Ground-Water Conditions and Quality in the Western Part of Kenai Peninsula, Southcentral Alaska

By Roy L. Glass

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Multiply	by	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
million gallons (Mgal)	3,785	cubic meter
gallon per minute (gal/min)	0.06309	liter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second
degree Fahrenheit (°F)	°C = 5/9 x (°F - 32)	degree Celsius (°C)

Vertical Datum

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

Water-Quality Information

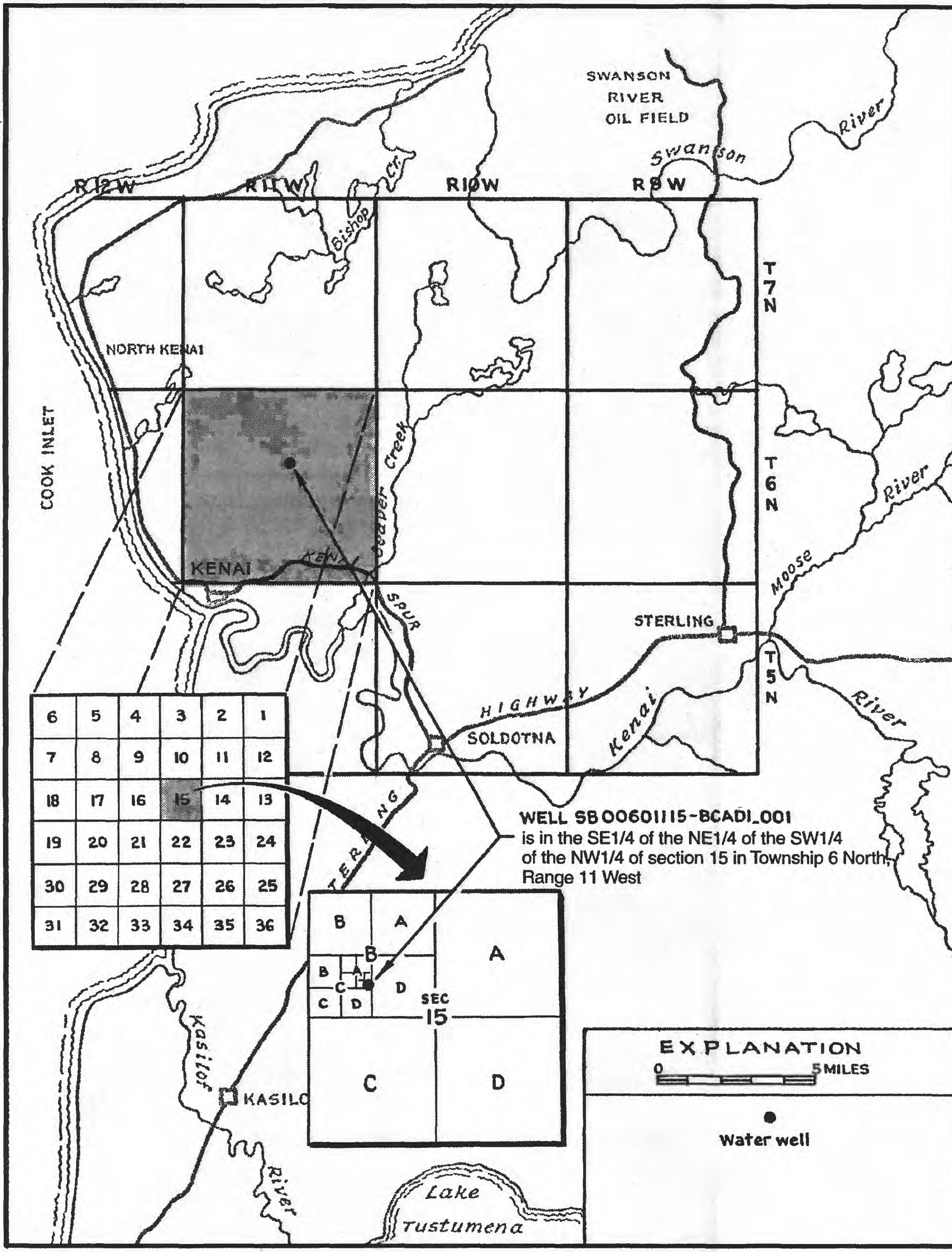
Chemical concentrations, water temperature, and specific conductance in this report are given in metric units. Absolute concentration of major dissolved ions is expressed in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams and micrograms per liter are units expressing weight of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. Micrograms per liter is equivalent to "parts per billion." The relative concentration of a cation or anion can be expressed as relative percentage of the total milliequivalents per liter (meq/L) of cations or anions. The milliequivalent concentration is obtained by multiplying the absolute concentration by the reciprocal of the combining weight of each ion, which is the formula weight divided by the ionic charge. Specific conductance is reported in microsiemens per centimeter (µS/cm) at 25 degrees Celsius.

Water Year

In U.S. Geological Survey reports, "water year" refers to the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.

Well-Numbering System

The "Local Number" of a well is derived from the official rectangular subdivision of public lands as illustrated on p. VI. The number of the well in the illustration is SB00601115-BCAD1_001. The first letter (S) indicates the Seward baseline and principal meridian, and the second letter (B) represents the northwest quadrant formed by the intersection of the baseline and the principal meridian in which the well is located. All well numbers in the upper peninsula begin with "SB" and all well numbers in the lower peninsula in and south of Ninilchik start with "SC."The first three digits indicate the township in which the well is located, the next three digits the range, and the next two, the section. Letters following the section number indicate the 1/4 1/4 1/4 1/4 subdivisions of the sections. Each of these successively smaller subdivisions is lettered counterclockwise beginning at the northeast corner. The next digit is a sequential number assigned to distinguish between wells that fall within the same site. The last three numbers are assigned sequentially to wells within each section.



Explanation of well-numbering system for local number.

Ground-Water Conditions and Quality in the Western Part of Kenai Peninsula, Southcentral Alaska

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ABSTRACT

The western part of Kenai Peninsula in southcentral Alaska is bounded by Cook Inlet and the Kenai Mountains. Ground water is the predominant source of water for commercial, industrial, and domestic uses on the peninsula. Mean daily water use in an oil, gas, and chemical processing area north of Kenai is more than 3.5 million gallons. Unconsolidated sediments of glacial and fluvial origin are the most productive aquifers. In the upper (northwestern) peninsula, almost all water used is withdrawn from unconsolidated sediments, which may be as thick as 750 feet. In the lower peninsula, unconsolidated sediments are thinner and are absent on many hills. Water supplies in the lower peninsula are obtained from unconsolidated sediments and bedrock, and a public-water supply in parts of Homer is obtained from Bridge Creek. Throughout the peninsula, ground-water flow occurs primarily as localized flow controlled by permeability of aquifer materials and surface topography.

The concentration of constituents analyzed in water from 312 wells indicated that the chemical quality of ground water for human consumption varies from marginal to excellent. Even though the median concentration of dissolved solids is low (152 milligrams per liter), much of the ground water on the peninsula does not meet water-quality regulations for public drinking water established by the U.S. Environmental Protection Agency (USEPA). About 8 percent of wells sampled yielded water having concentrations of dissolved arsenic that exceeded the USEPA primary maximum contaminant level of 50 micrograms per liter. Concentrations of dissolved arsenic were as great as 94 micrograms per liter. Forty-six percent of wells sampled yielded water having concentrations of dissolved iron greater than the USEPA secondary maximum contaminant level of 300 micrograms per liter.

Unconsolidated sediments generally yield water having calcium, magnesium, and bicarbonate as its predominant ions. In some areas, ground water at depths greater than a few hundred feet may be naturally too salty for human consumption. The leaking and spilling of fuel and chemical products and the disposal of industrial wastes has degraded the quality of ground water at numerous sites.

INTRODUCTION

Background

Ground water is the predominant source of water used in the western part of the Kenai Peninsula (fig. 1). Water-quality concerns on the peninsula are typical of those in many rural and urban areas throughout the United States. Residents, industries, and land and water planners and managers are concerned about the quantity and quality of water used for drinking and about contamination of water supplies by leaks and spills of fuel; by septic-tank effluent; by disposal of chemical, solid, and oil-field wastes; and by forestry, agricultural, and other land-use activities.

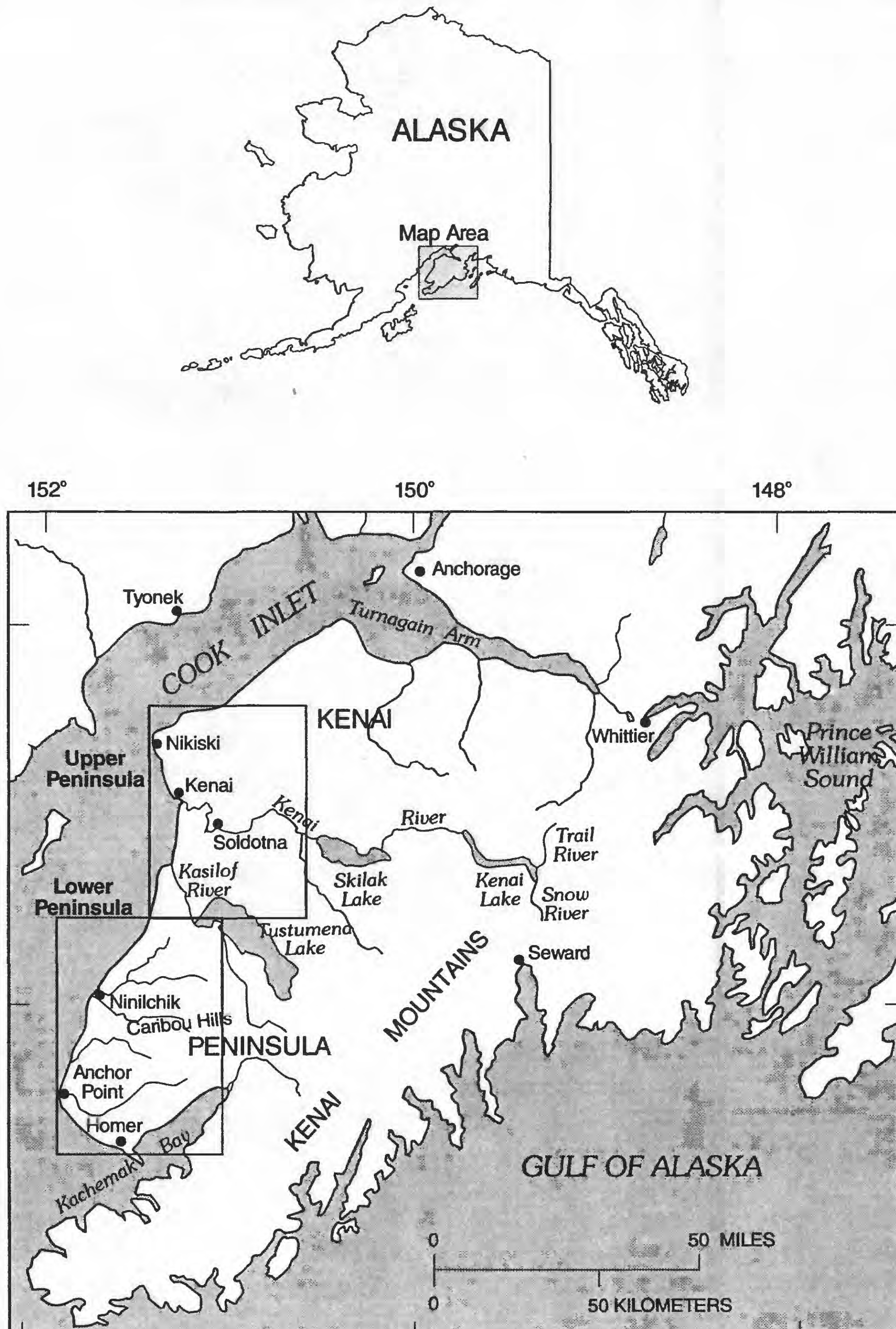


Figure 1. Location of study area, Kenai Peninsula, Alaska.

The objectives of this report are to describe at a regional scale the occurrence and quality of ground water in the main aquifers supplying water to residents and industries in the western part of the Kenai Peninsula between Kachemak Bay and Turnagain Arm. The information in this report is based on well and water-quality data collected by the U.S. Geological Survey (USGS) and Alaska Department of Natural Resources-Alaska Hydrologic Survey (ADNR-AHS). Information from more than 4,000 wells was used to help determine where and from which aquifers usable supplies of ground water were being obtained. Chemical analyses of water from 312 wells were used to help describe the concentrations of principal inorganic chemical constituents occurring naturally in the ground water of the peninsula. Results from the analyses of water samples collected from about 400 wells by the USGS, the ADNR-AHS, the Alaska Department of Environmental Conservation (ADEC), or private consultants were used to describe the concentrations of organic constituents in the ground water of the peninsula. The results from the analysis of each water sample are not included in this report but most are listed in the cited reports or can be obtained from one of the above agencies.

Acknowledgments

This study was part of multi-phased plan (Munter, 1990a, 1990b; Swan, 1991) developed by the Kenai Peninsula Ground-Water Task Force, a committee composed of representatives of Federal, State, and Kenai Peninsula Borough agencies, industry, environmental organizations, and the public. The task force was formed during 1990 to design, obtain funding for, and oversee studies that address ground-water issues on the peninsula. Funding for this study was provided by the U.S. Geological Survey, Alaska Department of Natural Resources, Kenai Peninsula Borough, and Kenai Soil and Water Conservation District (KS&WCD). Several Alaska Oil and Gas Association members (ARCO Alaska, Marathon Oil, Phillips Petroleum, Tesoro-Alaska Petroleum, Unocal Oil and Gas, and Unocal Chemical) contributed funding to ADNR-AHS and KS&WCD to help fund ground-water studies on the peninsula.

Previous Investigations

The water resources of the Cook Inlet basin are described by Freethey and Scully (1980) and Selkregg (1976). McGee (1977) estimates the depth to brackish water throughout the Cook Inlet basin using information from oil and gas wells. Bullington (1991) lists peninsula wells having water-quality data in the USGS WATSTORE database and selected well data in the USGS Ground Water Site Inventory database. The ground-water or water-quality conditions in the northwestern or "upper" part of the peninsula have been described by Anderson and Jones (1971a, 1971b, 1972), Dames and Moore (1976), Howland and Freethey (1978), Nelson (1981), Munter and Maurer (1991), and Maurer (1993). The U.S. Environmental Protection Agency (USEPA) analyzed water samples from 59 lakes in the upper peninsula in August 1988 (Eilers and others, 1993). Bailey and McIntire (1993) show the water-surface elevations of 12 lakes near Kenai and Nikiski from 1970 through 1992. Savard and Scully (1984) discuss the surface-water quantity and quality in the "lower" peninsula; Nelson and Johnson (1981) describe the ground-water resources of the western part of the lower peninsula. The Alaska Department of Environmental Conservation (1988), Petrik and Munter (1991), and Petrik (1993a) have also described ground-water conditions in the community of Anchor Point. Cederstrom and others (1950), Feulner (1963), Waller (1963), and Waller and others (1968) have described ground-water conditions in the Homer area. Harding Lawson Associates (1989) describe sites on the peninsula having known, potential, or alleged soil or water contamination.

More than 100 reports from site-specific studies of ground-water contamination on the peninsula are available at ADEC office in Soldotna or Anchorage or at ADNR-AHS office in Anchorage. The ADEC maintains a computerized "Contaminated Sites" database that describes sites of soil and water contamination and their remediation history. Most of the information in ADEC's database is collected during site investigations and remedial activities. The most common type of contamination is from leaking fuel-storage tanks. When a contaminated site has been remediated, the site is removed from the database. Biennially, the ADEC assesses the quality of water in Alaska; the 1992 water-quality assessment (Alaska Department of Environmental Conservation, 1992) lists 19 sites in the study area where petroleum products or chlorinated solvents have impaired ground water and one site where nitrogen products have impaired ground water.

DESCRIPTION OF STUDY AREA

Physical and Cultural Features

The Kenai Peninsula is in southcentral Alaska (fig. 1). The Kenai Mountains trend northeastward through the peninsula, and a lowland plain lies between these mountains and Cook Inlet. The study area encompasses much of the land west of the Kenai Mountains and north of Kachemak Bay and includes the communities of Nikiski, Kenai, Soldotna, Sterling, and Homer, as well as a part of Kenai National Wildlife Refuge. In this report, the term "upper peninsula" refers to the area north of Tustumena Lake and "lower peninsula" refers to the area southwest of Tustumena Lake and north of Kachemak Bay (fig. 1).

The surfaces of many low-lying areas are hummocky, and drainages are poorly defined. More than 800 lakes are present in the upper peninsula (Eilers and others, 1993), and many have closed basins, that is, they have no outlet. Scrub-shrub and black-spruce-forested wetlands cover many low-lying areas, whereas forests of white, black, and Sitka spruce cover drier upland areas, foothills, and lower mountains.

The peninsula is sparsely populated and most of the land is uninhabited. Most residents live near Cook Inlet, Kachemak Bay, or the Kenai River. The Alaska Department of Community and Regional Affairs (1992) reports that the population of Kenai Peninsula Borough in July 1991 was 40,312. The populations of the larger communities in the study area in July 1991 were Kenai—6,543; Homer—4,513; and Soldotna—3,733. Populations during 1990 for Sterling and Nikiski were 1,732 and 1,630, respectively. Residential development is generally of medium density (greater than one but less than six housing units per acre) in community centers and low density elsewhere.

Government, oil and gas development, commercial fishing, fish processing, outdoor recreation, and tourism are the major economic bases of the communities. Federal, State, and Borough government activities are concentrated in Soldotna and Kenai. Extraction of oil and natural gas occurs from platforms in Cook Inlet or from wells in upper and lower parts of the peninsula. The communities of Nikiski and Kenai are the main centers for oil, gas, and chemical industries.

Water Use

Except for parts of Homer, all water used in the study area for domestic, commercial, and industrial supplies is from ground water. Most residents are not served by public water or sewer systems and must rely on individual wells and septic systems. Water use in areas served by public supplies is described by Petrik (1991 and 1993b) and data for the three largest public-water suppliers are summarized in table 1. The water-distribution system for Kenai is supplied from two wells near Beaver Creek, about 4 mi east of Kenai. In Soldotna, most water is obtained from five wells, but during summer four more wells are used to provide water to campgrounds. Water used for public supply in Homer is obtained from a diversion from Bridge Creek, a stream about 2 mi north of Homer. All water used by oil, gas, and chemical industries in the Nikiski and remote oil field areas is supplied by private wells. The mean daily water use in the Nikiski industrial area during 1992 was more than 3.5 Mgal (Petrik, 1993b).

Table 1. Water use during 1990 and 1992 in selected areas served by a public-water supply, Kenai Peninsula

[Data from Petrik, 1991 and 1993b]

Location	Number of water connections in 1990		Source of water	Volume of water withdrawn (million gallons)		Mean daily water use in 1990 (million gallons per day)	
	Residential	Commercial and industrial		1990	1992	Residential	Commercial and industrial
Homer	798	211	Surface water	180	Unknown	0.16	0.24
Kenai	1,195	178	Ground water	265	283	.33	.33
Soldotna	1,210	146	Ground water	212	272	.24	.28
TOTAL	**3,203**	**535**		**657**		**0.73**	**0.85**

Water for public supply is withdrawn by public and private water suppliers and delivered to users for a variety of uses, such as domestic, commercial, or industrial purposes. Domestic uses of water include all water uses related to a household setting, such as drinking, food preparation, washing of clothes and dishes, bathing, flushing toilets, and watering of lawns and gardens. Commercial uses of water include water use by businesses such as in office buildings, institutions, hotels, motels, restaurants, and campgrounds. Industrial uses of water include seafood processing and the production of oil, gas, and chemicals.

Climate

The climate of the Kenai Peninsula varies widely and is transitional between the relatively mild maritime climate of Gulf of Alaska and the dry, cold, continental climate of interior Alaska. The study area is in a rain shadow of the Kenai Mountains. Seward, on the eastern side of the Kenai Mountains, has a mean annual precipitation of about 68 in. (Leslie, 1989), and high in the Kenai

Mountains mean annual precipitation may be as great as 200 in. (Blanchet, 1983). Values of mean annual precipitation for Homer and Kenai are about 25 and 19 in., respectively (Leslie, 1989). Most of the precipitation falls as rain in late summer and autumn and as snow from November to March.

Mean annual air temperature also decreases from south to north. Homer and Kenai have mean annual air temperatures of 37 °F and 34 °F, respectively. Temperatures in the study area rarely drop below -30 °F in winter or rise above 80 °F in summer. Mean temperatures for January for Homer and Kenai are 23 °F and 12 °F, and mean temperatures for July are 53 °F and 54 °F, respectively.

Geologic Setting

The physical makeup (including mineral composition, grain size, and grain packing); arrangement of lenses, beds, and formations; and structural features such as fractures, folds, and faults help control the location, movement, and natural quality of ground water. The geology of the Cook Inlet area has been studied extensively because the area contains rocks that yield oil, gas, and coal. Geologic studies by several investigators were helpful in evaluating the geohydrology of the water-supply aquifers in the study area. Martin and others (1915), Magoon and others (1976), Fisher and Magoon (1977), Sisson (1985), Bailey (1985), and Rawlinson (1986) describe the geology and mineral resources of the Kenai Peninsula. Karlstrom (1964), Reger (1977), and Schmoll and others (1984) describe the glacial history and map the extent of the unconsolidated materials that yield most of the water to wells in the study area. The geologic histories and descriptions of rock materials making up water-supply aquifers were derived from these reports.

The study area and the oil- and gas-producing basin lie between the Kenai Mountains and an arc of volcanoes that form parts of the Alaska and Aleutian Ranges. The Kenai Mountains are generally made up of metamorphosed sedimentary and volcanic rocks of Jurassic and Cretaceous ages (shown as *Brim*, fig. 2). During Tertiary time, sediments accumulated in low areas. These sediments (*Brs*, fig. 2) are now partially hardened and partially cemented beds of sand, clay, coal, and ash and they form a basin in which oil and gas have collected. These rocks of Tertiary age are locally known as the Kenai Group: they are partially exposed along beach cliffs from Clam Gulch to the head of Kachemak Bay northeast of Homer and occur within about 150 ft of land surface throughout much of the lower peninsula. The thickness of these Tertiary rocks ranges from 0 ft at the Kenai Mountains to about 20,000 ft near Nikiski. Wells producing gas in the upper part of the peninsula are typically 3,000 to 8,000 ft deep, whereas wells producing oil are 10,000 to 15,000 ft deep.

During Quaternary time (and possibly during late Tertiary time), at least five major glaciations affected the study area as indicated by moraine locations and stratigraphy of the sediments deposited. Clay, silt, sand, and gravel were deposited or moved by glaciers, streams, lakes, and wind throughout the study area. The total thickness of these deposits ranges from 0 ft in hills north of Kachemak Bay and the Kenai Mountains to about 750 ft beneath Nikiski. The sediments making up these deposits are commonly interlayered and are unconsolidated, that is, the rock particles are loosely arranged and are not cemented together.

Sediments left by glaciers (*Qmd*, fig. 2) are commonly called "till" or "drift" and typically are poorly sorted, that is, they consist of rocks having a wide variety of particle sizes (clay, silt, sand, gravel, and cobbles) that are mixed together and lack stratification. Outwash and fluvial deposits (*Qow*) commonly consist of stratified sediments, chiefly sand and gravel with some silt and clay intermixed, that were deposited by glacial meltwater streams, commonly across a plain below the terminus of an advancing or receding glacier. Sediments deposited by winds (*Qes*) consist of thin layers of clay, silt, and sand. Materials deposited in lakes and estuaries (*Qlf*) consist mostly of silt and clay, but are commonly interlayered with materials deposited by streams (alluvial deposits, *Qal*) that contain abundant sand and gravel. In poorly drained areas having little topographic relief, peat has developed. The peat consists of partially to well-decomposed plants, commonly mosses, sedges, grasses, reeds, and shrubs.

GROUND-WATER CONDITIONS

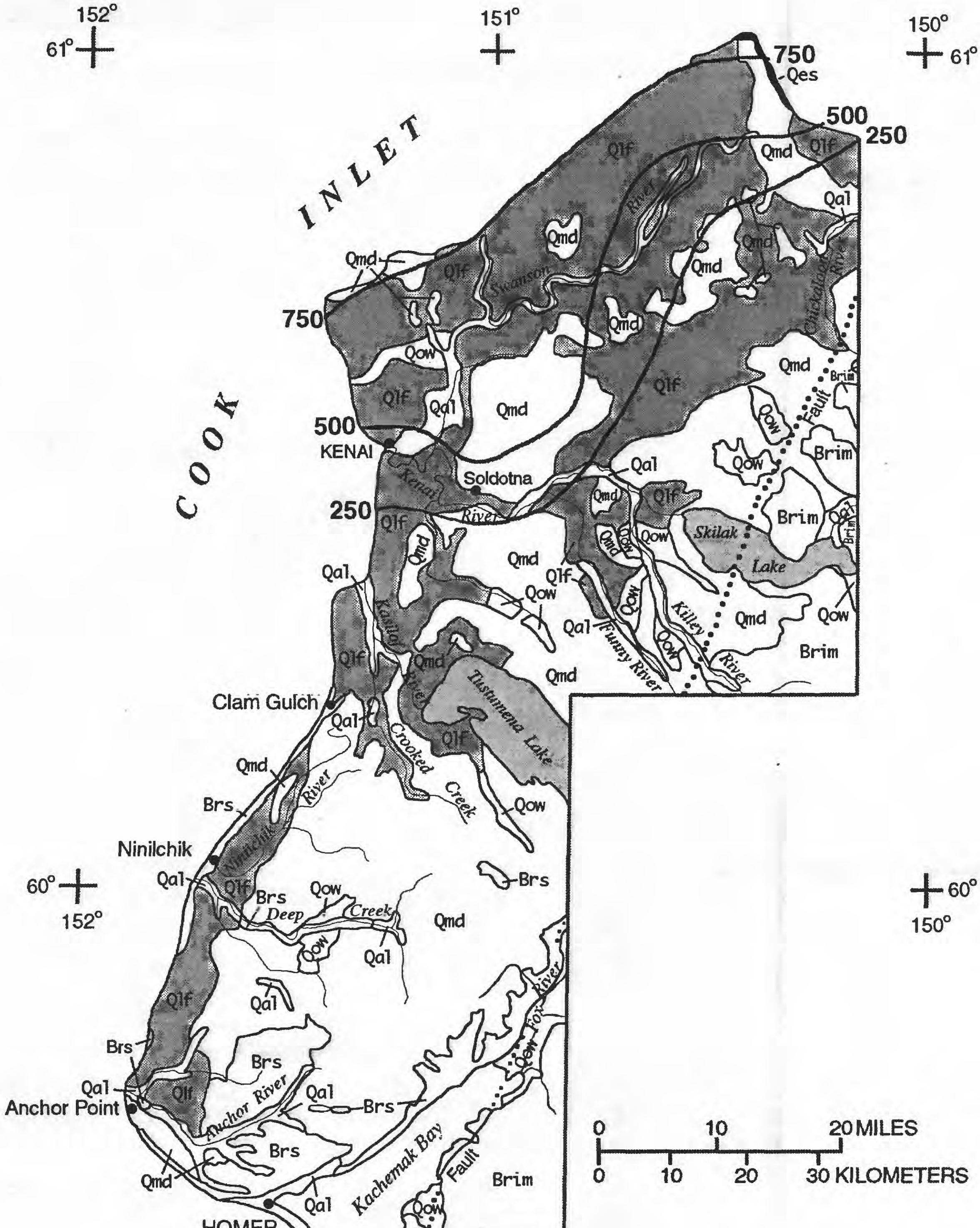
Sources and Types of Available Ground-Water Data

Ground-water and well information in Alaska is maintained by the USGS in a database called Ground Water Site Inventory (GWSI). The database contains information on wells such as location (township, range and section; latitude and longitude; and lot and block); construction (such as depth drilled, casing type, length, and diameter; depth and types of openings); static water level; yield; types of rocks penetrated; and type of water use. Most of the information is from well drillers' logs, but water levels in many wells have also been measured by USGS and ADNR-AHS personnel. Between January 1, 1990 and July 1, 1993, information from 2,290 wells was entered into the database. As of July 1993, data from more than 4,680 wells in the Kenai Peninsula Borough were available in the database. Information from more than 3,700 wells in the upper peninsula and more than 690 wells in the lower peninsula is available (fig. 3). Maps showing more detailed locations of these wells are available from the District Chief of the U.S. Geological Survey in Anchorage.

Ground-Water Hydrology

An aquifer is defined as the saturated part of permeable geologic materials that is capable of yielding significant water to wells or springs. Rock materials differ in their abilities to contain and yield water, depending on the degree of compaction and amount of interconnected space (holes) in the rock material. The rock material may be consolidated or unconsolidated. The water can occur in and move through fractures in consolidated rock, in small openings between grains of unconsolidated materials (clay, silt, sand, gravel, and cobbles), or in large open caverns or conduits, such as the solution cavities found in limestone and dolomite. The various types of aquifers that are common in different parts of the United States are illustrated in figure 4.

An unconfined or water-table aquifer is one in which the upper surface of the aquifer is the water table (fig. 5). Under normal conditions, all permeable rocks below the water table are saturated, and pressure at the water table is atmospheric. A confined or artesian aquifer is one that is overlain by materials of significantly lower permeability than those of the aquifer; this impedes the upward and downward movement of water between zones of more permeable materials. The water in the lower aquifer is thus "confined" under additional pressure, and, where the aquifer is tapped by a well, the water surface will rise in the well above the top of the aquifer to the level of the potentiometric surface for that aquifer. Such a well is an artesian well, and, if the pressure is sufficient to raise the water above land surface, it is a flowing artesian well.



EXPLANATION

—— • • • •	Fault (location generalized) - dotted where concealed
~~	Contact
—250—	Approximate line of equal thickness of unconsolidated Quaternary sediments--interval 250 feet

Figure 2. Generalized surficial geology and approximate thickness of unconsolidated Quaternary sediments. (Contours and geology from Freethey and Scully, 1980).

Map unit	Lithology	Landforms and occurrence	Surface drainage, infiltration, and permeability	Potential for ground-water use
Qow Outwash and valley train deposits	Stratified sediments, chiefly sand and gravel with some silt and clay intermixed. Generally grades to finer grained materials with increasing distance from its glacial source.	Forms as long, narrow deposits confined by the valley walls downstream from terminal moraines or as fans or other broad alluvial sheets of glacial outwash sediments immediately downstream from glaciers.	Surface drainage poor to moderate, since relief is generally low. Infiltration moderate to good, due to coarseness of material and thin soil cover. Permeability moderate to good where coarse-grained materials predominate; poor to moderate in finer grained sediments.	Ground-water potential depends on the extent and thickness of the deposit. Thickness usually limited in upper valleys. Recharge source is readily available. Occurs in unpopulated areas where few wells have been drilled. Ground-water availability probably poor to moderate.
Qal Holocene flood plains, terraces, and alluvial fans	Well stratified silt, sand, and gravel. Coarser grained materials near mountains grading to sand and silt away from mountains.	Forms alluvial flood plains, alluvial fans, and terraces along most streams. Long, narrow deposits too small to be shown at the map scale used.	Surface drainage, infiltration, and permeability moderate to good.	Ground-water potential usually good because of abundant sources for recharge and, normally, large saturated thickness. Wells drilled into this material usually obtain adequate domestic supplies at less than 100 feet. A few yields greater than 1,000 gallons per minute have been reported.
Qlf Proglacial lake and associated fluvial deposits	Heterogenous mixtures of silt, sand, and gravel, interlayered with more homogeneous deposits of silt and clay (lake deposition) and sand and gravel (fluvial deposition).	Forms channeled and terraced, marsh and muskeg-covered flat areas, typically in the lowest parts of the basin.	Surface drainage poor, due to low relief; numerous lakes, marshes, and swamps are typical. Infiltration poor to good, depending on soil texture and type of surficial deposits present. Permeability good in coarse-grained strata, poor in fine-grained strata.	Ground-water potential moderate to good where surficial materials are coarse grained and thick. Many domestic wells are less than 100 feet deep. Confined aquifers at greater depths have a potential for yields large enough for public supplies.
Qmd Moraines and other unsorted glacial drift	Heterogeneous blend of gravel, sand, silt, and clay, and with discontinuous lenses consisting largely of well-sorted material.	Forms hummocky terrain with muskeg-and marsh-filled depressions, in places extensively dissected by postglacial erosional processes. Typically occurs near the upland areas of basins where bedrock may be at shallow depths.	Surface drainage moderate to good on slopes, poor in depressions. Infiltration poor to good, depending on soil texture and grain size. Permeability poor to good, depending on amount of fine-grained materials.	Ground-water potential ranges from poor to moderate, depending on grain size of underlying material, saturated thickness, and availability of recharge. Typical domestic wells are finished in a relatively shallow lens of coarse-grained material which yields enough water for a household supply. Few large yield wells have been drilled in areas underlain by this material.
Qes Sand dunes and other eolian deposits	Well-sorted windblown sand and silt deposits containing some clay-size particles.	Numerous small loess deposits occur throughout the basin, generally as a thin mantle overlying thicker glacial deposits.	Surface drainage poor to good, depending on relief. Infiltration moderate to good, except where deposits consist of silt. Permeability poor to good.	Ground-water potential poor because deposits typically are thin and fine grained and are above the water table.
Brim Igneous and metamorphic bedrock	Igneous and highly metamorphosed rocks, usually well consolidated and dense; jointing and faulting common. Lower grade metamorphic rocks are less consolidated and less dense.	Underlies entire basin. Exposed in ridges and rounded hills near the foot of mountain ranges and on steep hills and peaks in the Kenai Mountains. Found at shallow depths in some places under Quaternary sediments near the mountain fronts.	Surface drainage very good. Infiltration poor to moderate. Primary permeability poor; secondary permeability in fault zones and jointed areas poor to moderate.	Ground-water potential poor because of low permeability and limited saturated thickness. Many wells drilled into this type of material are dry. Ground-water yields are typically less than 5 gallons per minute.
Brs Sedimentary bedrock	Well-consolidated to poorly consolidated sedimentary rocks, including arkose, graywacke, gravel conglomerate, sandstone, siltstone, shale, coal, and limestone.	Found at shallow depths beneath Quaternary sediments on the southern half of the Kenai Peninsula and in places near mountain fronts.	Surface drainage good. Infiltration poor to moderate. Primary permeability poor to good, depending on coarseness of material, type of cementation, and degree of consolidation. Secondary permeability in fault zones and joint systems, poor to moderate.	Ground-water potential poor where rocks are well consolidated or consist mostly of fine grained rock types such as siltstone, shale, or graywacke. Ground-water potential poor to good in poorly consolidated formations of coarse-grained sandstone and gravel conglomerate.

Explanation of geologic units on figure 2.

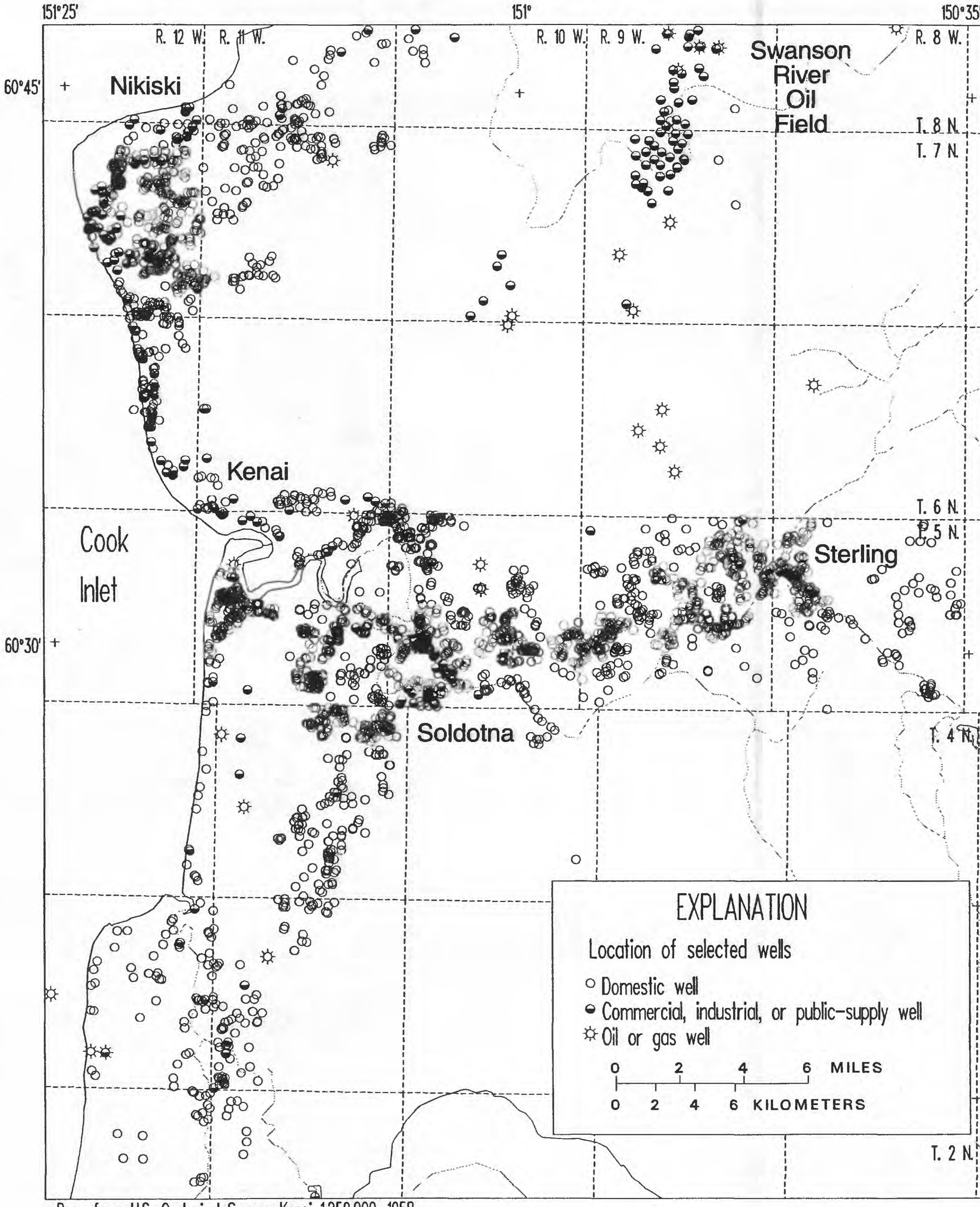


Figure 3A. Location of selected wells, upper Kenai Peninsula.

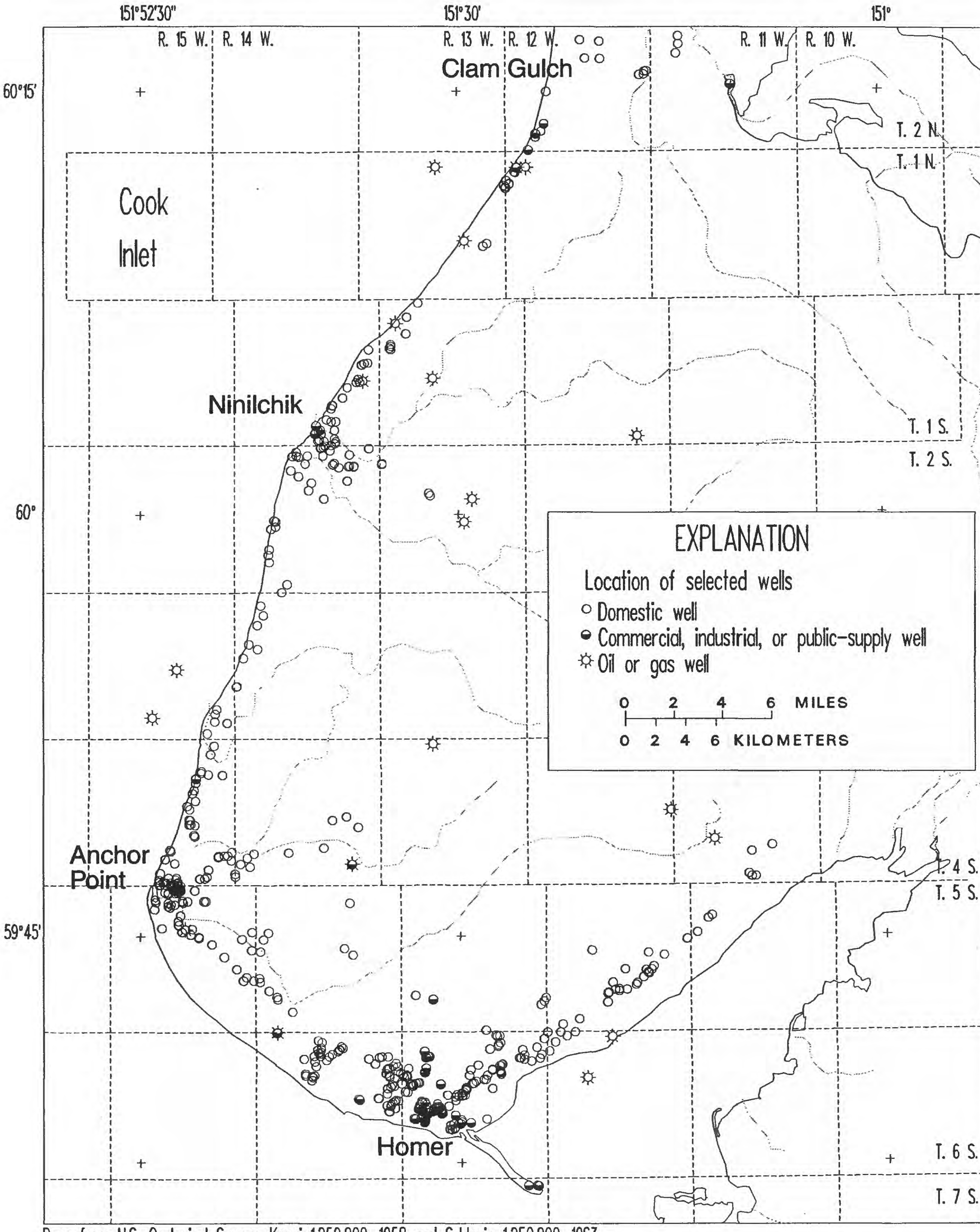


Figure 3B. Location of selected wells, lower Kenai Peninsula.

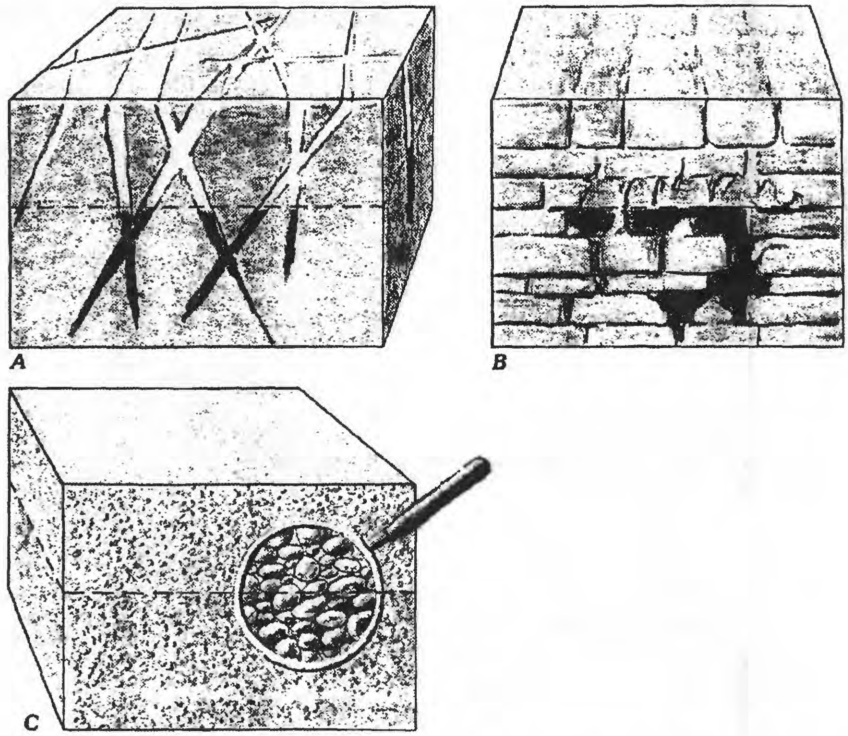


Figure 4. Generalized occurrence of ground water in various types of aquifers. *A*, Fractures and joints in igneous and metamorphic rocks. *B*, Solution cavities in limestone. *C*, Spaces between particles in unconsolidated sedimentary deposits. [From Molenaar, 1988.]

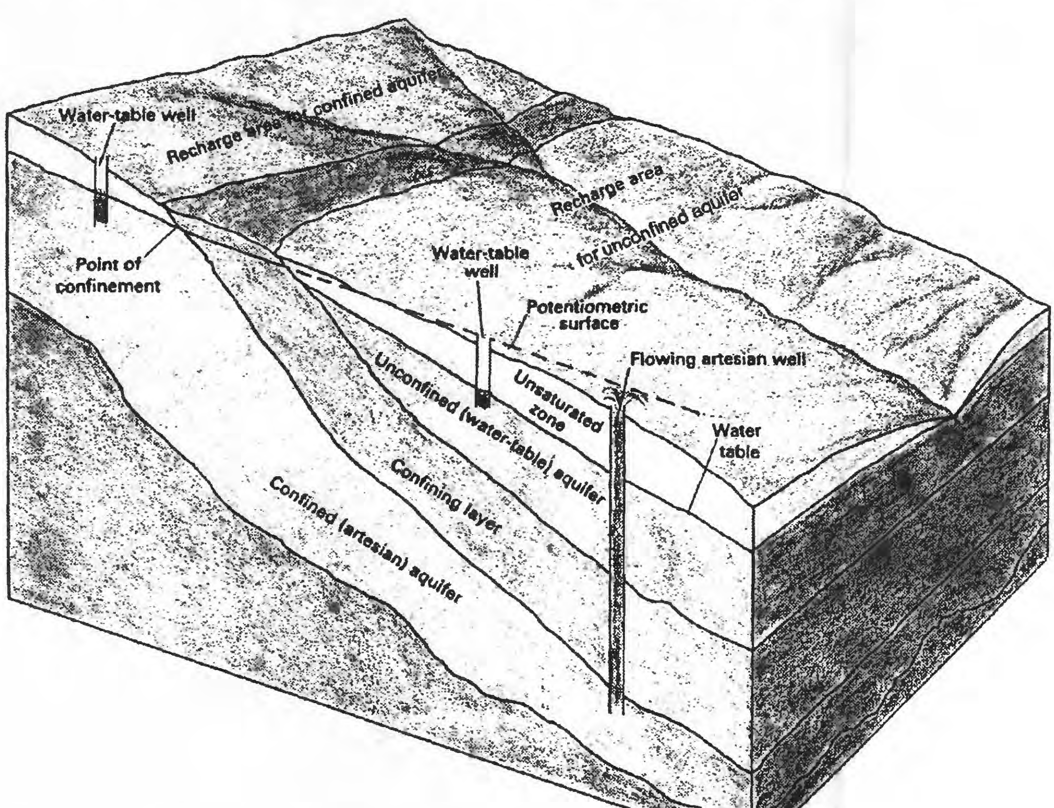


Figure 5. Confined and unconfined aquifers. [Modified from Molenaar, 1988.]

The level to which water will rise inside a well is known as hydraulic head. Ground-water levels are affected by recharge to and discharge from the aquifer. Recharge occurs when water from rain, snowmelt, streams, or lakes seeps into the aquifer. Discharge occurs when shallow water evaporates or transpires from plants, when water is pumped from an aquifer, and when water naturally flows out of the ground at a spring or into a lake, stream, wetland, or ocean. All areas having permeable materials at the surface that are not fully saturated are capable of accepting recharge waters. Ground water flows from areas of recharge to areas of discharge, which have lower values of hydraulic head in comparison to their areas of recharge.

How much and how fast ground water flows though an aquifer depends upon the thickness, width, hydraulic conductivity, and porosity of the saturated material and the hydraulic gradient (differences in hydraulic head; flow is from higher head to lower). Hydraulic conductivity is a measure of the ability of the aquifer material to transmit a fluid, the viscosity of the fluid, and is, to some extent, an indicator of the shape, size, and arrangement of the spaces in the aquifer materials. Well-sorted coarse-grained materials have large, connected spaces and high hydraulic conductivities. Poorly sorted and fine-grained materials have smaller, partly connected spaces and lower hydraulic conductivities.

Water-Supply Aquifers of the Kenai Peninsula

Water is available to wells from bedrock and unconsolidated rock aquifers. The metamorphosed rock of Jurassic and Cretaceous ages (*Brim*, fig. 2) have little or no primary (intergranular) porosity: most water is contained and conducted through fractures. The Kenai Group (*Brs*) contains beds of sand that are only partly hardened and cemented and thus has greater primary porosity. The Kenai Group is exposed or occurs at shallow depths (generally less than 150 ft) throughout much of the lower peninsula. Oil and gas wells drilled near the Swanson River, about 18 mi northeast of Kenai, penetrate the top of the Kenai Group approximately 600 ft below land surface, but the depth to bedrock may be as great as 750 ft near Nikiski. No water-supply wells in Nikiski or Kenai are known to yield water from bedrock, but several wells in Sterling may penetrate into bedrock and numerous wells in the lower peninsula yield water from bedrock. The median yield for 123 wells penetrating more than 25 ft of bedrock was 7.5 gal/min, but less than 10 percent yielded more than 25 gal/min. Water in the Kenai Group may be unconfined or may be confined by silty claystones within the Kenai Group or by glacier till.

Most of the water used on the peninsula is obtained from unconsolidated aquifers made up of complexly interlayered deposits of glacial, outwash, fluvial, lacustrine, and eolian origins. The composition and hydrologic properties of these deposits differ greatly over short horizontal and vertical distances. Thus, the depths, yields, water levels, and water quality of closely spaced wells are commonly dissimilar. The lacustrine and eolian deposits are commonly fine grained and provide little water to wells. Glacial tills contain large proportions of silt and clay, but in most places, saturated zones (thin beds, thick layers, or narrow stringers) of sand and gravel are present that yield water to wells at rates sufficient for domestic purposes. Deposits of sorted and stratified sand and gravel associated with streams are present within the till. These sand and gravel zones are commonly elongated and can be as much as several tens of feet thick. Because of the complex nature of deposition, it is difficult to map and predict the extent of coarse-grained glacier and coarse-grained stream deposits without extensive drill-hole information. Wells completed in glacier or stream deposits having thick saturated zones of sand and gravel may yield water at rates greater than 1,000 gal/min.

Throughout much of the upper peninsula, thick zones or layers of silt and clay occur within the saturated unconsolidated sediments, creating "confining" conditions in lower zones of permeable sand and gravel. Some areas having thick unconsolidated sediments may have more than one confined aquifer. For example, at an industrial area about 4 mi southwest of Nikiski, two extensive silt and clay layers occur (fig. 6). The top of the upper confining layer is about 100 ft below land surface and the top of a lower confining layer is about 200 ft below land surface. The lower silt and clay unit is more than 100 ft thick. Only a few wells have been drilled into the lower confined aquifer and the aquifer is poorly defined away from the industrial area—it may actually consist of many interconnected lenses and layers of sand and gravel at depths greater than 300 ft below land surface.

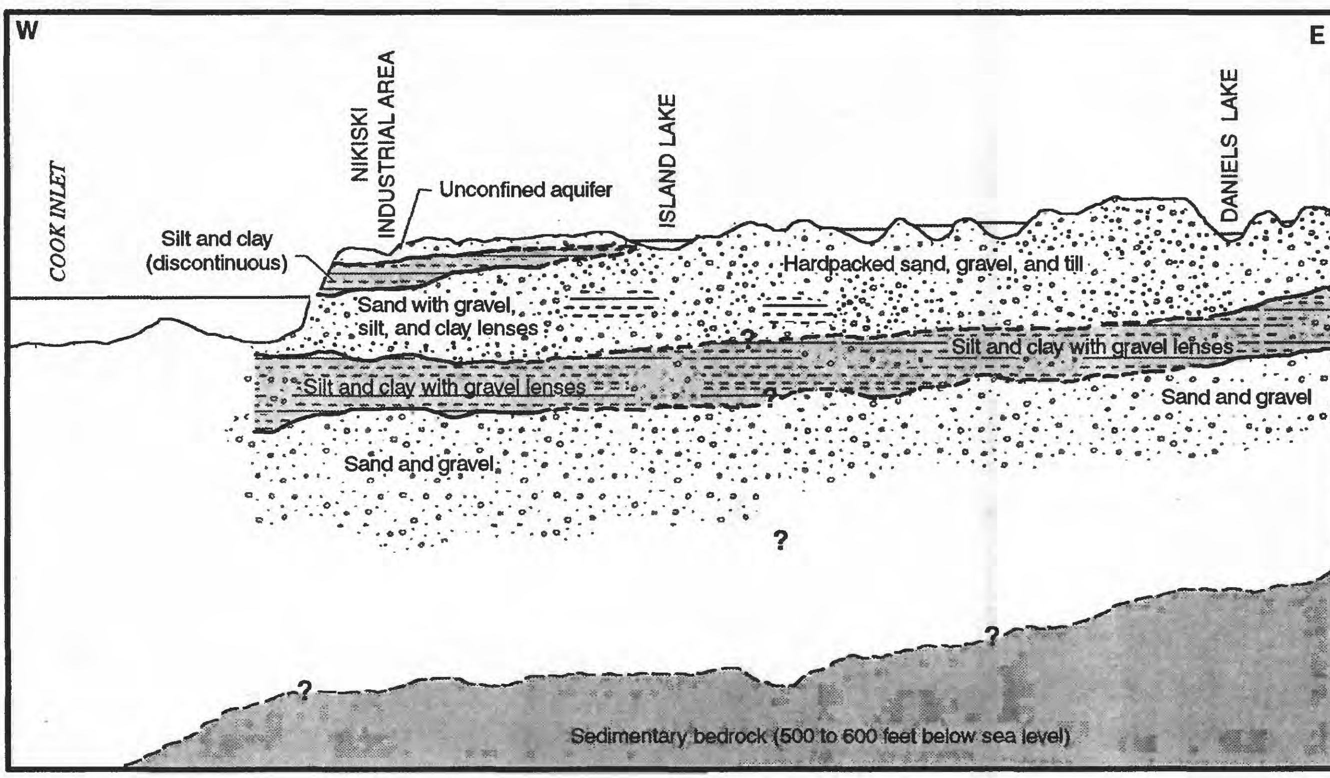


Figure 6. Generalized geology and aquifer conditions in the Nikiski area (vertical distance is greatly exaggerated). [From Freethey and Scully, 1980.]

The relations between type of water use and well yield and well depth are shown in figure 7. Domestic wells generally have well casings that are open only at the bottom of the wells. Depths of wells used for domestic water supply are similar in the upper and lower peninsula: the median well depths are 65 and 71 ft. However, domestic wells in the upper peninsula are capable of yielding much more water than those on the lower peninsula. The median value of yield for domestic wells in the upper peninsula is 15 gal/min, whereas the median value in the lower peninsula is only 6 gal/min. Public-supply, commercial, and industrial wells are drilled to depths necessary to yield water at rates sufficient for their water use, and are commonly screened wells. The median values of yield for public supply, commercial, and industrial wells in the upper peninsula are 50, 30, and 58 gal/min, respectively. The maximum yield reported is 4,000 gal/min from a 317-foot deep industrial well (SB00701221DDBC2 008) near Nikiski. The median values of yield for public supply, commercial, and industrial wells in the lower peninsula are 19, 8, and 15 gal/min. The maximum yield reported for a well in the lower peninsula is 480 gal/min from a 57-foot deep commercial well (SC00601321DACA1 012) at the Homer Airport.

Observation or monitoring wells are commonly used to detect or monitor contamination, to help determine directions of water flow, or to determine fluctuations in ground-water levels. Because most contamination originates from or near land surface, most contamination-monitoring wells are shallow.

Ground-Water Levels

Graphs showing water levels as a function of time in several wells representative of conditions throughout the peninsula indicate that in shallow wells seasonal changes are small, generally less than a few feet (fig. 8.). Variations in water levels are much larger in deep wells in Nikiski, Kenai, and Soldotna that are open in confined aquifers from which large volumes of water are pumped. Commonly, ground-water levels are lower during February through April than during May through August; however, high and low water levels can occur in any month. The median depths to water in domestic wells are 35 ft in the upper peninsula and 30 ft in the lower peninsula.

Some wells have water levels that show medium-term trends (about 5 years in length) that generally follow trends in precipitation; others show no trend. Few wells show long-term (greater than 10 years) trends in water levels. Water levels in a 90-foot-deep well (SB00701226BAAA7 003) (fig. 8) west of Cabin Lake in the Nikiski area have fluctuated about 10 ft between 1979 and 1993.

Direction of Ground-Water Flow

The general slope of the water table or potentiometric surface over a broad area indicates the general direction of ground-water flow. Water flows from areas of recharge to areas of discharge in response to differences in hydraulic head.

The altitudes of water levels in wells on the peninsula varied widely because some wells may tap perched, confined, or semi-confined parts of the unconsolidated aquifer; most well locations and altitudes of land surface are imprecisely known; and ground-water levels were measured over many years and during all seasons. On a regional scale, ground water generally moves through the unconsolidated aquifer system from topographically high areas toward topographically lower areas. However, because the size, sorting, and origin of the aquifer materials differ greatly—even over short horizontal and vertical distances—localized ground-water flow systems are complex. Ground water discharges naturally to wetlands, lakes, rivers, and Cook Inlet, and directly to the atmosphere by evaporation and transpiration.

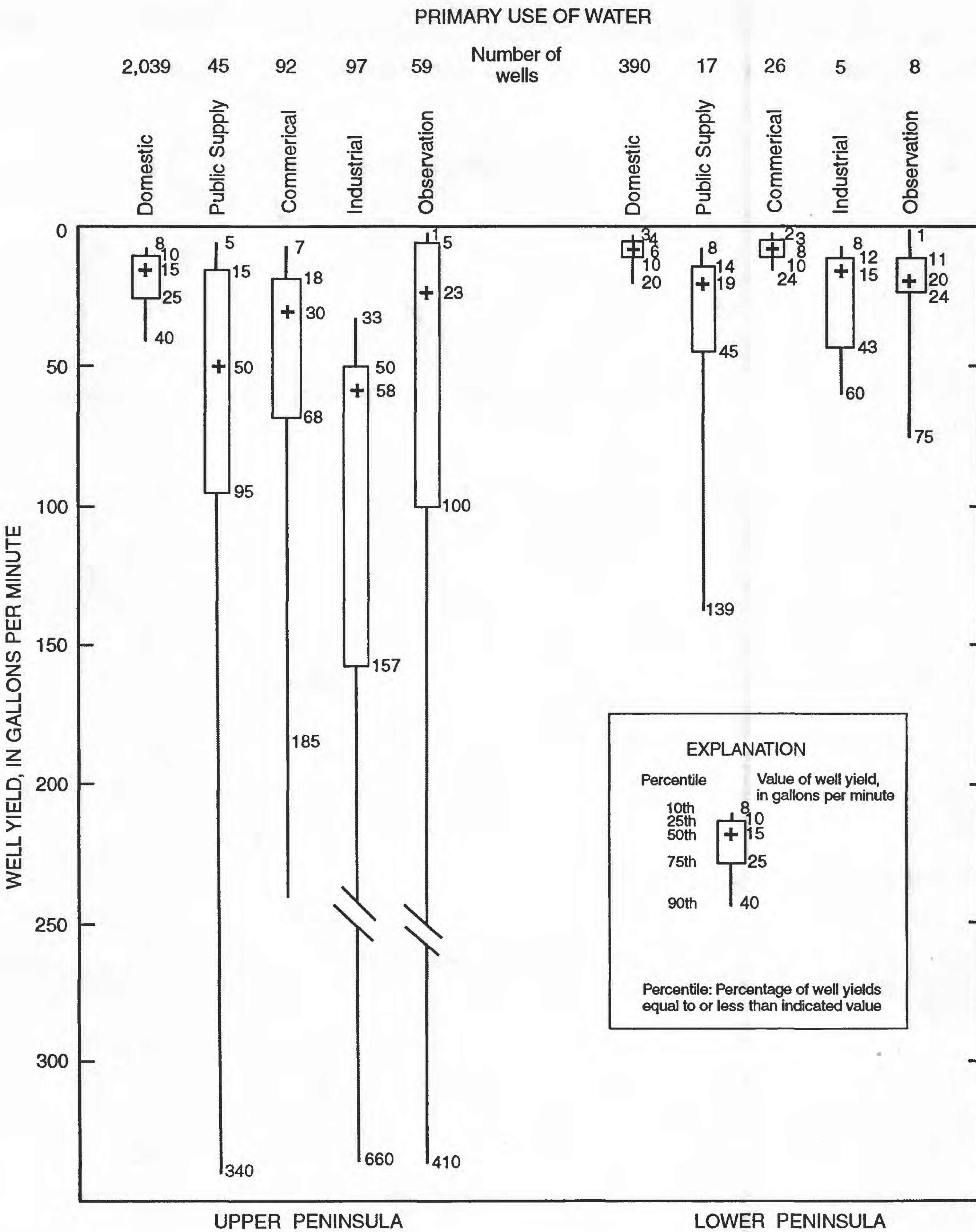


Figure 7A. Relation of well yield and water use.

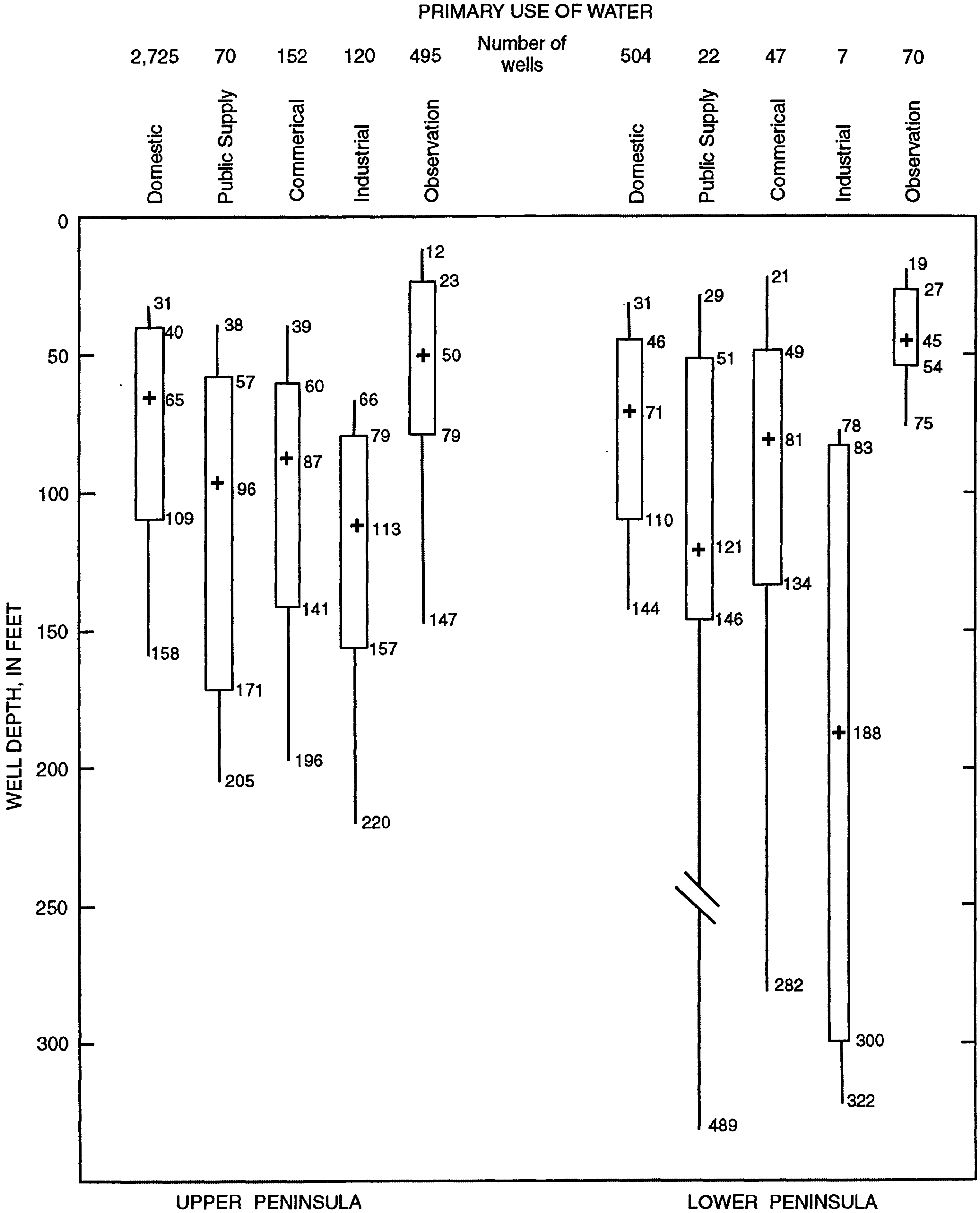
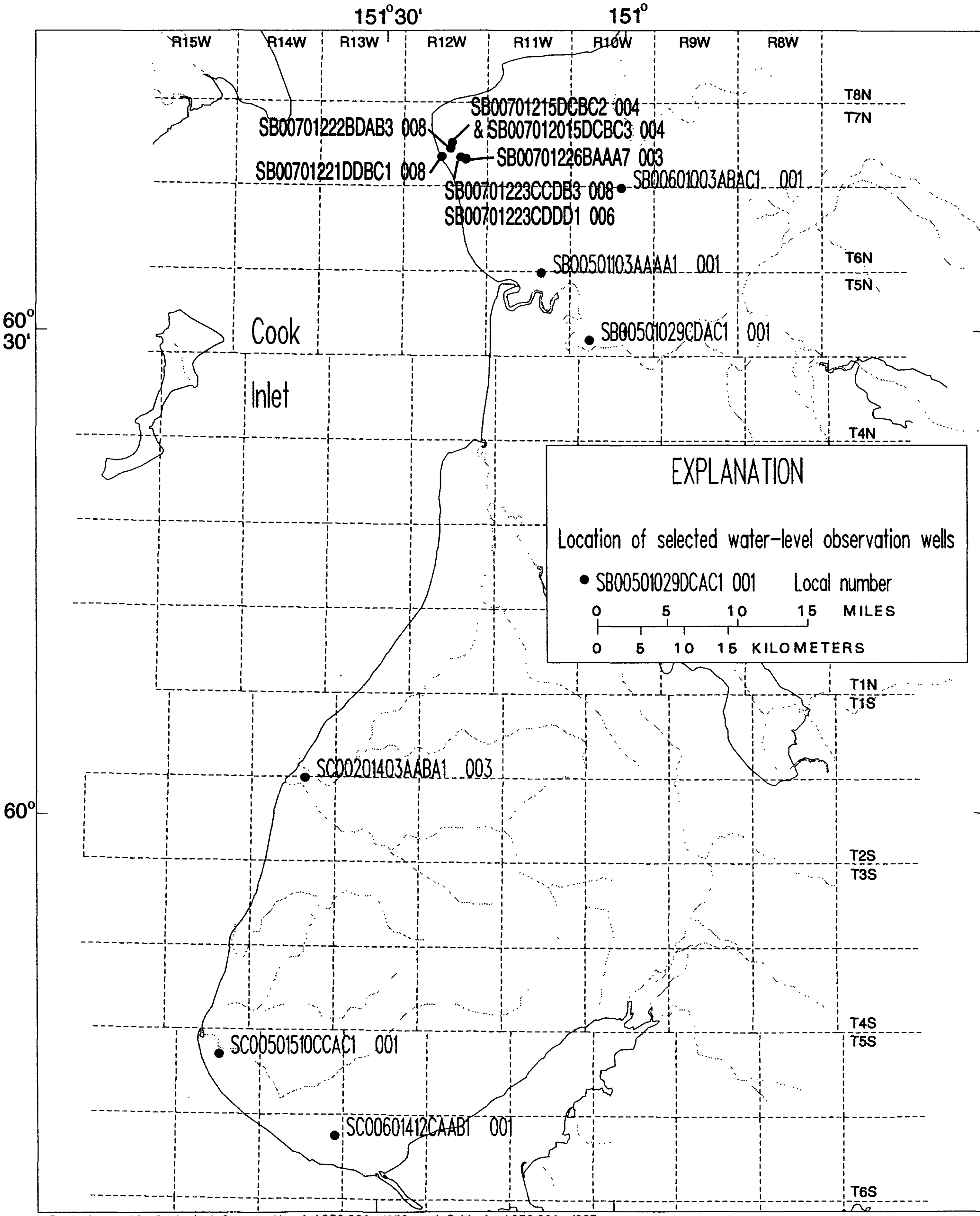


Figure 7B. Relation of well depth and water use.



Base from U.S. Geological Survey, Kenai 1:250,000, 1958 and Seldovia 1:250,000, 1963

Figure 8A. Location of selected water-level observation wells, western Kenai Peninsula. (See figure 8B for hydrographs.)

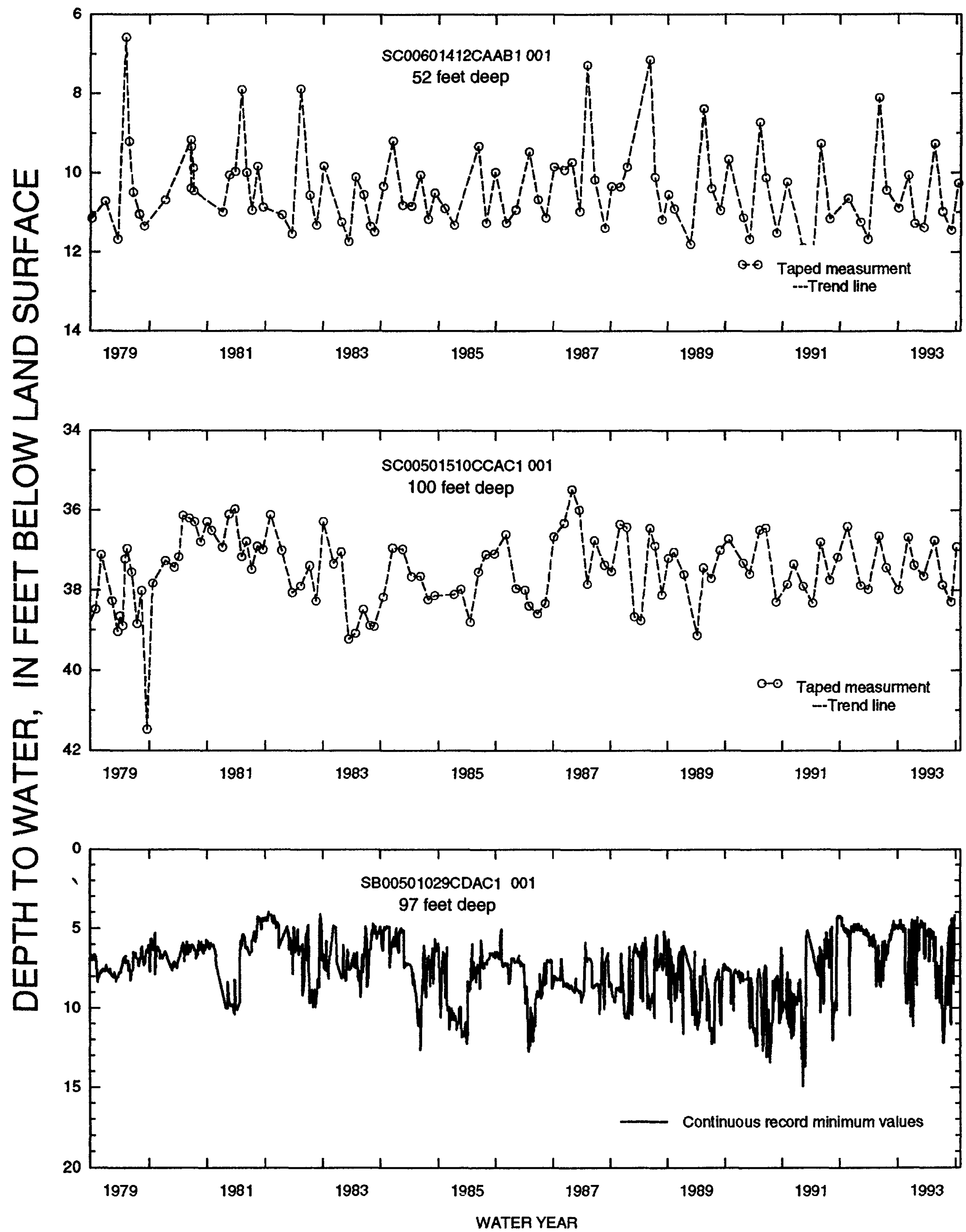


Figure 8B. Hydrographs of selected water-level observation wells, western Kenai Peninsula (see figure 8A for locations of wells).

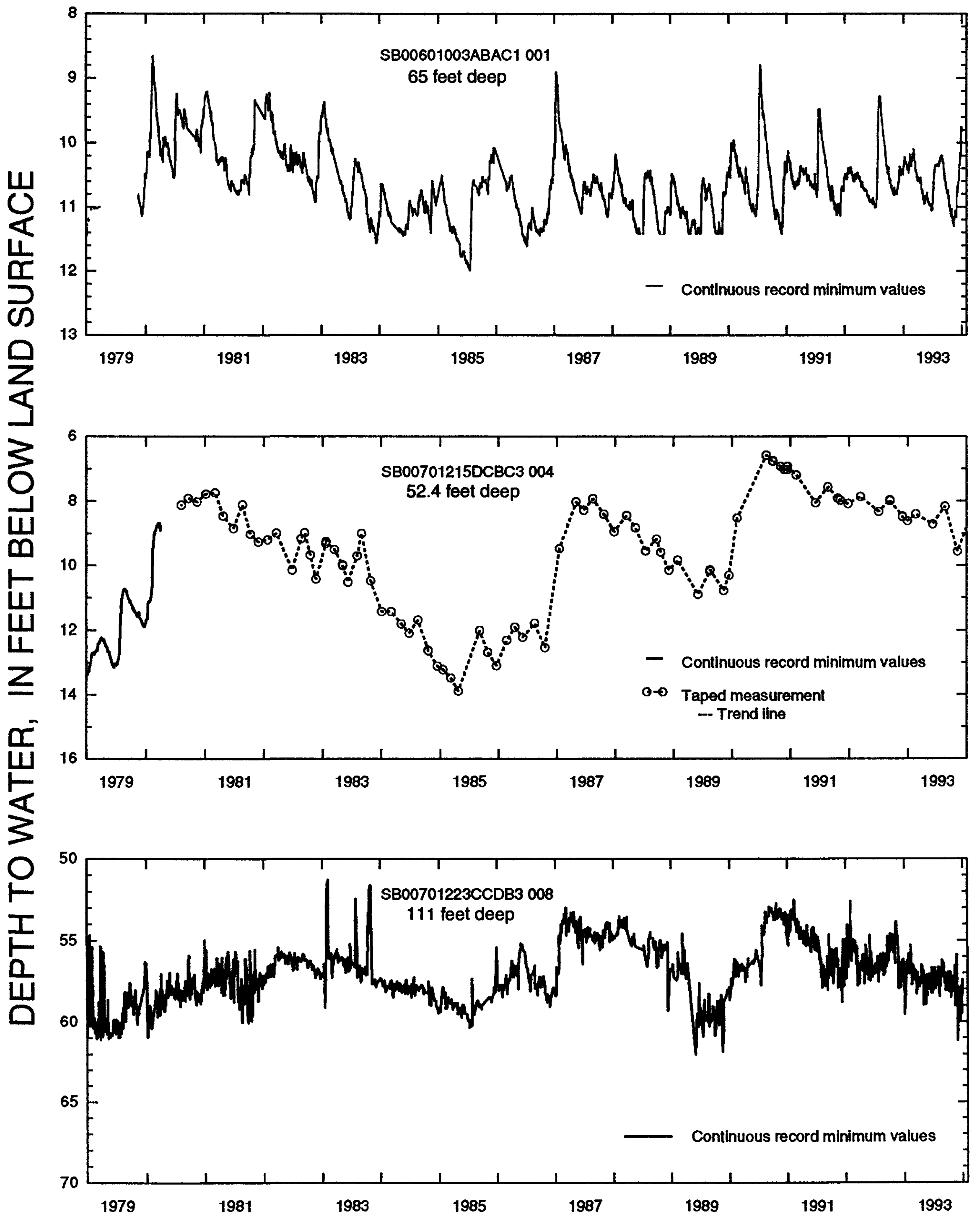


Figure 8B. Hydrographs of selected water-level observation wells, western Kenai Peninsula (see figure 8A for locations of wells)--Continued.

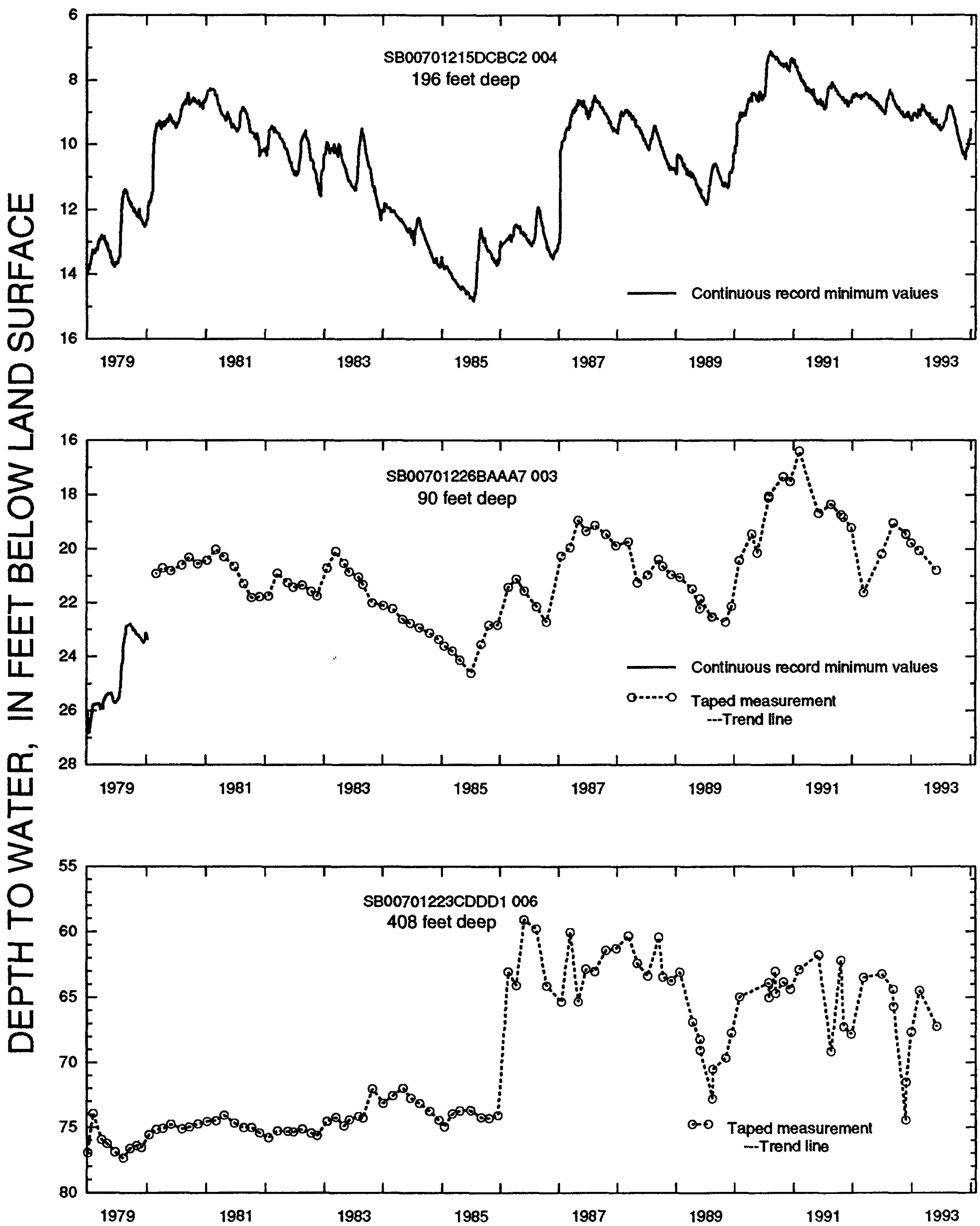


Figure 8B. Hydrographs of selected water-level observation wells, western Kenai Peninsula (see figure 8A for locations of wells)--Continued.

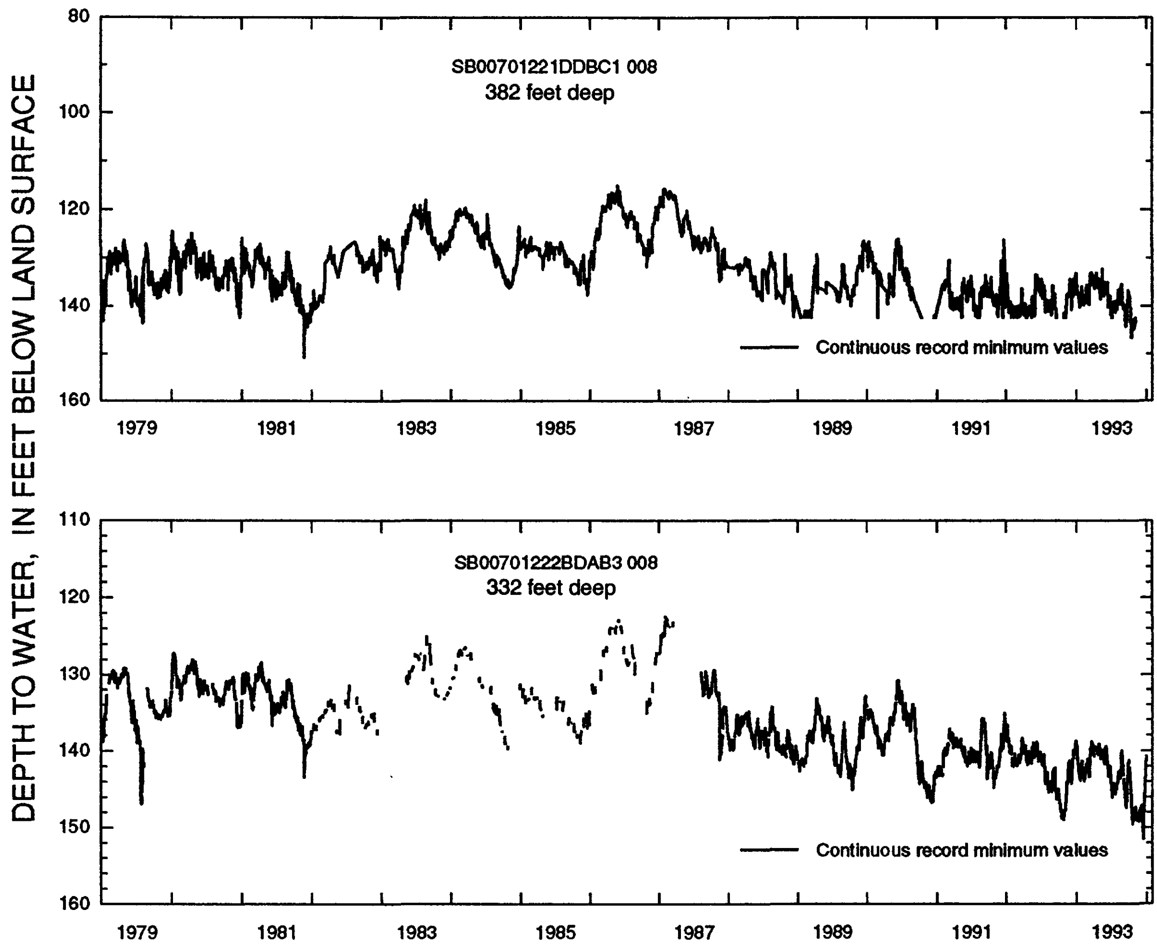


Figure 8B. Hydrographs of selected water-level observation wells, western Kenai Peninsula (see figure 8A for locations of wells)--Continued.

GROUND-WATER QUALITY

Factors Affecting Ground-Water Quality

Water is continually subject to chemical and biological changes as it progresses through the hydrologic cycle. The quantity and kinds of minerals and compounds dissolved in water depend on the natural and man-affected environments through which the water has passed. Freeze and Cherry (1979) and Hem (1985) describe in detail the chemical properties of water and its chemical constituents.

Rain and snow are usually quite pure. As water from rain and snowmelt passes over and through vegetation, soils, and rocks, the water picks up soluble minerals and organic materials. Water within, or that has been in contact with, sediments that were deposited in a marine environment may contain high concentrations of dissolved minerals, especially sodium and chloride. Waters within the study area that are associated with coal or oil and gas deposits commonly contain hydrogen sulfide, which has a "rotten-egg" odor. Some residents have reported that several wells in the upper and lower peninsula yield water having the odor of hydrogen sulfide, which most people can detect when the value is only at a few tenths of a milligram per liter.

Many of man's activities also change the composition of water. Chemical constituents are added to water from leaks and spills of fuel and chemical products, from septic-tank discharge of wastewater and household products, from leaching of pesticides and fertilizers, and from drainage of landfills and other waste-disposal sites. The Alaska Department of Environmental Conservation's 1992 water-quality assessment lists 20 sites in the study area having impaired ground water (fig. 9). Harding Lawson Associates (1989) describe sites on the peninsula having known, potential, or alleged soil or water contamination. These sites include gasoline stations, chemical and petroleum plants, fire-fighting training areas, fuel or waste-oil spill sites, storage and junk yards, sites where chemical containers were found, oil-field and gas-field reserve pits, and commercial septage-disposal sites. Eighteen Alaska Department of Environmental Conservation (ADEC) permitted waste-disposal sites (such as landfills, oil and gas drilling reserve pits, and septage-sludge or sewage-disposal sites) also occur in the study area (fig. 9); they are described in reports by ADEC (1992) and Harding Lawson Associates (1989).

Sources and Types of Available Ground-Water-Quality Data

Agencies, individuals, and private industries, collect water-quality data for diverse purposes. For example, water samples may be analyzed to help determine if the water is safe to drink, meets an industry's manufacturing needs, or has been degraded by man's activities. A variety of physical, chemical, and biological constituents and properties can be analyzed depending on a project's objectives. Also, a variety of collection and analytical techniques can be used depending on the project's data-quality objectives and the type of water that is being tested. Results from analytical procedures are in many forms, such as computer databases, original paper documents, and published and unpublished reports by agencies, by water users, and by private consultants. Computer databases of results of chemical analyses of water from wells on the Kenai Peninsula are maintained by USGS, ADNR-AHS, and ADEC.

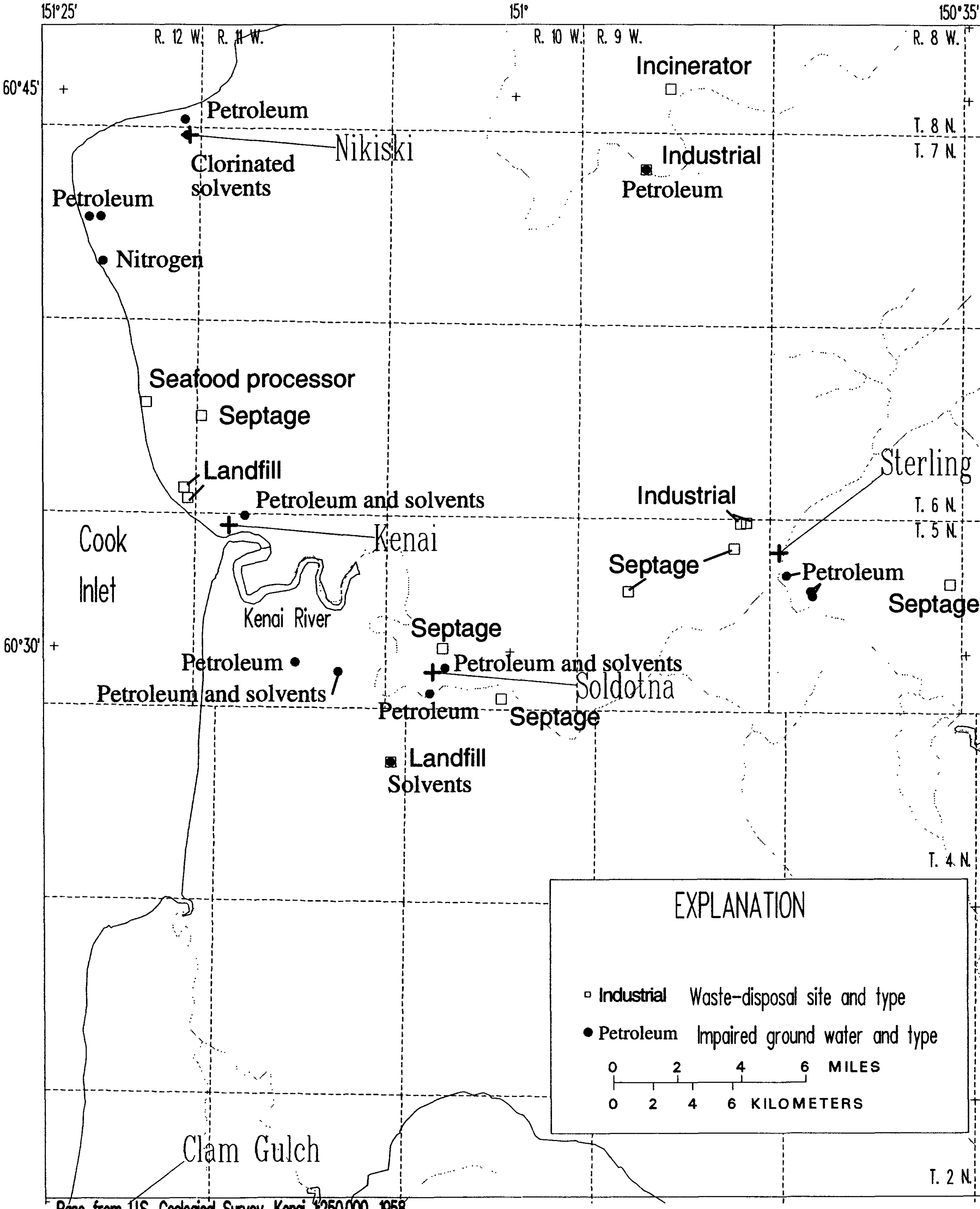
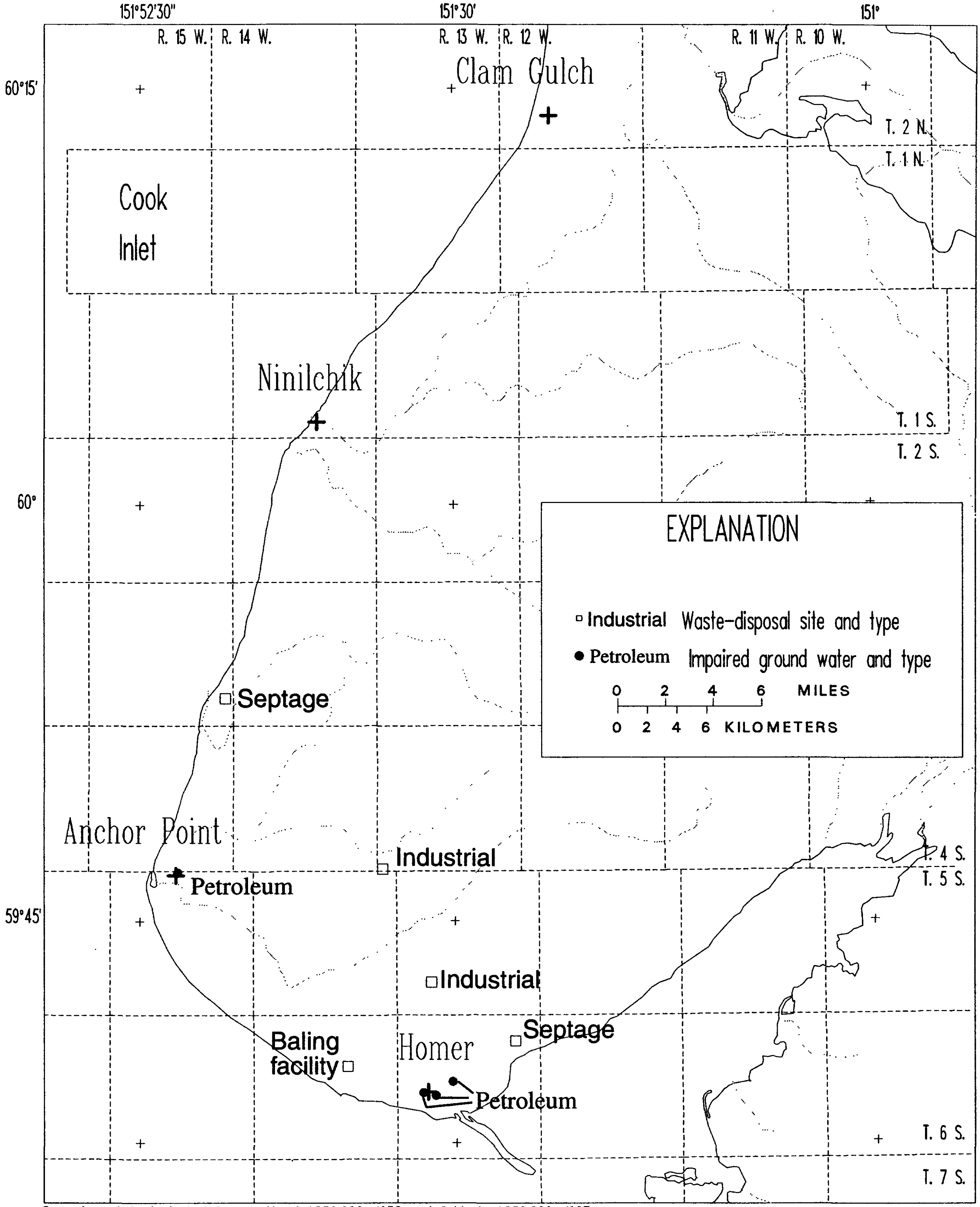


Figure 9A. Waste-disposal sites and locations of impaired ground water, upper Kenai Peninsula. [Waste-disposal data from Harding Lawson Associates (1989, appendix C); impaired ground-water data from Alaska Department of Environmental Conservation (1992, appendix 1.]



Base from U.S. Geological Survey, Kenai 1:250,000, 1958 and Seldovia 1:250,000, 1963

Figure 9B. Waste-disposal sites and locations of impaired ground water, lower Kenai Peninsula. [Waste-disposal data from Harding Lawson Associates (1989, appendix C); impaired ground-water data from Alaska Department of Environmental Conservation (1992, appendix 1.]

Water analyses available from USGS are generally from water samples that were collected and analyzed by USGS to determine natural chemical characteristics of water in aquifers. Water-quality results are available in published reports, in file records, and in a computerized database called WATSTORE (Water Data Storage and Retrieval System). The field measurements and sample collection, treatment, and preservation techniques followed procedures described by Marc Sylvester (U.S. Geological Survey, written commun., 1990), Fishman and Friedman (1989), and Fishman (1993). The specific water-sampling techniques used during this study are described in a preliminary planning document. At the beginning of this study, chemical analyses by USGS were available from about 250 wells in the study area. During 1991, water samples from 63 wells were collected and analyzed by the USGS to determine physical properties and concentrations of selected major inorganic constituents, nutrients, metals, and trace elements. During 1992, water samples from seven sites (six wells and a spring) near Sterling were collected and analyzed for selected inorganic constituents, nutrients, metals and trace elements, and organic constituents. Results of ground-water-quality analyses prior to 1991 are in a report by Bullington (1991). Results have been published for water year 1991 (Lamke and others, 1992, p. 386-387, 391-402) and water year 1992 (Kemnitz and others, 1993, p. 409-411).

The U.S. Fish and Wildlife Service intermittently monitors the quality of water from water-supply and contamination-monitoring wells in oil and gas fields in Kenai National Wildlife Refuge and from water-supply wells in refuge campgrounds. Data from about 20 wells are in file records at the refuge headquarters and many of these analytical results have been entered into a database by ADNR-AHS.

A water source that is being used by a public-water system is required by Alaska law to be analyzed intermittently for selected inorganic, organic, and biological constituents (Alaska Department of Environmental Conservation, 1993). Information about the quality of water from public-supply wells is submitted to ADEC and is available in file reports and a computer database (known as the "Drinking Water" database) maintained by ADEC. The location and construction of many wells are not always known and the water may be a blend from several wells. The analyses commonly are of water that has been "treated" to soften the water, to remove iron, and (or) to reduce turbidity and concentrations of bacteria and viruses. The ADEC requires that ground-water and ground-water-quality conditions be determined in or near sites of potential and known water-quality problems, such as ADEC permitted waste-disposal sites and sites where fuels or chemicals have been spilled. Water samples from wells at these sites have been collected and analyzed by ADEC and by private consultants. The location and construction of most monitoring wells are known. Reports and water-quality analyses are available in file records at ADEC, and many of the results of water-quality analyses have been entered into a computer database by ADNR-AHS.

The ADNR-AHS collected and analyzed water from 30 wells in the Nikiski area in 1991. The field measurements and sample collection, treatment, and preservation techniques used by ADNR-AHS followed procedures described by Maurer (1991). The results of water-quality analyses are available in a published report (Maurer, 1993) and in ADNR-AHS's water-quality database.

The availability of ground-water quality data is not uniform throughout the peninsula. Most ground-water quality analyses are from wells in or near Nikiski, Kenai, Soldotna, and Sterling. Only a few analyses are from wells in smaller communities such as Clam Gulch, Ninilchik, and Anchor Point, or from wells distant from a community. The concentrations of constituents in ground water in data-poor areas are not known. However, because the near-surface geology of the peninsula is complex, ground-water quality may vary widely—even over short distances—both horizontally and vertically.

Selection of Water-Quality Constituents and Analyses

Constituents for this study were selected for human health, aesthetic, geochemical, and contamination-detection purposes; however, not all constituents analyzed by all agencies are included in this report. The types of water-quality determinations selected can be categorized into five groups: (1) physical properties and field measurements; (2) major inorganic constituents; (3) nutrients; (4) metals and trace elements; and (5) organic compounds.

To reduce bias in the descriptive statistics, a mean value was calculated for each constituent from all water analyses from each well. This mean value for each well is given in the appendix; the value was used to determine the constituent's mean and median values (table 2) within the study area. Concentrations of some constituents were less than analytical detection levels. When this occurred and the detection level was known, the "not detected" concentration was set to the detection level before area-wide means and medians were calculated; when the detection level was not known, the "not detected" concentration was set to zero. Mean and standard deviation values were not reported in table 2 when more than 25 percent of the analyses for a constituent were less than analytical detection levels. Median (50th percentile) values were included because when data are highly skewed or contain less-than-detection-limit values, medians can be more useful than means in interpreting the data. The results of analyses for major inorganic constituents, nutrients, metals, and trace elements are from water samples that were filtered at the time of collection using a membrane filter having 0.45 micron (μm) openings. Physical properties (except hardness), field measurements, and analyses of organic compounds were determined from total (unfiltered) water samples. Some samples (especially samples that were turbid) that were analyzed for alkalinity were filtered; most were not.

For some constituents, regulations have been set for their maximum concentrations allowed (or recommended) for drinking water (table 2). A *primary maximum contaminant level* (PMCL) is health related. It is set by State (Alaska Department of Environmental Conservation, 1993) or Federal (U.S. Environmental Protection Agency, 1988a) agencies and is legally enforceable for suppliers of water to the public. A *secondary maximum contaminant level* (SMCL) applies to aesthetic qualities such as taste, odor, or staining properties, and is a guideline for public-water suppliers (U.S. Environmental Protection Agency, 1988b; Alaska Department of Environmental Conservation, 1993).

To determine the natural range in the quality of ground water that is generally unimpaired by human contamination, only analytical results that met the following criteria were used: (1) the water sample was obtained from a well between 20 and 450 ft deep, (2) the well was not in or immediately near a possible or ADEC-permitted waste-disposal site, (3) the well yielded fresh water, not brackish or saline water, (4) the water collected was untreated, and (5) the water sample was collected and analyzed using known and standardized procedures. Analyses from about 430 water samples from 312 wells met these criteria and were used in the statistical summary (table 2). All analyses used were from water samples collected by USGS or ADNR-AHS personnel. Some results from water sampled by other agencies and private industries, from water that is brackish or saline, from springs, or from wells shallower than 20 ft or deeper than 450 ft, or wells in and near actual and potentially contaminated sites are discussed but were not included in the statistical summary. For this study, fresh water is defined as water having a dissolved-solids content less than 3,500 mg/L.

Table 2. Statistical summary of selected physical properties and chemical constituents in ground water on the Kenai Peninsula

[Units and abbreviations: µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; µg/L, microgram per liter; <, less than; ND, not detected; @, at; Drinking-water regulation: (P) Primary maximum contaminant level; (S) Secondary maximum contaminant level; --, not regulated]

Property or constituent	Number of water samples	Number of wells sampled	Value or concentration[1]					Drinking-water regulation[2]	Remarks
			Minimum	Maximum	Mean	Median	Standard deviation		
Physical properties and field measurements									
Specific conductance (µS/cm at 25 degrees Celsius)	404	300	60	2,280	336	219	343	--	Specific conductance is a measure of the capacity of water to conduct electric current and is used to estimate the total dissolved constituents in water. Waters having less than 500 mg/L of dissolved solids, or specific conductance values less than about 820 µS/cm, are preferred for most uses. 18 sites had values greater than 820 µS/cm.
pH (units)	401	303	5.8	10.0	7.5	7.5	0.7	6.5-8.5 (S)	Hydrogen ion concentration. Values for pH can range between 0 and 14; a pH of 7.0 indicates neutrality of a solution. Values higher than 7 denote increasing alkalinity; values lower than 7 denote increasing acidity. Corrosiveness of water generally increases with decreasing pH. Excessively alkaline waters may also attack metals. 37 sites had pH values of 6.5 or less. 24 sites had pH values of 8.5 or greater.
Temperature (degrees Celsius)	327	268	2.5	22	6.2	5.0	3.2	--	Affects usefulness of water for many purposes. Most users desire water of uniformly low temperature.
Hardness (mg/L as $CaCO_3$)	334	260	2	209	65	57	39	--	Hardness describes the amount of scale that will form when the water evaporates and the amount of soap needed. Hardness is primarily due to the presence of calcium and magnesium and is expressed as mg/L as CaCO. In general, water of hardness as much as 60 mg/L is considered soft; 61-120 mg/L, moderately hard; 121-180 mg/L, hard; and greater than 180 mg/L, very hard. 142 sites had values less than 60 mg/L as $CaCO_3$; 92 sites had values between 60 and 120 mg/L; 23 sites had values between 120 and 180 mg/L. Three sites had values exceeding 180 mg/L.

Table 2. Statistical summary of selected physical properties and chemical constituents in ground water on the Kenai Peninsula--Continued

Property or constituent	Number of water samples	Number of wells sampled	Value or concentration[1]					Drinking-water regulation[2]	Remarks
			Minimum	Maximum	Mean	Median	Standard deviation		
Major inorganic constituents, dissolved (milligrams per liter)									
Calcium, Ca	327	259	0.3 12@<3.2 1@ND	52	17	14	11	--	Calcium is dissolved from almost all rocks and soils. It is a principal cation in Kenai ground water having specific conductance less than 1,000 µS/cm. Calcium and magnesium are the cause of most hardness and scale-forming properties of water.
Magnesium, Mg	326	258	0.2 2@ND	27	5.7	4.6	4.0	--	Magnesium is dissolved from many rocks. Its effect in water is similar to that of calcium. Magnesium significantly contributes to hardness.
Sodium, Na	328	258	1.1	448	43	8.0	75	--	Predominant cation in water having specific conductance greater than 1,000 µS/cm. High sodium concentrations may be harmful to individuals on a restricted sodium diet. 10 sites exceeded 250 mg/L.
Potassium, K	327	257	0.6	27	4.0	2.9	3.2	--	Potassium is dissolved from many rocks and is a minor cation in Kenai ground water. No sites exceeded 250 mg/L.
Alkalinity, fixed endpoint method	297	231	18	1,080	142	112	136	--	A property that describes the water's capacity for neutralizing acidity and is expressed as an equivalent concentration of calcium carbonate. Attributed mostly to bicarbonate, a principal anion in Kenai ground water. The significance of alkalinity to the domestic, agricultural, and industrial user is usually dependent on the nature of the cations (calcium, magnesium, sodium, and potassium) associated with it. Alkalinity in moderate quantities does not adversely affect most users. However, high alkalinity is usually associated with high pH, hardness, and dissolved solids, which can be detrimental.

Table 2. Statistical summary of selected physical properties and chemical constituents in ground water on the Kenai Peninsula--Continued

Property or constituent	Number of water samples	Number of wells sampled	Value or concentration[1]					Drinking-water regulation[2]	Remarks
			Minimum	Maximum	Mean	Median	Standard deviation		
Major inorganic constituents, dissolved (milligrams per liter)--Continued									
Sulfate, SO_4	327	259	1@<.01 2@<0.1 38@ND	73	4.5	2.0	8.7	500 (P)	Sulfate is dissolved from most sedimentary rocks. Concentrations greater than 250 mg/L may have a laxative effect on some people. No sites exceeded 250 mg/L.
Chloride, Cl	334	260	0.5	457	23	5.9	58	250 (S)	A principal cation in Kenai ground water having a specific conductance greater than 1,000 µS/cm. Large concentrations increase corrosiveness of water and, in combination with sodium, give a salty taste. Six sites exceeded 250 mg/L.
Fluoride, F	330	258	1@<.01 25@<0.1 17@ND	3.5	0.27	0.14	0.42	2 (S) 4 (P)	Fluoride concentrations of 0.6 to 1.7 mg/L in drinking water reduce incidence of tooth decay when the water is consumed during enamel calcification. Concentrations greater than 1.7 mg/L also protect the teeth from cavities but may cause an undesirable black stain. Five sites exceeded 2 mg/L.
Silica, SiO_2	298	231	2.2	55	31	31	9.5	--	Silica is dissolved from rocks and soils. Together with calcium and magnesium, silica forms scale in boilers and steam turbines.
Dissolved solids, sum of constituents	319	253	44	1,273	206	152	189	500 (S)	The sum of the concentrations of all constituents. Normally, the smaller the concentration, the better the quality for most uses. 15 sites exceeded 500 mg/L.

Table 2. Statistical summary of selected physical properties and chemical constituents in ground water on the Kenai Peninsula--Continued

Property or constituent	Number of water samples	Number of wells sampled	Value or concentration[1] Minimum	Maximum	Mean	Median	Standard deviation	Drinking-water regulation[2]	Remarks
Nutrients, dissolved (milligrams per liter)									
Nitrite as N	71	70	58@<.01	0.04	--	<0.01	--	1 (P)	Nitrite is unstable in aerated water.
Nitrate plus nitrite as N	129	116	34@<.05 24@<0.1	6	--	0.1	--	10 (P)	Nitrogen is an essential element in animal and plant nutrition; however, large concentrations in ground water are commonly associated with pollution by human activities. Nitrogen is usually found in water or soil as ammonia (NH_4), nitrate (NO_3), and nitrite (NO_2), but nitrite is unstable in aerated water. A nitrate concentration of 10 mg/L as N is equivalent to 44 mg/L as NO_3. Concentrations greater than 10 mg/L as nitrogen may cause methemoglobinemia, a sometimes fatal disease in infants. No sites exceeded 10 mg/L as N.
Ammonia, as N	71	70	15@<.01	0.6	--	0.06	--	--	Ammonia is a component of the nitrogen cycle, but is usually present in water in small concentrations.
Ammonia + organic nitrogen, as N	61	61	23@<0.2	0.9	--	0.3	--	--	Organic nitrogen and ammonia nitrogen. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials.
Phosphorus, P	71	70	8@<0.01	2.9	0.26	0.07	0.52	--	Phosphorus is an essential element in the growth of plants and animals. It occurs as organically bound phosphorus or as phosphate, PO_4. Concentrations of phosphorus found in water are not reported to be toxic to man, animals or fish; however the element can stimulate the growth of algae in surface waters.
Orthophosphorus, PO_4	131	117	17@<.01 24@<0.1	5.0	--	0.1	--	--	

Table 2. Statistical summary of selected physical properties and chemical constituents in ground water on the Kenai Peninsula--Continued

Property or constituent	Number of water samples	Number of wells sampled	Value or concentration[1] Minimum	Maximum	Mean	Median	Standard deviation	Drinking-water regulation[2]	Remarks
Metals and trace elements, dissolved (micrograms per liter)									
Arsenic, As	126	113	37@<1 1@<1.2	94	13	3	20	50 (P)	Arsenic compounds are present naturally in some waters. Arsenic is eliminated very slowly from the human body and in large quantities is toxic to man and animals. Nine sites exceeded 50 µg/L
Boron, B	12	9	3@<20	450	--	165	--	--	Small quantities of boron are essential to plant growth. Concentrations higher than 1,000 µg/L are harmful to some plants. Ocean water commonly contains about 4, 500 µg/L boron.
Iron, Fe	136	122	3 3@<30	41,000	2,800	210	5,400	300 (S)	Iron is dissolved from many rocks and soils and is an essential element in the metabolism of animals and plants. On exposure to air, iron in ground water oxidizes to become a reddish-brown sediment. If present in water in excessive quantities, it forms a red precipitate that stains laundry and plumbing fixtures, causes discoloration and unpleasant taste in beverages, and may promote growth of iron bacteria in pipes. Iron concentrations greater than 300 µg/L are not recommended for public water supply without treatment. 56 sites exceeded 300 µg/L.
Manganese, Mn	135	121	6@<1 6@<5	1,400	218	110	284	50 (S)	Dissolved in some rocks and soils and it resembles iron in its chemical behavior and its natural occurrence. It is an essential element for both plants and animals. If present in water in excessive quantities (greater than 200 µg/L), it forms black oxide stains and an unpleasant taste in beverages. 77 sites exceeded 50 µg/L.
Selenium, Se	23	19	16@<1	3.5	--	<1	--	50 (P)	Selenium is an essential nutrient, but is required in low concentrations. It is found naturally in food and soils and is used in electronics, photocopy operations, the manufacture of glass, chemicals, and drugs, and as a fungicide and as a feed additive. No sites exceeded 50 µg/L.

Table 2. Statistical summary of selected physical properties and chemical constituents in ground water on the Kenai Peninsula--Continued

Property or constituent	Number of water samples	Number of wells sampled	Value or concentration[1]					Drinking-water regulation[2]	Remarks
			Minimum	Maximum	Mean	Median	Standard deviation		
Organic compounds, total (micrograms per liter)									
Benzene	22	21	21@<0.2	21@<0.2	--	<0.2	--	5 (P)	Benzene is a major component of gasoline and is also used as a solvent and degreaser of metals.
Toluene	22	21	10@<0.2 11@<0.3	10@<0.2 11@<0.3	--	<0.2	--	1,000 (P)	Toluene is used as a solvent and in the manufacture of gasoline.
Ethylbenzene	22	21	21@<0.2	21@<0.2	--	<0.2	--	700 (P)	Ethylbenzene is a major component of gasoline.
Xylenes	22	21	21@<0.2	21@<0.2	--	<0.2	--	10,000 (P)	Xylene is used in the manufacture of gasoline and as a solvent for pesticides, and as a cleaner and degreaser of metals.

[1]Statistical values were calculated for each constituent using a mean concentration for each site. Values for analytical results below detection levels were set to the detection level, if known, or to zero if the detection level was not known (ND). Mean and standard deviation values were not calculated when more than 25 percent of sites had analytical values less than detection levels. Water samples were collected and analyzed by either USGS or ADNR-AHS.

[2]Drinking-water regualtions are from Alaska Department of Environmental Conservation (1993) and U.S. Environmental Protection Agency (1995)

For each constituent, the number of analyses available, the number of wells sampled, the values of minimum, maximum, mean, and median concentration, and standard deviation are listed in table 2. Most wells were sampled only once, but some wells have been sampled many times and have many sets of water analyses.

Physical Properties and Field Measurements

Physical properties and field measurements include specific conductance, pH, water temperature, and hardness (table 2; appendix table A). In general, most water from wells on the peninsula had a low mineral content, had a pH value between 6.5 and 8.5 units, and was "soft." The mean and median water temperatures were 6.2 °C (43 °F) and 5.0 °C (41 °F), slightly warmer than the mean annual air temperatures for Kenai (34 °F) and Homer (37 °F).

Specific Conductance: The presence of charged ionic species in solution makes water conductive. Measuring the electrical conductance of a water sample is a rapid and convenient way to determine the approximate concentration of dissolved constituents in the water sample. Specific conductance is the electrical conductance of a water sample measured in microsiemens per centimeter (μS/cm) with the water temperature at 25 °C. Pure water has low concentrations of dissolved minerals and a very low electrical conductance. Water with high concentrations of dissolved solids (more than about 2,000 mg/L) has high electrical conductance and usually contains minerals that give it a disagreeable taste or make the water unsuitable in other respects. The approximate relation between dissolved solids (determined by adding the concentrations separately determined for all the ions in the water) and specific conductance in ground water in the western part of the Kenai Peninsula is shown graphically in figure 10. The maximum recommended dissolved-solids concen-

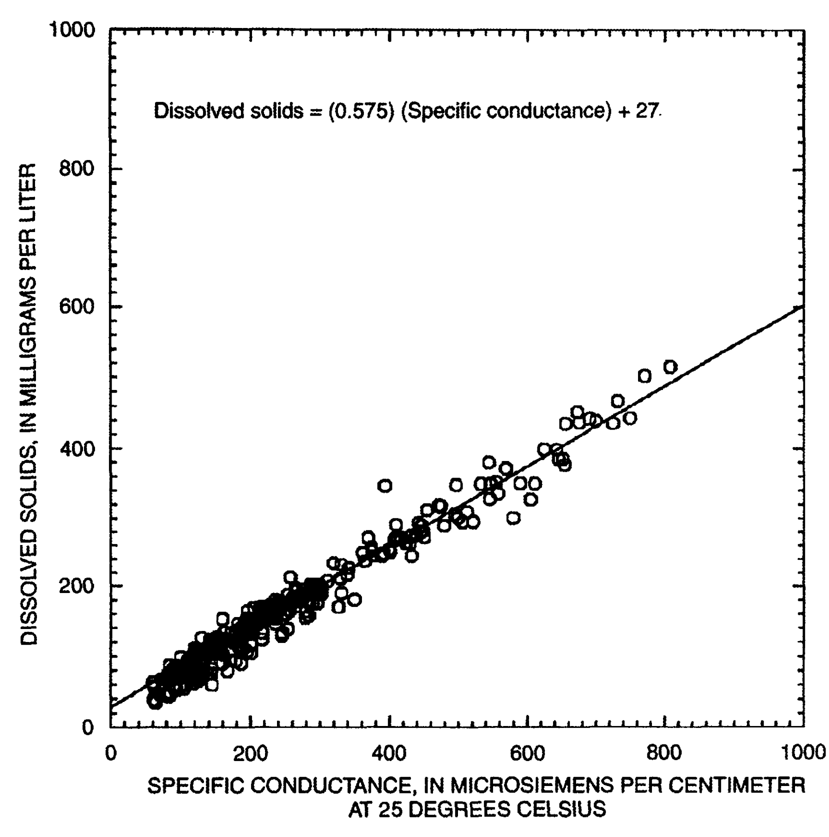


Figure 10. Approximate relation between values of dissolved solids and specific conductance in ground water on the Kenai Peninsula.

tration for drinking water is 500 mg/L, and for ground water in the Kenai Peninsula, 500 mg/L of dissolved solids is approximately 820 µS/cm. The mean value of specific conductance for ground water within the study area was 336 µS/cm, about equal to 224 mg/L of dissolved solids. The median value of specific conductance was 219 µS/cm. The areal distribution of specific conductance of water from wells is shown in figure 11. Most wells yielding water having high values of specific conductance are near the coast in the Nikiski, Kenai, Soldotna, and Homer areas. In comparison to water in lakes in the upper peninsula, ground water contains much more dissolved minerals. Fifty-nine lakes sampled by USEPA had specific conductance values that ranged from 8 to 175 µS/cm, and a median value of 21 µS/cm (Eilers and others, 1993).

pH is a measure of acidity. A pH value of 7.0 units is neutral: waters having lower values are acidic and waters having higher values are basic. The recommended range of pH for drinking water is 6.5 to 8.5 units. The median value of pH in ground water in the western part of the Kenai Peninsula was 7.5 units, but values ranged from 5.8 to 10 units. Wells yielding water with pH values of 6.5 or less were usually less than 100 ft deep, whereas wells yielding water with pH values of 8.5 and greater were usually more than 100 ft deep. The distribution of pH in well water is shown in figure 12.

Hardness: The property of hardness is associated with effects observed in the use of soap or with the encrustations left by some types of water when they are heated. Water hardness is caused by several different cations (principally calcium and magnesium), and is commonly reported in terms of an equivalent concentrations of calcium carbonate ($CaCO_3$). Hardness in water used for ordinary domestic purposes does not become particularly objectionable until it reaches a level of about 100 mg/L (Hem, 1985). The following classification from Hem (1985) is widely used:

Hardness range (milligrams per liter as calcium carbonate)	Description
0 - 60	Soft
61 - 120	Moderately hard
121 - 180	Hard
More than 180	Very hard

Using this classification, hardness data for 260 wells were evaluated. The percentage of wells falling within each range were 55 percent, soft; 35 percent, moderately hard; 9 percent, hard; and 1 percent, very hard. Values of hardness ranged widely in all areas (fig. 13). Hardness of well water in the study area ranged from 2 to 209 mg/L as $CaCO_3$; the mean and median hardness values were 65 and 57 mg/L as calcium carbonate. Several deep wells yielded water having high values of pH (more than 9 units) and low values of hardness (less than 15 mg/L as $CaCO_3$). Nineteen wells yielded water having hardness values less than 15 mg/L.

Major Inorganic Constituents

Major inorganic constituents generally occur in concentrations greater than a few milligrams per liter. They include calcium, magnesium, sodium, potassium, bicarbonate (which is a major part of alkalinity), sulfate, chloride, fluoride, silica, and the sum of all dissolved constituents, which is reported as dissolved solids (table 2; appendix table B). Almost all wells sampled by USGS and ADNR-AHS yielded water that meets the primary and secondary drinking water regulations for the major inorganic constituents.

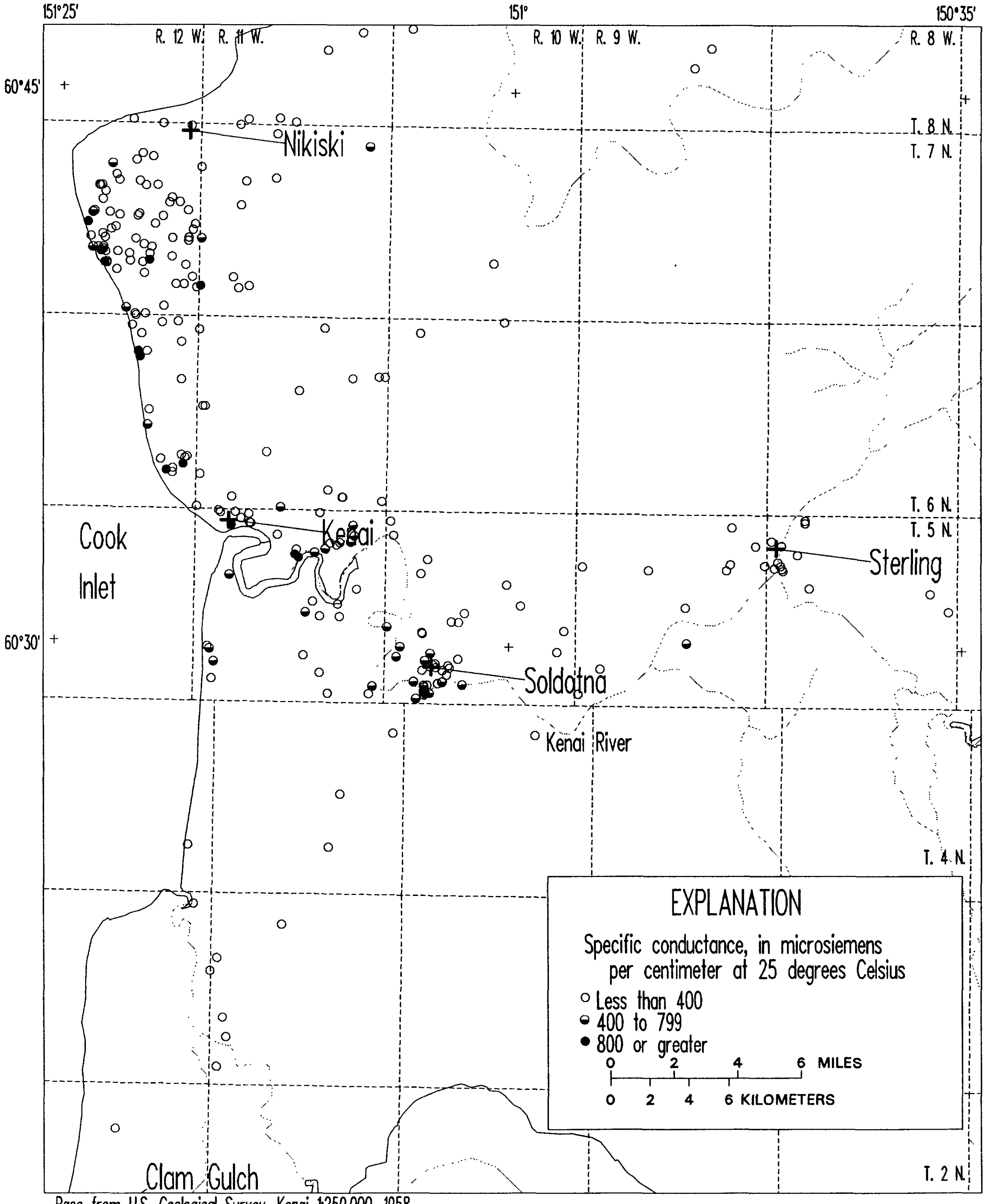


Figure 11A. Specific conductance of water from wells, upper Kenai Peninsula.

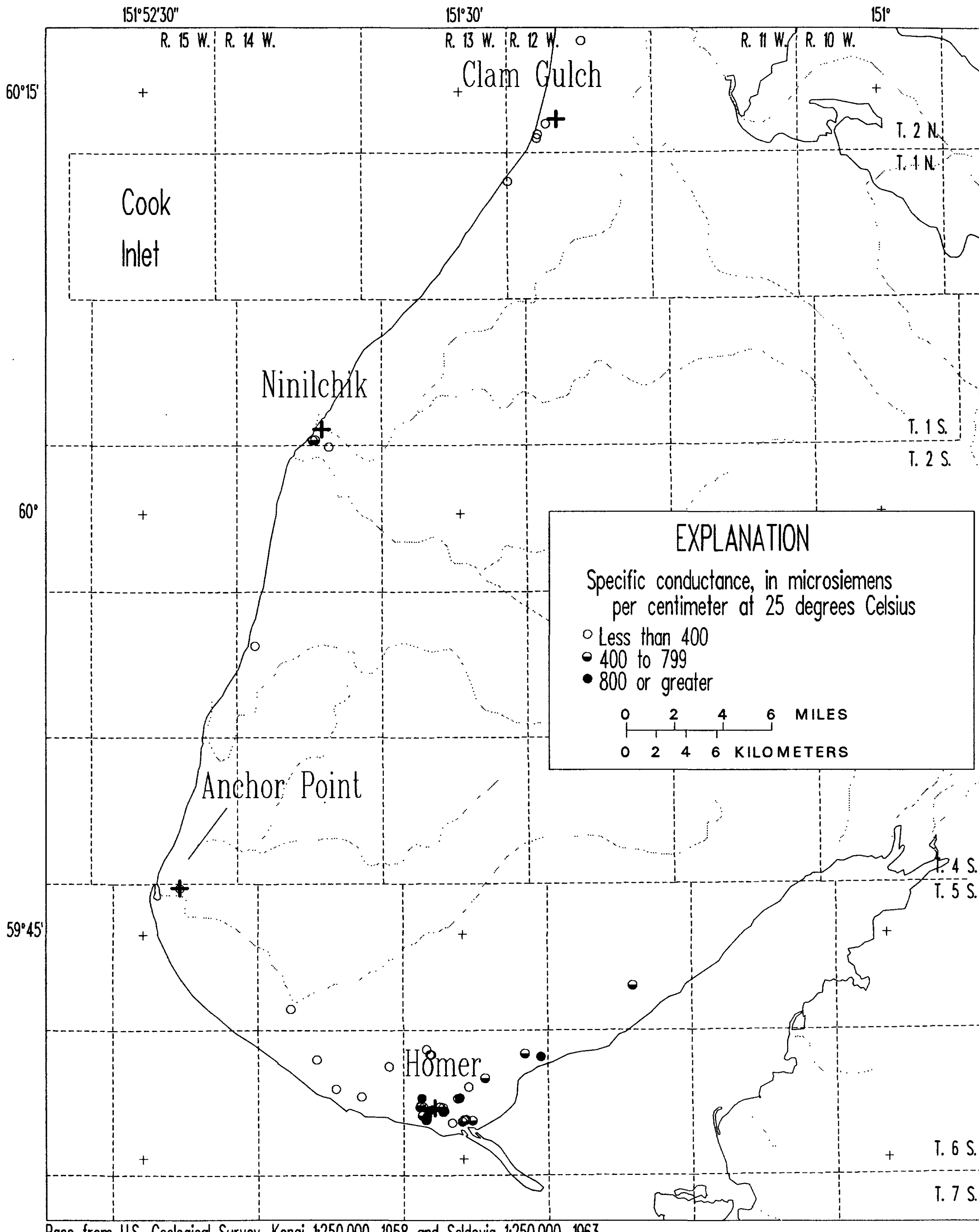


Figure 11B. Specific conductance of water from wells, lower Kenai Peninsula.

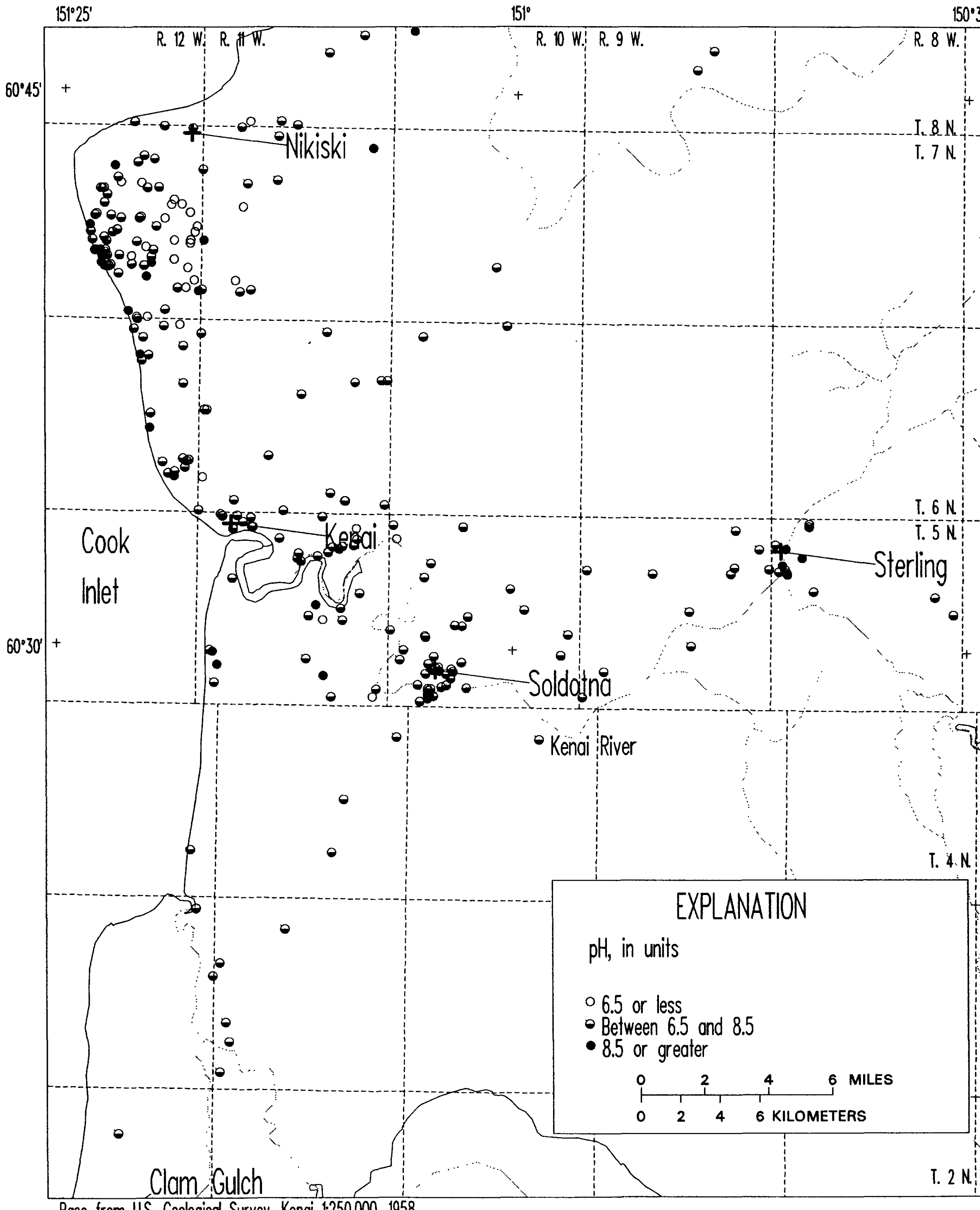


Figure 12A. pH of water from wells, upper Kenai Peninsula.

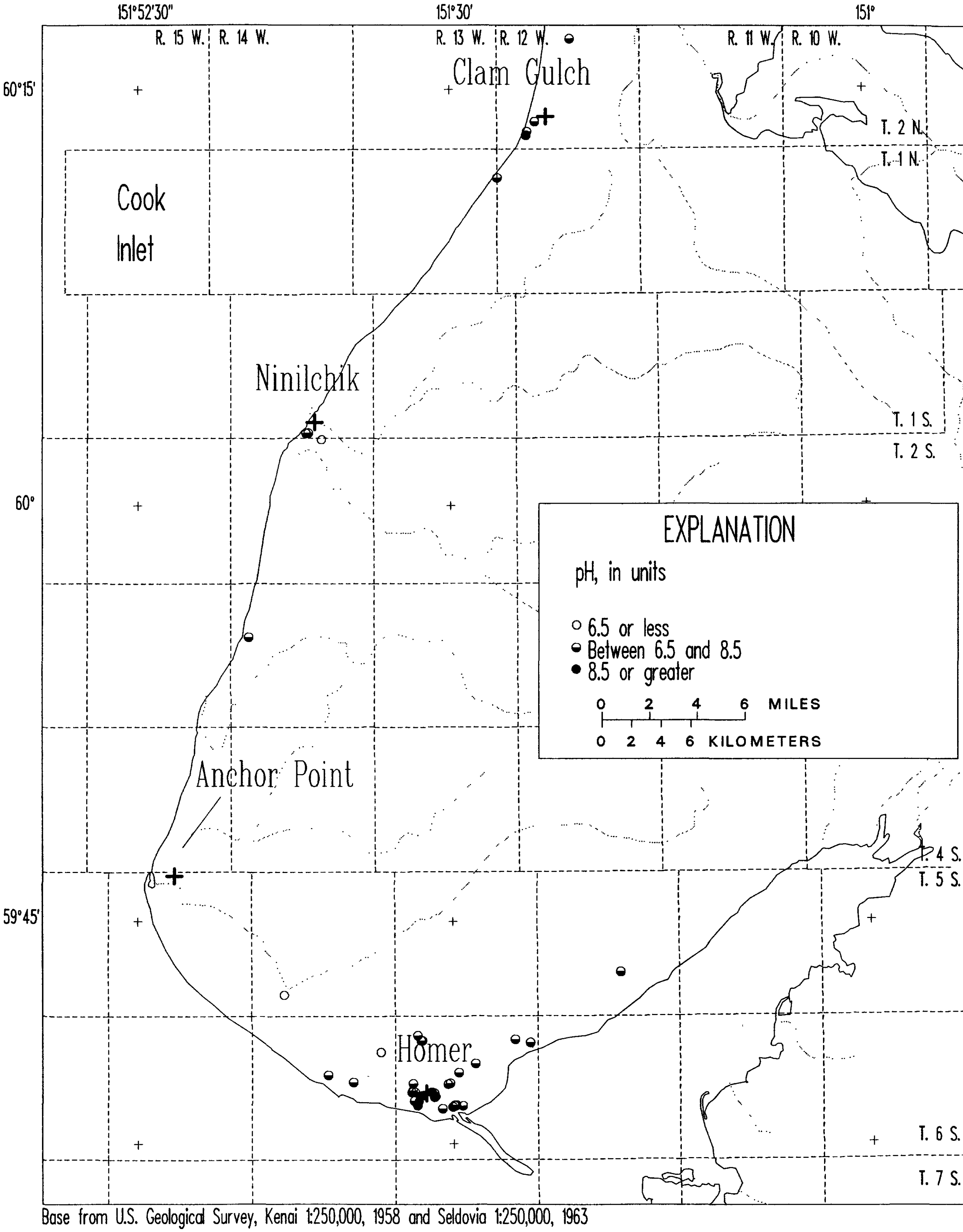


Figure 12B. pH of water from wells, lower Kenai Peninsula.

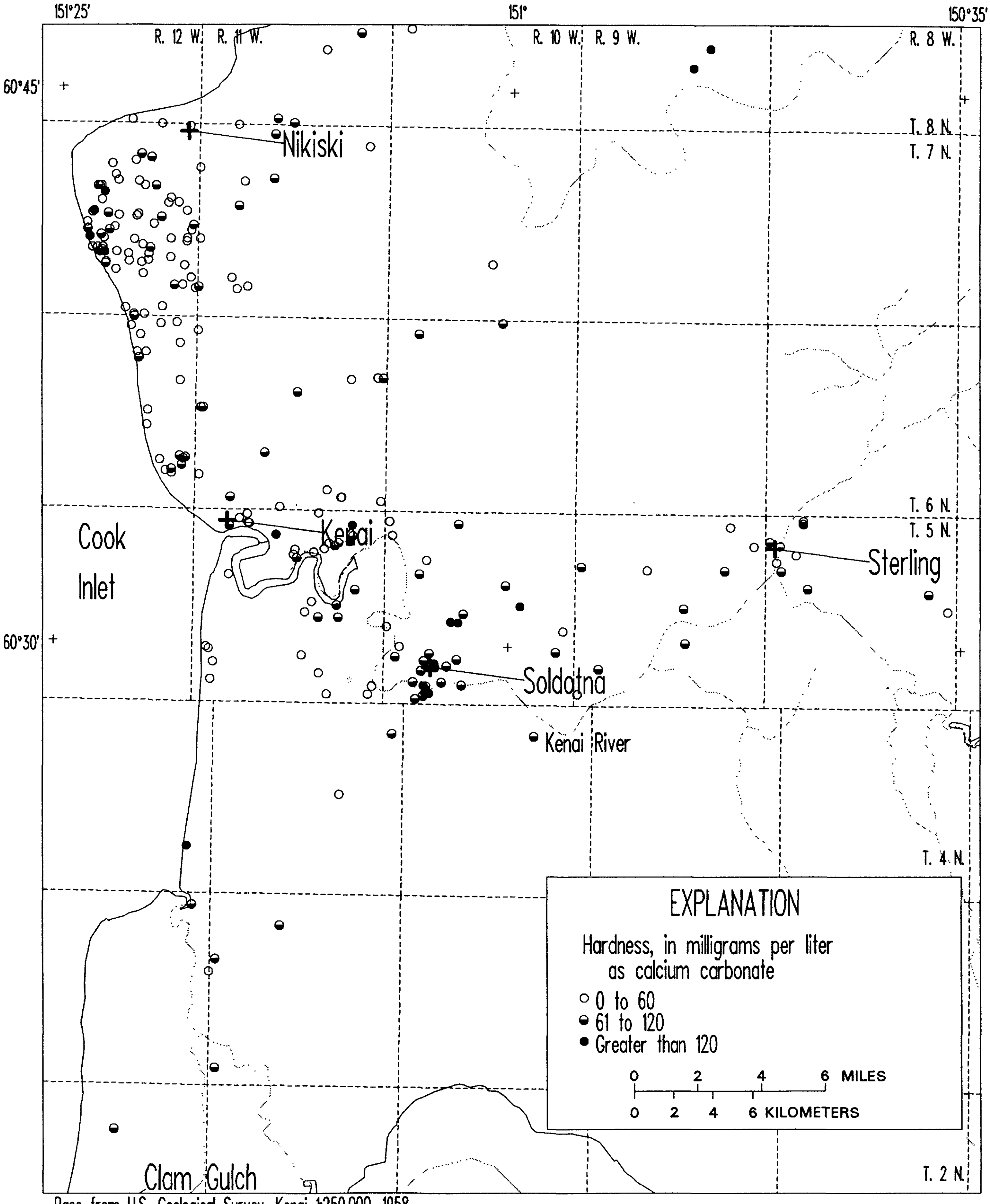


Figure 13A. Hardness in water from wells, upper Kenai Peninsula.

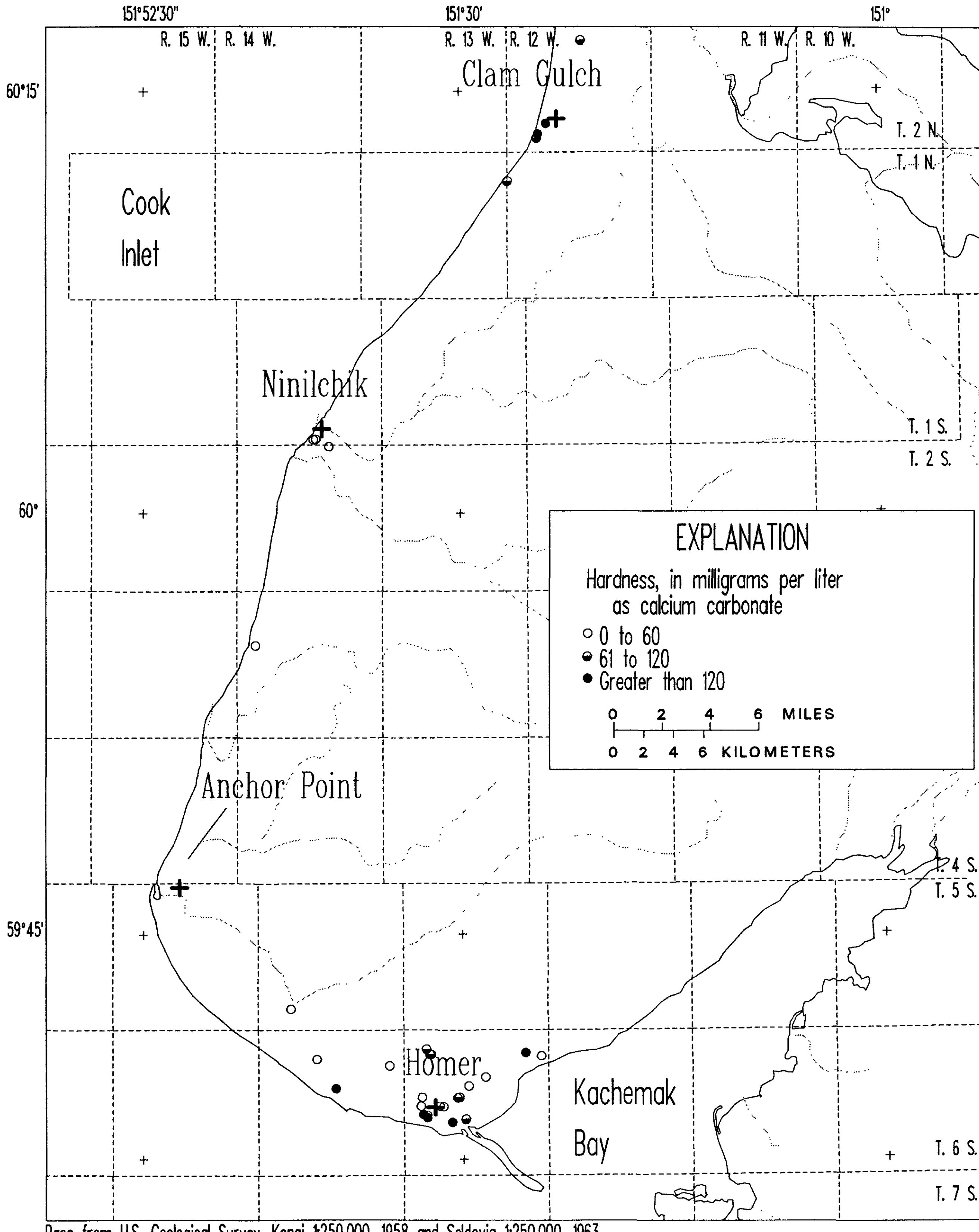


Figure 13B. Hardness in water from wells, lower Kenai Peninsula.

Sodium and chloride: Concentrations of dissolved sodium (fig. 14) or chloride (fig. 15) were greater than the recommended levels of 250 mg/L in water from about 10 wells that are deeper than 100 ft in coastal areas near Kenai and Homer. Concentrations of dissolved chloride (fig. 15) were greater than the recommended level of 250 mg/L in six wells. High concentrations of sodium in drinking water can adversely affect persons who must maintain low-sodium diets. High concentrations of chloride in drinking water, although not a health hazard, cause objectionable taste and can corrode pipes and plumbing fixtures. The mean and median concentrations of dissolved sodium within the study area were 43 and 8 mg/L, respectively. The mean and median concentrations of dissolved chloride were 23 and 5.9 mg/L, respectively.

Alkalinity: The alkalinity of a solution is the capacity for solutes it contains to react with and neutralize acid (Hem, 1985). Except for water having high pH (greater than about 9.5), alkalinity is produced predominantly by bicarbonate and carbonate. The principal sources of these carbon-dioxide species are atmospheric carbon dioxide, respiration by plants, and oxidation of organic matter. Alkalinity is determined by titrating a water sample with a strong acid and is expressed as an equivalent amount of calcium carbonate ($CaCO_3$). Water having low alkalinity is poorly buffered and is sensitive toward pH change, such as that resulting from the uptake and respiration of carbon dioxide by plants and from acid rain. The alkalinity of ground water in the peninsula ranged from 18 to 1,080 mg/L as $CaCO_3$ with mean and median values of 142 and 112 mg/L, respectively. The distribution of alkalinity in ground water is shown in figure 16. Eilers and others (1993) sampled water from 59 lakes in the upper peninsula. They observed that 47 lakes contained water that had alkalinities between 1 and 15 mg/L and 12 lakes had values between 36 and 87 mg/L.

Fluoride: Excessive concentrations of fluoride in drinking water can cause dental fluorosis (mottled tooth enamel). The primary drinking water regulation for fluoride is 4 mg/L and the secondary or recommended maximum concentration is 2 mg/L. The mean and median concentrations of dissolved fluoride were 0.27 and 0.14 mg/L. Only 5 wells yielded water exceeding 2 mg/L, and the highest concentration observed was 3.5 mg/L.

Silicon: The element silicon is second only to oxygen in abundance in the Earth's crust. A strong chemical bond forms between a silicon ion and four oxygen ions. The term "silica," meaning the oxide SiO_2, is widely used in referring to silicon in natural waters (Hem, 1985). Unlike other major ion constituents, dissolved silicon is not a charged ion and does not contribute to specific conductance. Concentrations of silica in ground water within the study area ranged from 2.2 to 55 mg/L and had both mean and median values of 31 mg/L. The distribution of dissolved silica in ground water is shown in figure 17. Of 59 lakes in the upper peninsula sampled by USEPA, 39 had concentrations of dissolved silica less than their analytical detection limit of 0.04 mg/L, and the highest concentration observed was 8.7 mg/L (Eilers and others, 1993).

Dissolved solids: Concentrations of dissolved solids in well water (determined by the sum of constituents) ranged from 44 to 1,273 mg/L, with a mean of 206 mg/L and a median of 152 mg/L. Wells yielding water having low concentrations of dissolved solids (less than 100 mg/L) were more commonly less than 100 ft deep. Wells yielding water having high concentrations of dissolved solids (more than 250 mg/L) were commonly deeper than 100 ft deep. Fifteen of 253 wells yielded water exceeding the secondary maximum contaminant level of 500 mg/L and all were within a few miles of the coast. Because the dissolved solids determine the property of conductance (dissolved solids average about 0.58 of specific conductance in the sampled wells), areas of high dissolved solids correspond directly with areas of high specific conductance (fig. 11).

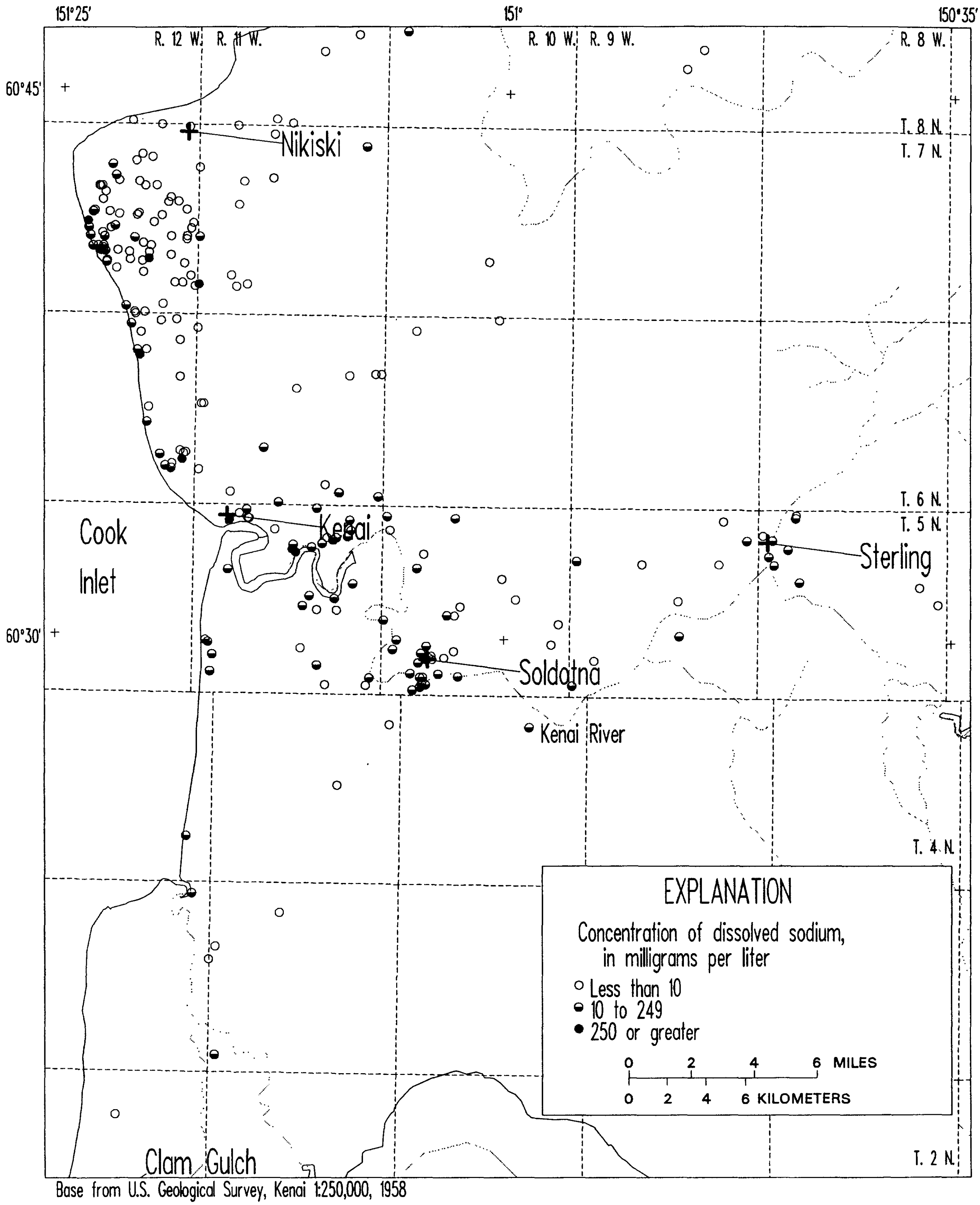
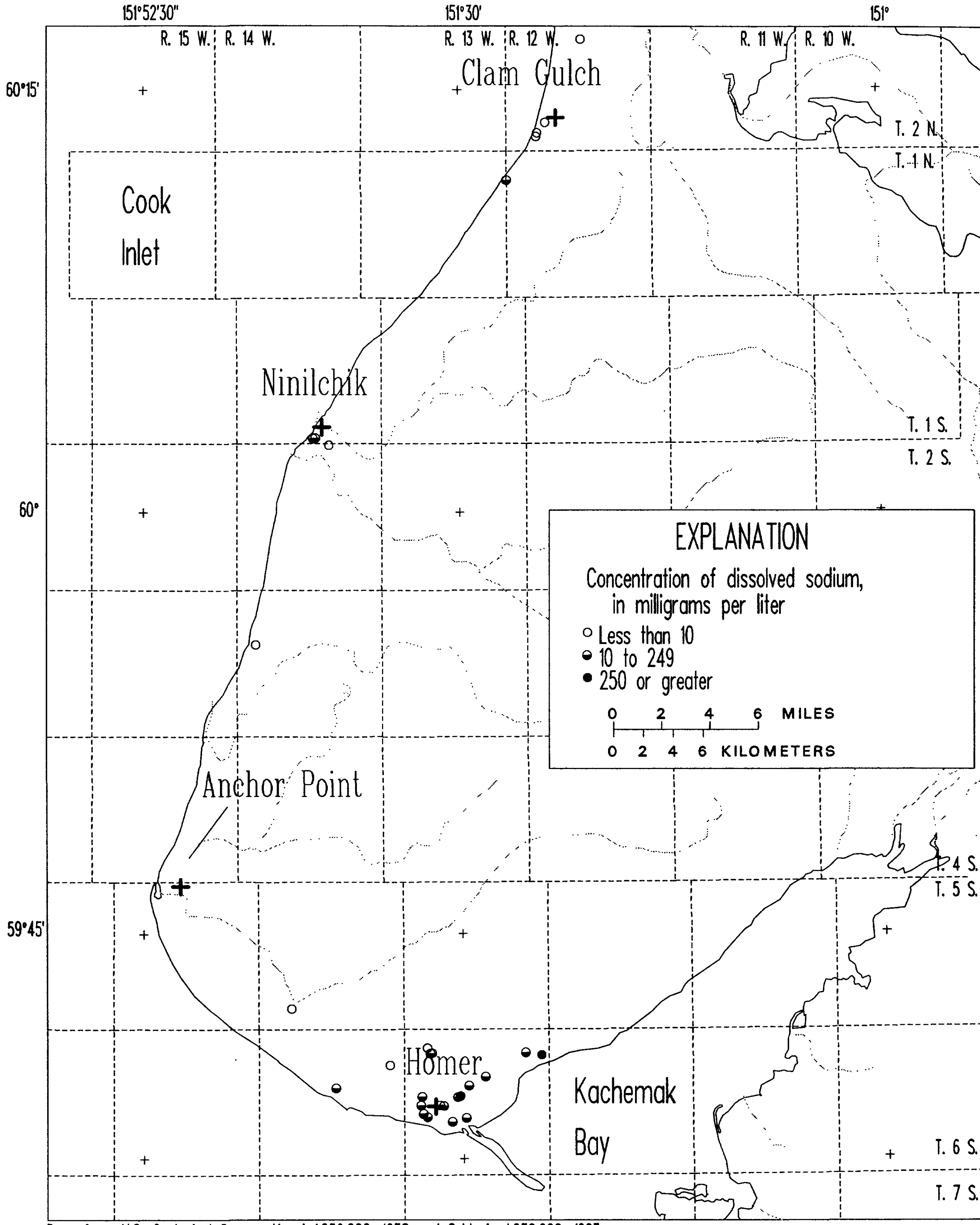


Figure 14A. Dissolved sodium in water from wells, upper Kenai Peninsula.



Base from U.S. Geological Survey, Kenai 1:250,000, 1958 and Seldovia 1:250,000, 1963

Figure 14B. Dissolved sodium in water from wells, lower Kenai Peninsula.

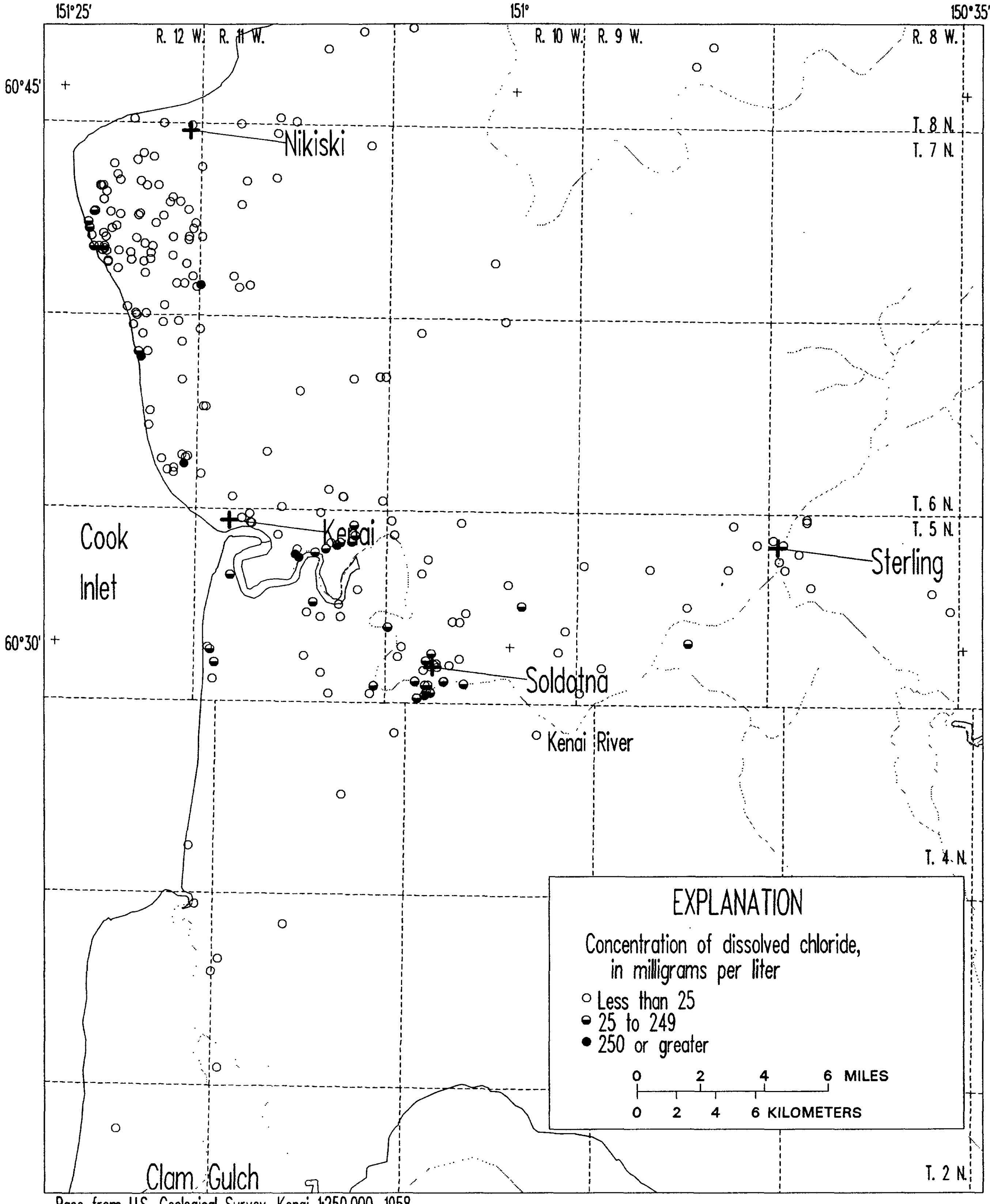


Figure 15A. Dissolved chloride in water from wells, upper Kenai Peninsula.

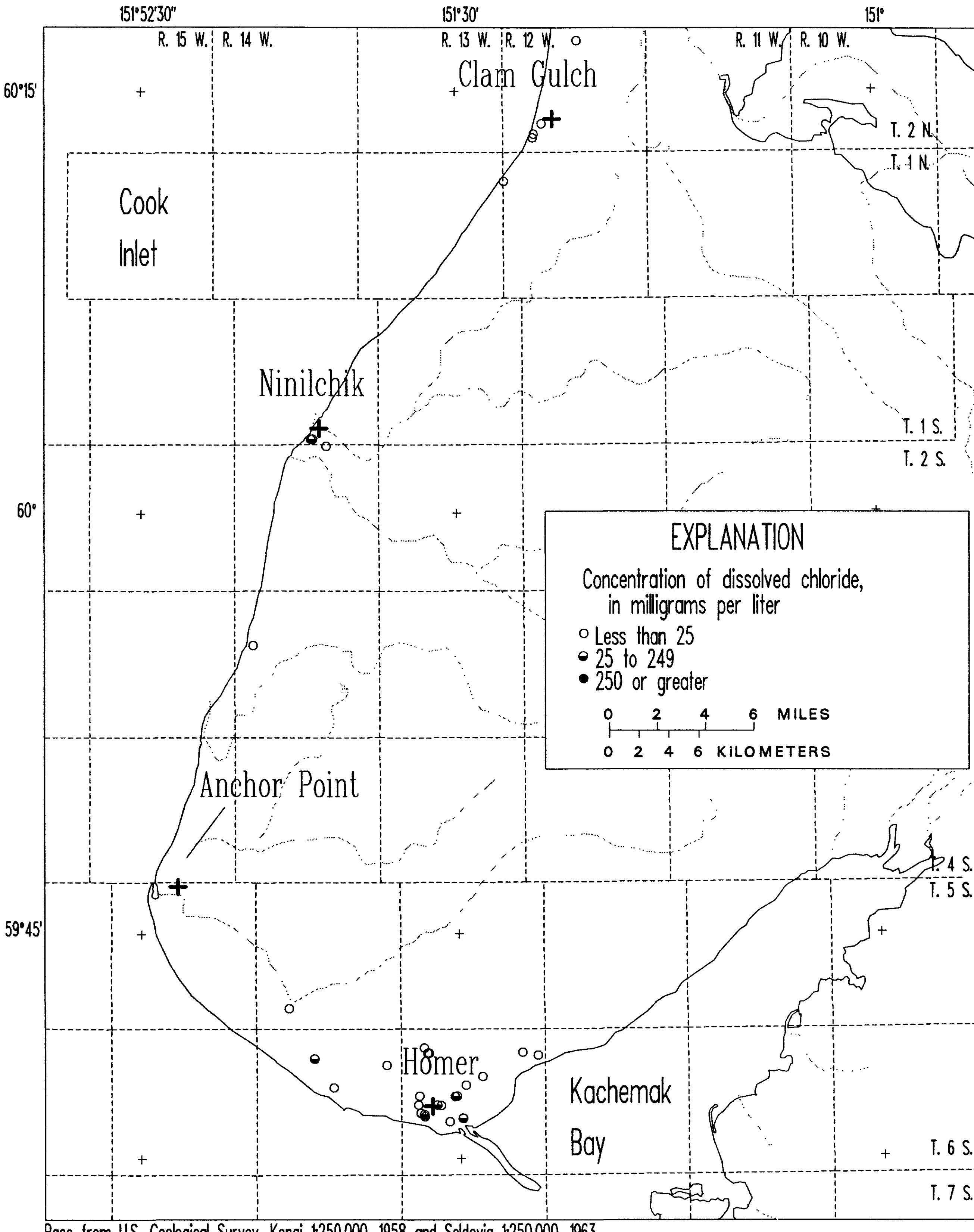


Figure 15B. Dissolved chloride in water from wells, lower Kenai Peninsula.

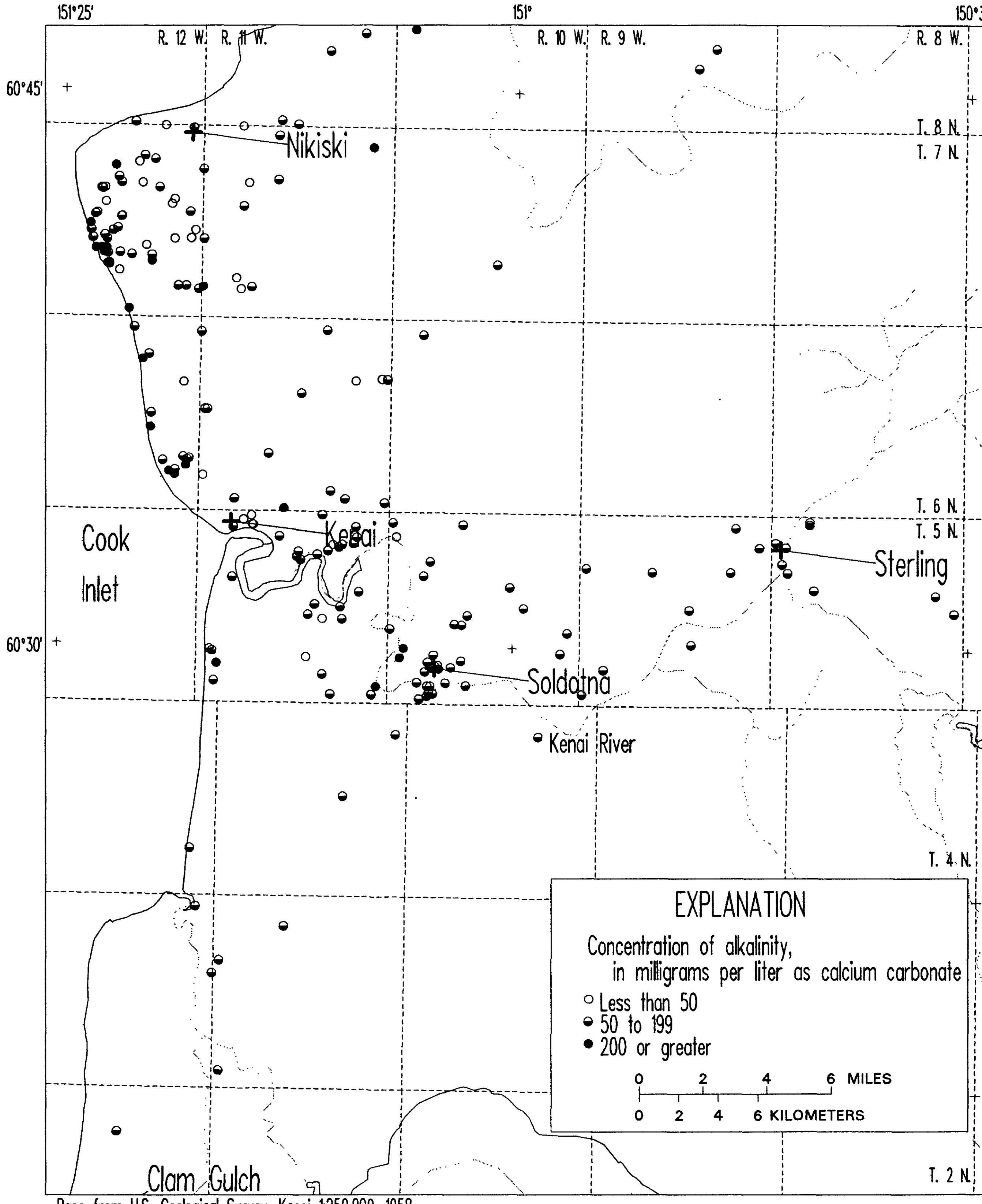


Figure 16A. Alkalinity in water from wells, upper Kenai Peninsula.

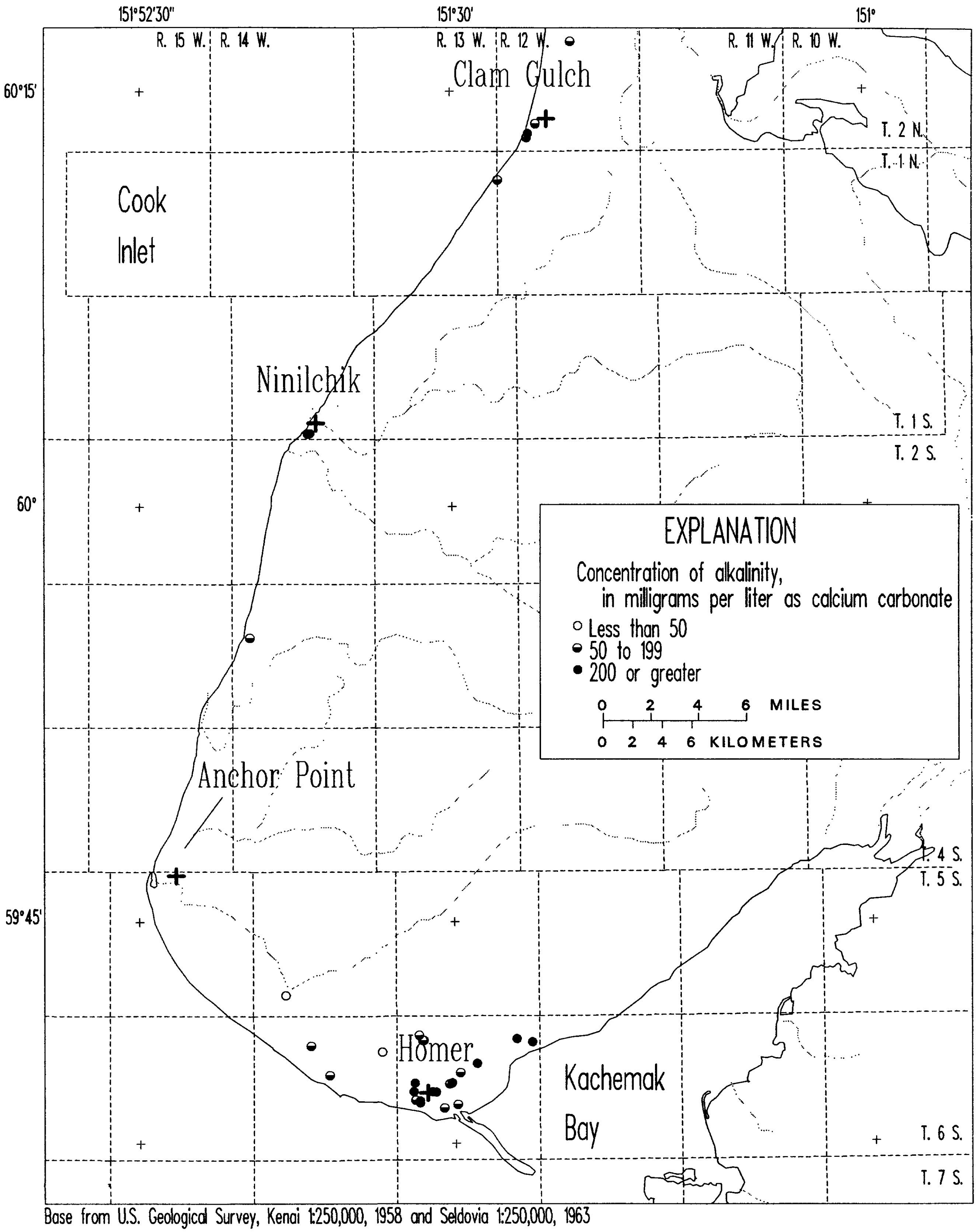


Figure 16B. Alkalinity in water from wells, lower Kenai Peninsula.

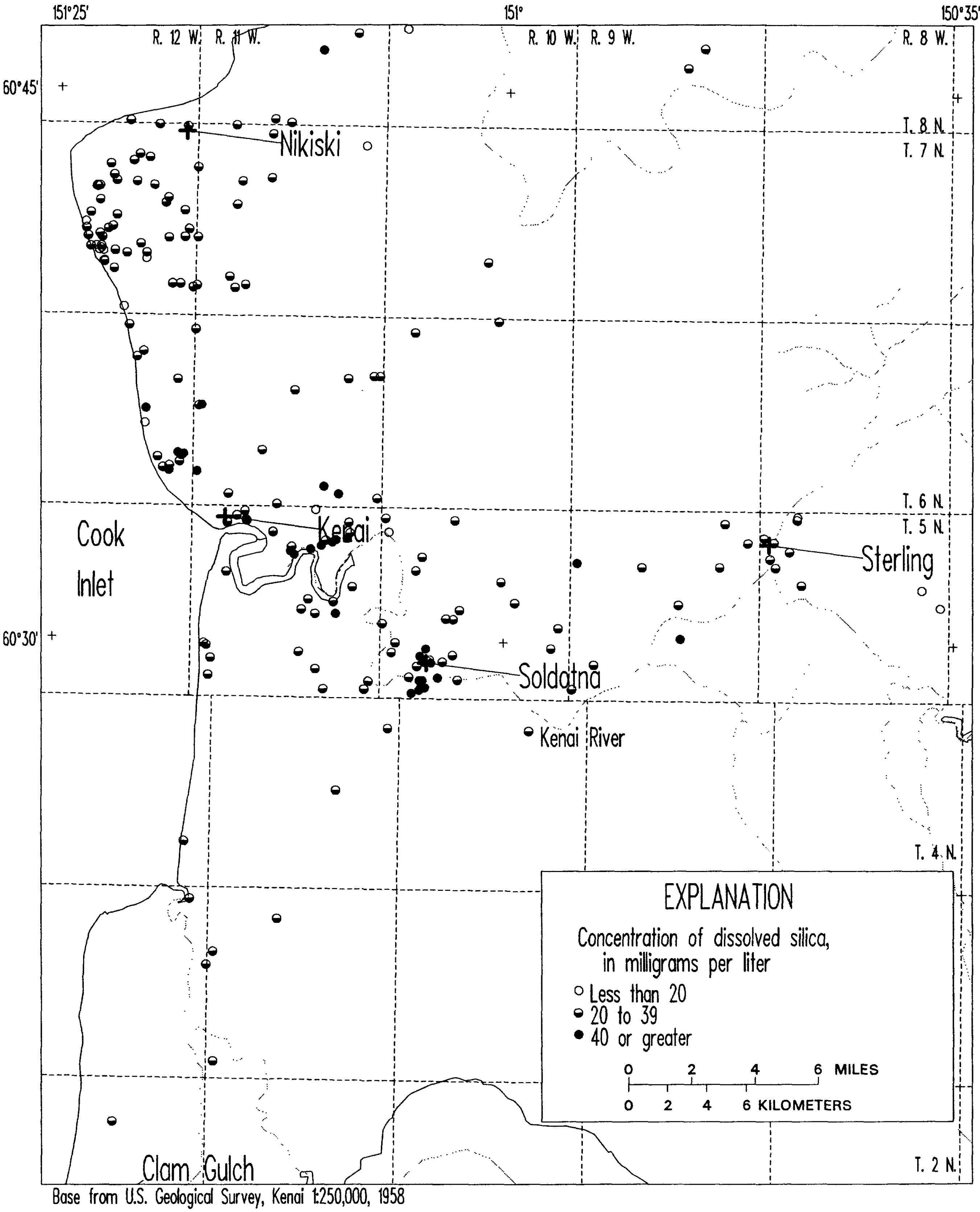


Figure 17A. Dissolved silica in water from wells, upper Kenai Peninsula.

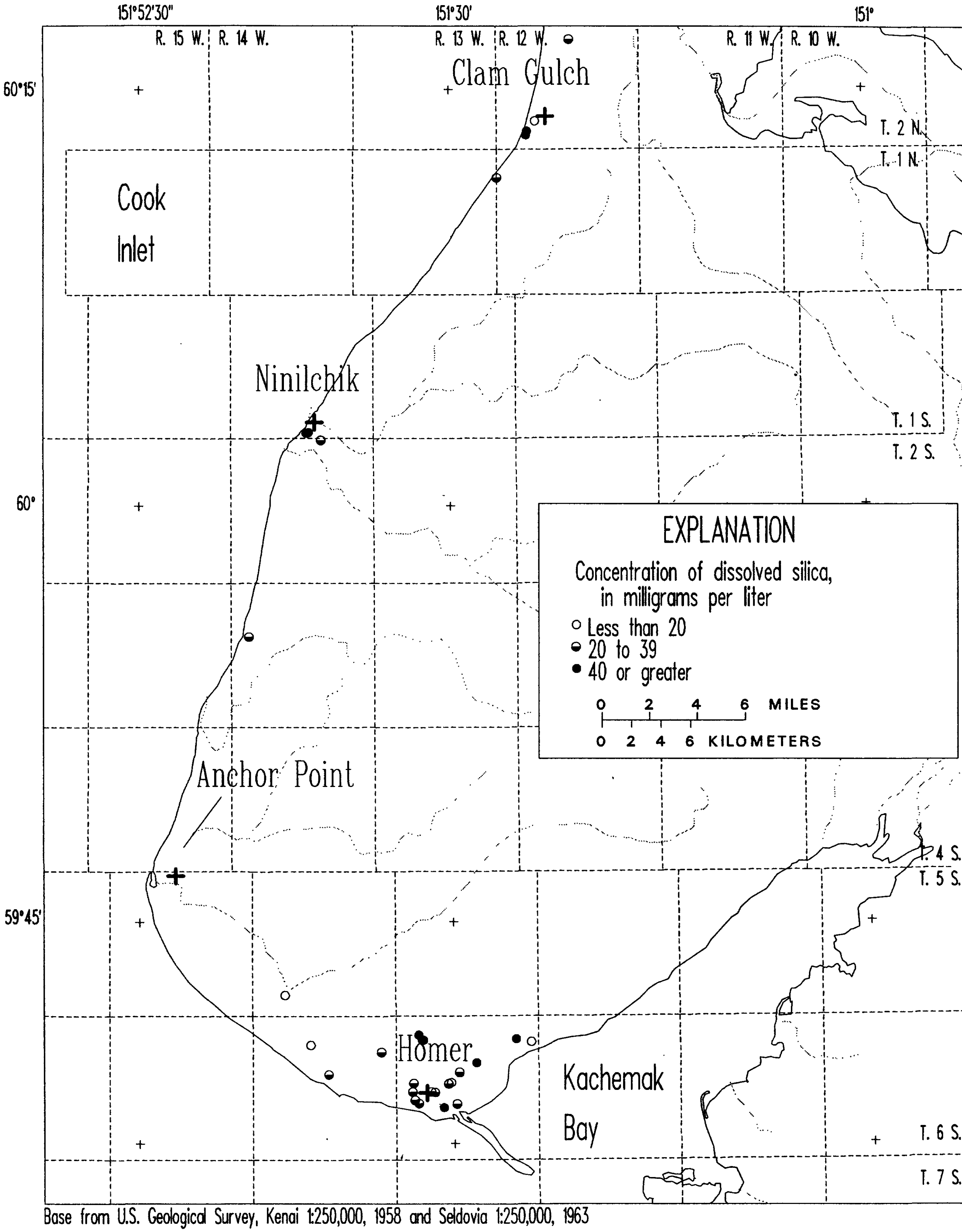


Figure 17B. Dissolved silica in water from wells, lower Kenai Peninsula.

Methods to compare water commonly describe relative chemical composition of each cation (positively charged ion) and anion (negatively charged ion). Units of milliequivalents per liter (meq/L) are used and are based on the absolute concentration of each major ion (in milligrams per liter), the ion's electrical charge, and the reciprocal of the ion's molecular weight. When expressed in milliequivalents per liter, the sum of the cation values equals the sum of the anion values.

One method of showing relative compositions of water is the trilinear diagram. A trilinear diagram contains three fields for plotting a water sample's major ion constituents—two equilateral triangles at the lower left and lower right corners of the diagram for cations and anions, respectively, and an intervening diamond-shaped field between the triangles for indicating the relative composition in terms of cation-anion pairs. Compositions of water from selected wells in the Nikiski area are shown in figure 18. As an example, the chemical composition of water from well SB00701216DDBB1 007, a 174-foot-deep well west of Bernice Lake is shown. Calcium and sodium compose about 43 and 39 percent of the cations, and chloride and bicarbonate about 46 and 34 percent of the total anions, respectively. It is a mixed water type because no single cation or anion exceeds 50 percent. The predominant ions occurring in ground water throughout the western part of the Kenai Peninsula are calcium, magnesium, and bicarbonate. Waters containing predominantly sodium, calcium, and bicarbonate water were less common. Only a few wells yielded sodium chloride type water. Water having sodium as the predominant cation commonly had a pH value of 8.5 or more and was from wells greater than 200 ft deep or from wells near the coast.

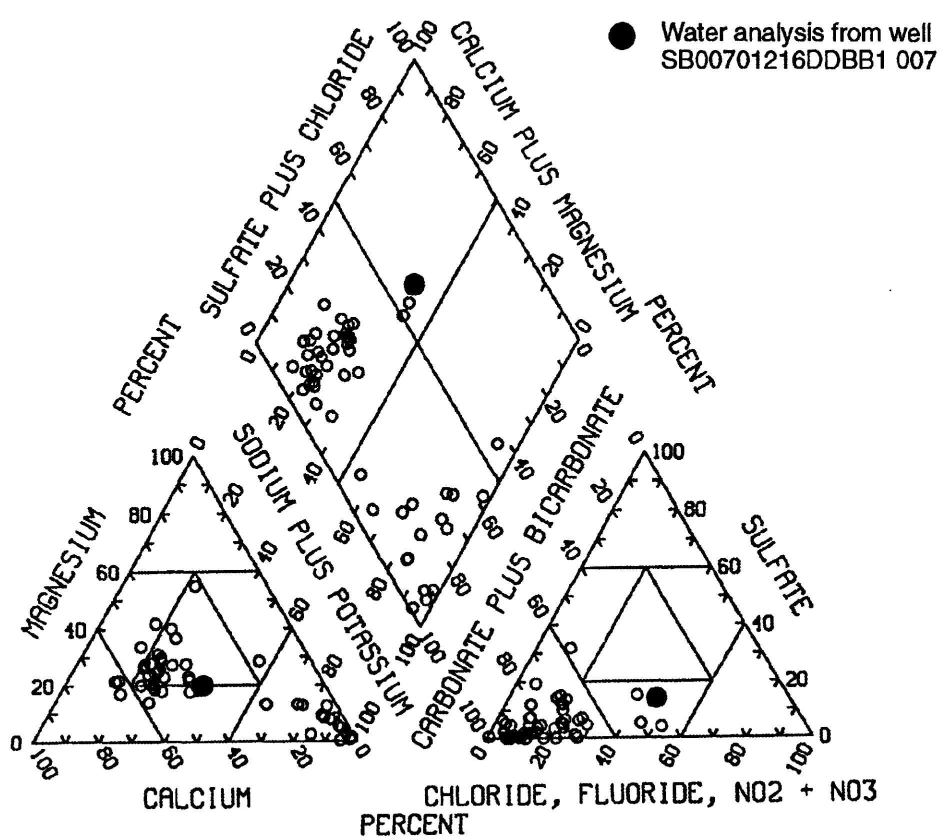


Figure 18. Trilinear diagram showing chemical composition of water from selected wells in the North Kenai area.

Nutrients

Some compounds of nitrogen and phosphorus are required nutrients for plants. However, high concentrations of nitrogen or phosphorus stimulate the growth of algae in lakes and streams and are commonly associated with contamination by human activities. Nutrients selected include nitrite, nitrate, ammonia plus organic nitrogen, phosphorus, and orthophosphorus (table 2; appendix table C). In general, concentrations of all nutrients were low. Many water samples had nutrient concentrations less than the analytical detection levels. Median concentrations of phosphorus and orthophosphorus were 0.07 and 0.1 mg/L, respectively.

Concentrations of nitrogen compounds are expressed in milligrams per liter as nitrogen (mg/L as N); for example, a nitrate (NO_3^-) concentration of 10 mg/L as N is equivalent to 44 mg/L as NO_3^-. Combined concentrations of nitrate and nitrite greater than 10 mg/L as N may cause a blood disorder known as methemoglobinemia in infants. This condition, which can be fatal, usually does not occur in older children or adults. In unimpaired areas, the highest concentration of nitrate plus nitrite observed was 6 mg/L as N, and most wells yielded water having concentrations less than 0.15 mg/L as N (fig. 19). Concentrations of ammonia and organic nitrogen were also low in ground water from unimpaired areas. Data from ADEC indicate that nitrogen concentrations in ground water beneath an industrial plant in Nikiski have exceeded 100 mg/L and ammonia plus organic nitrogen concentrations have exceeded 1,000 mg/L. The plant manufactures anhydrous ammonia and urea. A 90-foot deep well (SB00701201ABCC1 006) that was previously used to supply a subdivision in Nikiski yielded water having a nitrate-nitrogen concentration of 10 mg/L, but the water also has a high concentration of the solvent tetrachloroethylene. Both of these sites are listed as having impaired ground water (Alaska Department of Environmental Conservation, 1992).

Metals and Trace Elements

Many metals and trace elements are significant to man, animals, and plants. Some are essential to life in low concentrations; however, in high concentrations many are toxic to man, animals, and plants. High concentrations of some metals and elements give water a poor taste and stain laundry and plumbing. Metals and trace elements included in table 2 are arsenic, boron, iron, manganese, and selenium. Iron and manganese (appendix table D) commonly occur in ground water in the peninsula in concentrations greater than drinking-water regulations. Arsenic concentrations exceeded drinking-water regulations in water from 9 of 113 wells sampled. Concentrations of other metals and trace elements have also been determined and can be found in reports by Lamke and others (1992) and Kemnitz and others (1993). However, these are not discussed in this report because the results are from only a few wells and concentrations were not toxic or greatly out of ranges considered normal.

Arsenic is present in many rocks, and high concentrations of arsenic minerals commonly are associated with gold mineralization, volcanic gases, and geothermal waters. Arsenic is released into water by weathering of arsenic-containing rocks and volcanic activity. Arsenic in water can be acutely or chronically toxic to humans. As a result, the primary drinking water standard is 50 µg/L. Eight percent of the wells sampled yielded waters having concentrations of arsenic greater than 50 µg/L (fig. 20). Wells having high concentrations of arsenic were located both in and between Nikiski and Sterling. The highest concentration of dissolved arsenic measured by USGS or ADNR-AHS was 94 µg/L. The concentration range of arsenic in ADEC's Drinking Water database is sim-

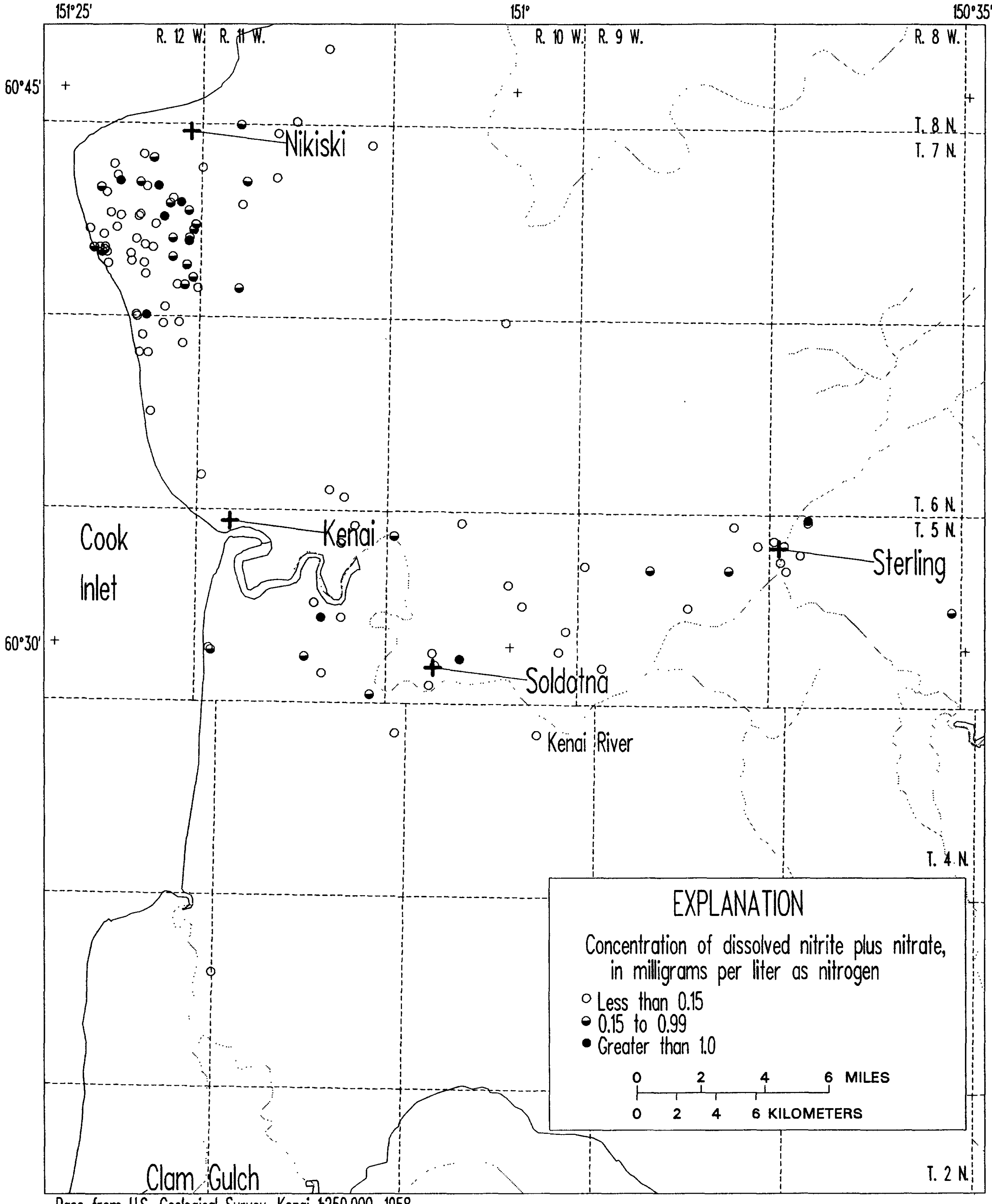


Figure 19A. Dissolved nitrite plus nitrate in water from wells, upper Kenai Peninsula.

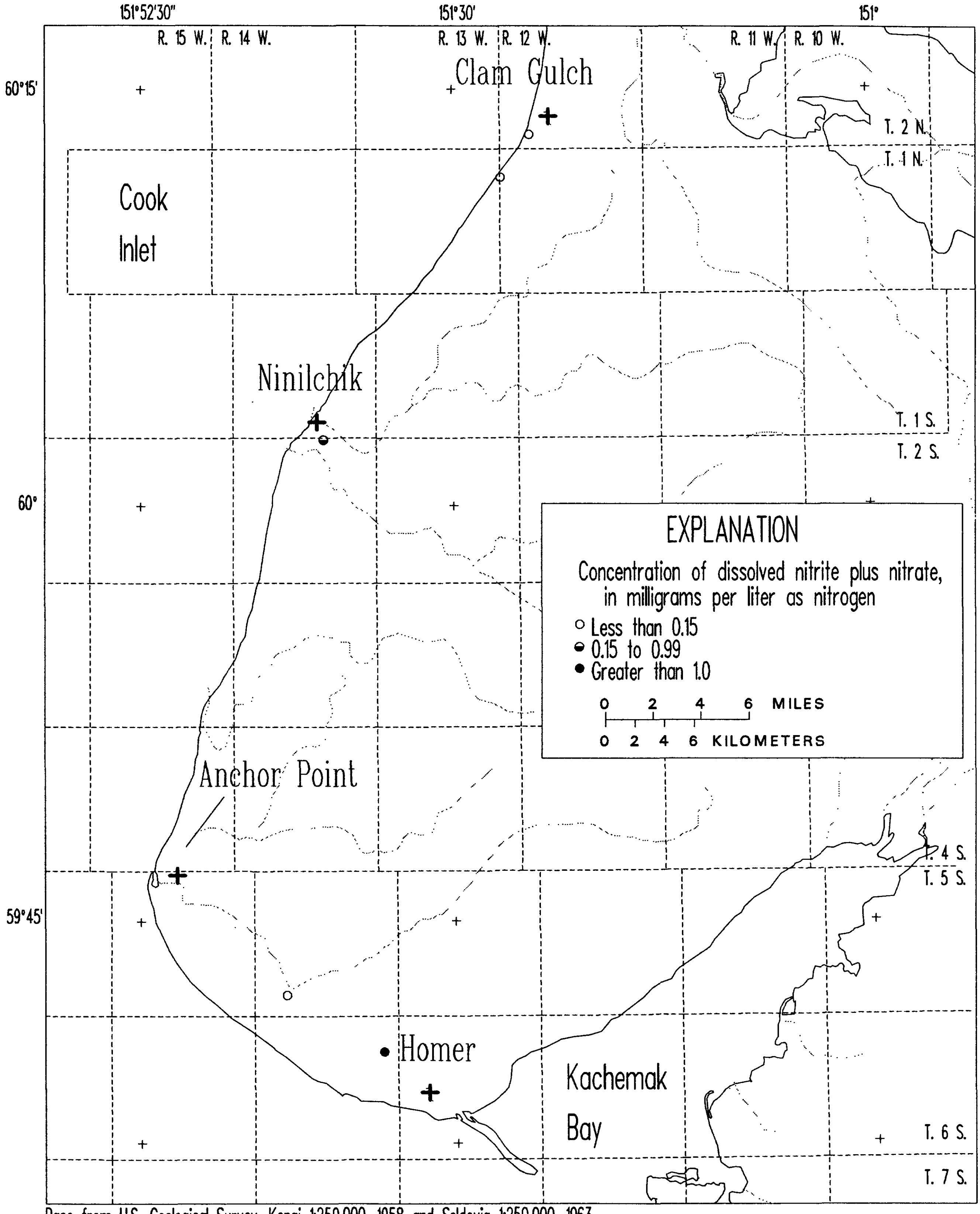


Figure 19B. Dissolved nitrite plus nitrate in water from wells, lower Kenai Peninsula.

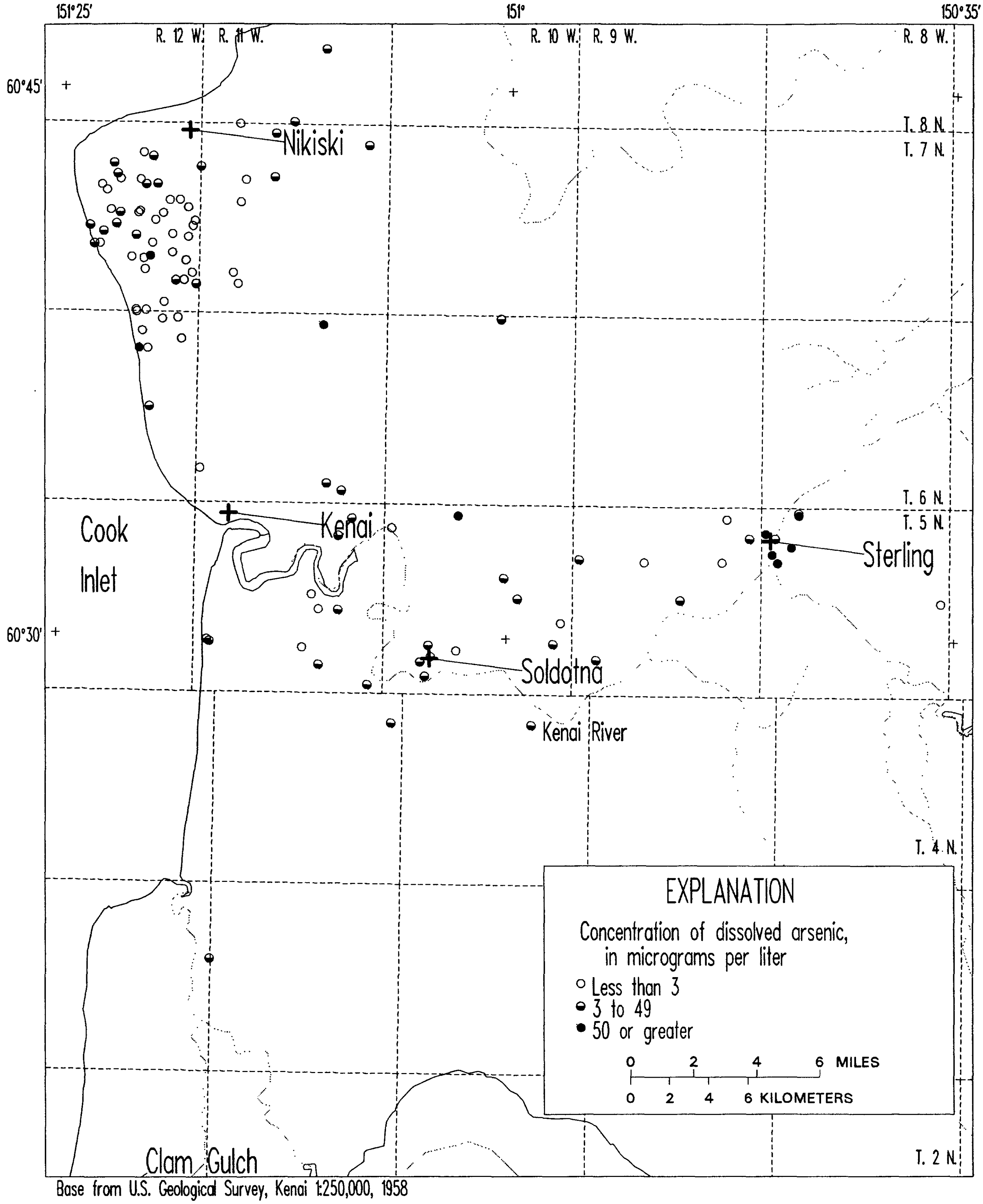
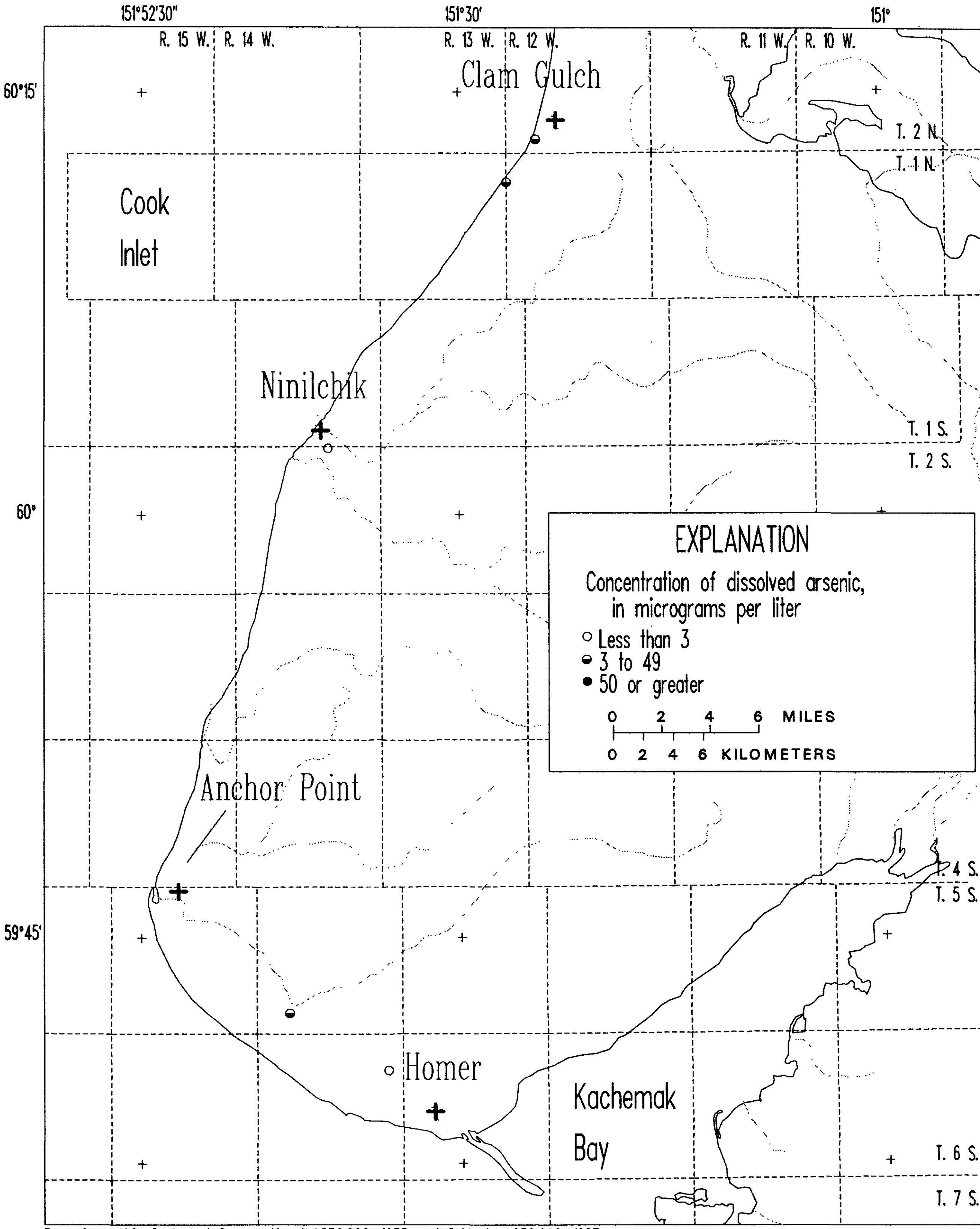


Figure 20A. Dissolved arsenic in water from wells, upper Kenai Peninsula.



Base from U.S. Geological Survey, Kenai 1:250,000, 1958 and Seldovia 1:250,000, 1963

Figure 20B. Dissolved arsenic in water from wells, lower Kenai Peninsula.

ilar to that found by USGS and ADNR-AHS: however, concentrations reported were as great as 110 µg/L. Public water systems in Homer, Kasilof, Soldotna, Sterling, Anchor Point, and Kenai have yielded water having arsenic concentrations greater than 50 µg/L. Concentrations of dissolved arsenic in water from wells less than 85 ft deep are generally less than 10 µg/L.

Boron and selenium, when present in high concentrations in irrigation water, are detrimental to plants. Because few analyses were made, analytical results are not listed in the appendix. Concentrations that were observed in ground water in the peninsula are low and not harmful to plants. The highest concentrations of boron and selenium were 450 and 3.5 µg/L, respectively.

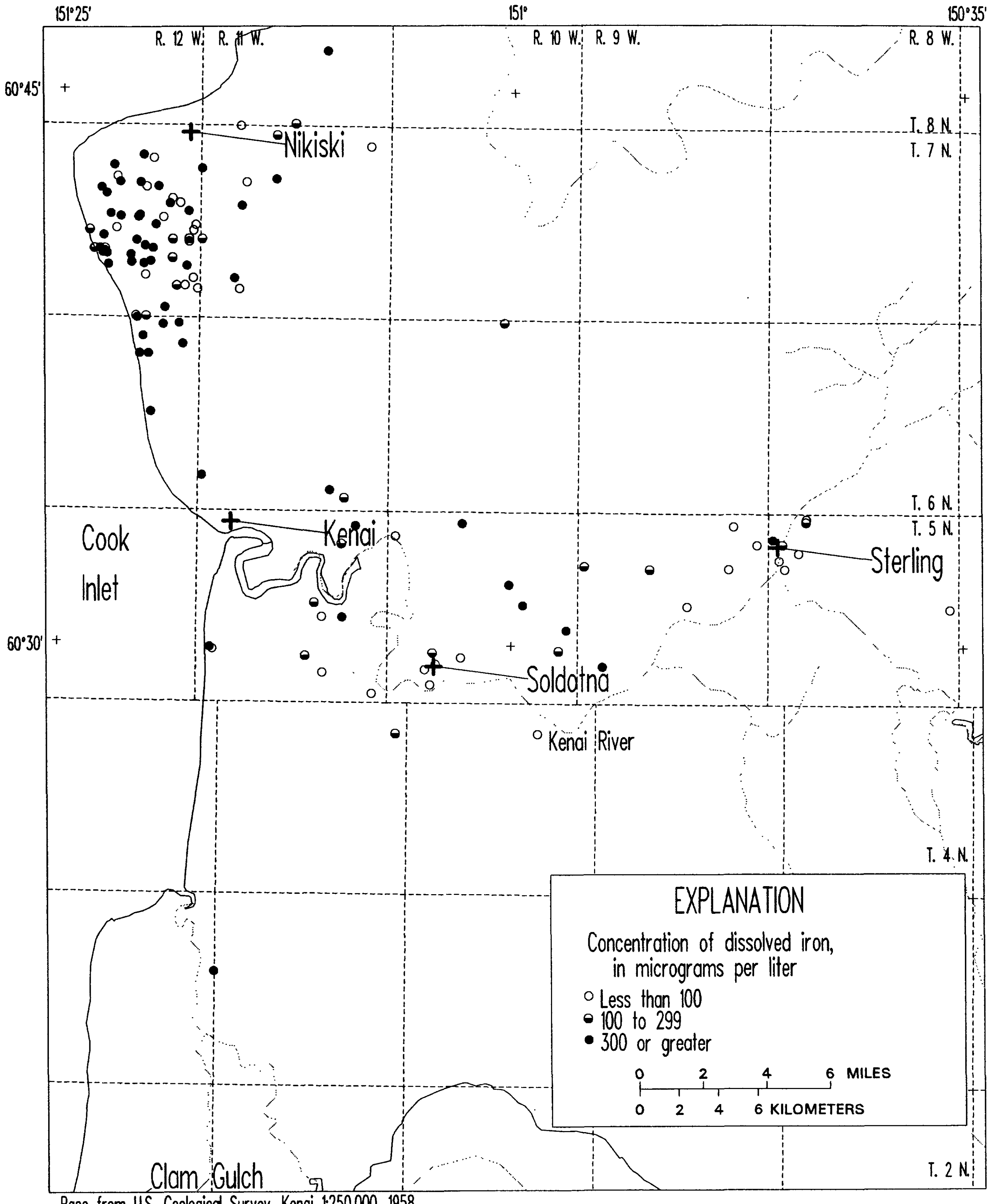
Iron and manganese commonly are present in many types of rocks and may dissolve into water under chemically reducing conditions present in parts of the ground-water system. They have similar chemical properties and are objectionable in water supplies because of their taste, staining of plumbing fixtures, spotting of laundered clothes, and accumulation of oxide deposits in distribution systems. Maximum recommended concentrations for iron and manganese in drinking water are 300 µg/L and 50 µg/L, respectively. Fifty-six of 122 wells sampled (46 percent) yielded waters having concentrations of iron greater than 300 µg/L (fig. 21) and 77 of 121 wells (64 percent) yielded waters having concentrations of manganese greater than 50 µg/L. The mean concentrations of dissolved iron and dissolved manganese are 2,800 and 218 µg/L. The median concentrations of dissolved iron and manganese are 210 and 110 µg/L. Concentrations of dissolved iron and manganese vary widely and can be high in water from wells of all depths.

Organic Compounds

All natural waters contain some compounds that contain carbon, but concentrations of organic compounds are usually much lower than concentrations of inorganic constituents. The composition of natural organic materials in ground water is similar to the decomposed wood, leaves, grasses, peat, and coal through which the water passed. These natural organic compounds commonly give ground water in the peninsula a yellowish color and undesirable taste and odor. Other naturally occurring organics include organisms such as algae, diatoms, and bacteria. In some places on the peninsula, ground water may also contain man-made organic compounds such as oil and gasoline products, herbicides, insecticides, cleaners, disinfectants, polishes, paints, and preservatives. Some organic compounds are toxic to humans, animals, and plant life, even at small concentrations.

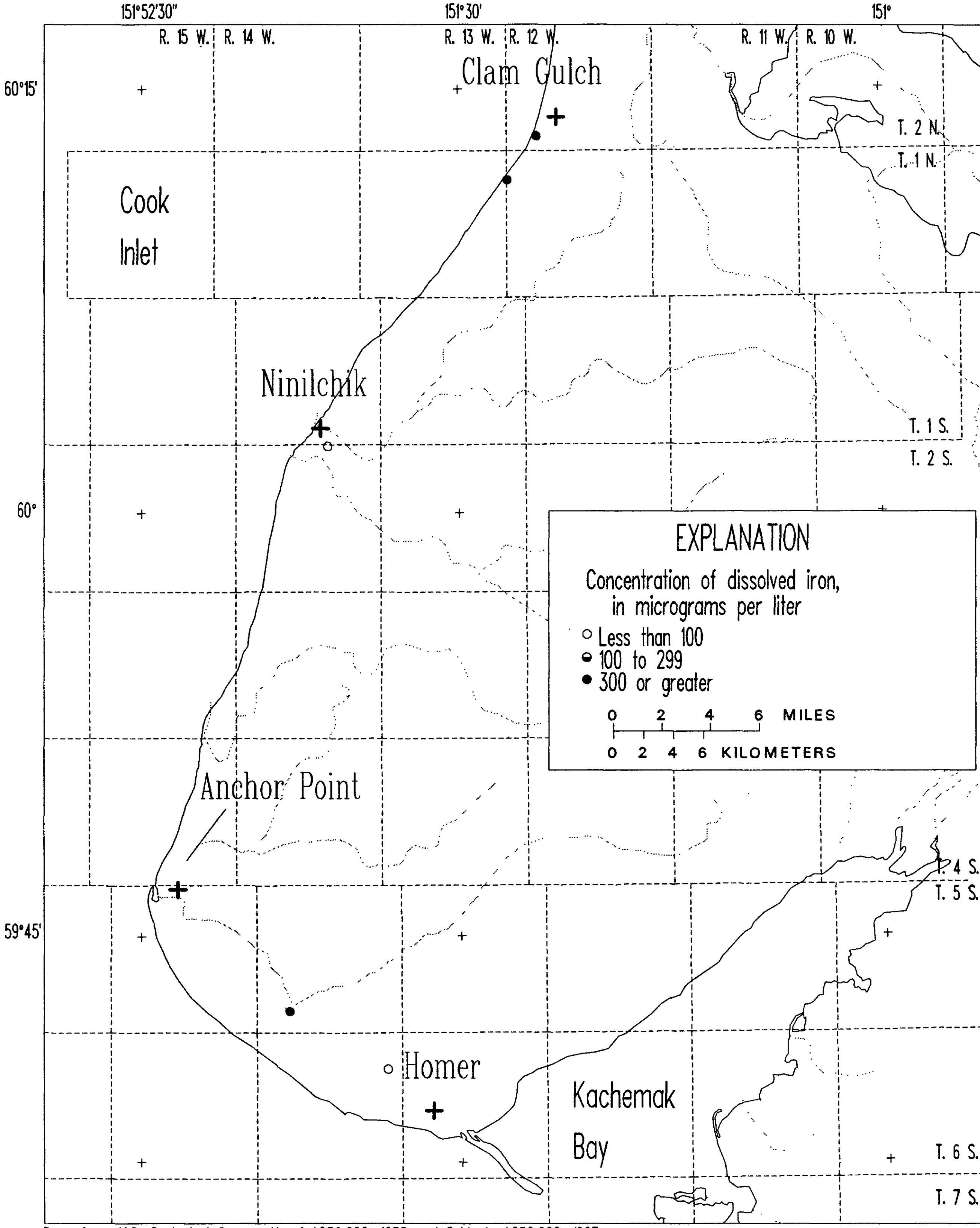
The most common type of contamination in Alaska is caused by spilling or leaking of fuel products (Munter and Maynard, 1987). Petroleum-derived fuels are complex mixtures of organic compounds, predominantly hydrocarbons, with varying compositions dependent on the source of crude oil and the refining process. Benzene, toluene, ethylbenzene, and xylenes are commonly associated with gasoline, kerosene, and diesel fuels and have primary maximum contaminant levels of 5 µg/L, 1,000 µg/L, 700 µg/L, and 10,000 µg/L, respectively.

In the upper peninsula, water from 10 wells sampled by USGS and from 11 wells sampled by ADNR-AHS for benzene, toluene, ethylbenzene, and xylenes had concentrations below analytical detection levels (0.2 or 0.3 µg/L). Results of water analyses to determine benzene concentrations from 394 wells (355 wells in the upper peninsula and 39 wells in the lower peninsula) were available in ADNR-AHS's water-quality database (fig. 22). Most of these wells are monitoring or domestic wells near known or potential fuel-spill sites. Most wells (273 of 394 wells) yielded no detectable concentrations of benzene, but 119 (105 from the upper peninsula, 14 from lower pen-



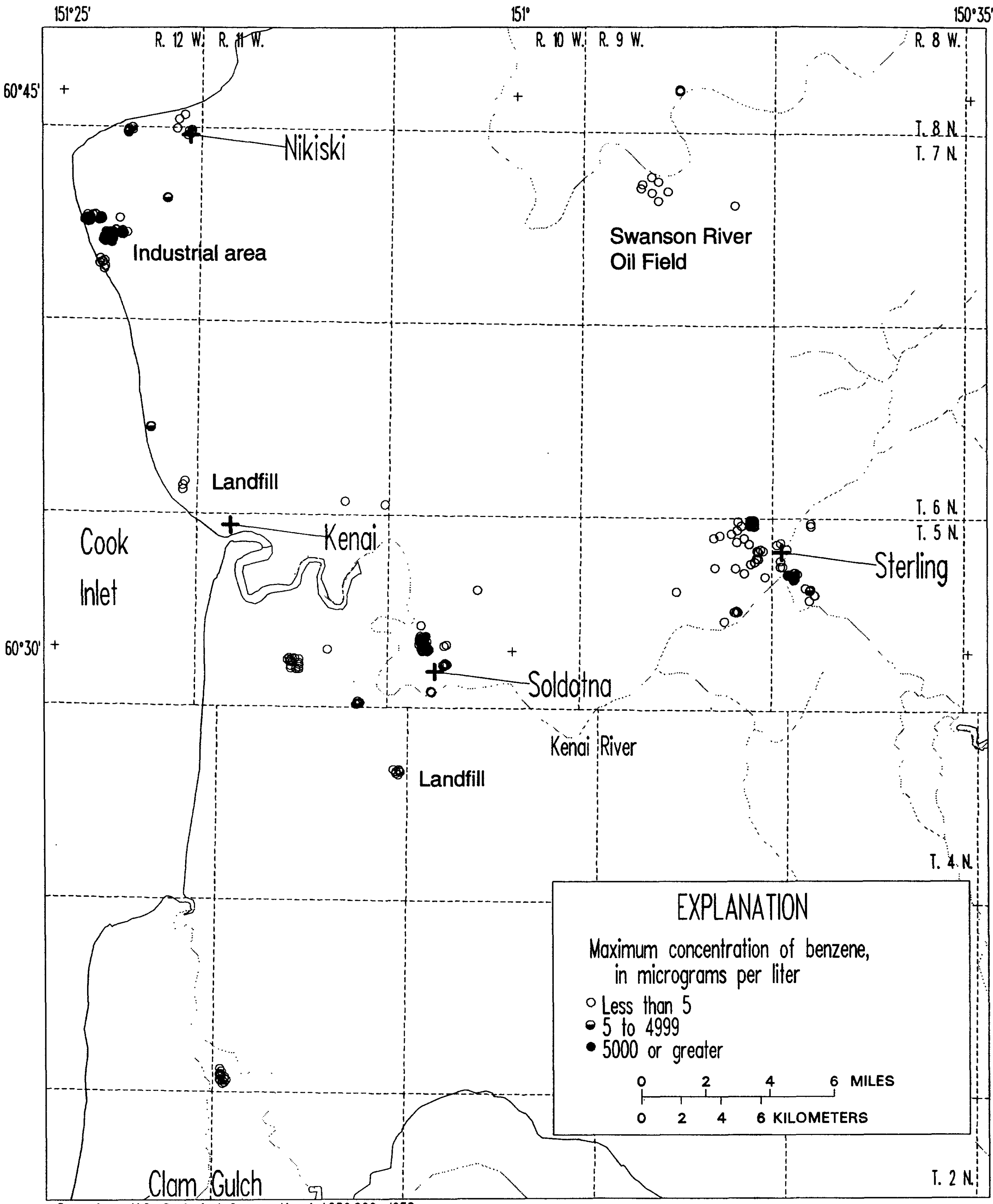
Base from U.S. Geological Survey, Kenai 1:250,000, 1958

Figure 21A. Dissolved iron in water from wells, upper Kenai Peninsula.



Base from U.S. Geological Survey, Kenai 1:250,000, 1958 and Seldovia 1:250,000, 1963

Figure 21B. Dissolved iron in water from wells, lower Kenai Peninsula.



Base from U.S. Geological Survey, Kenai 1:250,000, 1958

Figure 22A. Benzene in water from wells, upper Kenai Peninsula.
(Data from Alaska Departments of Natural Resources and Environmental Conservation.)

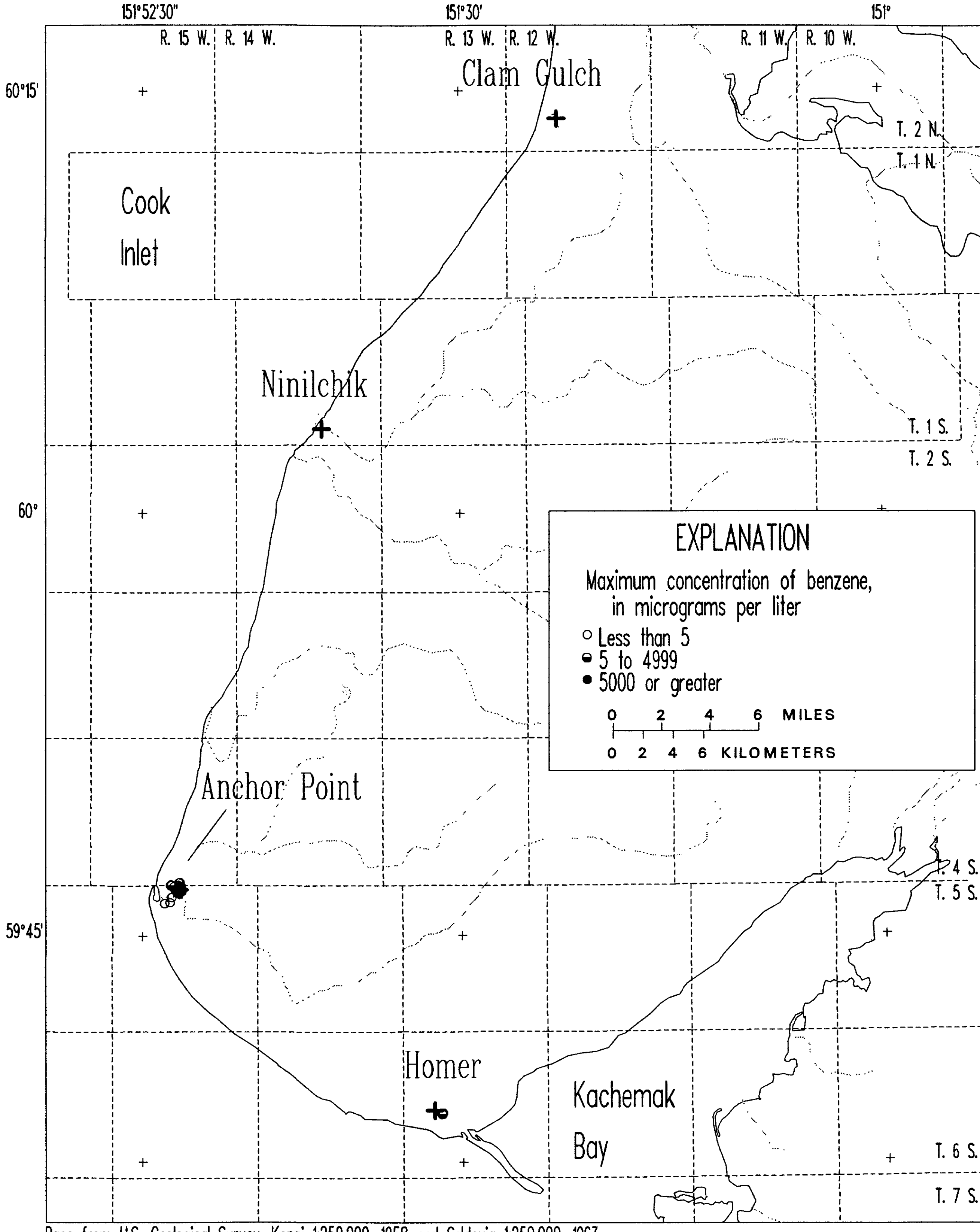


Figure 22B. Benzene in water from wells, lower Kenai Peninsula.
(Data from Alaska Departments of Natural Resources and Environmental Conservation.)

insula) yielded water having a benzene concentration equalling or exceeding the maximum contaminant level. Of the 20 sites listed by ADEC (1992) as having impaired ground water, 19 were impaired by petroleum products and (or) chlorinated solvents. Sites having high concentrations of benzene (greater than 5 µg/L) in ground water include petroleum refineries and fuel-storage facilities in Nikiski and areas near leaking fuel-storage tanks in Nikiski, Soldotna, Sterling, and Anchor Point. Spills and discharges into shop floor drains were other causes that led to concentrations of petroleum products or chlorinated solvents exceeding the maximum contaminant level.

In Anchor Point, leakage and (or) spillage of fuel created a plume of degraded water about 1,000 ft long and as great as 250 ft wide beneath the central part of the community and has negatively affected nine wells used to supply drinking water (Alaska Department of Environmental Conservation, 1988). Concentrations of benzene as great as 206 µg/L have been determined in water from a well in Anchor Point. A 19-foot deep well (SC00501504ACCB2 017) was drilled in 1988 to supply water to those affected by the contaminated ground water (Petrik, 1991).

SUMMARY AND CONCLUSIONS

Ground water is the predominant source of water supply for the residents, businesses, and industries in the western part of the Kenai Peninsula. Continued development in the area has increased the demand for this resource while introducing factors that may impair the quality of potable water available. These factors include spills and leaks of fuel products, discharge of domestic wastewater, and discharge of industrial wastes.

Almost all ground water in the upper peninsula is from unconsolidated sediments, whereas ground water in the lower peninsula is from unconsolidated sediments and from bedrock. The maximum thickness of unconsolidated sediments is about 750 ft. Well yields greater than 1,000 gal/min have been obtained in Nikiski where thick saturated zones of sand and gravel are present. Wells obtaining water from bedrock generally have yields less than 8 gal/min. Ground-water flow generally follows surface topography but is controlled by local permeabilities of aquifer materials.

Analyses of water samples from more than 300 wells in the western part of Kenai Peninsula showed water ranging from excellent quality (low concentrations of dissolved solids and potentially harmful trace constituents) to marginal quality (high in dissolved solids and approaching or exceeding established regulations for several constituents). In general, poorer quality water was near the coast. Water from 9 of 113 wells sampled exceeded the primary drinking water regulations for arsenic, 50 µg/L. Water from 46 percent of wells sampled yielded concentrations of iron exceeding secondary regulations and 64 percent of wells yielded concentrations of manganese exceeding secondary regulations. Background concentrations of nitrate and selected fuel-related organic compounds are low or absent in ground water throughout the peninsula. Fresh water occurs in most areas at depths less than about 100 ft and is most commonly calcium magnesium bicarbonate type. However, brackish and saline waters can be present at depths greater than 450 ft. A few wells throughout the peninsula may yield water having the "rotten-egg" odor of hydrogen sulfide.

Contamination of ground water with petroleum products and (or) chlorinated solvents has been documented at 19 sites. The most common sources of contamination by petroleum products and chlorinated solvents in the Kenai Peninsula include underground storage tanks, petroleum handing facilities, petroleum and chemical refineries, spills, and discharges into drains. Part of Anchor Point is underlain by fuel-contaminated ground water and a new well had to be drilled outside of the affected area to supply water to area residents.

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GLOSSARY

Alkalinity. The capacity for solutes contained in a solution to react with and neutralize acid.

Aquifer. The saturated part of permeable geologic materials that is capable of yielding significant water to wells or springs.

Confined (artesian) aquifer. An aquifer bounded above and below by impermeable beds, or by beds of distinctly lower permeability than that of the aquifer itself.

Dissolved solids. The quantity of dissolved material in a sample of water, either the residue on evaporation, dried at 180 °C, or, for many waters that contain more than about 1,000 parts per million, the sum of determined constituents.

Hardness. A property of water causing formation of an insoluble residue when the water is used with soap, and forming a scale in vessels in which water has been allowed to evaporate.

Hydraulic conductivity. A measure of the ability of the aquifer material to transmit a fluid, the viscosity of the fluid, and is, to some extent, an indicator of the shape, size, and arrangement of the spaces in the aquifer materials

Hydraulic gradient. In an aquifer, the rate of change of total head per unit of distance of flow at a given point and in a given direction.

Hydraulic head. The height of the free surface of a body of water above a given subsurface point.

pH. The measure of the alkalinity or acidity of a solution. Values higher than 7 denote increasing alkalinity; values lower than 7 denote increasing acidity.

Potentiometric surface. An imaginary surface representing the total head of ground water and defined by the level to which water will rise in a well. The water table is a particular potentiometric surface.

Specific conductance. Measure of the capacity of water to conduct electric current and is used to estimate the total dissolved constituents in water. It is measured in microsiemens per centimeter (µS/cm) corrected to 25 degrees Celsius.

Unconfined aquifer. An aquifer having a water table, containing unconfined ground water (i.e., water not confined under pressure beneath relatively impermeable rocks).

APPENDIX

Quality of ground water from selected wells in the Kenai Peninsula

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements

[µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, degree Celsius; mg/L, milligram per liter; NOA, number of analyses; --, not analyzed. Note: if more than one analysis was available, the value reported is the mean of all analyses]

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00101207BBCB1__001	19910829	208.0	221.0	240.	1	7.8	1	5.	1	99.	1
SB00201210BCDB1__001	19690812	102.0	250.0	205.	1	7.7	1	4.	1	91.	1
SB00201229DCDB1__001	19700819	330.0	310.0	294.	2	7.8	2	7.5	2	138.	1
SB00201232BCDA1__004	19910829	60.0	312.0	195.	1	6.4	1	5.	1	71.	1
SB00201232BDBB1__001	19700820	300.0	310.0	372.	2	7.9	2	5.8	2	181.	1
SB00301104CDCC1__003	19690717	160.0	250.0	239.	1	8.2	1	10.	1	107.	1
SB00301118BBAD1__001	19690811	138.0	100.0	242.	1	8.0	1	5.	1	109.	1
SB00301119CDDA1__004	19660909	35.0	125.0	133.	1	7.0	1	8.5	1	--	--
SB00301130ACCB1__006	19660909	70.0	95.0	143.	1	6.7	1	8.5	1	--	--
SB00301131BDCC1__001	19690620	150.0	140.0	222.	2	7.6	2	12.	1	81.	2
SB00301201BDAD2__001	19690717	265.0	25.0	287.	1	8.3	1	--	--	77.	1
SB00301213ADDD1__001	19910918	95.0	106.0	116.	1	6.9	1	3.5	1	46.	1
SB00401002CCDC1__004	19910828	135.0	287.0	188.	1	8.4	1	3.5	1	66.	1
SB00401101CCCC1__007	19910819	133.0	189.0	221.	1	7.8	1	4.	1	116.	1
SB00401114CCBC1__001	19680227	170.0	275.0	127.	1	7.6	1	8.	1	52.	1
SB00401127DBAB1__001	19660902	80.0	240.0	143.	1	7.3	1	8.	1	--	--
SB00401225CBAA1__001	19690811	130.0	45.0	342.	1	8.1	1	7.	1	132.	1
SB00500805BBDA2__003	19920824	72.0	172.0	146.	1	7.1	1	4.	1	71.	1
SB00500805BBDD1__001	19920824	199.0	189.0	233.	1	6.7	1	3.5	1	85.	1
SB00500806CCAB1__008	19910916	40.0	221.0	150.	1	7.8	1	6.	1	71.	1
SB00500806CDDB1__009	19910917	132.0	156.0	375.	1	9.2	1	4.	1	29.	1
SB00500807AADD1__013	19910917	177.0	189.0	210.	1	8.8	1	3.	1	58.	1
SB00500807BDCD2__035	19910917	91.0	180.0	280.	1	8.8	1	3.5	1	46.	1
SB00500807CAAD1__007	19660910	69.0	185.0	203.	1	7.4	1	8.	1	--	--
SB00500807CACB1__003	19660910	100.0	175.0	244.	1	7.6	1	5.	1	--	--
SB00500807CADD1__006	19660910	67.0	175.0	92.	1	6.7	1	9.5	1	--	--
SB00500807DBCC1__027	19920826	256.0	189.0	236.	1	8.4	1	4.	1	76.	1
SB00500813BCDB1__001	19700316	146.5	336.0	190.	1	7.9	1	3.	1	87.	1
SB00500813DCDD1__006	19910827	107.0	344.0	120.	1	7.2	1	5.	1	54.	1
SB00500817BDBA1__001	19680402	147.0	225.0	333.	2	7.8	2	11.8	2	77.	1
SB00500901DCDC2__002	19920826	150.0	225.0	187.	1	8.4	1	3.5	1	47.	1
SB00500902ADAD1__004	19920825	100.0	320.0	112.	1	7.0	1	3.5	1	49.	1

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00500907CBAD1__007	19910829	117.0	254.0	258.	1	7.1	1	5.	1	62.	1
SB00500909CACC1__016	19920825	97.0	320.0	89.	1	7.0	1	3.	1	36.	1
SB00500911DAAB1__001	19660910	70.0	250.0	103.	1	7.3	1	12.	1	--	--
SB00500911DACC2__025	19910916	38.0	213.0	148.	1	7.0	1	4.	1	69.	1
SB00500912DAAD1__002	19660910	60.0	225.0	159.	1	7.5	1	11.5	1	--	--
SB00500915CDDA1__039	19910820	147.0	271.0	136.	1	8.1	1	4.	1	67.	1
SB00500927ABBB1__002	19680708	285.0	150.0	652.	1	8.0	1	5.	1	104.	1
SB00500930DDBB1__016	19910821	85.0	287.0	196.	1	7.1	1	4.5	1	91.	1
SB00500931CBCA1__002	19680702	230.0	300.0	196.	1	8.2	1	4.5	1	52.	1
SB00501004BDBD1__001	19910821	216.0	246.0	--	--	7.8	1	4.5	1	118.	1
SB00501006BCAB1__010	19690718	177.0	62.0	184.	1	8.3	1	4.	1	33.	1
SB00501006CACC1__019	19910812	50.0	74.0	93.	1	6.2	1	5.	1	38.	1
SB00501008BDCD1__001	19670925	87.0	101.0	110.	1	7.1	1	7.	1	47.	1
SB00501008CCDB1__002	19720508	162.0	155.0	286.	15	7.9	15	15.	9	84.	14
SB00501014CDCB2__004	19910828	93.0	213.0	340.	1	6.8	1	5.	1	128.	1
SB00501015ADBB1__004	19910820	220.0	180.0	163.	1	8.1	1	6.	1	79.	1
SB00501019CBBD1__001	19680702	196.0	26.0	400.	1	8.2	1	13.	1	41.	1
SB00501020CCAB1__007	19660831	80.0	85.0	154.	1	7.2	1	6.5	1	--	--
SB00501020CCAC1__001	19660831	80.0	85.0	148.	1	6.8	1	6.5	1	--	--
SB00501021BADD1__001	19680925	112.0	195.0	239.	1	7.4	1	5.	1	120.	1
SB00501021BCCD1__006	19700701	173.0	203.0	302.	1	8.2	1	--	--	130.	1
SB00501021BDCD1__007	19700701	102.0	207.0	284.	1	8.0	1	7.	1	140.	1
SB00501024DBCA1__007	19910827	125.0	275.0	122.	1	6.7	1	4.	1	54.	1
SB00501025BDAC1__006	19910919	168.0	271.0	158.	1	8.2	1	6.5	1	70.	1
SB00501028CABD1__012	19910828	93.0	189.0	200.	1	6.7	1	5.	1	88.	1
SB00501028CCBB1__002	19690617	195.0	180.0	232.	2	7.3	2	9.	1	114.	2
SB00501028CCCA1__001	19660829	90.0	98.0	260.	1	7.5	1	10.	1	--	--
SB00501029BDDA1__005	19741002	163.0	90.0	446.	5	7.8	4	9.	2	79.	4
SB00501029CACB1__010	19700105	133.0	88.0	447.	1	8.3	1	--	--	78.	1
SB00501029CCDD1__020	19730418	147.0	87.0	343.	3	7.9	3	3.5	1	88.	3
SB00501029CDAC1__001	19681024	97.0	94.0	253.	1	7.4	1	3.5	1	100.	1
SB00501029DBCD1__002	19681125	84.0	93.0	265.	1	7.0	1	15.5	1	120.	1
SB00501029DCBB1__021	19740605	163.0	87.0	288.	3	7.7	3	4.5	1	114.	3
SB00501029DCCA1__018	19690825	156.0	80.0	263.	3	7.4	2	3.5	3	120.	1
SB00501029DDCD1__006	19660829	89.0	97.0	257.	1	7.6	1	8.	1	--	--

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00501030BADD1__001	19671025	93.0	38.0	472.	1	7.5	1	7.	1	58.	1
SB00501030CAAB1__003	19680703	140.0	75.0	533.	1	8.4	1	4.5	1	85.	1
SB00501031ADAA1__002	19710708	113.0	60.0	424.	1	8.0	1	--	--	120.	1
SB00501032AAAD1__011	19660831	65.0	80.0	266.	1	7.5	1	8.	1	--	--
SB00501032ACAD1__022	19660902	80.0	67.0	266.	1	7.4	1	14.5	1	--	--
SB00501032ADBA1__009	19691212	207.0	82.0	504.	2	7.9	2	--	--	110.	2
SB00501032ADBA2__009	19550408	54.0	82.0	247.	1	8.0	1	--	--	120.	1
SB00501032BDBC1__005	19550928	138.0	85.0	417.	1	7.3	1	4.	1	130.	1
SB00501032BDCA1__017	19730418	90.0	73.0	392.	1	7.5	1	--	--	92.	1
SB00501032BDCC1__010	19660831	86.0	73.0	399.	1	7.5	1	10.5	1	--	--
SB00501032CABC1__023	19660902	84.0	72.0	420.	1	7.5	1	8.	1	--	--
SB00501032CABC2__023	19660829	25.0	72.0	397.	1	7.8	1	7.	1	--	--
SB00501032CACA1__004	19660831	167.0	68.0	419.	1	7.4	1	9.5	1	--	--
SB00501032CACA2__004	19690902	75.0	70.0	412.	2	7.8	2	12.	2	130.	1
SB00501032CACC1__003	19670927	219.0	65.0	370.	2	7.8	2	6.5	2	110.	1
SB00501032CADA1__007	19670928	79.3	71.0	421.	2	7.8	2	10.5	2	120.	1
SB00501032CCBC1__002	19680703	107.0	90.0	412.	1	8.3	1	15.	1	110.	1
SB00501033BDDD2__003	19690507	220.0	65.0	433.	1	8.2	1	3.	1	97.	1
SB00501101CBCC2__005	19700226	282.0	50.0	451.	1	8.1	1	4.	1	90.	1
SB00501102ADDA1__009	19910919	30.0	57.0	480.	1	6.5	1	5.	1	126.	1
SB00501102CDCC1__001	19670922	40.0	45.0	84.	1	6.9	1	8.	1	31.	1
SB00501102DCCC1__008	19910813	130.0	49.0	354.	1	8.3	1	5.	1	26.	1
SB00501102DDDD1__002	19671129	156.0	38.0	646.	1	7.7	1	5.	1	126.	1
SB00501103AAAA1__001	19700512	273.0	80.0	278.	3	7.5	3	3.5	2	57.	3
SB00501104DCBA1__001	19670922	70.0	35.0	262.	1	7.9	1	5.	1	127.	1
SB00501105ABAD1__004	19660826	43.5	80.0	77.	2	7.2	2	14.5	2	9.4	2
SB00501105ACDA1__007	19661107	38.0	78.0	89.	2	6.9	2	--	--	35.	2
SB00501105ADCB2__006	19661107	28.0	78.0	118.	1	6.8	1	--	--	43.	1
SB00501105ADCB3__006	19661107	28.0	78.0	99.	1	7.0	1	--	--	38.	1
SB00501105BABB1__005	19660906	48.0	83.0	98.	1	6.6	1	15.5	1	--	--
SB00501105BCCC1__008	19600000	186.0	81.0	1670.	1	7.5	1	--	--	72.	1
SB00501105BDAA1__003	19660826	41.0	80.0	95.	2	6.9	2	7.	2	30.	2
SB00501106AABB1__003	19660902	48.0	75.0	95.	1	6.8	1	8.5	1	--	--
SB00501106AABD1__004	19660902	90.0	75.0	317.	1	7.7	1	6.5	1	--	--
SB00501110ADBB1__003	19550927	105.0	25.0	409.	1	8.0	1	--	--	14.	1

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00501110BCDC1__004	19710919	135.0	32.0	1690.	3	7.8	3	3.3	2	43.	3
SB00501110BDBC1__007	19710913	122.0	37.0	223.	2	8.0	2	4.	1	7.6	2
SB00501110BDCC1__005	19710909	140.0	38.0	1460.	2	7.6	2	3.8	2	83.	2
SB00501111BAAD1__004	19710909	218.0	40.0	364.	4	8.0	4	4.	2	70.	4
SB00501111BBCD1__001	19670922	110.0	30.0	725.	1	7.7	1	8.	1	42.	1
SB00501113CBBA1__001	19680701	105.0	82.0	191.	1	8.0	1	5.5	1	61.	1
SB00501114CDDD1__001	19700701	82.0	78.0	272.	1	8.0	1	7.	1	78.	1
SB00501115DCAD1__001	19910812	123.0	50.0	370.	1	9.1	1	4.	1	10.	1
SB00501117BBAB1__001	19680607	156.0	22.0	547.	1	8.0	1	4.	1	4.1	1
SB00501122ABCD1__004	19700820	115.0	73.0	417.	1	8.2	1	3.5	1	9.9	1
SB00501122ADAA1__007	19910815	37.0	74.0	186.	1	6.1	1	4.5	1	73.	1
SB00501123ACBA1__006	19910830	118.0	90.0	260.	1	8.1	1	5.5	1	160.	1
SB00501127CAAA2__006	19910813	37.0	74.0	92.	1	6.6	1	7.5	1	42.	1
SB00501130BDAA1__006	19910814	45.0	74.0	213.	1	7.0	1	4.	1	44.	1
SB00501130BDDA1__007	19910814	196.0	57.0	455.	1	8.6	1	5.	1	14.	1
SB00501130DCAB1__001	19680301	220.0	50.0	771.	1	8.5	1	10.	1	22.	1
SB00501131ACBD1__002	19660909	243.0	50.0	331.	1	8.0	1	5.	1	23.	1
SB00501134AAAD2__009	19910819	56.4	90.0	261.	1	8.5	1	4.	1	43.	1
SB00501135CACD1__001	19680808	35.0	83.0	125.	1	7.2	1	7.	1	52.	1
SB00501136DBAC1__002	19680807	200.0	82.0	656.	1	8.3	1	8.	1	34.	1
SB00501136DBCA1__006	19910814	35.0	90.0	139.	1	6.5	1	3.5	1	58.	1
SB00601003ABAC1__001	19900823	65.0	145.0	174.	2	8.0	2	3.5	2	87.	2
SB00601005BCCB1__001	19671108	45.0	95.0	182.	1	7.9	1	3.5	1	75.	1
SB00601103ADAD1__001	19790129	127.0	125.0	205.	1	8.3	1	2.5	1	--	--
SB00601106BCCA1__001	19680815	91.0	115.0	118.	1	7.5	1	4.	1	51.	1
SB00601111DDDA1__001	19680821	49.0	135.0	93.	1	7.3	1	3.	1	37.	1
SB00601112DCAC1__002	19691016	87.0	150.0	103.	1	7.7	1	--	--	40.	1
SB00601112DDAD1__001	19671107	85.0	165.0	147.	1	7.7	1	3.5	1	61.	1
SB00601115BCAD1__001	19680817	90.0	123.0	154.	1	7.9	1	4.	1	67.	1
SB00601118CBDC1__002	19600322	95.0	98.0	153.	1	7.7	1	4.	1	61.	1
SB00601118CCAD1__001	19680926	65.8	101.9	148.	3	7.1	3	4.5	2	66.	3
SB00601128BBDA2__001	19680821	65.0	100.0	296.	1	8.1	1	4.	1	115.	1
SB00601130CCDB1__005	19910813	44.0	90.0	100.	1	6.4	1	4.	1	29.	1
SB00601131CCCB1__002	19660902	80.0	80.0	134.	1	7.4	1	8.	1	--	--
SB00601132CBCB1__001	19680605	53.0	80.0	182.	1	8.0	1	--	--	79.	1

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00601133DDCB1__007	19670926	201.0	81.0	482.	2	8.1	2	22.	2	4.1	1
SB00601135BCAC1__003	19910815	32.0	90.0	142.	1	6.9	1	5.5	1	55.	1
SB00601135DBBD1__001	19700520	240.0	60.0	217.	1	8.2	1	3.5	1	2.	1
SB00601135DBBD2__001	19771026	287.0	59.0	211.	5	7.9	5	4.2	3	40.	5
SB00601136DADC1__005	19710909	240.0	33.9	219.	4	8.1	4	4.	4	33.	4
SB00601201BACA2__004	19910709	31.0	102.0	116.	1	6.4	1	6.4	1	36.	1
SB00601201CDAA1__008	19910718	34.0	104.0	77.	1	6.7	1	4.3	1	25.	1
SB00601202AACD1__008	19910719	46.0	107.0	179.	1	6.6	1	5.6	1	59.	1
SB00601202CABB1__009	19910717	65.0	103.0	121.	2	7.0	2	3.7	2	36.	2
SB00601203ADAD1__001	19670911	211.0	95.0	194.	2	7.9	2	5.8	2	37.	1
SB00601211BAAC1__012	19910722	87.0	93.0	125.	2	6.9	2	5.9	2	35.	2
SB00601211BBBD1__011	19910719	303.0	94.0	1473.	1	8.6	1	4.5	1	26.	1
SB00601211BCAA1__005	19680604	287.0	94.0	1750.	1	8.3	1	7.	1	63.	1
SB00601212DCCC1__001	19680822	63.0	97.0	110.	1	7.4	1	4.	1	46.	1
SB00601214DCCD2__021	19910729	65.0	90.0	130.	1	6.8	1	3.5	1	39.	1
SB00601223BDDD1__001	19680605	157.0	83.0	643.	1	8.9	1	5.	1	7.2	1
SB00601225ACAD1__003	19600322	90.0	86.2	217.	1	6.9	1	4.5	1	98.	1
SB00601225ACBD1__002	19680813	91.9	85.1	248.	4	7.2	4	3.8	2	111.	4
SB00601225ACDB1__001	19680813	83.9	76.8	219.	3	7.3	3	4.	1	96.	3
SB00601225ACDB2__001	19600321	95.0	86.9	238.	2	6.7	2	4.5	1	105.	2
SB00601225CACC2__008	19710617	70.0	80.0	223.	2	7.5	2	--	--	95.	2
SB00601225CCBA1__006	19690825	288.0	77.0	813.	2	8.5	2	9.8	2	18.	1
SB00601225CDCB1__007	19670919	180.0	79.0	320.	1	8.3	1	6.5	1	20.	1
SB00601225DBAC1__005	19720418	268.0	83.0	2275.	5	8.3	2	--	--	86.	2
SB00601226ADDC1__001	19700730	160.0	77.0	274.	2	8.3	2	9.	2	21.	1
SB00701027BDBB1__001	19680815	78.0	140.0	133.	1	7.3	1	4.	1	57.	1
SB00701101CADB1__009	19910724	227.0	74.0	625.	1	8.6	1	4.5	1	8.7	1
SB00701104BDAB2__003	19910730	85.0	156.0	130.	1	7.4	1	4.5	1	61.	1
SB00701105BABB1__012	19910729	38.0	180.0	90.	1	6.9	1	4.5	1	34.	1
SB00701107BCBD1__002	19910731	68.0	123.0	125.	1	7.4	1	8.	1	55.	1
SB00701108CDAA2__006	19910722	31.0	115.0	80.	1	6.9	1	6.5	1	29.	1
SB00701109CADB2__002	19910730	43.0	123.0	165.	1	7.3	1	4.5	1	76.	1
SB00701117CABA1__001	19910725	43.0	123.0	210.	1	6.2	1	5.	1	76.	1
SB00701119BCCC1__001	19720627	343.0	145.0	402.	1	8.5	1	3.5	1	40.	1
SB00701129CCBA1__010	19910717	33.0	123.0	110.	1	6.4	1	4.5	1	38.	1

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701131BBBA1__001	19680216	449.0	125.0	1740.	1	8.4	1	--	--	67.	1
SB00701132ABAB1__001	19680816	77.0	130.0	128.	1	7.4	1	7.	1	54.	1
SB00701132BABC1__002	19910801	31.0	139.0	62.	1	6.7	1	3.5	1	23.	1
SB00701201AABB1__001	19670907	96.0	129.0	139.	1	7.3	1	7.	1	56.	1
SB00701202AABA1__004	19690604	224.0	145.0	107.	1	7.3	1	7.	1	41.	1
SB00701202CCDC1__010	19910730	105.0	172.0	173.	1	6.8	1	4.	1	75.	1
SB00701209DDCD1__002	19690615	210.0	126.0	147.	1	7.3	1	--	--	61.	1
SB00701209DDCD3__002	19910724	98.0	139.0	140.	1	6.5	1	4.5	1	52.	1
SB00701209DDDD1__001	19660906	61.0	131.0	109.	1	6.5	1	6.	1	36.	1
SB00701210BDBB1__016	19910730	217.0	135.0	410.	1	9.5	1	4.5	1	11.	1
SB00701210CAAC1__024	19910731	96.0	136.0	150.	1	8.3	1	4.	1	55.	1
SB00701210CDAA2__006	19910723	60.0	139.0	145.	1	6.5	1	4.5	1	52.	1
SB00701211ABBB1__004	19910723	136.0	130.0	150.	1	8.4	1	5.5	1	63.	1
SB00701211BBCC1__003	19670909	86.0	159.0	79.	1	7.0	1	4.	1	30.	1
SB00701211CCBD1__008	19910724	97.0	152.0	146.	2	6.4	2	4.5	2	54.	2
SB00701211CDCC1__037	19910723	90.6	152.0	138.	1	7.6	1	5.	1	51.	1
SB00701211DCAC1__027	19910718	99.0	131.0	212.	1	7.5	1	7.	1	87.	1
SB00701213BCBD1__004	19771020	56.0	120.0	95.	1	5.8	1	4.	1	34.	1
SB00701213BCCC1__013	19910718	52.0	135.0	108.	1	6.5	1	6.	1	21.	1
SB00701213BDCD1__016	19910712	59.0	138.0	126.	1	6.4	1	4.8	1	49.	1
SB00701213DBCD1__023	19910717	70.0	151.0	115.	1	6.2	1	4.	1	45.	1
SB00701214CCBD1__015	19910720	75.0	132.0	90.	1	6.6	1	4.3	1	31.	1
SB00701214CCCB1__002	19910709	60.0	122.0	116.	1	7.	1	4.	1	36.	1
SB00701214DDCA1__018	19910721	55.0	140.0	186.	2	6.3	2	5.7	2	73.	2
SB00701215BBCB1__011	19910722	49.0	122.0	327.	1	6.9	1	4.5	1	124.	1
SB00701215CCAB1__010	19910720	128.5	78.0	195.	1	7.9	1	5.8	1	80.	1
SB00701215DCBC1__004	19720525	57.1	81.6	107.	1	7.1	1	5.	1	43.	1
SB00701215DCBC2__004	19900823	196.0	84.6	147.	2	8.2	2	5.3	2	59.	2
SB00701216ADAD2__012	19690409	60.0	122.0	82.	1	7.4	1	7.	1	28.	1
SB00701216DCAA2__005	19640712	174.0	120.0	433.	1	8.2	1	--	--	33.	1
SB00701216DDBB1__007	19640511	174.0	121.0	608.	2	8.4	2	20.3	2	175.	2
SB00701221ABBC1__002	19620000	272.0	70.0	1154.	1	8.6	1	--	--	57.	1
SB00701221ACBA1__004	19770729	158.0	55.7	--	--	8.0	1	--	--	100.	1
SB00701221ADDD2__009	19771208	151.0	72.6	200.	1	7.4	1	4.5	1	93.	1
SB00701221DBAB1__001	19550928	62.0	53.0	331.	1	8.0	1	--	--	130.	1

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (μS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701221DDAC2__010	19770217	356.0	117.1	590.	1	8.7	1	3.	1	36.	1
SB00701221DDBC1__008	19760521	382.0	118.2	600.	1	8.5	1	4.	1	43.	1
SB00701221DDBC2__008	19771208	371.0	110.0	700.	1	8.0	1	5.	1	54.	1
SB00701222BCAA1__009	19681210	150.0	110.0	176.	1	8.0	1	--	--	74.	1
SB00701222BDAB3__008	19780420	332.0	125.0	250.	3	7.6	2	3.5	3	31.	2
SB00701222CBBD3__005	19690623	308.0	75.0	311.	1	8.1	1	--	--	27.	1
SB00701222CCBD1__011	19770601	336.0	110.0	750.	1	8.4	1	--	--	48.	1
SB00701222CCCB1__010	19750617	73.0	115.0	217.	1	6.4	1	5.	1	88.	1
SB00701223ABBC1__017	19910710	68.0	141.0	117.	1	7.1	1	3.1	1	37.	1
SB00701223CACC1__012	19771018	55.0	134.0	100.	1	6.4	1	4.	1	33.	1
SB00701223CBBC1__002	19910711	35.0	112.0	127.	2	6.7	2	5.9	2	13.	2
SB00701223DCBC1__010	19910710	107.0	131.0	254.	1	7.8	1	4.8	1	120.	1
SB00701224AABD1__016	19910716	58.5	154.0	160.	1	6.3	1	5.9	1	73.	1
SB00701224ADBB1__015	19910716	58.0	156.0	78.	1	6.5	1	5.	1	27.	1
SB00701224CBAB1__009	19910716	46.0	130.0	93.	1	6.4	1	4.5	1	34.	1
SB00701224DBAB1__003	19771018	55.0	135.0	60.	1	6.0	1	5.	1	19.	1
SB00701224DBAC1__005	19910716	45.0	128.0	85.	1	6.5	1	7.8	1	32.	1
SB00701225ACBA1__021	19910715	59.0	134.0	105.	1	6.5	1	5.1	1	34.	1
SB00701225BBAC1__028	19910715	58.0	123.0	145.	1	5.9	1	3.8	1	42.	1
SB00701225CDCC1__003	19910715	109.0	125.0	140.	1	7.5	1	5.	1	63.	1
SB00701225DACC1__027	19910715	39.0	131.0	82.	1	6.5	1	4.8	1	28.	1
SB00701225DCCC1__020	19910715	52.0	130.0	130.	1	6.3	1	5.	1	53.	1
SB00701226BAAA2__003	19690408	152.0	118.0	128.	1	8.0	1	5.	1	54.	1
SB00701226BADD1__008	19770727	280.0	122.0	1300.	1	8.9	1	4.	1	25.	1
SB00701226BCAA1__039	19910709	55.0	131.0	171.	1	7.0	1	4.6	1	59.	1
SB00701226CACB1__024	19910713	128.0	105.0	126.	1	8.6	1	6.4	1	56.	1
SB00701227AABA1__005	19771020	66.0	125.0	130.	1	6.0	1	3.5	1	50.	1
SB00701227ABBB1__003	19670908	195.0	120.0	143.	1	7.7	1	11.5	1	53.	1
SB00701227ADBA1__027	19910710	63.0	123.0	144.	1	7.1	1	4.5	1	47.	1
SB00701227BBAB2__013	19750617	74.0	115.0	350.	1	7.4	1	--	--	156.	1
SB00701227BCAA1__016	19750618	71.0	115.0	--	--	6.6	1	5.	1	--	--
SB00701227BCAB1__001	19690409	165.0	115.0	140.	1	8.0	1	3.	1	54.	1
SB00701227BCAC1__019	19750618	70.0	115.0	394.	1	6.4	1	5.	1	97.	1
SB00701227BCBD1__020	19750618	75.0	117.0	1700.	1	8.4	1	5.	1	--	--
SB00701227BCCB1__021	19750618	75.0	117.0	--	--	6.3	1	5.	1	--	--

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701227CAAA1__008	19670908	90.0	115.0	87.	1	7.3	1	4.	1	33.	1
SB00701228AAAC1__003	19750619	70.0	113.0	1760.	1	8.4	1	16.5	1	83.	1
SB00701228AADC1__002	19750619	70.0	113.0	--	--	10.0	1	11.	1	--	--
SB00701234DACC1__001	19700220	219.0	108.0	546.	1	8.9	1	4.	1	7.1	1
SB00701235CCCB1__015	19910712	84.5	108.0	123.	1	8.4	1	3.6	1	54.	1
SB00701235CCCC2__004	19910717	82.0	102.0	201.	1	7.4	1	5.4	1	85.	1
SB00701235CDCA3__018	19910718	40.0	96.0	167.	1	6.0	1	6.7	1	57.	1
SB00701235DADB1__037	19910717	56.0	116.0	94.	1	7.0	1	4.2	1	28.	1
SB00701236AAAB1__006	19910723	155.0	122.0	149.	2	8.7	2	5.0	2	50.	2
SB00800923BCDB1__001	19580919	156.0	300.0	302.	1	7.2	1	--	--	145.	1
SB00800927ABAB1__001	19571123	130.0	250.0	269.	1	7.4	1	--	--	131.	1
SB00801018DCDC1__002	19690731	160.0	50.0	377.	1	8.5	1	5.5	1	39.	1
SB00801122DAAD1__002	19910801	165.0	107.0	160.	1	6.8	1	4.	1	56.	1
SB00801124BBBD1__005	19680925	300.0	150.0	215.	1	7.8	1	5.	1	94.	1
SB00801132DCBC1__002	19660906	37.0	158.0	236.	1	6.4	1	5.5	1	--	--
SB00801133DCBB1__002	19690605	100.0	160.0	158.	1	8.2	1	--	--	68.	1
SB00801134CCBC1__010	19910725	120.0	139.0	185.	1	7.7	1	4.	1	76.	1
SB00801234DDDB1__001	19680606	156.0	155.0	154.	1	7.2	1	6.	1	58.	1
SC00101434CACD1__002	19700820	280.0	100.0	676.	1	8.0	1	4.	1	52.	1
SC00101434CCAA1__001	19690827	292.0	90.0	570.	3	7.3	3	12.8	2	60.	1
SC00201403AABA1__003	19890511	181.0	125.0	84.	1	6.0	1	3.	1	32.	1
SC00301418ADBB1__004	19671114	38.0	150.0	146.	1	7.5	1	5.5	1	43.	1
SC00501227ABCC1__001	19660812	143.0	650.0	590.	1	7.3	1	8.	1	--	--
SC00501227ABCC2__001	19660812	101.0	650.0	495.	1	7.5	1	14.5	1	--	--
SC00501432BAAC1__003	19910918	30.0	418.0	70.	1	6.1	1	5.	1	18.	1
SC00501504AACC5__006	19660916	70.0	140.0	130.	1	--	--	8.	1	--	--
SC00601301CCCC1__003	19630424	115.0	280.0	446.	1	6.8	1	--	--	209.	1
SC00601306DDDD1__001	19690617	140.0	905.0	195.	2	7.3	2	3.	1	78.	2
SC00601308BBAB2__006	19680424	122.0	934.2	202.	3	6.9	3	--	--	71.	3
SC00601308BBBA1__005	19680403	130.0	920.0	247.	2	7.4	2	--	--	79.	2
SC00601310CDDC1__001	19630328	72.0	200.0	545.	1	7.5	1	--	--	48.	1
SC00601312ABDB1__001	19621214	146.0	130.0	1150.	1	7.2	1	--	--	10.	1
SC00601316ACAD1__015	19630424	78.0	200.0	266.	1	7.3	1	5.	1	6.8	1
SC00601316CAAA1__001	19630328	90.0	160.0	--	--	--	--	--	--	--	--
SC00601316CCAA1__003	19630424	78.0	120.0	177.	1	6.9	1	--	--	10.	1

Table A. Quality of water from selected wells in the Kenai Peninsula: Physical properties and field measurements--Continued

Local number	Date of last analysis (yr/mo/day)	Well depth (feet below land surface)	Altitude (feet above sea level)	Specific conductance (µS/cm at 25 °C)		pH (units)		Temperature (°C)		Hardness (mg/L as $CaCO_3$)	
				Value	NOA	Value	NOA	Value	NOA	Value	NOA
SC00601316CDBA1__017	19660810	99.0	100.0	586.	2	7.1	2	9.	2	115.	1
SC00601316CDBA2__017	19671114	116.0	100.0	1440.	1	6.9	1	6.	1	70.	1
SC00601316DBCB1__008	19630115	75.0	130.0	--	--	--	--	--	--	--	--
SC00601316DBCB2__008	19630328	90.0	130.0	--	--	--	--	--	--	--	--
SC00601318DDAC1__002	19621207	115.0	300.0	--	--	--	--	--	--	--	--
SC00601318DDBB1__001	19660812	195.0	360.0	925.	5	8.1	5	12.8	2	20.	3
SC00601319AABB1__018	19630328	57.0	270.0	--	--	--	--	--	--	--	--
SC00601319AACB1__006	19660810	132.0	225.0	621.	1	7.7	1	16.5	1	--	--
SC00601319AACB2__006	19660815	165.0	220.0	645.	3	7.5	3	5.8	3	31.	3
SC00601319AACD1__010	19660815	50.0	220.0	520.	1	8.2	1	8.	1	--	--
SC00601319DAAA1__003	19481201	113.0	80.0	1620.	1	8.5	1	3.5	1	20.	1
SC00601319DABA3__002	19660812	92.3	85.0	445.	2	7.5	2	9.	1	153.	2
SC00601319DADA1__001	19540701	115.0	60.0	537.	2	6.9	2	4.	2	185.	2
SC00601319DADA2__001	19660815	212.0	60.0	498.	3	6.9	3	7.2	3	152.	1
SC00601319DADA3__001	19621206	110.0	65.0	--	--	--	--	--	--	--	--
SC00601319DADA4__001	19660815	65.0	50.0	590.	2	7.2	2	11.5	2	--	--
SC00601320ABCD1__006	19630531	116.0	115.0	732.	1	7.7	1	--	--	4.	1
SC00601320ACAB1__012	19660823	60.0	60.0	452.	1	7.6	1	10.	1	--	--
SC00601320ACAD1__024	19660812	25.0	50.0	520.	1	6.6	1	9.	1	--	--
SC00601320BADA1__013	19660818	52.0	140.0	433.	1	8.2	1	9.	1	--	--
SC00601320BADB1__010	19630424	93.0	140.0	555.	1	8.5	1	6.	1	9.8	1
SC00601320BCAB1__023	19660810	26.0	140.0	1000.	1	6.9	1	11.	1	--	--
SC00601320BCBA1__001	19660819	134.0	145.0	1345.	2	8.2	2	9.	2	--	--
SC00601320BCBA2__001	19660823	146.0	145.0	1350.	1	8.4	1	8.	1	--	--
SC00601321CADC1__001	19660815	70.0	55.0	739.	2	6.8	2	11.8	2	--	--
SC00601321CADD1__017	19660818	79.0	5.0	325.	1	7.2	1	5.	1	--	--
SC00601321CCBC1__015	19701105	70.0	55.0	292.	3	7.3	3	11.7	3	130.	2
SC00601321DACA1__012	19660822	57.0	55.0	518.	1	7.1	1	8.	1	--	--
SC00601321DBCA1__009	19621025	41.0	70.0	296.	1	8.2	1	4.5	1	110.	1
SC00601321DBCC1__014	19660816	49.0	70.0	376.	2	6.8	2	15.	2	--	--
SC00601404DBAD1__001	19621207	50.0	770.0	--	--	--	--	--	--	--	--
SC00601409BADC1__001	19500921	25.0	640.0	315.	1	--	--	--	--	58.	1
SC00601412CAAB1__001	19910918	52.0	1150.0	98.	1	6.1	1	5.	1	22.	1
SC00601414CACC2__001	19660818	415.0	710.0	113.	1	6.8	1	15.5	1	--	--
SC00601415BCDC1__001	19630531	237.0	720.0	316	2	6.7	2	4.5	1	127.	2

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved

[All values in milligrams per liter; NOA, number of analyses; ND, not detected; --, not analyzed; < , less than.
Note: if more than one analysis was available, the value reported is the mean of all analyses]

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00101207BBCB1__001	26.	1	8.2	1	10.	1	6.	1	116.	1	2.7	1	5.4	1	0.2	1	38.	1	169.	1
SB00201210BCDB1__001	24.	1	7.6	1	6.6	1	4.8	1	102.	1	0.2	1	4.3	1	0.1	1	32.	1	141.	1
SB00201229DCDB1__001	29.	1	16.	1	7.	1	5.5	1	149.	1	1.4	1	4.8	1	0.2	1	19.	1	175.	1
SB00201232BCDA1__004	14.	1	8.8	1	9.3	1	3.	1	89.	1	1.8	1	9.	1	<0.1	1	47.	1	154.	1
SB00201232BDBB1__001	46.	1	16.	1	9.9	1	6.9	1	202.	1	1.8	1	4.	1	0.2	1	44.	1	252.	1
SB00301104CDCC1__003	30.	1	7.8	1	7.	1	4.6	1	128.	1	ND	1	1.8	1	0.3	1	35.	1	164.	1
SB00301118BBAD1__001	24.	1	12.	1	8.	1	5.4	1	128.	1	2.5	1	2.5	1	0.2	1	34.	1	166.	1
SB00301131BDCC1__001	23.	2	5.8	2	19.	2	3.2	2	124.	2	0.32	2	2.6	2	0.2	2	39.	2	167.	2
SB00301201BDAD2__001	18.	1	7.9	1	32.	1	5.3	1	138.	1	0.2	1	11.	1	0.3	1	32.	1	190.	1
SB00301213ADDD1__001	10.	1	5.	1	5.1	1	3.1	1	58.	1	2.7	1	4.9	1	0.1	1	33.	1	100.	1
SB00401002CCDC1__004	19.	1	4.5	1	15.	1	3.	1	98.	1	2.1	1	1.7	1	0.2	1	27.	1	133.	1
SB00401101CCCC1__007	34.	1	7.5	1	6.5	1	2.6	1	125.	1	3.9	1	4.9	1	0.1	1	34.	1	170.	1
SB00401114CCBC1__001	12.	1	5.3	1	4.7	1	1.9	1	62.	1	ND	1	3.2	1	0.1	1	30.	1	94.	1
SB00401225CBAA1__001	33.	1	12.	1	22.	1	10.	1	188.	1	ND	1	2.1	1	0.2	1	35.	1	227.	1
SB00500805BBDA2__003	23.	1	3.2	1	4.2	1	1.6	1	72.	1	2.2	1	3.2	1	<0.1	1	17.	1	103.	1
SB00500805BBDD1__001	21.	1	7.8	1	19.	1	2.9	1	126.	1	2.4	1	6.4	1	0.2	1	20.	1	158.	1
SB00500806CCAB1__008	23.	1	3.3	1	2.8	1	1.6	1	79.	1	0.8	1	1.9	1	0.1	1	31.	1	114.	1
SB00500806CDDB1__009	6.6	1	3.1	1	79.	1	5.1	1	183.	1	11.	1	14.	1	0.6	1	24.	1	257.	1
SB00500807AADD1__013	13.	1	6.1	1	24.	1	5.1	1	--	--	3.1	1	5.3	1	0.3	1	20.	1	145.	1
SB00500807BDCD2__035	13.	1	3.3	1	50.	1	4.5	1	164.	1	<0.1	1	3.2	1	0.6	1	26.	1	--	--
SB00500807DBCC1__027	18.	1	7.4	1	20.	1	3.2	1	117.	1	1.4	1	3.2	1	0.3	1	28.	1	154.	1
SB00500813BCDB1__001	31.	1	2.4	1	3.7	1	2.7	1	90.	1	3.3	1	2.5	1	ND	1	11.	1	111.	1
SB00500813DCDD1__006	16.	1	3.5	1	3.4	1	1.	1	56.	1	3.4	1	1.8	1	<0.1	1	12.	1	76.	1
SB00500817BDBA1__001	21.	1	6.	1	48.	1	2.	1	182.	1	0.45	1	0.7	1	0.1	1	24.	1	211.	1
SB00500901DCDC2__002	11.	1	4.7	1	20.	1	6.8	1	100.	1	1.4	1	3.1	1	0.2	1	23.	1	132.	1
SB00500902ADAD1__004	15.	1	2.8	1	3.3	1	1.3	1	59.	1	1.8	1	0.6	1	<0.1	1	22.	1	83.	1
SB00500907CBAD1__007	13.	1	7.2	1	36.	1	2.9	1	144.	1	2.6	1	17.	1	0.2	1	46.	1	213.	1
SB00500909CACC1__016	8.1	1	3.9	1	3.4	1	1.6	1	53.	1	1.1	1	0.5	1	<0.1	1	27.	1	79.	1
SB00500911DACC2__025	20.	1	4.6	1	4.4	1	1.8	1	75.	1	3.1	1	4.6	1	0.1	1	22.	1	107.	1
SB00500915CDDA1__039	20.	1	4.1	1	4.2	1	2.	1	74.	1	0.6	1	0.8	1	<0.1	1	29.	1	106.	1
SB00500927ABBB1__002	33.	1	5.3	1	97.	1	0.8	1	175.	1	0.4	1	100.	1	1.1	1	41.	1	386.	1
SB00500930DDBB1__016	28.	1	5.	1	6.	1	1.8	1	119.	1	0.5	1	1.1	1	<0.1	1	39.	1	163.	1
SB00500931CBCA1__002	12.	1	5.3	1	22.	1	5.3	1	101.	1	1.1	1	5.6	1	0.3	1	29.	1	141.	1
SB00501004BDBD1__001	29.	1	11.	1	10.	1	4.9	1	142.	1	<0.1	1	3.7	1	0.2	1	34.	1	--	--

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00501006BCAB1__010	5.8	1	4.6	1	28.	1	4.9	1	98.	1	ND	1	0.7	1	0.2	1	35.	1	138.	1
SB00501006CACC1__019	9.9	1	3.1	1	4.1	1	1.2	1	36.	1	1.4	1	6.9	1	<0.1	1	19.	1	70.	1
SB00501008BDCD1__001	14.	1	2.9	1	3.8	1	1.4	1	55.	1	ND	1	1.1	1	0.1	1	25.	1	82.	1
SB00501008CCDB1__002	18.	14	9.6	14	30.	14	4.7	14	136.	14	1.44	14	12.1	14	0.31	14	35.	14	194.	14
SB00501014CDCB2__004	35.	1	9.7	1	7.	1	2.5	1	101.	1	0.8	1	47.	1	<0.1	1	37.	1	217.	1
SB00501015ADBB1__004	21.	1	6.4	1	6.8	1	3.	1	90.	1	0.3	1	1.4	1	0.2	1	38.	1	133.	1
SB00501019CBBD1__001	9.3	1	4.2	1	72.	1	2.5	1	138.	1	4.4	1	41.	1	0.3	1	37.	1	254.	1
SB00501021BADD1__001	40.	1	4.	1	5.	1	3.2	1	128.	1	ND	1	0.5	1	0.1	1	33.	1	164.	1
SB00501021BCCD1__006	34.	1	11.	1	12.	1	6.4	1	161.	1	0.6	1	2.1	1	0.1	1	28.	1	191.	1
SB00501021BDCD1__007	39.	1	10.	1	1.1	1	3.9	1	149.	1	ND	1	1.4	1	0.1	1	30.	1	175.	1
SB00501024DBCA1__007	13.	1	5.3	1	4.6	1	1.6	1	58.	1	2.7	1	2.8	1	<0.1	1	26.	1	92.	1
SB00501025BDAC1__006	21.	1	4.3	1	6.1	1	3.1	1	89.	1	0.1	1	2.6	1	0.2	1	32.	1	125.	1
SB00501028CABD1__012	22.	1	8.1	1	6.4	1	2.	1	89.	1	2.6	1	6.6	1	<0.1	1	26.	1	139.	1
SB00501028CCBB1__002	31.	2	9.3	2	6.2	2	2.9	2	126.	2	2.	2	1.	2	0.1	2	26.	2	155.	2
SB00501029BDDA1__005	16.	4	9.7	4	53.	4	4.4	4	124.	4	5.7	4	54.8	4	0.17	4	45.	4	264.	4
SB00501029CACB1__010	16.	1	9.2	1	65.	1	4.7	1	129.	1	5.5	1	68.	1	0.2	1	43.	1	290.	1
SB00501029CCDD1__020	23.	3	7.4	3	40.	3	6.3	3	157.	3	0.95	3	18.3	3	0.33	3	35.	3	225.	3
SB00501029CDAC1__001	28.	1	8.5	1	10.	1	4.	1	128.	1	1.4	1	5.	1	0.1	1	40.	1	175.	1
SB00501029DBCD1__002	31.	1	11.	1	8.3	1	4.8	1	114.	1	28.	1	4.5	1	0.2	1	39.	1	197.	1
SB00501029DCBB1__021	32.	3	8.6	3	14.	3	4.	3	135.	3	2.2	3	10.2	3	0.13	3	40.	3	192.	3
SB00501029DCCA1__018	35.	1	8.8	1	7.2	1	4.	1	166.	1	1.2	1	1.4	1	0.3	1	40.	1	184.	1
SB00501030BADD1__001	15.	1	4.9	1	96.	1	7.5	1	246.	1	ND	1	11.	1	0.9	1	35.	1	319.	1
SB00501030CAAB1__003	21.	1	7.8	1	94.	1	7.3	1	274.	1	1.5	1	15.	1	1.1	1	29.	1	350.	1
SB00501031ADAA1__002	28.	1	12.	1	42.	1	4.4	1	150.	1	1.	1	49.	1	0.1	1	37.	1	263.	1
SB00501032ADBA1__009	22.	2	13.5	2	63.	2	5.6	2	170.	2	1.6	2	58.	2	0.15	2	41.	2	308.	2
SB00501032ADBA2__009	34.	1	7.6	1	6.2	1	3.2	1	114.	1	16.	1	2.	1	0.2	1	39.	1	177.	1
SB00501032BDBC1__005	29.	1	14.	1	38.	1	5.	1	170.	1	1.	1	34.	1	ND	1	49.	1	272.	1
SB00501032BDCA1__017	22.	1	9.1	1	44.	1	4.2	1	128.	1	4.3	1	45.	1	0.1	1	42.	1	249.	1
SB00501032CACA2__004	43.	1	5.2	1	37.	1	4.2	1	170.	1	ND	1	36.	1	0.2	1	42.	1	270.	1
SB00501032CACC1__003	36.	1	5.5	1	36.	1	3.2	1	160.	1	ND	1	28.	1	0.2	1	44.	1	249.	1
SB00501032CADA1__007	42.	1	4.1	1	50.	1	4.	1	170.	1	ND	1	45.	1	0.2	1	46.	1	294.	1
SB00501032CCBC1__002	23.	1	13.	1	44.	1	5.8	1	162.	1	0.8	1	38.	1	0.3	1	42.	1	269.	1
SB00501033BDDD2__003	19.	1	12.	1	51.	1	4.7	1	143.	1	36.	1	33.	1	0.2	1	34.	1	276.	1
SB00501101CBCC2__005	13.	1	14.	1	55.	1	9.3	1	132.	1	ND	1	67.	1	0.1	1	35.	1	273.	1
SB00501102ADDA1__009	34.	1	10.	1	29.	1	4.1	1	63.	1	0.7	1	120.	1	0.1	1	31.	1	289.	1
SB00501102CDCC1__001	9.6	1	1.6	1	6.9	1	0.9	1	38.	1	ND	1	3.6	1	0.1	1	25.	1	74.	1
SB00501102DCCC1__008	3.7	1	4.2	1	68.	1	6.3	1	130.	1	<0.1	1	40.	1	0.1	1	43.	1	--	--

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00501102DDDD1__002	16.	1	21.	1	80.	1	11.2	1	140.	1	ND	1	120.	1	ND	1	52.	1	385.	1
SB00501103AAAA1__001	15.1	3	4.7	3	37.	3	6.7	3	117.	3	5.8	3	14.4	3	0.37	3	15.	3	169.	3
SB00501104DCBA1__001	43.	1	4.7	1	5.3	1	3.4	1	144.	1	ND	1	1.1	1	0.1	1	38.	1	185.	1
SB00501105ABAD1__004	1.6	2	1.3	2	11.	2	2.6	2	20.	2	2.7	2	5.0	2	0.1	2	29.	2	69.	2
SB00501105ACDA1__007	9.8	2	2.7	2	4.0	2	1.6	2	38.	2	2.2	2	3.3	2	ND	2	40.	2	86.	2
SB00501105ADCB2__006	12.	1	3.2	1	4.7	1	1.3	1	44.	1	1.	1	3.9	1	0.1	1	31.	1	88.	1
SB00501105ADCB3__006	9.2	1	3.6	1	3.4	1	1.2	1	43.	1	0.5	1	2.1	1	0.1	1	24.	1	70.	1
SB00501105BCCC1__008	9.1	1	12.	1	320.	1	18.	1	151.	1	--	--	400.es	1	--	--	37.	1	890.	1
SB00501105BDAA1__003	9.9	2	1.3	2	7.6	2	1.9	2	35.	2	1.2	2	5.0	2	ND	2	28.	2	76.	2
SB00501110ADBB1__003	2.8	1	1.7	1	89.	1	4.8	1	125.	1	5.5	1	52.	1	0.1	1	41.	1	272.	1
SB00501110BCDC1__004	4.5	1	6.1	1	340.	1	8.	1	142.	3	0.4	1	455.	3	0.1	1	41.	3	935.	1
SB00501110BDBC1__007	ND	1	0.3	1	55.	2	1.9	2	114.	2	2.	1	6.6	2	0.3	1	33.	2	170.	1
SB00501110BDCC1__005	14.	1	9.	1	280.	1	12.	1	140.	2	2.9	1	418.	2	0.1	1	40.	2	844.	1
SB00501111BAAD1__004	8.8	3	12.1	3	48.	4	9.9	4	126.	4	0.57	3	43.	4	0.17	3	43.	4	247.	3
SB00501111BBCD1__001	13.	1	2.3	1	139.	1	9.2	1	148.	1	1.	1	137.	1	0.2	1	45.	1	436.	1
SB00501113CBBA1__001	15.	1	5.8	1	12.	1	3.6	1	76.	1	1.9	1	13.	1	0.1	1	31.	1	128.	1
SB00501114CDDD1__001	16.	1	9.3	1	28.	1	3.8	1	121.	1	3.7	1	13.	1	ND	1	39.	1	186.	1
SB00501115DCAD1__001	2.	1	1.3	1	91.	1	3.1	1	163.	1	7.7	1	27.	1	0.2	1	39.	1	272.	1
SB00501117BBAB1__001	0.5	1	0.7	1	125.	1	4.3	1	190.	1	22.	1	45.	1	0.4	1	37.	1	349.	1
SB00501122ABCD1__004	2.	1	1.2	1	98.	1	4.9	1	180.	1	7.7	1	22.	1	0.4	1	22.	1	269.	1
SB00501122ADAA1__007	21.	1	4.9	1	8.2	1	1.4	1	48.	1	2.8	1	14.	1	<0.1	1	22.	1	130.	1
SB00501123ACBA1__006	31.	1	6.6	1	5.4	1	2.7	1	120.	1	0.2	1	3.	1	<0.1	1	40.	1	176.	1
SB00501127CAAA2__006	12.	1	3.	1	3.8	1	1.1	1	44.	1	1.3	1	4.2	1	<0.1	1	20.	1	74.	1
SB00501130BDAA1__006	11.	1	4.	1	12.	1	1.4	1	114.	1	4.3	1	4.	1	<0.1	1	37.	1	156.	1
SB00501130BDDA1__007	3.2	1	1.4	1	110.	1	2.8	1	192.	1	12.	1	27.	1	0.4	1	37.	1	312.	1
SB00501130DCAB1__001	5.	1	2.3	1	190.	1	7.8	1	372.	1	12.	1	34.	1	1.5	1	28.	1	503.	1
SB00501131ACBD1__002	3.6	1	3.4	1	75.	1	2.7	1	168.	1	1.4	1	6.	1	0.2	1	37.	1	232.	1
SB00501134AAAD2__009	10.	1	4.3	1	41.	1	4.3	1	124.	1	2.1	1	16.	1	0.4	1	28.	1	183.	1
SB00501135CACD1__001	14.	1	4.	1	4.6	1	1.3	1	56.	1	0.4	1	2.6	1	ND	1	20.	1	81.	1
SB00501136DBAC1__002	7.8	1	3.6	1	150.	1	5.5	1	238.	1	22.	1	67.	1	0.5	1	36.	1	436.	1
SB00501136DBCA1__006	16.	1	4.3	1	6.7	1	1.6	1	59.	1	2.6	1	6.8	1	0.1	1	24.	1	101.	1
SB00601003ABAC1__001	26.5	2	5.1	2	4.7	2	2.7	2	--	--	<0.1	2	2.6	2	<0.1	2	35.	2	--	--
SB00601005BCCB1__001	21.	1	5.4	1	6.3	1	4.8	1	93.	1	ND	1	2.5	1	0.1	1	26.	1	122.	1
SB00601103ADAD1__001	--	--	--	--	--	--	--	--	100.	1	--	--	--	--	--	--	--	--	--	--
SB00601106BCCA1__001	16.	1	2.6	1	3.4	1	1.4	1	54.	1	ND	1	3.8	1	0.2	1	35.	1	95.	1
SB00601111DDDA1__001	11.	1	2.3	1	3.4	1	1.4	1	42.	1	ND	1	2.4	1	ND	1	32.	1	78.	1
SB00601112DCAC1__002	9.	1	4.2	1	3.6	1	1.8	1	47.	1	1.	1	1.4	1	0.1	1	29.	1	78.	1

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00601112DDAD1__001	19.	1	3.3	1	3.	1	2.	1	73.	1	ND	1	3.2	1	0.1	1	36.	1	111.	1
SB00601115BCAD1__001	20.	1	4.2	1	3.8	1	2.7	1	75.	1	ND	1	4.2	1	0.1	1	36.	1	116.	1
SB00601118CBDC1__002	18.	1	3.8	1	8.2	1	2.6	1	76.	1	1.	1	4.5	1	ND	1	43.	1	127.	1
SB00601118CCAD1__001	18.	3	5.0	3	5.6	3	1.5	3	74.	3	0.63	3	2.6	3	0.1	3	39.	3	117.	3
SB00601128BBDA2__001	28.	1	11.	1	16.	1	7.7	1	155.	1	ND	1	4.5	1	0.2	1	31.	1	191.	1
SB00601130CCDB1__005	7.9	1	2.3	1	4.	1	1.3	1	46.	1	1.2	1	4.6	1	<0.1	1	40.	1	98.	1
SB00601132CBCB1__001	28.	1	2.2	1	4.5	1	1.4	1	87.	1	0.6	1	4.	1	ND	1	22.	1	115.	1
SB00601133DDCB1__007	0.5	1	0.7	1	110.	1	4.7	1	268.	1	2.	1	5.6	1	1.2	1	32.	1	317.	1
SB00601135BCAC1__003	14.	1	4.8	1	3.5	1	1.4	1	70.	1	0.9	1	2.8	1	<0.1	1	46.	1	123.	1
SB00601135DBBD1__001	0.3	1	0.3	1	52.	1	2.6	1	112.	1	ND	1	0.7	1	0.5	1	44.	1	168.	1
SB00601135DBBD2__001	5.9	5	6.1	5	30.2	5	4.7	5	99.	5	4.5	5	6.4	5	0.3	5	45.	5	164.	5
SB00601136DADC1__005	4.9	3	4.2	3	35.5	4	5.2	4	111.	4	ND	3	4.2	4	0.43	3	39.	4	159.	3
SB00601201BACA2__004	9.8	1	2.8	1	3.7	1	0.9	1	--	--	0.09	1	3.4	1	0.14	1	--	--	62.	1
SB00601201CDAA1__008	6.7	1	2.1	1	3.9	1	1.1	1	--	--	4.5	1	4.3	1	0.11	1	--	--	45.	1
SB00601202AACD1__008	17.1	1	4.0	1	6.6	1	2.1	1	--	--	1.1	1	4.9	1	0.2	1	--	--	94.	1
SB00601202CABB1__009	9.9	2	2.8	2	4.2	2	1.7	2	--	--	<0.01	2	4.8	2	0.15	2	--	--	67.	2
SB00601203ADAD1__001	9.2	1	3.4	1	29.	1	5.	1	102.	1	0.45	1	4.3	1	0.3	1	29.	1	142.	1
SB00601211BAAC1__012	8.8	2	3.2	2	4.3	2	1.5	2	62.	1	<0.1	2	4.5	2	0.16	2	24.	1	81.	2
SB00601211BBBD1__011	3.4	1	4.4	1	201.	1	8.9	1	--	--	42.	1	94.	1	<0.01	1	--	--	520.	1
SB00601211BCAA1__005	9.2	1	9.8	1	370.	1	10.	1	371.	1	34.	1	320.	1	1.7	1	23.	1	1002.	1
SB00601212DCCC1__001	12.	1	4.	1	4.1	1	2.8	1	49.	1	0.2	1	4.1	1	ND	1	37.	1	94.	1
SB00601214DCCD2__021	8.	1	4.6	1	4.7	1	1.3	1	61.	1	6.8	1	5.3	1	0.1	1	45.	1	125.	1
SB00601223BDDD1__001	0.9	1	1.2	1	150.	1	5.4	1	330.	1	2.5	1	12.	1	1.4	1	14.	1	399.	1
SB00601225ACAD1__003	28.	1	6.8	1	6.1	1	2.4	1	112.	1	ND	1	4.	1	ND	1	51.	1	165.	1
SB00601225ACBD1__002	31.	4	8.1	4	5.4	4	2.0	4	120.	4	0.91	4	4.2	4	0.22	5	47.	4	171.	4
SB00601225ACDB1__001	25.	3	8.1	3	5.3	3	1.3	3	100.	3	2.07	3	6.4	3	0.27	3	38.	3	147.	3
SB00601225ACDB2__001	29.5	2	7.6	2	6.1	2	2.4	2	121.	2	0.72	2	3.8	2	ND	2	30.	2	153.	2
SB00601225CACC2__008	19.	2	11.5	2	7.4	2	1.6	2	75.	2	10.3	2	19.	2	0.1	2	39.	2	154.	2
SB00601225CCBA1__006	3.1	1	2.5	1	200.	1	7.3	1	450.	1	ND	1	7.3	1	2.1	1	22.	1	516.	1
SB00601225CDCB1__007	<3.2	1	2.9	1	80.	1	4.6	1	182.	1	6.	1	6.	1	0.6	1	21.	1	234.	1
SB00601225DBAC1__005	17.	2	10.5	2	448.	2	15.5	2	424.	2	42.	2	457.	2	2.3	5	25.	2	1273.	2
SB00601226ADDC1__001	3.9	1	2.8	1	51.	1	7.8	1	137.	1	1.6	1	4.6	1	0.6	1	22.	1	177.	1
SB00701027BDBB1__001	17.	1	3.7	1	3.4	1	1.4	1	65.	1	0.6	1	2.2	1	0.2	1	26.	1	93.	1
SB00701101CADB1__009	1.5	1	1.2	1	150.	1	4.5	1	330.	1	0.5	1	19.	1	2.1	1	14.	1	399.	1
SB00701104BDAB2__003	19.	1	3.3	1	4.7	1	2.	1	63.	1	0.9	1	4.2	1	0.1	1	29.	1	102.	1
SB00701105BABB1__012	9.8	1	2.4	1	5.2	1	1.8	1	39.	1	3.2	1	3.8	1	0.1	1	33.	1	84.	1
SB00701107BCBD1__002	17.	1	3.	1	4.3	1	1.9	1	80.	1	0.7	1	3.8	1	0.1	1	29.	1	110.	1

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701108CDAA2__006	8.8	1	1.8	1	4.1	1	1.	1	35.	1	1.9	1	4.2	1	0.1	1	23.	1	68.	1
SB00701109CADB2__002	23.	1	4.5	1	5.1	1	1.9	1	83.	1	3.4	1	7.9	1	0.1	1	26.	1	124.	1
SB00701117CABA1__001	21.	1	5.6	1	5.4	1	1.9	1	110.	1	0.2	1	7.9	1	0.1	1	30.	1	152.	1
SB00701119BCCC1__001	4.4	1	7.	1	73.	1	8.3	1	187.	1	3.2	1	13.	1	0.9	1	28.	1	250.	1
SB00701129CCBA1__010	11.	1	2.6	1	4.9	1	1.4	1	48.	1	2.7	1	4.8	1	<0.1	1	30.	1	91.	1
SB00701131BBBA1__001	12.	1	9.	1	360.	1	13.	1	380.	1	56.	1	313.	1	0.8	1	29.	1	1027.	1
SB00701132ABAB1__001	17.	1	2.9	1	4.1	1	2.8	1	59.	1	ND	1	3.6	1	0.2	1	24.	1	90.	1
SB00701132BABC1__002	6.8	1	1.4	1	3.6	1	1.	1	26.	1	2.1	1	3.1	1	<0.1	1	23.	1	58.	1
SB00701201AABB1__001	19.2	1	1.9	1	5.8	1	1.8	1	58.	1	ND	1	7.4	1	0.1	1	31.	1	104.	1
SB00701202AABA1__004	12.	1	2.6	1	5.7	1	2.1	1	36.	1	4.8	1	6.4	1	0.2	1	28.	1	88.	1
SB00701202CCDC1__010	20.	1	6.	1	7.5	1	2.8	1	76.	1	3.2	1	8.9	1	0.1	1	36.	1	133.	1
SB00701209DDCD1__002	17.	1	4.6	1	6.2	1	4.5	1	71.	1	0.4	1	4.3	1	0.1	1	25.	1	104.	1
SB00701209DDCD3__002	14.	1	4.1	1	7.	1	1.7	1	60.	1	2.5	1	9.9	1	0.2	1	34.	1	115.	1
SB00701209DDDD1__001	9.6	1	2.9	1	4.9	1	1.6	1	41.	1	ND	1	5.3	1	0.5	1	31.	1	81.	1
SB00701210BDBB1__016	2.1	1	1.5	1	99.	1	5.	1	232.	1	0.3	1	12.	1	0.8	1	23.	1	291.	1
SB00701210CAAC1__024	14.	1	4.8	1	11.	1	5.7	1	76.	1	0.3	1	5.3	1	0.2	1	27.	1	115.	1
SB00701210CDAA2__006	15.	1	3.5	1	7.8	1	1.7	1	56.	1	3.8	1	8.9	1	0.1	1	31.	1	120.	1
SB00701211ABBB1__004	20.	1	3.2	1	5.2	1	2.2	1	73.	1	1.6	1	5.6	1	0.2	1	27.	1	111.	1
SB00701211BBCC1__003	9.6	1	1.4	1	4.4	1	1.8	1	27.	1	ND	1	7.1	1	0.2	1	27.	1	71.	1
SB00701211CCBD1__008	14.8	2	4.3	2	6.2	2	2.3	2	31.	1	5.4	2	7.4	2	0.16	2	31.	1	91.	2
SB00701211CDCC1__037	14.2	1	3.8	1	6.2	1	4.0	1	--	--	1.6	1	4.3	1	0.19	1	--	--	75.	1
SB00701211DCAC1__027	26.	1	5.3	1	5.6	1	2.1	1	90.	1	1.3	1	15.	1	0.1	1	25.	1	157.	1
SB00701213BCBD1__004	10.	1	2.1	1	5.2	1	1.4	1	32.	1	5.2	1	5.4	1	0.1	1	27.	1	76.	1
SB00701213BCCC1__013	5.6	1	1.8	1	5.3	1	0.9	1	42.	1	2.7	1	7.6	1	<0.1	1	28.	1	88.	1
SB00701213BDCD1__016	14.2	1	3.4	1	6.1	1	1.4	1	--	--	2.9	1	8.0	1	0.16	1	--	--	66.	1
SB00701213DBCD1__023	12.	1	3.6	1	5.1	1	1.7	1	51.	1	1.6	1	5.	1	0.1	1	31.	1	94.	1
SB00701214CCBD1__015	8.2	1	2.6	1	5.8	1	1.8	1	--	--	6.4	1	7.9	1	0.13	1	--	--	55.	1
SB00701214CCCB1__002	8.7	1	3.4	1	5.2	1	1.3	1	--	--	3.0	1	6.4	1	0.14	1	--	--	67.	1
SB00701214DDCA1__018	21.	2	5.1	2	7.3	2	2.2	2	--	--	2.5	2	6.7	2	0.21	2	--	--	90.	2
SB00701215BBCB1__011	30.4	1	11.6	1	9.5	1	3.1	1	--	--	3.2	1	4.9	1	0.31	1	--	--	170.	1
SB00701215CCAB1__010	24.3	1	4.8	1	4.3	1	1.2	1	--	--	8.2	1	6.7	1	0.22	1	--	--	107.	1
SB00701215DCBC1__004	11.	1	3.7	1	4.8	1	1.4	1	48.	1	ND	1	4.5	1	0.1	1	29.	1	83.	1
SB00701215DCBC2__004	15.	2	5.3	2	5.7	2	3.7	2	72.	1	1.3	2	5.5	2	<0.1	2	30.	2	110.	2
SB00701216ADAD2__012	6.6	1	2.8	1	5.3	1	1.9	1	30.	1	ND	1	5.7	1	0.1	1	34.	1	76.	1
SB00701216DCAA2__005	11.	1	1.3	1	80.	1	0.8	1	194.	1	1.	1	9.2	1	0.9	1	23.	1	245.	1
SB00701216DDBB1__007	48.	2	13.	2	53.	2	0.8	2	137.	2	44.	2	95.5	2	--	--	--	--	338.	2
SB00701221ABBC1__002	8.4	1	8.8	1	273.	1	14.	1	486.	1	23.	1	97.	1	3.	1	12.	1	733.	1

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701221ACBA1__004	27.	1	8.9	1	31.	1	4.6	1	90.	1	9.1	1	58.	1	0.1	1	33.	1	227.	1
SB00701221ADDD2__009	28.	1	5.7	1	5.5	1	3.1	1	94.	1	4.2	1	8.1	1	0.2	1	33.	1	145.	1
SB00701221DBAB1__001	26.	1	16.	1	10.	1	3.8	1	125.	1	18.	1	9.	1	ND	1	32.	1	190.	1
SB00701221DDAC2__010	5.4	1	5.5	1	120.	1	8.4	1	230.	1	16.	1	43.	1	0.9	1	7.6	1	350.	1
SB00701221DDBC1__008	6.7	1	6.4	1	120.	1	8.8	1	--	--	19.	1	53.	1	0.8	1	25.	1	--	--
SB00701221DDBC2__008	9.2	1	7.5	1	140.	1	9.5	1	250.	1	22.	1	65.	1	0.8	1	25.	1	440.	1
SB00701222BCAA1__009	22.	1	4.6	1	4.8	1	2.5	1	84.	1	ND	1	4.1	1	0.2	1	31.	1	119.	1
SB00701222BDAB3__008	5.8	2	4.1	2	41.5	2	6.	2	110.	2	4.2	2	12.	2	0.5	2	24.	2	166.	2
SB00701222CBBD3__005	4.4	1	3.8	1	62.	1	7.	1	142.	1	3.7	1	16.	1	0.7	1	25.	1	208.	1
SB00701222CCBD1__011	7.	1	7.4	1	150.	1	9.7	1	246.	1	25.	1	67.	1	0.9	1	24.	1	443.	1
SB00701222CCCB1__010	17.	1	11.	1	9.9	1	3.2	1	77.	1	16.	1	12.	1	0.1	1	7.5	1	133.	1
SB00701223ABBC1__017	9.9	1	3.0	1	4.3	1	1.4	1	--	--	4.6	1	5.9	1	0.14	1	--	--	61.	1
SB00701223CACC1__012	8.5	1	2.7	1	4.4	1	1.5	1	37.	1	7.2	1	5.1	1	0.1	1	30.	1	84.	1
SB00701223CBBC1__002	3.4	2	1.0	2	15.2	2	1.0	2	--	--	13.6	2	8.5	2	0.13	2	--	--	75.	2
SB00701223DCBC1__010	36.6	1	6.9	1	6.1	1	2.5	1	--	--	9.3	1	5.5	1	0.27	1	--	--	138.	1
SB00701224AABD1__016	21.4	1	4.7	1	6.8	1	2.0	1	--	--	2.9	1	4.9	1	0.21	1	--	--	90.	1
SB00701224ADBB1__015	8.	1	1.8	1	5.1	1	1.3	1	25.	1	2.8	1	4.5	1	<0.1	1	27.	1	69.	1
SB00701224CBAB1__009	10.	1	2.1	1	5.9	1	1.5	1	34.	1	2.9	1	6.5	1	0.1	1	31.	1	81.	1
SB00701224DBAB1__003	6.1	1	1.	1	5.	1	1.	1	22.	1	5.8	1	3.3	1	0.1	1	26.	1	63.	1
SB00701224DBAC1__005	9.9	1	1.9	1	3.7	1	1.5	1	--	--	4.8	1	3.1	1	0.13	1	--	--	46.	1
SB00701225ACBA1__021	9.4	1	2.6	1	4.7	1	1.7	1	--	--	3.8	1	9.6	1	0.13	1	--	--	55.	1
SB00701225BBAC1__028	12.4	1	2.8	1	5.9	1	1.5	1	--	--	3.0	1	4.5	1	0.17	1	--	--	60.	1
SB00701225CDCC1__003	19.	1	3.7	1	5.4	1	1.8	1	66.	1	2.2	1	2.7	1	0.1	1	36.	1	111.	1
SB00701225DACC1__027	8.3	1	1.7	1	4.4	1	1.1	1	--	--	2.7	1	5.0	1	0.13	1	--	--	44.	1
SB00701225DCCC1__020	16.	1	3.2	1	7.7	1	1.8	1	58.	1	2.5	1	5.1	1	<0.1	1	30.	1	102.	1
SB00701226BAAA2__003	16.	1	3.4	1	5.4	1	3.5	1	53.	1	13.	1	2.8	1	0.1	1	30.	1	106.	1
SB00701226BADD1__008	3.5	1	3.9	1	390.	1	10.	1	840.	1	19.	1	21.	1	3.5	1	5.4	1	978.	1
SB00701226BCAA1__039	16.	1	4.7	1	5.9	1	1.7	1	--	--	6.1	1	6.5	1	0.19	1	--	--	94.	1
SB00701226CACB1__024	15.6	1	4.1	1	4.6	1	2.9	1	--	--	1.3	1	4.2	1	0.18	1	--	--	71.	1
SB00701227AABA1__005	12.	1	4.9	1	5.8	1	1.8	1	64.	1	5.5	1	5.2	1	0.1	1	29.	1	106.	1
SB00701227ABBB1__003	13.	1	4.9	1	6.4	1	6.1	1	67.	1	ND	1	2.8	1	0.5	1	34.	1	109.	1
SB00701227ADBA1__027	11.9	1	4.3	1	5.1	1	1.5	1	--	--	5.0	1	6.8	1	0.16	1	--	--	75.	1
SB00701227BBAB2__013	18.	1	27.	1	16.	1	8.7	1	164.	1	1.1	1	6.4	1	0.1	1	4.4	1	181.	1
SB00701227BCAB1__001	11.	1	6.5	1	4.8	1	6.5	1	68.	1	3.5	1	2.8	1	ND	1	29.	1	106.	1
SB00701227BCAC1__019	14.	1	15.	1	51.	1	7.8	1	303.	1	17.	1	7.6	1	0.1	1	10.	1	347.	1
SB00701227BCBD1__020	--	--	--	--	--	--	--	--	673.	1	--	--	--	--	--	--	--	--	--	--
SB00701227CAAA1__008	9.6	1	2.2	1	4.2	1	1.8	1	31.	1	6.	1	5.7	1	0.1	1	30.	1	79.	1

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701228AAAC1__003	6.7	1	16.	1	190.	1	27.	1	1080.	1	73.	1	14.	1	0.3	1	2.2	1	981.	1
SB00701234DACC1__001	1.2	1	1.	1	130.	1	5.9	1	260.	1	0.4	1	19.	1	1.3	1	13.	1	328.	1
SB00701235CCCB1__015	16.3	1	3.2	1	4.1	1	1.7	1	--	--	3.8	1	5.1	1	0.17	1	--	--	72.	1
SB00701235CCCC2__004	24.5	1	5.7	1	6.1	1	2.7	1	--	--	7.1	1	5.4	1	0.29	1	--	--	116.	1
SB00701235CDCA3__018	16.4	1	3.8	1	8.2	1	1.9	1	--	--	5.5	1	14.	1	0.19	1	--	--	79.	1
SB00701235DADB1__037	7.1	1	2.6	1	4.0	1	1.4	1	--	--	3.0	1	6.4	1	0.12	1	--	--	53.	1
SB00701236AAAB1__006	10.5	2	5.7	2	7.9	2	5.0	2	71.	1	1.5	2	4.1	2	0.19	2	28.	1	92.	2
SB00800923BCDB1__001	46.	1	7.3	1	7.	1	3.7	1	159.	1	2.	1	3.5	1	0.2	1	23.	1	188.	1
SB00800927ABAB1__001	40.	1	7.6	1	6.4	1	3.7	1	147.	1	0.5	1	2.	1	ND	1	35.	1	183.	1
SB00801018DCDC1__002	7.6	1	4.8	1	76.	1	10.	1	203.	1	ND	1	5.	1	1.	1	18.	1	245.	1
SB00801122DAAD1__002	13.	1	5.8	1	7.5	1	3.2	1	82.	1	2.8	1	4.9	1	0.1	1	55.	1	152.	1
SB00801124BBBD1__005	23.	1	8.8	1	9.8	1	6.7	1	108.	1	ND	1	5.	1	0.2	1	34.	1	153.	1
SB00801133DCBB1__002	20.	1	4.4	1	5.5	1	3.1	1	75.	1	2.3	1	4.2	1	0.3	1	33.	1	118.	1
SB00801134CCBC1__010	18.	1	7.6	1	8.6	1	6.1	1	87.	1	0.8	1	5.9	1	0.3	1	29.	1	130.	1
SB00801234DDDB1__001	14.	1	5.7	1	4.9	1	0.6	1	62.	1	5.2	1	5.1	1	0.1	1	34.	1	107.	1
SC00101434CACD1__002	8.4	1	7.5	1	140.	1	9.3	1	275.	1	0.4	1	54.	1	0.3	1	43.	1	437.	1
SC00101434CCAA1__001	11.	1	7.8	1	124.	1	11.	1	264.	1	0.4	1	16.	1	0.3	1	48.	1	377.	1
SC00201403AABA1__003	8.8	1	2.4	1	5.6	1	1.3	1	--	--	2.	1	5.1	1	0.1	1	25.	1	72.	1
SC00301418ADBB1__004	10.	1	4.4	1	8.9	1	2.7	1	67.	1	ND	1	4.6	1	0.1	1	38.	1	110.	1
SC00501432BAAC1__003	5.1	1	1.2	1	2.9	1	1.5	1	33.	1	2.5	1	3.1	1	<0.1	1	5.6	1	46.	1
SC00601301CCCC1__003	49.	1	21.	1	12.	1	8.2	1	221.	1	6.	1	11.	1	0.3	1	41.	1	281.	1
SC00601306DDDD1__001	16.5	2	9.	2	6.2	2	5.7	2	89.	2	0.9	2	8.2	2	0.1	2	46.	2	147.	2
SC00601308BBAB2__006	13.4	3	9.2	3	7.3	3	5.8	3	68.	3	5.4	3	6.2	3	0.37	3	51.	3	140.	3
SC00601308BBBA1__005	14.5	2	10.4	2	12.1	2	7.9	2	120.	2	1.7	2	7.8	2	0.1	2	50.	2	176.	2
SC00601310CDDC1__001	13.	1	3.8	1	127.	1	3.4	1	290.	1	4.	1	14.	1	0.2	1	40.	1	380.	1
SC00601312ABDB1__001	4.	1	ND	1	308.	1	4.	1	656.	1	1.	1	16.	1	0.2	1	17.	1	744.	1
SC00601316ACAD1__015	2.4	1	0.2	1	65.	1	13.	1	139.	1	ND	1	6.	1	0.1	1	22.	1	192.	1
SC00601316CCAA1__003	2.4	1	1.	1	40.	1	1.	1	72.	1	3.	1	16.	1	0.1	1	21.	1	128.	1
SC00601316CDBA1__017	32.	1	8.5	1	60.	1	2.4	1	62.	1	8.2	1	108.	1	0.1	1	19.	1	301.	1
SC00601316CDBA2__017	27.	1	--	--	320.	1	--	--	588.	1	2.	1	140.	1	0.1	1	--	--	841.	1
SC00601318DDBB1__001	6.5	3	0.8	3	238.	3	4.6	3	527.	3	2.2	3	6.8	3	0.13	3	35.	3	610.	3
SC00601319AACB2__006	9.	3	2.	3	156.	3	3.2	3	333.	3	3.8	3	20.3	3	0.2	3	28.	3	422.	3
SC00601319DAAA1__003	4.8	1	1.9	1	--	--	--	--	736.	1	3.	1	114.	1	0.4	1	6.6	1	--	--
SC00601319DABA3__002	36.5	2	14.9	2	38.	2	2.5	2	162.	2	1.6	2	21.	2	0.1	2	33.	2	273.	2
SC00601319DADA1__001	52.	2	13.5	2	33.	1	5.	1	265.	2	2.7	2	14.	2	0.15	2	33.5	2	295.	1
SC00601319DADA2__001	41.	1	12.	1	41.	1	5.3	1	235.	1	2.8	1	16.	1	ND	1	36.	1	295.	1
SC00601320ABCD1__006	1.6	1	ND	1	184.	1	2.4	1	382.	1	ND	1	16.	1	0.1	1	34.	1	467.	1

Table B. Quality of water from selected wells in the Kenai Peninsula: Major inorganic constituents, dissolved--Continued

Local number	Calcium		Magnesium		Sodium		Potassium		Alkalinity		Sulfate		Chloride		Fluoride		Silica		Dissolved solids	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SC00601320BADB1__010	3.6	1	0.2	1	131.	1	4.2	1	280.	1	2.	1	14.	1	0.2	1	28.	1	352.	1
SC00601321CCBC1__015	44.5	2	4.8	2	10.	2	1.7	2	129.	2	1.2	2	19.	2	0.1	2	40.	2	197.	2
SC00601321DBCA1__009	25.	1	11.	1	13.	1	1.7	1	72.	1	7.	1	41.	1	0.1	1	33.	1	175.	1
SC00601409BADC1__001	--	--	--	--	--	--	--	--	112.	1	7.	1	28.	1	0.2	1	19.	1	--	--
SC00601412CAAB1__001	5.2	1	2.1	1	9.2	1	2.4	1	18.	1	3.2	1	15.	1	0.1	1	29.	1	83.	1
SC00601415BCDC1__001	33.5	2	10.6	2	14.	2	2.8	2	134.	2	8.	2	15.5	2	0.15	2	39.	2	203.	2

Table C. Quality of water from selected wells in the Kenai Peninsula: Nutrients, dissolved

[All values in milligrams per liter; NOA, number of analyses; --, not analyzed; < , less than
Note: if more than one analysis was available, the value reported is the mean of all analyses]

Local number	Nitrate plus nitrite		Ammonia		Ammonia plus organic nitrogen		Phosphorus		Orthophosphorus	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00101207BBCB1__001	<0.05	1	0.62	1	0.7	1	0.39	1	0.36	1
SB00201232BCDA1__004	0.06	1	0.06	1	<0.2	1	0.04	1	0.01	1
SB00301213ADDD1__001	0.14	1	<0.01	1	0.4	1	0.06	1	0.05	1
SB00401002CCDC1__004	<0.05	1	0.11	1	<0.2	1	0.43	1	0.37	1
SB00401101CCCC1__007	<0.05	1	0.06	1	<0.2	1	0.1	1	0.1	1
SB00500805BBDA2__003	1.1	1	<0.01	1	--	--	0.07	1	0.08	1
SB00500805BBDD1__001	<0.05	1	0.42	1	--	--	0.39	1	0.43	1
SB00500806CCAB1__008	0.06	1	0.06	1	0.2	1	0.18	1	0.18	1
SB00500806CDDB1__009	<0.05	1	0.19	1	0.3	1	1.2	1	1.2	1
SB00500807AADD1__013	<0.05	1	0.27	1	0.3	1	0.59	1	0.6	1
SB00500807BDCD2__035	<0.05	1	0.17	1	0.3	1	1.7	1	1.5	1
SB00500807DBCC1__027	<0.05	1	0.37	1	--	--	0.39	1	0.38	1
SB00500813DCDD1__006	0.27	1	<0.01	1	<0.2	1	<0.01	1	<0.01	1
SB00500901DCDC2__002	<0.05	1	0.19	1	--	--	0.42	1	0.41	1
SB00500902ADAD1__004	0.11	1	0.02	1	--	--	<0.01	1	0.01	1
SB00500907CBAD1__007	<0.05	1	0.51	1	0.6	1	0.07	1	0.07	1
SB00500909CACC1__016	0.34	1	0.03	1	--	--	<0.01	1	0.01	1
SB00500911DACC2__025	0.35	1	<0.01	1	<0.2	1	0.02	1	0.02	1
SB00500915CDDA1__039	<0.05	1	0.07	1	<0.2	1	0.07	1	0.07	1
SB00500930DDBB1__016	<0.05	1	0.26	1	0.6	1	0.11	1	0.02	1
SB00501004BDBD1__001	<0.05	1	0.15	1	0.3	1	0.33	1	0.31	1
SB00501006CACC1__019	0.55	1	<0.01	1	<0.2	1	<0.01	1	0.01	1
SB00501014CDCB2__004	<0.05	1	0.5	1	0.4	1	0.02	1	0.04	1
SB00501015ADBB1__004	<0.05	1	0.21	1	0.4	1	0.2	1	0.19	1
SB00501024DBCA1__007	0.09	1	<0.01	1	<0.2	1	<0.01	1	<0.01	1
SB00501025BDAC1__006	<0.05	1	0.11	1	0.4	1	0.34	1	0.36	1
SB00501028CABD1__012	2.6	1	0.01	1	<0.2	1	0.02	1	<0.01	1
SB00501029BDDA1__005	0.14	2	--	--	--	--	--	--	0.35	3
SB00501029CCDD1__020	--	--	--	--	--	--	--	--	0.09	1
SB00501029DCBB1__021	0.02	2	--	--	--	--	--	--	0.12	2
SB00501032BDCA1__017	0.01	1	--	--	--	--	--	--	0.24	1
SB00501102ADDA1__009	<0.05	1	0.24	1	0.5	1	0.14	1	0.06	1
SB00501102DCCC1__008	<0.05	1	0.36	1	0.5	1	0.21	1	0.21	1

Table C. Quality of water from selected wells in the Kenai Peninsula: Nutrients, dissolved--Continued

Local number	Nitrate plus nitrite		Ammonia		Ammonia plus organic nitrogen		Phosphorus		Orthophosphorus	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00501115DCAD1__001	0.05	1	0.23	1	0.3	1	0.58	1	0.6	1
SB00501122ADAA1__007	6.	1	<0.01	1	0.6	1	0.01	1	0.01	1
SB00501123ACBA1__006	<0.05	1	0.48	1	0.5	1	0.33	1	0.26	1
SB00501127CAAA2__006	0.45	1	<0.01	1	0.4	1	0.01	1	0.01	1
SB00501130BDAA1__006	<0.05	1	0.15	1	0.2	1	0.03	1	0.01	1
SB00501130BDDA1__007	0.32	1	0.42	1	0.6	1	1.1	1	0.23	1
SB00501134AAAD2__009	<0.05	1	0.34	1	0.4	1	0.69	1	0.69	1
SB00501136DBCA1__006	0.74	1	<0.01	1	<0.2	1	0.04	1	0.05	1
SB00601003ABAC1__001	<0.1	2	0.03	2	--	--	0.14	2	0.13	2
SB00601130CCDB1__005	0.06	1	0.04	1	<0.2	1	0.07	1	<0.01	1
SB00601135BCAC1__003	<0.05	1	0.03	1	<0.2	1	0.07	1	0.04	1
SB00601135DBBD2__001	<0.1	4	--	--	--	--	--	--	0.42	4
SB00601201BACA2__004	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00601201CDAA1__008	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00601202AACD1__008	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00601202CABB1__009	<0.1	2	--	--	--	--	--	--	<0.1	2
SB00601211BAAC1__012	0.07	2	0.14	1	0.3	1	0.04	1	0.05	2
SB00601211BBBD1__011	<0.1	1	--	--	--	--	--	--	4.7	1
SB00601214DCCD2__021	<0.05	1	0.08	1	0.4	1	0.09	1	0.07	1
SB00701101CADB1__009	<0.05	1	0.18	1	0.5	1	2.9	1	2.6	1
SB00701104BDAB2__003	0.11	1	0.04	1	0.3	1	0.07	1	0.04	1
SB00701105BABB1__012	0.23	1	<0.01	1	0.2	1	0.04	1	0.04	1
SB00701107BCBD1__002	<0.05	1	0.04	1	<0.2	1	0.05	1	0.04	1
SB00701108CDAA2__006	0.44	1	0.01	1	<0.2	1	0.01	1	<0.01	1
SB00701109CADB2__002	<0.05	1	0.02	1	0.3	1	0.05	1	0.03	1
SB00701117CABA1__001	0.05	1	0.61	1	0.9	1	0.05	1	<0.01	1
SB00701132BABC1__002	0.29	1	<0.01	1	<0.2	1	0.02	1	<0.01	1
SB00701202CCDC1__010	<0.05	1	0.02	1	0.5	1	0.03	1	<0.01	1
SB00701209DDCD3__002	0.16	1	<0.01	1	<0.2	1	<0.01	1	<0.01	1
SB00701210BDBB1__016	<0.05	1	0.14	1	0.6	1	2.5	1	2.3	1
SB00701210CAAC1__024	<0.05	1	0.09	1	<0.2	1	0.33	1	0.32	1
SB00701210CDAA2__006	3.2	1	0.01	1	<0.2	1	<0.01	1	<0.01	1
SB00701211ABBB1__004	0.43	1	0.04	1	<0.2	1	0.08	1	0.05	1
SB00701211CCBD1__008	<0.1	2	--	--	--	--	--	--	0.05	2
SB00701211CDCC1__037	0.1	1	--	--	--	--	--	--	0.2	1
SB00701211DCAC1__027	3.4	1	0.07	1	0.4	1	0.01	1	<0.01	1
SB00701213BCBD1__004	0.09	1	--	--	--	--	--	--	0.01	1

Table C. Quality of water from selected wells in the Kenai Peninsula: Nutrients, dissolved--Continued

Local number	Nitrate plus nitrite		Ammonia		Ammonia plus organic nitrogen		Phosphorus		Orthophosphorus	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701213BCCC1__013	0.35	1	0.42	1	0.5	1	0.02	1	<0.01	1
SB00701213BDCD1__016	1.62	1	--	--	--	--	--	--	0.1	1
SB00701213DBCD1__023	0.26	1	0.05	1	<0.2	1	0.04	1	0.02	1
SB00701214CCBD1__015	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701214CCCB1__002	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701214DDCA1__018	4.45	2	--	--	--	--	--	--	<0.1	2
SB00701215BBCB1__011	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701215CCAB1__010	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701215DCBC2__004	<0.1	1	0.04	1	--	--	0.12	1	0.09	1
SB00701221ACBA1__004	<0.1	1	--	--	--	--	--	--	0.08	1
SB00701221ADDD2__009	0.04	1	--	--	--	--	--	--	0.12	1
SB00701221DDAC2__010	<0.1	1	--	--	--	--	--	--	0.66	1
SB00701221DDBC2__008	0.28	1	--	--	--	--	--	--	2.	1
SB00701222BDAB3__008	0.02	2	--	--	--	--	--	--	0.74	2
SB00701222CCBD1__011	0.4	1	--	--	--	--	--	--	1.3	1
SB00701222CCCB1__010	<0.1	1	--	--	--	--	--	--	<0.01	1
SB00701223ABBC1__017	0.1	1	--	--	--	--	--	--	<0.1	1
SB00701223CACC1__012	<0.1	1	--	--	--	--	--	--	0.01	1
SB00701223CBBC1__002	<0.1	2	--	--	--	--	--	--	<0.1	2
SB00701223DCBC1__010	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701224AABD1__016	0.41	1	--	--	--	--	--	--	<0.1	1
SB00701224ADBB1__015	0.71	1	0.02	1	<0.2	1	0.02	1	0.02	1
SB00701224CBAB1__009	0.15	1	0.02	1	<0.2	1	<0.01	1	0.01	1
SB00701224DBAB1__003	0.26	1	--	--	--	--	--	--	0.01	1
SB00701224DBAC1__005	0.46	1	--	--	--	--	--	--	<0.1	1
SB00701225ACBA1__021	0.32	1	--	--	--	--	--	--	<0.1	1
SB00701225BBAC1__028	0.55	1	--	--	--	--	--	--	<0.1	1
SB00701225CDCC1__003	<0.05	1	<0.01	1	0.3	1	0.05	1	0.06	1
SB00701225DACC1__027	0.3	1	--	--	--	--	--	--	<0.1	1
SB00701225DCCC1__020	0.15	1	<0.01	1	<0.2	1	0.05	1	0.02	1
SB00701226BADD1__008	--	--	--	--	--	--	--	--	5.	1
SB00701226BCAA1__039	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701226CACB1__024	0.11	1	--	--	--	--	--	--	<0.1	1
SB00701227AABA1__005	<0.05	1	--	--	--	--	--	--	<0.01	1
SB00701227ADBA1__027	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701227BBAB2__013	0.02	1	--	--	--	--	--	--	<0.01	1
SB00701227BCAC1__019	0.02	1	--	--	--	--	--	--	<0.01	1

Table C. Quality of water from selected wells in the Kenai Peninsula: Nutrients, dissolved--Continued

Local number	Nitrate plus nitrite		Ammonia		Ammonia plus organic nitrogen		Phosphorus		Orthophosphorus	
	Value	NOA	Value	NOA	Value	NOA	Value	NOA	Value	NOA
SB00701228AAAC1__003	0.62	1	--	--	--	--	--	--	--	--
SB00701235CCCB1__015	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701235CCCC2__004	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701235CDCA3__018	2.72	1	--	--	--	--	--	--	<0.1	1
SB00701235DADB1__037	<0.1	1	--	--	--	--	--	--	<0.1	1
SB00701236AAAB1__006	<0.05	2	0.08	1	0.3	1	0.21	1	0.19	2
SB00801122DAAD1__002	0.1	1	0.03	1	0.3	1	0.11	1	0.08	1
SB00801134CCBC1__010	<0.05	1	0.09	1	0.2	1	0.42	1	0.43	1
SC00201403AABA1__003	0.22	1	0.01	1	--	--	0.01	1	<0.01	1
SC00501432BAAC1__003	<0.05	1	0.1	1	0.6	1	0.06	1	0.05	1
SC00601412CAAB1__001	1.3	1	<0.01	1	0.2	1	0.02	1	0.02	1

Table D. Quality of water from selected wells in the Kenai Peninsula: Metals and trace elements, dissolved

[All values in micrograms per liter; NOA, number of analyses; ND, not detected;
--, not analyzed; < , less than.
Note: if more than one analysis was available, the value reported is the mean of all analyses]

Local number	Arsenic		Iron		Manganese	
	Value	NOA	Value	NOA	Value	NOA
SB00101207BBCB1__001	29.	1	350.	1	210.	1
SB00201232BCDA1__004	5.	1	6300.	1	510.	1
SB00301213ADDD1__001	6.	1	300.	1	27.	1
SB00401002CCDC1__004	34.	1	88.	1	140.	1
SB00401101CCCC1__007	19.	1	260.	1	310.	1
SB00500805BBDA2__003	13.	1	8.	1	4.	1
SB00500805BBDD1__001	94.	1	140.	1	87.	1
SB00500806CCAB1__008	55.	1	510.	1	910.	1
SB00500806CDDB1__009	36.	1	130.	1	30.	1
SB00500807AADD1__013	56.	1	30.	1	49.	1
SB00500807BDCD2__035	68.	1	68.	1	65.	1
SB00500807DBCC1__027	54.	1	82.	1	77.	1
SB00500813DCDD1__006	2.	1	50.	1	8.	1
SB00500901DCDC2__002	38.	1	89.	1	64.	1
SB00500902ADAD1__004	2.	1	3.	1	<1.	1
SB00500907CBAD1__007	4.	1	290.	1	81.	1
SB00500909CACC1__016	<1.	1	110.	1	3.	1
SB00500911DACC2__025	2.	1	7.	1	<1.	1
SB00500915CDDA1__039	11.	1	85.	1	380.	1
SB00500930DDBB1__016	48.	1	8800.	1	1200.	1
SB00501004BDBD1__001	52.	1	910.	1	740.	1
SB00501006CACC1__019	<1.	1	59.	1	11.	1
SB00501014CDCB2__004	22.	1	15000.	1	1400.	1
SB00501015ADBB1__004	16.	1	410.	1	240.	1
SB00501024DBCA1__007	<1.	1	330.	1	3.	1
SB00501025BDAC1__006	43.	1	190.	1	230.	1
SB00501028CABD1__012	<1.	1	38.	1	2.	1
SB00501029BDDA1__005	11.3	3	170.	3	133.	3
SB00501029CCDD1__020	7.	1	30.	1	360.	1
SB00501029DCBB1__021	6.7	3	60.	2	345.	2
SB00501032BDCA1__017	6.	1	90.	1	240.	1
SB00501102ADDA1__009	4.	1	21000.	1	740.	1
SB00501102DCCC1__008	28.	1	280.	1	50.	1
SB00501115DCAD1__001	2.	1	110.	1	17.	1

Table D. Quality of water from selected wells in the Kenai Peninsula: Metals and trace elements, dissolved--Continued

Local number	Arsenic		Iron		Manganese	
	Value	NOA	Value	NOA	Value	NOA
SB00501122ADAA1__007	<1.	1	12.	1	3.	1
SB00501123ACBA1__006	19.	1	12000.	1	1200.	1
SB00501127CAAA2__006	<1.	1	110.	1	3.	1
SB00501130BDAA1__006	6.	1	13000.	1	390.	1
SB00501130BDDA1__007	5.	1	90.	1	20.	1
SB00501134AAAD2__009	33.	1	52.	1	42.	1
SB00501136DBCA1__006	3.	1	6.	1	<1.	1
SB00601003ABAC1__001	23.	2	130.	2	280.	2
SB00601103ADAD1__001	57.	1	--	--	--	--
SB00601130CCDB1__005	2.	1	8700.	1	220.	1
SB00601135BCAC1__003	13.	1	6900.	1	690.	1
SB00601135DBBD1__001	<40.	1	--	--	--	--
SB00601135DBBD2__001	25.	3	210.	4	38.	4
SB00601201BACA2__004	<1.	1	7860.	1	310.	1
SB00601201CDAA1__008	<1.	1	2680.	1	80.	1
SB00601202AACD1__008	<1.	1	9610.	1	210.	1
SB00601202CABB1__009	1.	2	7975.	2	265.	2
SB00601211BAAC1__012	<1.	2	9035.	2	315.	2
SB00601211BBBD1__011	71.	1	380.	1	30.	1
SB00601214DCCD2__021	3.	1	12000.	1	400.	1
SB00701101CADB1__009	3.	1	99.	1	20.	1
SB00701104BDAB2__003	19.	1	130.	1	310.	1
SB00701105BABB1__012	2.	1	16.	1	<1.	1
SB00701107BCBD1__002	9.	1	1100.	1	320.	1
SB00701108CDAA2__006	<1.	1	19.	1	33.	1
SB00701109CADB2__002	7.	1	1400.	1	300.	1
SB00701117CABA1__001	<1.	1	12000.	1	560.	1
SB00701119BCCC1__001	--	--	150.	1	50.	1
SB00701129CCBA1__010	2.	1	4700.	1	170.	1
SB00701132BABC1__002	<1.	1	11.	1	<1.	1
SB00701202CCDC1__010	2.	1	2700.	1	210.	1
SB00701209DDCD3__002	1.	1	4300.	1	240.	1
SB00701210BDBB1__016	30.	1	430.	1	16.	1
SB00701210CAAC1__024	25.	1	56.	1	53.	1
SB00701210CDAA2__006	<1.	1	470.	1	62.	1
SB00701211ABBB1__004	7.	1	36.	1	130.	1
SB00701211CCBD1__008	<1.	1	865.	2	25.	2
SB00701211CDCC1__037	9.9	1	30.	1	60.	1

Table D. Quality of water from selected wells in the Kenai Peninsula: Metals and trace elements, dissolved--Continued

Local number	Arsenic		Iron		Manganese	
	Value	NOA	Value	NOA	Value	NOA
SB00701211DCAC1__027	4.	1	6200.	1	630.	1
SB00701213BCBD1__004	--	--	30.	1	20.	1
SB00701213BCCC1__013	2.	1	8100.	1	270.	1
SB00701213BDCD1__016	<1.	1	40.	1	<5.	1
SB00701213DBCD1__023	1.	1	2100.	1	120.	1
SB00701214CCBD1__015	<1.	1	2160.	1	50.	1
SB00701214CCCB1__002	<1.	1	5110.	1	220.	1
SB00701214DDCA1__018	<1.	2	30.	2	<5.	2
SB00701215BBCB1__011	<1.	1	16200.	1	940.	1
SB00701215CCAB1__010	<1.	1	4480.	1	640.	1
SB00701215DCBC1__004	--	--	8000.	1	--	--
SB00701215DCBC2__004	12.	1	75.	1	71.	1
SB00701221ACBA1__004	13.	1	210.	1	200.	1
SB00701221ADDD2__009	11.	1	390.	1	250.	1
SB00701221DDAC2__010	<1.	1	3500.	1	110.	1
SB00701221DDBC1__008	30.	1	70.	1	60.	1
SB00701221DDBC2__008	19.	1	140.	1	80.	1
SB00701222BDAB3__008	23.	2	85.	2	45.	2
SB00701222CCBD1__011	--	--	180.	1	70.	1
SB00701222CCCB1__010	--	--	9000.	1	880.	1
SB00701223ABBC1__017	<1.	1	3990.	1	220.	1
SB00701223CACC1__012	--	--	2100.	1	120.	1
SB00701223CBBC1__002	8.9	2	7385.	2	120.	2
SB00701223DCBC1__010	1.8	1	440.	1	550.	1
SB00701224AABD1__016	<1.	1	<30.	1	<5.	1
SB00701224ADBB1__015	<1.	1	20.	1	<1.	1
SB00701224CBAB1__009	1.	1	160.	1	3.	1
SB00701224DBAB1__003	--	--	120.	1	120.	1
SB00701224DBAC1__005	<1.	1	<30.	1	<5.	1
SB00701225ACBA1__021	<1.	1	970.	1	100.	1
SB00701225BBAC1__028	<1.	1	140.	1	<5.	1
SB00701225CDCC1__003	7.	1	210.	1	330.	1
SB00701225DACC1__027	<1.	1	<30.	1	<5.	1
SB00701225DCCC1__020	1.	1	17.	1	28.	1
SB00701226BADD1__008	90.	1	1700.	1	60.	1
SB00701226BCAA1__039	<1.	1	9450.	1	420.	1
SB00701226CACB1__024	<1.2	1	50.	1	70.	1
SB00701227AABA1__005	--	--	3500.	1	110.	1

Table D. Quality of water from selected wells in the Kenai Peninsula: Metals and trace elements, dissolved--Continued

Local number	Arsenic		Iron		Manganese	
	Value	NOA	Value	NOA	Value	NOA
SB00701227ADBA1__027	<1.	1	4740.	1	260.	1
SB00701227BBAB2__013	--	--	460.	1	280.	1
SB00701227BCAC1__019	--	--	41000.	1	1100.	1
SB00701228AAAC1__003	--	--	320.	1	20.	1
SB00701235CCCB1__015	<1.	1	130.	1	370.	1
SB00701235CCCC2__004	<1.	1	3870.	1	600.	1
SB00701235CDCA3__018	<1.	1	180.	1	30.	1
SB00701235DADB1__037	<1.	1	4440.	1	180.	1
SB00701236AAAB1__006	17.	2	22.	2	32.	2
SB00801122DAAD1__002	4.	1	9800.	1	240.	1
SB00801134CCBC1__010	46.	1	120.	1	120.	1
SC00201403AABA1__003	<1.	1	85.	1	8.	1
SC00501432BAAC1__003	3.	1	3600.	1	420.	1
SC00601412CAAB1__001	<1.	1	26.	1	2.	1