SOIL FEATURES
Tri-County Area, North Dakota

The following table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A restrictive layer is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. Depth to top is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as low, moderate, or high, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as low, moderate, or high. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

SOIL FEATURES--Continued
Tri-County Area, North Dakota

Map symbol and soil name	Restrictive layer				Potential for Frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated Steel	Concrete
		In	In				
Ad:							
Aberdeen--------	---	---	---	---	Moderate	High	Moderate
Ak:							
Alluvial Land---	---	---	---	---	High	High	Moderate
An:							
Arveson---------	---	---	---	---	High	High	Low
Ar:							
Arveson, MODERATELY SHALLOW--------	---	---	---	---	High	High	Low
Aw:							
Arveson---------	---	---	---	---	High	High	Low
BaB:							
Barnes----------	---	---	---	---	Moderate	Moderate	Low
BbC:							
Barnes----------	---	---	---	---	Moderate	Moderate	Low
Buse----------	---	---	---	---	Moderate	Moderate	Low
BbD:							
Barnes----------	---	---	---	---	Moderate	Moderate	Low
Buse----------	---	---	---	---	Moderate	Moderate	Low
BdB:							
Barnes----------	---	---	---	---	Moderate	Moderate	Low
Svea----------	---	---	---	---	Moderate	High	Low
Be:							
Bearden---------	---	---	---	---	High	High	Low
Bf:							
Bearden---------	---	---	---	---	High	High	Low
Bg:							
Bearden, SALINE-	---	---	---	---	High	High	Moderate
Bh:							
Bearden---------	---	---	---	---	High	High	Low
Overly----------	---	---	---	---	High	High	Low
Bo:							
Borup----------	---	---	---	---	High	High	Low
Bp:							
Borup, VERY WET-	---	---	---	---	High	High	Low
BuD:							
Buse----------	---	---	---	---	Moderate	Moderate	Low
Dc:							
Dimmick---------	---	---	---	---	High	High	Low
Dv:							
Divide----------	---	---	---	---	Moderate	High	Low
EcA:							
Eckman----------	---	---	---	---	High	Moderate	Low
EcB:							
Eckman----------	---	---	---	---	High	Moderate	Low
EcC:							
Eckman----------	---	---	---	---	High	Moderate	Low
EgB:							
Eckman, TILL SUBSTRATUM-----	---	---	---	---	High	Moderate	Low
EnA:							
Egeland---------	---	---	---	---	Moderate	Low	Low
EnB:							
Egeland---------	---	---	---	---	Moderate	Low	Low
Eo:							
Embden----------	---	---	---	---	Moderate	Moderate	Low
Ep:							
Embden----------	---	---	---	---	Moderate	High	Low
Gardena---------	---	---	---	---	High	Moderate	Low
Es:							
Embden----------	---	---	---	---	Moderate	Moderate	Low
Glyndon---------	---	---	---	---	High	Moderate	Low
Et:							
Embden----------	---	---	---	---	Moderate	High	Low
Hecla----------	---	---	---	---	Moderate	High	Low
Ex:							
Exline----------	---	---	---	---	Moderate	High	High
Fa:							
Fairdale, LEVEE-	---	---	---	---	Moderate	Moderate	Low

SOIL FEATURES--Continued
Tri-County Area, North Dakota

Map symbol and soil name	Restrictive layer				Potential for Frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated Steel	Concrete
		In	In				
Fc:							
Fargo	---	---	---	---	High	High	Low
Fg:							
Fargo	---	---	---	---	High	High	Low
Fh:							
Fargo	---	---	---	---	High	High	Low
Fk:							
Fargo, SALINE	---	---	---	---	High	High	Moderate
Fn:							
Fargo	---	---	---	---	High	High	Low
Exline	---	---	---	---	Moderate	High	High
Fw:							
Southam	---	---	---	---	High	High	Low
GbA:							
Gardena, VERY DEEP	---	---	---	---	High	Moderate	Low
GbB:							
Gardena, VERY DEEP	---	---	---	---	High	Moderate	Low
GcA:							
Gardena, DEEP	---	---	---	---	High	Moderate	Low
GdA:							
Gardena, MODERATELY SHALLLOW	---	---	---	---	High	Moderate	Low
GdB:							
Gardena, MODERATELY SHALLOW	---	---	---	---	High	Moderate	Low
GeA:							
Gardena, TILL SUBSTRATUM	---	---	---	---	Moderate	High	Low
GfA:							
Gardena, TILL SUBSTRATUM	---	---	---	---	Moderate	High	Low
Eckman	---	---	---	---	Moderate	High	Moderate
GgA:							
Gardena	---	---	---	---	High	Moderate	Low
Glyndon	---	---	---	---	High	High	Low
GkA:							
Gardena, TILL SUBSTRATUM	---	---	---	---	Moderate	High	Low
Glyndon	---	---	---	---	High	High	Low
GmA:							
Glyndon, VERY DEEP	---	---	---	---	High	High	Low
GmB:							
Glyndon, VERY DEEP	---	---	---	---	High	High	Low
GnA:							
Glyndon, DEEP	---	---	---	---	High	High	Low
GsA:							
Borup, STRONGLY SALINE	---	---	---	---	High	High	Moderate
Glyndon, STRONGLY SALINE	---	---	---	---	High	High	Moderate
GtA:							
Glyndon	---	---	---	---	High	High	Low
Gardena	---	---	---	---	High	Moderate	Low
GuA:							
Glyndon, SALINE	---	---	---	---	High	High	Moderate
Hamerly	---	---	---	---	High	High	Moderate
Gv:							
Gravel Pits	---	---	---	---	None	Low	Low
Ha:							
Hamar	---	---	---	---	Moderate	High	Low
Hb:							
Hamar	---	---	---	---	Moderate	High	Low
Ulen	---	---	---	---	Moderate	Low	Low

SOIL FEATURES--Continued
Tri-County Area, North Dakota

Map symbol and soil name	Restrictive layer				Potential for Frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated Steel	Concrete
		In	In				
HdB:							
Hamerly---------	---	---	---	---	High	High	Low
HeA:							
Hamerly---------	---	---	---	---	High	High	Low
HgB:							
Hamerly---------	---	---	---	---	High	High	Low
Barnes----------	---	---	---	---	Moderate	Moderate	Low
HkAx:							
Hecla----------	---	---	---	---	Low	Moderate	Low
HlAx:							
Hecla----------	---	---	---	---	Moderate	Moderate	Low
HmA:							
Hecla, MODERATELY SHALLOW--------	---	---	---	---	Moderate	High	Low
HoAx:							
Hecla, LOAMY SUBSTRATUM-----	---	---	---	---	Moderate	High	Low
HpAx:							
Hecla, MODERATELT SHALLOW--------	---	---	---	---	Moderate	High	Low
HrA:							
Hecla, LOAMY SUBSTRATUM-----	---	---	---	---	Low	Moderate	Low
HsAx:							
Hecla----------	---	---	---	---	Moderate	Low	Low
Hecla, FINE SANDY LOAM-----	---	---	---	---	Moderate	High	Low
HtAx:							
Hecla----------	---	---	---	---	Moderate	Moderate	Low
Embden----------	---	---	---	---	Moderate	Moderate	Low
HuB2:							
Hecla, HUMMOCKY, ERODED---------	---	---	---	---	Low	Moderate	Low
Hamar, HUMMOCKY, ERODED---------	---	---	---	---	Moderate	High	Low
HvAx:							
Hecla----------	---	---	---	---	Moderate	Low	Low
Hamar----------	---	---	---	---	Moderate	High	Low
HxAx:							
Hecla----------	---	---	---	---	Moderate	Moderate	Low
Ulen----------	---	---	---	---	Moderate	Low	Low
HyAx:							
Hecla, LOAMY SUBSTRATUM-----	---	---	---	---	Moderate	High	Low
Ulen, LOAMY SUBSTRATUM-----	---	---	---	---	Moderate	Low	Low
La:							
Lamoure---------	---	---	---	---	High	High	Moderate
Lf:							
La Prairie------	---	---	---	---	Moderate	Moderate	Low
Fairdale, OCCASIONLY FLOODED--------	---	---	---	---	Moderate	Moderate	Low
Lp:							
La Prairie------	---	---	---	---	Moderate	Moderate	Low
MaAx:							
Maddock---------	---	---	---	---	Low	Moderate	Low
MaBx:							
Maddock---------	---	---	---	---	Low	Moderate	Low
MaCx:							
Maddock---------	---	---	---	---	Low	Moderate	Low
MdAx:							
Maddock---------	---	---	---	---	Low	Low	Low
MdBx:							
Maddock---------	---	---	---	---	Low	Low	Low
MhD:							
Maddock---------	---	---	---	---	Low	Moderate	Low

SOIL FEATURES--Continued
Tri-County Area, North Dakota

Map symbol and soil name	Restrictive layer				Potential for Frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated Steel	Concrete
		In	In				
MkAx:							
Maddock, MODERATELY SHALLOW--------	---	---	---	---	Low	High	Low
Mx3:							
Maddock, SEVERLY ERODED---------	---	---	---	---	Low	Moderate	Low
Hamar----------	---	---	---	---	Moderate	High	Low
OaA:							
Overly----------	---	---	---	---	High	High	Low
ObA:							
Overly, SALINE--	---	---	---	---	High	High	Moderate
OcA:							
Overly----------	---	---	---	---	High	High	Low
Bearden---------	---	---	---	---	High	High	Low
OxA:							
Overly----------	---	---	---	---	High	High	Low
Exline----------	---	---	---	---	Moderate	High	High
OyA:							
Overly----------	---	---	---	---	High	High	Low
Gardena---------	---	---	---	---	High	Moderate	Low
Pa:							
Parnell---------	---	---	---	---	High	High	Low
Pe:							
Perella---------	---	---	---	---	High	High	Low
Pr:							
Perella---------	---	---	---	---	High	High	Low
Ra:							
Rauville--------	---	---	---	---	High	High	Moderate
RnA:							
Renshaw---------	---	---	---	---	Low	Moderate	Low
Sioux----------	---	---	---	---	Low	Low	Low
RnB:							
Renshaw---------	---	---	---	---	Low	Moderate	Low
Sioux----------	---	---	---	---	Low	Low	Low
RsA:							
Renshaw---------	---	---	---	---	Low	Moderate	Low
Sioux----------	---	---	---	---	Low	Low	Low
RsC:							
Renshaw---------	---	---	---	---	Low	Moderate	Low
Sioux----------	---	---	---	---	Low	Low	Low
Sa:							
Sioux----------	---	---	---	---	Low	Low	Low
SbC:							
Renshaw---------	---	---	---	---	Low	Moderate	Low
Sioux----------	---	---	---	---	Low	Low	Low
ScA:							
Spottswood, LOAMY SUBSTRATUM-----	---	---	---	---	Moderate	High	Low
SdA:							
Spottswood, LOAMY SUBSTRATUM-----	---	---	---	---	Moderate	Low	Low
SmA:							
Spottswood------	---	---	---	---	Moderate	High	Low
Embden----------	---	---	---	---	Moderate	Moderate	Low
SoA:							
Spottswood------	---	---	---	---	Moderate	High	Low
Gardena---------	---	---	---	---	High	Moderate	Low
St:							
Stirum----------	---	---	---	---	Moderate	High	Moderate
Glyndon---------	---	---	---	---	High	High	Low
Sx:							
Svea----------	---	---	---	---	Moderate	High	Low
Barnes----------	---	---	---	---	Moderate	Moderate	Low
Sy:							
Svea----------	---	---	---	---	Moderate	High	Low
Hamerly---------	---	---	---	---	High	High	Low

SOIL FEATURES--Continued
Tri-County Area, North Dakota

Map symbol and soil name	Restrictive layer				Potential for Frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated Steel	Concrete
		In	In				
Tf:							
Tiffany	---	---	---	---	High	High	Low
Tk:							
Tetonka	---	---	---	---	High	High	Low
Uc:							
Ulen, SALINE	---	---	---	---	Moderate	Low	Low
Ulen, NONSALINE	---	---	---	---	Moderate	Low	Low
Uf:							
Ulen	---	---	---	---	Moderate	Low	Low
Um:							
Ulen, LOAMY SUBSTRATUM	---	---	---	---	Moderate	Low	Low
Un:							
Ulen, MODERATELY SHALLOW	---	---	---	---	Moderate	Low	Low
Us:							
Ulen	---	---	---	---	Moderate	Low	Low
Gardena	---	---	---	---	Moderate	High	Low
Vr:							
Vallers	---	---	---	---	High	High	Low
W:							
Water	---	---	---	---	---	---	---
WeA:							
Fordville	---	---	---	---	Low	Moderate	Low
WeB:							
Fordville	---	---	---	---	Low	Moderate	Low
WsA:							
Fordville	---	---	---	---	Low	Moderate	Low
WsB:							
Fordville	---	---	---	---	Low	Moderate	Low
ZfB:							
Zell	---	---	---	---	High	Low	Low
ZmB:							
Zell	---	---	---	---	High	Low	Low
ZmD:							
Zell	---	---	---	---	High	Low	Low