STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

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September 1986

Report of Investigations 86-24

GROUND-WATER CONTAMINATION AT PETERS CREEK, MUNICIPALITY OF ANCHORAGE, ALASKA: GROUND-WATER OCCURRENCE AND MOVEMENT

By

James A. Munter

In cooperation with Alaska Department of Environmental Conservation

STATE OF ALASKA
Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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GROUND-WATER CONTAMINATION AT PETERS CREEK, MUNICIPALITY OF ANCHORAGE, ALASKA: GROUND-WATER OCCURRENCE AND MOVEMENT

By James A. Munter[1]

INTRODUCTION

During April through August 1986, 15 private domestic wells at Peters Creek, Municipality of Anchorage, Alaska (figs. 1 and 2), were found to be contaminated with a variety of aromatic hydrocarbons, including benzene, toluene, and xylene (Alaska Department of Environmental Conservation, written commun., 1986). As of August 1986, the source of contamination was unknown. A hydrogeologic investigation was conducted to provide a framework for further work to discover the source and evaluate movement of the contaminant plume. This report summarizes data collected and analyzed through August 1986 pertinent to the occurrence and movement of ground water and associated contaminants at Peters Creek.

ACKNOWLEDGMENTS

James F. Hayden and other staff members of the Alaska Department of Environmental Conservation (ADEC) collected much of the data described herein and provided useful consultation; area well drillers produced many useful well logs. Randall G. Updike of the Alaska Division of Geological and Geophysical Surveys and Gordon Nelson of the U.S. Geological Survey (USGS) provided helpful reviews of the manuscript.

WELL-LOG DATA

The analyses presented in this report are based largely on information obtained from logs of water wells drilled in the Peters Creek area. Well logs typically consist of drillers' descriptions of geologic materials encountered during drilling and well-construction data such as casing diameter, well depth, and type and depth of well opening. During April and May 1986, water levels were measured in numerous wells (DOWL Engineers, 1986), including some for which no well logs are available. The plotted locations of most wells shown in this report are approximate because exact locations of wells on most lots are not known. Some wells were plotted in the middle of the fourth-order aliquot parcel of a section (2.5-acre area).

GEOLOGIC SETTING

The Peters Creek study area is located at the western edge of the Chugach Mountains of southcentral Alaska, about 2 mi from Knik Arm (fig. 1). The Chugach Mountains near Peters Creek are composed of metasedimentary, metavolcanic, and plutonic rocks of Jurassic to Cretaceous age (Brunett and Lee, 1983) The Kenai Group (Tertiary) consists of siltstone, sandstone, and coal (Zenone and others, 1974) and occurs throughout much of the lowlands near

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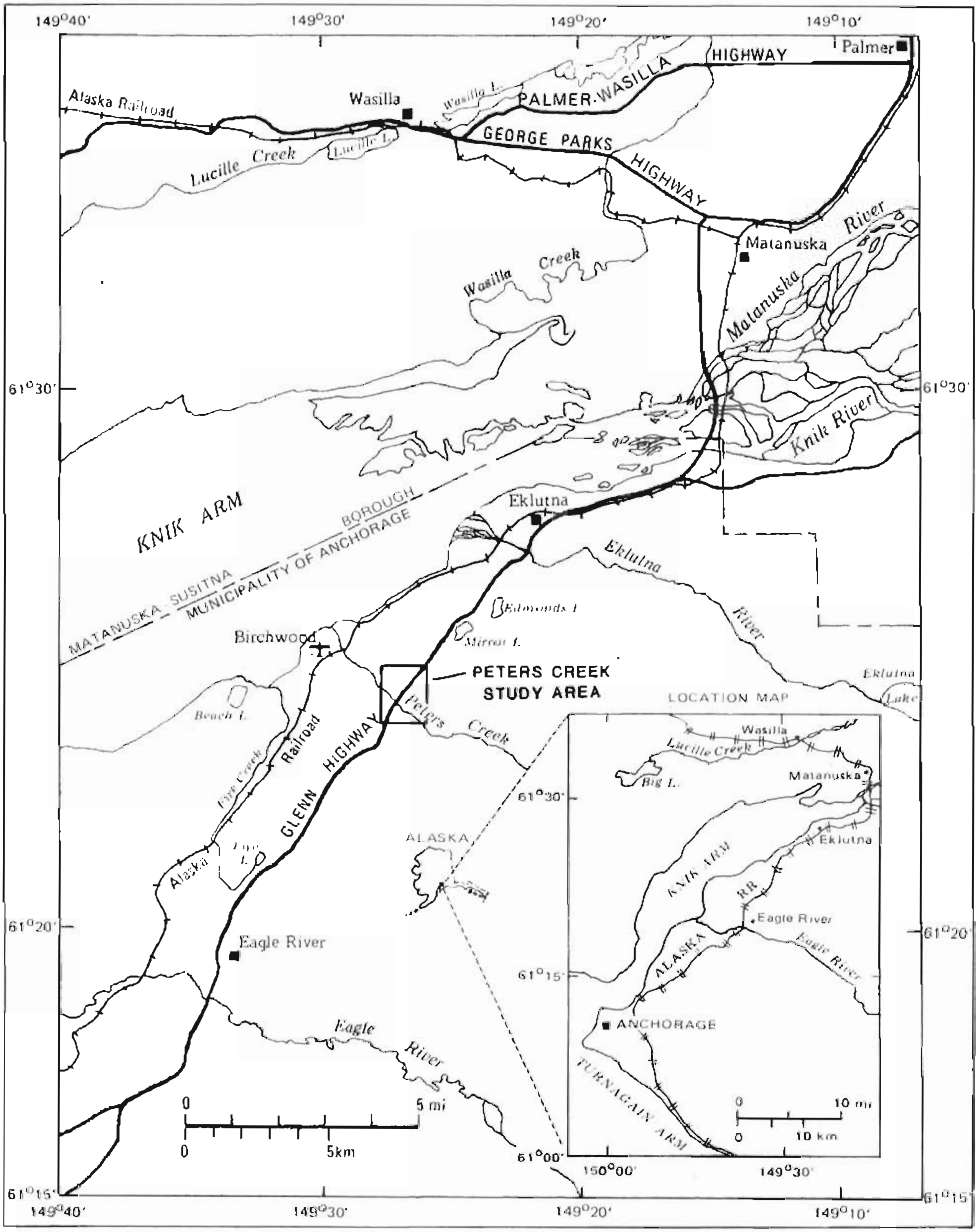
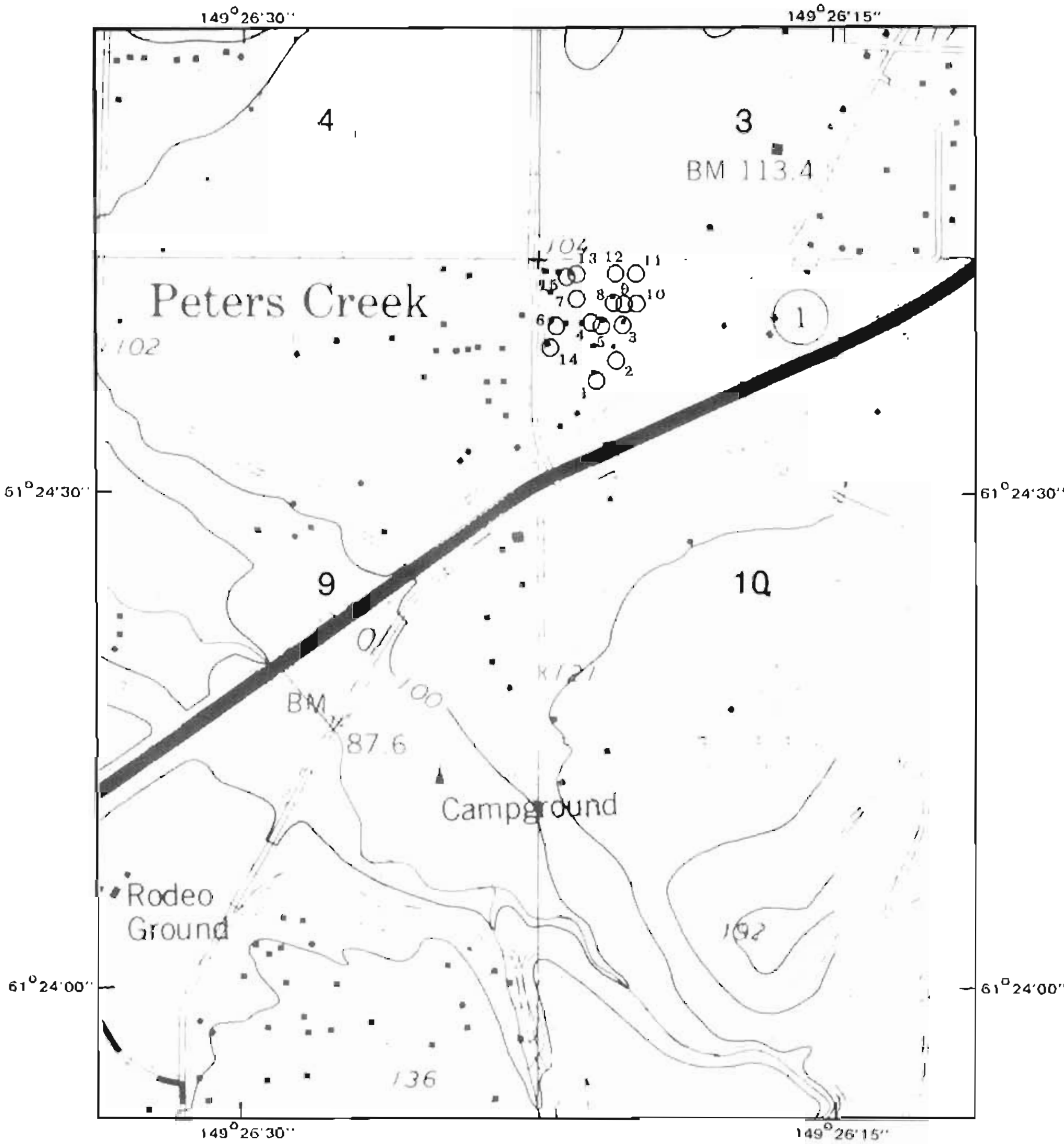


Figure 1. Location of the Peters Creek study area.



Base from U.S. Geological Survey Anchorage B-7 NE and NW Quadrangles, Alaska, 1979.

The study area is located within T. 15 N. and R. 1 W., Seward Meridian

CONTOUR INTERVALS 5 AND 20 METERS
DATUM IS MEAN SEA LEVEL

0 1000 2000 feet
0 200 400 600 meters

EXPLANATION

O_2 Locations of wells that contain benzene-contaminated water, (see table 1).

Figure 2. Location of contaminated wells at Peters Creek.

Peters Creek; it is overlain by a mantle of nonlithified glacial deposits of Quaternary age. Because the contact between rocks of Tertiary and pre-Tertiary age is obscured by glacial drift and because no wells are known to penetrate Kenai Group rocks in the study area, it is not known whether Kenai Group rocks underlie the study area. The term bedrock is used in this report to refer to rocks of Tertiary and pre-Tertiary age in the Peters Creek area.

A structure contour map of the bedrock surface, based on well-log and available outcrop data (Zenone and others, 1974), is shown in figure 3. At approximately the section line that separates secs. 9 and 10, T. 15 N., R. 1 W., the elevation of the bedrock surface drops sharply west compared to the relatively flat bedrock surface to the east. This subsurface escarpment is not evident from surface topographic features, but may be associated with the contact between rocks of Tertiary and pre-Tertiary age.

Geologic deposits near the land surface are primarily nonlithified glacial and glaciofluvial deposits of Quaternary age with minor alluvial and colluvial deposits near Peters Creek (Zenone and others, 1974). The total thickness of nonlithified deposits (fig. 4) is derived from contour maps of the bedrock surface and land surface (fig. 3). The thickening of Quaternary deposits that occurs in section 9 primarily results from the escarpment on the bedrock surface.

MAJOR CONFINED AQUIFERS

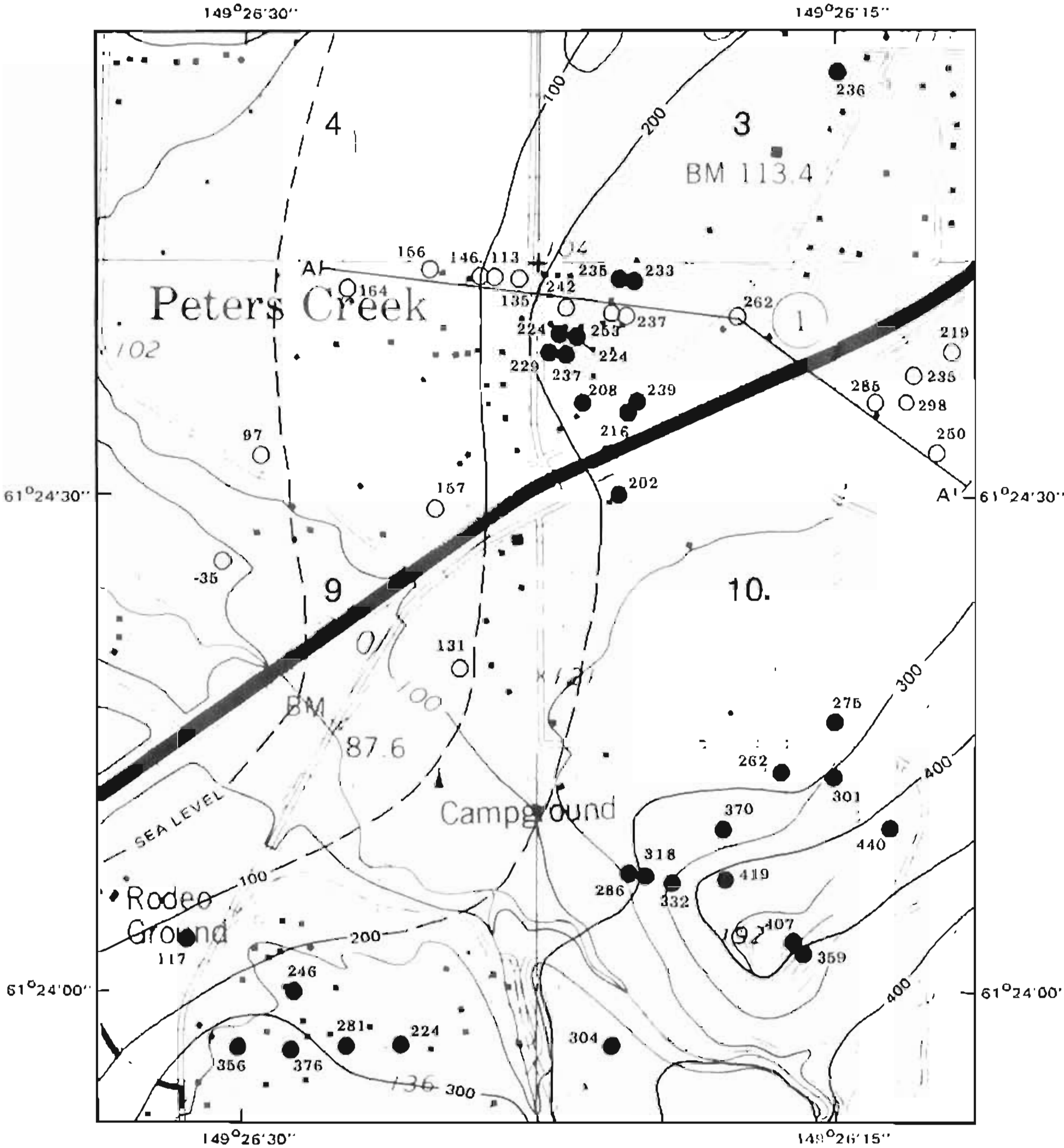
Most wells at Peters Creek obtain water from glaciofluvial aquifers composed principally of sand and gravel that are confined by silty glacial sediments, predominantly till. Figure 5 shows the locations of four major confined aquifers and the structure contours of the top of each aquifer; figure 6 shows the potentiometric surfaces of the aquifers. The potentiometric surface of an aquifer is the level to which water rises in a well that taps the aquifer. Figure 7 is a hydrogeologic cross section that depicts subsurface conditions near the contaminated area.

Ski Road Aquifer

The Ski Road aquifer occurs in most of the eastern half of the study area and is tapped by at least 32 wells. Most wells penetrate the aquifer only a few feet and have reported yields of 5 to 25 gallons per minute (gpm). Well yields as high as 100 gpm have been reported, and the aquifer may be up to 100 ft thick. The potentiometric surface of the aquifer (fig. 6) shows that ground water in the aquifer moves principally from east to west.

Peters Creek Aquifer

The Peters Creek aquifer covers an area of about 15 acres and is tapped by at least 19 wells. All 15 of the benzene-contaminated wells in the area obtain water from the Peters Creek aquifer or are located adjacent to the aquifer and obtain water from the bedrock aquifer. The Peters Creek aquifer is relatively thin (reported thicknesses vary from 1 to 20 ft) and unproductive (reported yields range from 2 to 15 gpm). The potentiometric surface of the aquifer (fig. 6) shows that ground water moves principally from east to west through the aquifer.



Base from U.S. Geological Survey Anchorage B-7 NE and NW Quadrangles, Alaska, 1979.

The study area is located within T. 15 N. and R. 1 W., Seward Meridian

EXPLANATION

● 286 Location of well that penetrates bedrock and elevation of bedrock surface (ft)

○ 97 Location of well that does not penetrate bedrock and elevation of bottom of well (ft)

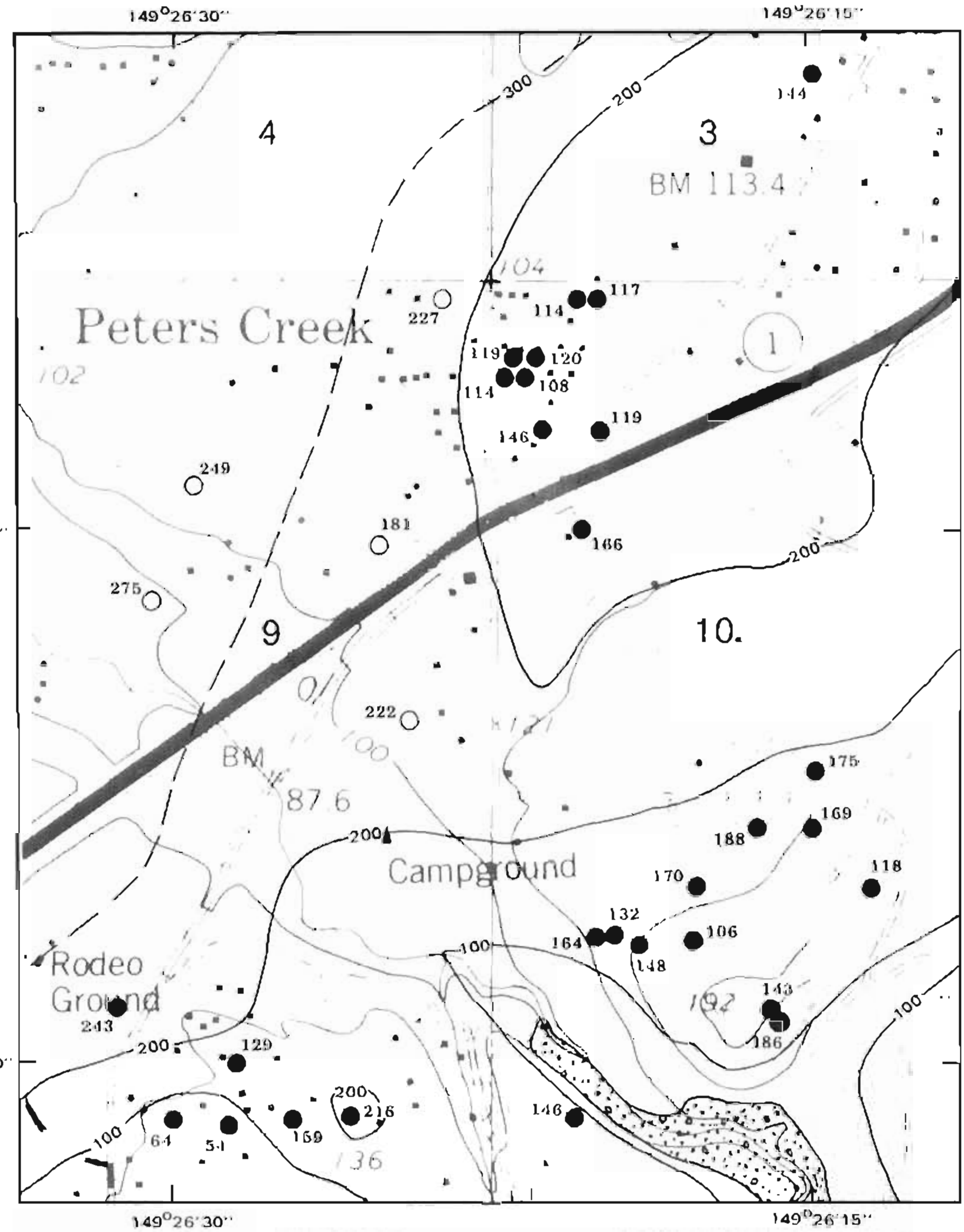
—100— Line of equal elevation of bedrock surface. Contour interval 100 feet, line dashed where approximate.

A├──┤A' Cross section (see fig. 7)

CONTOUR INTERVALS 5 AND 20 METERS
DATUM IS MEAN SEA LEVEL

0 1000 2000 feet
0 200 400 600 meters

Figure 3. Structure contour map of the bedrock surface.



Base from U.S. Geological Survey Anchorage B-7 NE and NW Quadrangles, Alaska, 1979.

The study area is located within T. 15 N. and R. 1 W., Seward Meridian

EXPLANATION

114 ● Location of well that penetrates bedrock and thickness of nonlithified deposits (ft)

246 ○ Location of well that does not penetrate bedrock and depth of well (ft)

—100— Line of equal thickness of nonlithified materials. Contour interval 100 feet, contour dashed where approximate.

Area where bedrock is at or near the land surface (Brunett and Lee, 1983)

CONTOUR INTERVALS 5 AND 20 METERS

DATUM IS MEAN SEA LEVEL

0 1000 2000 feet

0 200 400 600 meters

Figure 4. Isopach map of Quaternary sediments.

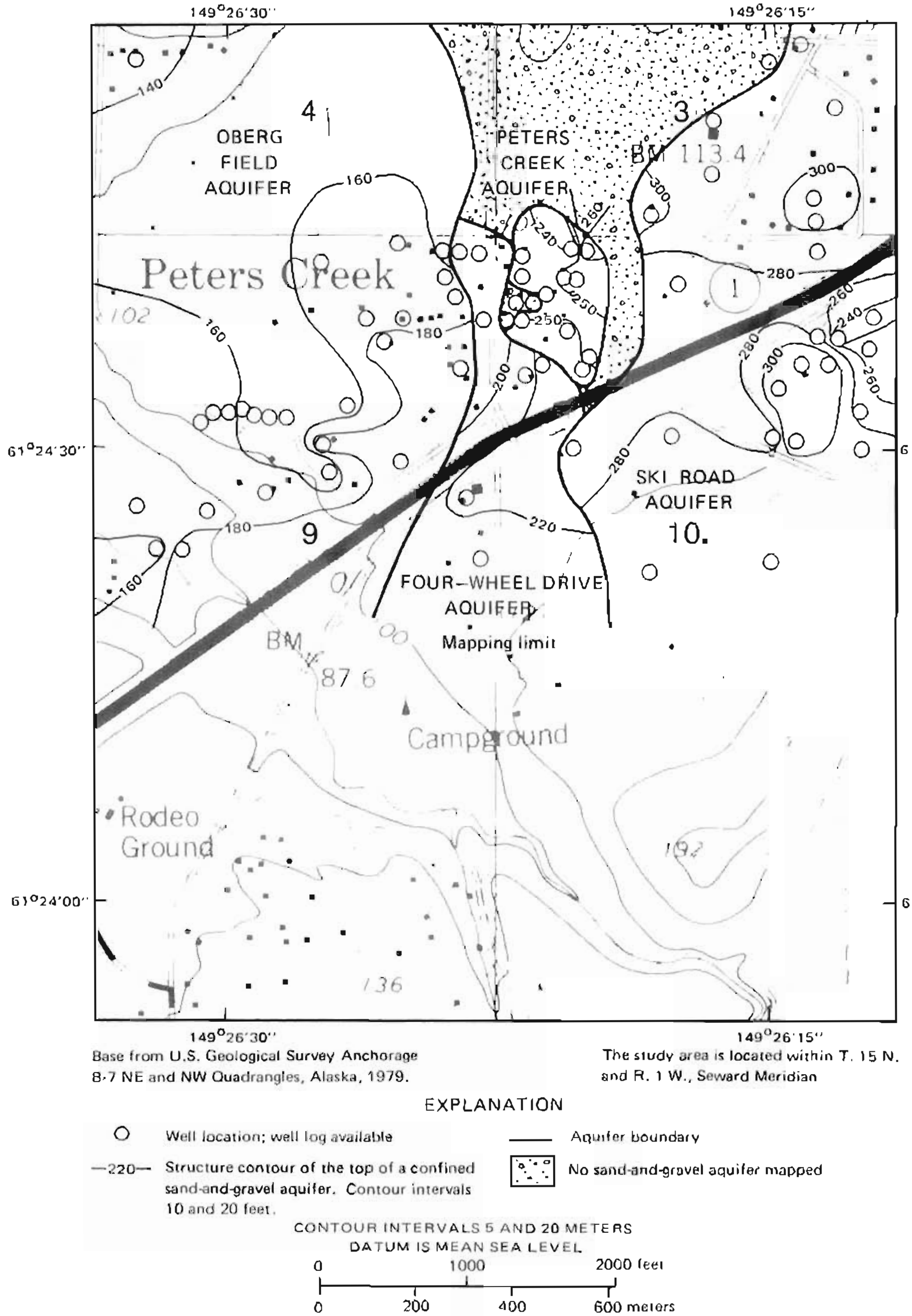
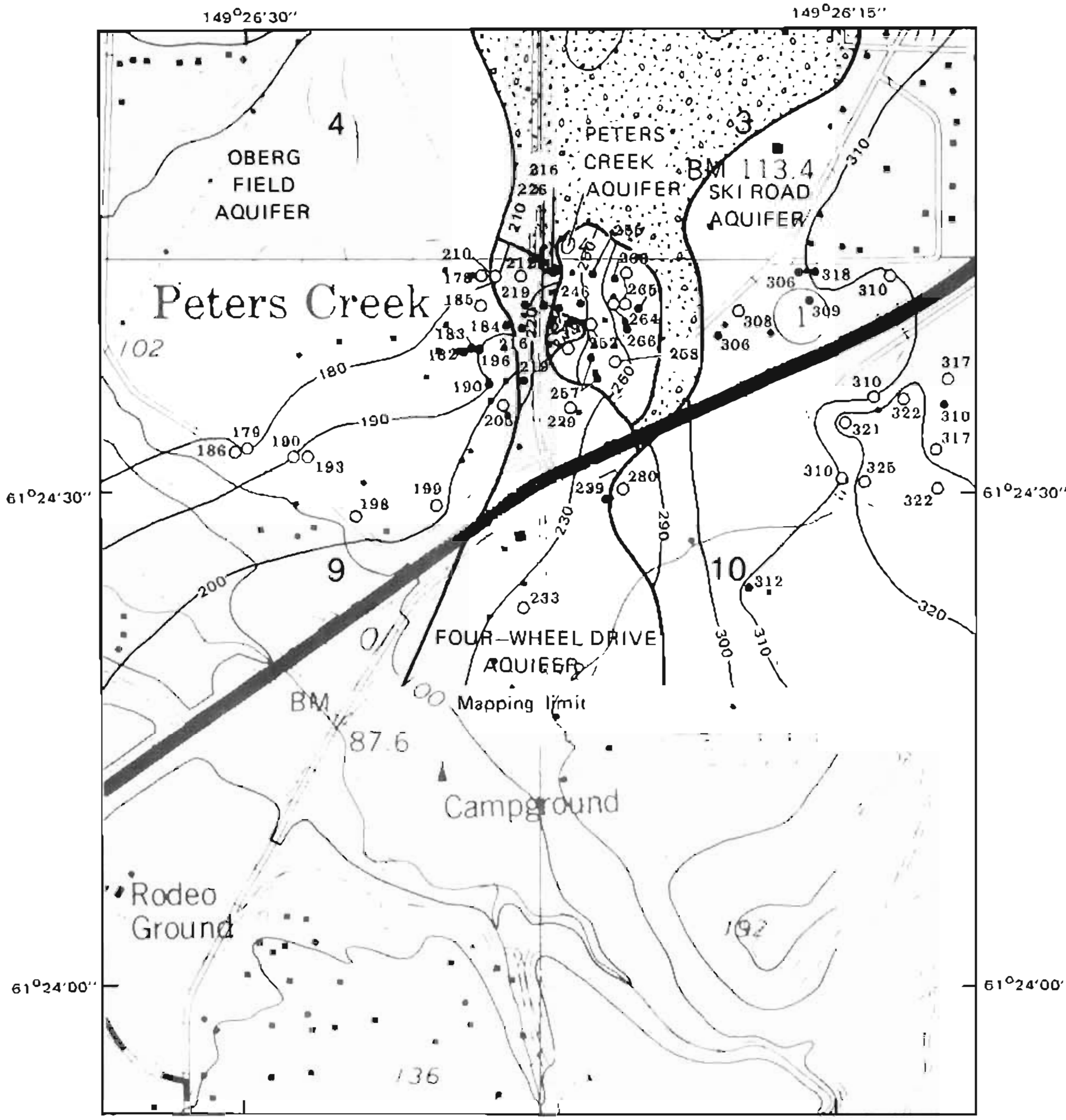


Figure 5. Structure contour map of the top of major confined aquifers at Peters Creek.



Base from U.S. Geological Survey Anchorage B-7 NE and NW Quadrangles, Alaska, 1979.

The study area is located within T. 15 N. and R. 1 W., Seward Meridian

EXPLANATION

Elevation (ft) of water level measured during April-May 1986 (DOWL Engineers, 1986)

312 ○ Well location; well log available

● 198 Well location; no well log available

—— Aquifer boundary

No sand-and-gravel aquifer mapped

—200— Potentiometric contour, April–May 1986. Contour interval 10 feet

CONTOUR INTERVALS 5 AND 20 METERS
DATUM IS MEAN SEA LEVEL

0 1000 2000 feet

0 200 400 600 meters

Figure 6. Potentiometric surfaces of major confined aquifers at Peters Creek.

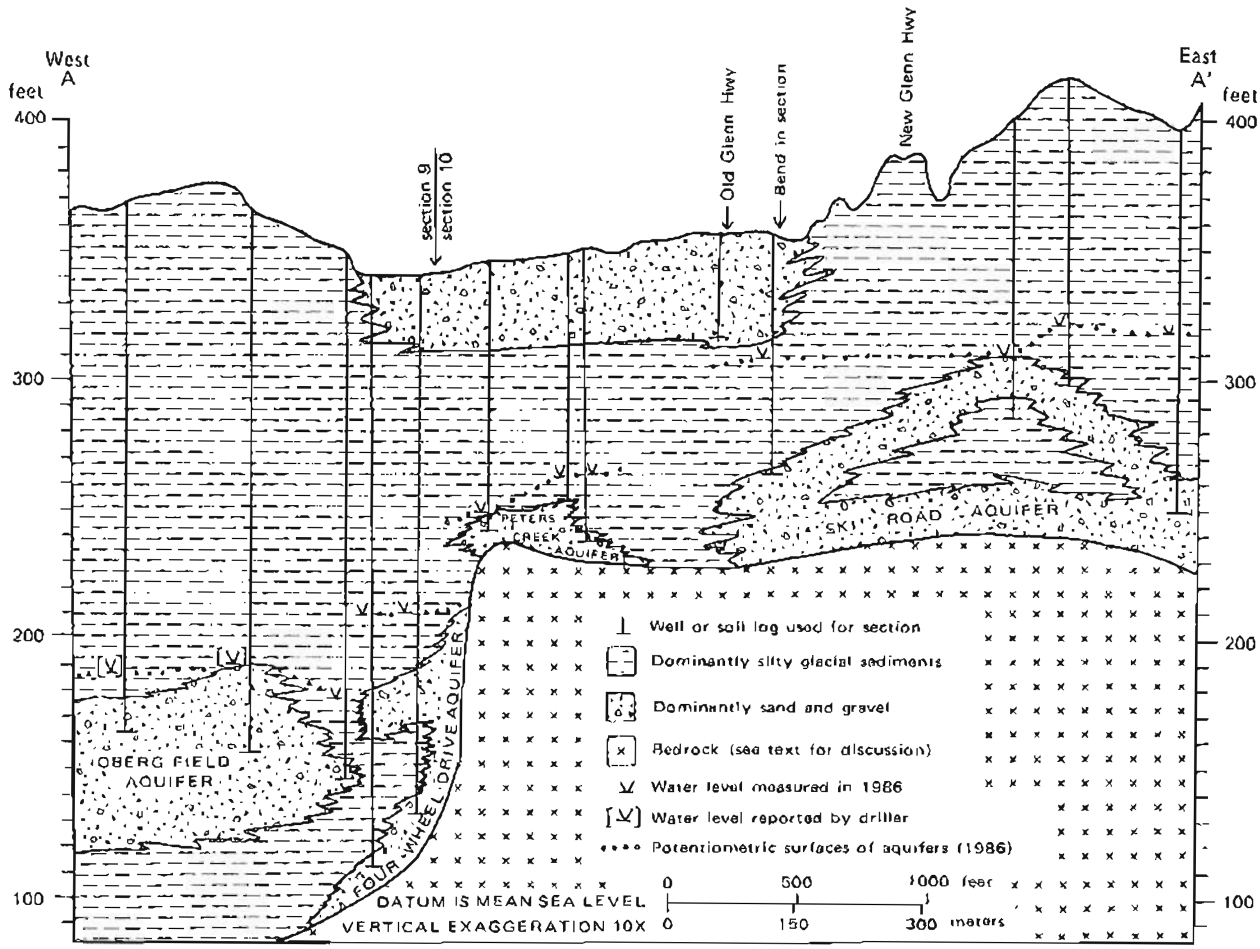


Figure 7. Hydrogeologic cross section showing surburface conditions near the contaminated area.

Four Wheel Drive Aquifer

The Four Wheel Drive aquifer occurs immediately west of the Peters Creek and Ski Road aquifers and has an elongated north-south orientation. The aquifer overlies an area where the bedrock surface slopes downward relatively steeply to the west. Available well-log data, although sparse, suggest that the aquifer is composed of multiple sand and gravel bodies that are complexly interconnected. Reported yields of wells that tap the aquifer range from 3 to 13 gpm, and available water-level data show that ground water moves principally from southeast to northwest (fig. 6).

Oberg Field Aquifer

The Oberg Field aquifer is a productive aquifer tapped by at least 30 wells in the west half of the study area, including two wells used to supply water to a temporary public water system that serves the area of contaminated ground water. A public well that serves Northwoods subdivision is located about 0.67 mi northwest of the contaminated ground water and probably also taps the Oberg Field aquifer.

The top of the Oberg Field aquifer occurs at a depth of 160 to 200 ft in most of the study area. Although no wells are known to fully penetrate the aquifer, its thickness may be 100 ft in some areas. Most reported well yields range from 10 to 50 gpm, but yields of up to 200 gpm have been reported. A test of the Oberg Field aquifer (Munter, 1986) confirmed that the aquifer is relatively productive. Ground-water flow within the Oberg Field aquifer is generally from the southeast towards the northwest in the study area.

A hydrogeologic cross section (fig. 7) through the area of contaminated ground water shows that ground water generally moves from the land surface down to the confined aquifers and from east or southeast to west or northwest through the series of aquifers. Ground-water gradients within the aquifers are typically less steep than gradients between aquifers, which is consistent with the inferred permeability contrasts between aquifer sands and gravels and silty confining-unit lithologies. Because specific hydraulic characteristics of the aquifers and confining units are largely unknown, meaningful ground-water flow velocities cannot be estimated.

Available well and soil-boring logs (DOWL Engineers, 1986) show that the near-surface alluvium shown in figure 7 is composed of a variety of sediment types, including silts, sands, and gravels, and may be locally or seasonally water-bearing. Permeable sands and gravels within this unit may have significant potential for lateral migration of contaminants under water-table conditions.

Observed Pattern of Ground-water Contamination

Table 1 lists the maximum levels of benzene contamination observed from April through August 1986 in wells at Peters Creek (ADEC, written commun., 1986). Although consistent sampling methods were not used at all wells (J.F. Hayden, ADEC, oral commun., 1986), the benzene-concentration data are useful indicators of the extent and intensity of the contaminant plume because their values span four orders of magnitude. The highest values are for wells in the eastcentral part of the plume (fig. 2) with decreasing values to the north, west, and south. Most wells that tap the Peters Creek aquifer are contaminated, which suggests that substantial contaminant migration may have occurred within the aquifer since the contamination was initially discovered in March and April 1986 (Bennett, 1986).

Although collected data cover a short period of time, a review of contaminant-concentration data (ADEC, written commun., 1986) suggests that contaminant levels were increasing, and contamination was spreading within the Peters Creek aquifer through August 1986. This indicates that wells that are currently not known to be contaminated, yet tap the Peters Creek aquifer, are at a high risk of becoming contaminated.

Table 1. Maximum levels of benzene concentrations determined from water drawn from Peters Creek wells from April through August 1986. (See fig. 1 for well locations.)

Well	Benzene concentration (mg/l)
1	1.6
2	9.1
3	40
4	9.0
5	0.81
6	0.051
7	3.4
8	35
9	25
10	9.1
11	0.081
12	5.7
13	0.0026
14	0.002
15	5.2

CONCLUSIONS

Four major confined sand and gravel aquifers at Peters Creek, Alaska, have been identified and mapped. The aquifers are confined by tens of feet of silty glacial sediments (till). Near-surface alluvial deposits may constitute a significant local or seasonal aquifer. Extensive contamination of the Peters Creek confined aquifer by benzene, toluene, and xylene has occurred, but contamination is not known to have spread to the other confined aquifers (as of August 1986). Contamination of the Peters Creek aquifer through August 1986 appears to be increasing in extent and intensity. Because the source of contamination is unknown, a specific migration path(s) of contamination is unknown. The natural direction of ground-water flow is toward the Four Wheel Drive and Oberg Field aquifers, which are used for water supply. Leakage of contaminated water from the Peters Creek aquifer to the Four Wheel Drive or Oberg Field aquifers could contaminate these aquifers.

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