

TERRAIN CLASSIFICATION AND SENSITIVITY SERIES
LEGEND

To accompany map sheets 106G (Upper Ramparts River), 106H (Sas Sault Rapids), 96E (Norman Wells), 96F (Mahony Lake), 96G (Fort Franklin), 96D (Carcajou Canyon), and 96B (Blackwater Lake).

TERRAIN SENSITIVITY AND PERFORMANCE RATING TABLE

To accompany map sheets 106G (Upper Ramparts River), 106H (Sas Sault Rapids), 96E (Norman Wells), 96F (Mahony Lake), 96G (Fort Franklin), 96D (Carcajou Canyon), and 96B (Blackwater Lake).

Map Unit	Name	General Description	Local Description	Permafrost, Ground Ice Conditions	Drainage (thaw season)	Hazards	Sources of Construction Material
I	ORGANIC TERRAINS (including muskeg)	Peat, fen, peat-fen complex; commonly occurring as a cover on units II, IX and X; flat to moderately sloping.	Fenland: Wet, commonly unfrozen woody sedge peat 5-10 ft. thick over mineral soil. Surface flat to gently sloping (up to 3%), relief to 3 ft., in part with reticulate network of low ridges. Peatland: Elevated frozen sedge peat, and woody sedge peat overlain by sphagnum peat (5-15 ft. thick over mineral soil); flat to very gently sloping with numerous shallow (5-10 ft.) steep-sided depressions occupied by lakes, ponds, or bogs.	Commonly unfrozen to depths of more than 6 ft. Little data available on segregated ice ¹ content at greater depths. Ice content moderate to high; commonly up to 20%, locally up to 60% segregated ice by volume within peat; typically 1-1 ft. and locally up to 3 ft. total thickness of segregated ice in mineral soil immediately below peat. Peat in wet depressions commonly thawed to 3 ft. or more.	Ground surface wet and subsurface material saturated; on sloping sites water seeps downslope on surface and subsurface; small ponds. Higher surfaces of peat platforms dry. Depressions interconnected by seepage channels.	Wet sites; material compressible and of low strength. Removal of vegetation can lead to subsidence of up to 5 ft.; unfrozen material highly compressible and of low strength.	Unsuitable
II	SILT-CLAY PLAINS (siltstone and lake deposits)	Clay and silt, commonly surfaced by sand or silty sand, with discontinuous organic cover (see Unit I). Principally forming plains bordering rivers and coastal areas. Highly unstable in eroded slopes.	Silt and clay 3-60 ft. thick, locally overlain by glacioluvial sand (8-100 ft. thick) with minor silt; flat to gently sloping. Where sand is thin or absent over clay and silt, in widespread, poorly drained, thick (3-12 ft.) peaty tracts that are nearly flat or depositional, the development of thermokarst topography is characteristic.	Moderate to high. Commonly up to 10% segregated ice as thin (<1") seams in upper 3-10 ft.; segregated ice as reticulate network to 40% by volume or tabular bodies of nearly pure ice at greater depth. Segregated ice rare in sand but common in silt and clay beneath sand.	Seepage towards ponds and lakes, intermittent seepage through ice-filled depressions between ponds and lakes.	Thermokarst slumping on steep slopes around ponds; detachment slides, followed by the development of retrogressive flow slides on valley walls and other sloping areas (major hazard areas also plotted as Unit XIII adjoining Unit II). Unfrozen ground is soft. Removal of vegetation can lead to rapid gullying.	No sources of coarse granular material; most of the unit is a poor source of fill but local coarse sands are suitable for fill.
III	THERMOKARST ² LAKE BEDS	Clay, silt, peat, and local sand on low, flat areas formerly occupied by tundra ponds. These materials generally less than 10 feet thick over till or sand. Flugs generally confined to this unit.	Not present	Not present	Not present	Not present	Not present
IV	BEACHES (marine and lake)	Gravel and/or sand ridges or flat areas along present or former shorelines.	Low beach ridges (<50 ft.) composed of fine to medium sand and fine gravel are located in areas bordering lacustrine plains (see Unit II). Typically developed in Norman Wells area (96E) but not characteristic of other glacio-lacustrine areas.	Ground ice generally not present, except where ridges contain fine sand and silt.	Ground surface commonly dry except where ridges contain fine sand and silt.	Minor ground ice slumping and gullying on hillsides and sloping banks; principally where material is fine sand or silt.	Locally good source of coarse granular material.
V	RIVER DEPOSITS - FINE	Silt and silty sand in river channels, floodplains, low terraces adjoining rivers and alluvial fans; includes organic silt, peat and minor gravel.	Silt and fine sand (10-15 ft.) forming floodplains and low bordering terraces, commonly with meander scars; in places with numerous channels and thermokarst ponds. The unit is flat (overall relief ranges from 3-15 ft. except for channel and pond margins). Peat cover is negligible on the active floodplains, but is up to 10 ft. thick in the abandoned channels and terraces. Includes modern floodplain of the Mackenzie River.	Permafrost generally moderate to high. Permafrost is generally absent in the unvegetated part of the floodplains; elsewhere to 10% segregated ice by volume as thin (<1") seams in upper 6-10 ft.; lakes and ponds are actively expanding through the thermokarst collapse of banks in some areas.	Many areas are wet; small chow ponds, lakes and marshy areas are common. No integrated drainage system other than that inherited from the river.	Thermokarst subsidence; ground ice slumping and gullying on margins of lakes and channels, undercutting and bank collapse along channels during high water; flooding during breakup and summer storms; channel shifts.	Gravel deposits rare and small; generally poor source of borrow material.
VI	RIVER DEPOSITS - COARSE	Gravel and sand in river channels, floodplains, low terraces adjoining rivers, and alluvial fans. Includes some silt, peat and organic silt.	Floodplains and terraces consisting of sand and gravel 3-15 ft. in thickness, commonly with a veneer of silt 1-6 ft. thick. Topography is level to gently sloping (0-3%) with local relief to 15 ft., due to the presence of former channels, bars, steep scarps etc. (slopes to 35%). Alluvial fans and fan aprons consist of silt, sand and gravel to thickness of 150 ft. and form slopes of 1:120 with relief to 150 ft. (from head to toe). Peat cover is largely restricted to former river channels, and ranges in thickness from 2-10 ft.	Ice content low in coarse-grained material; ice lenses in finer sediments. Moderate to high ice content in the silt veneer. Thermokarst ponds on low terraces. In alluvial fans ice content is variable (low in gravels to very high in silt); generally more ice in finer sediments at margin of fans than in coarse material at head of fans.	Surfaces of coarser-grained materials are dry; ponds and swamps in former river channels, downslope seepage in alluvial fans.	Minor thermokarst subsidence, minor ice lenses in finer sediments, and slumps in former river channels and areas with a veneer of silt; undercutting and bank collapse along channels during high water; flooding during breakup and summer storms; channel shifts.	Includes much gravel and mixed gravel material; generally suitable as borrow material. Exploitation of sites adjoining rivers may lead to accelerated erosion or channel shifts.
VII	GRAVEL-SAND HILLS, RIDGES, AND TERRACES	Gravel, sand and some silt. Includes eskers, and other glacioluvial deposits, river terraces, sand dunes, and a few small moraines consisting of deformed gravelly-sandy strata.	Plains and Terraces areas: Sand and gravel 5-50 ft. thick, locally with veneer of silt or sand; forms flat to gently sloping benches interrupted by shallow channels and low scarps (relief to 30 ft.). Thick glacioluvial deposits (up to 200 ft. thick) often cut by broad channels and high scarps (relief to 80 ft.). Characteristic areas bordering the Mackenzie Mountains. Hummocky and ridged areas: Sand, gravel, in places more than 100 ft. thick; relief to 120 ft.; slopes to 15%; includes small waters (up to 30 ft. high). Dune areas: Fine to medium sand up to 60 ft. thick. Occurring as a thin veneer or as dune ridges within, or adjacent to, areas of Unit II.	Ice content variable; typically cement ice only or no segregated ice in well drained sites; locally high segregated ice in silt and below peat in channels or depressions. In dunes ice content low (probably cement ice only); segregated ice in adjacent silt and fine sand of Unit II.	Ground surface relatively dry, except on large flat areas and in channel traces; drainage mainly subsurface.	Ground ice slumping and gullying on hillsides and sloping banks, principally where material is fine sand or silt; blowing sand, and blowouts in dune areas.	Major source of gravel and mixed gravel and sand; generally suitable as borrow material.
VIII	SILT-CLAY HILLS AND RIDGES	Nearly silt and clay with minor sand and gravel in moraine strata tilted and folded.	Not present	Not present	Not present	Not present	Not present
IX	TILL PLAINS	Till, occurring as ground moraine with low rolling relief or parallel drumlin ridges. Large areas are clayey to silty till as a thin veneer on shale; locally forms a thin veneer on other kinds of bedrock. Includes undifferentiated areas of Unit I.	Silty to clayey till, generally 0-20 ft. thick (locally to 60 ft.) underlain by bedrock ³ . Forms a sloping rolling plain with slopes to 3%; generally bedrock controlled. Local relief (due to stream incision) up to 60 ft. Discontinuous peat cover (Unit I) up to 15 ft. in depressions and as irregular patches on hills.	Ice content moderate in till; commonly up to 10% segregated ice as thin seams in upper 5-10 ft., locally thicker ice lenses (0.5-2 ft.) at depth. Generally little ice in underlying bedrock ³ , except in shale where fractures are filled with ice to a depth of 100-150 ft.	Ground surface commonly wet - water in depressions - no organized drainage with shallow subs-parallel runs.	Minor to moderate susceptibility to thermokarst. Moderate susceptibility to gullying. Ground ice slumps and superficial mudflows on slopes, and large flow slides in clay-rich till.	Gravel deposits rare and small; usefulness of the silty till ³ material as fill is limited by its ice content. Where bedrock is close to the surface, it is a source of low-ice borrow material.
X	HUMMOCKY TILL	Clayey to gravelly-sandy till, locally gravel, forming rolling to hilly moraine composed of individual and coalescent hummocks. Local contrasts in material and ground-ice between well drained hills and poorly drained depressions. Includes small undifferentiated areas of Unit I.	Mainly silty to clayey till 5-150 ft. thick, with coarser gravelly till and local bodies of gravel. Topography is hummocky and in places ridged (typical hummocks 300-1000 ft. in diameter). Local relief ranges from 30-100 ft. (in places exceeds 150 ft.). Peat (Unit I) occurs in depressions to thicknesses of 15 ft. Generally absent on 96C, 96E, 96F and 106H, but locally developed on 96G (relief to 150 ft.) and eastern half of 96E (relief to 50 ft.).	Ice content highly variable depending on topographic position; crests of prominent ridges and hummocks well-drained and ice-free to depths of 5-15 ft.; lower slopes commonly up to 10% (locally up to 40%) ice as thin (<1"), irregular, discontinuous seams in upper 9 ft. Thicker (0.2-2 ft.) ice lenses at depth. Ice content generally low in drumlinoid features. ⁴	Well-drained hills, poorly drained depressions in places containing bogs or ponds. Water moves downslope, and follows poorly defined drainage ways connecting depressions.	Minor to moderate susceptibility to thermokarst subsidence, and ground ice slumps; minor susceptibility to gullying.	Includes minor sources of gravel and mixed gravel and sand; usefulness of till material as fill is limited by its ice content. The silty ³ till is suitable borrow material where ice content is low.
XI	UPLAND AND PIEDMONT COMPLEX	Areas of moderate to low slope, in part hilly, surfaced by till, disintegrated bedrock, and local clay, silt, sand, or gravel. Unconsolidated deposits generally form a thin veneer over rock but in places they are thick (<100 ft.).	Not present	Not present	Not present	Not present	Not present
XII	MOUNTAINOUS AND ROCKY AREAS	Rocky outcrop or rock thinly covered by rubble. Moderate to steep slopes.	Includes Precambrian carbonates, volcanics and shale, Paleozoic and Mesozoic carbonates and shale, and Cenozoic (Tertiary) poorly consolidated gravel, sandstone, shale and mudstone; some formations flat-lying, some tilted and faulted. Forms ridges, scarps, and hills with local relief of up to 1,000 ft. Bedrock covered by rubble on lower slopes, and by alluvium in valley bottoms.	Little ice in bedrock (except shale - see Unit IX); ice content low to moderate in rubble, scree, and other overburden. Local high-ice in fine debris in valley bottoms.	Downslope drainage, wet ground on local flat areas.	Rock falls, slides and active creep, on steep slopes, gullying of soft materials. Mudflows and flash floods in steep gullies. Large rotational slumps common on high cliffs of shale.	Rubble and in-place rock from limestone, dolomite and harder sandstone units can serve as sources of coarse granular material. Less resistant sandstone and shale is a source of low-ice borrow material. Tertiary sands and gravels provide a good source of construction material.
XIII	ERODED AND/OR ERODING RIVER BANKS, COASTAL CLIFFS AND VALLEY WALLS - UNCONSOLIDATED MATERIALS	Various unconsolidated materials on moderate to steep slopes; generally with surface veneer of slope debris; includes unstable areas.	Same as general description. Surface colluvial debris up to 15 ft. thick. Material on upper part of slope is same as adjacent map unit; different materials commonly occur lower on the slope; locally bedrock rubble forms the base of the slope (see Unit XIII). Slopes generally less than 150 ft. high.	Quantity of ground ice as indicated for adjacent map unit. Ground ice visible in freshly slumped faces.	Surface of sandy and gravelly materials is generally dry; other materials commonly wet with local running water and active gullying.	Active stream erosion; major ground ice slumping and gullying.	Varied material; see description pertaining to adjoining unit.
XIIIa	ERODED AND/OR ERODING RIVER BANKS, COASTAL CLIFFS, AND VALLEY WALLS - BEDROCK	Bedrock outcrops or bedrock partly covered by rock detritus or unconsolidated materials; slopes commonly steep; includes unstable areas.	Steep slopes and rock faces consisting of shale, sandstone, or limestone (contains gypsum and coal seams), some partly covered by debris. Strata are flat-lying or inclined at a low angle. Unconsolidated material on upper part of slope same as adjacent map unit.	No observations of segregated ice; possibility of ice in joints and in fracture zones. Ice in overlying unconsolidated materials as indicated for the appropriate unit.	Locally water runs down rock face; gullying.	Rock falls, and superficial debris flows on steep eroded slopes; local susceptibility to gullying and slumping in areas of soft shale or where substantial thickness of overburden covers the rock. Flooding in valley bottoms.	Rubble and in-place rock from limestone, dolomite and harder sandstone units can serve as sources of coarse granular material. Less resistant sandstone and shale is a source of low-ice borrow material.

Map Unit	Occurrence	Permafrost Terrain		Performance of newly thawed materials	Non-Permafrost Terrain		Flooding Hazard
		Degradation following disturbance of ground surface	flat ground (<3° slope)		sloping ground (>3° slope)	Occurrence	
I	peatlands	3K	2S, 2G	3	Fenland	3	N
II	general	3K, 2G	3S, 3G	3	N	N	N
III	N	N	N	N	N	N	N
IV	general	1	1-2S, 1-2G	1-2	N	1-2	N
V	general	2K	(2-3S, 3G)	3-2	active river deposits	2-1	3-2
VI	general	1-2K	(1-2S, 1-2G)	1-2	active river deposits	1	3-2
VII	general	1	1-2S, 1-2G	1-2	N	1	N
VIII	N	N	N	N	N	N	N
IX	general	2K	2S, 2G	2	N	N	N
X	general	2K	2S, 2G	2	N	N	N
XI	N	N	N	N	N	N	N
XII	general	1	1-2S, 1-2G	1	N	N	N
XIII	general	N	(as for unit XI where overburden is present)	3-1	N	N	3-2 (valley bottoms)
XIIIa	general	N	(as for unit XIII where overburden is present)	1-2	N	N	3-2 (valley bottoms)
1	2	3	4	5	6	7	8

KEY TO PERFORMANCE RATING TABLE - EXPLANATORY NOTES

Sensitivity - Performance Scale

Rating Number	General	Columns 3 and 4	Columns 5 and 7	Column 8
1	good sites	low frequency, and/or low intensity	least troublesome materials	-----
2	fair sites	moderate frequency and intensity	moderately troublesome materials	flooding under extreme conditions
3	poor sites	high frequency and/or high intensity	highly troublesome materials	flooding a common occurrence
N		not applicable or not represented		no flood hazard

Degradation following disturbance of ground surface (Columns 3 and 4)

Rating applies to changes resulting from man-induced disturbance such as stripping of the surface down to mineral soil, long term ponding of water on surface, or re-routing of flowing water for substantial periods. Degradation of somewhat lesser intensity and/or frequency results from compaction or mechanical disturbance of the surface vegetation mat or peat. Earthflows may develop in sloping sites following fire on units rated as 2 or 3.

K - thermokarst depressions or ground subsidence from melting of ground ice.

S - slope failures such as ground ice slumps, earth flows, landslides, block collapse (minor sloping sites in brackets)

G - gully erosion (minor sloping sites in brackets)

Sloping ground includes:

- eroded banks in gullies, along rivers, valley walls, and eroded coasts (Note: major eroded areas mapped as unit XIII)
- slumped banks around thermokarst lakes or thermokarst depressions
- sloping hillsides (units VII, VIII, X, XI, XII, XIII)
- mountainside and escarpments (Units XII, XIII)

Performance of newly thawed material (Column 5)

The rating is for performance of thawed materials under worst conditions (i.e. immediately after melting of constituent ice) when subjected to load in place, when used as fill, or when exposed on a cut slope. Rating also applies to "normal" active layer materials under the same conditions.

Performance of normal unfrozen material (Column 7)

The rating is for performance of materials under typical field moisture conditions when subjected to load in place, when used as fill, or when exposed on a cut slope.

TERRAIN CLASSIFICATION AND SENSITIVITY SERIES
 Produced for
 Indian and Northern Affairs
 by
 Department of Energy, Mines and Resources
 as part of
 the Environmental-Social Program,
 Task Force on Northern Oil Development

OPEN FILE
 132
 JAN 1978
 GEOLOGICAL SURVEY
 OTTAWA

This map has been reprinted from a scanned version of the original map. Reproduction par numérisation d'une carte sur papier.

To accompany maps 106G (Upper Ramparts River), 106H (Sas Sault Rapids), 96E (Norman Wells), 96F (Mahony Lake), 96G (Fort Franklin), 96D (Carcajou Canyon), and 96B (Blackwater Lake). Terrain sensitivity and performance rating is provisional and subject to revision and correction.

¹Segregated ice: Ice as distinct lenses, layers, veins, and masses in soils, commonly, but not always, oriented normal to direction of heat loss.

²Thermokarst: Heat from water in thaw pits, sinks and ponds results in melting of ground ice in areas of saturated peat and underlying mineral soils. The thaw basins may enlarge to the point of coalescing. They are usually steep-sided and flat-bottomed and are best developed in peat-covered, stratified, waterlaid silt and fine sand.

³Clay, silt, and fine sand are commonly poor borrow materials under permafrost conditions because of their instability under the high moisture content that results from thawing of contained ground ice. Some improvement in properties for use as fill could be achieved by artificial drying.

⁴See bedrock map insert and legend on individual map sheets.

⁵Access ice: Ice in excess of the quantity that would be retained as water in the soil voids upon thawing.

⁶Little data available.