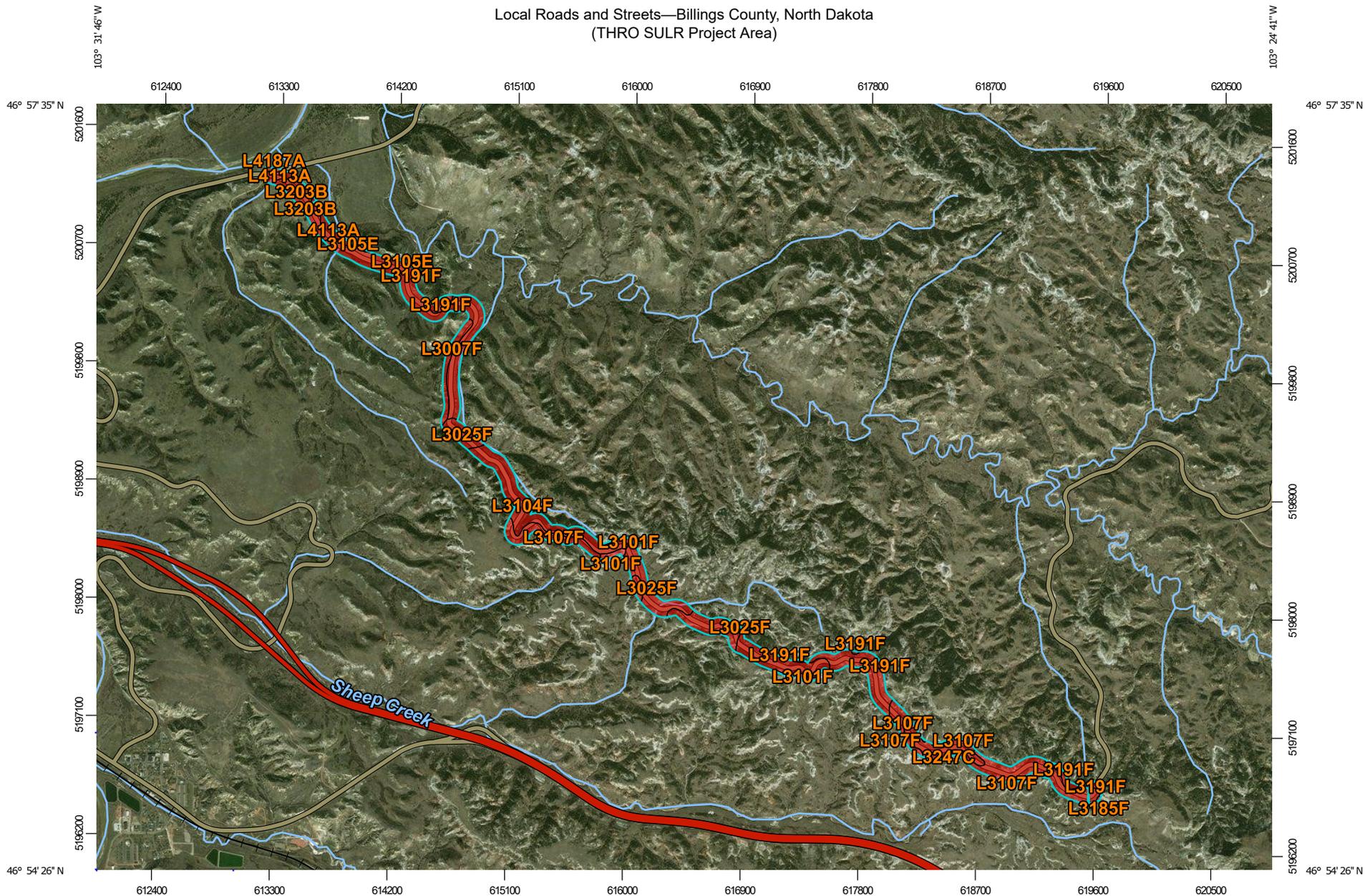
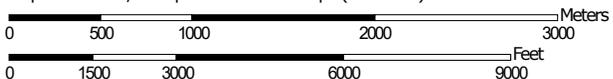


**APPENDIX C**  
**NATURAL RESOURCES CONSERVATION SERVICE**  
**SOIL DATA EXPLORER:**  
**SUITABILITIES AND LIMITATIONS RATINGS**

Local Roads and Streets—Billings County, North Dakota  
(THRO SULR Project Area)



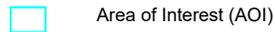
Map Scale: 1:41,100 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

## MAP LEGEND

### Area of Interest (AOI)



Area of Interest (AOI)

### Background



Aerial Photography

### Soils

#### Soil Rating Polygons



Very limited



Somewhat limited



Not limited



Not rated or not available

#### Soil Rating Lines



Very limited



Somewhat limited



Not limited



Not rated or not available

#### Soil Rating Points



Very limited



Somewhat limited



Not limited



Not rated or not available

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Billings County, North Dakota

Survey Area Data: Version 23, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 9, 2015—Jul 1, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Local Roads and Streets

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
L3007F	Kirby-Badland-Patent complex, 9 to 70 percent slopes	Very limited	Kirby, channery loam (38%)	Slope (1.00)	8.6	2.9%
				Large stones (0.66)		
				Frost action (0.50)		
			Badland (25%)	Depth to soft bedrock (1.00)		
				Low strength (1.00)		
				Slope (1.00)		
			Patent, badland fan ESD (20%)	Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Cabbart (10%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Lonna (4%)	Slope (1.00)		
Low strength (1.00)						
Frost action (0.50)						
Maltese (3%)	Low strength (1.00)					
	Shrink-swell (0.99)					
	Slope (0.37)					
L3025F	Lonna-Kirby-Cabbart complex, 2 to 50 percent slopes	Very limited	Lonna (35%)	Slope (1.00)	27.8	9.2%
				Low strength (1.00)		
				Frost action (0.50)		
			Kirby, channery loam (34%)	Slope (1.00)		
				Large stones (0.61)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Frost action (0.50)		
			Cabbart (17%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Kremlin (8%)	Low strength (1.00)		
				Frost action (0.50)		
				Slope (0.04)		
			Maltese (4%)	Low strength (1.00)		
				Shrink-swell (1.00)		
			Rock outcrop, porcelanite (2%)	Large stones (1.00)		
				Slope (1.00)		
L3101F	Badland-Cabbart complex, 6 to 70 percent slopes	Very limited	Badland (60%)	Depth to soft bedrock (1.00)	31.2	10.4%
				Low strength (1.00)		
				Slope (1.00)		
			Cabbart (30%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Patent, badland fan ESD (3%)	Low strength (1.00)		
				Frost action (0.50)		
				Slope (0.04)		
			Arikara, low precipitation (3%)	Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
				Shrink-swell (0.03)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI		
			Boxwell (2%)	Slope (1.00) Low strength (1.00) Frost action (0.50)				
			Rock outcrop, porcelanite (2%)	Large stones (1.00) Slope (1.00)				
L3104F	Kirby-Arikara-Badland complex, 9 to 70 percent slopes	Very limited	Kirby, channery loam (42%)	Slope (1.00) Large stones (0.66) Frost action (0.50)	38.8	12.9%		
			Arikara, low precipitation (27%)	Slope (1.00) Low strength (1.00) Frost action (0.50) Shrink-swell (0.05)				
			Badland (16%)	Depth to soft bedrock (1.00) Low strength (1.00) Slope (1.00)				
			Patent, badland fan ESD (7%)	Low strength (1.00) Frost action (0.50) Slope (0.04)				
			Lonna (4%)	Low strength (1.00) Frost action (0.50) Slope (0.37)				
			Cabbart (4%)	Depth to soft bedrock (1.00) Slope (1.00) Low strength (1.00) Frost action (0.50)				
L3105E	Badland-Patent complex, 6 to	Very limited	Badland (55%)	Depth to soft bedrock (1.00)			1.3	0.4%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
	25 percent slopes			Low strength (1.00)		
			Slope (1.00)			
			Patent, badland fan ESD (31%)	Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Lonna (5%)	Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Cabbart (5%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Rock outcrop, porcelanite (2%)	Large stones (1.00)		
				Slope (1.00)		
			Patent, frequently flooded, flat bottom draw ESD (2%)	Flooding (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
L3107F			Cabbart-Badland complex, 6 to 70 percent slopes	Very limited		
	Slope (1.00)					
	Low strength (1.00)					
	Frost action (0.50)					
	Badland (25%)	Depth to soft bedrock (1.00)				
		Low strength (1.00)				
		Slope (1.00)				
	Patent, badland fan ESD (10%)	Low strength (1.00)				
		Frost action (0.50)				

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope (0.04)		
			Boxwell (5%)	Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Kirby, channery loam (4%)	Slope (1.00)		
				Large stones (0.61)		
				Frost action (0.50)		
			Kremlin (4%)	Low strength (1.00)		
				Frost action (0.50)		
				Slope (0.04)		
			Gerda (2%)	Low strength (1.00)		
				Shrink-swell (0.75)		
L3185F	Patent-Badland-Cabbart complex, 6 to 50 percent slopes	Very limited	Patent, badland fan ESD (35%)	Low strength (1.00)	55.4	18.4%
				Frost action (0.50)		
				Slope (0.37)		
			Cabbart (20%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Badland (20%)	Depth to soft bedrock (1.00)		
				Low strength (1.00)		
				Slope (1.00)		
			Lonna (10%)	Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
			Boxwell (4%)	Low strength (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI	
				Frost action (0.50)			
				Slope (0.37)			
			Gerda (4%)	Low strength (1.00)			
				Shrink-swell (0.75)			
			Patent, frequently flooded, flat bottom draw ESD (3%)	Flooding (1.00)			
				Low strength (1.00)			
				Frost action (0.50)			
			Kirby, channery loam (2%)	Slope (1.00)			
				Large stones (0.61)			
				Frost action (0.50)			
			Arikara, low precipitation (2%)	Slope (1.00)			
				Low strength (1.00)			
				Frost action (0.50)			
				Shrink-swell (0.03)			
L3191F	Badland-Arikara-Cabbart complex, 15 to 70 percent slopes	Very limited	Badland (30%)	Depth to soft bedrock (1.00)	29.6	9.8%	
							Low strength (1.00)
							Slope (1.00)
			Arikara, low precipitation (27%)	Slope (1.00)			
							Low strength (1.00)
							Frost action (0.50)
							Shrink-swell (0.06)
			Cabbart (17%)	Slope (1.00)			
							Depth to soft bedrock (1.00)
							Low strength (1.00)
							Frost action (0.50)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Patent, badland fan ESD (10%)	Slope (1.00) Low strength (1.00) Frost action (0.50)		
			Lonna (6%)	Slope (1.00) Low strength (1.00) Frost action (0.50)		
			Boxwell (5%)	Low strength (1.00) Frost action (0.50) Slope (0.37)		
			Patent, frequently flooded, flat bottom draw ESD (5%)	Flooding (1.00) Low strength (1.00) Frost action (0.50) Shrink-swell (0.40)		
L3203B	Lonna silt loam, 0 to 6 percent slopes	Very limited	Lonna (85%)	Low strength (1.00) Frost action (0.50) Shrink-swell (0.50)	8.8	2.9%
			Patent, occasionally flooded (5%)	Flooding (1.00) Low strength (1.00) Frost action (0.50) Shrink-swell (0.50)		
			Ethridge (5%)	Shrink-swell (1.00) Low strength (1.00)		
			Lonna (3%)	Low strength (1.00) Frost action (0.50) Shrink-swell (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI		
			Maltese (2%)	Shrink-swell (1.00) Low strength (1.00) Frost action (0.50)				
L3247C	Patent, occasionally flooded-Vanda-Gerda, barren complex, 0 to 9 percent slopes	Very limited	Patent, occasionally flooded (40%)	Flooding (1.00) Low strength (1.00) Frost action (0.50) Shrink-swell (0.50)	15.1	5.0%		
			Vanda (25%)	Shrink-swell (1.00) Low strength (1.00)				
			Gerda, severely eroded (15%)	Ponding (1.00) Shrink-swell (1.00) Low strength (1.00)				
			Patent, gullied, occasionally flooded (8%)	Flooding (1.00) Slope (1.00) Low strength (1.00) Frost action (0.50) Shrink-swell (0.50)				
			Benz (5%)	Flooding (1.00) Low strength (0.86) Frost action (0.50)				
			Ethridge (3%)	Shrink-swell (1.00) Low strength (1.00)				
			Sham, occasionally flooded (2%)	Flooding (1.00) Frost action (0.50)				
L4113A	Wolf Point silty clay loam, wooded, 0 to 2 percent	Very limited	Wolf Point, wooded, occasionally flooded (78%)	Shrink-swell (1.00) Flooding (1.00)			8.1	2.7%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI				
	slopes, occasionally flooded		Havre, wooded, occasionally flooded (11%)	Low strength (1.00)						
Flooding (1.00)										
Low strength (1.00)										
Fluvaquents, channeled, frequently flooded (5%)			Frost action (0.50)							
			Ponding (1.00)							
			Depth to saturated zone (1.00)							
Glendive, wooded, occasionally flooded (4%)			Frost action (1.00)							
			Flooding (1.00)							
			Flooding (1.00)							
Ethridge (2%)			Frost action (0.50)							
			Shrink-swell (1.00)							
L4121A			Havre silt loam, 0 to 2 percent slopes, occasionally flooded	Very limited			Havre, occasionally flooded (82%)	Flooding (1.00)	5.6	1.9%
	Low strength (1.00)									
	Frost action (0.50)									
	Shrink-swell (0.09)									
	Glendive, occasionally flooded (10%)	Flooding (1.00)								
		Frost action (0.50)								
	Fluvaquents, channeled, frequently flooded (5%)	Ponding (1.00)								
		Depth to saturated zone (1.00)								
		Flooding (1.00)								
		Frost action (0.50)								
	Lallie, occasionally flooded (3%)	Ponding (1.00)								
		Depth to saturated zone (1.00)								
		Shrink-swell (1.00)								

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI		
				Frost action (1.00)				
				Flooding (1.00)				
L4187A	Glendive fine sandy loam, 0 to 2 percent slopes, occasionally flooded	Very limited	Glendive, occasionally flooded (75%)	Flooding (1.00)	0.9	0.3%		
				Frost action (0.50)				
			Hanly, occasionally flooded, mwd (12%)	Flooding (1.00)				
			Havre, occasionally flooded, mwd (8%)	Flooding (1.00)				
				Low strength (1.00)				
				Frost action (0.50)				
				Shrink-swell (0.02)				
			Fluvaquents, channeled, frequently flooded (5%)	Ponding (1.00)				
				Depth to saturated zone (1.00)				
				Flooding (1.00)				
				Frost action (0.50)				
<b>Totals for Area of Interest</b>							<b>300.9</b>	<b>100.0%</b>

Rating	Acres in AOI	Percent of AOI
Very limited	300.9	100.0%
<b>Totals for Area of Interest</b>	<b>300.9</b>	<b>100.0%</b>

## Description

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

## Rating Options

*Aggregation Method: Dominant Condition*

*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*