## GEOLOGY OF THE

			FAIRE	BANKS (D-2) QUADRA	NGLE, AI	LASKA					
				By Troy L. Péwé							
central Alaska iles south of the cludes the Fairbea with a populat 955). Fairbanks, ty in the Territor ade center of the gically located with a ghway and railred is one of the avel. Ladd Air Fent to Fairbanks on the avel. Ladd Air Fent to Fairbanks on the avel. Ladd Air Fent to Fairbanks on the avel. The center of the greater of the g	dates from the early days of the local placer-mining camps and today provides dairy products, livestock, oats, barley, spring wheat, potatoes, garden vegetables, and other products.	tween the Brooks and Alas South of the Yukon-Tan lies the wide Tanana lowle ment-filled trough between on the north and the towe Range on the south. He fans extend northward fron tains to the Tanana flood ing the Tanana River to the north edge of the lowle Central Alaska has not ated except in small loca masses, but glaciers from Range on the north, the Al on the south, and the Yul on the east almost surr interior of Alaska durin glacial maxima. Glaciers	Loess, ranging in thickness from a few inches on summits to more than 100 feet on middle slopes, blankets the ridges 2,000 attered discher moundand ridges and winter temperatures. The absolute minimum recorded temperature is —66° F.; the absolute maximum is 99° F. The mean annual number of days with freezing temperatures is 233, and freezing temperatures is 234, and freezing temperatures is 235, and freezing temperatures is 236, and upland and, a seditate	sake of convenience. The Birch Creek and associated igneous rocks were metamorphosed, probably in more than one period of diastrophism. Subsequent events are unknown until the intrusion of granitic rocks in Mesozoic time. It is thought that the gold mineralization in the area accompanied this period of igneous intrusion.  Although the Tertiary record in the interior of Alaska is only imperfectly known, it is believed that continental Tertiary sediments with local lava flows once covered much of the Yukon-Tanana upland. Perhaps a marine embayment extended into central Alaska as far as Fairbanks in which marine or estuarine sediments were deposited. Erosion, following orogenic movements, removed most of the Tertiary sediments from the upland during later Tertiary time.  A complex series of events took place in Quaternary time. The deposition and erosion of silt and gravel, the formation and destruction of permafrost, and climatic fluctuations ranging from a climate warmer than that which exists now to one colder than the present. In early Quaternary time gold placers were formed in creek valleys of the upland; later, much gravel alluviation occurred in these valleys. This early period of gravel deposition was followed by erosion and removal of most of this coarse angular local gravel. Streams reconcentrated much of the gold in the earlier placers and deposited additional gold placers. Most of the stream channels of the second gold concentration are offset from the location of the earlier channels, and,  D E S C R I P T I O N O F G E O L 6.	Quaternary time the hills ted with loess derived from ain of the Tanana River outwash plains south of ks D-2 quadrangle. Much dblown silt was retransalley bottoms, incorporated organic debris, includate remains, and became frozen. Much of the loess the valley bottom silt was ring a later erosional period iately preceded Wisconsins thought that permafrost perhaps disappeared durm interval. Uniternary time more loess ed on the hills and valleys nd; organic silts accumuley bottoms, became frozen, ground-ice masses formed. In the manner of the manner of the manner of the count of the placer excavate fairbanks loess from the count in the placer excavate fairbanks. Excellent of the count of the count of the placer excavate fairbanks. D-2 quadranally on Gold Hill, 8 miles irbanks, and in the center of the count of the count of the count of the count of the placer excavate fairbanks, and in the center of the count of the count of the count of the placer excavate fairbanks, and in the center of the count of the c	west of Fairbanks.  During Quaternary time the sediment fill of the Tanana Valley probably was also modified by alternating periods of erosion and deposition and the formation and destruction of permafrost; however, information is not available to permit reconstruction of a detailed history.  GENERAL FOUNDATION  CONDITIONS  In addition to considering conventional foundation problems, engineers in this area must also consider problems caused by permafrost and intense seasonal frost action. Foundation conditions are good in the areas where igneous rock is exposed and fair to good on Birch Creek schist. Most of the sediments would provide fair to good foundation if they were in the temperate latitudes; however, in this area the widespread blanket of silt is subject to intense seasonal frost action, especially where poorly drained, and special precautions must be taken for construction of roads, airfields, bridges, unheated buildings, and structures on piers or piling to prevent frost heaving. In addition to removing the fine-grained material or improving the drainage, it is locally possible to anchor the foundation in the underlying permafrost to overcome the effect of frost action.  Permafrost is one of the most important factors to consider when evaluating foundation conditions in this area. Permafrost, or perennially frozen ground, is defined as soil or bedrock in which a temperature below freezing has existed continuously for a long	of texture, degree of induration, water content or lithologic character. The destructive action of permafrost has materially impeded the development of the far northern part of the continent. Engineering structures have been extensively damaged because the existence and condition of the frozen ground was not known prior to construction and the behavior of frozen ground was little understood. Stripping of the insulating vegetation cover from the frozen ground in preparation for construction or farming disturbs the thermal regimen and causes thawing of permafrost. As the ground thaws the foundations settle differentially causing great damage to structures. If the type and extent of permafrost is known, it is possible to evaluate the problem and determine whether to thaw the ground prior to construction or use a more passive method and attempt to leave the permafrost undisturbed and frozen so that it will form a firm foundation.  Permafrost in the Fairbanks D-2 quadrangle is of two types: 1) continuous perennially frozen silt with large ice masses, and 2) discontinuous permafrost in silt, sand, and gravel with relatively low ice content and no large ice masses, and 2) discontinuous permafrost in silt, sand, and gravel with relatively low ice content and no large ice masses, The perennially frozen fine-grained sediments (Qs, Qsu, Qso, and Qp) present many foundation problems, but the frozen coarsegrained sediments cause relatively little trouble.  The Fairbanks D-2 quadrangle lies in a major earthquake zone. In 1937	Muller, S. W., 1945, Permafrost permanently frozen ground and related engineering problems: U. Geol. Survey Special Rept., Streic records, post-post for Engineers, U.S. Army. Also lith printed by Edwards Brothers, A. Arbor, Mich., 1947, 231 p.  Péwé, T. L., 1952, Preliminary reponent activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hstand major earthmark activity in the at buildings should hat activity			
GEOLOGIC	DISTRIBUTION and	TERRAIN	DRAINAGE and	(See explanation on facing page for litho	SUSCEPTIBILITY	BEARING STRENGTH	EXCAVATION and COMPACTION	POSSIBLE USE			
UNIT Flood plain alluvium (Qal)	THICKNESS  Covers most of southern one-half of quadrangle. Surface layer of silt 1 to 15 ft thick. Total thickness of alluvium adjacent to bedrock hills 1-200 ft; up to approximately 700 ft thick near Tanana River.	NATURAL SLOPES  Flat plain with meandering streams and complex network of shallow swales.	locally in silt or where perennially frozen. Drain-	Depth to permafrost 2-4 ft in older parts of flood-plain and more than 4 ft on inside meander curves near river. Depth to perm frost 25-40 ft in some cleared areas. Permafrost absent in maraeas, esp. beneath lakes, rivers, and creeks. Active layer 2 ft thick. Permafrost 5-265 ft thick. Permafrost discontinuoun frozen lenses, layers and vertical zones. Low ground-content; mostly interstitial. Water table 10-15 ft where permafrost is absent or deep.	na- tense; sand and ny gravel: unsuscep- z-8 tible. us; ice	SLOPE STABILITY  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 1:1 to ½:1 except in unfrozen sand.	Easily excavated with power equipment except where perennially frozen. Difficult to compact. Very little or no subsidence of ground upon thawing of permafrost.	grade, base course, and if crushed and screened, for roa metal, concrete aggregate, and railroad-engine sand Source of tremendous quantities of ground water. Surfact silt fair to good for agricultural soil if fertilized.  Poor for construction foundation or fill. Should be removed if possible, prior to construction. Possible source of			
Floodplain swale and slough deposits (Qs)	Widely distributed in a complex drainage network on flood- plain in southern one-half of quadrangle. Thickness gen- erally less than 15 ft; maximum probably 30 ft.	Elongate, sinuous, flat- floored meander and slough scars and wide shallow basin-like areas. Some intermittent streams present.	Impermeable substratum of permafrost and organic silt in broad basin-like depressions creates poor drainage; marshy and undrained in summer. Drainage slightly better in linear scars. Drainage in both type areas improves slightly to moderately with land clearing and lowering of permafrost table. Subject to flooding.	In broad basin-like areas depth to permafrost 1½-2 ft. Actilayer 1½-2 ft thick; permafrost 5-30 ft thick and continuous High ground-ice content of small segregations. May be in contact with underlying permafrost of Qal. In sinuous linear scategory to permafrost 2-4 ft or absent. Active layer 2-4 ft thick Permafrost 5-30 ft thick with high ground-ice content of sm segregations. Water table 10-15 ft where permafrost absorb deep.	us. on- ars ck.	High bearing strength when frozen; very low when thawed. Slopes subject to sloughing and land-sliding upon thaw- ing until well or moderately drained.	Very difficult to excavate unless thawed. When thawed viscous sediment slides into excavation. Difficult to compact. Moderate subsidence of ground upon thawing of permafrost.				
Fairbanks loess (Qf)	Widespread on hill slopes in northern one-half of quadrangle.  Thickness ranges from 3 ft on upper hill slopes to a maximum of 200 ft on middle slopes and low hill tops. Not mapped on most hill tops and upper slopes, where it exists as a veneer less than 3 ft thick.	and low rounded hills. Old, slightly subdued parallel gullies and ridges at right angles to contours characteristic of most upper slopes.	Good surface drainage. Lateral permeability poor to fair; vertical permeability good.		Mild to unsusceptible; locally intense if drainage poor.	original position; very low when wet. Will stand in near vertical slopes. Extremely susceptible to gullying; freshly exposed surfaces susceptible to wind \$768168.	Easily excavated with hand tools. Difficult to compact.	Source of fines, possible source of impervious fill. Goo foundation for heated buildings if protection provide against gullying. Unsurfaced roads unstable—powder when dry; plastic and sticky when wet. Good agriculture soil if fertilized.			
Perenially frozen undifferentiated silt, (Qsu)	Widespread on lower hill slopes and creek valley bottoms in northern one-half of quadrangle. Thickness 3 ft to maxi- mum of 313 ft.	Very gently sloping alluvial fans and colluvial slopes; broad alluviated creek valley bottoms with small lakes.	III valley bottoms, dicases poor di dinase, indiase,	layer 1½-4 ft thick. Permafrost 3 to at least 176 ft thick; pinc out upslopes; continuous except under lakes and near cont with Fairbanks loess (Qf). Ground-ice abundant as horizon	ches cact ntal ular net-	dry very low when wet or thawed.	successful. When thawed viscous sediment slides into excavation except near contact with Fairbanks loess (Qf) or on low hills. Difficult to compact. Great differential ground subsidence upon thawing of permafrost; formation of thermokarst mounds 10-50 ft diameter and 1-10 ft high	frost table. Source of fines; possible source of impervious			
Silt composing fans over flood-plain alluvium (Qsf)	Four areas: 1) sec. 5, T. 1 S., R. 1 E.; 2) secs. 1, 2, T. 1 S., R. 2 W.; 3) sec. 15, T. 1 S., R. 2 W.; 4) sec. 32, T. 1 S., R. 2 W. Thickness: trace to probably 30 ft.	Gently sloping alluvial fans from loess-covered hills and overlying flood plain alluvium.	Surface and subsurface drainage generally fair to good, especially after land clearing and lowering of permafrost table. Permeability moderate.	Depth to permafrost 3-25 ft. Active layer 3-4 ft thick. Permafr 2-30 ft thick and in contact with underlying permafrost of Discontinuous. Ground-ice content low to moderate, mai interstitial. Water table 15-30 ft where permafrost absent deep.	inly	High bearing strength when frozen or dry; low when wet or thawed unless well drained. Subject to sloughing and land sliding when thawed and undrained; when drained stable at 3%:1 to 1:1. Susceptible to gullying.	except where perennially frozen. Difficult to compact.  Little to moderate ground subsidence upon thawing of permafrost.	Good foundation for heated structures. Unsurfaced roa unstable—powdery when dry; plastic and sticky whe wet. Good agricultural soil if fertilized.			
Perennially frozen organic silt (Qso)	Four areas: 1) secs. 32, 33, 34, 35, T. 1 N., R. 1 W; 2) sec. 23, T. 1 N., R. 2 W.; 3) sec. 18, T. 1 N., R. 1 W.; 4) secs. 4, 8, 9, T. 1 N., R. 1 W. Thickness: 50 to more than 100 ft.	sided cave-in-lakes and a pattern of trenches 1-4 ft deep and 2-5 ft wide in a polygonal network.	ganic soil creates very poor drainage; marshy and undrained in summer. Land clearing pro- duces summer quagmire. Permeability poor.	lakes. Ground-ice very abundant as small segregations large polygonal ice masses 1½-10 ft beneath surface. Watable below permafrost.	nder and ater	High bearing strength when frozen; very low when thawed. Slopes in cuts subject to sloughing and landsliding upon thawing.	erately successful. When thawed viscous sediment slides into excavation. Difficult to compact. Great differential subsidence of ground upon thawing of permafrost.	agriculture. Good for mosquito studies!!!			
Perennially frozen peat (Qp)	Three small areas in secs. 32 and 33, T. 1 N., R. 1 W. Thickness more than 20 ft.	Flat oval-shaped peat- filled lake basins.	Impermeable substratum of permafrost and or- ganic material creates very poor drainage; marshy and undrained in summer. Land clear- ing produces summer quagmire. Permeability poor.	lakes. Ground-ice very abundant as small segregations. Wa	nder	High bearing strength when frozen; very low when thawed. Slopes in cuts subject to sloughing and landsliding upon thawing.	erately successful. When thawed viscous sediment slides	Very poor foundation for construction of any sort. Poor f agriculture. Good source of raw peat in thawed areas; exc vation pits generally need dewatering for peat extraction			
Creek gravel (Qg) (including tailings)	Exposed as placer mine dredge tailings on upper Goldstream Creek and tributaries, Gold Hill, Ester Creek, Cripple Creek, and Sheep Creek. Borings indicate buried gravel under Qsu in most drainage ways in northern one-half of quadrangle. Thickness: 3 to 250 ft.	symmetrical gravel piles forming rough terrain	Excellent drainage and permeability except locally where perennially frozen.	Locally perennially frozen. Low ground-ice content.	Unsusceptible	High bearing strength. Slopes generally stable at 1:1.	Easily excavated by power tools. Relatively easily compacted	Good foundation for any structure if tailing piles level.  Good for subgrade, ballast, rip rap, pervious fill, and crushed and screened, good for base course and aggregation.			
Basalt (Tb)	Three small areas: secs. 3, 4, 14, T. 1 S., R. 1 E. Maximum thickness probably 200 ft.	Moderate to steep slopes.	Good surface drainage. Well-developed joints result in low to fair permeability.	No permafrost.	Locally mildly sus- ceptible when weathered.		Pillow lavas easily excavated with power tools; little or no blasting necessary. Columnar basalt requires blasting Difficult to compact.				
Altered dike rock (ad)	Small isolated deposits at extreme northern edge of quadrangle and sec. 3, T. 1 N., R. 1 E. Probably less than 10 ft thick.	Gently rolling topography.	Good surface drainage. Low permeability.	Possible local permafrost.	Unsusceptible	slopes.	Weathered material easily excavated with power tools non-weathered requires blasting. Difficult to compact.	Minor source for road base course material and road me without crushing.			
Granite (gr)	One small elongate area sec. 3, T. 1 N., R. 2 W. Thickness at least 500 ft.	Forms rounded ridges and hill tops.	Good surface drainage. Low permeability.	No permafrost.	Unsusceptible	slopes.	Weathered material easily excavated with power tools non-weathered requires blasting. Difficult to compact.	concrete aggregate without crushing. Fresh rock go for rip rap or pervious fill.			
Quartz diorite (qd)	Comprises most of Approach Hill sec. 9, T. 1 S., R. 1 E. Thickness at least 100 ft.	hill tops. Steep slopes adjacent to Qal.		No permafrost.	Unsusceptible	slopes.	Weathered material easily excavated with power tools non-weathered requires blasting. Difficult to compact.	concrete aggregate without crushing. Fresh rock go for rip rap or pervious fill.			
Birch Creek schist	Exposed on steep faces; also mapped on hill tops and steep slopes in northern two-thirds of quadrangle where a veneer	Rounded gently rolling topography. Steep slopes	Surface drainage good to excellent. Joints, faults, fracture cleavage, and foliation result in poor to	No permafrost except locally under Qsu and Qg in valley botto or on north-facing slopes. Low ground-ice content. Water to	oms Locally moderately able susceptible in	High bearing strength in gneissic facies; stands in vertical cuts. Schistose facies	Schistose facies easily excavated with power tools with only little to moderate blasting; gneissic facies requires additional blasting. Posistont leaves a constant of the constant leaves and the constant leaves are constant leaves are constant leaves and the constant leaves are constant leaves are constan	Gneissic facies good for rip rap and ballast, and coar aggregate; if crushed, good for base course, and ro			

SAMPLE DESCRIPTION OF MATERIAL																				L	ABORA	TOR	YTE	STS1													
Location 5 (A-abundant, N-numerous, F-few)					MECHANICAL ANALYSIS													PRO	PERT	IES			MOISTURE CONTENT														
ion be				pe	mat																		nit weig	ht					Unfrozen			Frozen					
letth lon Sect		llect	c for										H .	ical		Cuit	ion	reles	imit		8				Permafrost			Seasonal frost <sup>a</sup>									
Sample	Range	Section 14 Secti	1/2 of 1/4	Date or	Geologi	Colmito	Calcite Chlorite Chlorito Chlorito Clinozoi Epidote Feldspau Garnet Hornble Hyperst Muscovi Opaque Quartz Rutile Sphene Tourma Tremoliti		1.65	0.833		_		0.050 0.022 0.005			8		Specific gravity	Maximu density lb/cu ft	Theoret density lb/cu ft	Percent voids Loose	Dry	rodded Adsorpt percent	os A orași orcer	Liquid 1	Plastic	Plasticit	Percent by dry weight Depth sample		of le	Percent by dry weight	Depth of sample	Percent by dry weight	Depth of sample	Date of collection	
A 1S	1W	6 NE	sw	7-21-	47 Qf		(See inset block for sample A)	H 1																													
B 1S	2W	5 SW	NE	9- 2-	49 Qsu		F F N F A F	F F	100	100	100	100	90 72	38	3		(4)																				
C 1S	1W	1 NW	NE	8- 5-	47 Qf	I	F F F A F F F A	F F	100	100	100	100	96 89	40	8		(5)																				
D 1S	1E 1	14 SW	SW	8- 2-	47 Qf		F F N F F N F A F F	F F F	100	100	100	. 100	96 82	39	4		(5)																				
E 2N	tremata.	200	100000		49 Qf		F F F N F F N F A F F	FF	100	100	100	100	98 98	3 41	6		(4)																				
F 1S		_					Loess						93.2 82	2.0 44	1.5 19.	0	(6)		2.81	105.9	120.0	8.78				627.5	622.6	8 5.2	18.0	2 ft	No	o permafrost		17.29	1 ft	1-24-	
G 18							Silt						98.46 9:	1.5 48	3.0 12.	0	( 6 )		2.45	103.6	109.4	9.4				<sup>6</sup> 24.1	*19.4	64.7	25.90	3 ft 6	in	ND	ND	30.81	1 ft	1-24-	
H 1N				100000000000000000000000000000000000000			Silt						95.30 93	2.0 56	5.0 22.	5	( a )		2.34	108.0						629.7	623.0	66.7	17.0	2 ft 6	in	52.6 738.6	16 ft 7 40 ft	36.24	1 ft	1-24-	
I 1N							Peat												ND	ND		ND				ND	ND	0.00	641.00	1 ft 5	in	826.00	2 ft 1 in	1176.00	1 ft	1-24-	
J 1S		_					River silt						92.73						2.50	89.8	101.2	8.87				25.6	0.00	0.00	ND	ND	)	ND	ND	ND	ND		
K 1N			-		1000		Peat												ND	ND	ND	ND				ND	ND	ND	804.0	1 ft 6	in	ND	ND	ND	ND		
L 1N		_	-	-			Organic silt			95.3	80.0	80.0 60.2 44.0		0.35	22.0		Organic e	ontent (	loss by ig	nition) 5	54.03 % <sup>6</sup>			274.5	1 ft		141.0	1 ft 8 in	315.0	1 ft	1-24-5						
M 1N	ACCUMUNCT NO.	44	- 1-07/2011	100000000000000000000000000000000000000	A4000		Silt						99.1 91	1.0 68	6.6 17.	0	( a )		2.00	85.2	85.2					634.3	<sup>5</sup> 26.8	6 7.5	42.6	1 ft		93.9	1 ft 6 in	56.32	10 in	1-24-56	
N 1N	_		-	_			Loess						98.6 78	3.5 36	3.0 13.	0	(6)		2.60	102.0	104.7	9.7				624.7	622.9	6 1.8	11.4	2 ft 6	in No	o permafrost	No permafrost	16.28	11 in	1-24-5	
0 1S	1W 1	5 SW	NE	10-10-	55 Qs		Organic silt						99.6 98	3.0 76	.0 18.	8	(6)		1.70	84.6	97.2	8.7				646.0	634.2	<sup>8</sup> 12.8	52.5	1 ft 6	in	61.0	3 ft	74.00	1 ft 1 in	1-24-5	
			Percen									ercent smaller than size units in millimeters															Heavy-mineral analysis			sis of sample	of sample A <sup>10</sup>						
															.39 4.70 1.65 0.4		0.417 0.175 0.074										Mine		ıl	Numerical fr in percer				FOOTNOTES			
P 1S						River 5%,	gravel; quartz 50%, gneiss 25%, schist 6%, diorite 3%, others 5%.	chert 6%, slate	Before crush	91.1	84.9	74.0	60.2 46	.8 35	.2 30.	24.0	7.5	6.6	2.63	109.1	124.7	3.8 NI	) Ni	D 1.32		25.6	Opaqu Zoisite	e miner	als	37.0 10.3	10	<ul> <li>All laboratory tests, unless otherwise indicated, by the Fairbanks District of the Alaska Road Commission, Department of the Interior</li> <li>Analyses by Marie L. Lindberg, U.S. Geological Survey, Washington D.C. Much-altered grains of low index assumed to be altered.</li> </ul>					
Q 2N		100	17000000	-	1000		to coarse-grained white limestone*.			100	100	98.6	86.2 51	.0 21	.5 10.	5 5.8	4.5	3.1	92.87			NI	) NI	0	23.8		Hornb	lende		10.1							
R 1N		_		10-11-	55 Qg	Grave	; schist 45%, quartz 29%, gneiss 26%.		100		94.7	90.7	76.9 56	.7 29	.9 14.	9 5.7	3.7	2.3	2.57	137.7	142.5	.6 99.	0 112	.0 1.17	38		Garnet 9.6 Epidote 7.2					feldspa	ir.	Dates TI C C	-1i1 C	T2-/-b	
S 1N	0.000	Section 2012		JA: 131. 1943 97.70	55 p€b		, compact sericitic schist, light gray with iron	staining.	100	100.0	86.0	71.39	60.32 47	.43 33	.08 21.	64 10.54		4.55	2.33	100.00	ATTACABLE DATE	ID 89.	ALC: NAME OF STREET	200	38.75		Unkno	wn frag	ments	6.0 3.8		Alaska	content by R. A	Faige, U.S. G	eological Surve	y, Fairban	
T IS					100		micaceous slaty schist to slate.		100				70.7 60		100				10-00-00	ND	ND 1	ID 97.	2 114.	0 1.14	34.60		Augite			3.1		4Analyses	by Permafrost	Division, St. I	St. Paul Office, Corps of Eng		
	_	-	-	_	_	River	gravel.		Before crush	100	95.4	81.0	65.8 50	.5 32	.9 27.0	24.4	9.9	6.7	2.66			102,9	126.	0		27.6	Tourm Hyper	aline sthene		2.8 2.6		neers, U.S. Army, Fairbanks, Alaska. <sup>5</sup> Analyses by Rock Island Office, Corps of Engineers, U.S. Arm Rock Island, Ill.					
V IS						cite,	intersertal texture; olivine, labradorite, pyro tachylyte, plagioclase, and palagonite.	xene, iron, cal-	100	93.5	72.4	56.2	42.6		.3 21.			5.1	2.61	2007		ID 92.		Star Property			Zircon Apatit Rutile	e		1.9 1.4 0.7		<sup>6</sup> Analyses by Frost Effects Laboratory, Corps of Engineers, I Army, Fairbanks, Alaska.					
W 1S	1E	9 SW	SW	10-10-	55 qd	orth	olored, medium-grained, granodiorite, quar- oclase, andesine, biotite, pyroxene, chlorite, zircon.	tz, microcline, iron minerals,	100	95.0	70.8	55.4	42.5	22	.0 20.1	8.3	6.3	4.8	2.54	ND	ND N	D 91.0	49.	5 2.40	24.4		Enstat Tremo	lite		0.2 0.2		Moisture content by Dr. E. B. Rice, University of Alaska. Sam collected by Maurice Butler, Fairbanks, Alaska.					
X 1S	1E 1	4 SW	NW	10-10-	55 Tb	Basalt	zircon.  , black; olivine, labradorite, plagioclase, pyro: and tachylyte.	xene, iron, cal-	100	93.0	74.6	53.2	45.6	25	.0 16.	5 9.7	7.9	6.5	2.47	ND	ND 1	ID 90.	0 109.	2 2.36	19.0		pern	Separation made with acetylene tetrabromide; permanent mount made in Canada balsam; 415 grains counted. Opaque minerals approximately 70 percent magnetite and ilmenite.  *Chemical analyses by Henton 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination 16.67%; CO <sub>2</sub> —42.52%; Si *Determination by W. F. Attraction 16.67%; CO <sub>2</sub> —42.52%; Si *Determination 16.67%; CO <sub>2</sub> —42.52%; Si *Determination 16.67%; CO <sub>2</sub> —42.52%; Si *Determination 16.67%; CO <sub>2</sub> —42.52%; CO <sub>2</sub> —42.							Al <sub>2</sub> O <sub>3</sub> and F	$e_2O_3-0.39$	

weathered rock. | high bearing strength if horizontal or | tional blasting. Resistant layers more easily excavated | metal; only fair for concrete aggregate. Schistose facies

ing strength. Susceptible to sliding and erately difficult to compact.

slumping along joint, cleavage, and foli-

ation planes, esp. sericite-laden planes.

vertical; dipping beds moderate bear- where interbedded with schistose rock. Difficult to mod- fair for base course material without crushing; breaks

High bearing strength. Steep stable Blasting and power tools necessary. Difficult to compact. Good for foundations and fill and if crushed, concrete

down to silt by traffic and frost action.

aggregate; for agriculture if finely ground. Estimate at least 100 tons present.

fair permeability. Upper weathered layer 1 to generally deep.

more than 50 ft thick has low permeability.

of less than 3 ft of loess is present. Probably underlies sur- adjacent to Qal.

Limestone Four small deposits: 1 and 2) sec. 36, T. 2 N., R. 1 W.; 3) Steep slopes along valley Good surface drainage. Lower permeability. No permafrost.

ficial deposits in nearly all the quadrangle. Thickness at

lower left limit of O'Conner Creek; 4) lower left limit of Moose Creek. Thickness at least 100 ft.

