DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

DESCRIPTION OF UNITS

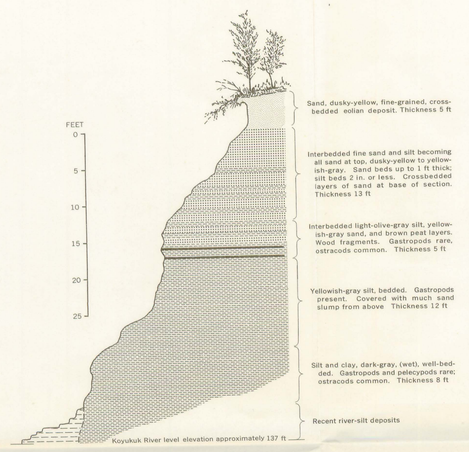
GEOLOGIC UNIT		LITHOLOGY	DISTRIBUTION AND THICKNESS	DRAINAGE	VEGETATION	PERMAFROST	SUSCEPTIBILITY TO FROST ACTION	BEARING STRENGTH AND SLOPE STABILITY	EXCAVATION AND COMPACTION	EVALUATION FOR ROAD CONSTRUCTION AND OTHER USES
Floodplain alluvium	Linear phase (Qa4)	Well-stratified layers and lenses of light-gray micaceous silt with some sand and gravel. Sand very fine- to medium-grained quartz and chert. Gravel subangular to well-rounded pebbles of white quartz, medium-gray to dark-gray and black chert, medium-light-gray fine-grained granite, light-gray quartzite, medium-gray graywacke, rare angular fragments of dark-gray shale; pebbles range from 1/4 to 3 inches in diameter.	Lowest lying unit. Borders major streams and forms most active part of floodplain. Thickness unknown but probably at least equal to depth of channels of Koyukuk and Yukon Rivers, 20–60 feet. Sand and gravel found only on the Yukon River at Galena and at the mouth of the Koyukuk River. Gravel and sand extend below a depth of 200 feet in wells at Galena.	Distinct linear lakes parallel to river, no integration of drainage.	Horsetail, grasses, alder, willow, cottonwood—the latter up to 24 in. in diameter. Rare spruce up to 36 in. in diameter.	Permafrost probably absent or at depths of more than 20 feet near rivers. Discontinuous lenses and layers of permafrost at depths of 3–5 feet elsewhere. No large ground-ice masses.	Sand and gravel unsusceptible; silt moderate to intense.	High bearing strength when frozen. Sand and gravel high when thawed, silt moderate to high when thawed and well drained, low when poorly drained. Slopes may stand at 2/3:1 to 1:1 except in unfrozen sand.	Easily excavated with power equipment except when frozen. Silt difficult to compact but mixture of silt, sand, and gravel easy to compact.	Fairly good for road foundation but subject to flooding, river cutting, and icing. Gravel good for subgrade, base course, and, if screened, for road metal. Good foundation for structures if gravel present. Source of moderate to large supply of water.
	Advanced linear phase (Qa3)	Well-stratified layers and lenses of light-gray micaceous silt, rare lenses of gravel and sand, some clay and slightly organic-rich silt in lake depressions.	Approximately 4 to 6 feet above river level, adjoining unit Qa4. Forms abandoned channels, higher parts of slip-off slopes, and islands. Thickness 4 to 15 feet.	Linear lakes parallel to drainage trends. No integration of drainage. Lakes partly broken into segments by encroaching vegetation.	Bunchberry, rose, willow, alder, birch, black spruce—latter up to 30 in. in diameter. Moss 4 to 8 inches thick.	Sporadic permafrost in islands. Depth to permafrost 1–3 feet on interlake areas and more than 10 feet under the lake basins. Probably no large ground-ice masses.	Silt moderate to intense.	High bearing strength when frozen. Silt moderate to high when thawed and well drained, low when poorly drained. Sand and gravel high when thawed and well drained. Slopes may stand at 2/3:1 to 1:1 except in unfrozen sand.	Easily excavated with power equipment except when frozen. Silt difficult to compact but mixture of silt, sand, and gravel easy to compact.	Fair for road foundation if gravel and sand present. Silt poor because susceptible to frost heaving. Subject to river cutting and flooding. Gravel good for subgrade, base course, and, if screened, for road metal. Good foundation for structures if gravel present. Source of moderate to large supply of water.
	Coalescent phase (Qa2)	Well-stratified layers and lenses of light-gray micaceous silt with much dark-colored silt, rich in organic matter.	Extensive areas in the higher part of the active floodplain, usually forms the cutbank of major streams and may stretch away from rivers up to six miles, rarely forms the very highest parts of big islands. Thickness 5–30 feet.	Numerous linear lakes and swamps modified by cave-in coalescence. Lakes lie at various angles to flow of major river. No integrated drainage.	Stunted spruce and birch 4–6 in. in diameter. Small alder and willow in damp places. Cottongrass tussocks, other sedges, cranberry, and peat moss common in tundra area.	Depth to permafrost 18–24 in. in forest areas and 12–18 in. in tundra areas. More than 10 feet in lake basins. Large ground-ice masses present in organic silt but no polygonal pattern observed on surface.	Intense.	High bearing strength when frozen or dry; low when wet or thawed unless well drained. Organic silt with high moisture content, flows as slud when thawed. When drained, silt stable at 2/3:1 to 1:1.	Easily excavated with power equipment except when frozen. Difficult to compact.	Poor for road foundation. Intense frost heaving, subsidence upon thawing of permafrost, poor surface drainage, subject to river cutting, and flooding. Unsurfaced road unstable—powdery when dry, sticky when wet. Poor foundation for structures.
	Scalloped phase (Qa1)	Well-stratified layers and lenses of light-gray micaceous silt with large amounts of dark-colored organic-rich silt, wood, peat, and other vegetal material. Organic material is at least 8,000 years old (8,140 ±300 years B. P., W–472) based on radiocarbon dating (Rubin and Alexander, 1958).	Highest part of active floodplain, 1/2 to 12 miles wide. Adjoins terrace units, adjoins major streams rarely on cutbanks. Up to 70 feet thick.	Numerous lakes and swamps with scalloped and irregular borders, small circular cave-in lakes. Some integration of drainage from lake to lake and along a few through streams. Strangmoor present near Koyukuk River. Few trenches in polygonal pattern.	Tundra with peat moss, reindeer moss, cottongrass and other sedges, cranberry, blueberry. Tundra mat 12–24 in. thick. Also stunted (2–4 in. diameter) black spruce, larch, and a few small birch and willows along sloughs and around lakes.	Depth to permafrost 12 in. in tundra areas, slightly greater in forested areas, and more than 10 feet under lakes. Large ground-ice masses present.	Intense.	High bearing strength when frozen or dry; low when wet or thawed unless well drained. Organic silt with high moisture content. Flows when thawed. Drained silt stable at 2/3:1 to 1:1.	Easily excavated with power equipment except when frozen. Difficult to compact.	Poor for road foundation. Intense frost heaving, subsidence upon thawing of permafrost, poor surface drainage, subject in a few places to river cutting. Unsurfaced road unstable—powdery when dry, sticky when wet. Poor foundation for structures.
Tributary alluvium	Gravel, sand, and silt (Qag)	Fairly well- to well-stratified layers of angular to well-rounded, fairly well sorted gravel composed of quartz, chert, sandstone, mafic and rare acidic volcanic rocks, granite, and diorite. Cobbles and boulder-size gravel in higher mountains. Grades downstream into Qas.	Underlies the major part of the valley floor meander belt of rivers and creeks flowing in the bedrock uplands. Estimated thickness 1/2 to 20 feet.	Well drained.	Spruce, birch, alder, willow, larch, bushy plants. Trees fairly large in some places.	Sporadic permafrost at depth of 2–8 feet. No large ground-ice masses.	Sand and gravel unsusceptible. Silt moderate to intense.	High bearing strength when frozen. Sand and gravel high when thawed; silt moderate to high when thawed and well drained, low when poorly drained. Slopes may stand at 2/3:1 to 1:1 except in unfrozen sand.	Easily excavated with power equipment except when frozen. Silt difficult to compact but mixture of silt, sand, and gravel easy to compact.	Good for road or structure foundations except where silt predominates. Subject to flooding and icing. Gravel good for subgrade, base course, and, if screened, for road metal and for concrete aggregate. Source of moderate to large supply of water.
	Silt and sand (Qas)	Well-stratified layers of fine to coarse, well-sorted silt and sand. Same lithologic composition as Qag.	Found in the lower reaches of stream valleys and in stream valley bottoms in heavily silt-mantled hills. Estimated thickness 1/2 to 30 feet.	Fair in smaller stream valley bottoms, a few beaded streams, meandering streams, some small cave-in lakes, oxbow lakes. Trenches in polygonal pattern.	Alder, willow, dwarf birch thickets, a few stunted black spruce, and some tundra.	Depth to permafrost 12 in. in larger stream valleys; sporadic close to the streams. Depth to permafrost 1–2 feet in valleys cut in silt-mantled hills. Large ground-ice masses.	Intense.	High bearing strength when frozen. Silt is subject to sloughing and landsliding when thawed and undrained. Ground subsides upon thawing of permafrost.	Easily excavated with power equipment except when frozen. Difficult to compact.	Poor for road foundation and for foundation of structures. Intense seasonal frost heaving, subsidence upon thawing of permafrost. Unsurfaced road unstable—powdery when dry, sticky when wet. Difficult in places to aline road because of stream meanders.
Alluvial and colluvial fan deposits (Qaf)		Made up of relatively poorly sorted silt and sand and angular rock fragments. Silt and sand primarily adjacent to terrace scarps and coarser material near rock outcrops.	Slope wash on hillsides, talus slopes, landslides, fans at mouths of gullies. Thickness extremely variable.	Well drained.	Alder, willow, dwarf birch thickets, sedges, grass, lichens, or no vegetation.	Permafrost sporadic or absent. Extensive fine-grained deposits contain much ground ice.	Unsusceptible to intense.	High bearing strength when frozen. Variable bearing strength and slope stability when thawed depending on grain size.	Easily excavated with power equipment except when frozen.	Gravel fans and talus slopes of small lateral extent have little value for road foundation. Good foundation for structures where coarse materials predominate. Possible source of base course and road metal. Sand and silt deposits fair to poor for road foundation.
Sand deposits	Primarily dune cover (Qs)	Sand, dark-yellowish-orange to light-gray, fine- to medium-grained; composed of subangular to rounded grains of 80 percent clear quartz, 5 percent white quartz, 2 percent muscovite, and the remainder of gray chert and dark-colored igneous and sedimentary rock fragments. Most of the light-colored grains, including the better rounded, are frosted. Gradation upward from alluvial silt and sand of terrace deposits to eolian sand deposits.	Sheets of sand with parabolic or compound dunes 5–50 feet high on top, presently stabilized by vegetation; also isolated vegetated longitudinal dunes. Sheets of sand and dunes extend from vicinity of Chips Island on Koyukuk River northeastward for 75 miles; 30–100 feet thick.	Semi-integrated drainage near Koyukuk River. Sand very porous and internally well drained.	Birch, aspen, spruce forest.	Dry, perennially frozen ground. No large ground-ice masses.	Unsusceptible.	High bearing strength when frozen or thawed. Unfrozen sand slopes very unstable.	Easily excavated with power equipment except when frozen. Difficult to compact.	Relatively good for road foundation. Few or no problems with seasonal frost action or thawing permafrost. Good source of sand.
	Thin sandy colluvial and mantle deposits (Qsc)	Sand is the same as Qs but may be mixed with silt and organic matter.	Mantle of sand, in places retransported by slope wash from Qs; elsewhere eolian mantle over low bedrock hills.	Well drained.	Vegetation depends on elevation, drainage, and nature of underlying unit. Generally similar to that usually found growing on underlying unit.	Dry, perennially frozen ground. No large ground-ice masses.	Unsusceptible.	High bearing strength when frozen or thawed. Unfrozen sand slopes very unstable.	Easily excavated with power equipment except when frozen. Difficult to compact.	Fair for road foundation if sand veneer is 30–40 feet thick. If underlying material is silt, foundation subject to frost heaving and subsidence.
Loess and colluvium (Qlc)		Eolian silt or loess, well-sorted, less than 10 percent clay; grains angular, consist mainly of quartz, feldspar, and mica; locally cemented by iron oxide. Colors buff to tan-gray when dry; brown when wet. Locally grades downslope into colluvium composed of silt and frost rubble.	Massive homogenous unconsolidated eolian silt on upper slopes and hilltops; 1 to 100 feet thick—thickest on hills immediately adjacent to lowland.	Well drained on upper slopes, poorer drained on lower slopes.	Heavily wooded—spruce, aspen, birch, alder, and willow.	Local permafrost more than 6 feet on more gentle slopes. Moderate to little ground ice.	Loess on high hills unsusceptible. Colluvium and loess moderately susceptible elsewhere.	High bearing strength when frozen or dry. Silt subject to sloughing and landsliding when thawed and poorly drained.	Easy to excavate except when frozen. Difficult to compact in absence of well-graded material.	Fair for road and structure foundation but poor where silt mantle is thick and poorly drained. Road cuts in slopes subject to flowing in spring and icing in winter. Easily gullied.
Terrace deposits	Younger (low) terrace deposits (Qty)	Well-stratified layers and lenses of gray micaceous silt and organic-rich silt. Locally same sand as in Qto.	Lower of two silt-terrace levels. Found primarily bordering the Yukon and Koyukuk River floodplains as remnant ridges on low, flat areas 30 to 80 feet above the rivers. Large parts of low terrace to north covered with dune sand (Qs). Total thickness unknown.	Drainage good on terrace scarps where permafrost is absent. Cave-in lakes very common. Impermeable substratum of permafrost creates poor drainage.	Peat moss, cottongrass tussocks and other sedges, stunted spruce, a few birch, aspen. Much tundra with thick vegetal mat.	Depth to permafrost 1 foot. Large ground-ice masses abundant as horizontal and vertical sheets, and saucer-shaped irregular masses 1–50 feet diameter.	Intense.	High bearing strength when frozen or dry, low when wet or thawed unless well drained. Silt is subject to sloughing and landsliding when thawed and undrained. When drained, silt stable at 2/3:1 to 1:1. Susceptible to gullying.	Easily excavated with power equipment except when frozen. Difficult to compact.	Very poor for road foundation. Intense frost heaving, great subsidence upon thawing of permafrost. Unsurfaced road unstable—powdery when dry, sticky when wet. If cleared, forms a summer quagmire.
	Older (high) terrace deposits (Qto)	Well-stratified layers and lenses of well-sorted gray micaceous silt and organic-rich silt. Sand included in terrace at Cave-Off Cliffs is well stratified, fine to coarse grained, well sorted, angular to subangular, composed of about 75 percent white and clear quartz, 10 percent dark gray and black chert, and aphanitic mafic igneous rock fragments, 3 percent biotite, and the remainder of varicolored chert, quartz, chlorite, quartzite, claystone, and other rock fragments. Locally the unit contains a single 8-inch light-gray devitrified volcanic-ash layer.	An extensive high terrace which occupies much of outer margins of the lowland bordering the hills and extending up some of smaller stream valleys. Terrace stands 100 to 200 feet above river level. Total thickness may be in excess of 500 feet at places like Cave-Off Cliffs. Qto plus Qty occupy an area of about 40 percent of the mapped region.	Scarp above Qty prominent in most places. Integrated drainage, many beaded streams, many cave-in lakes, some filled with vegetation. Some trenches in polygonal pattern.	Peat moss, cottongrass tussocks and other sedges, cranberry.	Depth to permafrost 1 foot. Large ground-ice masses abundant as horizontal and vertical sets, and saucer-shaped and irregular masses 1–50 feet in diameter near terrace scarp.	Intense.	High bearing strength when frozen or dry, low when wet or thawed unless well drained. Silt subject to sloughing and landsliding when thawed and undrained. When drained, silt stable at 2/3:1 to 1:1. Very susceptible to gullying.	Easily excavated with power equipment except when frozen. Difficult to compact.	Poor for road foundation. Intense heaving, great subsidence upon thawing of permafrost. Unsurfaced road unstable—powdery when dry, sticky when wet. Less subsidence near terrace scarp but numerous gullies require extensive bridging. If cleared, forms a summer quagmire.
Conglomerate, sandstone, and siltstone (Tc)		Poorly consolidated conglomerate of fairly well rounded cobbles and pebbles of very light gray schistose quartzite, white quartz, rare black, green, red, and yellow chert, and rare conglomerate cobbles. Part of the beds are iron oxide stained. Local sandstone layers interbedded with conglomerate consist of coarse, fairly well rounded grains similar in composition to conglomerate pebbles. Local beds of soft, white to tan siltstone containing brown clay ironstone concretions.	Crops out only on Yukon River Bluff–near Louden. Consolidated gravel at bottom of Campion water well 2 is also Tertiary(?). Thickness unknown.	Good.	Birch, aspen, spruce.	Perennially frozen but with little ground ice.	Conglomerate and sand unsusceptible. Silt mantle is intensely susceptible.	Conglomerate has high bearing strength when frozen or thawed. Stands as vertical cliffs along river. Silt subject to sloughing and landsliding when thawed and undrained. Silt susceptible to gullying.	Easily excavated with power equipment except when frozen. Mixture of silt, sand, and gravel easy to compact.	Good for road and structure foundation. Conglomerate, if crushed, good for subgrade, base course, and, if screened, road metal.
Sandstone, graywacke, clay shale, conglomerate, and coal (Ks)		Yellowish-gray to dark-gray and dark-greenish-gray marine and nonmarine sandstone, graywacke, and conglomerate. Conglomerate is pebble size. Sandstone or graywacke is fine to coarse grained, thin to thick bedded, crossbedded, lenticular and argillaceous in places. Dark-gray and olive-gray clay shale and siltstone, locally yellowish orange. Local bituminous coal.	Major sedimentary rock unit forming hills on eastern and western margins of Yukon-Koyukuk Lowland. Thickness estimated 4,000 to 6,000 feet.	Good.	Lichen-covered rock rubble, heath and heath-like plants, willow. Spruce on lower slopes.	No ground ice.	Unsusceptible.	High bearing strength. Relatively steep, stable slopes.	Can be excavated with power tools but blasting may be necessary. Difficult to compact unless well-graded material.	Good for road and structure foundation on ridge tops, but may require removal of considerable amount of bedrock for road alinement. Fair on slopes. Good for road metal and fill if crushed and screened.
Intrusive rocks (TKi)		Fine- to coarse-grained, gray to dark-gray granitic rocks of acidic and intermediate composition.	Roundabout Mountain, Pilot Mountain, Mueller Mountain, and core of some of hills north of Bear Creek.	Good.	Lichen-covered rock, matted heath and heath-like plants. Some spruce, birch, aspen on hill slopes.	No ground ice.	Unsusceptible.	High bearing strength. Steep, stable slopes.	Requires blasting and heavy equipment for quarrying and crushing. Frost-rived blocks on surface easy to excavate. Difficult to compact unless well-graded material. Easy to compact if weathered zone present at surface.	Good for road and structure foundation. Good for riprap, fill, and aggregate, road metal if crushed and screened. May require removal of considerable amount of bedrock for road alinement.
Extrusive rocks (KJe)		Andesite, basalt, locally tuff, agglomerate, breccia. Includes minor amounts of graywacke, chert, shale, and impure limestone. Green gray, brown, black, rarely light gray or pinkish gray, vesicular, amygdaloidal, folded, and faulted; local columnar jointing.	Koyukuk Mountain and ridges to the north and northeast, hills northeast of Galena, and hills in the northeastern corner of mapped area.	Good. Good permeability because of jointing.	Lichen-covered rock, matted heath and heath-like plants. Spruce on lower slopes, birch and aspen on higher.	No ground ice.	Unsusceptible.	High bearing strength. Steep, stable slopes.	Can be excavated with power tools but blasting probably necessary. Difficult to compact.	Good for road and structure foundation. Good for riprap, base course, subgrade or pervious fill. Good for road metal and aggregate if crushed and screened.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1970—G49097

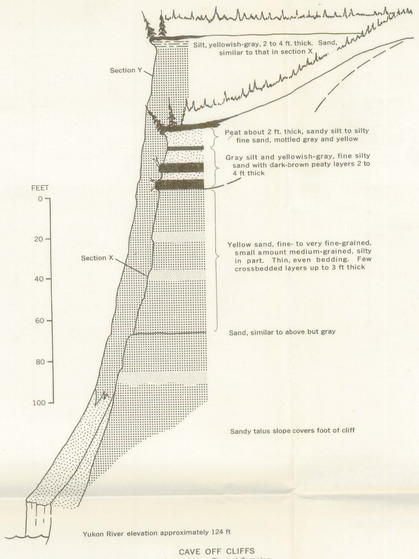
SURFICIAL AND ENGINEERING GEOLOGY OF THE CENTRAL PART OF THE YUKON-KOYUKUK LOWLAND, ALASKA

By
Florence R. Weber and Troy L. Péwé

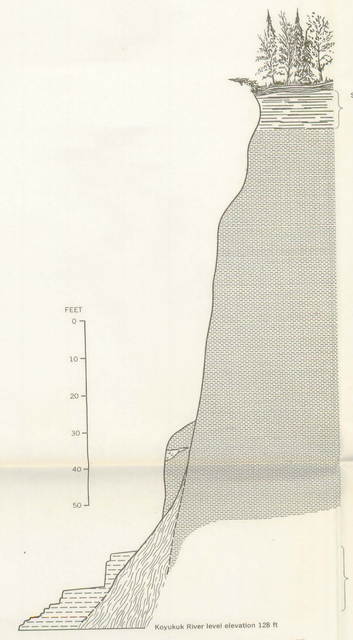
1970



SAND BLUFF
Edge of the sand-covered terrace on the Koyukuk River 17 miles above the mouth of Kateel River



CAVE OFF CLIFFS
On the Yukon River at Campion



WOODYARD BLUFF
Terrace north of the mouth of Woodyard Creek on the Koyukuk River

DIAGRAMMATIC PROFILES OF LOCALITIES ALONG THE KOYUKUK AND YUKON RIVERS

FOSSIL COLLECTIONS

[Snails and clams identified by D. W. Taylor, U.S. National Museum]

Louden Point (from 50-ft silt terrace overlying Tertiary(?) rocks)
59A Rb 41 (USGS Cenozoic loc. 23236)
Land snails:
cf. *Succinea*
Vertigo modesta (Say)
Deroceras laeve (Mueller)
Ostracods, 2 species (59A Rb 70)
Mammoth(?) radius and ulna fragment

Cave off Cliffs (Campion) (from silty sand 7 ft below the surface in north wall of canyon north of Baker Canyon—beneath two layers of peat)
59A Rb 43 (USGS Cenozoic loc. 23237)
Fresh water clam:
Pisidium lilljeborgii Clessin
Fresh water snail:
Valvata lewisi Currier
Ostracods, 2 species
Mammal bones have been obtained from peat pockets

Sand Bluff on Koyukuk River (from middle section of interbedded silt and sand terrace)
59A Rb 55 (USGS Cenozoic loc. 23238)
Fresh water snail:
Valvata lewisi Currier
Ostracods, 4 species
Charophytes
Insect parts

Woodyard Bluff on Koyukuk River (4 ft from top of 100-ft silt bluff)
59A Rb 59 (USGS Cenozoic loc. 23239)
Land snail:
cf. *Succinea*
Ostracods, 3 species (59A Rb 61—middle section of bluff)
Charophytes
Mammoth(?) femur and tusk fragments (59A Rb 62—in slump at base of bluff)

Vicinity of Point of the Rabbit (40-ft silt cutbank on Dulbi River)
59A Rb 49A
Ungulate leg bone (in slump at base of bluff)

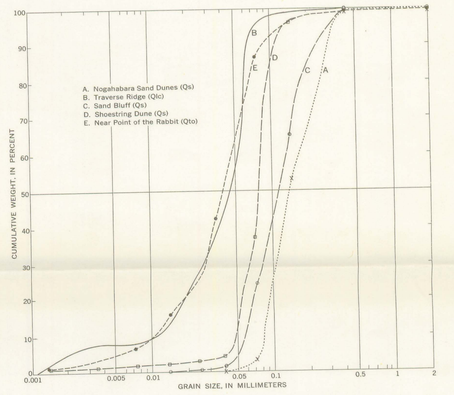
WELL LOGS

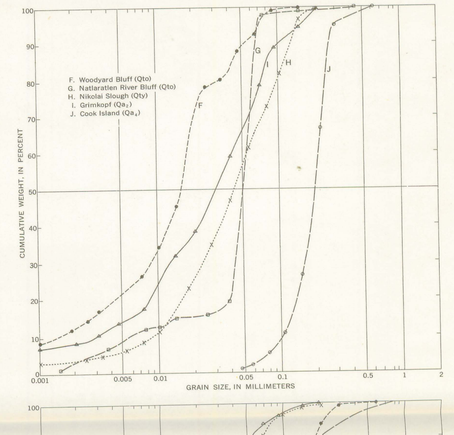
Campion water well 2 (Elev. 368 ft)

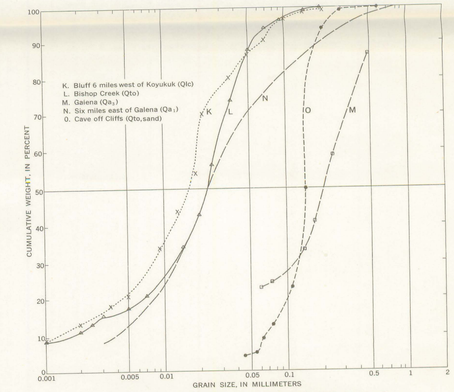
Log of well	Thickness (feet)	Depth (feet)
Silt and fill	7	0–7
Tundra vegetation	2	7–9
Silt	8	9–17
Frozen silt	285	17–302
Frozen gravel	40	302–342
Large boulders	26	342–368
Frozen silt	34	368–402
Thawed sand with water	3	402–405
Thawed gravel (water-bearing)	11	405–416
Thawed gravel (cemented, no water)	12	416–428

Galena water well 1

Log of well	Thickness (feet)	Depth (feet)
No permafrost reported		
Fill sand and gravel	32	0–32
Gravel (water-bearing)	70	32–102
"Quick" sand	70	102–172
Dirty sand and gravel	3	172–175
Very silty sand	17	175–192
Water-bearing gravel	10	192–202
Fine sand	1/2	202–202 1/2







MECHANICAL ANALYSES OF REPRESENTATIVE SAMPLES COLLECTED IN THE YUKON-KOYUKUK LOWLAND

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