

MEMORANDUM

Date: December 19, 2023

Re: North Bend Wind Access Road Maintenance
File 0029705.01

To: Taylor Carlson, Wanzek Construction

From: Travis Garvin, Westwood Professional Services

Taylor,

The access roads at North Bend Wind have been designed to accommodate light duty (pickup trucks and maintenance vehicles) for low volume use in normal operating conditions. Access roads will require ongoing maintenance over the lifetime of the facility. This ongoing maintenance includes annual maintenance as well as maintenance after major storm events. The low water crossings at North Bend Wind were designed to a 25-year, 24-hour storm event (4.11”). The culverts were also sized for a 25-year, 24-hour storm (4.11”). It is expected that culverts will be overtopped during some storms and maintenance will be required through the life of the project. Low water crossings will also require maintenance throughout the life of the project. The NOAA Point Precipitation Frequency Estimate used for North Bend Wind hydrology design is attached.

Listed below are our maintenance recommendations:

Access Roads

Complete the following maintenance on an annual basis and after major storm events.

1. Inspect all roadways for areas of rutting, poor crown or cross slope, washing, or potholes.
2. Blade the road to re-establish the designed crown or cross slope, remove any wash-boarding. Re-establish the gravel driving surface with gravel that has been displaced to the sides of the road. Fill small depressions or potholes in the road surface.
3. Add gravel as necessary to reconstruct areas of severe washing and rutting and blade as described in 2 above.
4. On an annual basis - inspect shoulders and ensure the shoulders are lower than the road surface to allow for drainage off of the driving surface.

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Stormwater Conveyances

Complete the following maintenance on an annual basis and after major storm events:

1. Inspect all ditches, culverts and low water crossings for signs of erosion, standing water, and excessive sediment. Excessive sediment buildup would be buildup filling more than 1/2 of the capacity of the ditch, more than 1/4 of the capacity of the culvert, or more than 3 inches of sediment in the low water crossing.
2. Clean culverts, ditches and low water crossings to remove any blockages or excessive sediment buildup.
3. Inspect culvert inlets and low water crossings for trash buildup or other impediments to flow.
4. Inspect culvert and low water crossing outlets and reposition any rip rap that has been displaced by stormwater flows.
5. Repair any damage to the surfacing of and restore surface slopes of the low water crossings.
6. Remove excessive sediment and re-grade areas of excess erosion to the original grades. Utilize proper erosion control or turf establishment methods to prevent future washing.



NOAA Atlas 14, Volume 8, Version 2
Location name: Harrold, South Dakota, USA*
Latitude: 44.381°, Longitude: -99.6804°
Elevation: 1885.88 ft**



* source: ESRI Maps
 ** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.312 (0.247-0.393)	0.382 (0.301-0.481)	0.495 (0.389-0.624)	0.587 (0.459-0.742)	0.712 (0.538-0.917)	0.807 (0.597-1.05)	0.900 (0.646-1.19)	0.994 (0.687-1.34)	1.12 (0.744-1.53)	1.21 (0.787-1.67)
10-min	0.457 (0.361-0.575)	0.559 (0.441-0.704)	0.724 (0.570-0.914)	0.859 (0.672-1.09)	1.04 (0.788-1.34)	1.18 (0.875-1.54)	1.32 (0.947-1.74)	1.46 (1.01-1.96)	1.63 (1.09-2.24)	1.77 (1.15-2.45)
15-min	0.558 (0.440-0.702)	0.682 (0.538-0.859)	0.884 (0.695-1.11)	1.05 (0.820-1.33)	1.27 (0.961-1.64)	1.44 (1.07-1.87)	1.61 (1.15-2.12)	1.78 (1.23-2.39)	1.99 (1.33-2.73)	2.15 (1.41-2.99)
30-min	0.763 (0.603-0.961)	0.935 (0.738-1.18)	1.21 (0.953-1.53)	1.44 (1.13-1.82)	1.74 (1.32-2.24)	1.97 (1.46-2.56)	2.20 (1.58-2.90)	2.42 (1.67-3.26)	2.71 (1.81-3.72)	2.93 (1.91-4.06)
60-min	0.949 (0.750-1.20)	1.15 (0.903-1.44)	1.47 (1.16-1.86)	1.75 (1.37-2.22)	2.15 (1.63-2.79)	2.46 (1.83-3.22)	2.78 (2.00-3.69)	3.11 (2.16-4.21)	3.57 (2.39-4.91)	3.92 (2.56-5.44)
2-hr	1.14 (0.905-1.42)	1.36 (1.08-1.69)	1.73 (1.38-2.17)	2.07 (1.63-2.59)	2.55 (1.97-3.30)	2.95 (2.22-3.84)	3.36 (2.45-4.45)	3.81 (2.67-5.12)	4.42 (2.99-6.06)	4.90 (3.23-6.76)
3-hr	1.24 (0.990-1.53)	1.45 (1.16-1.81)	1.85 (1.47-2.30)	2.20 (1.75-2.75)	2.75 (2.14-3.56)	3.21 (2.44-4.18)	3.70 (2.72-4.90)	4.24 (3.00-5.71)	5.00 (3.41-6.86)	5.62 (3.72-7.72)
6-hr	1.43 (1.16-1.76)	1.65 (1.34-2.04)	2.08 (1.68-2.57)	2.49 (1.99-3.08)	3.13 (2.47-4.05)	3.68 (2.83-4.78)	4.28 (3.19-5.65)	4.95 (3.54-6.65)	5.93 (4.08-8.09)	6.72 (4.49-9.18)
12-hr	1.66 (1.36-2.03)	1.93 (1.57-2.35)	2.41 (1.97-2.95)	2.88 (2.33-3.53)	3.59 (2.86-4.60)	4.21 (3.26-5.41)	4.88 (3.66-6.37)	5.61 (4.05-7.47)	6.68 (4.63-9.04)	7.55 (5.08-10.2)
24-hr	1.91 (1.58-2.31)	2.23 (1.84-2.70)	2.80 (2.30-3.40)	3.32 (2.72-4.04)	4.11 (3.29-5.19)	4.76 (3.71-6.05)	5.47 (4.13-7.06)	6.23 (4.52-8.20)	7.31 (5.11-9.80)	8.18 (5.55-11.0)
2-day	2.18 (1.82-2.62)	2.55 (2.12-3.06)	3.18 (2.64-3.83)	3.75 (3.10-4.52)	4.58 (3.69-5.72)	5.27 (4.14-6.63)	6.00 (4.56-7.67)	6.77 (4.95-8.83)	7.86 (5.53-10.4)	8.72 (5.97-11.7)
3-day	2.39 (2.01-2.86)	2.76 (2.31-3.29)	3.39 (2.83-4.06)	3.96 (3.29-4.75)	4.80 (3.89-5.96)	5.50 (4.35-6.88)	6.23 (4.77-7.94)	7.02 (5.16-9.11)	8.13 (5.75-10.8)	9.01 (6.20-12.0)
4-day	2.57 (2.16-3.05)	2.94 (2.47-3.49)	3.58 (3.01-4.27)	4.16 (3.47-4.97)	5.01 (4.08-6.20)	5.72 (4.54-7.12)	6.46 (4.96-8.19)	7.25 (5.35-9.38)	8.37 (5.95-11.0)	9.26 (6.40-12.3)
7-day	2.97 (2.52-3.50)	3.41 (2.89-4.02)	4.15 (3.51-4.91)	4.79 (4.03-5.69)	5.71 (4.66-6.97)	6.44 (5.14-7.94)	7.21 (5.56-9.05)	8.00 (5.94-10.3)	9.10 (6.50-11.9)	9.96 (6.93-13.2)
10-day	3.34 (2.85-3.92)	3.82 (3.26-4.49)	4.63 (3.93-5.45)	5.31 (4.49-6.28)	6.27 (5.14-7.60)	7.03 (5.63-8.61)	7.80 (6.04-9.73)	8.59 (6.40-10.9)	9.66 (6.93-12.6)	10.5 (7.33-13.8)
20-day	4.48 (3.86-5.21)	5.02 (4.32-5.85)	5.91 (5.07-6.90)	6.64 (5.67-7.78)	7.65 (6.32-9.16)	8.43 (6.82-10.2)	9.21 (7.20-11.4)	10.0 (7.51-12.6)	11.0 (7.99-14.2)	11.8 (8.35-15.5)
30-day	5.44 (4.72-6.30)	6.06 (5.26-7.03)	7.07 (6.11-8.21)	7.89 (6.78-9.19)	9.00 (7.47-10.7)	9.85 (8.00-11.8)	10.7 (8.39-13.1)	11.5 (8.68-14.4)	12.6 (9.14-16.1)	13.4 (9.49-17.4)
45-day	6.65 (5.80-7.66)	7.44 (6.49-8.58)	8.71 (7.57-10.1)	9.72 (8.40-11.3)	11.1 (9.22-13.1)	12.1 (9.84-14.4)	13.0 (10.3-15.9)	14.0 (10.6-17.4)	15.1 (11.0-19.3)	16.0 (11.4-20.7)
60-day	7.66 (6.71-8.79)	8.66 (7.59-9.95)	10.2 (8.94-11.8)	11.5 (9.97-13.3)	13.1 (10.9-15.4)	14.3 (11.7-17.0)	15.4 (12.2-18.7)	16.5 (12.5-20.4)	17.8 (13.0-22.5)	18.7 (13.4-24.2)

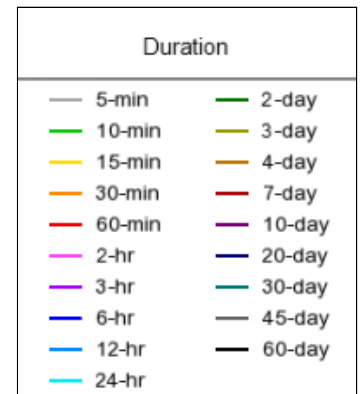
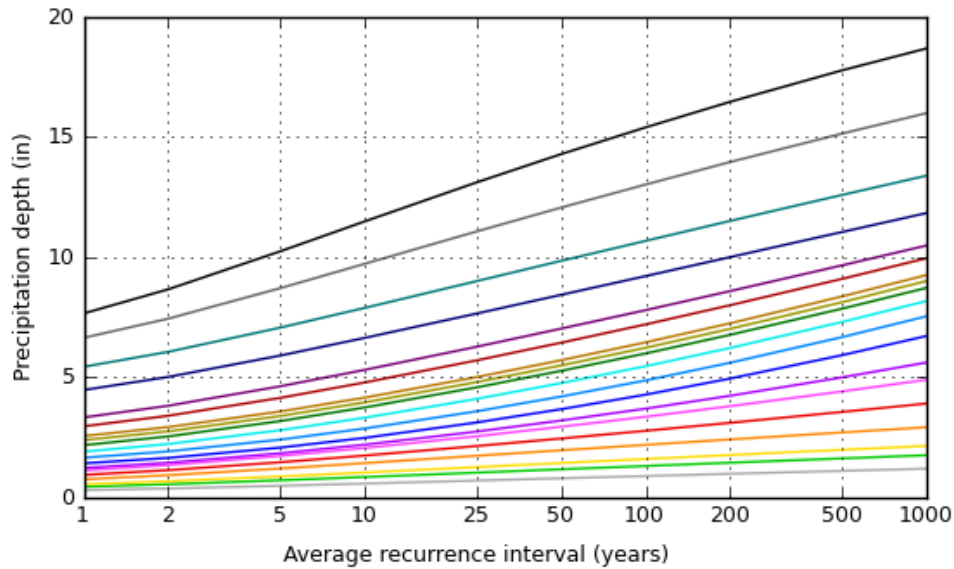
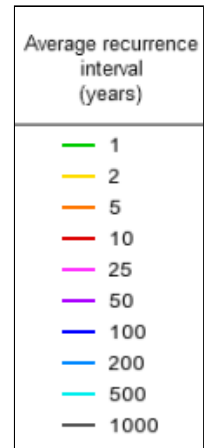
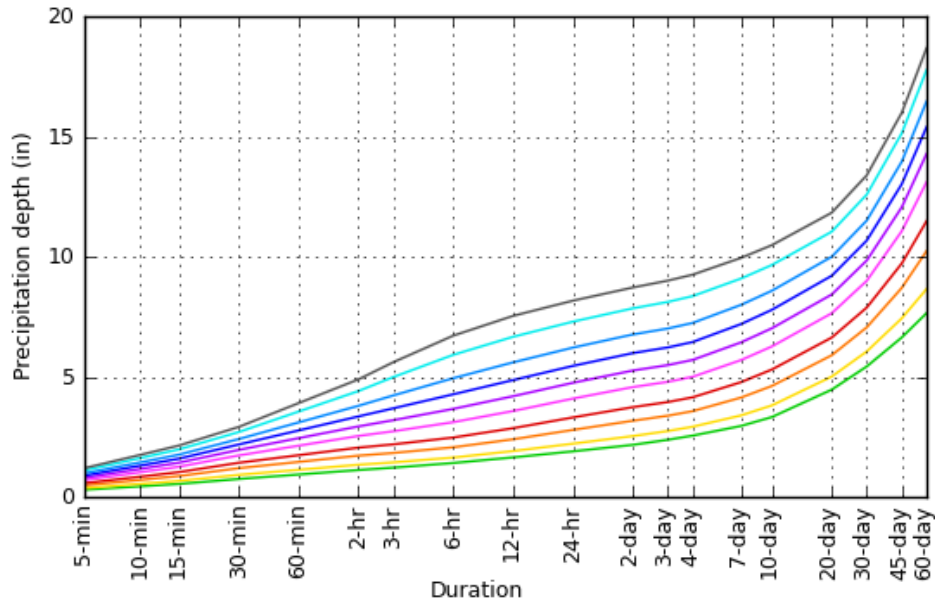
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based depth-duration-frequency (DDF) curves

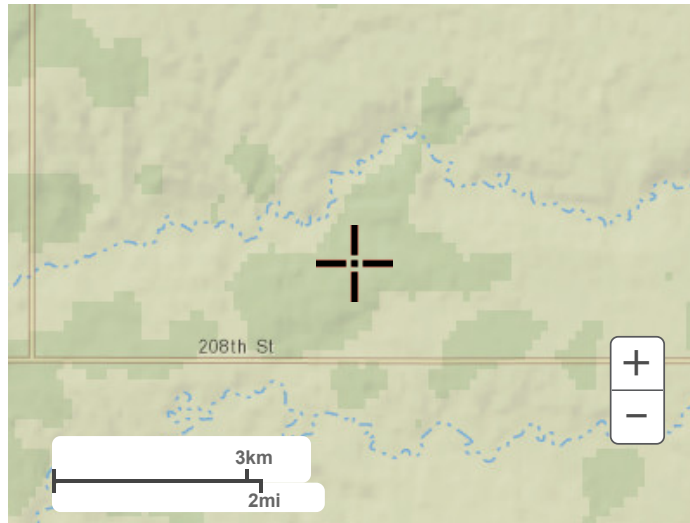
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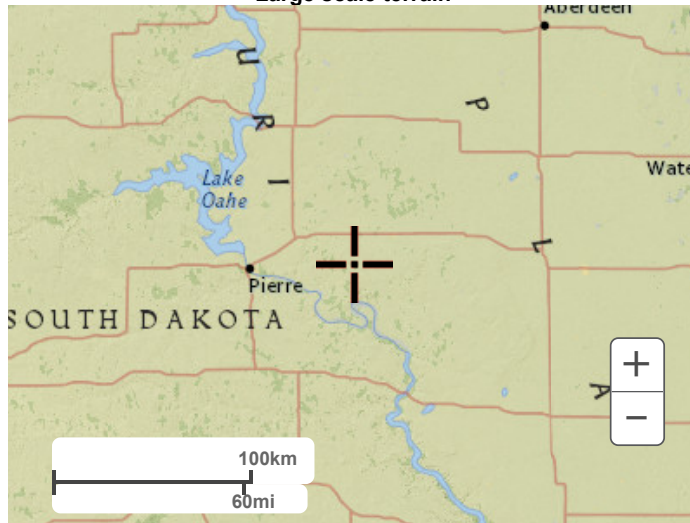
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Maps & aerials

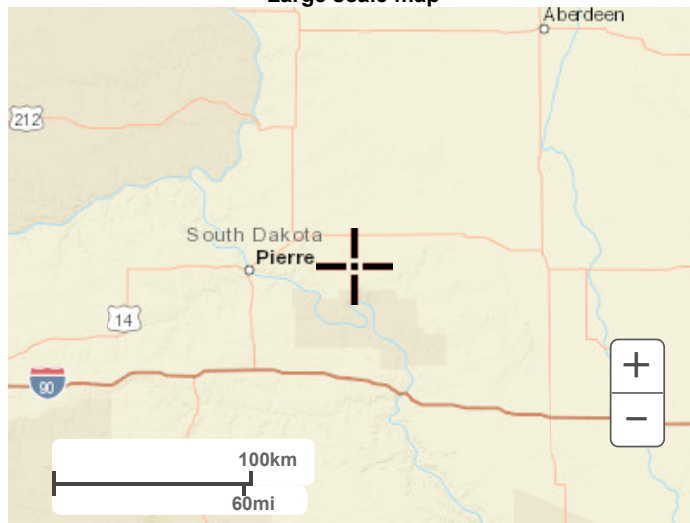
Small scale terrain



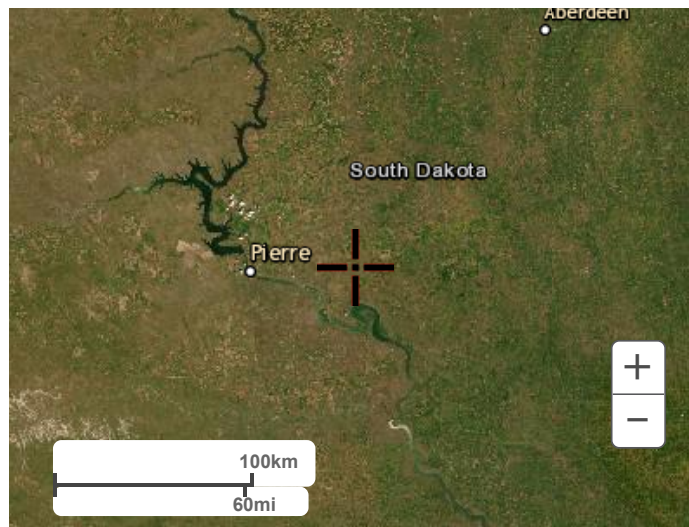
Large scale terrain



Large scale map



Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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