TERRAIN CLASSIFICATION AND SENSITIVITY SERIES

LEGEND

To accompany map sheets 107B west (Aklavik)
117A (Blow River), 117C Demarcation Point),
and 117D (Herschel Island).

Map Unit	Name	General Description	Local Description	Permafrost, Ground Ice Conditions	Drainage (thaw season)	Hazards	Sources of Construction Material
I	ORGANIC TERRAIN (including muskeg)	Peat, peat-fen complex; commonly occurring as a cover on Units II, IX, III, V, VI, and on flatter parts of VII. Peat also occurs in depressions within units VIII, X, and XII.	Peat-fen complex underlain by sedge and moss. Flat to gently sloping (up to 2°), relief to 3 ft., in part with reticulate network of low ridges. The surface of peat commonly takes on polygonal patterns of two types; high-centred peat polygons which range in diameter from 10-20' and low-centred peat polygons ranging in from 20-30 ft. Peat occurs largely in isolated depressions and, on larger abandoned thermokarst lakes. The peat is 3-15 ft. thick and is commonly interbedded with lacustrine silts.	Ice content high; commonly up to 60% segregated ice[1] by volume within peat; typically 1-3 ft. total thickness of segregated ice in mineral soil immediately below peat.	Higher surfaces of peat platforms dry, intervening trenches often contain water. Low-centre polygons commonly contain surface water; some near-surface seepage may occur.	Erosion along ice wedge cracks. Removal of vegetation can lead to subsidence of 5-10 ft.; unfrozen material highly compressible and of low strength.	Unsuitable
II	SILT-CLAY PLAINS (marine and lake deposits)	Clay and silt, with discontinuous organic cover (see Unit I). Principally forming plain bordering coastal areas. Unstable in eroded slopes.	Silt and clay 3-60+ ft. thick. Flat to gently sloping with extensive thermokarst[2] topography (oriented lakes). Discontinuous organic cover.	Moderate. Commonly up to 10% excess ice[3] as thin (<1") seams in upper 3-10 ft.	Ground surface wet in areas where low-centre polygons have developed.	Erosion along ice wedges. Thermokarst slumping along coast and on steep slopes around ponds; removal of thawed material can lead to subsidence of 10 ft. +. Unfrozen material of low strength.	No sources of granular material or fill.
III	THERMOKARST LAKE BEDS	Clay, silt, peat, and local sand and low, flat areas formerly occupied by tundra ponds. These materials range in thickness from 5-25 ft.	See general description. Materials generally similar to those comprising adjacent map unit(s). Widespread peat cover to 10 ft. + (see unit I). Surface generally flat or gently sloping.	Generally moderate. 10-40% segregated ice as thin (<½ in) seams common.	Areas wet and marshy where low-centre polygons are present at surface.	Erosion along ice wedge cracks. Thermokarst slumping may occur along coast; removal of thawed material can lead to subsidence of 10+ ft. unfrozen material compressible if organic beds present, generally low strength.	Gravel present, but rare around depressions; generally poor source of fill.
IV	BEACHES (marine and lake)	Gravel and/or sand ridges or flat areas along present or former shorelines	Marine beaches, spits and bars, along and adjacent to present coast ; consist of sand and gravel underlain by finer, poorly sorted material. Includes actively forming ridges 2-8 ft. above sea level, as well as stabilized shore deposits.	Low ice content in active beaches; moderate ice content, including ice wedges, in stabilized beaches.	Ground surface relatively dry on ridges; depressions between stabilized ridges wet and marshy.	Frequent flooding of lowest areas; flooding of higher ridges during major storms accompanied by coastal erosion and re-shaping of beach ridges.	Suitable source of gravel or mixed gravel and sand; exploitation may accelerate coastal erosion.
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,fine sand and clay (10 - 15 ft.+) with peaty beds, 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.	Ice content generally moderate. 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 thermokarst collapse of banks in some areas.	Many areas are wet; small thaw pools, 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 autumn storms; channel shifts.	Generally poor[4] source of borrow material. Rare and small gravel deposits on alluvial fans west Aklavik.
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 terracesconsisting of sand and gravel 3-20+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 a thickness of 150 ft. and form slopes of 1-12°. Peat cover is largely restricted to former river channels, and ranges in thickness from 3-10 ft.	Ice content low in coarse-grained material; rare ice lenses in finer sediments. Moderate to high ice content in the silt veneer. Very shallow thermokarst ponds on low terraces.	Surfaces of coarser-grained materials are generally dry; (moist on large flat areas where water table is perched because of permafrost table); ponds and swamps in former river channels.	Minor thermokarst subsidence; undercutting and bank collapse along channels during high water; flooding during breakup and summer storms; channel shifts.	Includes much gravel and mixed gravel and sand; the unit contains much sandy material suitable for fill. Exploitation of sites adjoining rivers may lead to accelerated erosion of channel shifts.
VII	GRAVEL SAND HILLS RIDGES AND TERRACES	Gravel, sand, and some silt. Includes glaciofluvial deposits, and undifferentiated fluvial deposits; river terraces.	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.).	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.	Ground surface relatively dry, except on large flat areas and in channel traces; drainage mainly subsurface.	None except where peat cover is present (see Unit I).	Major source of gravel and mixed gravel and sand; generally suitable as borrow material.
VIII	SILT - CLAY HILLS AND RIDGES	Mainly silt and clay with minor sand and gravel in moraines; strata tilted and folded.	Topographic highs consisting of deformed clay, silt, fine sand. Locally sand and gravel up to 200+ft. thick. (West of King Pt., 117D). Unit is flat to moderately sloping.	Excess ice to 10% common in finer textured materials in the form of thin ice lenses. Thick tabular bodies of ice occasionally present in silts and clays. Sand and gravel free of excess ice.	Few moist areas on broad flat uplands; slopes generally adequate to allow drainage by seepage.	Detachment slides followed by the development of retrogressive flow slides on valley walls; ground ice slumps and along coasts, also thermal niching and block failures; soft when thawed.	Good source of gravel and mixed sand and gravel in local areas west of King Pt. (117D). Otherwise poor.
IX	TILL PLAINS	Till, occuring 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. Forms a sloping rolling plain; relief generally bedrock controlled. Local relief (due to stream incision) up to 150 ft. Discontinuous peat cover (Unit I) in depressions and as irregular patches.	Ice content moderate in till; commonly up to 10% segregated ice as thin seams in upper 5-10 ft., locally thicker ice lenses (0.5-9 ft.) at depth. Generally little ice in underlying bedrock.	Ground surface commonly dry but may be moist on flat areas. No organized drainage with downslope seepage in shallow sub-parallel runs.	Minor to moderate susceptibility to thermokarst and gullying. Superficial mudflows on slopes.	Gravel deposits rare and small; usefulness of the silty till 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, local 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 5-50 ft. thick, with local bodies of gravel. Topography is hummocky and in places ridged (Typical hummocks 300-1500 ft. in diameter). Local relief ranges from 30-100 ft. (in places exceeds 150 ft.), with slopes to 20° (exceptionally to 30°). Material immediately underlying till generally marine and/or estuarine silts and clay, with occasional gravel. Peat (Unit I) occurs in depressions to thicknesses of 15 ft.	Up to 10% (locally up to 40%) ice as thin (<1"), irregular, discontinuous seams in upper 9 ft. Thicker (0.5-9 ft.+) ice lenses at depth.	Well-drained hills, poorly-drained depressions in places containing bogs or ponds.	Minor to moderate susceptibility to thermokarst subsidence, and ground ice slumps; minor susceptibility to gullying.	Includes very minor sources of aggregate; usefulness of till material as fill is limited by its ice content.
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 (<100ft.).	Glaciated area; east of Firth River (117D); till, minor sand and gravel, silt and clay over bedrock. Overburden occurs in thicknesses of up to 15 ft. on hills and slopes; thicker in depressions. Topography is gently sloping to rolling (controlled by underlying bedrock)[5] with relief of up to 500 ft. and slopes to 15°. Peat in depressions and on flatter areas (see Unit I). Unglaciated area: west of Firth River (local areas east of Firth River) (117D); mainly silty colluvium with minor sand and gravel over bedrock or gravel: extensive areas of gravel on flat to gently sloping pediment surfaces. Overburden generally up to 50 ft. thick over bedrock, although locally much thicker.	Ice content moderate; commonly up to 10% excess ice as thin seams in the upper 10 ft. with locally thicker seams (0.5-10 ft.) at depth, in areas of till or fine-grained unconsolidated sediments. Colluvial silts and clays may have up to 90% excess ice in upper 10+ ft. with seams of ice up to 5 ft. thick. Ice content low in areas where bedrock overlain by coarser rubble or where gravel and sand present.	Slopes and hilltops are relatively dry, depressions and flat areas are wet, with bogs and ponds. Seepage downslope, permanent streams in valleys.	Minor to moderate thermokarst subsidence. Minor to major susceptibility to gullying, slumps, and mudflows. Some ice slumps present along stream banks and lake boundaries.	Includes sources of gravel and mixed gravel and sand in glaciated area and a major source in the unglaciated area where gravels are present on the pediments. The till, silt and clay are fair to poor sources of borrow material; where bedrock is close to surface, it is a source of low-ice borrow material.
XII	MOUNTAINOUS AND ROCKY AREAS	Rock outcrop or rock thinly covered by rubble. Moderate to steep slopes.	Glaciated area; east of Firth River (117D): predominantly shale and siltstone, with resistant sandstone ridges; areas of resistant quartz sandstone and volcanic rocks in Richardson Mts. (107B) west. Comprises several formations of Paleozoic, Mesozoic and Cenozoic age, some flat-lying, and some tilted and faulted. Rubble common on slopes and hills. Unglaciated area; west of Firth River (117D): argillite, sandstone, limestone, dolomite, shale and siltstone; comprises several formations of Paleozoic, Mesozoic, and Cenozoic age , some flat-lying, and some tilted and faulted. Rubble common on slopes and hills.	Little ice in bedrock; ice content low to moderate in rubble, scree, and other overburden. Local high-ice in fine debris in valley bottoms, and on flatter areas.	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.	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.
XIII	ERODED AND/OR ERODING RIVER BANKS, COASTAL CLIFFS, AND VALLEY WALLS (UNCONSOLIDATED MATERIAL)	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 XIIIR). Slopes generally less 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. Flooding in valley bottoms.	Varied material; see description pertaining to adjoining unit.
XIIIR	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,some partly covered by debris. 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 undercutting 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.

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

[2] Thermokarst: 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.

[3] Excess Ice: ice in excess of the quantity that would be retained as water in the soil voids upon thawing.

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

[5] See bedrock map insert and legend on individual map sheets.

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

TERRAIN SENSITIVITY AND PERFORMANCE RATING TABLE

To accompany map sheets 117C (Demarcation Point), 117D (Herschel Island), 117A (Blow River), and 107B west half, (Aklavik).

Map Unit	Permafrost Terrain				Non-Permafrost Terrain		Flooding Hazard
	Occurrence	Degradation following disturbance of ground surface		Performance of newly thawed materials	Occurrence	Performance of unfrozen materials	
		flat ground (<3° slope)	sloping ground (>3° slope)				
I	general	3K	(2S,2G)	3	N	N	2 (low coastal areas only)
II	general	3K, 2G	(2-3S, 2G)	3	N	N	N
III	general	3K, 2G	(2S,2G)	3-2	N	N	2 (low coastal areas only)
IV	general	1 (2K)	N	1-2	active beaches	1	3
V	general	2K	(2S,2-3G)	3-2	active river deposits	2-3	3-2 (flood plain & low coastal(areas)
VI	general	1	1 (2G)	1	active river deposits	1	3-2 (flood plain & low coastal areas)
VII	general	1	(1-2G)	1	N	N	N
VIII	general	2-3K, 2G	2-3S, 2G	3 (1)	N	N	N
IX	general	2K	2S, 2G	2	N	N	N
X	general	2K	2S, 2G	2	N	N	N
XI	general	2-3K	2-3S, 2G	2-3	N	N	N
XII	general	1 (2K)	1-2S, 1-2G	1 (2)	N	N	N
		(as for unit XI where overburden is present)					
XIII	general	N	2-3S, 2G	3-1	N	N	3-2 (valley (bottoms)
XIIIR	general	N	1-2S	1	N	N	3-2 (valley bottoms)
		(as for unit XIII where overburden is present)					
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, XI)

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

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To accompany maps 117C (Demarcation Point), 117D (Herschel Island), 117A (Blow River), and 107B west half (Aklavik). Terrain sensitivity and performance rating is provisional and subject to revision and correction.