Overview of Environmental and Hydrogeologic Conditions near Juneau, Alaska

U.S. GEOLOGICAL SURVEY

Open-File Report 95-412

Prepared in cooperation with the

FEDERAL AVIATION ADMINISTRATION

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By Michael G. Alcorn and Eppie V. Hogan

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Anchorage, Alaska

1995

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

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CONVERSION FACTORS

Multiply	By	To obtain
millimeter (mm)	0.03937	inch
centimeter (cm)	0.3937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
meter per kilometer (m/km)	5.2801	foot per mile
square kilometer (km^2)	0.3861	square mile
cubic meter (m^3)	35.31	cubic foot
liter per second (L/s)	15.85	gallon per minute
liter per day (L/d)	0.2642	gallon per day
cubic meters per second (m^3/s)	35.31	foot per second

In this report, temperature is reported in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F = 1.8\ (°C) + 32$$

ABBREVIATED WATER-QUALITY UNITS

Chemical concentration and water temperature are given only in metric units. Chemical concentration in water is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the solute mass per unit volume (liter) of water. Specific conductance is given in microsiemens per centimeter (µS/cm) at 25°C.

VERTICAL DATUM

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—A geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

The Federal Aviation Administration is making preliminary environmental assessments at most of its present or former facilities in Alaska. The Juneau International Airport and associated sites on the Mendenhall Peninsula, Point Lena, and Coghlan Island are Federal Aviation Administration facilities near the City of Juneau, Alaska. The Juneau International Airport is underlain by unconsolidated glacial, alluvial, and estuarine deposits and metamorphic volcanic and sedimentary rocks. Mendenhall Peninsula, Point Lena, and Coghlan Island are composed of metamorphic volcanic and sedimentary rocks. Ground water is available from an unconfined aquifer in Mendenhall Valley. Coastal hemlock-spruce forest characterizes the vegetation. The climate is dominated by mild maritime conditions which result in small annual temperature variations, heavy precipitation, and frequent cloudy and foggy conditions. Mendenhall River, Duck Creek, and Jordan Creek flow north to south adjacent to the Juneau International Airport. Drinking water for the Federal Aviation Administration facilities at the airport, Mendenhall Peninsula, and Point Lena is supplied by the City and Borough of Juneau. Drinking water is imported to the facilities on Coghlan Island.

INTRODUCTION

The Federal Aviation Administration (FAA) owns and (or) operates airway-support and navigational facilities throughout Alaska. Fuels and potentially hazardous materials such as solvents, polychlorinated biphenyls, and pesticides may have been used and (or) disposed of at many of these sites. To determine if environmentally hazardous materials are present at the sites, the FAA is conducting environmental studies mandated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). To complete these more comprehensive environmental studies, the FAA requires information on the hydrology and geology of areas surrounding the sites. This report, the product of compilation, review, and summary of existing hydrologic and geologic data by the U.S. Geological Survey, in cooperation with the FAA, provides such information for the FAA facilities near Juneau, Alaska. Also presented in this report are brief descriptions of the FAA facilities and the physical setting of the area.

BACKGROUND

Location

The FAA facilities near Juneau are in or near the Mendenhall Valley at approximate lat 58°22' N., and long 134°35' W. FAA facilities are at the Juneau International Airport, on the Mendenhall Peninsula, at Point Lena, and on Coghlan Island (fig. 1). The Mendenhall Valley encompasses about 20 km^2 and is about 11 km northwest of the City of Juneau. It is a glacial

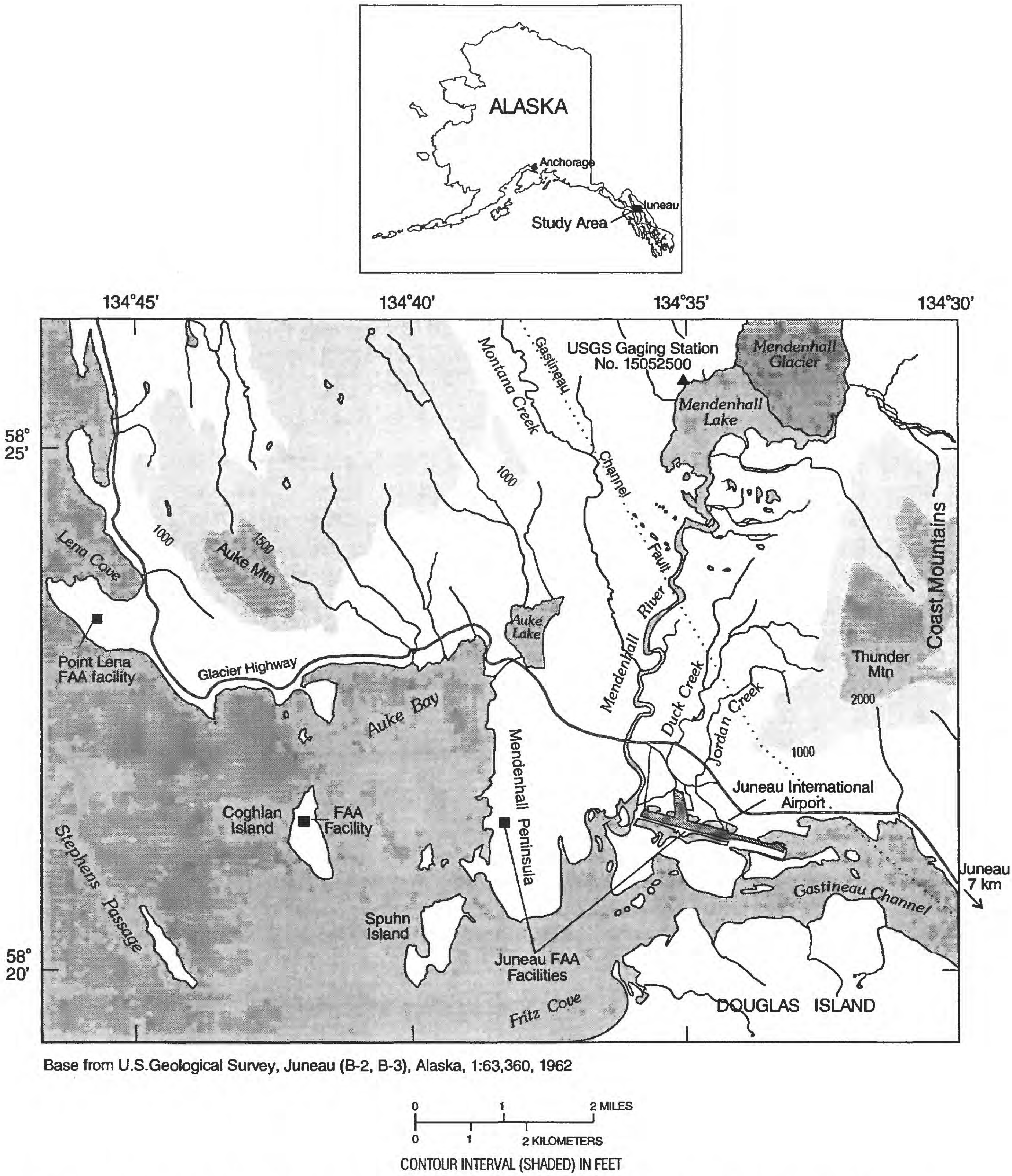

Figure 1. Location of the Juneau and Coghlan Island Federal Aviation Administration facilities, Alaska.

outwash plain bounded by the steep Coast Mountains on the east, the Mendenhall Peninsula on the west, the Mendenhall Glacier on the north, and Gastineau Channel, an arm of Stephens Passage, on the south. The Juneau International Airport is at the foot of the valley and has a runway elevation of about 6 m. From the airport, Coghlan Island is about 5 km west and Point Lena is about 10 km northwest.

FAA Facilities

The Juneau FAA facilities, including airway-support and navigational aids, are concentrated at the Juneau International Airport (fig. 1). An H-marker facility and a localizer-type directional aid (LDA) facility are about 3 km west of the airport on the Mendenhall Peninsula. A Remote Center Air/Ground Communications facility is located at Point Lena. The FAA also leases facilities on nearby Coghlan Island (fig. 1). More detailed descriptions of FAA properties near Juneau and a list of suspected sources of environmental contamination are given in environmental compliance investigation reports by Ecology and Environment Inc. (1992a and b).

Climate

The climate near Juneau is dominated by maritime influences (Hartman and Johnson, 1984). Climatic conditions are characterized by small temperature variations, high humidity, heavy precipitation, and frequent cloudy and foggy periods. Summers are cool and winters are mild. Surface winds generally are strong and persistent (Hartman and Johnson, 1984). The mean annual temperature at the Juneau International Airport is 4.6 °C. Temperatures range from a July mean maximum of 17.8 °C to a January mean minimum of -8.0 °C (Leslie, 1989). Total annual precipitation is about 1,340 mm and total annual snowfall is about 2,570 mm. Mean monthly and annual temperature, precipitation, and snowfall for the Juneau International Airport are summarized in table 1 (Leslie, 1989).

Table 1. Mean monthly and annual temperature, precipitation, and snowfall, Juneau International Airport, Alaska, 1949-87

[Modified from Leslie (1989); °C, degree Celsius; mm, millimeter]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	**Annual**
Temperature (°C)													
Mean maximum	-1.9	1.0	3.4	8.2	12.6	16.3	17.8	16.9	13.3	8.3	3.0	-0.1	8.2
	(Record maximum 32.2 °C, July 1975)												
Mean minimum	-8.0	-5.3	-3.4	-0.2	3.7	7.0	8.8	8.3	5.9	2.6	-2.2	-5.2	1.0
	(Record minimum -30.0 °C, January 1972)												
Mean	-4.9	-2.1	0.0	4.0	8.2	11.7	13.3	12.7	9.6	5.5	0.4	-2.7	4.6
Precipitation (mm of moisture)													Total
	101	93	82	72	88	77	104	130	159	194	130	114	1,344
Snowfall (mm)													Total
	671	503	417	91	0.0	0.0	0.0	0.0	0.0	31	269	589	2,571

Vegetation

Vegetation near Juneau consists of coastal hemlock-spruce forest (Selkregg, 1976; Viereck and Little, 1972). The vegetation is characterized by an overstory of Sitka spruce, western hemlock, Alaska cedar, and black cottonwood and an understory of blueberry, five-leaf bramble, gold thread, and several types of ferns, lichens, and mosses. Muskeg vegetation is found in low-lying areas and includes sphagnum moss, Labrador tea, and bog rosemary. Shoreline vegetation, common in coastal areas, consists of silverweed, hair grass, yarrow, buttercup, and a variety of sedges. Alpine vegetation, starting at about 600 m above mean sea level, includes mountain hemlock, low mat-forming shrubs, deer cabbage, heather, lichen, berries, and willow.

GEOLOGY

Bedrock Geology

Mendenhall Valley, Mendenhall Peninsula, and Coghlan Island are in a northwest-trending belt of metamorphosed volcanic and sedimentary rocks of Cretaceous age (Brew and Ford, 1985). Rock types include volcanic breccia, tuff, graywacke, slate, and conglomerate. Primary porosity may decrease as the metamorphic grade increases to the northeast. Secondary porosity may increase with increasing fracturing of the rocks. The regional joint pattern is parallel to bedding, which generally strikes to the northwest and dips 40-60 degrees northeast (Barnwell and Boning, 1968). Bedrock is exposed in the Mendenhall Valley along the east and west slopes of the valley and is more than 230 m below the surface near the valley's southern end (Osgood, 1990). Bedrock is exposed on Mendenhall Peninsula, Point Lena, and Coghlan Island above 30 m elevation (Miller, 1975). A major fault, called the Gastineau Channel Fault (fig. 1), trends northwestward in the Gastineau Channel and extends through the Mendenhall Valley slightly more than 1 km northeast of the Juneau International Airport.

Surficial Geology

Surficial deposits in the Mendenhall Valley include glacial deposits (outwash and moraine), glaciomarine deposits, alluvium, muskeg deposits, intertidal deposits, and manmade fill (Barnwell and Boning, 1968; Miller, 1975). Seismic studies indicate that the unconsolidated deposits range in thickness from 75 m near Mendenhall Lake to 230 m near the coast (Miller, 1975). Surficial deposits on the Mendenhall Peninsula, Point Lena, and Coghlan Island consist principally of beach and glaciomarine deposits (Miller, 1975).

Morainal ridges up to 15 m thick are found in the northern part of the Mendenhall Valley extending from the southern edge of Mendenhall Lake to about 4 km north of the Juneau International Airport. These deposits consist of light-gray loosely consolidated till and unsorted gravelly sand (Miller, 1975). Outwash deposits found throughout the valley are 3 to 30 m thick and consist of gray silty sand and gravel (Miller, 1975). The particle size of the outwash decreased downvalley from the morainal ridges. Glaciomarine deposits are found along the edges of the valley floor and on the Mendenhall Peninsula, Lena Point, and Coghlan Island. These deposits are typically 1.2 to 3.6 m thick and consist of light-gray to greenish-gray, compact to soft sandy diamicton rich in molluscan shells and foraminifera (Miller, 1975). Alluvial deposits consisting of brown to gray sand and pebble gravel with isolated boulders are found intermittently along the Mendenhall River and along most of Duck Creek and Jordan Creek (Miller, 1975). Muskeg deposits are found in saturated areas adjacent to the Mendenhall River to the northwest. These deposits consist of dark-brown plant debris in various stages of decay and are about 3 m thick (Miller, 1975). Intertidal deposits consisting of dark-gray sandy silt and gravelly sand are found in low-lying areas along Gastineau Channel (Miller, 1975). Manmade fill from 1 to 7.6 m thick underlies the Juneau International Airport and consists of rock, silt, sand, gravel, sawdust, and trash (Miller, 1975). Most of the fill is fine grained and much of it was obtained from borrow pits in sandy delta deposits adjacent to the runway. Slate, greenstone, and granite are the most common clast types (Miller, 1972).

Raised beach deposits composed of slate, graywacke, greenstone, and flow breccia and ranging in thickness from 1.5 to 12 m are found near the FAA facilities on the Mendenhall Peninsula, Lena Point, and Coghlan Island (Miller, 1972). These deposits consist of olive-gray to dark-brown heterogeneous mixtures of pebbles, cobbles, and boulders in a sandy matrix (Miller, 1975) and are underlain by undifferentiated glaciomarine deposits (Miller, 1972). The Juneau area generally is free of permafrost (Ferrians, 1965).

HYDROLOGY

Surface Water

Major surface-water bodies within the vicinity of the Juneau International Airport include Gastineau Channel, Mendenhall Lake, Mendenhall River, Jordan Creek, and Duck Creek. The FAA facilities on the Mendenhall Peninsula, Lena Point, and Coghlan Island are on the east side of Stephens Passage near Auke Bay.

During high tides, seawater flows up the river and creeks near the Juneau International Airport, causing reversal of flow direction, increases in water depths, and a change from freshwater to saltwater (Noll, 1994). Mean tide range is 4.1 m, but high tides have been recorded at more than 6 m (Noll, 1994). Tide ranges are based on mean low water levels that are 2.6 m below mean sea level for this location (National Oceanic and Atmospheric Administration, 1993). Saltwater flows into the Mendenhall River as far north as the mouth of Montana Creek, which is the limit of the tidal effects (Barnwell and Boning, 1968).

Mendenhall Lake, which forms the headwaters of the Mendenhall River, has a surface area of 3.1 km^2, a maximum depth of 61 m, and maximum volume of about 50 million m^3 (Barnwell and Boning, 1968). The Mendenhall River had an average discharge of 32.7 m^3/s from 1965 to 1994 at gaging station 15052500 at the north end of Mendenhall Lake, 11 km upstream from its mouth at Fritz Cove (U.S. Geological Survey, 1995). The peak flow recorded at this station was more than 480 m^3/s in September 1981 (U.S. Geological Survey, 1995). Ground water/surface water interactions in the Mendenhall Valley were defined by measuring stream discharges at different points along its path. The Mendenhall River gains about 0.3 m^3/s from ground water in the upper 1-km reach and another 0.5 m^3/s in the lowest 1-km reach. Between these two gaining reaches, the river fluctuates between gains and losses (E.F. Bugliosi and G.L. Nelson, U.S. Geological Survey, written commun., 1987). Measurements made on Duck Creek showed no flow during July 1993 and 1994 at miscellaneous sites located between 0.6 and 1.3 km upstream from the mouth of the creek (U.S. Geological Survey, 1994, 1995). Discharge on Duck Creek was also measured intermittently at four sites on or adjacent to the airport between December 1993 and

March 1994. These measurements ranged from 0.3 m^3/s in March to no flow in January (Noll, 1994). The highest recorded flow rate during 1993 and 1994 for the lower reaches of Duck Creek was 0.8 m^3/s measured 0.8 km upstream from the mouth (U.S. Geological Survey, 1995). Seven flow measurements made on Jordan Creek during 1965 and 1966 showed discharges ranging from 0.006 m^3/s in February 1966 to 0.8 m^3/s in August 1965 (Barnwell and Boning, 1968).

Flooding is a possible hazard at the Juneau International Airport primarily due to the proximity of the Mendenhall River. Flood studies completed by the U.S. Army Corps of Engineers (1971), however, indicate that the FAA facilities at the airport are above the 100-year flood level. The study also indicated that floods exceeding the 100-year flood level by 1 m may affect some buildings and parking lots that are lower than 6 m above sea level. Jordan Creek and Duck Creek may present a local flood hazard where bridges and culverts restrict flow (Federal Emergency Management Agency, 1990). Because of development in the Mendenhall Valley, stream channels have been moved and altered, which may affect stream height, flooding potential, channel erosion and deposition (Noll, 1994). Those effects, however, have not been quantified. The airport is protected from coastal flooding by encircling dikes (Federal Emergency Management Agency, 1990).

Water quality of the Mendenhall River and Duck Creek has been degraded by the dumping of cars and trash in the channels. The U.S. Army Corps of Engineers (1971) reported that junk cars were being used as riprap on an eroding bank of Mendenhall River, but that practice was not expected to stop erosion and would increase the flood hazard. Noll's 1994 study of Duck Creek identified oil sheens on the water throughout the study area, as well as car parts and other trash in the channel.

Ground Water

The Mendenhall Valley contains two aquifers: an upper unconfined one and a lower confined one (Balding, 1982). The confined aquifer is brackish and is not used for drinking-water purposes. The unconfined aquifer is of adequate quality for drinking, but may require treatment for high concentrations of iron (Balding, 1982). The unconfined aquifer consists of a downward-fining sequence of glaciofluvial and alluvial sediments. This aquifer thickness ranges from 0 to 60 m in thickness, but may extend to 90 m in some locations (Osgood, 1990; E.F. Bugliosi and G.L. Nelson, U.S. Geological Survey, written commun., 1987). Both upper and lower aquifers are bounded by bedrock on the east and west, the Mendenhall Glacier to the north, and Gastineau Channel to the south (Osgood, 1990). Several wells have been drilled in the Mendenhall Valley (Appendix 1). Depths of these wells range from about 3 to 100 m. The deepest well extends into the lower aquifer. The water table in the unconfined aquifer typically ranges from 1 to 5 m below ground surface (Osgood, 1990; Appendix 1). The water table slopes southwestward at about 3 m/km (Osgood, 1990). This indicates that the general ground-water flow direction is southwestward.

In 1974, the USGS collected aquifer data from four wells in the Mendenhall Valley (Balding, 1982; Appendix 2). Pumping of a 15-centimeter diameter test well at about 19 L/s for 24 hours produced drawdowns of 3 m, 0.4 m, and 0.35 m in observation wells located 6.9 m, 30 m, and 45 m, respectively from the test well. Drawdowns of such small magnitude indicate that more than 19 L/s could be obtained from wells having larger diameters (Appendix 2). An observation well drilled during the 1974 study penetrated the confining layer and reached a brackish-water aquifer at a depth of 106 m (Appendix 2). The Mendenhall Valley unconfined aquifer is recharged by infiltration of precipitation and water exchange with Mendenhall Lake, Mendenhall River, Montana Creek, Jordan Creek, and Duck Creek (fig. 1; Osgood, 1990).

In 1994, the State of Alaska Department of Natural Resources completed a report that included data on wells near Duck Creek at the Juneau International Airport (Noll, 1994). Eleven monitoring wells were installed and water levels were measured. Results showed that the water-table gradient sloped from east to west towards the Mendenhall River. Water-level changes in the wells, which ranged from 0.6 m to 0.9 m, are caused by precipitation and sea-level variations. Depth to water ranged from 0.2 m to 4.0 m below ground surface. Soil and near-surface unconsolidated sediments near the creek consisted of a thin layer of silt and organics overlying thick layers of sand, sand and gravel, and gravel with thin layers of silt and clay. To the north of Duck Creek, Noll (1994) found fine sands, silts and clays.

An interface between freshwater and saltwater exists within coastal areas of the Mendenhall Valley aquifer. Removal of water from the freshwater zone may induce the movement of saltwater farther into the aquifer, resulting in the wells being unusable for drinking water without treatment. On the basis of model simulations performed by Osgood (1990), the freshwater/saltwater interface in the Mendenhall Valley aquifer ranges from near surface at the coast to about 12 m below ground surface at about 1 km inland. The interface can be expected to respond to pumping of wells up to 3 km north of the Juneau International Airport.

With the exception of iron concentrations in some wells, a small set of properties and dissolved constituents that were analyzed in the Mendenhall Valley aquifer are within current U.S. Environmental Protection Agency (USEPA, 1995) and Alaska Department of Environmental Conservation (ADEC, 1995) drinking-water standards (table 2; Barnwell and Boning, 1968; McConaghy and Bowman, 1971; Balding, 1982). Analyses of samples collected at various depths indicate that dissolved solids and specific conductance typically increase with depth.

Table 2. Selected water-quality data for the Mendenhall Valley aquifer, Alaska
[Data in milligrams per liter]

Constituent	USEPA Drinking-water standards	Concentrations in the aquifer
Iron (Fe)	0.3	0.01-2.3
Sulfate (SO_4)	250	4.4-66
Manganese (Mn)	0.05	0-.001
Fluoride (F)	2	0-0.3
Chloride (Cl)	250	0-5.3
Total dissolved solids	500	85-318

Aquifers on the Mendenhall Peninsula, Point Lena, and Coghlan Island are entirely within bedrock, which is composed chiefly of fractured slate and metamorphosed volcanic agglomerate and breccia (Barnwell and Boning, 1968; Motyka, 1988). Well depths on the Mendenhall Peninsula average about 60 m and well yields range from less than 0.05 L/s to a maximum of 1.3 L/s (Barnwell and Boning, 1968). Most well depths on Point Lena are greater than 60 m. Average yields from bedrock are about 0.2 L/s (Motyka, 1988). Concentrations of iron, chloride, arsenic, and total dissolved solids in aquifers on the Mendenhall Peninsula may exceed USEPA and ADEC drinking-water regulations (Barnwell and Boning, 1968; Motyka, 1988). Most of the wells showing chloride contamination are near the coast, indicating the occurrence of saltwater intrusion into the aquifer (Motyka, 1988).

Drinking Water

Domestic water is supplied by the City and Borough of Juneau to the Juneau International Airport, the Mendenhall Valley, Mendenhall Peninsula, and Point Lena. The water source is from a well field in the Last Chance Basin of Gold Creek, about 10 km southeast of the airport, and from a reservoir on Salmon Creek, about 8 km east of the airport (Ecology and Environment, Inc., 1992a). These water resources are not vulnerable to contamination by activities at the FAA facilities near Juneau because of their distance and lack of hydrologic connection. Furthermore, the water supplied by the City and Borough of Juneau is presumed to be of adequate quality as it is monitored and tested monthly to meet USEPA and ADEC drinking-water standards. Drinking water for Coghlan Island is brought in from off the island (Ecology and Environment, Inc., 1992b).

Drinking-water alternatives for the airport and Mendenhall Valley include the Mendenhall Valley aquifer and surface-water sources, such as the Mendenhall River, Montana, Jordan, and Duck Creeks, and Mendenhall Lake. Alternatives for the FAA facilities on the Mendenhall Peninsula, Point Lena, and Coghlan Island include fractured bedrock aquifers.

The estimated average water needed for commercial users in Alaska is about 125 L/d per person (Solley and others, 1993). The commercial needs at the airport probably can be met by the City and Borough of Juneau Utilities. The average water used for domestic uses in Juneau is about 300 L/d per person (William Joiner, City and Borough of Juneau Utilities, oral commun., 1995).

SUMMARY

The Juneau International Airport and Mendenhall Peninsula are about 11 km northwest of the City of Juneau. Coghlan Island lies about 5 km west and Point Lena lies about 10 km to the northwest of the airport. The Juneau International Airport is underlain by thick sequences of sands, gravels, and clays that make up a confined and an unconfined aquifer. Ground-water flow direction under the airport is generally to the southwest. The water table typically ranges from 1 to 5 m below ground surface. The Juneau International Airport, the Mendenhall Valley, Mendenhall Peninsula, and Point Lena receive drinking water from the City and Borough of Juneau municipal water system. Currently, this is an adequate water source. An alternative drinking-water source of lesser quality would be to utilize ground water from the unconfined aquifer in the Mendenhall Valley. Coghlan Island drinking water must be imported. Juneau International Airport would not be flooded by the Mendenhall River during the 100-year flood.

REFERENCES CITED

Alaska Department of Environmental Conservation, 1995, Alaska water-quality standards 18 AAC 70: Alaska Department of Environmental Conservation, Water-quality Management Section, 47 p.

Balding, G.O., 1982, Aquifer data from four wells in the Mendenhall Valley near Juneau, Alaska: U.S. Geological Survey Open-File Report 82-271, 14 p.

Barnwell, W.W., and Boning, C.W., 1968, Water resources and surficial geology of the Mendenhall Valley, Alaska: U.S. Geological Survey Hydrologic Investigations Atlas HA 259, 6 p.

Brew, D.A., and Ford, A.B., 1985, Preliminary reconnaissance geologic map of the Juneau, Taku River, Atlin, and part of the Skagway 1:250,000 quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 85-395, 23 p.

Ecology and Environment, Inc., 1992a, Environmental Compliance Investigation Report (ECIR), Juneau FAA station, Juneau, Alaska: Anchorage [Copy available from the Environmental Compliance Section, AAL-465, Federal Aviation Administration, Alaskan Regional Office, Anchorage, AK], variously paged.

____1992b, Environmental Compliance Investigation Report (ECIR), Coghlan Island FAA station, Coghlan Island, Alaska: Anchorage [Copy available from the Environmental Compliance Section, AAL-465, Federal Aviation Administration, Alaskan Regional Office, Anchorage, AK], variously paged.

Federal Emergency Management Agency, 1990, Flood insurance study, City and Borough of Juneau, Alaska: Federal Emergency Management Agency, variously paged.

Ferrians, O.J., 1965, Permafrost map of Alaska: U.S. Geological Survey Miscellaneous Investigations Map I-445, scale, 1:2,500,000.

Hartman, C.W., and Johnson, P.R., 1984, Environmental atlas of Alaska: University of Alaska Fairbanks, Institute of Water Resources/Engineering Experiment Station, 95 p.

Leslie, L.D., 1989, Alaska climate summaries (2d ed.): University of Alaska Anchorage, Arctic Environmental Information and Data Center, Alaska Climate Center Technical Note No. 5, 478 p.

McConaghy, J.A., and Bowman, W.N., 1971, Water resources of the Juneau area, Alaska: U.S. Geological Survey Open-File Report 71-190, 62 p.

Miller, R.D., 1972, Surficial geology of Juneau urban area and vicinity, Alaska, with emphasis on earthquake and other geologic hazards: U.S. Geological Survey Open-File Report 72-255, 180 p.

____1975, Surficial geologic map of the Juneau urban area and vicinity, Alaska: U.S. Geological Survey Miscellaneous Investigations Series Map I-885, scale 1:48,000.

Motyka, R.J., 1988, Preliminary results of water quality investigations in the Mendenhall Peninsula and Auke Bay area, Juneau, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 88-6, 20 p.

National Oceanic and Atmospheric Administration, 1993, Tide tables 1994, high and low water predictions, west coast of North and South America, including the Hawaiian Islands: National Oceanic and Atmospheric Administration, 233 p.

Noll, R., 1994, Hydrologic investigation of Duck Creek at the Juneau International Airport, Juneau, Alaska: Alaska Department of Natural Resources Division of Water report, 30 p. + appendixes.

Osgood, G.N., 1990, Simulation of the freshwater-saltwater interface in the aquifer at Mendenhall Valley, Alaska, Fairbanks, Alaska: Fairbanks, Alaska, University of Alaska Fairbanks, M.S. thesis, 31 p.

Selkregg, L., 1976, Alaska regional profiles—Southwest region: University of Alaska, Arctic Environmental Information and Data Center, 313 p.

Solley, W.B., Pierce, R.R., and Perlman, H.A., 1993, Estimated use of water in the United States in 1990: U.S. Geological Survey Circular 1081, 69 p.

U.S. Army Corps of Engineers, 1971, Flood plain information, Mendenhall River, Juneau, Alaska: Corps of Engineers, U.S. Army, Alaska District, 23 p.

U.S. Environmental Protection Agency, 1995, Drinking-water regulations and health advisories: U.S. Environmental Protection Agency report, May 1995, 10 p.

U.S. Geological Survey, 1994, Water resources data for Alaska, water year 1993: U.S. Geological Survey Water-Data Report AK-93-1, 368 p.

____1995, Water resources data for Alaska, water year 1994: U.S. Geological Survey Water-Data Report AK-94-1, 284 p.

Viereck, L.A., and Little, E.L. Jr., 1972, Alaska trees and shrubs: U.S. Department of Agriculture Handbook No. 410, 265 p.

APPENDIX 1

Data from wells near Juneau, Alaska

JUNEAU - 8 MILE RADIUS

LOCAL WELL NUMBER	PRIMARY USE OF WATER	DEPTH OF WELL (FEET)	WATER LEVEL (FEET)	DATE WELL CONSTRUCTED	OWNER	ASSIGNOR OF OTHER IDENTIFIER	OTHER IDENTIFIER
CD04006631ACDA1 003	C	40.0	12.00	01-27-73	TATE & CO	USS 1195	B0J
CD04006631ACDC1 002	U	43.5	--	- -60	JUNEAU C+B S.P. 10	--	--
CD04006631BABD1 010	H	42.0	--	09-18-65	JOSTEN L	MENDHALL VALLEY	MM137
CD04006631BACB1 005	P	80.0	5.00	06-16-60	JUNEAU AIRPORT	--	--
CD04006631BACD1 006	C	52.0	8.00	07-10-63	DAVE'S CHEVRON	--	--
CD04006631BACD2 006	P	71.0	7.00	05-06-79	SHOP 'N CART	MENDHALL VALLEY	MM057
CD04006631BACD3 006	-	70.0	14.00	02-03-66	USGS M-4	BRNWELL HA-259	M-4
					--	MENDHALL VALLEY	MM109
CD04006631BBAA1 007	P	43.0	--	12-01-63	AIRPORT MOTEL	--	--
CD04006631BBAA2 007	U	262	--	05-13-63	AIRPORT MOTEL	--	--
CD04006631BBAA3 007	H	45.0	--	01-01-55	AIRPORT MOTEL	--	--
CD04006631BBAA4 007	U	50.0	5.30	05-29-63	AIRPORT MOTEL	--	--
CD04006631BBAA5 007	H	60.0	--	01-01-59	KIRKBRIDE J	MENDHALL VALLEY	MM139
CD04006631BBAB1 004	H	46.0	8.00	12-29-71	WILLIAMSON G R	MCKINLEY SUB	L10B32
CD04006630BDCC3 012	-	68.0	--	--	RILEY B	MENDHALL VALLEY	MM169
CD04006630BDDB1 006	H	40.0	--	01-01-45	KODZOFF GEORGE	--	--
CD04006630BDDD1 013	H	126	--	06-01-64	SMITH SIDNEY	MENDHALL VALLEY	MM155
CD04006630BDDD2 013	H	90.0	--	01-01-62	HURLOCK DON	MENDHALL VALLEY	MM135
CD04006630CABA1 014	D	24.0	9.20	08-14-71	STUDNEK CONST CO	MENDHALL VALLEY	MM158
CD04006630CACD1 021	U	39.5	12.50	02-10-75	TURNKEY INC	MENDHALL VALLEY	MM079
CD04006630CADC1 002	U	50.0	--	- -60	JUNEAU C+B S.P. 8	--	--
CD04006630CBDC1 007	H	60.0	8.00	07-05-61	HENDRICKSN ARNOT	--	--
CD04006630CCBD2 015	H	30.0	--	01-01-55	KIRCHHOFER EVERETT	MENDHALL VALLEY	MM138
CD04006630CCCB1 016	C	27.0	--	09-25-65	GLOVER CONCRETE	MENDHALL VALLEY	MM126
CD04006630CCCB2 016	P	78.9	8.67	01-01-62	TOTEM PARK SUBD	MENDHALL VALLEY	MM164
CD04006630CCCC1 003	P	93.0	9.40	04-03-74	TOTEM PARK ASSOCIATI	USS 0381	L22T00F
CD04006630CCCD1 017	C	36.0	--	01-01-61	FAA JUNEAU	MENDHALL VALLEY	MM121
CD04006630CCDA1 018	H	42.0	--	01-01-62	GRAVES WM JR	MENDHALL VALLEY	MM128
CD04006630CCDA2 018	H	53.0	--	--	CHOQUETTE PAUL	MENDHALL VALLEY	MM118
CD04006630CDBA1 019	H	70.0	--	01-01-65	STROOPE J	MENDHALL VALLEY	MM157
CD04006630DBCB1 020	H	20.0	--	01-01-59	SUMMERS H	MENDHALL VALLEY	MM159
CD04006631ABBA1 015	P	34.8	5.90	10-16-83	SUPER-8 MOTEL	--	--
CD04006631ABBD1 008	H	36.0	--	01-01-60	SMITH F	MENDHALL VALLEY	MM153
CD04006631ABBD2 008	H	100	--	09-17-65	VUILLE JAMES	MENDHALL VALLEY	MM166
CD04006631BBBD1 009	C	39.5	10.80	08-07-82	PROFESSIONAL PLAZA	MENDENHALL ACRE	L04B44
CD04006631BBCB1 010	P	42.0	7.26	01-01-65	THUNDERBRD TERRACE	MENDHALL VALLEY	MM162
CD04006631BBCC1 011	U	36.5	7.63	05-11-68	USGS ARPRT 4	MENDHALL VALLEY	MM111
CD04006631BBCD1 001	U	43.6	--	--	JUNEAU C+B S.P. 9	--	--
CD04006631BBCD2 001	U	78.0	7.40	05-10-68	USGS ARPRT 5	MENDHALL VALLEY	MM112
CD04006631BDAC1 012	U	9.0	--	04-25-84	USGS OBS WELL	USGS	GS-22
CD04006631BDDB1 013	U	8.0	--	03-25-84	USGS OBS WELL	USGS	GS-21
CD04006632ADDD1 001	H	303	--	10-24-78	BARBUTTI BOB	--	--
CD04006633BCDC1 001	H	169	--	05-15-66	ABEL DON JR.	SUNNY PT PARK	L07B01
CD04006633CAAC1 002	H	250	--	--	TRIPLETTE CONST	--	--
CD04006633CADC1 003	H	200	--	- -81	TRIPLETTE CONST	--	--
CD04006634ACAD1 003	H	42.0	14.00	05-01-71	CARLSON	GLACIER VIEW	L17B0C
CD04006634ACBA1 001	H	62.0	12.00	10-04-71	STOTZ ALBERT	PINEWOOD PARK	L07B0Z
CD04006634ADBC1 002	H	41.0	18.00	01-06-79	SCHAEFER GEORGE	GLACIER VIEW	L21B0D
CD04006634BDAC1 004	H	65.0	5.00	09-27-73	LOTCHANSKY LEO	USS 0204	L09B0M
CD04106601CBDD1 003	H	--	--	--	LEIBOWITZ S	--	--
CD04106601DDAB1 001	H	253	1.00	12-06-76	CUNNINGHAM FRED	USS 3543	L135
CD04106601DDBA1 002	H	200	15.00	04-02-81	KOEHLER ERWIN K	LAS	000065
CD04106604AABC1 002	H	165	--	12-23-63	MARTIN LLOYD	USS 2903	L23
CD04106705ABAB1 003	T	200	--	--	LDS CHURCH	--	--
CD04106708DBBB1 001	H	150	12.00	01-23-62	SATKO JOE	USS 3174	L66A
CD04106713CCCC1 001	U	97.	-6.	06-10-77	CITY&BOROUGH OF JUNE	SECTION 67 LOTS	UNSUB AREA
					--	JUNEAU BOROUGH	GOLD CK BASII
CD04106714DDDA1 001	P	95.	2.	03-05-61	MUNICIPALITY OF JUNE	CITY WELL	HOLE NO. 2
					--	LAS	009733
CD04106716CAAA1 002	H	205	5.00	07-17-74	KING BARBARA	USS 2960	L10

LOCAL WELL NUMBER		PRIMARY USE OF WATER	DEPTH OF WELL (FEET)	WATER LEVEL (FEET)	DATE WELL CONSTRUCTED	OWNER	ASSIGNOR OF OTHER IDENTIFIER	OTHER IDENTIFIER
CD04006525DADD1	010	H	58.0	--	05-01-65	ELLIS R M	MENDHALL VALLEY	MM120
CD04006525DCAA1	005	H	28.0	--	07-01-71	ELLIS J G	MENDHALL VALLEY	MM004
CD04006525DCAA2	005	H	45.6	14.61	01-01-68	MCNABB CONSTR	MENDHALL VALLEY	MM146
CD04006525DCDA1	006	H	30.0	--	05-01-79	DENIGER JOHN	MENDHALL VALLEY	MM003
CD04006525DDAD1	012	H	100	--	01-01-60	LOCKHART R E	MENDHALL VALLEY	MM141
CD04006525DDBB1	007	H	48.0	--	09-01-70	HORTON GARY W	MENDHALL VALLEY	MM005
CD04006525DDDC1	008	H	60.0	7.90	10-01-80	PETERSON RON	MENDHALL VALLEY	MM002
CD04006536AAAC1	002	H	50.0	--	10-01-75	DELAND IVY	MENDHALL VALLEY	MM001
CD04006536AACD1	004	U	98.5	13.60	05-08-68	USGS	USGS	ARPRT. 1
						--	MENDHALL VALLEY	MM088
CD04006536AACD2	004	U	31.5	13.40	05-08-68	USGS	USGS	ARPRT. 1A
						--	MENDHALL VALLEY	MM089
CD04006536AACD3	004	U	79.0	16.00	05-09-68	USGS	USGS	ARPRT 2
						--	MENDHALL VALLEY	MM090
CD04006536AACD4	004	U	35.3	12.20	05-09-68	USGS	USGS	ARPRT. 2A
						--	MENDHALL VALLEY	MM091
CD04006536AADA1	003	U	38.0	6.72	01-01-65	THUNDERBRD TERRACE	MENDHALL VALLEY	MM163
CD04006536AADC1	001	H	33.0	10.09	05-11-73	RAMSEY SADIE J	USS 1742	T00A
CD04006536AADC2	001	U	36.3	7.80	05-11-68	USGS	USGS	ARPRT. 3
						--	MENDHALL VALLEY	MM092
CD04006536ADBB1	005	U	63.0	9.70	02-04-66	USGS	MENDHALL VALLEY	MM093
						--	USGS	M5
CD04006536ADBB2	005	U	60.0	9.70	01-01-66	JUNEAU C&B	MENDHALL VALLEY	MM170
CD04006619DAAD1	029	H	55.0	6.70	06-01-83	MUELLER SAM	MENDHALL VALLEY	MM034
CD04006619DABC1	039	H	54.0	--	01-01-62	CAMERON WILLIAM	MENDHALL VALLEY	MM116
CD04006619DACC1	004	U	35.0	--	--	JUNEAU C+B S.P. 6	--	--
CD04006619DADA1	030	H	58.0	--	06-01-83	STEFFENSEN KEITH	MENDHALL VALLEY	MM033
CD04006619DBDA1	041	H	65.0	--	01-01-60	CARROLL LAWRENCE	MENDHALL VALLEY	MM117
CD04006619DBDD1	006	H	48.1	4.05	08-24-78	PLEASANT GEORGE	USS 2100	L13
CD04006619DCAA1	043	H	38.0	--	01-01-64	ANDREW FRANK	MENDHALL VALLEY	MM113
CD04006619DCCC1	044	H	60.0	--	--	GROSS ENTRPRS	MENDHALL VALLEY	MM129
CD04006619DCDC1	031	P	44.0	--	10-01-78	LAKESIDE APTS	MENDHALL VALLEY	MM029
						ALLISON DAVE	--	--
CD04006619DDAA1	032	H	25.0	--	01-01-68	--	MENDHALL VALLEY	MM032
CD04006619DDBB1	010	T	80.0	2.00	01-01-62	GLACIER VAL SCHL	--	--
CD04006619DDBB2	010	T	43.0	3.00	01-01-63	GLACIER VAL SCHL	--	--
CD04006619DDBB3	010	N	14.0	--	01-01-63	GLACIER VAL SCHL	--	--
CD04006619DDCC1	045	H	50.0	--	01-01-64	GOERTZEN WILLIAM	MENDHALL VALLEY	MM127
CD04006619DDDB1	033	H	25.0	--	01-01-75	KORNELIUS NEAL	MENDHALL VALLEY	MM031
CD04006619DDDB2	033	H	40.0	--	01-01-63	DEAGAN JAMES	MENDHALL VALLEY	MM030
CD04006620BBDC1	006	H	90.0	--	01-01-63	KOWALSKI AL	MENDHALL VALLEY	MM140
CD04006620BCAD1	003	H	58.0	--	06-01-75	SHIELDS GENE	MENDHALL VALLEY	MM036
CD04006620BCBA1	007	H	45.0	--	--	MOLLAN P	MENDHALL VALLEY	MM149
CD04006620BCCC1	002	H	70.0	--	07-01-82	THOMPSON KEN	MENDHALL VALLEY	MM035
CD04006620BCDB1	008	H	65.0	2.15	09-01-65	JOHNSON DOUGLAS	MENDHALL VALLEY	MM136
CD04006630BABA1	008	H	40.0	--	01-01-78	BRAYTON JAMES A	MENDHALL VALLEY	MM009
CD04006630BACA1	009	H	60.0	--	04-01-79	JOHNSON WILL	MENDHALL VALLEY	MM008
CD04006630BCAB1	011	H	40.0	--	05-01-79	BECKS JOE	MENDHALL VALLEY	MM006
CD04006630BCCA1	022	U	77.9	9.28	05-15-68	USGS RILEY 2	MENDHALL VALLEY	MM105
CD04006630BCCB1	023	U	31.4	11.20	05-13-68	USGS RILEY 1	MENDHALL VALLEY	MM106
CD04006630BCCB2	023	U	78.3	10.60	05-14-68	USGS RILEY 1A	MENDHALL VALLEY	MM107
CD04006630BCDA1	024	U	82.5	7.12	05-18-68	USGS RILEY 4	MENDHALL VALLEY	MM108
CD04006630BCDB1	025	U	78.5	9.06	05-17-68	USGS RILEY 3	MENDHALL VALLEY	MM110
CD04006630BDAB1	004	P	95.0	--	01-01-60	KODZOFF ACRES	--	--
CD04006630BDBB1	001	U	43.5	--	- -60	JUNEAU C+B S.P. 7	--	--
CD04006630BDBB2	001	H	46.0	--	03-01-78	WASSENBURG CARL	MENDHALL VALLEY	MM007
						MURPHY JAMES	--	--
CD04006630BDBD1	005	H	42.0	--	01-01-41	KODOZOFF GEORGE	--	--
CD04006630BDCC1	012	H	68.0	--	01-01-61	GLACIER DEV CORP	MENDHALL VALLEY	MM124
CD04006630BDCC2	012	U	32.0	8.65	09-25-65	GLACIER DEV CORP	MENDHALL VALLEY	MM125

APPENDIX 2

Excerpts from U.S. Geological Survey Open-File Report 82-271:
Aquifer data from four wells in the Mendenhall Valley near
Juneau, Alaska

AQUIFER DATA FROM FOUR WELLS IN THE MENDENHALL VALLEY NEAR JUNEAU, ALASKA

By G. O. Balding

ABSTRACT

The report summarizes data collected during drilling and testing of four wells in Mendenhall Valley, an area being developed as a suburb of Juneau. Previous studies indicated that the glacial deposits on the east side of the valley had the potential for producing the large quantities of water needed for a community water supply. The drilling defined an upper aquifer between the water table and a depth of 215 feet and a lower aquifer below 347 feet. The testing did not define the storage coefficient or transmissivity of the upper aquifer. Drawdowns within 20 feet of the test well were less than 12 feet when the pumping rate was 300 gallons per minute. Greater pumping rates could be sustained in larger diameter wells having larger screened intervals in the upper aquifer but would produce greater drawdowns. The performance of the lower aquifer was not tested. Water in the upper aquifer is of adequate quality for drinking water, but may require treatment for iron; water from the lower aquifer is brackish.

INTRODUCTION

The City and Borough of Juneau are investigating the feasibility of a centralized water-distribution system in the Mendenhall Valley-Auke Bay area, west of Juneau. Ground water from the Mendenhall Valley is a likely source of water for the system.

This study, which was jointly funded by the U.S. Geological Survey and the City and Borough of Juneau, consisted of an evaluation of three existing wells and the drilling and testing of a 386-foot well.

The objectives of the study were to:

- Describe the unconsolidated materials that might provide water to high-capacity public-supply wells.
- Evaluate the quality of the ground water as a public-supply source.

HYDROGEOLOGY

The Mendenhall Valley (fig. 1) is underlain by fluvial, glaciofluvial, and glaciomarine sediments that are locally overlain by peat (Miller, 1975). Seismic studies indicate that the unconsolidated sediments range from 250 ft thick near Mendenhall Lake to 750 ft thick near the coast. The valley walls consist of metamorphic rocks that are mantled on the lower slopes by mass-wasting deposits.

Barnwell and Boning (1968) concluded that bedrock, mass-wasting deposits, and glaciomarine deposits are unlikely to provide the large quantities of water required by municipal-supply wells. However, they thought that the fluvial and

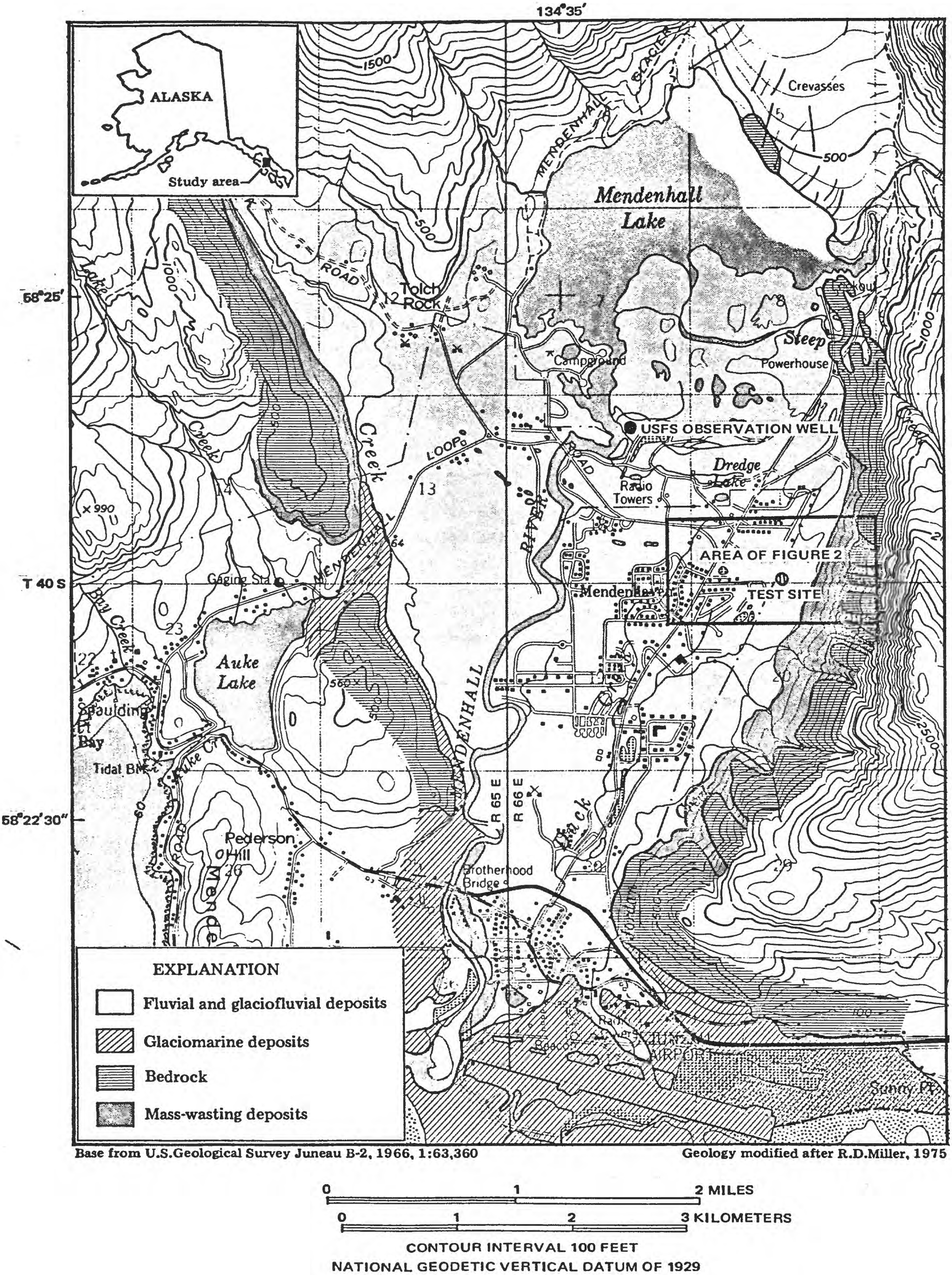

Figure 1. -- Location of study area and surficial geology of Mendenhall Valley.

glaciofluvial deposits had good potential as sources of ground water for municipal wells. Logs of domestic wells (McConaghy, 1969) also indicated abundant water from the fluvial and glaciofluvial sediments. Consequently, a site for a test-well field was chosen in glaciofluvial sediments, more specifically in glacial outwash near the east side of the valley (fig. 2).

DRILLING AND TESTING

The test well and observation wells 1 and 2 were drilled by the City and Borough of Juneau in 1974 (table 1). The wells penetrated sand and gravel and were completed at depths that range from 70 to 82 ft. Highly permeable zones were found in those wells at 55-60 ft and 78-82 ft. The 55-60 ft zone produced water having a high concentration of iron and consequently was cased off.

Table 1.--Well-construction data.

Well	Diameter (in.)	Hole depth (ft)	Finished well depth (ft)	Screened interval (ft)	Screen size (in.)	Completion date
Test*	6	85	82	78-82	.060	1974
Test*	6	110	106	102-106	.040	1979
Obs. 1	6	71.5	71	67.5-71	.040	1974
Obs. 2	6	70	70	67.5-70	.040	1974
Obs. 3	6	386	386	open end	none	1979

*Test well was first pumped when it was 85 ft deep. It was subsequently deepened to 110 ft for the February 1980 test.

In 1979, observation well 3 was drilled (table 1), and two aquifer performance tests were conducted. The configuration of the wells is shown in figures 2 and 3. Observation well 3 at the time of the tests was 67 ft deep, as shown by the solid line. It was subsequently deepened to 386 ft but did not reach bedrock. The total depth is shown as a dotted line.

Geophysical logs were run in the three observation wells to aid in correlation of geologic units. The composite driller's and geophysical logs for observation wells 1, 2, and 3 are shown in figures 4 and 5.

Observation well 3 (fig. 5) was drilled to 386 ft to evaluate deep aquifers and their water quality. The well penetrated a generally downward-fining sequence of interlayered sand, silt, and gravel from land surface to 347 ft. Between 347 ft and 386 ft the sand was coarser than in the interval between 200 and 347 ft. Marine shell fragments found at 302 and 352 ft indicate that the lower part of the sedimentary sequence contains marine sediments.

The sediments between the water table and a depth of 215 ft are hereafter referred to as the upper aquifer. The sediments below 347 ft are the lower aquifer. The fine-grained, silty sand between 215 and 347 ft was much less permeable than the aquifers.

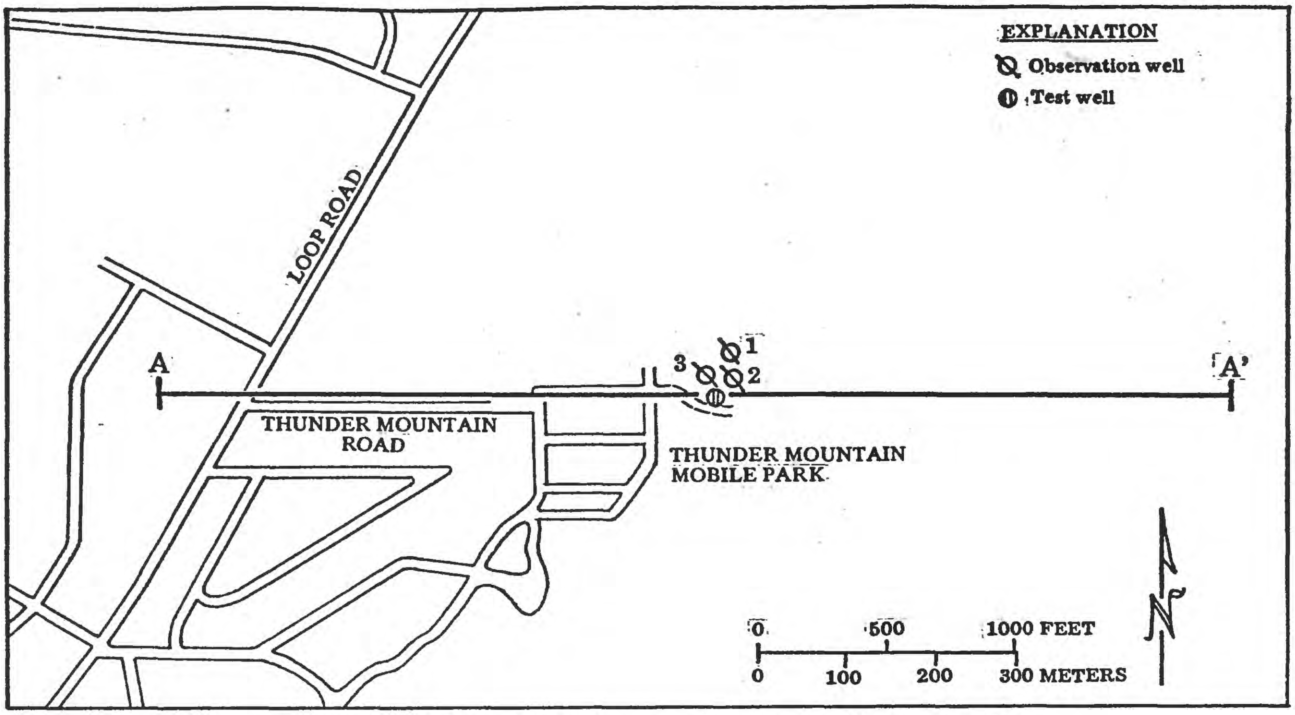

Figure 2. -- Map of test-site area showing locations of wells.

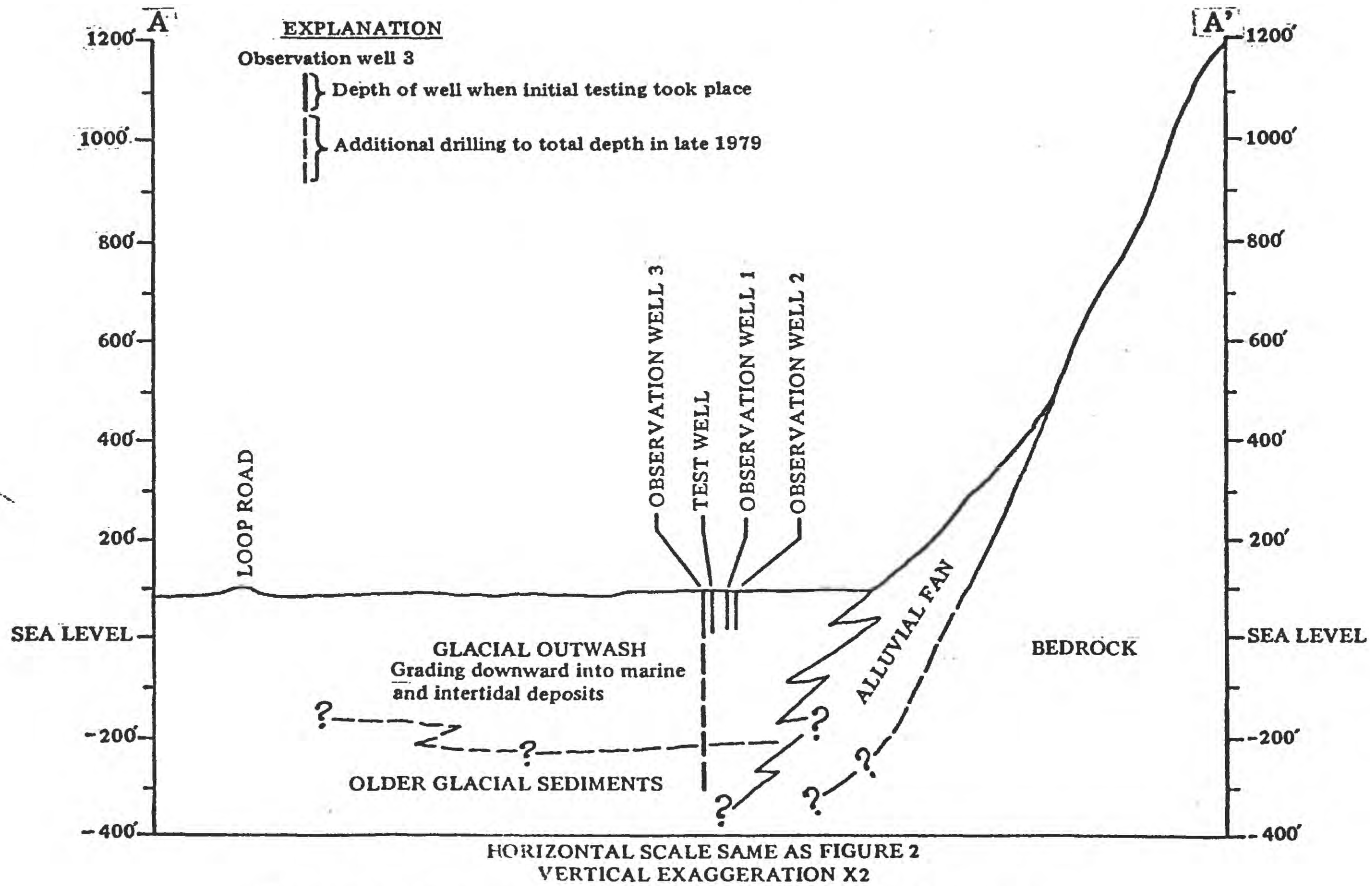

Figure 3. -- Geologic section along A-A' in figure 2. Observation wells are projected onto the plane of the section.