Accompanies
Preliminary geologic map of Seattle and vicinity, Washington
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GENERALIZED DESCRIPTION OF ENGINEERING PROPERTIES OF MAP UNITS

MAP UNIT	SPECIAL FEATURES	DRAINAGE	GROUND WATER	EASE OF EXCAVATION	FOUNDATION STABILITY	SLOPE STABILITY	SEISMIC STABILITY	REPORTED OR POSSIBLE USE	SOIL TYPES[1]
Artificial fill	----------	Highly variable	Highly variable	Highly variable	Highly variable, may be highly compressible and have low supporting value	Highly variable	Very poor. Maximum destruction during quake of April 1949 occurred on fill and alluvium	----------	Highly variable
Alluvium Qa	May contain interbedded peat and muck	Runoff generally poor[2] because of low slope. Infiltration moderate to very slow. Susceptible to flooding	Water table near surface. Permeability variable	Generally easy to excavate with hand or power equipment. Can generally be dredged	Fair; may settle excessively and irregularly because of layers of compressible organic material	Generally poor because saturated. May stand in steep cuts for short periods where above water table	Same as above	Fill. Source of topsoil for lawns and gardens. Alluvium in Duwamish Valley contains glassy volcanic material probably reactive in high-alkali concrete	SM, ML, OL.
Beach deposits Qb	Generally thin	Runoff generally poor. Infiltration moderate to fast	Water table near surface. Permeability moderate to high	Same as above	Highly variable. May contain compressible layers of organic material	Generally poor because saturated	Poor to fair	Fill	SP.
Peat Qp	Highly mobile; low shear strength. Water content may be as much as 10X dry weight. Generally is acidic. Includes inorganic clay and silt	Runoff poor, unit occupies closed depressions. Infiltration moderate where dry, but generally saturated. Seasonal flooding common	Water table usually at or near surface. Permeability variable	Generally easy to excavate with hand or power equipment. Can generally be dredged. May contain large criss-crossed logs	Very poor. Will settle excessively under load. Low bearing capacity	Not generally found on natural slopes. Cut slopes variable. Peat in upper few feet of deposit will stand in steep cuts; lower peat may run freely when wet	Very poor	Source of organic material for topsoil beneficiation	Pt.
Landslide deposits Ql	Includes intimately mixed material from various units, and discrete blocks of various units	Runoff poor. Slide movement typically produces closed depressions. Infiltration slow. Springs very common	Water table generally close to surface. Permeability generally low	Generally easy to excavate with hand or power equipment	Mostly unsuitable. Correction measures needed	Both natural and cut slopes generally unstable	Very poor	----------	
Lacustrine sediments Qsc	Mostly mixtures of silt, clay, and fine sand, but may contain organic material	Runoff generally poor; materials occupy closed depressions and have low surface slope. Infiltration slow	Water table within a few feet of ground surface. Permeability low	Generally easy to excavate with hand or power equipment. May be cohesive	Generally poor to fair. May contain compressible layers	Not generally found on natural slopes. Will stand in steep cuts for long periods if dry, but deposits generally are wet and will stand for only short periods	Poor to fair	----------	Chiefly ML., but locally may include CL and OL.
Younger sand Qys	Generally well sorted, poorly graded loose sand. Where unit overlies impermeable material, springs near base cause erosion and subsequent sliding of sand	Runoff poor to fair on natural surfaces, poor where vegetation and soil have been removed. Infiltration moderate on natural surfaces, fast on newly cut surfaces. Springs common near base and above silty layers	Presence depends on topography and underlying material. Contains perched ground water in lower part in many areas. Permeability high	Generally easy to excavate with hand or power equipment. Noncohesive	Fair to excellent; best on areas of little or no slope. Little settlement expectable	Generally unstable on slopes steeper than about 30°. Subject to severe rain-wash erosion and gullying. May stand in steep cuts for short periods	Good	Fill, sand for concrete	SP, SM, SW.
Younger gravel Qyg	Same as younger sand	Runoff poor. Infiltration moderate on natural surfaces, fast on cut surfaces. Springs common near base	Same as younger sand	Same as younger sand	Same as younger sand	Generally unstable on slopes steeper than about 30°. May stand in steep cuts for short periods	Good	Road metal, concrete and asphalt aggregate, fill	GW, GP, SP.
All surficial formations below have been overridden and compacted by one or more glaciers at least 3000 feet thick									
Vashon till Qt	Intimately graded mixture of clay to gravel sizes. May contain local lenses of sand and gravel. "Hardpan" of common usage. In some areas till is thin and consists of loose silty sand and gravel. Elsewhere till is thick; characteristics in table refer to till where it is more than 5 feet thick	Runoff variable. Undrained and poorly drained depressions common. Runoff good on steeper slopes. Infiltration very slow	Height of water table depends on topographic position. Permeability very low except in contained lenses of sand and gravel	Very difficult to excavate with hand or light power equipment. Dense, tough, and cohesive. Generally lacks bedding or extensive fracturing	Excellent. No settlement expectable	Stands in steep natural and cut slopes for long periods. May ravel and spall by wetting and drying, and freezing and thawing	Good	Fill	GW-GM, GW-GC.
Older gravel Qog	Generally uncemented. Physical characteristics fairly consistent vertically and laterally. Where unit overlies impermeable material, springs near base cause erosion	Runoff fair on natural surfaces; poor where natural vegetation and soil have been removed. Infiltration moderate on slopes with natural cover of soil and vegetation, but fast where these have been removed. Springs common near base and above silty layers	Same as younger sand	May be excavated with hand or light power equipment. May be partly cemented locally	Generally excellent, but may be poor on slopes that approach angle of repose of material	May stand in steep slopes for short period. Generally unstable on slopes steeper than about 30°, except where silt or clay binder present. Slope failures usually extend to depth of only a few feet	Good	Road metal, concrete and asphalt aggregate, fill	GW, GP, SP
Older sand Qos	Generally uncemented. Physical characteristics consistent vertically and laterally over broad areas. Where unit overlies impermeable material, springs near base cause erosion	Same as older gravel	Generally contains unconfined water. May be perched. Permeability high	Same as older gravel	Same as older gravel	Same as older gravel. Scattered silty beds stand in steep cuts. Subject to gullying	Good	Fill	
Older clay till and gravel Qc	Much vertical and lateral variation of physical properties is characteristic. Interbedding of materials with very different size range and engineering properties also characteristic	Runoff variable. Infiltration slow. Seeps common	Generally contains water, much of which is under high hydrostatic head. Permeability generally low to medium, but variable, depending on texture	Highly variable. Generally difficult to excavate with hand or light power equipment Compact and cohesive. Till lacks bedding or fractures	Fair to excellent. Dependent on local conditions of slope and ground water conditions	Highly variable. Till, silt, and clay may stand in steep cuts. Abundant silt and clay together with contained water under high hydrostatic head results in low natural slopes. Shear strength of silt and clay indicated by laboratory tests may not be strictly applicable to field conditions owing to fracturing. Especially subject to landsliding. Rebound reported in silt and clay	Good	Fill, clay products. Some interbedded sand contains material probably reactive in high-alkali concrete	
Sand and gravel lenses in older clay, till, and gravel Qcg	Lenticular and of local occurrence. Partly stained and cemented with iron oxides	Springs very common	Generally contains water, much of which is under high hydrostatic head. Permeability medium to high	Generally difficult to excavate with hand or light power equipment. Locally cemented	Good to excellent. Dependent on slope, drainage, and especially, contained ground water under high hydrostatic head	Partly cemented. Generally will stand in steep cuts. Covered by landslide debris in many areas	Good	Fill	
All formations below are bedrock									
Sedimentary rocks of Oligocene age Tb	Generally cemented but may be weathered near surface. Contain some opal cement	Runoff excellent. Infiltration slow. Few springs	Permeability low	Firmly cemented. Blasting or heavy power equipment required for excavation	Excellent, but subject to limitations of slope. No settlement expectable	Stands for long periods in steep natural and artificial cuts. In places, weathered and soft at surface. Dip of beds may affect slope stability	Good	Fill, riprap	
Renton formation Tr	Generally cemented, but contains uncemented beds	Same as above	Same as above	Same as above	Same as above	Same as above	Good	Fill, riprap, coal clay products, foundry sand	
Tukwila formation Tt Tta	Generally cemented. May be weathered near surface; contains volcanic tuff beds that are weathered	Same as above	Same as above	Same as above	Same as above	Same as above	Good	Riprap, fill	
Sedimentary rocks of middle Eocene age Td	Partly cemented	Same as above	Same as above	Same as above	Same as above	Same as above	Good	Fill	
Intrusive rocks Ti	Predominantly firm, hard rock, but contains zones partly altered to clay, and veins of clay and calcite	Same as above	Ground water only in fractures	Same as above. Breaks along conjugate joints	Excellent	Excellent	Good	Riprap, fill, ballast, crushed for road metal and concrete and asphalt aggregate, residential rockwork	

1 Unified Soil Classification group symbol; only most abundant soil types indicated.

2 Terms used to describe relative rates of infiltration are fast, moderate, and slow; permeability expressed as high, medium, and low; and other characteristics are expressed as excellent, good, fair, and poor.

Washington State (Seattle area). Geol. 1:24,000. 1961.
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