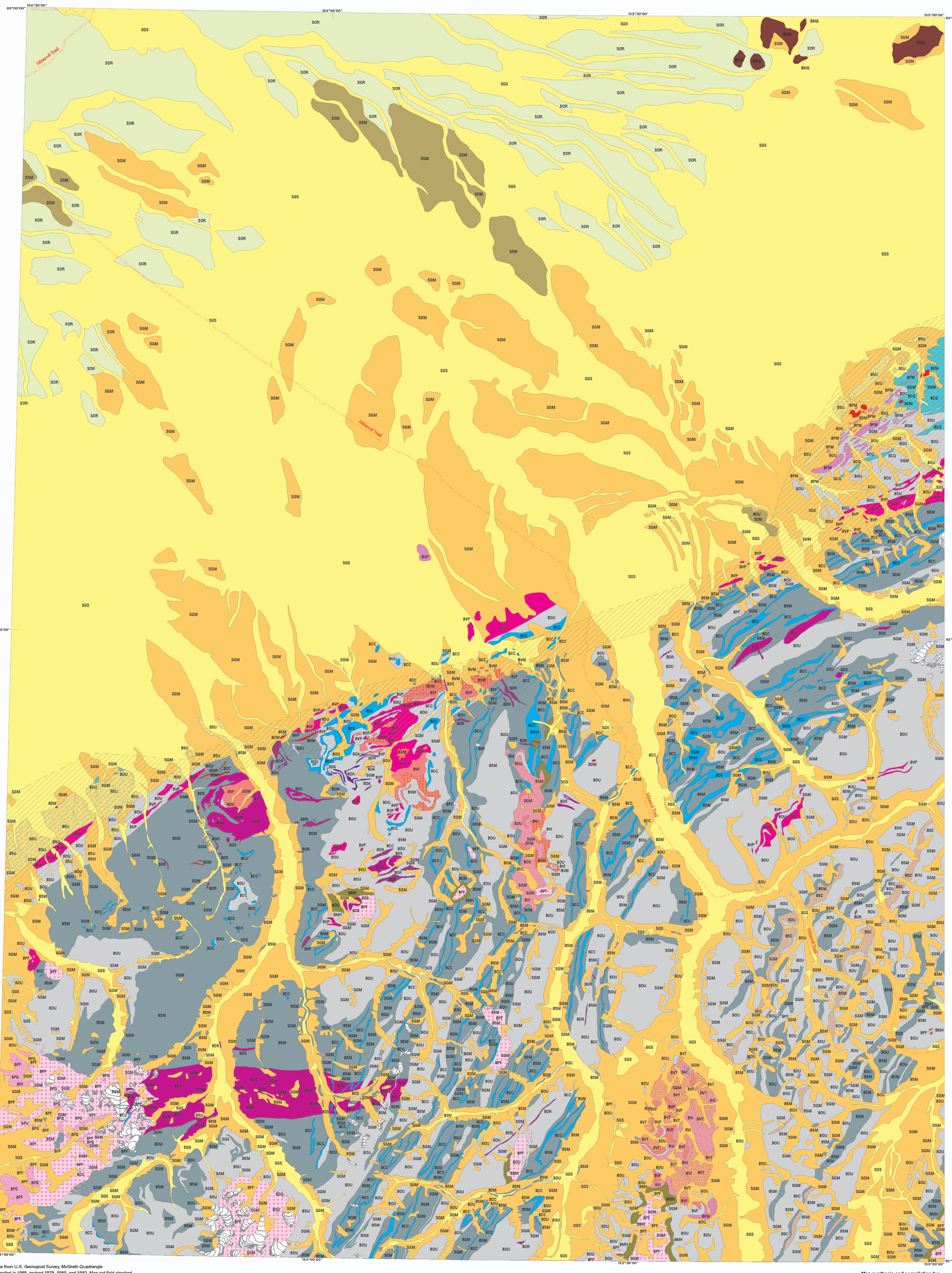

Base from U.S. Geological Survey, McGrath Quadrangle
Compiled in 1965, revised 1978, 1980, and 1982. Map not field checked.
Projection and 10,000-meter grid Universal Transverse Mercator, zone 5.
1927 North American datum

SCALE 1:125,000

5 0 5 10 Miles

5 0 5 10 15 Kilometers

CONTOUR INTERVAL 200 FEET
DOTTED LINES REPRESENT 100-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
1984 MAGNETIC DECLINATION AT SOUTH EDGE OF SHEET VARIES 22° TO 23°30' EAST

Map synthesis and compilation by:
D.S. Pinney
Technical review by:
R.A. Combellick and T.K. Bundtzen
Electronic digital cartography by:
A.M. McCarthy and G.R.C. Graham
Color design by:
Ann-Lillian Schell
Edited by:
Paula K. Davis

DISCUSSION

This map illustrates potential near-surface sources of various geologic materials that may be useful for construction. Field observations indicate that each geologic unit (for example, stream alluvium) has a definite composition or range of composition wherever that unit is found. Therefore, the presence of materials is interpreted from the distribution of geologic units on the geologic map of this quadrangle. This map is generalized and is not intended to show exact locations of specific materials. The purpose is to indicate general areas that deserve consideration for certain materials and to eliminate other general areas from consideration for these materials. Local variations are common, especially near unit boundaries.

Potential uses of map units are qualitatively summarized in the tables below, which show potential availability of various construction materials in each geologic-materials unit. Precise economic evaluations of specific deposits as sources of construction materials will require detailed examination of each deposit, including areal extent, volume, grain-size variation, thickness of overburden, thermal state of the ground, and depth to water table as well as logistical factors, demand, and land ownership.

The map also addresses some of the principal geologic hazards that may be associated with the deposits based upon their general physical properties and conditions that are characteristic of their depositional environment. Potential geologic hazards directly relate to surficial geologic units because (1) the processes that form the surficial units are hazardous and are ongoing, and (2) conditions (like ground ice) in the surficial deposit present hazards if development occurs. In general, our main concerns in lowland areas are natural hazards related to a lack of bearing (shear) strength (such as saturated, organic-rich swamp deposits and thawing of ice-rich permafrost) and seasonal flooding. In highlands, mass movements are locally a serious concern. Local, unevaluated factors affecting mass movement (rock avalanches, landslides, and debris flows) include the texture of sediments, bedrock structures, and water content. Faulting and related earthquakes can produce sudden displacements by shaking and impacts and may cause liquefaction and mass movements in both highlands and lowlands. The hazards presented here are intended only as a general guide to some common hazards that might possibly be present at given localities, and does not preclude the presence of other unevaluated or site-specific hazards.

This map is derived electronically from the geologic map of the area (Bundtzen and others, 1997) using ARC/INFO, a Geographic Information System (GIS). Unit descriptions, engineering characteristics, and hazards information presented here are largely based upon the mapping and observations of Kline and others (1986), Bundtzen and others (1987, 1997), and Gilbert and others (1988).

DESCRIPTION OF MAP UNITS

Unconsolidated Deposits

SGS — Fluvial and glaciofluvial silt, sand, and gravel. Chiefly (estimated >80 percent) clean sand and gravel. Grain size, sorting and degree of stratification are variable. Permafrost may be present, especially in older deposits. Older deposits may contain highly weathered clasts and thus may not be suitable as construction materials. Rare oversized materials. Includes primarily GP and GW of the Unified Soil Classification (Wagner, 1957).

SGM — Poorly- to moderately well-sorted clay, silt, sand, gravel, and diamicton of colluvial and alluvial origins. Includes angular, unsorted talus debris, chaotically deformed colluvium derived from landslides, and unsorted, angular, frost-shattered cobbles and boulders of rock glaciers. Engineering applications vary widely due to large range of grain size and sorting properties. Commonly frozen. Estimated 20-80 percent coarse, granular deposits with considerable oversized material. Includes primarily GC and GM of the Unified Soil Classification (Wagner, 1957).

SSM — Well-sorted sand and silt deposited by wind. Sand deposits mostly thawed and dry. Silt mostly frozen and ice-rich. Chiefly fine materials. Estimated >80 percent sand and silt. Includes primarily ML, MH, SM, SP, and SW of the Unified Soil Classification (Wagner, 1957).

SOR — Poorly stratified organic-rich silt and peat. Mostly frozen. Might be suitable for horticultural or energy applications. Chiefly organic materials. Estimated >50 percent peat, organic sand, or organic silt. Includes Pt of the Unified Soil Classification (Wagner, 1957).

Bedrock Deposits

Clastic Sedimentary Rocks

BSC — Pebble to boulder conglomerate. Pebbles are subangular to rounded. Total thickness is highly variable up to 350 m thick, with some individual massive conglomerate layers measuring 25 m thick. Resistant and forms large, 1-m-long, blocky rubble.

BSM — Medium- to coarse-grained, massive to locally thin-bedded, calcareous lithic sandstone with lesser amounts of interbedded siltstone, shale, pebble conglomerate, and minor limestone. Up to 400 m thick. Generally resistant, especially the thick sandstone layers that form blocky rubble.

BSU — Poorly to moderately indurated, thin- to thick-bedded, granule to pebble and cobble conglomerate, minor sandstone, and interbedded carbonaceous shale and coal. Conglomerate clasts are poorly- to moderately well-sorted, subangular to rounded pebbles and cobbles. Matrix ranges in size from silt and clay to granules. Unit includes weakly to well-cemented diamicton interbedded with crudely stratified sand, silt, and gravel. Up to 300 m thick. Some unconsolidated conglomerate beds might be excellent sources of sand and gravel.

Carbonate Sedimentary Rocks

BCC — Massive- to thick-bedded limestone and dolomitized limestone with minor silty sandstone intervals and thin black chert partings. Ranges from 10 m to 50 m thick. Very resistant and cliff-forming, and may form large blocks.

BCQ — Thin-bedded quartzitic limestone, silty limestone, and shale. Up to 100 m thick. Moderately resistant where quartz-rich lime beds exceed 50 percent of unit.

Plutonic Igneous Rocks

BPF — Fine- to coarse-grained felsic plutonic rocks, including granite, granodiorite, monzonite, quartz monzonite, monzodiorite, quartz porphyry, and syenite. Very resistant and forms jointed cliffs, tors, high uplands, and rugged terrain. Typically weathers in large blocks.

BPG — Fine- to coarse-grained plutonic rocks of varied composition, including gabbro, granite, and quartz syenite. Typically weathers to grus and forms rounded outcrops.

BPM — Medium- to coarse-grained plutonic rocks of varied composition, including granite, diorite, and gabbro. Moderately resistant. Forms subdued rubble.

Volcanic Igneous Rocks

BVF — Flows and tuffs of andesitic and rhyolitic composition. Andesite flows may exhibit columnar jointing. Up to 150 m thick. Moderately resistant and forms large, locally elongated blocks to 1 m in diameter.

BVI — Massive dacite and lesser andesite flows with zones of pyroclastic breccia. May contain abundant angular clasts of sedimentary rocks. Up to 400 m thick. Resistant and forms large, angular blocks up to 3 m in diameter.

BVM — Basalt and basaltic andesite flows and minor andesite flow breccia. Groundmass typically altered. May be columnar jointed. Moderately resistant where not brecciated.

BVP — Massive, fine- to medium-grained pillow basalt, diabase and gabbro sills, and mafic agglomerate. Rocks are extensively chloritized. Ranges from 150 m to 200 m thick. Very resistant where fresh, but nonresistant where altered.

BVT — Lapilli tuff, dacite, and rhyodacite flows with lapilli tuff beds 1 m to 4 m thick. Moderately resistant and may form flaggy rubble.

Dike/Sill Rocks

BDA — Fine- to coarse-grained ultramafic (picrite) sills, gabbro, and diorite up to 20 m thick. Magnetite is locally extremely abundant (up to 40 percent). Relatively resistant where fresh, but nonresistant where hydrothermally altered.

BDM — Sills and dikes of variable composition. Up to 10 m thick. Generally resistant.

BDR — Very fine- to medium-grained gabbro, diorite, alkali syenite, and andesite dikes up to 20 m thick. Groundmass commonly altered. Resistant and forms ribs and blocky rubble.

BDS — Heterogeneous dike swarms and hornfels of variable composition. Generally resistant.

Metamorphic Rocks

BMH — Massive fine- to coarse-grained hornfels and local highly altered carbonate rocks (skarns). Generally resistant and forms equant blocks.

BMQ — Fine- to coarse-grained metaquartzite, quartz-feldspar grit, calcareous phyllite, and minor metachert. Quartz-rich grits locally resistant and produce blocky rubble up to 50 cm in diameter.

Other Rocks

BOU — Rocks of variable lithology and character that are generally unsuited for use as construction materials.

EXPLANATION OF MAP SYMBOLS

Denali-Farewell fault system. Offset or strong shaking in this zone could pose a hazard to structures.

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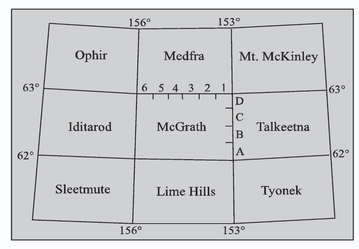

ACKNOWLEDGMENTS

The authors would like to thank Rodney A. Combellick, Owen K. Mason, and Thomas K. Bundtzen for their technical reviews and Ann-Lillian Schell for her cartographic review of this map.

Table 1. *Engineering properties of unconsolidated units*

Map unit	Drainage	Permafrost	Frost susceptibility	Slope stability	Bearing strength	Potential primary products	Potential hazards and other engineering considerations	Component geologic units[a]
SGS	Good in recently deposited alluvium above stream level, fair to poor in older alluvium where permafrost has developed and where covered by silty colluvium and peat. Good in younger permafrost-free terrace deposits without significant cover of organic silt. Good where outwash gravels are at or near surface of deposit; very poor where peat and silt cover promotes frost development and near springs where water table is close to ground surface. Drainage may be inhibited in older, inactive alluvial fans mantled by appreciable thickness of silt and organics.	Absent in younger alluvial deposits; locally present in older deposits mantled with silt and peat. Present discontinuously in older terrace deposits; may be ice rich in organic silt or where silt has infiltrated into gravels by percolating ground water. Sporadic in outwash, occurring where accumulations of peat and organic silt promote development of segregated ice. Ice is typically limited to fine-grained overburden. May occur in older, inactive fans mantled by appreciable thickness of silt and organics.	Minimal in well-drained modern alluvium; may be moderate to intense in permafrost-bearing active layer mantled with silt and peat. Terrace gravels generally not susceptible to heave; heave occurs in organic silt that caps older terrace alluvium. Outwash deposits not susceptible unless thickly mantled by silty organic material. Fans are frost stable, except for silt and organics on old fan surfaces, especially where shallow zones of permafrost inhibit drainage.	Generally stable, except for ice-rich permafrost-bearing deposits subject to thaw instability and areas adjacent to cutbanks or free faces, where sudden, rapid collapse may occur due to stream erosion or surface loading. Fill terraces may be subject to slumping and rapid erosion. Fans are generally stable, except where overburden is susceptible to frost heaving.	Variable, but generally good to fair, especially below peat and silt overburden.	Crushed aggregates and miscellaneous clean fill.	Older terrace and fan deposits that contain permafrost and have significant cover of eolian, organic, or colluvial sediments are generally undesirable as materials sources. Very short, steep tributaries of some fans may have high potential for debris flows or avalanches. Cutbanks along active streams may fail, thus may not be suitable for structure sites. High flooding potential along margins of streams.	Qa, Qai, Qof, Qdo, Qdot, Qdic, Qaf
SGM	Variable, depending on proportion of silt- to clay-sized material and stage of permafrost development. Deposits may be subject to avalanche and torrential flooding during periods of snowmelt or heavy precipitation. Well developed in pre-Wisconsin tills, moderately well developed in lower Wisconsin till, and poorly developed in upper Wisconsin till.	Common along north-facing slopes, especially in older deposits. Segregated-ice content may be high where silt and organics are prevalent. Present in toes of thick talus accumulations, sometimes with significant interstitial ice, and in talus that grades into rock glaciers containing permafrost. Widespread in till. In areas of thick permafrost development, permafrost table is about 1m below surface; interstitial ground ice and occasional large ice masses are common throughout upper 5m of deposit.	High in deposits that contain large proportions of silt or organic silt and in deposits with poor drainage. Tills may be thaw unstable following surface disturbance if deposit contains ice-rich permafrost.	Thaw unstable where perennially frozen or where deposit contains excess ice. Deposits of predominantly silty material are susceptible to creep, especially where saturated by near-surface ground water, such as springs along faults. Steep colluvial deposits, such as talus aprons at or near the angle of repose, are generally unstable. In addition, talus is subject to snow avalanches, mudflow, and rock falls. Tills are generally stable in permafrost areas if kept frozen, but subject to failure where saturated or where oversteepened by stream erosion.	Variable but generally fair to poor. Good in permafrost-free till on low to moderate slopes with no appreciable peat or silt accumulation.	Unclassified fills, although some local pods or lenses may be a source of small quantities of moderately sorted, gravel-rich fluvial sand.	Fan surfaces may be subject to avalanches, mudflows, subsidence, and local liquefaction. Therefore, caution should be exercised during excavation and construction activities. Saturated or oversteepened deposits may be subject to slope failure, and local thaw subsidence may occur in areas of permafrost.	Qea, Qet, Qel, Qrg, Qdt, Qdtf, Qdts, Qdtlm, Qdt, Qdtplm
SSM	Highly variable depending on grain size of material and stage of permafrost development. Generally quite good in sand deposits. Very poor in silt deposits that promote frost development.	Common in silt deposits. Interstitial ice, segregated ice, and massive ground ice may be present, especially in deposits with appreciable organic content or in areas of limited drainage. Generally absent in well-drained sand deposits.	High in deposits with high proportion of silt or organic silt and in areas of poor drainage. Thaw unstable following surface disturbance if deposit contains ice-rich permafrost.	Silt deposits are thaw unstable where perennially frozen or where containing excess ice; subject to slumping and earthflows, especially if organic content is high. Sand deposits are generally unstable due to lack of cohesiveness.	Generally poor.	Silt deposits are generally unsuitable as materials source. Sand may be useful in some construction situations and as unclassified fine fills.	Silt deposits may be subject to slump, slough, subsidence, liquefaction, mudflows, and thaw subsidence.	Qe
SOR	Very poor, often with standing water.	Ubiquitously frozen except near stream cuts.	Very high. Thaw unstable following surface disturbance.	Thaw unstable; subject to failure due to saturation.	Generally poor, especially where thawed.	May be suitable for horticultural or energy applications.	Surfaces subject to inundation, extreme frost heaving, and thaw subsidence in saturated soils. Generally unsuitable as structure sites unless structures are pile supported.	Qsp

[a] Source of geologic units: Bundtzen, T.K., Harris, E.E., and Gilbert, W.G, 1997, Geologic map of the eastern half McGrath Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 97-14a.

Table 2. *Engineering properties of bedrock units*

Map unit	Principal rock characteristics	Potential primary products	Component geologic units[a]
BSC	Medium- to coarse-jointed, medium- to coarse-grained sedimentary rocks. Block size up to 1-m diameter.	• Riprap and drain rock • Crushed rock • Unclassified fills	KJc
BSM	Medium-jointed, fine- to medium-grained sedimentary rocks.	• Riprap and drain rock • Crushed rock • Unclassified fills	KJs, mSs
BSU	Poorly indurated, medium- to coarse-grained sedimentary rocks.	• Sand and gravel	QTg, Tcf, Tcg, Tcl
BCC	Coarse-jointed, fine- to coarse-grained sedimentary carbonate rocks and their dolomitized equivalents. Large blocks.	• Dimension stone • Ornamental stone • Crushed rock • Cement	lDl, uDl, lDd, mSl
BCQ	Medium-jointed, fine-grained sedimentary quartzose carbonate rocks	• Riprap and drain rock • Crushed rock • Unclassified fills	Trls
BPF	Coarse-jointed, fine- to coarse-grained igneous rocks of felsic composition. Large blocks.	• Dimension and ornamental stone • Riprap, armor, gabion and drain rock • Crushed rock and grus	Twg, Tgd, Tqm, Tgqm, Tsy, TKqm
BPG	Fine- to coarse-grained igneous rocks that weather to grus.	• Dimension and ornamental stone • Crushed rock and grus • Unclassified fills	Tgb, Tgsy
BPM	Medium-jointed, medium- to coarse-grained igneous rocks.	• Dimension and ornamental stone • Riprap and drain rocks • Crushed rock and grus • Unclassified fill	Tgr, KJg
BVF	Medium-jointed, fine-grained volcanic igneous rocks of intermediate to felsic composition. Block size up to 1-m diameter.	• Riprap and drain rock • Crushed rock • Unclassified fills	Tva, Tvf, TKvf
BVI	Coarse-jointed, fine-grained volcanic igneous rocks of intermediate composition. Block size up to 3-m diameter.	• Riprap, armor, gabion and drain rock • Crushed rock	Tvd, Tvvd, Tvab, Tkvd
BVM	Medium-jointed, fine-grained volcanic igneous rocks of mafic composition, typically altered.	• Riprap and drain rock • Crushed rock • Unclassified fills	TKvm, Tvm
BVP	Fine- to medium-grained volcanic igneous rocks of mafic composition, typically altered.	• Riprap and drain rock if unaltered • Crushed rock if unaltered • Unclassified fills	Trab
BVT	Fine- to medium-grained volcanic igneous rocks of intermediate to felsic composition.	• Riprap and drain rock • Crushed rock • Unclassified fills	Tvld, Tvlr
BVT	Fine- to medium-grained volcanic igneous rocks of intermediate to felsic composition.	• Riprap and drain rock • Crushed rock • Unclassified fills	Tvld, Tvlr
BDA	Fine- to coarse-grained igneous dike rocks of ultramafic to intermediate composition.	• Magnetite • Dimension and ornamental stone • Riprap and drain rock • Crushed rock	Trum
BDM	Fine- to coarse-grained igneous dike rocks.	• Ornamental and dimension stone • Riprap and drain rock • Crushed rock	Tim, Tif
BDR	Medium-jointed, very fine- to medium-grained igneous dike rocks, commonly altered.	• Ornamental and dimension stone • Riprap and drain rock • Crushed rock	MzPzi, Tid, Tia
BDS	Fine- to coarse-grained igneous dike rocks and their metamorphic aureoles.	• Ornamental and dimension stone • Riprap and drain rock • Crushed rock	TKm, Tids
BMH	Coarse-jointed, fine- to coarse-grained contact-metamorphic rocks.	• Riprap and drain rock • Crushed rock • Unclassified fills	Thf, TKhf
BMQ	Medium-jointed, fine- to medium-grained quartzose sedimentary rocks and their metamorphic equivalents. Block size up to 50-cm diameter.	• Riprap and drain rocks • Crushed rock • Unclassified fills	PzpCs
BOU	Rocks of various compositions and character.	• Unclassified fills • Phosphate (unit Us)	Tvs, Tvt, Tvgt, Tvl, TKvt, KJsh, uPzs, uPzc, KJm, Trs, PDs, uSsl, mSvs, lSl, SOsh, OCls, Ts, DSl Dls, Us

[a] Source of geologic units: Bundtzen, T.K., Harris, E.E., and Gilbert, W.G, 1997, Geologic map of the eastern half McGrath Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 97-14a.

DERIVATIVE MAP OF GEOLOGIC MATERIALS AND HAZARDS IN THE EASTERN HALF MCGRATH QUADRANGLE, ALASKA

by

J.T. Kline and D.S. Pinney

1997

Final compilation, editing and development of this map occurred after the death of Jeff Kline on January 3, 1997. In his absence, I have made every effort to maintain consistancy with Jeff's work and to adhere to his high geologic standards. I am solely responsible for any omissions or misinterpretations.

DeAnne S. Pinney
Fairbanks, Alaska, March 1997

This DGGS Report of Investigations is a final report of scientific research. It has received technical review and may be cited as an agency publication.

Alaska Division of Geological and Geophysical Surveys
Geologic Data Modeling System