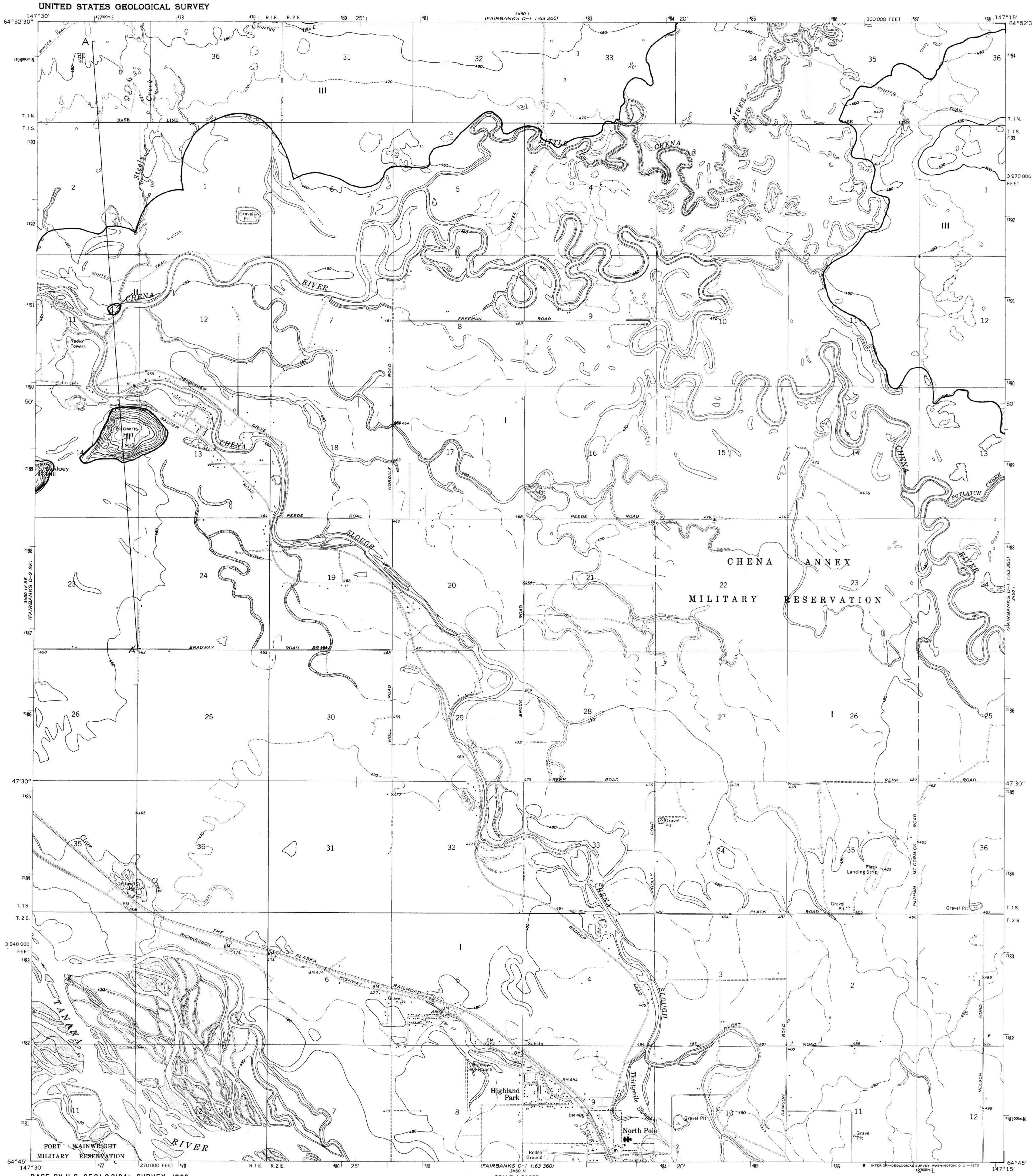
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF– 671B



BASE BY U.S. GEOLOGICAL SURVEY, 1966

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

MAP SHOWING GROUND WATER CONDITIONS IN THE FAIRBANKS D-1 SW QUADRANGLE, ALASKA

BY
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INTRODUCTION

The primary controlling factors determining ground-water conditions in the Fairbanks D-1 SW quadrangle are (1) topographic position, (2) water-bearing characteristics of the rocks, and (3) distribution of permafrost. These interrelated factors generally limit the conditions in any particular area.

Basic data from the geologic map of the Fairbanks D-1 SW quadrangle (Map I-949, Péwé and others, in press), the map showing distribution of permafrost in the Fairbanks D-1 SW quadrangle (Map MF-671A, Péwé and Bell, 1975a), and the map showing foundation conditions in the Fairbanks D-1 SW quadrangle (Map MF-671D, Péwé and Bell, 1975c) have been used in conjunction with well data to establish generalized potential ground-water conditions.

OCCURRENCE OF GROUND WATER

Tanana-Chena flood plain

The deposits of the flood plain of the Tanana and Chena Rivers consist of alternating layers of alluvial silt, sand, and gravel. The alluvium is generally very permeable, so the occurrence of ground water is controlled by the distribution of permafrost. Permafrost is discontinuous; there is no consistency as to where permafrost will be found, but it is generally absent beneath the younger sloughs and meander scars, on the inside of river meander curves (slip-off slopes), and under present rivers. Maximum known thickness of the permafrost is as much as 275 feet; depth to permafrost is generally 2-4 feet but may be 25-40 feet under cleared areas.

In unfrozen areas the water table is normally 10-15 feet below the surface. In perennially frozen areas, ground water occurs above, within, and below permafrost. The sporadic occurrence of permafrost accounts for the differences in character of wells that may be very close together.

Because the perennially frozen alluvium serves as an impermeable layer, water movement is restricted to circulation near the surface. This frequently results in poor water quality because of the high potential for contamination of the near-surface water by man.

Unfrozen layers and lenses within the permafrost bodies contain ground water that is less susceptible to contamination than the water above permafrost. The movement of water through the intrapermafrost zones is generally dependent upon the subsurface stratigraphy (as well as the permeability and hydraulic head) of the river alluvium, and it also helps to maintain the unfrozen condition.

Unfrozen intrapermafrost layers are not found everywhere; where they are not present, water is confined both above permafrost and below it. Water confined below permafrost is abundant and is better than the near-surface water because the deep water is not likely to be contaminated. Depth to the base of the frozen layer is highly variable, and no general statement can be made about how deep it will be in a given area.

Along the margin of the flood plain where the alluvium is adjacent to the upland areas, large alluvial-silt fans originating in the upland have covered parts of the flood plain. Ground water is available beneath the silt fans in the river sand and gravel. Permafrost is discontinuous and commonly extends from the silt fan into the underlying alluvium. In these areas, ground water is above, within, and below permafrost.

Upland hills

Within the Tanana-Chena River flood plain are gently rolling bedrock hills covered by windblown silt (loess). The topographic relief of the hills and the fair to good vertical permeability of the unfrozen loess make the loess well drained, and no wells tapping ground water in the loess have been reported.

Ground water in the schist bedrock is primarily controlled by fractures, joints, and fractured quartz veins. Ground water percolates through these zones, and it is usually these zones that drillers attempt to tap. The location and frequency of these zones are random, and it is difficult to estimate where they might be found.

Creek valley bottoms

As much as 300 feet of organic silt has accumulated in the valley bottoms of the upland and serves as a very poor water-bearing formation. Because of the high organic content and low permeability of the silt, ground water obtained from the silt is undesirable.

Occurrence of ground water is primarily controlled by permafrost distribution. Nearly all the valley-bottom muck contains continuous permafrost with maximum known thicknesses of more than 175 feet; depth to permafrost is generally 1 1/2 - 3 feet but may be as much as 25 feet under cleared areas. Ground water can be found above and below permafrost and occasionally within permafrost.

Because the frozen zone commonly extends up the lower hill slopes, percolating ground water is forced to flow under the permafrost as it moves downhill. This produces a hydraulic head that can cause the formation of springs and icings, pingos, and frost blisters in the valley bottoms. Wells drilled in such areas are commonly artesian and may present difficult problems unless properly constructed. Although the conditions that would produce artesian wells exist in the Fairbanks D-1 SW quadrangle, no such wells have been recorded.

In many of the major upland creek valleys, the valley-bottom muck is underlain by coarse creek-gravel deposits as much as 100 feet thick. The gravel, which usually lies beneath 30-300 feet of valley-bottom silt, can provide abundant quantities of water if not perennially frozen. Permafrost commonly extends from the silt through the gravel into bedrock, preventing the gravel from serving as an aquifer.

Because the water percolates through the organic silt before reaching the gravel, water obtained from the gravel may be of poor quality. To obtain better quality water, the wells generally are drilled through the buried creek gravel into bedrock. Water extracted from fractures and quartz veins in the bedrock, while usually of better quality, may also be of poor quality.

SELECTED BIBLIOGRAPHY

Cederstrom, D. J., 1963, Ground water resources of the Fairbanks area, Alaska: U. S. Geol. Survey Water-Supply Paper 1590, 84 p.

Cederstrom, D. J., and Péwé, T. L., 1960, Ground water data, Fairbanks, Alaska: Alaska Dept. of Health, section of Sanitation and Engineering, in cooperation with the U. S. Geol. Survey, 28 p.

Cederstrom, D. J., and Tibbitts, G. C., Jr., 1961, Jet drilling in the Fairbanks area, Alaska: U. S. Geol. Survey Water-Supply Paper 1539-B, p. B1-B28.

Childers, J. M., and Meckel, J. P., 1967, Flood of August, 1967, at Fairbanks, Alaska: U. S. Geol. Survey Hydrol. Inv. Atlas HA-294.

Holmes, G. W., Hopkins, D. M., and Foster, H. L., 1968, Pingos in central Alaska: U. S. Geol. Survey Bull. 1241-H, p. H1-H40.

Hopkins, D. M., Karlstrom, T. N. V., and others, 1955, Permafrost and ground water in Alaska: U. S. Geol. Survey Prof. Paper 264-F, p. 113-146.

Péwé, T. L., 1958, Geologic map of the Fairbanks D-2 quadrangle, Alaska: U. S. Geol. Survey Geol. Quad. Map GQ-110, scale 1:63,360.

_____, 1965, Resume of the Quaternary geology of the Fairbanks area, in Schultz, C. B., and Smith, H. T. U., eds., INQUA guidebook for field conference F, central and south-central Alaska: The Nebraska Academy of Sciences, Lincoln, Nebraska, p. 6-36.

Péwé, T. L., and Bell, J. W., 1975a, Map showing distribution of permafrost in the Fairbanks D-1 SW quadrangle, Alaska: U. S. Geol. Survey Misc. Field Studies Map MF-671A, scale 1:24,000.

_____, 1975b, Map showing construction materials in the Fairbanks D-1 SW quadrangle, Alaska: U. S. Geol. Survey Misc. Field Studies Map MF-671C, scale 1:24,000.

_____, 1975c, Map showing foundation conditions in the Fairbanks D-1 SW quadrangle, Alaska: U. S. Geol. Survey Misc. Field Studies Map MF-671D, scale 1:24,000.

Péwé, T. L., Bell, J. W., Williams, J. R., and Paige, R. A., 197_, Geologic map of the Fairbanks D-1 SW quadrangle, Alaska: U. S. Geol. Survey Misc. Inv. Series Map I-949, scale 1:24,000. (in press)

Williams, J. R., 1965, Ground water in permafrost regions, an annotated bibliography: U. S. Geol. Survey Water-Supply Paper 1792, 295 p.

_____, 1970, Ground water in the permafrost regions of Alaska: U. S. Geol. Survey Prof. Paper 696, 83 p.

Williams, J. R., Péwé, T. L., and Paige, R. A., 1959, Geologic map of the Fairbanks D-1 quadrangle, Alaska: U. S. Geol. Survey Geol. Quad. Map GQ-124, scale 1:63,360.

EXPLANATION

The ground-water units described below have been defined on the basis of occurrence, yield, recharge, and quality of ground water and type of aquifer. These units represent generalized conditions, and local variations may occur, especially near contacts between units.

I

TANANA-CHENA FLOOD PLAIN

River sand and gravel contain abundant ground water; water table 10-15 feet below surface. Where permafrost is present, water is found above, within, and below permafrost. High yield (as much as 2000-3000 gpm) with excellent recharge. Water quality generally poor because of high iron content and high hardness (as much as 300 ppm); water above permafrost very undesirable because of high potential for contamination

II

UPLAND HILLS

Bedrock hills covered by 3-200 feet of windblown silt; generally deep water table; water table influenced by permafrost along lower slopes. Water restricted to fractures, joints, and quartz veins. Good to very good quality; high hardness (100-400 ppm) but low iron content. Yields are generally low (2-10 gpm), recharge slow, and drawdown large

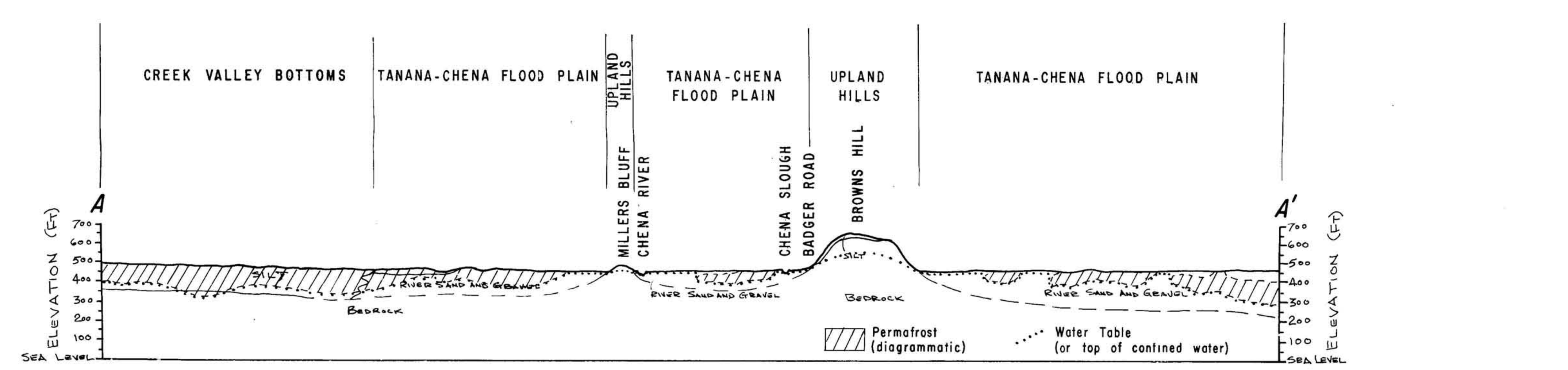
III

CREEK VALLEY BOTTOMS

Valley-bottom organic silt overlies creek gravel in major stream valleys of upland. Material perennially frozen; ground water available under permafrost. Ground water available locally beneath loess on permafrost-free loess-covered low hills. Unfrozen gravel 30-300 feet below the surface can yield moderate to high quantities (75-200 gpm). Very poor quality because of high organic content; very high iron content. Water quality probably better if water obtained from bedrock beneath muck and gravel

SYMBOLS

Contact
Generally indefinite or gradational



VERTICAL EXAGGERATION X4

GENERALIZED CROSS SECTION

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