30" x 30"	21	42
W20-1	ROAD WORK AHEAD	2	48" x 48"	34	68
W20-5	LEFT or RIGHT LANE CLOSED AHEAD	2	48" x 48"	34	68
W20-7	FLAGGER (symbol)	2	48" x 48"	34	68
G20-1	ROAD WORK NEXT __ MILES	2	48" x 24"	24	48
G20-2	END ROAD WORK	4	48" x 24"	24	96
				TOTAL UNITS	526

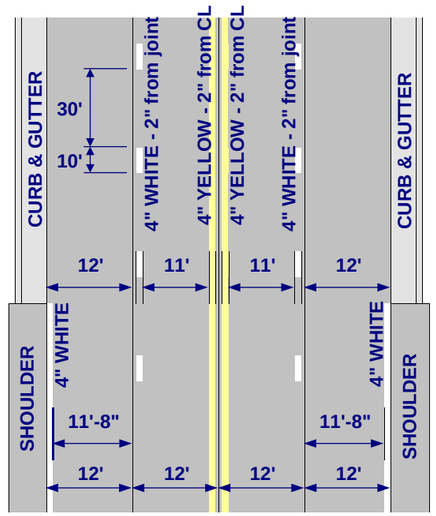
STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	31	33

FURNISHING AND APPLYING PAVEMENT MARKING PAINT

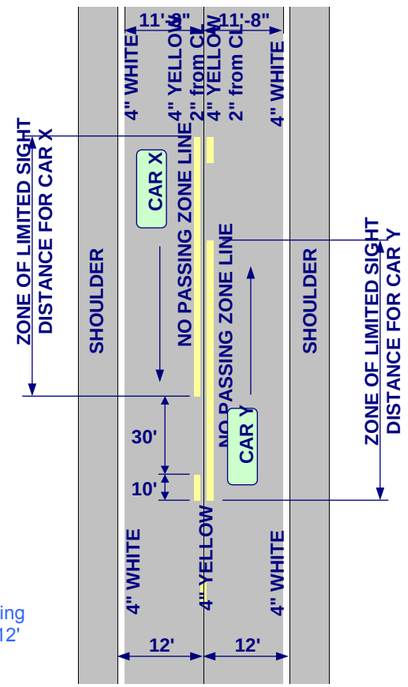
DIVIDED ROADWAY (ONE DIRECTION SHOWN)



UNDIVIDED ROADWAY



UNDIVIDED ROADWAY



NOTE: All pavement marking dimensions are based on 12' driving lanes.

Approximate paint application rates shall be as follows:

Two Lane Roadway (Rates for one line)
Dashed Yellow Centerline Rate = 6.2 Gals./Pass-Mile
Solid Yellow Centerline Rate = 22.5 Gals./Pass-Mile
Solid White Edgeline Rate = 22.5 Gals./Pass-Mile
Glass = 8 lbs/Gal.

Two Lane Roadway With 8" White Edgeline (Rates for one line)
Dashed Yellow Centerline Rate = 6.2 Gals./Pass-Mile
Solid Yellow Centerline Rate = 22.5 Gals./Pass-Mile
Solid White Edgeline Rate = 45 Gals./Pass-Mile
Glass = 8 lbs/Gal.

Dvided & Undivided Roadway (Rates for one line)
Dashed White Centerline Rate = 6.2 Gals./Pass-Mile
Solid Yellow Edgeline Rate = 22.5 Gals./Pass-Mile
Solid White Edgeline Rate = 22.5 Gals./Pass-Mile
Glass = 8 lbs/Gal.

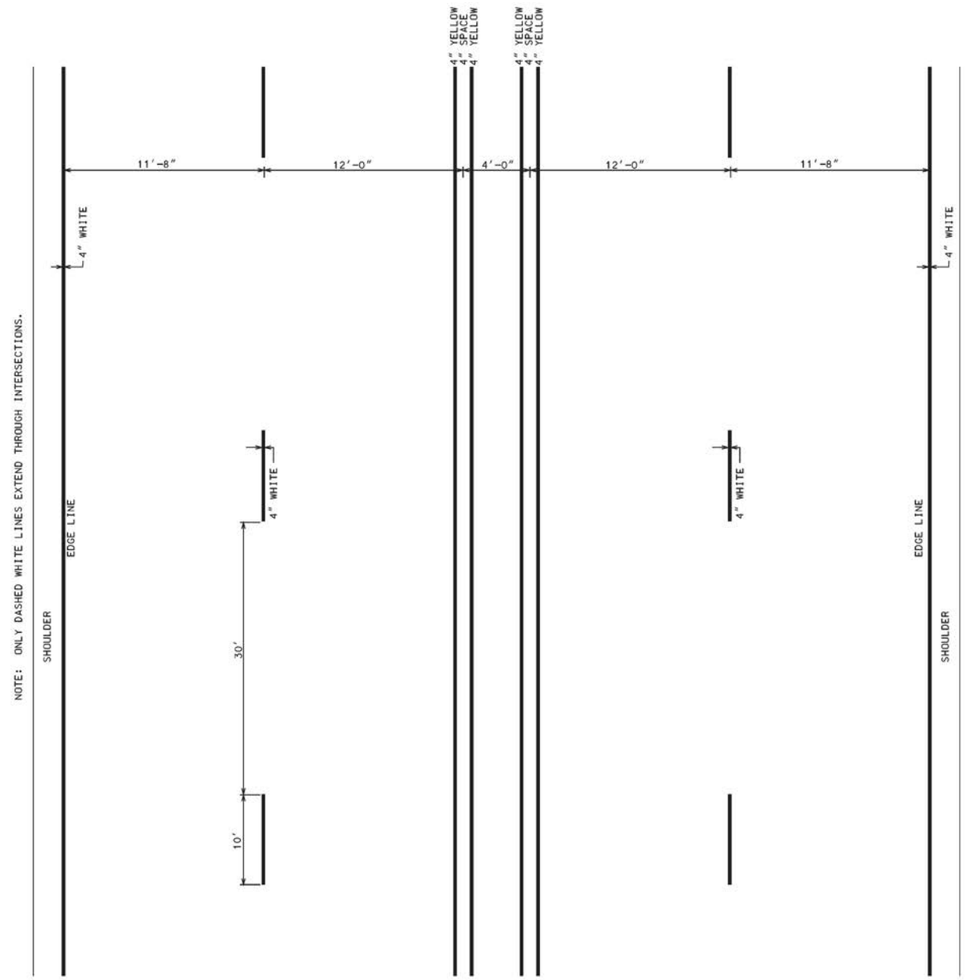
Typical Pavement Markings shown on this sheet shall be applied throughout the entire length of the roadway

Traffic Control shall be incidental to the cost of the application. The striper and advance or trailing warning vehicle shall be equipped with flashing amber lights or adcance warning arrow panel

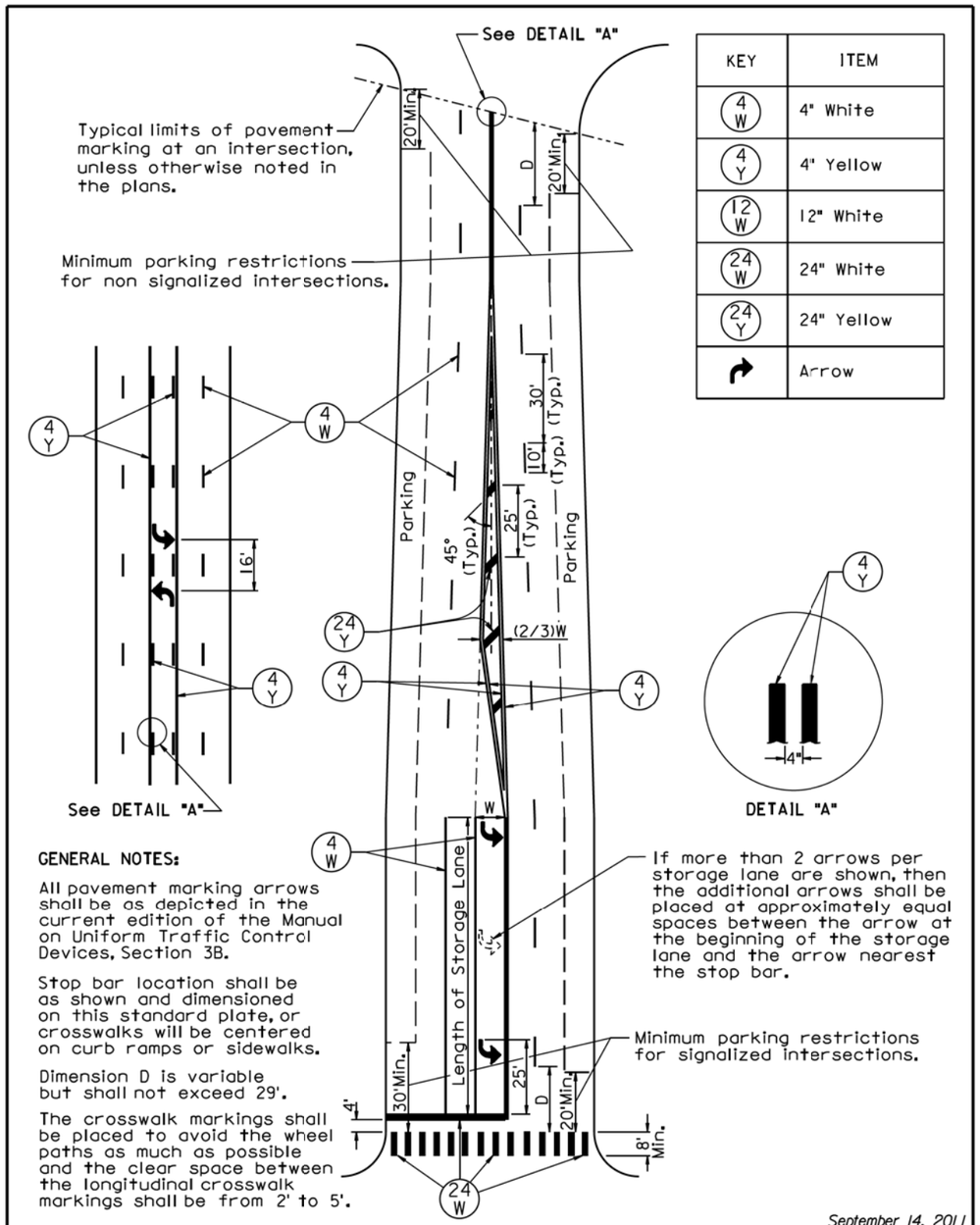
PLOTTED FROM - TRABINT01

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P0011(83)	32	33

Segment 8 Pavement Marking Detail



PLOTTED FROM - TRAB1NT01



KEY	ITEM
4 W	4" White
4 Y	4" Yellow
12 W	12" White
24 W	24" White
24 Y	24" Yellow
	Arrow

GENERAL NOTES:

All pavement marking arrows shall be as depicted in the current edition of the Manual on Uniform Traffic Control Devices, Section 3B.

Stop bar location shall be as shown and dimensioned on this standard plate, or crosswalks will be centered on curb ramps or sidewalks.

Dimension D is variable but shall not exceed 29'.

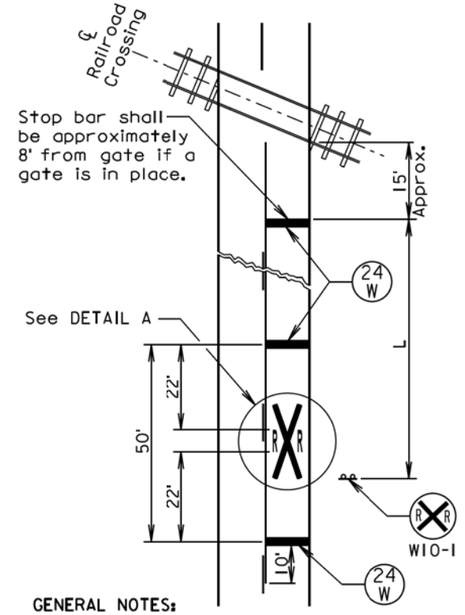
The crosswalk markings shall be placed to avoid the wheel paths as much as possible and the clear space between the longitudinal crosswalk markings shall be from 2' to 5'.

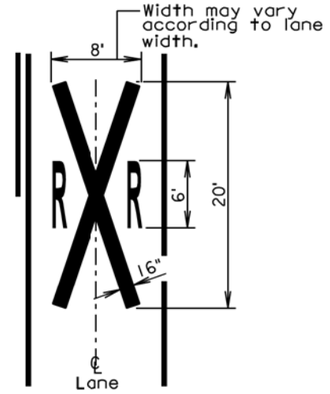
September 14, 2011

Published Date: 4th Qtr. 2014	SDDOT	***PAVEMENT MARKINGS FOR ADJACENT INTERSECTIONS AND CENTER TURN LANE***	***PLATE NUMBER*** 633.01 *Sheet 1 of 1*

KEY	ITEM
24 W	24" White
	White

Posted Speed Limit (M.P.H.)	L (Ft.)
≤ 30	100
35	100
40	125
45	175
50	250
55	325
60	400
65	475
70	550





DETAIL A

GENERAL NOTES:

The railroad crossing pavement markings shall be placed symmetrically about the centerline of the railroad crossing.

When pavement markings are used, a portion of the RXR symbol shall be placed directly opposite of the advance warning sign W10-1.

On multi-lane roads the transverse bands shall extend across all approach lanes and individual RXR symbols shall be placed in each approach lane.

The railroad crossing pavement markings shall consist of all the transverse bands, stop bars, and RXR symbols.

When pavement marking paint is used for marking the railroad crossing, all costs for furnishing and painting the markings, materials, labor, and necessary equipment shall be incidental to the contract unit price per gallon for "Pavement Marking Paint, White".

When pavement marking tape is used for marking the railroad crossing, all costs for furnishing and placing the markings, materials, labor, and necessary equipment shall be incidental to the contract unit price per each for "Cold Applied Plastic Pavement Marking, Railroad Crossing".

June 26, 2013

Published Date: 4th Qtr. 2014	SDDOT	***PAVEMENT MARKINGS AT RAILROAD CROSSING***	***PLATE NUMBER*** 633.10 *Sheet 1 of 1*