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Ground-Water Extraction at the Fire Lake Recreation Center, Eagle River, Alaska

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INTRODUCTION

The Alaska Department of Natural Resources Division of Geological and Geophysical Surveys (DGGS), in response to a request from the Division of Land and Water Management (DLWM), conducted a study of an alluvial fan aquifer in the vicinity of Fire Lake Recreation Center, Eagle River, Alaska (fig. 1). The Municipality of Anchorage Parks and Recreation Department has filed a water rights application (LAS 1495) to appropriate 11,650 gallons per day (gpd) of water from the aquifer. The water is used at Fire Lake Recreation Center and Fire Lake Elementary School, and is drawn from a common well at the recreation center (Well 1), with a backup well (Well 2, fig. 2). Three homeowners in the area have filed complaints with DLWM or with the Municipality attributing declining water levels or turbidity in their domestic wells to pumpage of the recreation center well, and have expressed concern over possible future impacts related to overpumping. DGGS examined well logs and measured static water levels in 13 wells to determine whether wells in the area are hydraulically connected to the recreation center well, and if so, whether the production of the wells would be affected by pumpage at Fire Lake Recreation Center. This report summarizes conditions present during February and March 1986, when the study was conducted.

HYDROGEOLOGY

Alluvial fans are formed by stream sedimentation and mudflows (Verhoogen and others, 1970). As streams flow down steep slopes, they carry a load which may include coarse material such as boulders and gravel, or finer material, such as sand, silt, or clay. When the slope becomes less steep, causing the stream to lose energy, these materials will be deposited. With time, the position of the stream, and thus the area where material is deposited, shifts

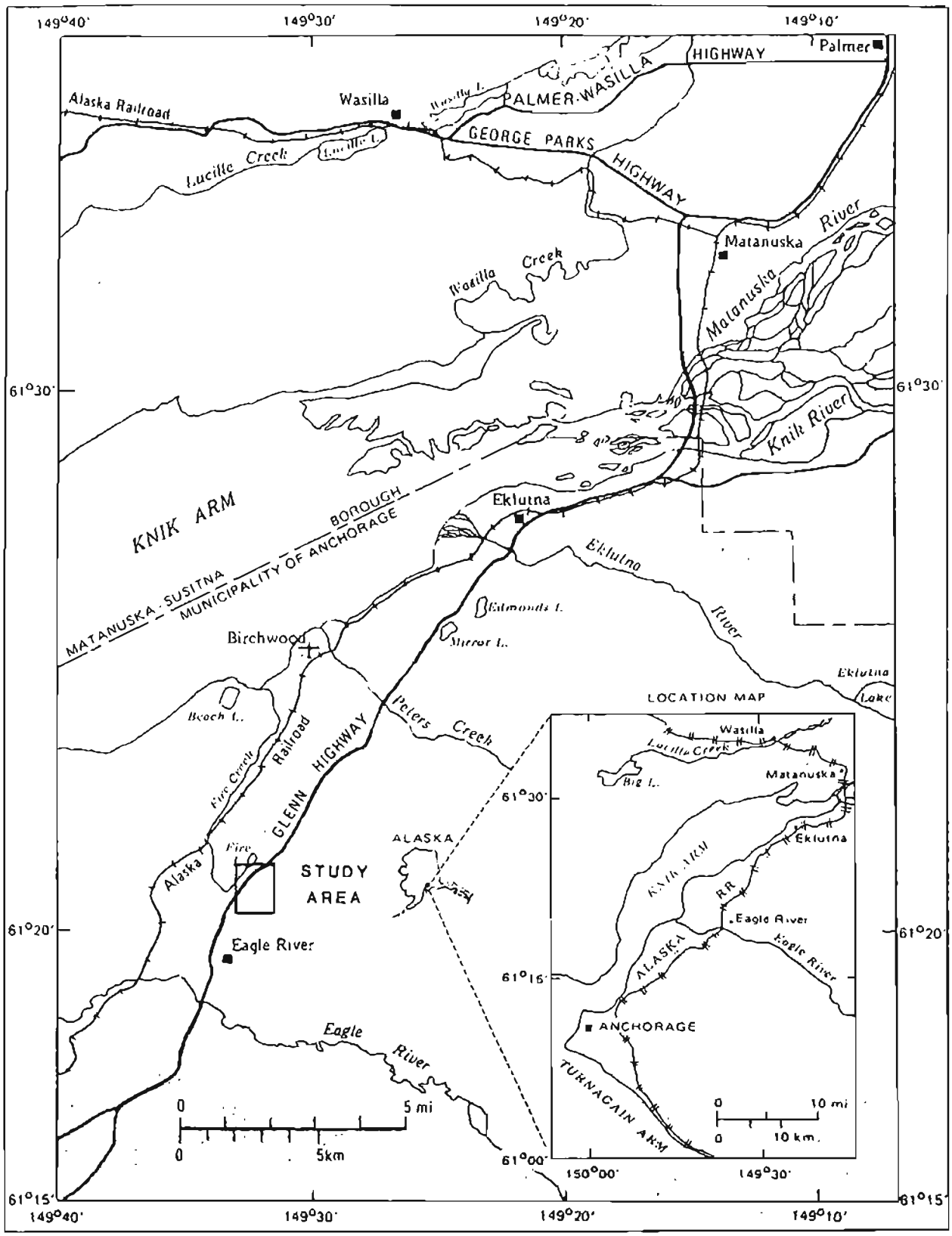

Figure 1. Location of the Carol Creek study area.

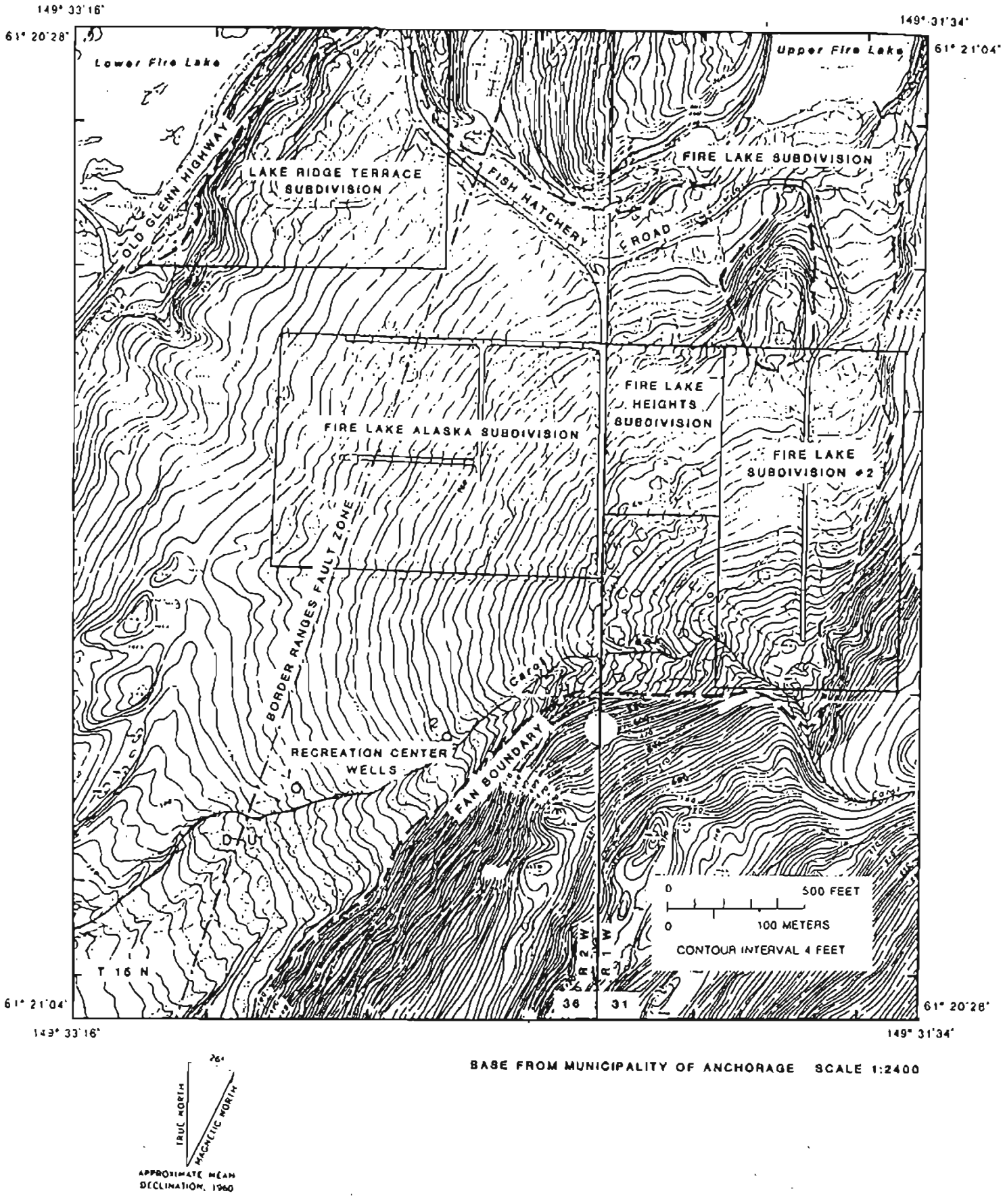

Figure 2. Surface topography of the Carol Creek alluvial fan, Eagle River, Alaska, with recreation center wells.

repeatedly, and layers of unconsolidated material are built into a fan-shaped feature which may range in size from a few sq ft to hundreds of sq mi.

Carol Creek originates from snowmelt and precipitation runoff in the mountains overlooking Eagle River. The stream flows past the Fire Lake Recreation Center and crosses the Old Glenn Highway near the Eagle River Car Wash. Field visits during February and March of 1986 indicate that the creek flow is insignificant during winter months in the reaches above the the recreation center wells. During that part of the year when the creek is free of ice, however, it is a significant potential source of recharge. Flow in the creek during June and July has been estimated at greater than 720,000 gpd (500 gallons per minute) (Ott Water Engineers and Rodney P. Kinney Associates, 1981). The fan formed by Carol Creek is a moderately sloping, roughly triangular feature approximately 3000 ft long and 4000 ft wide at the toe. The lithified deposits forming the fan function as an unconfined (water-table) aquifer capable of yielding moderate amounts of water to wells.

The fan consists of up to at least 110 ft of predominantly silty or clayey sand and gravel, based on examination of well logs on file at DGGS (fig. 3). Clay lenses of up to 10 ft thick have been reported in individual well logs. The fan deposits beneath the Fish Hatchery Road area, in Lake Ridge Terrace and Fire Lake Subdivisions, are thinner (less than 5 ft on some lots) and are underlain by fractured metamorphic and sedimentary bedrock. Regional geologic mapping (R.G. Updike, DGGS, oral commun., 1986) indicates that the fan overlies the Border Ranges fault zone (fig. 1). Wells finished in bedrock near Lower Fire Lake, in the northwestern portion of the fan, encounter sandstones and coals which appear to be part of the Tertiary-age

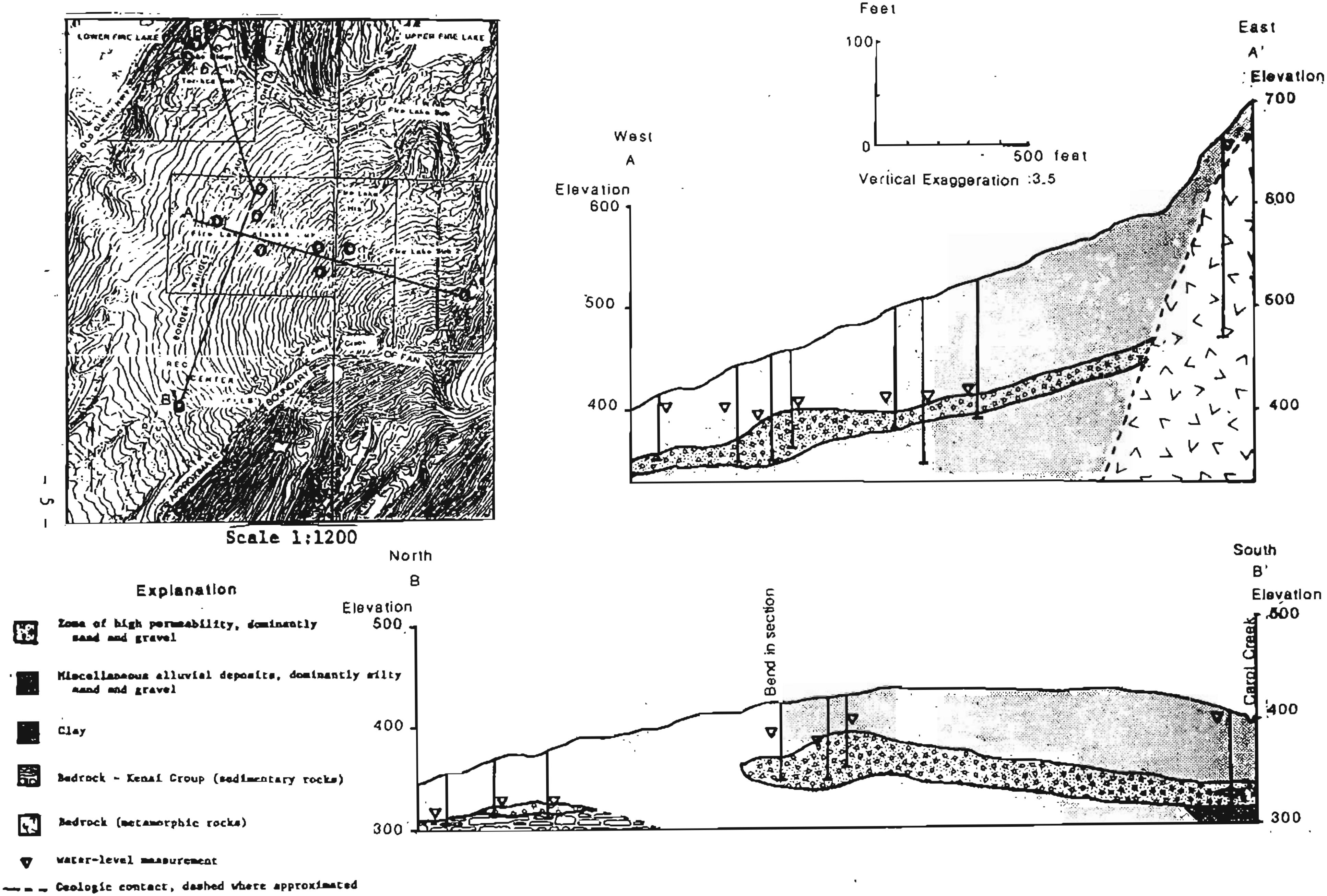

Figure 3. General hydrogeology of the Carol Creek alluvial fan aquifer. (Elevations in feet above mean sea level). Source of information: well logs on file at DGGS Eagle River office.

Kenai Group described by Magoon and others (1976). Wells drilled near Upper Fire Lake, in the upper northeastern fan area, encounter metamorphic rocks of Permian and/or Jurassic age described by Magoon and others (1976). The uppermost silty or clayey sands and gravel mixtures encountered during drilling of the recreation center wells were described as "weeping" by the drilling contractor (Ott Water Engineers and Rodney P. Kinney Associates, 1981). The presence of weeping soils, as well as springs and seeps along the western edges of the fan, indicate a fairly shallow water table. However, while most of the fan material may be saturated, permeabilities are low and wells do not obtain water directly from the uppermost portion of the fan sediments. In the central and southern portions of the fan a zone of high permeability exists at depth of about 45 to 85 ft below the surface, consisting of clean, well-sorted sand and gravel which reportedly is capable of producing 5 - 10 gpm in domestic wells, and 109 - 135 gpm in the screened commercial wells at the recreation center. The zone typically lies 50 - 100 ft beneath the surface and is approximately 10 - 30 ft thick (fig. 3). Near the Fire Lake Recreation Center the zone is underlain by up to 12 ft of clay which is in turn underlain by bedrock (fig. 4).

Many of the wells in the northern third of the fan pass through the unconsolidated alluvial fan deposits and withdraw water from bedrock, which is capable of producing 0.5 to 3 gpm, according to available well logs.

WATER-LEVEL MEASUREMENTS

In February and March, 1986, DGGS personnel measured non-pumping water levels in 13 wells located on the Carol Creek fan, in an effort to determine whether water levels had declined significantly since the wells were drilled.

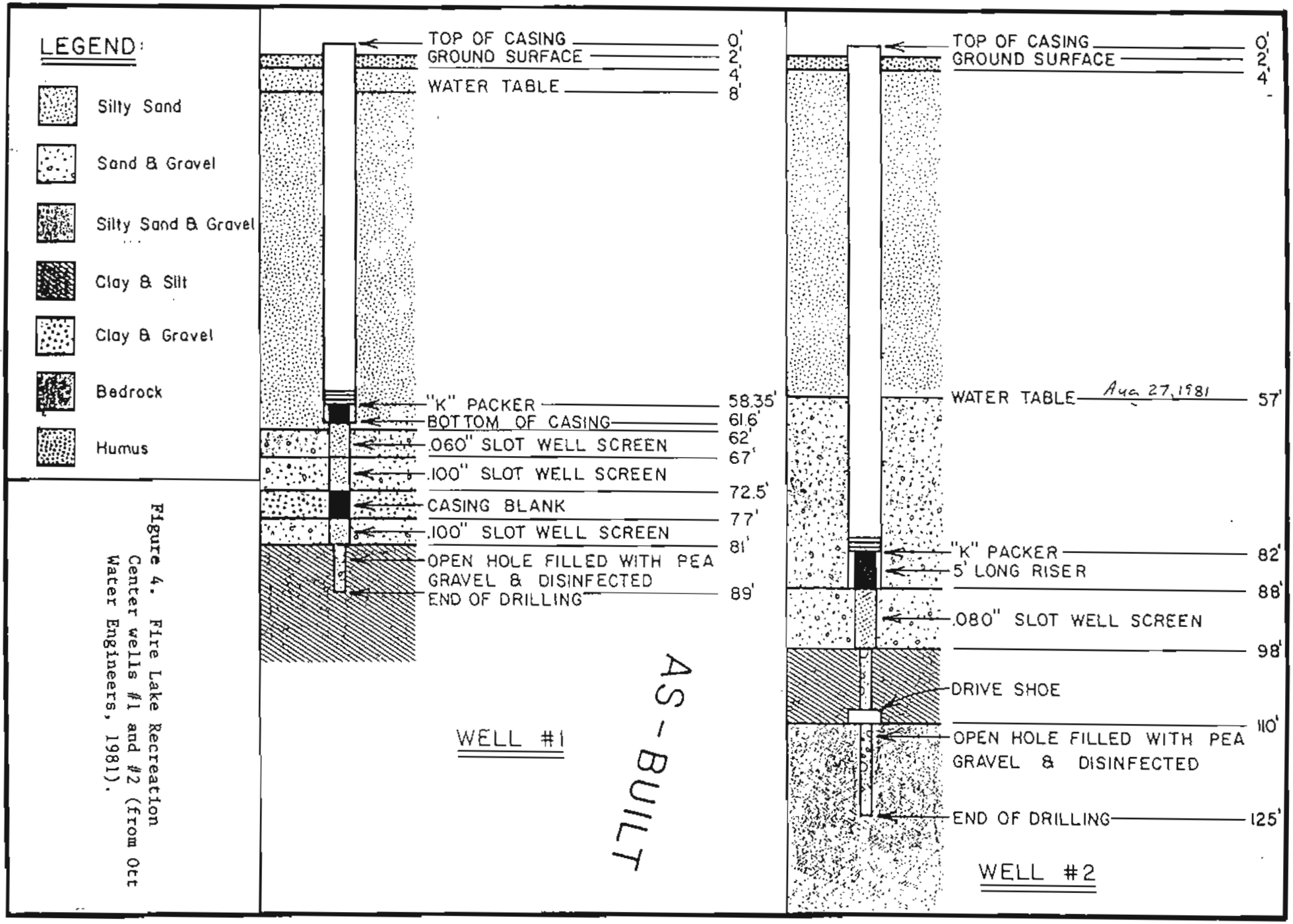

Figure 4. Fire Lake Recreation Center wells #1 and #2 (from Ott Water Engineers, 1981).

Two of the three wells visited in the northwest portion of the fan (Lake Ridge Terrace Subdivision) have water levels which are significantly lower than at the time the wells were drilled (Table 1). Water-level measurements from wells in the central portion of the fan ranged from 2 ft lower than the level at the time of drilling, to 9 ft above the initial measurement, except for a well on Fire Lake Alaska Subdivision L11A B2 which exhibited an apparent 19 ft decline. This measurement probably represents an erroneous initial measurement. Water levels in Table 1 not measured by DGGS personnel were generally obtained by the driller at the time of well completion. The data gathered in this manner are subject to several uncertainties, such as whether the depth to water was measured from the ground surface or from the top of a 6" protective steel casing, or the amount of precipitation in the year the well was drilled. Occasionally, water levels may have been reported as static (non-pumping, stable levels) when they were actually rising. Finally, the accuracy of the procedures used by the contractors to measure the water levels is undocumented. Therefore, a single measurement that differs markedly from the overall trend in a given area may be suspect and treated as an erroneous value.

Water-level elevations determined from the measurements ranged from 395 ft to 401 ft above sea level throughout most of the fan (fig. 5). Water-levels in the bedrock wells of the northwest (Lake Ridge Terrace Subdivision) portion of the fan were considerably lower, ranging from 224 to 314 ft above sea level. The difference in the water-level elevations of the two areas suggests that the wells in the northern third of the fan (the bedrock aquifers) are not in hydraulic communication with the Carol Creek alluvial fan deposits.

Table 1. Water level measurements (1986) compared with data from previous years.

Township	Range	Sec	Property Description	Date Measured	Depth to water (ft)*	Change	1986 Water level elev.**
15N	1W	31	Fire Lake Sub 2 L6 B2	08-77	18		
				02-86	18	0	651
			Pee Tract	02-86	156	-	399
15N	2W	36	Fire Lake AK Sub L8A B1	03-86	117	-	401
			Fire Lake AK Sub L6A B1	10-77	100		
				03-86	102	-2	399
			Fire Lake AK Sub L1A B2	05-84	51		
				03-86	42	+9	397
			Fire Lake AK Sub L11A B2	08-82	2		
				03-86	21	-19	395
			Fire Lake AK Sub L15A B2	04-81	55		
				03-86	51	+4	395
			Fire Lake AK Sub L1A B3	06-81	68		
				03-86	59	+9	399
			Lake Ridge Terrace Sub L12 B9	-	52		
				03-86	51	-1	314
			Lake Ridge Terrace Sub L13 B9	06-82	100		
				03-86	140	-40	224
			Lake Ridge Terrace Sub L14 B9	09-84	30		
				03-86	42	-12	298
			Fire Lake Recreation Center Production Well	09-81	6		
				03-86	9	-3	405
			Fire Lake Recreation Center Standby Well	07-81	55		
				03-86	56	-1	408

* Below land surface
** Mean sea level

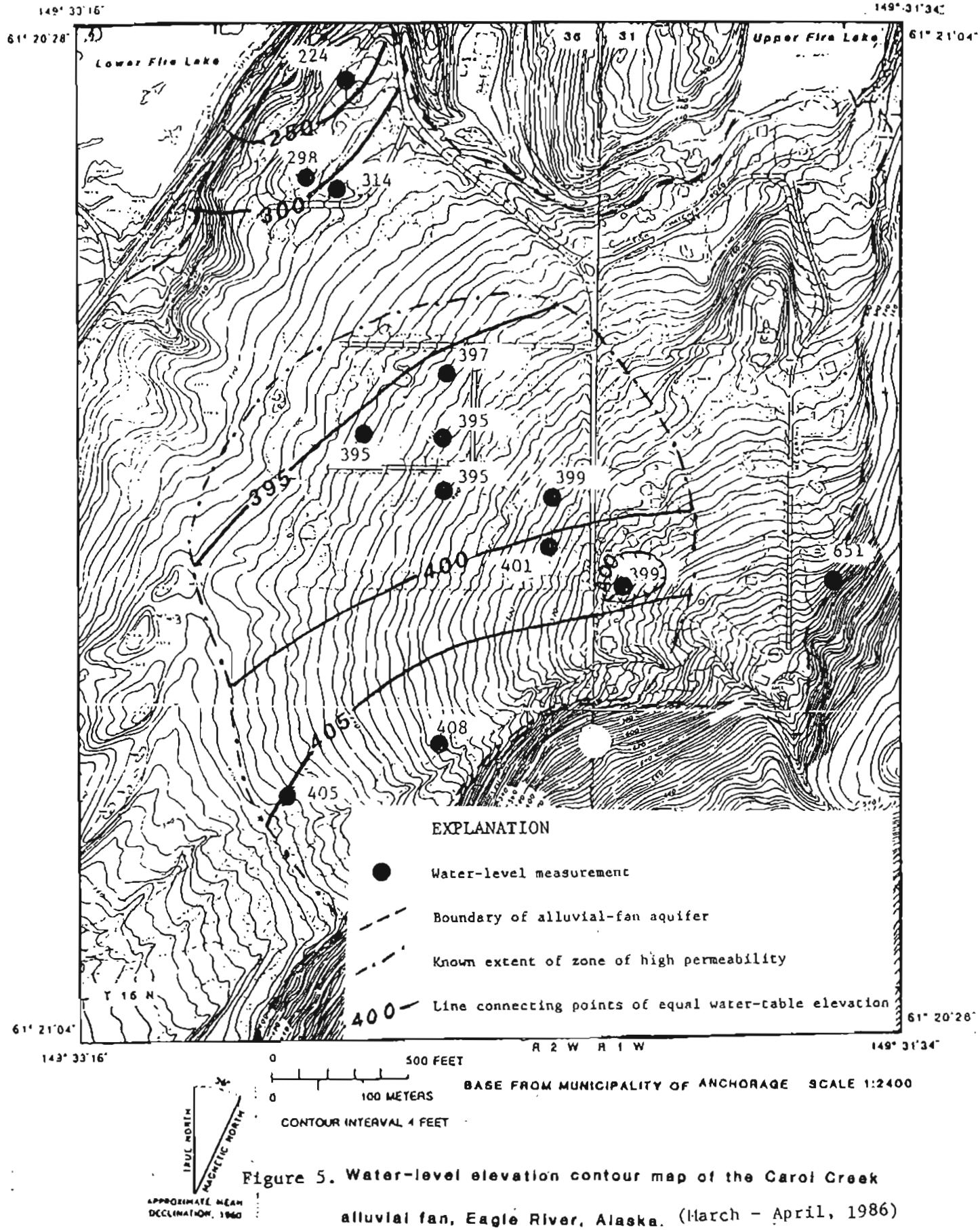

Figure 5. Water-level elevation contour map of the Carol Creek alluvial fan, Eagle River, Alaska. (March - April, 1986)

RECHARGE

The amount of recharge available to the Carol Creek aquifer is unknown. It is reasonable to assume that Carol Creek provides significant amounts, based upon pumping tests at the recreation center wells (Ott Water Engineers and Rodney P. Kinney Associates, 1981). The study area receives rainfall totalling approximately 15 in./yr (Selkregg, 1974) Determination of the amount of precipitation infiltrating the aquifer is beyond the scope of this report. Short-term, temporary effects are related to pumpage and are discussed below.

WATER-USE BY APPLICANTS

Short-term impacts to water wells may be caused by temporary lowering of the water table during pumping, and disappear when pumpage stops or decreases. Short-term problems may also be related to seasonal lowering of the water table, when wells typically have less available drawdown. Detailed pumping patterns at the recreation center and elementary school are not available. It is possible to discuss the water usage in a general way, however. Fire Lake Elementary School is estimated to require 9000 gpd, for use in a 9-hour period. The school has the capacity to store only 3000 gallons (J. Rodda, Fire Lake Recreation Center, oral commun., 1986). Water-supply system design commonly requires pumping when water storage is reduced by 10-15 percent. In this case, the pump, rated at 100 gpm, could supply the needs of the school by working 10 minutes per hour for 9 hours. The recreation center, in contrast, has a reported storage capacity of about 10,000 gallons and the estimated daily use of 2650 gpd causes operation of the pump only once a day or less (J. Rodda, Fire Lake Recreation Center, oral commun., 1986). The required amount could be supplied once a day with the pump operating at full capacity for

about 25 minutes a day. Any resultant drawdown in wells finished in the same aquifer would likely be unnoticed by residents unless the lowering in the water levels in their wells was several feet. Available records for the wells drawing from the Carol Creek aquifer indicate 15 - 100 ft of water in the wells, providing an available minimum drawdown of at least 10 ft. This should be sufficient available drawdown to prevent interference from the recreation center well.

CONCLUSIONS

1. Examination of well logs on file at DGGS indicate that wells in the northwest fan area (Lake Ridge Terrace Subdivision) withdraw water from bedrock or from saturated sand and gravel immediately above the bedrock, and do not appear to be related to the Carol Creek alluvial aquifer from which the Fire Lake Recreation Center and Fire Lake Elementary School extract water.

2. There appears to be the potential for recharge available to the aquifer in amounts sufficient to offset the effects of current pumping.

3. The storage utilized by the recreation center and elementary school should prevent the necessity of excessive pumping during a typical 24-hour time period.

4. It is unlikely that the granting of water rights application LAS 2495 will adversely affect prior appropriators.

ACKNOWLEDGMENTS

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