298

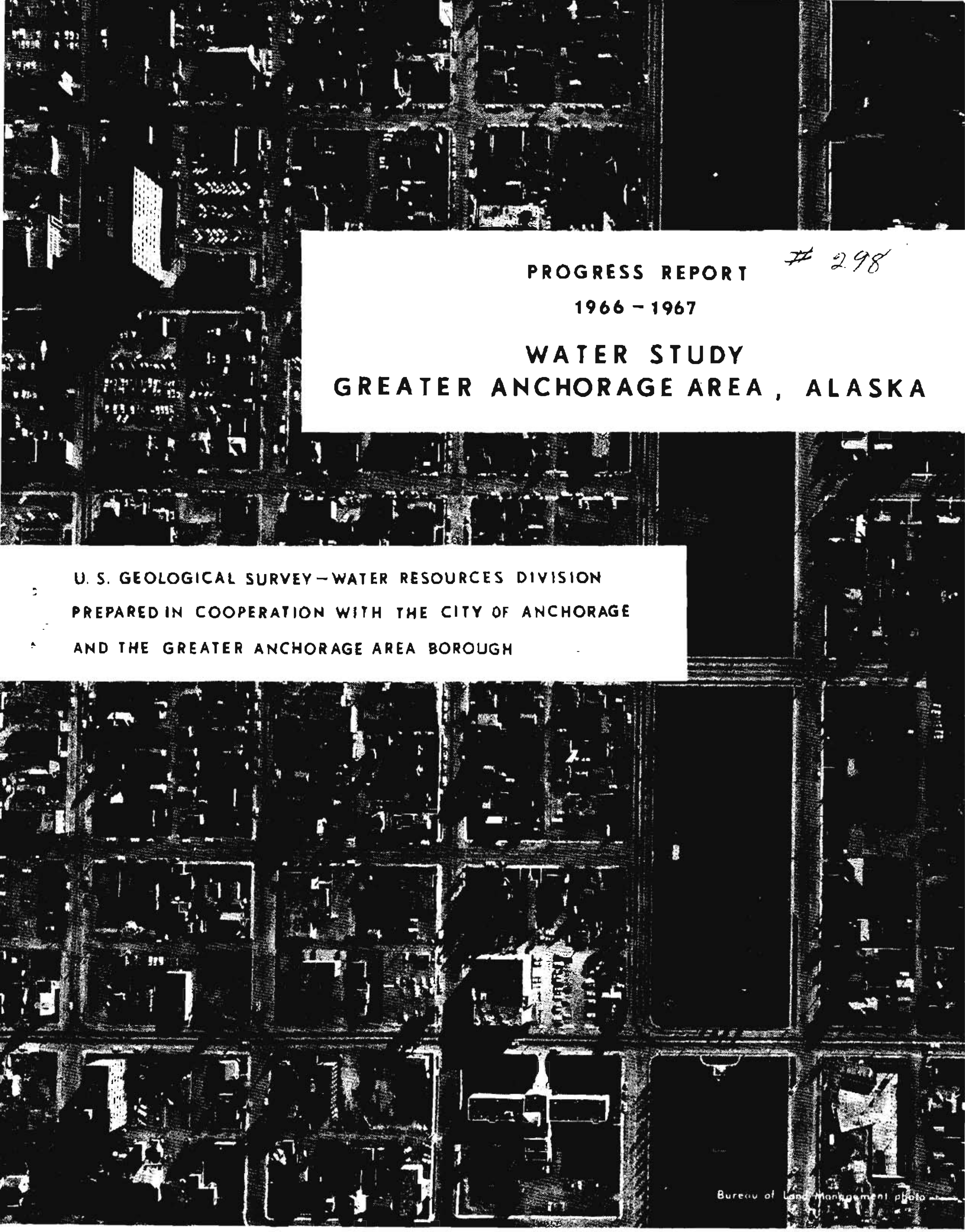
PROGRESS REPORT

1966 – 1967

WATER STUDY
GREATER ANCHORAGE AREA, ALASKA

U. S. GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

PREPARED IN COOPERATION WITH THE CITY OF ANCHORAGE
AND THE GREATER ANCHORAGE AREA BOROUGH



Bureau of Land Management photo

PROGRESS REPORT

1966 - 1967

WATER STUDY - GREATER ANCHORAGE AREA, ALASKA

By

William W. Barnwell and Raymond S. George

Open-file Report

U.S. Geological Survey - Water Resources Division

Prepared in Cooperation with the City of Anchorage

and the Greater Anchorage Area Borough

CONTENTS

ILLUSTRATIONS

The Greater Anchorage Area Water Resources Study

Progress Report 1966-67

SUMMARY

The purpose of the 5-year cooperative water resources study of the Greater Anchorage area by the Geological Survey is to appraise the water resources of the area and obtain data needed to solve water problems and to assist in the orderly development and management of the resource.

Work accomplished during the first year of the study has been concerned largely with the organization and compilation of existing data preparatory to interpretation and analysis. In addition new data were acquired regarding the geohydrology of the area. This involved cooperative studies with the Engineering and Geophysics Branches of the Geological Survey to understand better the nature of rocks underlying the area and their structural and stratigraphic relations. The studies used seismic, electrical-resistivity, and borehole geophysical methods to define the geology. Only preliminary interpretations of the geologic data have been made to date. The study of hydrology has required an inventory of new water wells in the area and an expansion of the stream-gaging and water-quality programs to include Eagle River, Ship Creek, Chester Creek, South Fork Campbell Creek, Campbell Creek, and Glacier Creek. Miscellaneous measurements were also made to determine flow losses or gains in streams. The amount and particle size distribution of sediment carried by selected streams and the chemical quality of both surface and ground water was also determined. Preliminary work was started to determine the water budget of the area. The budget involves determining the total inflow and outflow of water in the area including evapotranspiration. Maps were constructed showing the artesian pressure levels in the glacial water-bearing rocks underlying the area. The maps show the artesian water pressure levels in 1956 soon after pumping from those aquifers was begun, the levels in 1967, and the change in the levels during the interval.

During 1967, the Geological Survey worked closely with City, Borough, and Federal officials and with local consulting engineers on specific problems relating to ground water and to pollution.

Special hydrologic studies involving the use of remote sensing techniques were initiated and monitoring programs to detect salt-water encroachment were established.

Work plans for the 1968 fiscal year call for a greater use of automatic data-processing techniques to more effectively interpret the accumulated data. An electric-analog model of the Anchorage hydrologic system is under construction. The model and processing techniques will provide management with tools to better utilize the water resources of the area. Additional gaging stations will be established on Rabbit Creek, Little Rabbit Creek, Peters Creek, and on Fire Lake. Emphasis will be placed on the exploration by test drilling of new sources of ground water in the alluvial fan areas on Ship and Campbell Creeks. Test drilling is planned to establish more adequate monitoring points for salt-water encroachment and to verify geologic concepts derived from past geophysical studies. During the year, field tests will be conducted to determine rates of flow of ground water, the permeability of materials, and the relationship of surface and ground water. Other plans include analysis of existing production-well pumping schedules and the extension of the well inventory to outlying communities within the Borough.

INTRODUCTION

The objective of the study is to appraise the water resources of the Anchorage area and to obtain some of the basic data needed to solve water problems in the Anchorage area. The problems include development of new water sources, maintenance of existing supplies, water management, possible effects of salt-water encroachment, water temperature in distribution lines, drainage of waterlogged areas, and effects of floods and pollution on the water system. During the study, facts about the hydrologic system in the Greater Anchorage area will be assembled and integrated to aid city and borough officials in the orderly development of the water resource.

The information needed for development includes definition of hydrologic boundaries, inventory of existing developments, investigation of undeveloped sources, and an estimate of total quantities of water potentially available.

In July 1966 the Geological Survey undertook a 5-year cooperative program with the city of Anchorage and the Greater Anchorage Area Borough to assess the water resources of the Borough. Many related studies by other Federal and State agencies are contributing valuable information. These related studies are described elsewhere in this report.

This report summarizes progress by the Water Resources Division of the U.S. Geological Survey's program to date and outlines future work plans. Work during the first year has been concentrated mainly in the metropolitan area of Anchorage.

STATUS OF CURRENT WORK

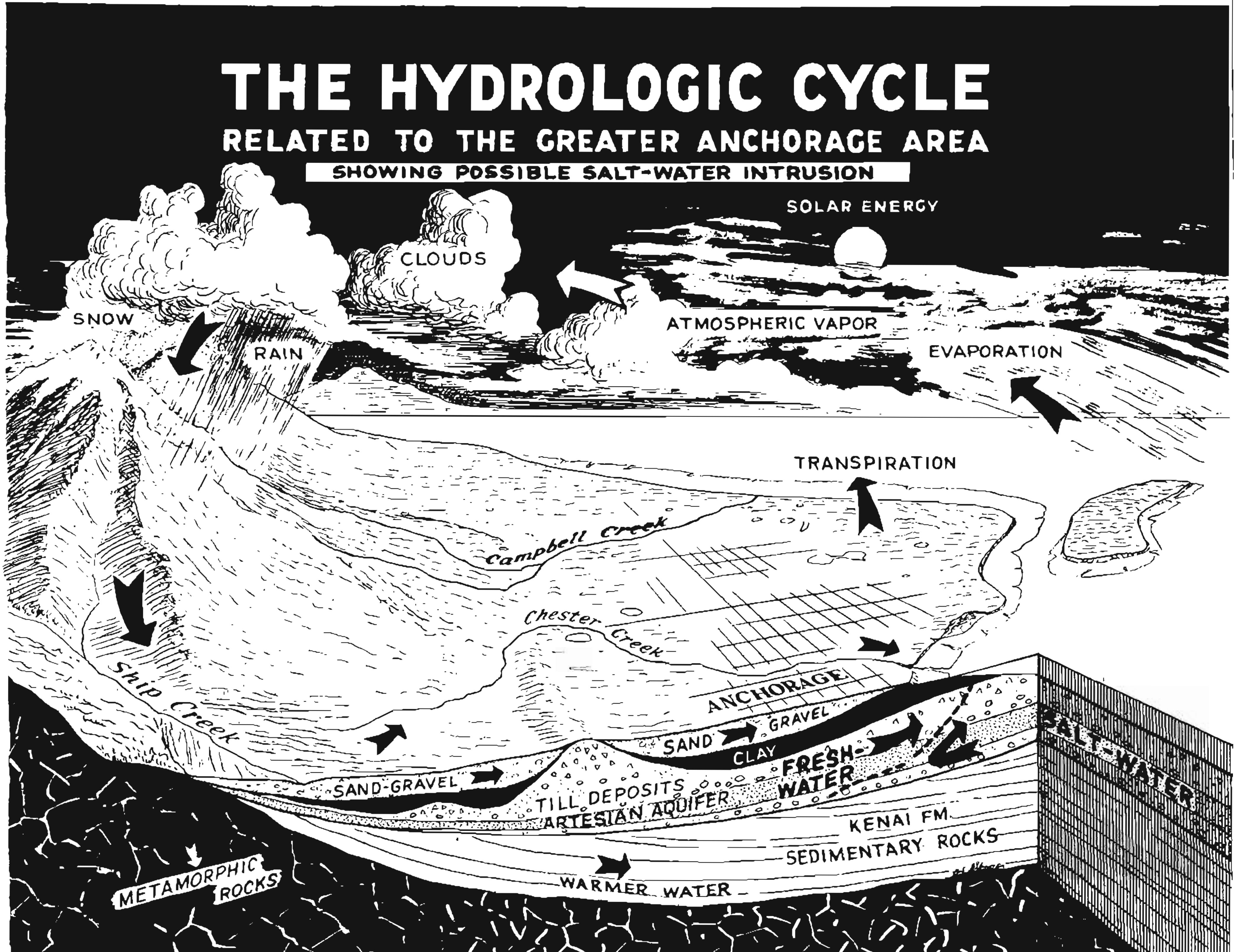
It is necessary to explore in many directions to obtain data needed to solve the complex problems being encountered in the Greater Anchorage area. The work of the project is aimed at providing data for the solution not only of current problems but also long-range problems.

Specific kinds of work designed to accomplish the foregoing objectives are discussed below under geologic studies, geophysical studies, hydrologic studies, special studies, and collection of basic data.

Geologic Studies

Geologic studies in cooperation with the Engineering Geology Branch, U.S. Geological Survey, are continuing. The Engineering Geology Branch is presently conducting an independent, federally financed, engineering geology study of the Borough. These studies are aimed at defining the engineering geology and geohydrology of the Anchorage area. Figures 1, 2, and 3 illustrate the geohydrologic setting of Anchorage. At present most ground water is obtained from the Quaternary sediments. In the future water may also be obtained from the deeper, underlying Tertiary sediments. Sixteen shallow test wells were completed in the area during 1967. Data from these wells are being integrated with subsurface geologic data. During the course of these studies, various aquifers in the Anchorage area will be mapped and areas for future ground-water development will be delineated.

The main goal of the preliminary phase of our geologic studies is the correlation of existing geologic and hydrologic data in order to arrive at a conceptual model of the Anchorage geohydrologic system.


THE HYDROLOGIC CYCLE
RELATED TO THE GREATER ANCHORAGE AREA
SHOWING POSSIBLE SALT-WATER INTRUSION
SOLAR ENERGY
CLOUDS
SNOW
RAIN
ATMOSPHERIC VAPOR
EVAPORATION
TRANSPIRATION
Campbell Creek
Chester Creek
Ship Creek
ANCHORAGE
SAND
GRAVEL
CLAY
FRESH-WATER
SALT-WATER
SAND-GRAVEL
TILL DEPOSITS
ARTESIAN AQUIFER
KENAI FM.
SEDIMENTARY ROCKS
WARMER WATER
METAMORPHIC ROCKS

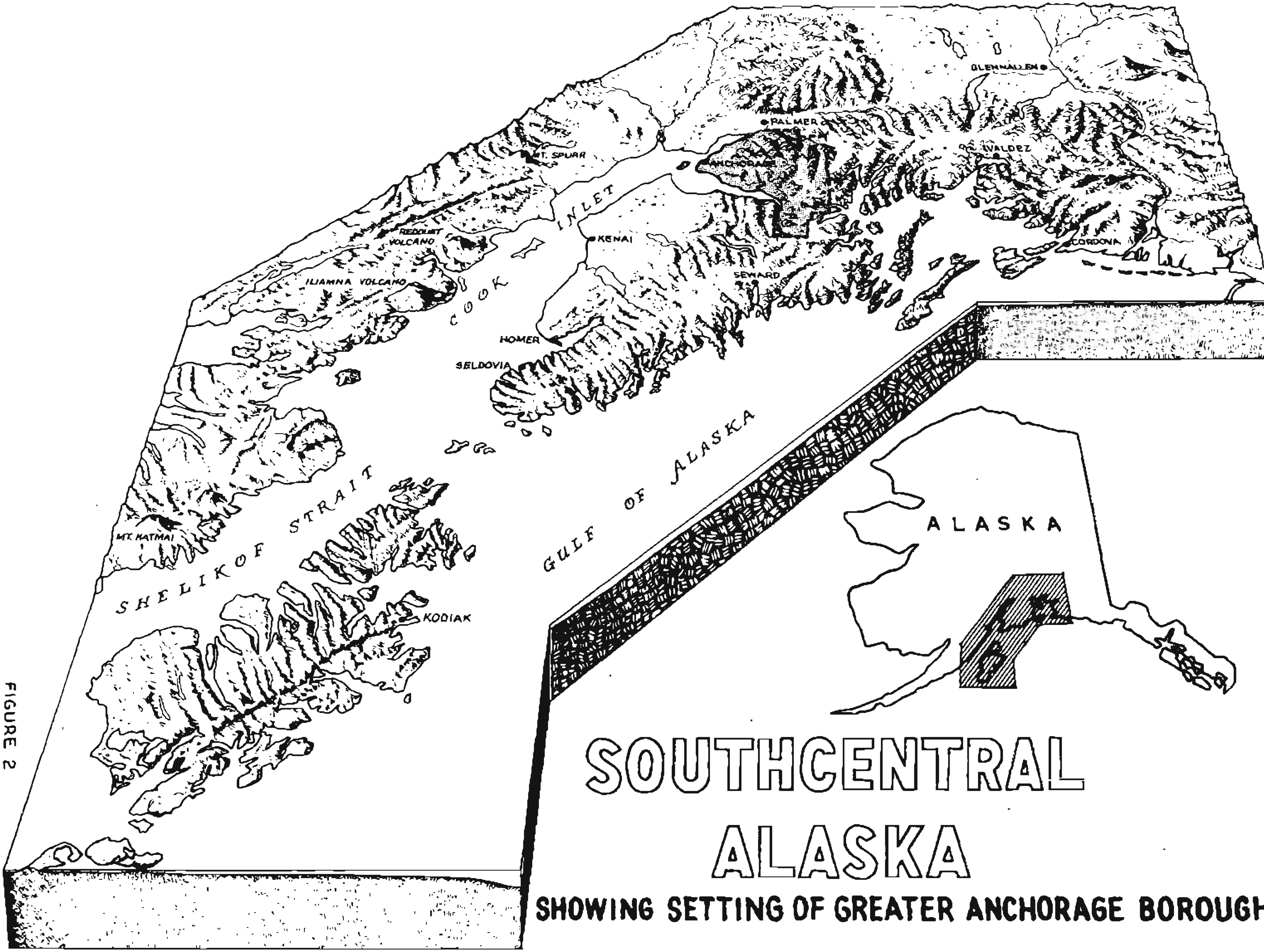
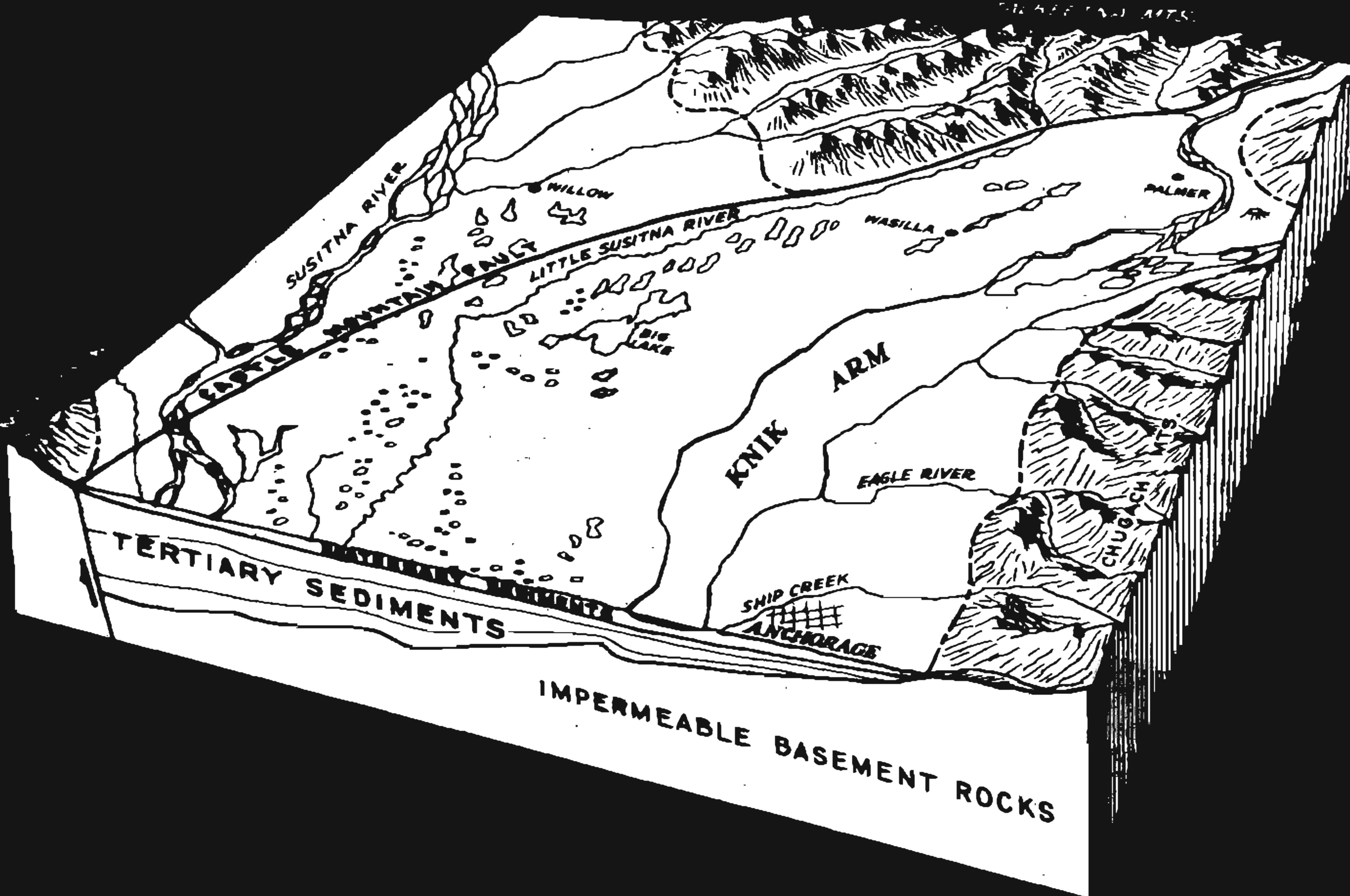

SOUTHCENTRAL
ALASKA
SHOWING SETTING OF GREATER ANCHORAGE BOROUGH
ALASKA
GLENNALLEN
PALMER
VALDEZ
CORDOVA
SEWARD
KENAI
HOMER
SELDOVIA
MT. SPURR
REDOUBT VOLCANO
ILIAMNA VOLCANO
COOK INLET
GULF OF ALASKA
SHELIKOF STRAIT
MT. KATMAI
KODIAK

FIGURE 2

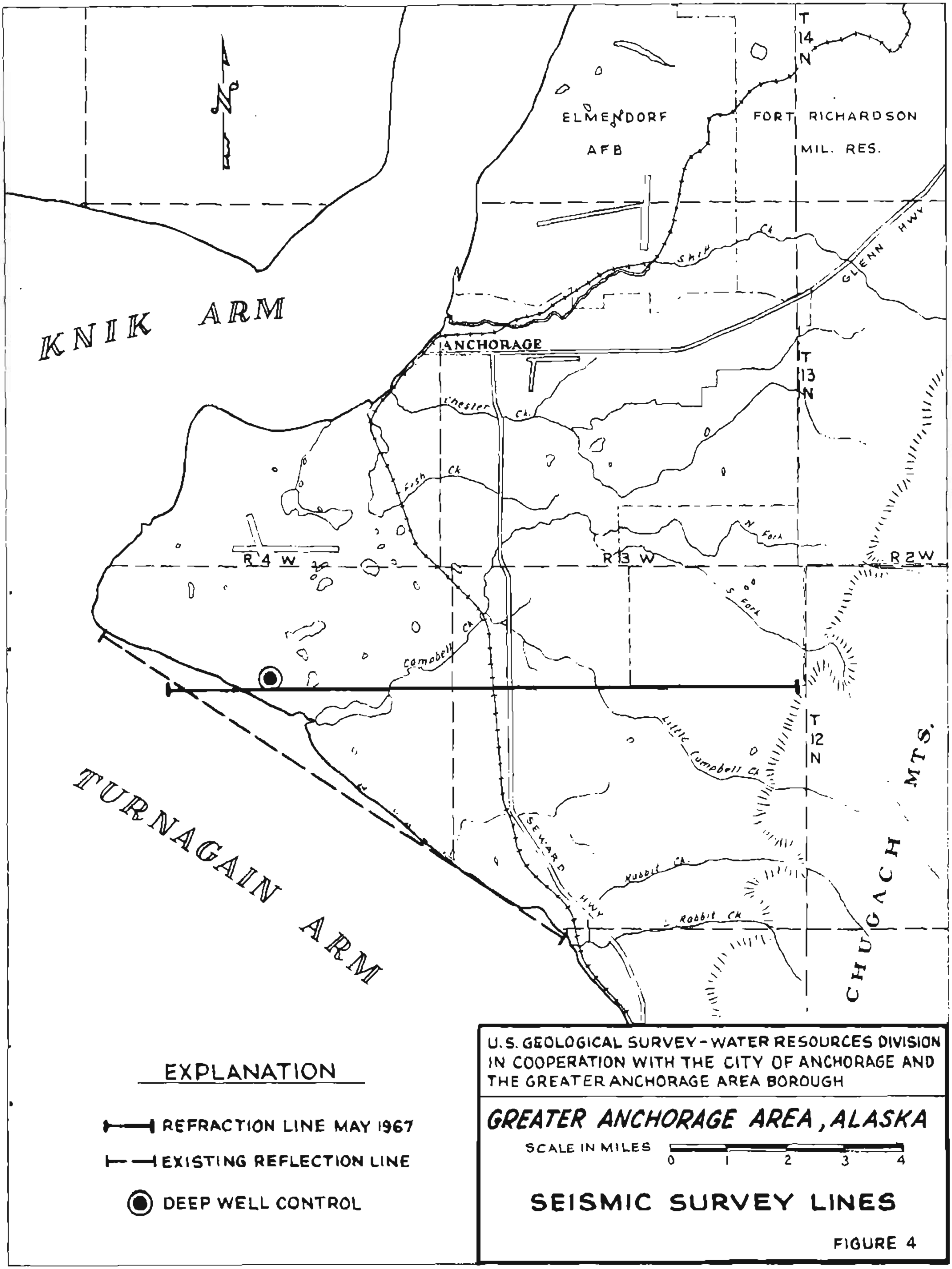
BLOCK DIAGRAM OF UPPER COOK INLET REGION



Geophysical Studies

In the Anchorage area, surveys were conducted during 1967 to determine the depth to bedrock and thickness and lithology of overlying water-bearing glacial sediments. This work was concentrated in the area of Ship Creek and Campbell Creek to establish control. Information from these control areas will then be correlated with other subsurface data from surrounding areas to establish a model of the geohydrologic system.

Seismic survey.--A 10-mile east-west seismic-refraction line, shown on the accompanying map (fig. 4), was surveyed in May 1967. This work was contracted to the Western Geophysical Company. Prior to shooting this line all available geophysical data for the area were compiled. They included a velocity survey of the Pan American Petroleum Company's Romig Park deep test well in T. 12 N., R. 4 W., Sec. 9 (fig. 4), a seismic-reflection line along the shore of Turnagain Arm, seismic-refraction work in the Turnagain Heights area, and gravity data from various sources. The Western Geophysical Company submitted a final interpretation in July 1967 and this data is now available in our Anchorage office. The Areal Geophysics Branch, U.S. Geological Survey, will make an interpretive review of the data during 1967-68.

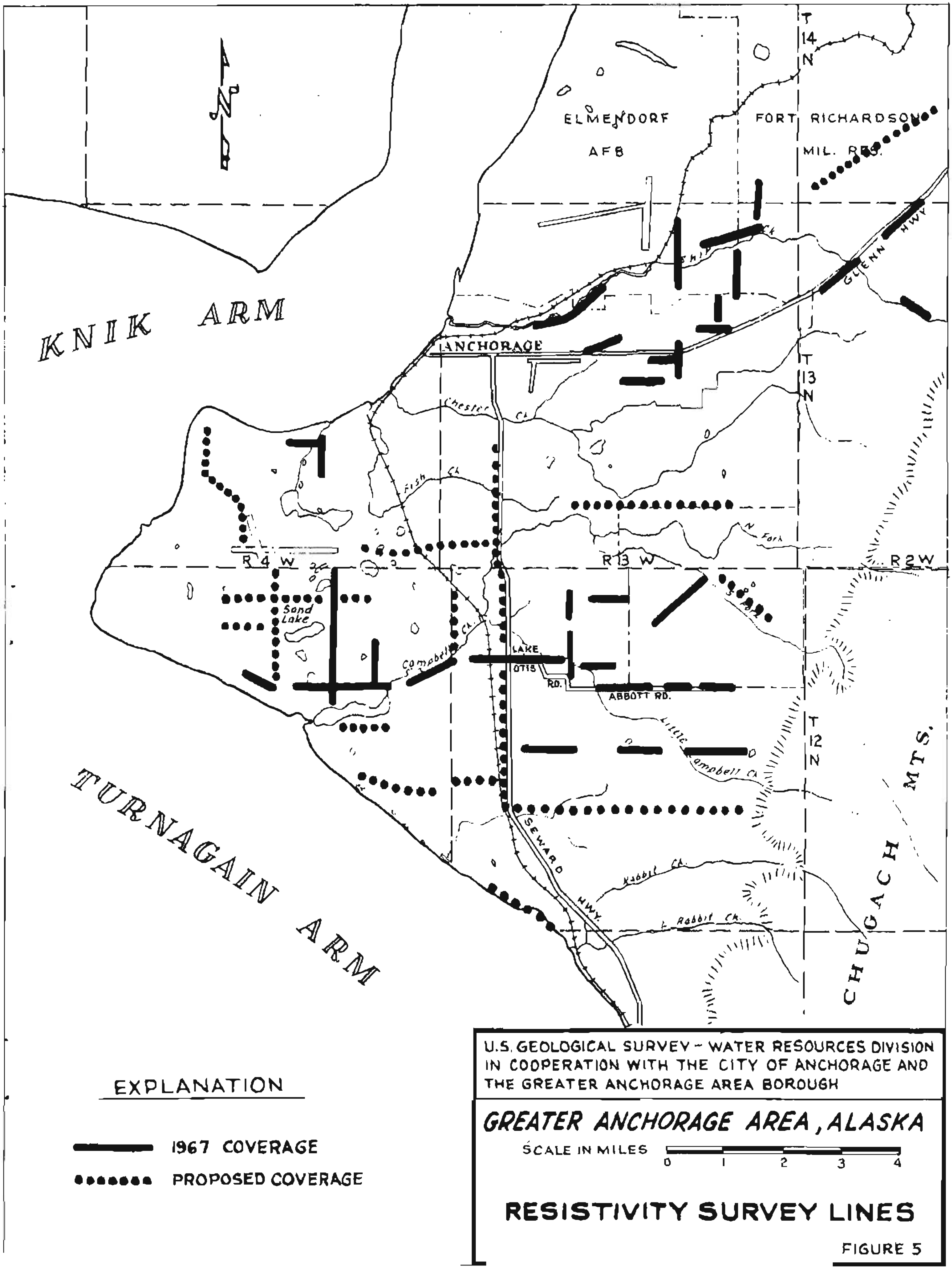


KNIK ARM
TURNAGAIN ARM
ELMENDORF AFB
FORT RICHARDSON MIL. RES.
ANCHORAGE
T 14 N
T 13 N
T 12 N
R 4 W
R 3 W
R 2 W
GLENN HWY
SEWARD HWY
Ship Ck
Chester Ck
Fish Ck
N Fork
S Fork
Campbell Ck
Little Campbell Ck
Rabbit Ck
Little Rabbit Ck
CHUGACH MTS.
EXPLANATION
REFRACTION LINE MAY 1967
EXISTING REFLECTION LINE
DEEP WELL CONTROL
U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH
GREATER ANCHORAGE AREA, ALASKA
SCALE IN MILES
0 1 2 3 4
SEISMIC SURVEY LINES

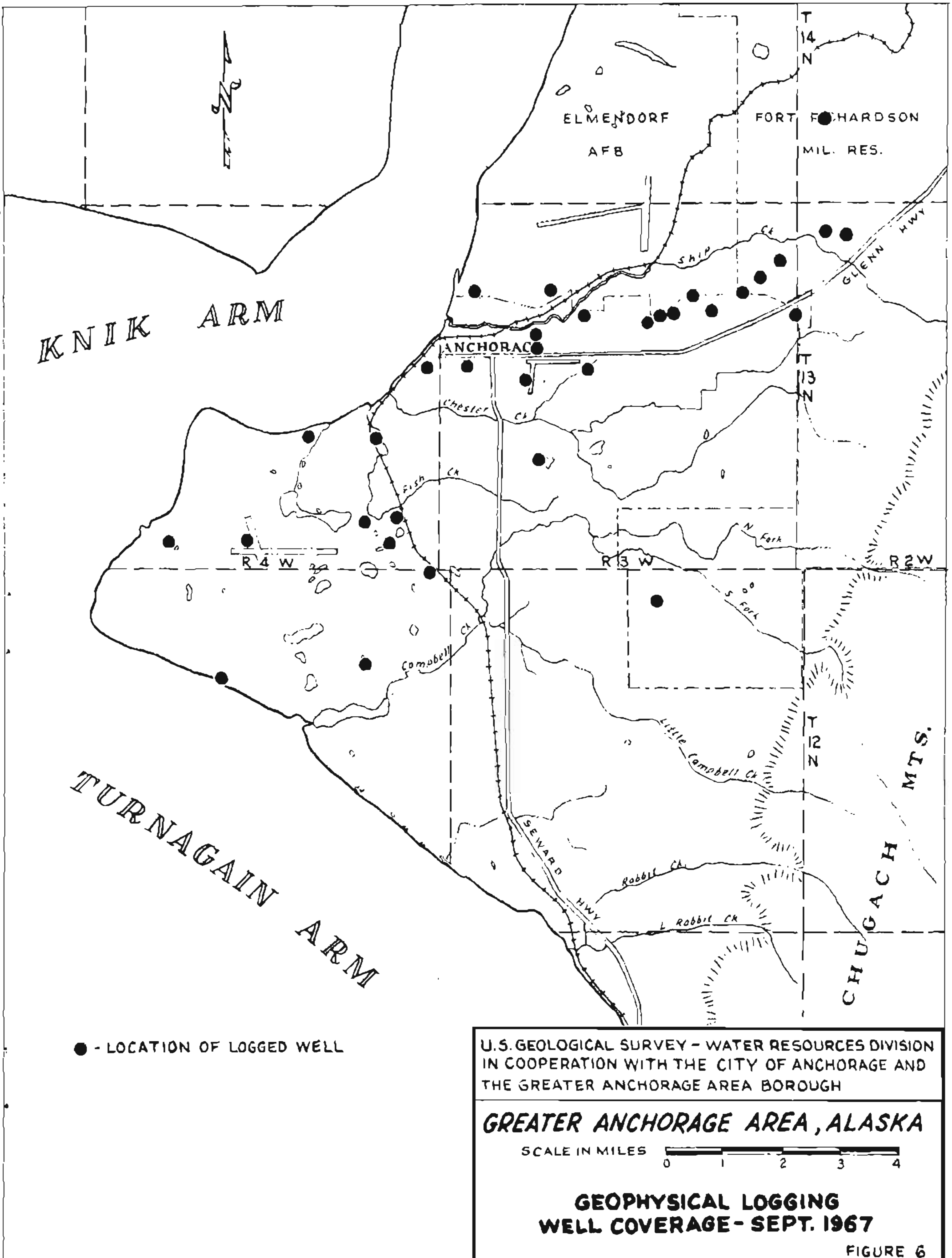
FIGURE 4

Resistivity survey.--Twenty-six miles of electrical resistivity lines were established during August and September 1967 by a Geological Survey crew from the Regional Geophysics Branch, Denver, Colo. The locations of these lines are shown on figure 5. An interpretation of this data is now being made in Denver. At this time resistivity data will be further integrated with existing well logs and other subsurface data. Additional soundings, as shown on the accompanying map, will be made if the interpretation of the 1967 work shows that they are needed.

Preliminary results indicate reliable depths to the top of the Kenai Formation, but less precise information on the lithologic differences between the glacial sediments. There is a significant resistivity contrast (1:4) between the Kenai Formation, composed of consolidated sandstone, siltstone, and coal, and the glacial sediments from which most of Anchorage's ground water is produced. A less distinct contrast within the glacial sediments is mappable between surficial sand and gravel and clay and impermeable sediments. Data from all soundings suggests that salt water is not present at depth in the sediments of the area. The thickness of glacial sediments in the Sand Lake area is estimated to be between 1200 and 1500 feet. In the vicinity of the intersection of Lake Otis Road and the Seward Highway these sediments are 500 to 600 feet thick. A fault or an abrupt thinning of glacial sediments is located near the intersection of Lake Otis and Abbot Roads. West of this locality sediments are 500 feet thick and to the east they are 300 feet thick.


KNIK ARM
TURNAGAIN ARM
ELMENDORF AFB
FORT RICHARDSON MIL. RES.
ANCHORAGE
GLENN HWY
SEWARD HWY.
Chester Ck.
Fish Ck.
N. Fork
Sand Lake
Campbell Ck.
Little Campbell Ck.
Rabbit Ck.
L. Rabbit Ck.
LAKE OTIS RD.
ABBOTT RD.
CHUGACH MTS.
T 14 N
T 13 N
T 12 N
R 4 W
R 3 W
R 2 W
EXPLANATION
1967 COVERAGE
PROPOSED COVERAGE
U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH
GREATER ANCHORAGE AREA, ALASKA
SCALE IN MILES
0 1 2 3 4
RESISTIVITY SURVEY LINES
FIGURE 5

Borehole geophysics.--Geophysical logging was conducted during 1967 with three objectives in mind. Logs were made to assist in well engineering problems, to aid lithologic correlation, and to develop new techniques. Part of the cost of this work was borne by the U.S. Geological Survey Research Unit on Geophysical Logging. Thirty-three wells, shown in figure 6, were logged using equipment from this unit. Caliper, natural gamma, gamma-gamma, neutron-epithermal-neutron, collar-locater, temperature, and flowmeter logs were made with this equipment. During 1967, logs were made on 7 production wells in the Anchorage area, Chugiak High School, Dimond High School, 2 wells at the new Federal Aviation Agency Control Center, City of Anchorage Well 8, City Test Well 9, and the City Honor Farm Well. Assistance was also provided in remote television surveys of the Dimond High School Well and City Well 8.



U.S. GEOLOGICAL SURVEY – WATER RESOURCES DIVISION
IN COOPERATION WITH THE CITY OF ANCHORAGE AND
THE GREATER ANCHORAGE AREA BOROUGH

GREATER ANCHORAGE AREA, ALASKA

GEOPHYSICAL LOGGING
WELL COVERAGE – SEPT. 1967

FIGURE 6

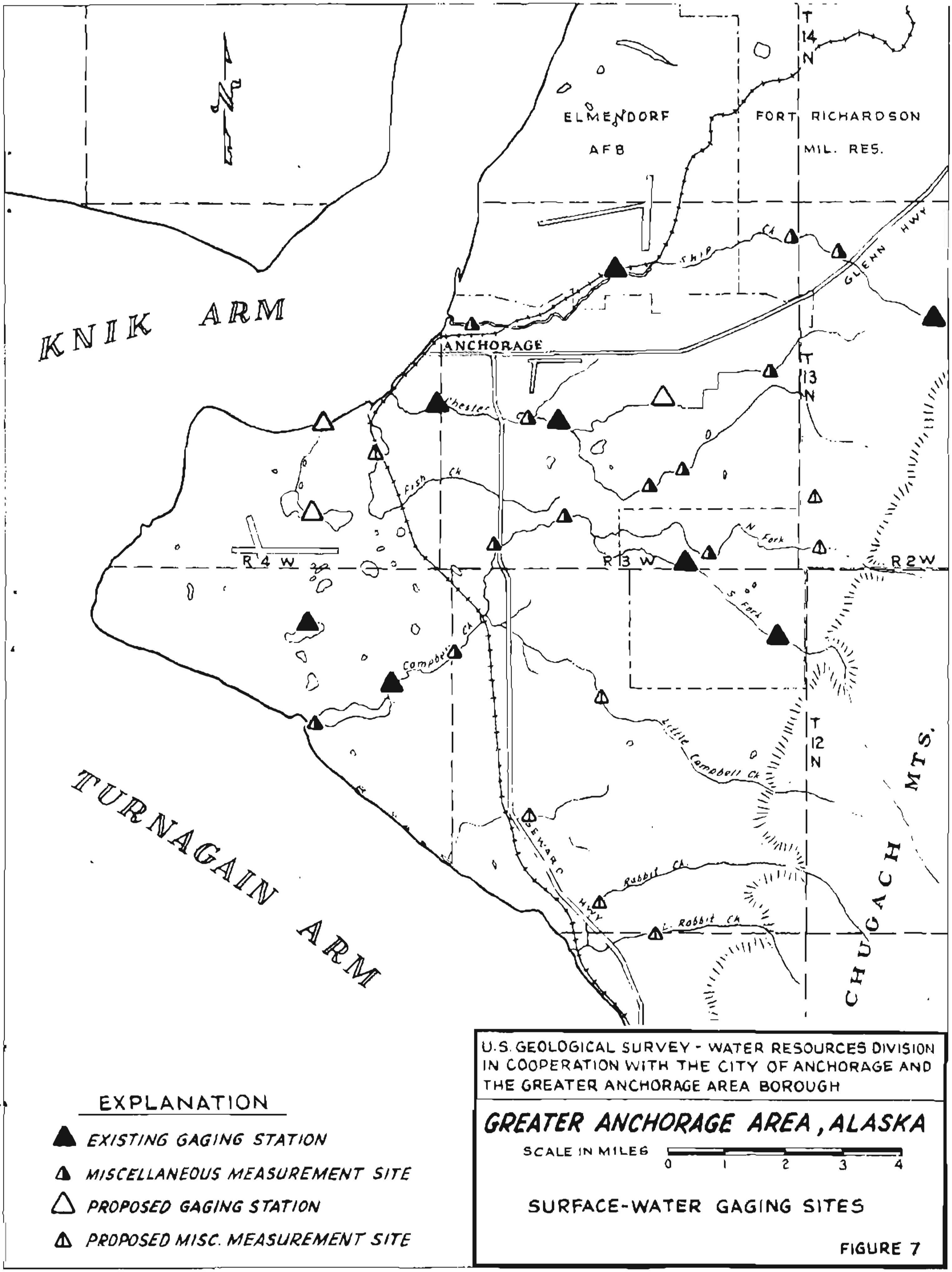
Hydrologic Studies

The objective of hydrologic studies is to define the characteristics of the hydrologic system in the area. The principal data being collected are:

1. Stream discharge and its seasonal variations
2. Flow losses or gains in various reaches of channels
3. Data on the capacity and distribution of aquifers to produce water in the area
4. The size and volume of sediment carried by streams
5. The chemical quality of both surface and ground water
6. The total water budget, gains and losses to the system of the area

Streamflow.--The stream-gaging program has been concentrated in the more populated areas. Stream-discharge records were obtained this year on Eagle River, Ship Creek, Chester Creek, South Fork Campbell Creek, Campbell Creek, and Glacier Creek. Periodic measurements were made at several sites other than the regular gaging stations shown on plate 1. These periodic or miscellaneous measurements were made to determine flow losses or gains in channels, to determine peak and low flows, and to assist the Greater Anchorage Borough Health Department in their pollution studies of Campbell and Chester Creeks.

During the past 20 years, miscellaneous streamflow data have been obtained at many places throughout the Borough. The locations of these sites are shown on the map on plate 1. A compilation and analysis of the data will be completed during 1967-68 and integrated with newly acquired data. In 1968 the network of gaging stations and miscellaneous measuring sites will be expanded to include Rabbit Creek, Little Rabbit Creek, and Peters Creek.



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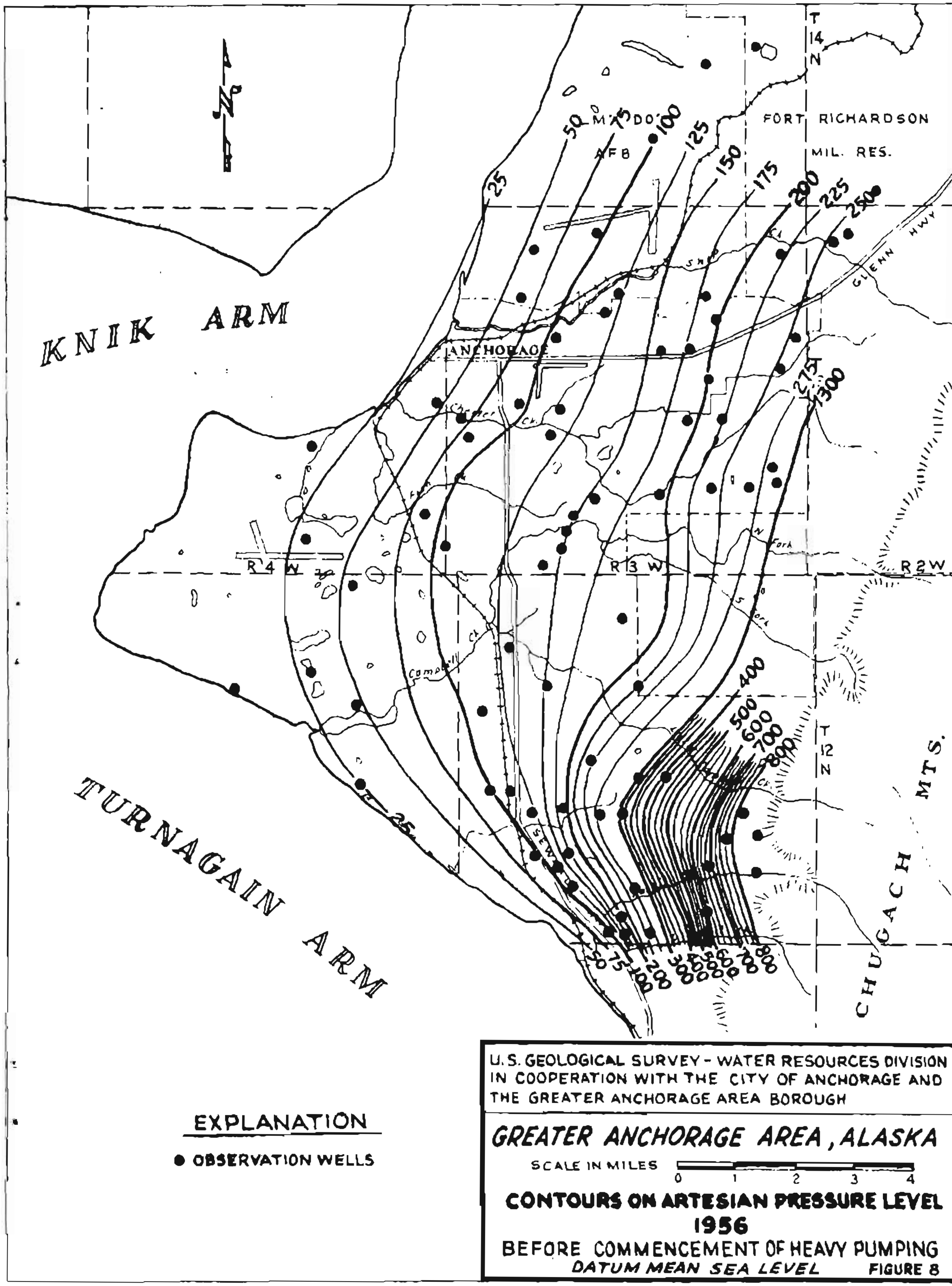
GREATER ANCHORAGE AREA, ALASKA

SURFACE-WATER GAGING SITES

FIGURE 7

The U.S. Army Corps of Engineers is making a flood-frequency study of Chester Creek and Campbell Creek, the results of which will also be included in our reports. This study is financed entirely by Federal funds.

Ground water.--During the year, maps of artesian pressure levels have been made for selected periods of record. The maps show water levels at various times since the beginning of appreciable ground-water pumping in the area in 1956. Maps showing pressure levels in 1956 (fig. 8) and in 1967 (fig. 9) accompany this report. Figure 10 shows the approximate decrease in artesian pressure levels between 1956 and 1966. The net lowering is presumed to be the result of increased pumpage during this period. Analysis of these and other maps along with pumpage rates and past withdrawal totals provides knowledge of the effects of withdrawal of water from various aquifers in the area and allows the prediction of future pressure levels and the selection of optimum pumping rates. An observation-well network in the area is being maintained. Artesian pressure levels are recorded by continuous recorders in five wells. Thirty-five other wells are measured monthly. This network is currently being expanded to obtain added control in the Rabbit Creek and military reservation areas.



U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH

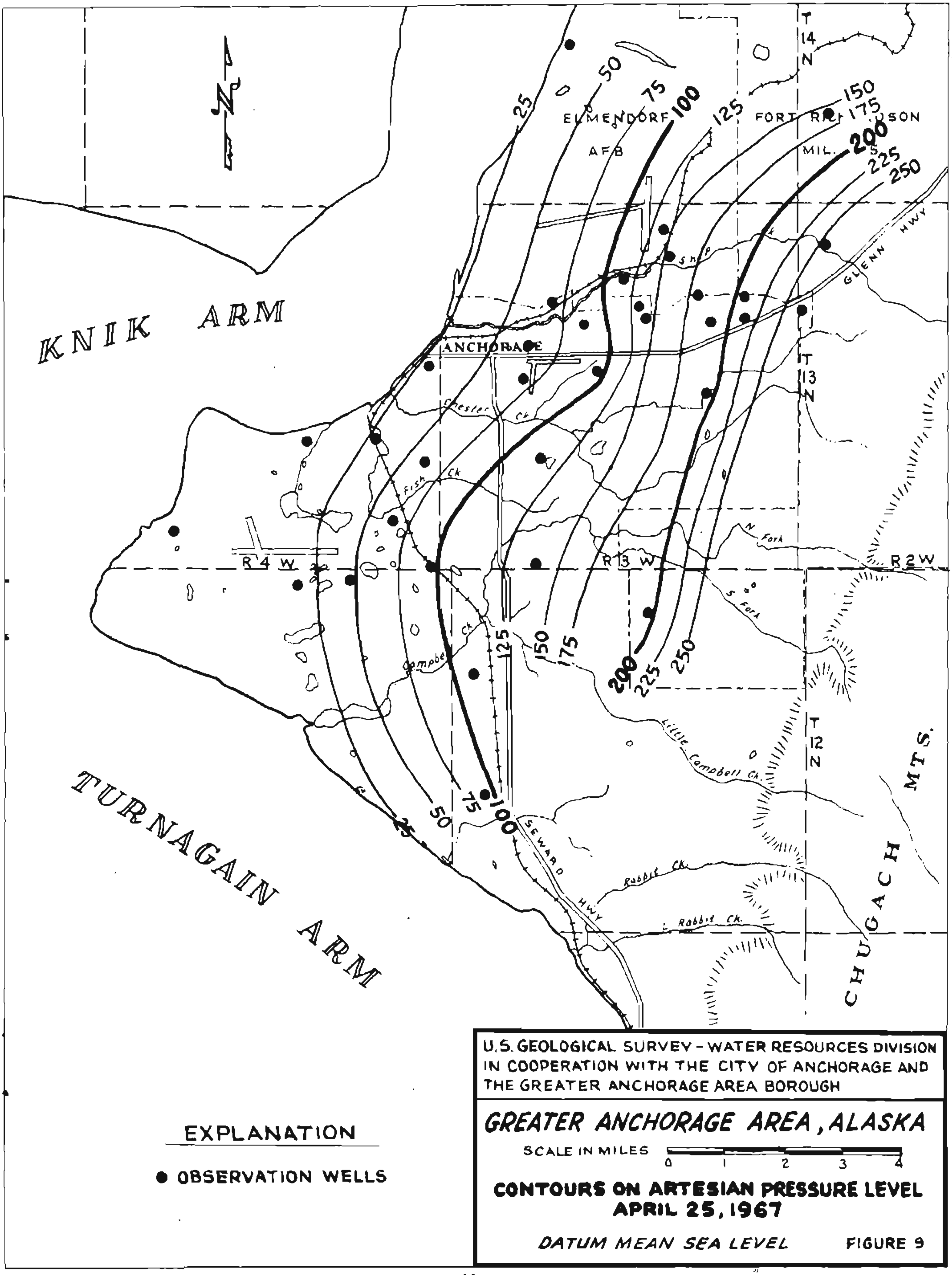
GREATER ANCHORAGE AREA, ALASKA

SCALE IN MILES 0 1 2 3 4

CONTOURS ON ARTESIAN PRESSURE LEVEL 1956

BEFORE COMMENCEMENT OF HEAVY PUMPING

DATUM MEAN SEA LEVEL FIGURE 8


KNIK ARM
TURNAGAIN ARM
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T 14 N
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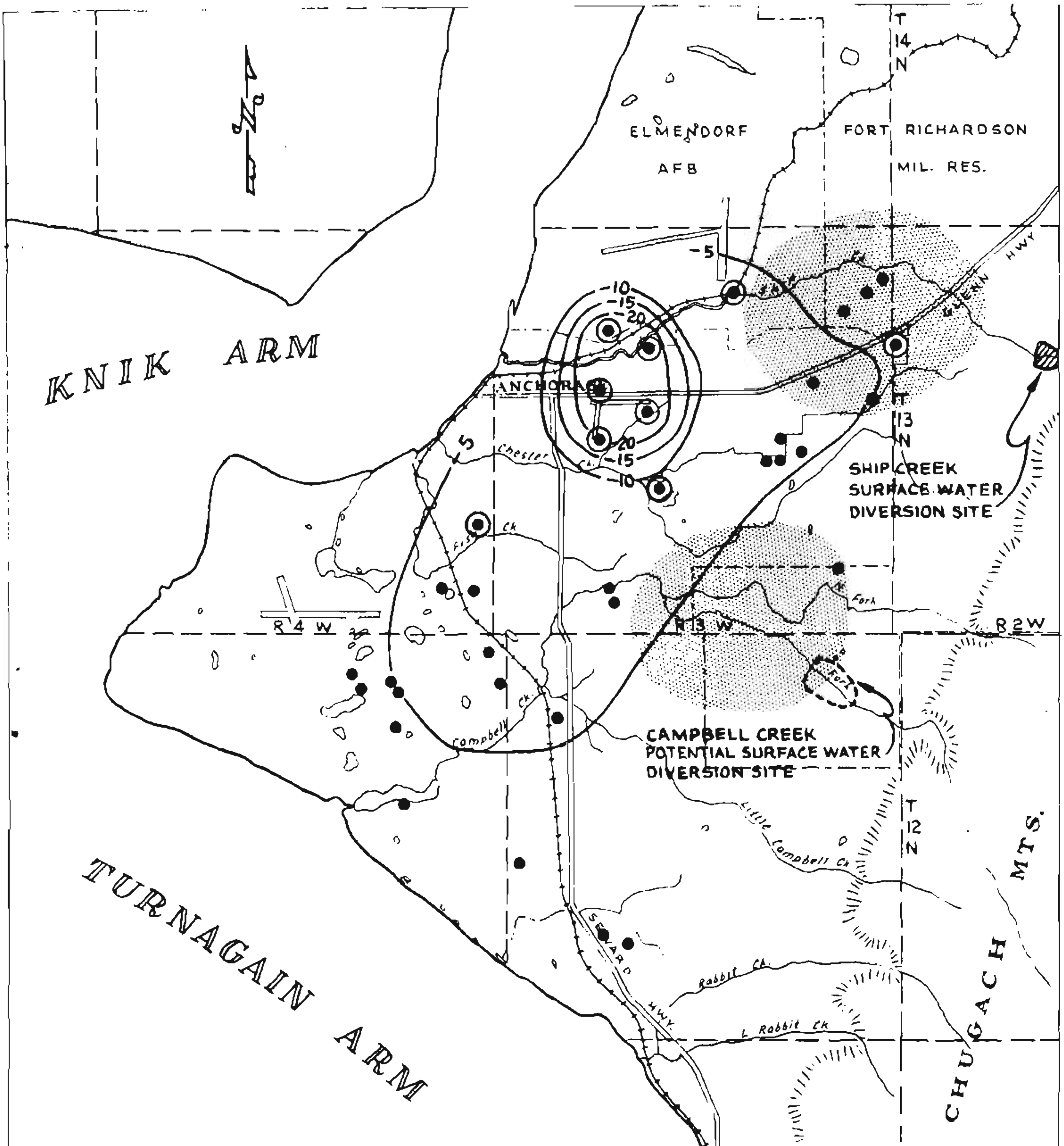
R 3 W
R 2 W
GLENN HWY
SEWARD HWY
Chester Ck
Fish Ck
Campbell Ck
N Fork
S Fork
Little Campbell Ck.
Rabbit Ck.
L. Rabbit Ck.
25
50
75
100
125
150
175
200
225
250
EXPLANATION
● OBSERVATION WELLS
U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH
GREATER ANCHORAGE AREA, ALASKA
SCALE IN MILES
0 1 2 3 4
CONTOURS ON ARTESIAN PRESSURE LEVEL APRIL 25, 1967
DATUM MEAN SEA LEVEL
FIGURE 9



U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH

GREATER ANCHORAGE AREA, ALASKA

SCALE IN MILES 0 1 2 3 4

PRODUCTION WELLS
AND ESTIMATED DECREASE IN WATER LEVELS FROM 1956 TO 1966

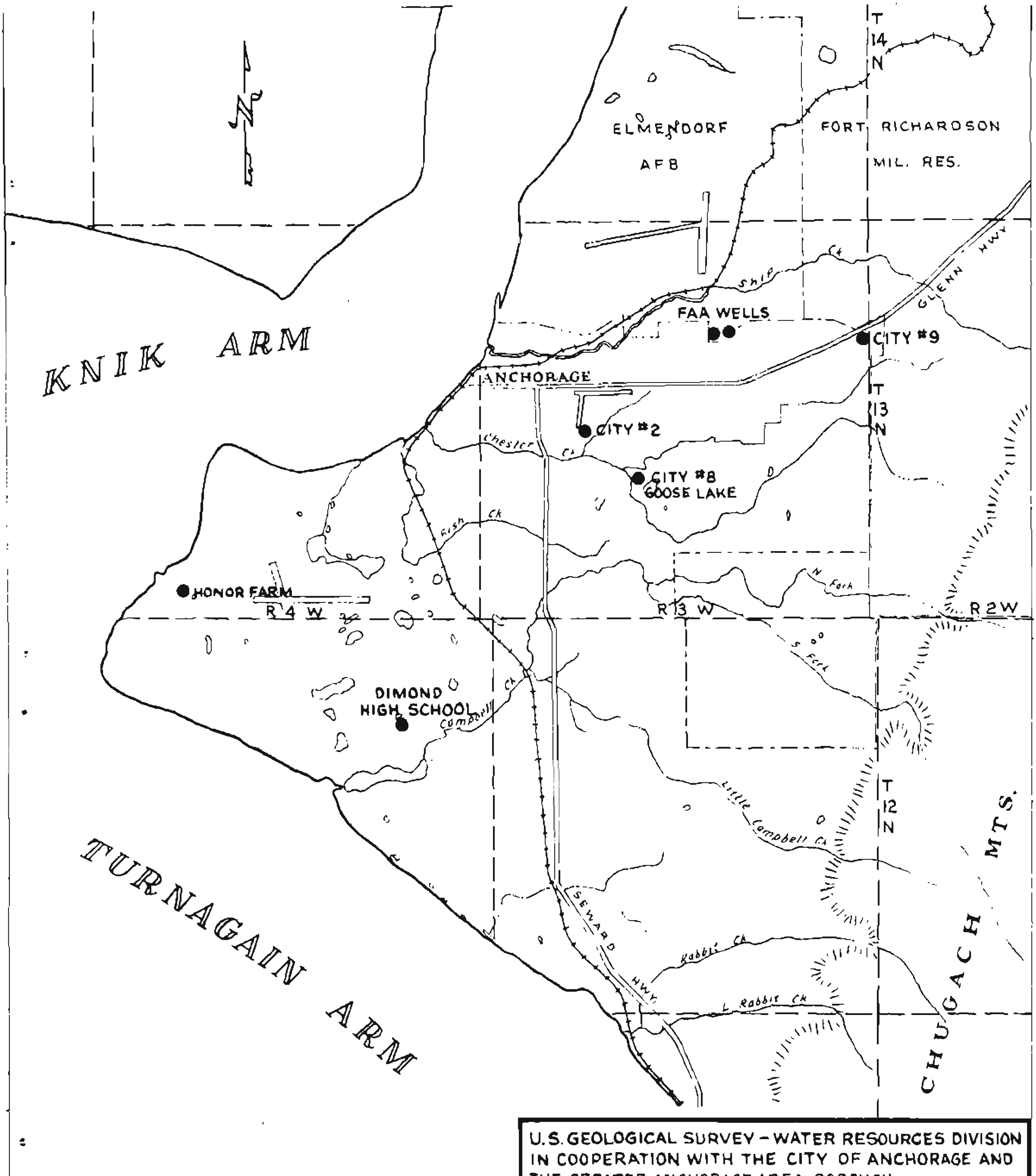
FIGURE 10

EXPLANATION

- ● PRODUCTION WELLS LESS THAN 1 MILLION GPD
- ◉ PRODUCTION WELLS MORE THAN 1 MILLION GPD
- -5—— WATER LEVEL DECREASE, IN FEET
- (stippled) POTENTIAL AREAS FOR FUTURE MAJOR PRODUCTION WELLS OR GALLERIES

During 1966 and 1967, the Geological Survey has worked closely with City, Borough, and Federal officials and with local consulting engineers on specific problems relating to ground water such as the construction of a new production well for the City near the city water treatment plant, the design of two wells for the Federal Aviation Agency Air Traffic Control Center in Anchorage, and the location of wells at Dimond High School, Chugiak High School, the City Honor Farm, and elsewhere. Figure 11 shows the location of some of these wells.

The effects of possible artificial drainage of low-lying areas in relation to lake and ground-water levels and the interconnection between the shallow water table and deeper aquifers are being investigated (fig. 12). A water-level gage has been installed on Sand Lake and is read daily during the open-water season.



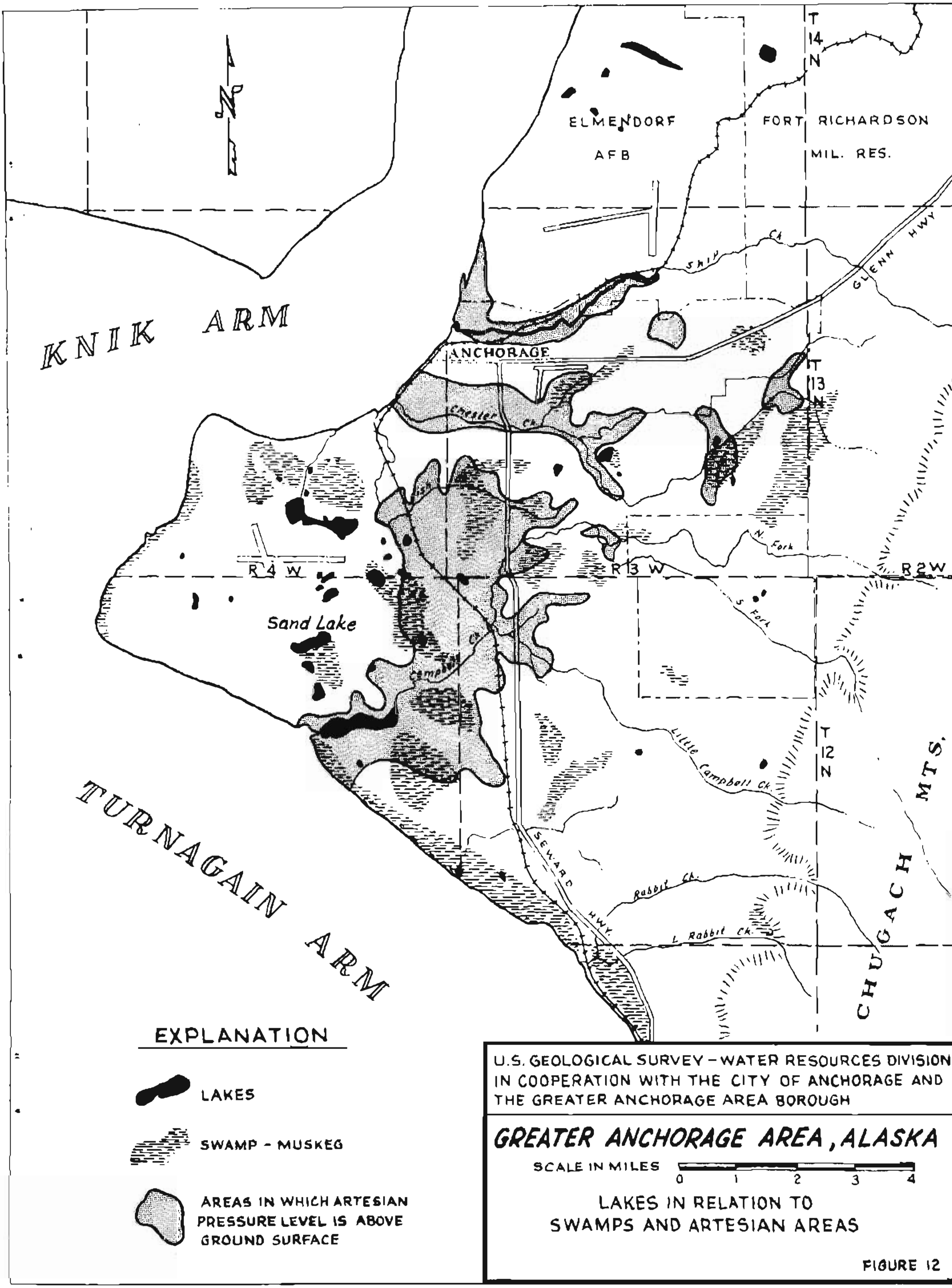
U.S. GEOLOGICAL SURVEY – WATER RESOURCES DIVISION
IN COOPERATION WITH THE CITY OF ANCHORAGE AND
THE GREATER ANCHORAGE AREA BOROUGH

GREATER ANCHORAGE AREA, ALASKA

SCALE IN MILES 0 1 2 3 4

PRODUCTION WELLS UNDER CONSTRUCTION OR REPAIR

FIGURE 11



LAKES IN RELATION TO SWAMPS AND ARTESIAN AREAS

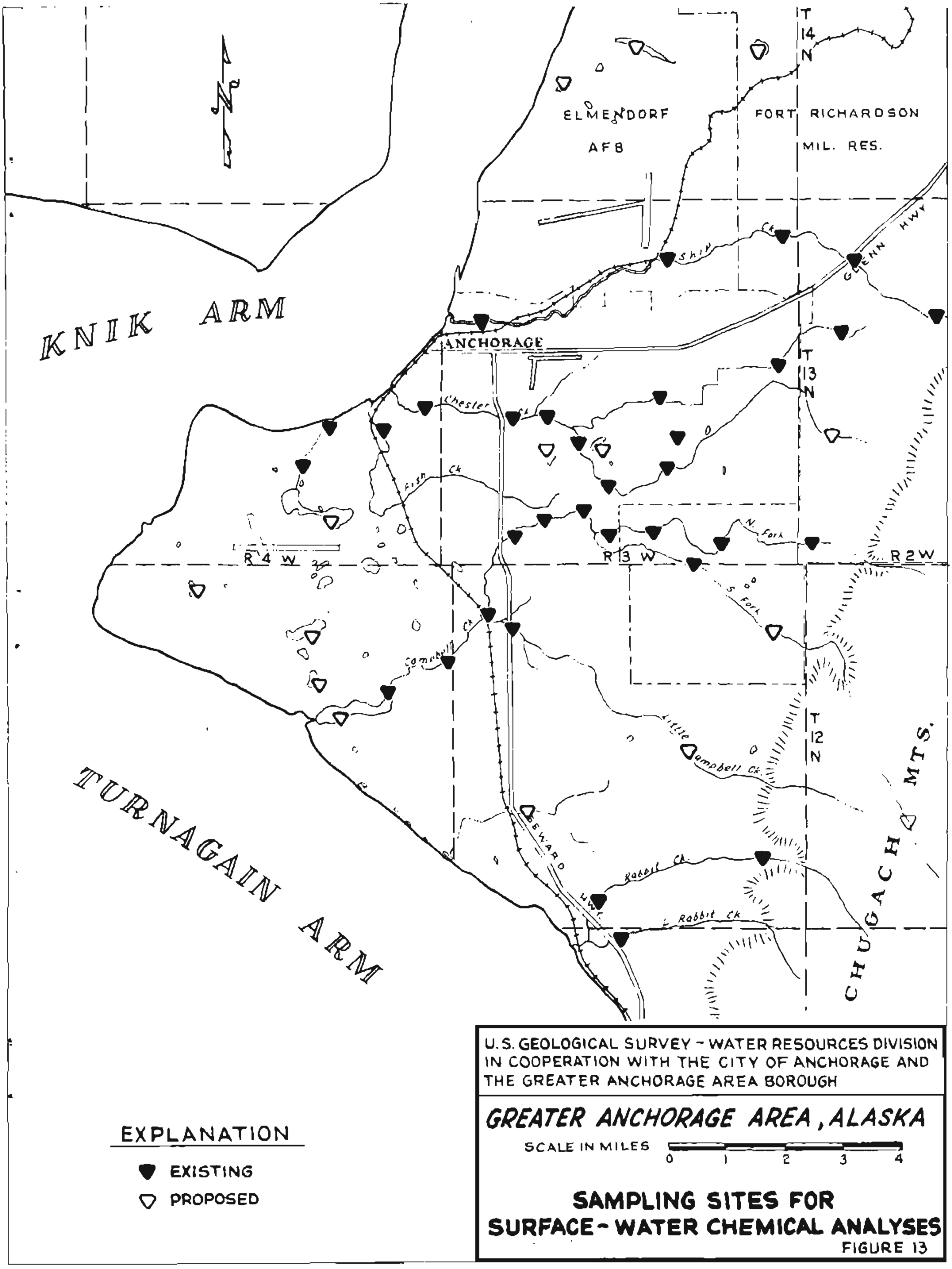
FIGURE 12

Quality of water.--During 1967, information was obtained at selected sites throughout the Borough on the suitability of water for domestic, municipal, and industrial use. Data were compiled on the nature and amounts of dissolved solids in Ship, Campbell, and Chester Creeks and Eagle River, and on the quantity and particle size distribution of suspended sediment transported by Chester Creek. Chemical quality and sediment transport data for many other streams shown in figure 13 have been or are being obtained intermittently. Data also were obtained periodically on chemical quality of water from the city production wells and other wells in the Borough area shown on figure 14.

In addition, during 1967, all existing chemical analyses of ground water have been coded on maps and well schedules, and are being punched on cards. A pilot computer program was completed for analysis of selected chemical-quality samples from 46 Anchorage wells to determine the presence or absence of significant trends in the chemical constituents of ground water in the area.

Close cooperation has been maintained with the State of Alaska, Department of Health and Welfare, the Greater Anchorage Borough Health Department, and the Federal Water Pollution Control Administration to help them determine the effects and extent of present pollution in both surface and ground water and to find means to prevent future pollution of Anchorage water resources. This cooperation consisted of furnishing results of chemical analyses of water, seepage loss measurements along streams, identification of ground-water recharge areas, and determination of hydraulic interconnection between deep and shallow wells.

Samples of stream water for analysis of trace elements, such as iron, lead, and copper, were collected for the Federal Water Pollution Control Administration. These analyses are part of a study aimed at defining the distribution of these elements in both surface and ground water. The distribution may indicate the source and direction of movement of ground water in the area.

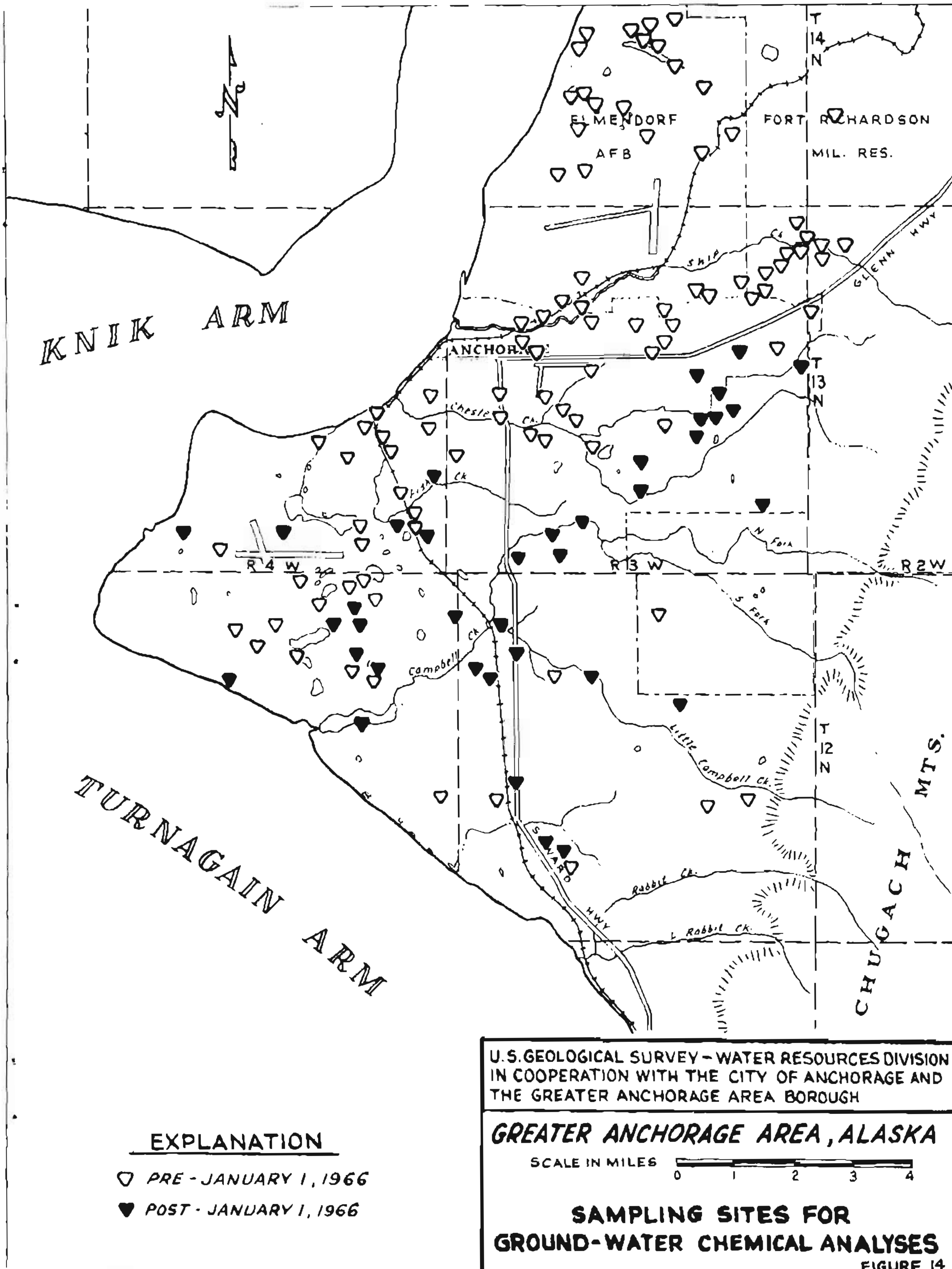


U.S. GEOLOGICAL SURVEY – WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH

GREATER ANCHORAGE AREA, ALASKA

SAMPLING SITES FOR SURFACE-WATER CHEMICAL ANALYSES

FIGURE 13



U.S. GEOLOGICAL SURVEY – WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH

GREATER ANCHORAGE AREA, ALASKA

SAMPLING SITES FOR GROUND-WATER CHEMICAL ANALYSES

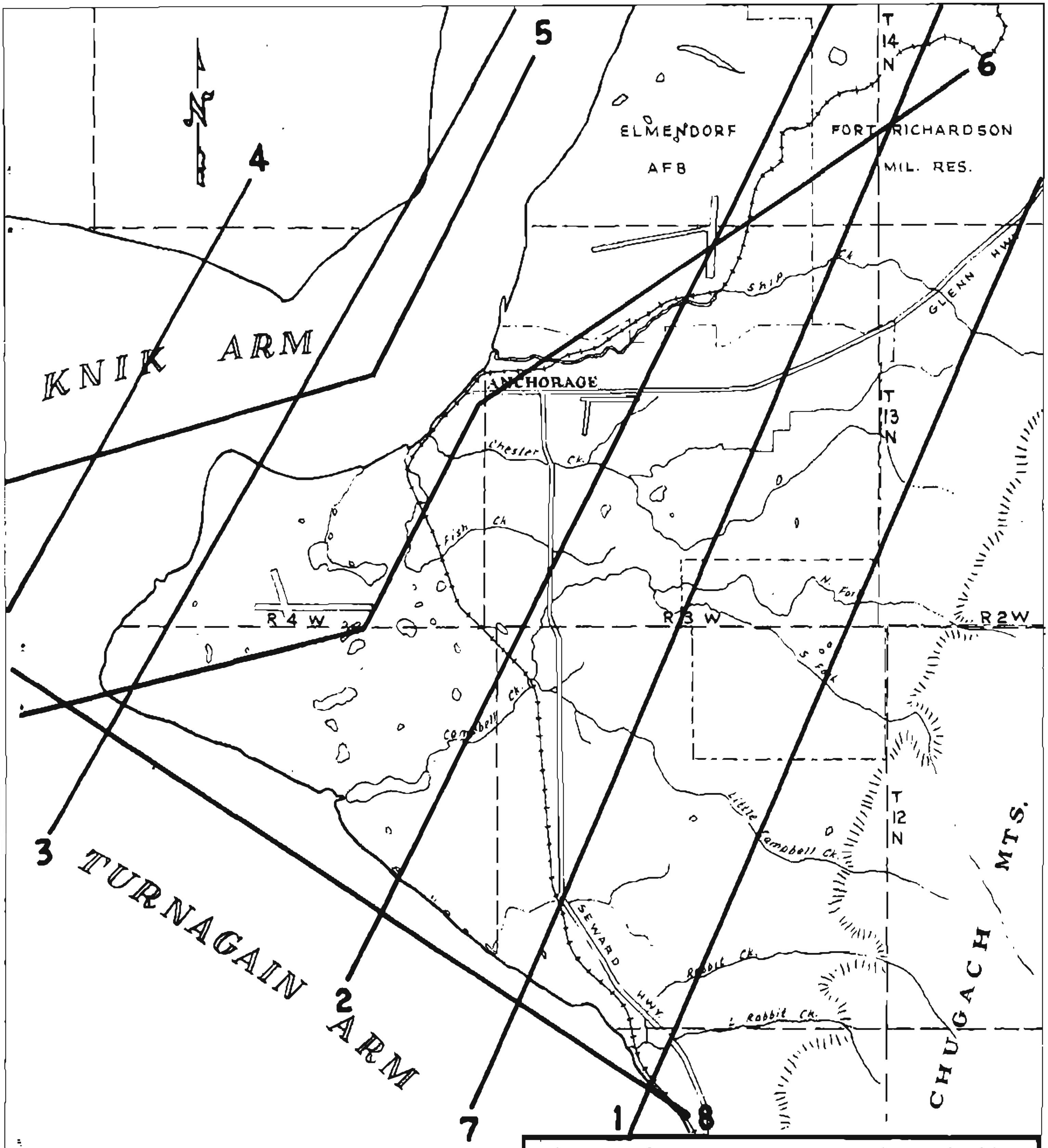
FIGURE 14

Water budget.--To formulate a model of the hydrologic system it is necessary to determine the water budget of the area. This means that the total inflow and outflow of water in the study area must be determined. The amount of evapotranspiration is an important element in outflow. The amount of precipitation in the area will be determined from U.S. Weather Bureau records. Then it will be determined how much of this water evaporates, how much is transpired by plants, how much and where water enters the ground-water system, how much runs off as surface water, and finally how much ground water enters the Cook Inlet. All of these elements must be estimated. Plate 1 shows the Weather Bureau's current network of precipitation stations in the area. Several new stations have been installed in the Anchorage area since July 1966 at no cost to the project. Depth of snowpack in the Borough area is being measured by the Soil Conservation Service at no cost to the project. Snow-thickness and water content data and runoff relations are being analyzed by the Geological Survey to determine the amount of water available to the Borough area from this source.

Special Studies

Remote sensing.--In early May 1967 the National Aeronautics and Space Administration made color and color infrared areal photographs and recorded infrared imagery along flight lines in the Anchorage area. The location of these lines is shown on figure 15. This work was done to see if areas of outflow of ground water into Cook Inlet could be determined by remote sensing techniques. These data are now being processed and interpretation will be made during 1967-68.

Effects of salt-water encroachment.--As ground-water development proceeds in the Anchorage area, there is a possibility of future salt-water intrusion into artesian aquifers. Figure 1 shows these relations schematically. Steps have already been taken to monitor the chemical quality of water in Fire Island wells and in several coastal wells for signs of encroachment. During August and September 1967, electrical-resistivity soundings were also made near Turnagain Heights and Campbell Lake to determine if salt water is present in deep coastal aquifers. Preliminary results of this work suggest that salt water is not present in these aquifers. All these studies will ultimately produce conclusions concerning salt-water intrusion in the area and will suggest methods to retard, or avoid, intrusion at Anchorage.



U.S. GEOLOGICAL SURVEY – WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH

GREATER ANCHORAGE AREA, ALASKA

SCALE IN MILES 0 1 2 3 4

REMOTE-SENSING FLIGHT LINES MAY, 1967

FIGURE 15

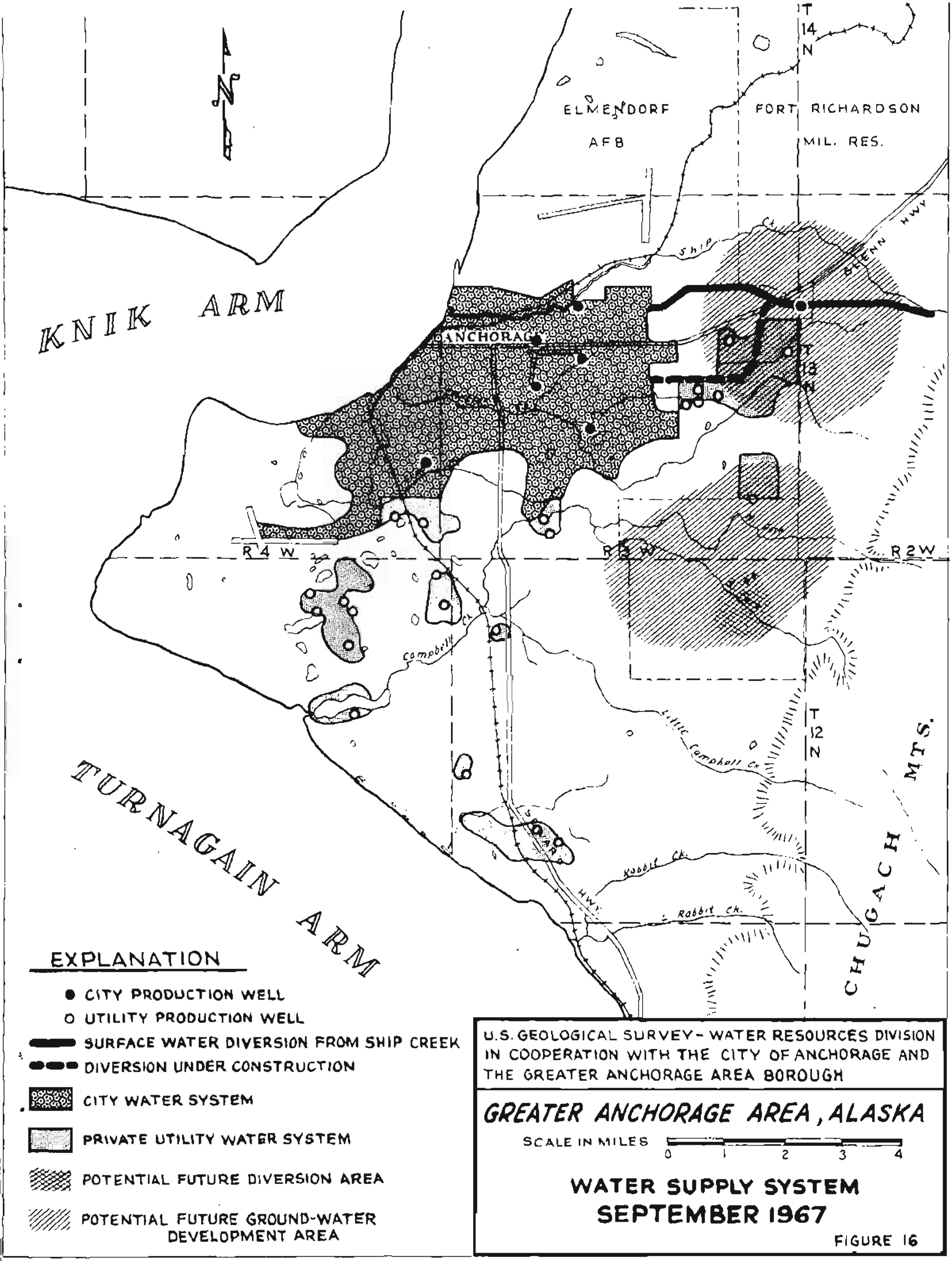
Basic Records

The large quantity of data becoming available from studies of the Anchorage area makes it advantageous to convert to automatic data processing. Use of computers will provide an economical and rapid means of analyzing and presenting the detailed data. Data from more than 900 water wells in the Anchorage area were coded for computer analysis during 1967. By June 1968 most of the quality-of-water and ground-water data will be on punchcards. This will facilitate rapid processing of data for release as well as for complex interpretive analysis. Eventually all applicable data will be placed on punchcards for computer analysis and printout.

PLANS FOR FUTURE WORK

The primary objective of the study is to determine where and in what quantities water is available for use. Future work plans are designed to accomplish this objective.

Water used in the Anchorage area presently is obtained from diversion from Ship Creek and from wells (fig. 16). Use in the metropolitan area averages 24 mgd, 14 mgd of which is diverted from Ship Creek (fig. 17). Ground-water sources supply 10 mgd. The City currently pumps from 6 wells. Private utility companies, chiefly Central Alaska Utilities, pump from approximately 23 wells in the area (fig. 16). Outside the areas served by central supply systems there are approximately 2,000 to 3,000 private and commercial wells in operation.



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ELMENDORF AFB
FORT RICHARDSON MIL. RES.
GLENN HWY
Ship Cr.
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T 13 N
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R 3 W
R 2 W
Campbell Cr.
T 12 N
Little Campbell Cr.
TURNAGAIN ARM
Rabbit Ck.
L. Rabbit Ck.
HWY.
CHUGACH MTS.
EXPLANATION
CITY PRODUCTION WELL
UTILITY PRODUCTION WELL
SURFACE WATER DIVERSION FROM SHIP CREEK
DIVERSION UNDER CONSTRUCTION
CITY WATER SYSTEM
PRIVATE UTILITY WATER SYSTEM
POTENTIAL FUTURE DIVERSION AREA
POTENTIAL FUTURE GROUND-WATER DEVELOPMENT AREA
U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION IN COOPERATION WITH THE CITY OF ANCHORAGE AND THE GREATER ANCHORAGE AREA BOROUGH
GREATER ANCHORAGE AREA, ALASKA
SCALE IN MILES
0 1 2 3 4
WATER SUPPLY SYSTEM SEPTEMBER 1967
FIGURE 16

ESTIMATED

AVERAGE DAILY WATER CONSUMPTION IN ANCHORAGE AREA 1954 - 1967

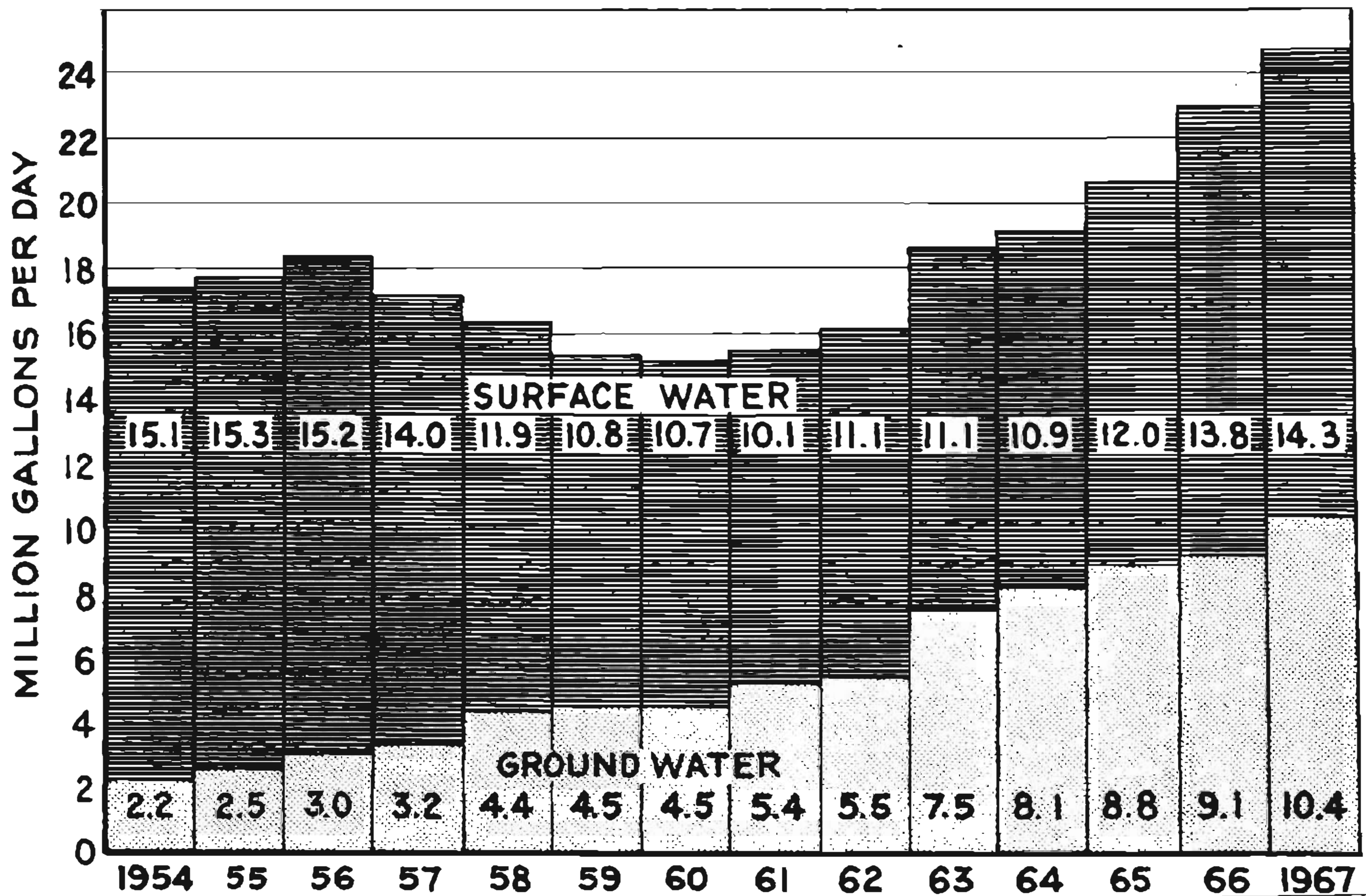


FIGURE 17

By 1980 the population may approach 260,000 according to studies by various consultants (fig. 18). Water requirements for this population are estimated at 60 mgd (million gallons per day). This means that an additional 36 mgd must be sought in new wells or infiltration galleries by diversion of streams or from additional storage on Ship Creek or other streams. Predicted use of 200 mgd in 2000 further emphasizes the need for orderly development of new water sources.

Development of New Sources

Surface water.--The 20-year average monthly flow of Ship Creek, at the diversion dam gage, is shown in figure 19. This curve is for the water year 1953-54 which is the lowest annual flow for the period of record. The diagram for this one year suggests that a storage reservoir with a capacity of 2,450 acre-feet would provide a reliable supply of 30 mgd. Present diversions amount to about 14 mgd.

The 19-year average monthly flow of South Fork Campbell Creek, at the gage near Campbell airstrip, is shown in figure 20. A mass curve for this station is also shown. This diagram is also for the 1953-54 water year. The low-flow yield is about 5 mgd. With a storage of 1,300 acre-feet about 10 mgd would be available.

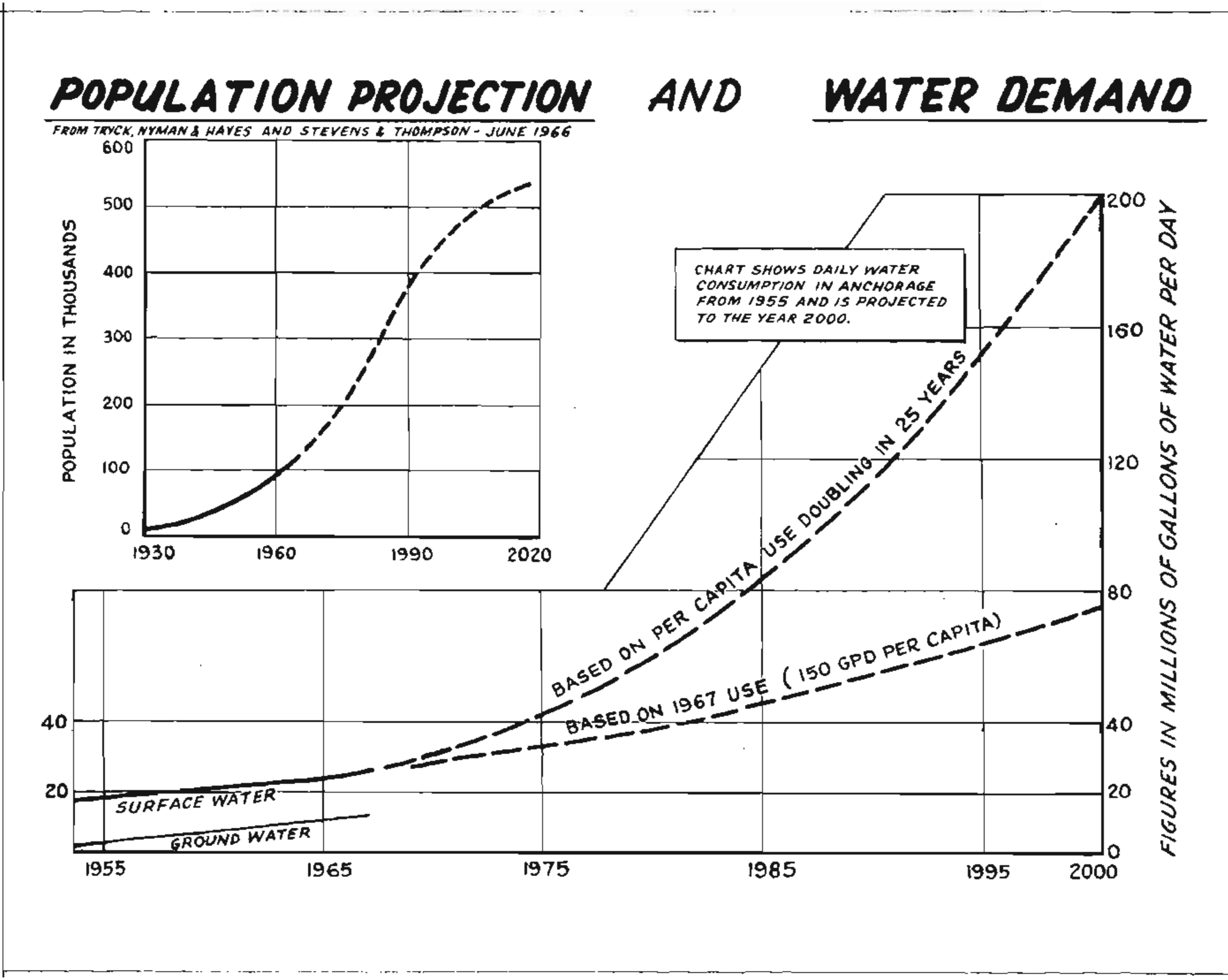
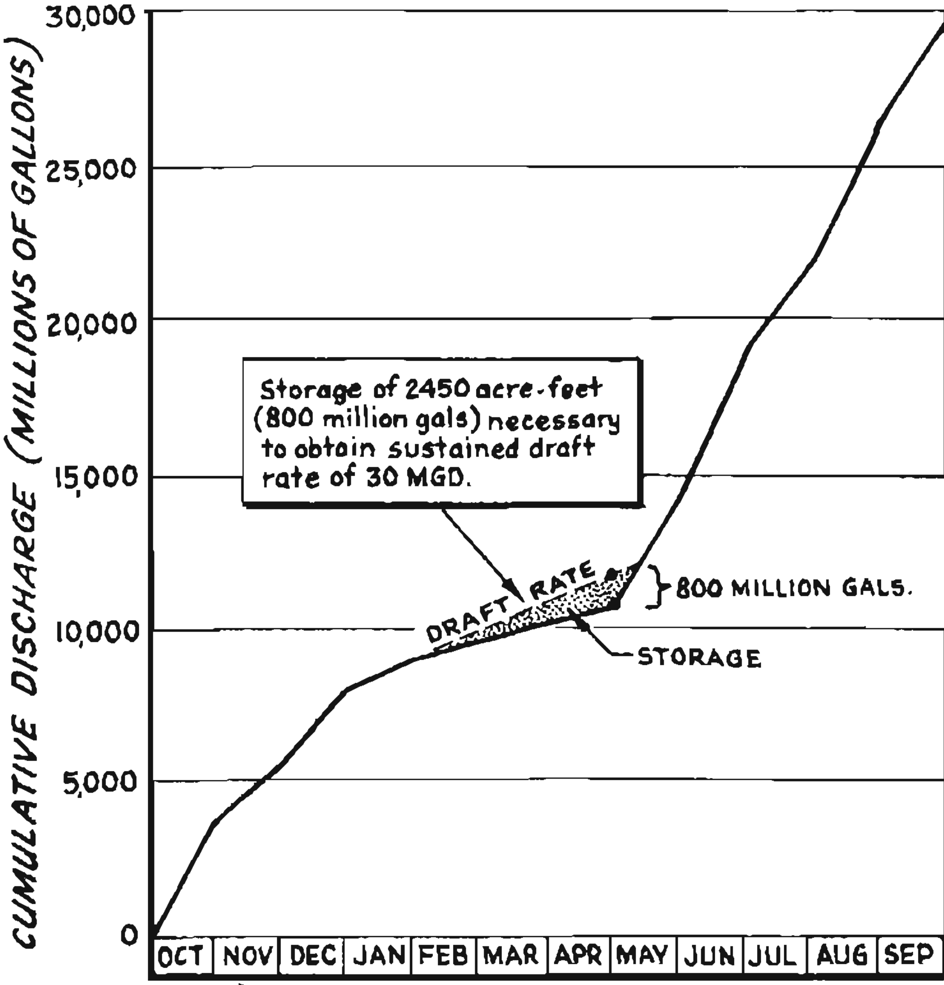

POPULATION PROJECTION AND WATER DEMAND
FROM TRYCK, NYMAN & HAYES AND STEVENS & THOMPSON - JUNE 1966
POPULATION IN THOUSANDS
0
100
200
300
400
500
600
1930
1960
1990
2020
CHART SHOWS DAILY WATER CONSUMPTION IN ANCHORAGE FROM 1955 AND IS PROJECTED TO THE YEAR 2000.
BASED ON PER CAPITA USE DOUBLING IN 25 YEARS
BASED ON 1967 USE (150 GPD PER CAPITA)
SURFACE WATER
GROUND WATER
FIGURES IN MILLIONS OF GALLONS OF WATER PER DAY
0
20
40
80
120
160
200
1955
1965
1975
1985
1995
2000

FIGURE 18

SHIP CREEK - *Cumulative Discharge and Average Monthly Flow*



The mass curve at left shows the accumulated flow in Ship Creek for water year 1953-54, the lowest annual average flow for 20 years of record. With 2450 acre-feet of storage, the stream would yield 30 million gallons per day.

Chart below shows average monthly and average annual flow in Ship Creek (1947-66). Shaded area with figures is average monthly diversion for 1965-66.

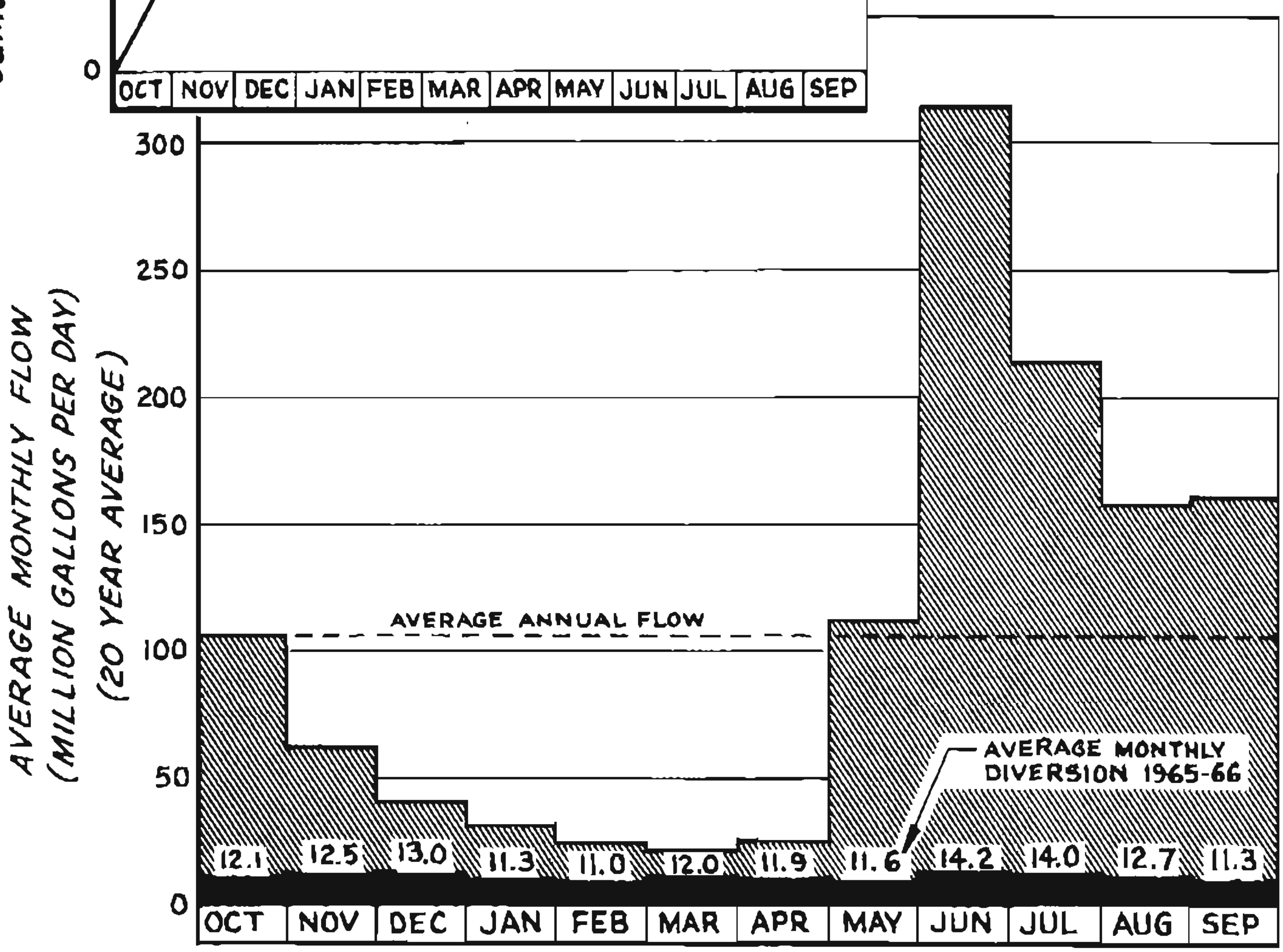
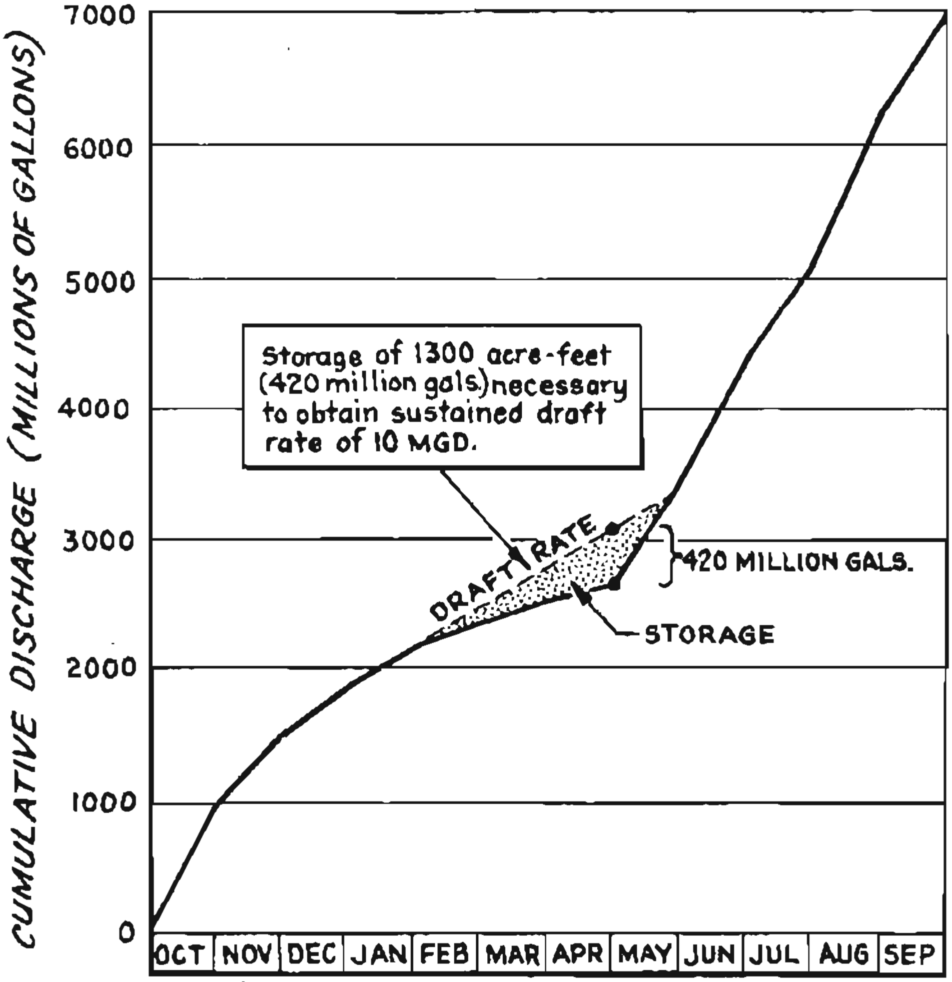


FIGURE 19

SOUTH FORK CAMPBELL CREEK – Cumulative Discharge and Average Monthly Flow



The mass curve at left shows the accumulated flow in South Fork Campbell Creek for water year 1953-54, the lowest annual average flow for 19 years of record. With 1300 acre-feet of storage, the stream would yield 10 million gallons per day.

Chart below shows average monthly and average annual flow in South Fork Campbell Creek covering 19 years of record.

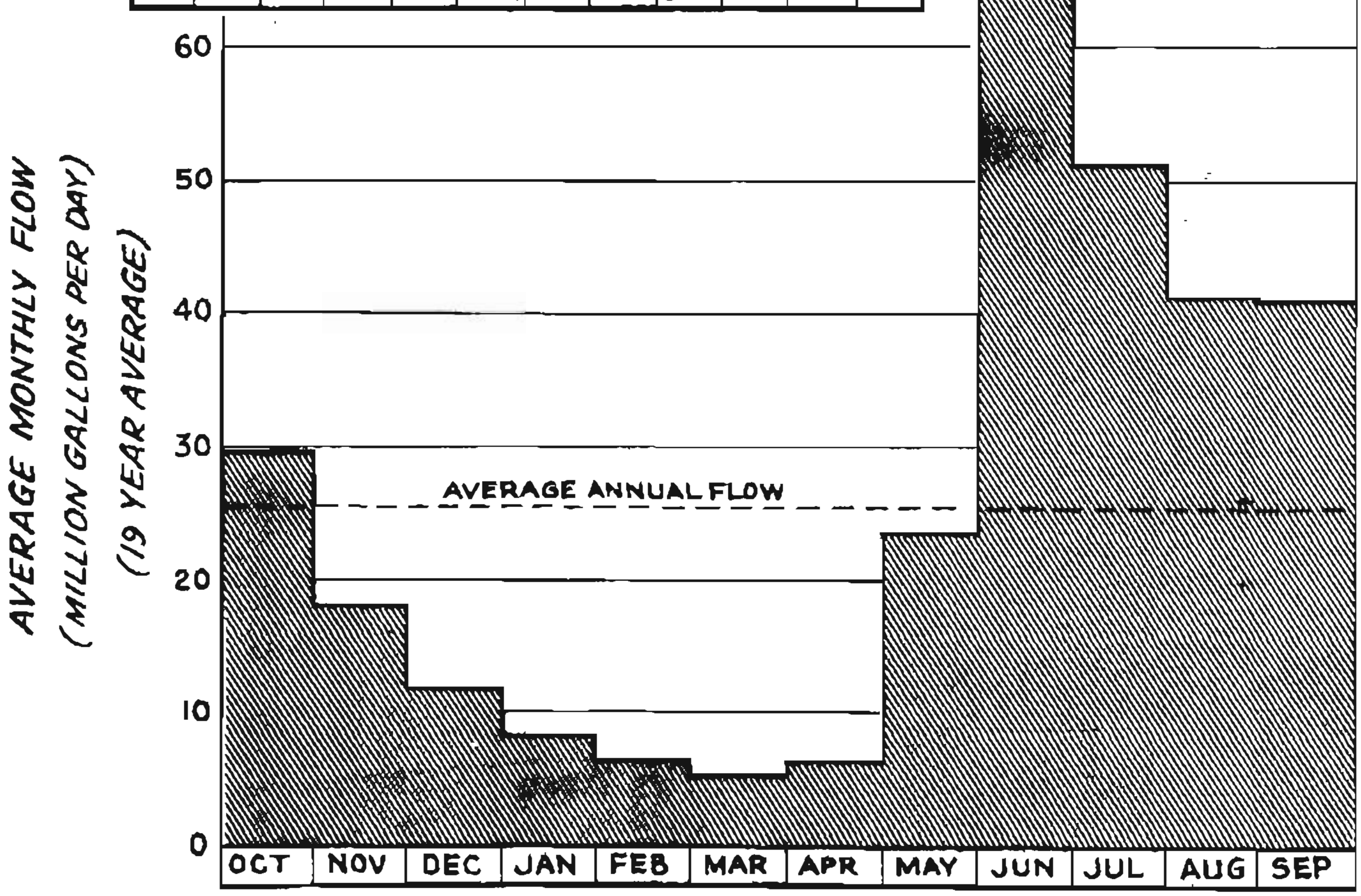


FIGURE 20

These curves for Ship Creek and South Fork Campbell Creek are based on only one year's record and do not take into consideration needs for storage releases necessary to maintain a base flow in the channel downstream, evaporation losses, or losses due to ice storage or any other such considerations. Data from the gaging station on South Fork Campbell Creek, which is located in the bedrock canyon before the creek flows out onto its alluvial fan, may result in a slightly different mass curve for the stream.

At present the diversion from Ship Creek nearly equals the yield without storage during low-flow periods. A simple diversion on South Fork Campbell Creek would not provide more than 5 mgd during those same periods.

Additional surface water can be obtained from Eagle River which has a low flow of about 30 mgd. That water would require treatment to remove glacier flour and silt and clay-sized particles.

Ground water.--Potential sources of ground water are being investigated throughout the Borough. Ground water has several advantages over surface water. The temperature of the ground water averages 3°C (38°F) the year around and is warmer than surface water in the winter months. Consequently, when it is mixed with surface water, freezing in water mains is retarded. Figure 17 shows the effect of the addition of ground water to the water distribution system. Between 1957 and 1960, even when the population steadily increased, a decline in water use occurred. The decline was caused by the addition of warmer ground water to the city water system. This reduced the hazard of freezing in mains and connection pipes and eliminated the necessity for water users in the area to leave their water taps constantly open during the winter months. Another advantage of ground water is that it can be obtained from wells located near the area in which it is needed and requires little or no treatment prior to use.

The development of future ground-water sources is presently concentrated in the Ship Creek and Campbell Creek fans (fig. 16) because those areas are close to areas of greatest population. During 1968 field tests will be conducted in those areas to measure the permeability and porosity of aquifers by standard methods including pump tests and test drilling. These tests will provide data on the rate of movement of ground water, the storage capacity of the water-bearing materials, and the rate of natural recharge. Tests and observations will also be made to determine the seasonal relationship of surface-water and ground-water temperatures and to assess the possibility of using infiltration galleries and shallow wells to develop ground-water supplies. Water-spreading experiments will also be conducted to provide data on the amount of excess surface water that could be added artificially to aquifers to increase their yield during low-flow periods. Estimates of the perennial yield and total water available from wells in the fan areas will be made.

Plans for the 1968 fiscal year include a series of shallow test wells to be drilled by the Geological Survey auger rig and by contract drilling in the fan areas and elsewhere in the Borough. Those test wells will provide geological information, will serve as water-level observation wells, and will be used for logging and various other tests.

A series of deep test holes will also be drilled in the Anchorage area to investigate the deeper aquifers. Those holes will be used to test the water potential and chemical quality of water in the Kenai Formation which is known to contain warmer water than the shallow aquifers. The deep tests, when combined with areal geophysical data already available, will indicate the total thickness of potential aquifers in the area and may also provide data on salt-water encroachment.

Ground-water studies within the Borough will be extended during the coming year to outlying communities such as Birchwood, Chugiak, Eagle River, Portage, and Girdwood.

Maintenance of Existing Supplies

Data on existing production wells in the Anchorage vicinity, shown in figure 16, are being compiled and studied to assure that those sources will continue to yield quantities of water comparable to the past. This data will be constantly updated to provide information from which pumping rates and schedules can be drawn.

Water Management

A preliminary electric-analog model of the principal aquifers in the Anchorage area, diagrammatically illustrated on figure 21, has been constructed at a scale of 1:24,000 by the Geological Survey Analog Model Unit in Phoenix, Ariz. This model is now operational in Phoenix and will provide data on the effect of future water withdrawals from the area and will allow planning for optimum use of water available in the Anchorage area. Problems of well spacing and the interrelations of various sources of water under anticipated load conditions will be analyzed by use of the model. Data from the model can be combined with digital or mathematical models to make more advanced economical analyses of future water-supply and distribution systems. An auxiliary test model of the city of Anchorage well field is also under construction to obtain data needed in the larger model of the Anchorage area.

Preliminary problems will be solved by the model by late in 1968 fiscal year. The solutions will become more reliable and accurate during 1969 and 1970 as more basic data on the system are collected. They will provide guidelines for future exploratory work.

ELECTRIC ANALOG MODEL OF ANCHORAGE
IN RELATION TO GROUND WATER SYSTEM

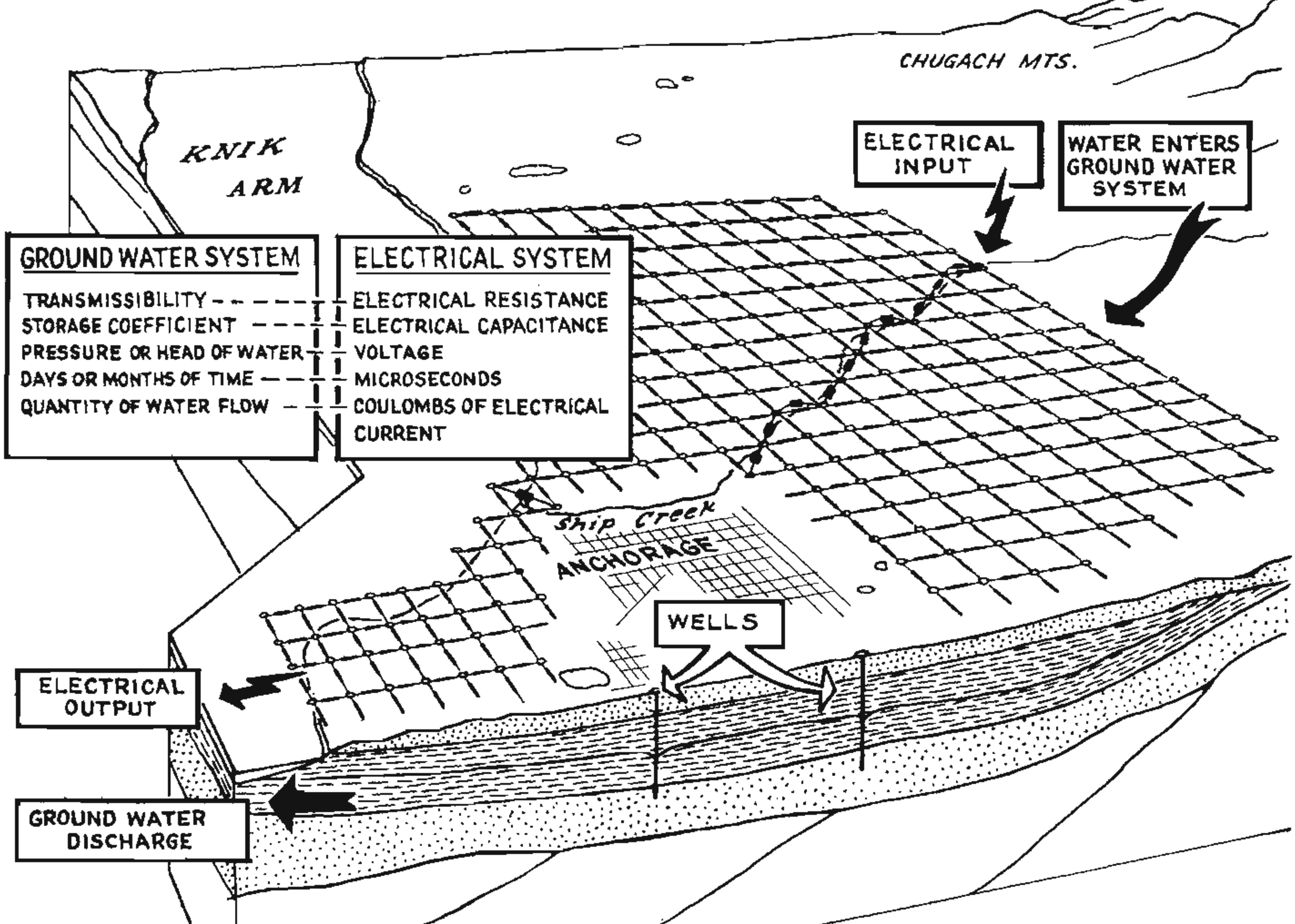


FIGURE 21