THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program

43335 Kalifornsky Beach Road, Suite 11
Soldotna, Alaska 99669
Main: 907-262-5210
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www.dec.alaska.gov

File: 2323.38.032

July 14, 2022

Meghan Teegarden
Sr. Advisor, Environmental Remediation
Safety, Health and Environment
Nutrien
5296 Harvest Lake Drive
Loveland, Colorado 80538

Re: UNOCAL/Agrium Ammonia Urea Plant
ADEC Spill # 1988230918305
Biosparge Remediation System Plan – ADEC Review

Ms. Teegarden:

On June 29, 2022, the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program received the Biosparge Remediation System Plan, dated June 23, 2022 and prepared by Cook Inlet Environmental.

ADEC has reviewed the document. In future communications please include the name, address, and signature of the Qualified Environmental Professional who prepared the work plan, the name and address of the person who the report is prepared for at Nutrien, and the DEC file number and Hazard ID number on a cover letter. This allows staff unfamiliar with the project to file and respond appropriately.

Figure 4, Cross Section highlights a potential issue with the work plan. The ammonia isolines on Figure 4 are depicted crossing the unsaturated zone of soils below the semi-confining aquitard. This is not a valid method of depicting data. The iso-lines depicting liquid concentrations, cannot cross an unsaturated zone. No soils data has been presented depicting ammonia concentrations. The study *Groundwater Investigation - Interrelationship Between Aquifers and Surface Water Regimes* (Dames & Moore, 1976) highlighted some long-term trends with water table fluctuation at the site. During periods of drought, which we are in currently, the water table fluctuates, rising and falling with changes in precipitation and infiltration.

Since the contamination has moved from the surface through the unconfined to the semi-confined aquifer, we can assume that the aquitard is permeable on site and that the unsaturated soils have been impacted. Not understanding the extent of these unsaturated soils impacts leads to an incomplete conceptual site model, particularly in the source area. With a potential future rise in both the unconfined and semi-confined aquifer water table, additional urea could be mobilized. Understanding and addressing this potential issue now could be

important to the project. Please be aware that future mobilization of urea in the presently unsaturated aquifer, caused by a rise in the water table could delay site remediation.

Were unsaturated soils sampled to completely characterize source area impacts to the unsaturated zone? Was any consideration given to remediation alternatives in the unsaturated zone?

The work plan is approved. If there are any questions, please contact me at (907) 262-3412 or by e-mail at peter.campbell@alaska.gov.

Sincerely,

Peter Campbell

Peter Campbell
Environmental Program Specialist

C: Electronic copies:
Jene' Worley - Cook Inlet Environmental
Lisa Krebs-Barsis – ADEC

Attachment: Groundwater Investigation - Interrelationship Between Aquifers and Surface Water Regimes (Dames & Moore, 1976)

Drilling Co. Soldotna Drilling USGS no. and ADL 78077 ADL 403100 X/C

Driller J. Shellman Type of rig Cable Date well completed 8/76

Well owner Union Chemicals Division PW No. 6 Nearest community Kenai

Well location: (address & legal description 2779.7' North & 62.6' W of S.E. Corner of Sec. 21, T7N, R12W Longitude 1512247 Latitude 604102

Depth of well 160 ft. Casing: Depth 151 ft. Diameter 16 in.

Static water level 61.8 ft. (above, below) land surface. Date

Finish of well: (open end, screen, perforated, open hole, other) Stainless

Describe screen intervals and size: 101-136" = 0.125 Slot 136-151 =0.035 Slot

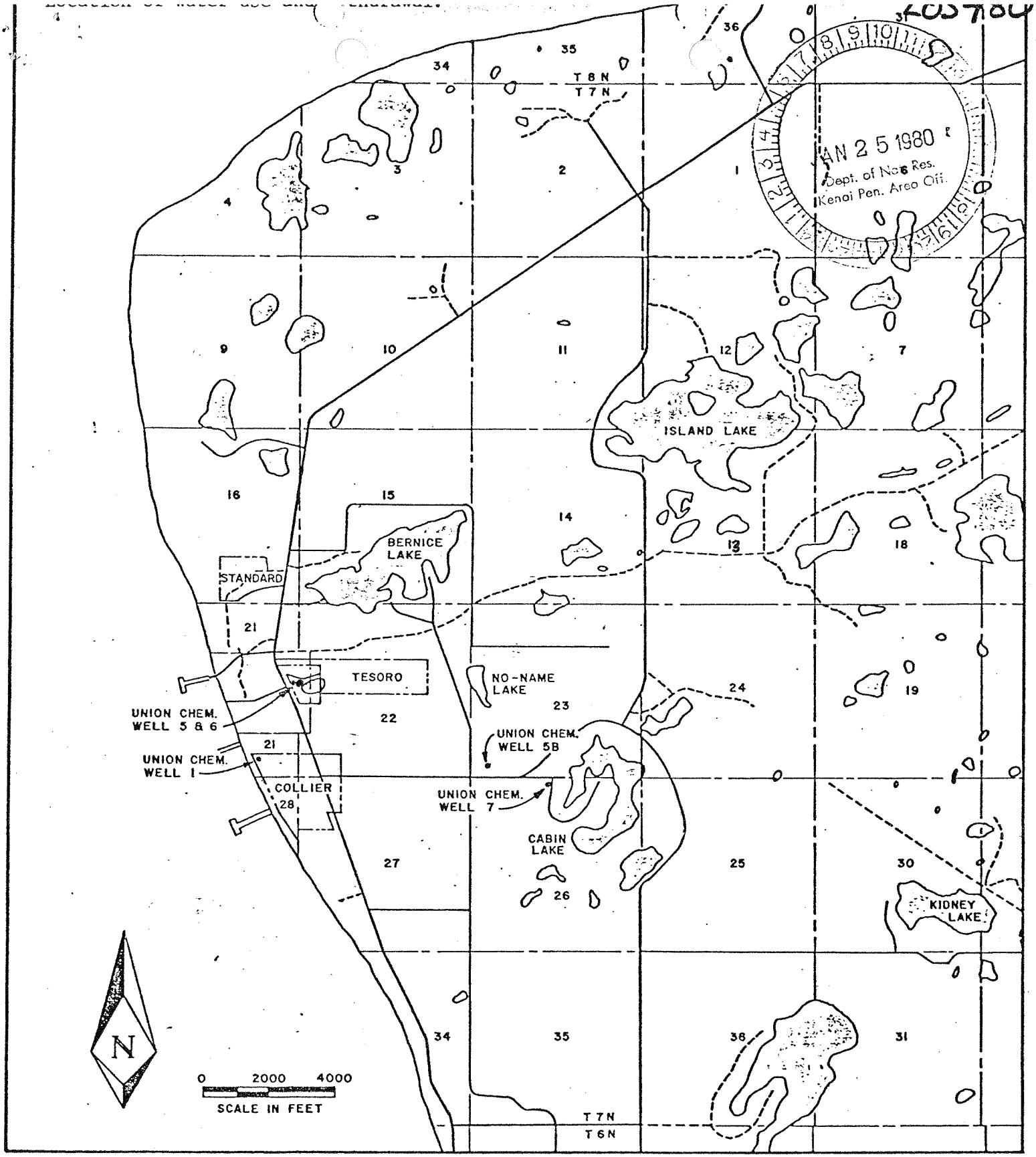
Well yield tested by (pumping, bailing, air) at 1200 gal/min.

for 48 hours with 31.6 ft. of drawdown from static level.

DRILLER'S MATERIAL LOG

Depth below land surface in feet	Give description of strata penetrated (size of material, color, hardness of drilling, and water content)
0 to 23	Dry Gravel
23 to 71	Coarse Sand & Gravel-Plenty of Water
71 to 77	Fine to Medium Sand
77 to 101	Solid Blue Clay Some Large Rock
101 to 109	Coarse Gravel
109 to 114	Coarse Sand & Gravel 30% Gravel
114 to 124	Medium-Coarse Sand- 50% Coarse Gravel
124 to 128	Coarse Sand & Small Gravel
128 to 136	Small, Medium, Coarse Gravel with Coarse Sand
136 to 139	Very Coarse Sand with 10% Gravel
139 to 160	Very Coarse Sand Grading to Fine
to	
to	This well is called PW No. 6 please
to	This file is all the Well logs that name as
to	DGGS has available. USGS has a
to	bunch - call & request.
to	
to	
to	8/16/69
to	
to	
to	
to	
to	

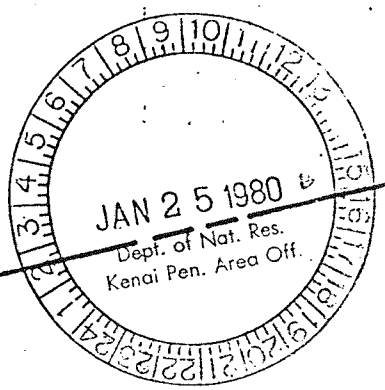
USGS local No: SB-7-12-21ADDD 2-009



VICINITY MAP

FIGURE NO.

#5 & #6 WELL LAND BOUNDARIES



N

This pt. recovered in field
5/16/79 Stan McClane

(S 79° E — 483.6)
N 78° 58' W — 212.01

(N 76° E — 501.8)
S 76° 02' W — 501.80

100'

R/W LINE

NORTH KENAI ROAD
N 20° 29' 45" W

75'
(STATE R/W)

COLLIER CARBON AND CHEMICAL CORP.

R.M

220.54

489.46

(311.65)

(177.81)

INVESTIGATION WELL NO. 5

10'

388.5

PRODUCTION WELL NO. 5
Top casing Elev. 91.22
Dec. 14, 1976

PRODUCTION WELL NO. 6
Top casing Elev. 92.67 - Dec. 14, 1976
Ground Elev. 90.5
Located 2,779.7' North and
62.6' from the SE corner of Sec. 21,
T7N, R12W, S.M.

1/4 Position

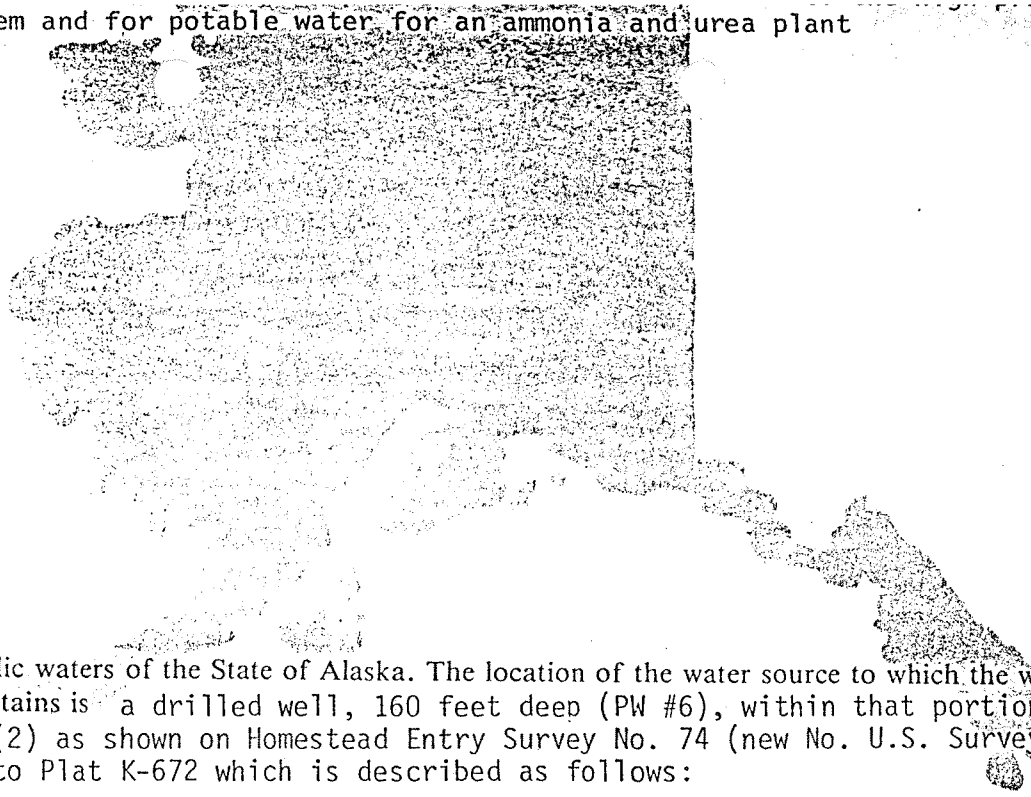
21 | 22

314.2

PROP LINE
(WEST 608.2)

21 | 22
28 | 27

steam system and for potable water for an ammonia and urea plant

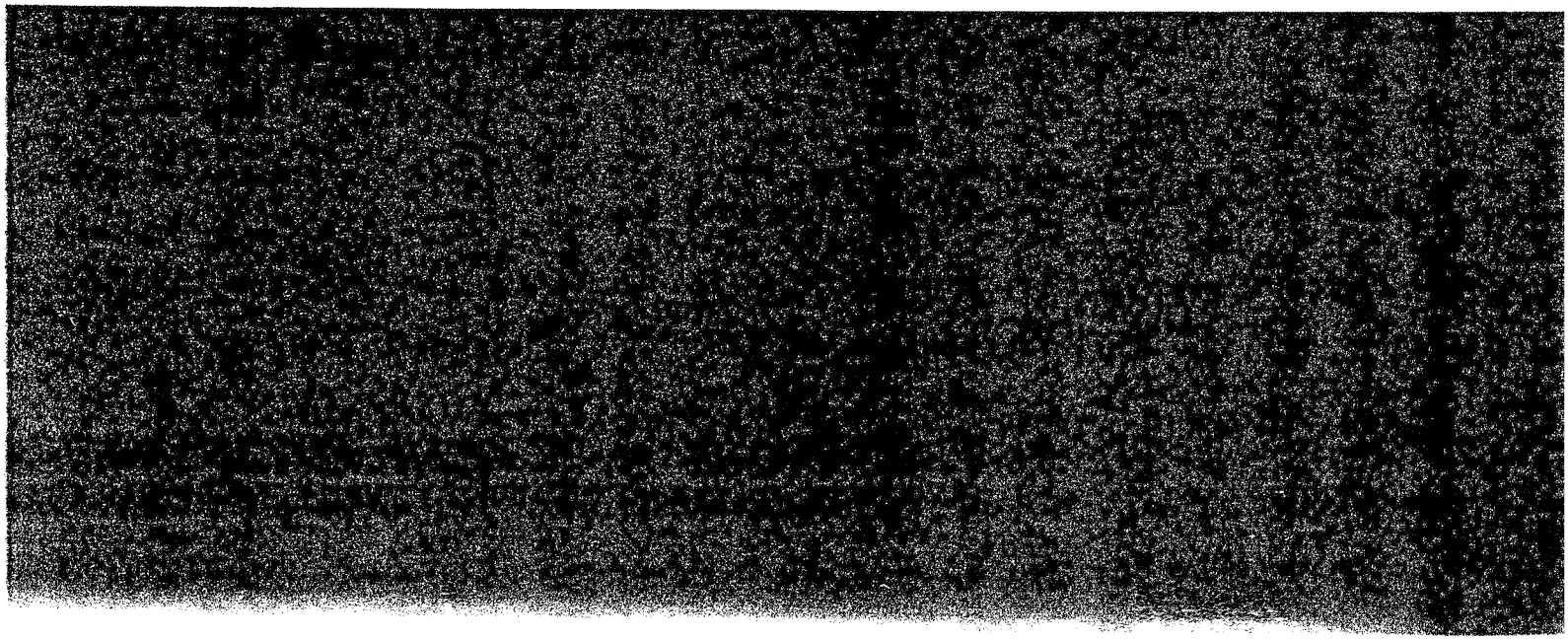


from the public waters of the State of Alaska. The location of the water source to which the water right granted appertains is a drilled well, 160 feet deep (PW #6), within that portion of Tract Two (2) as shown on Homestead Entry Survey No. 74 (new No. U.S. Survey 1095) according to Plat K-672 which is described as follows:

Location M&B

Starting at Corner No. 4 of Homestead Entry Survey No. 74 (U.S. Survey No. 1095), go North 1140 feet, the True Point of Beginning and Corner No. 1; thence West 608.2 feet to the intersection with the Kenai Boulder Point Road and Corner No. 2; thence North 23°30' West a distance of 457.4 feet to Corner No. 3; thence North 26°45' West a distance of 310.9 feet to Corner No. 4; thence South 79° East a distance of 483.6 feet to Corner No. 5; thence North 76° East a distance of 501.8 feet to Corner No. 6; thence South along the East boundary of Homestead Entry Survey No. 74, (U.S. Survey No. 1095), a distance of 710 feet to Corner No. 1, said parcel of property located within Sections 21 and 22, Township 7 North, Range 12 West, Seward Meridian.

LS 8-28-80



ADL# 203480, 78017

WATER WELL USC SITE ID 604102151224702

LOCAL NO. SB7-12-21-ADDD 2-9

(1) OWNER:

NAME COLLIER CARBON & CHEMICAL

ADDRESS KENAI, ALASKA

(2) LOCATION OF WELL:

COUNTY: OWNER'S NUMBER, IF ANY: PROD. WELL 6

KENAI BOROUGH NEAR NIKISKI, ALASKA

2,779.7' NORTH & 62.6' WEST OF SE CORNER OF SEC. 21, T7N, R12W, SEWARD MERIDIAN,

GROUND ELEV. 90.5 MLLW DATUM

(3) TYPE OF WORK (check)

NEW WELL [X] DEEPENING [ ] RECONDITIONING [ ] ABANDON [ ]

IF ABANDONMENT, DESCRIBE MATERIAL AND PROCEDURE IN ITEM 11.

(4) PROPOSED USE (check)

DOMESTIC [ ] INDUSTRIAL [X] MUNICIPAL [ ]

IRRIGATION [ ] TEST WELL [ ] OTHER [ ]

(5) EQUIPMENT:

ROTARY [ ]

CABLE [X]

DUG WELL [ ]

(6) CASING INSTALLED:

SINGLE [X] DOUBLE [ ]

FROM FT.	TO FT.	DIAM.	GAGE OR WALL	IF GRAVEL PACKED: DIAM. OF HOPE	FROM FT.	TO FT.
+1(±)	101	16"				

TYPE AND SIZE OF SHOE OR WELL RING:

SIZE OF GRAVEL:

DESCRIBE JOINT 3 BEAD WELD

(7) ~~PERFORATING OR~~ WELL SCREEN: STAINLESS

TYPE ~~OF PERFORATOR USED~~ STEEL - 16" TELESCAPIC

SIZE OF ~~PERFORATIONS~~ SLOT IN., LENGTH, BY IN.

FROM FT.	TO FT.	~~PERF. PER FOOT~~	~~ROWS PER FT.~~
101	136	0.125" SLOT	
136	151	0.035 SLOT	

(8) CONSTRUCTION:

WAS A SURFACE SANITARY SEAL PROVIDED? [X] YES [ ] NO TO DEPTH FT.

WERE ANY STRATA SEALED AGAINST POLLUTION? [ ] YES [ ] NO DEPTH FT.

FROM FT.	TO FT.

METHOD OF SEALING

(9) WATER LEVELS:

DEPTH AT WHICH WATER WAS FIRST FOUND 23', 101' FT.

STANDING LEVEL BEFORE PERFORATING FT.

STANDING LEVEL AFTER PERFORATING FT.

PIEZOMETRIC ARTESIAN HEAD @ 61.8'

WAS A PUMP TEST MADE? [X] YES [ ] NO IF YES, BY WHOM? DRILLER

YIELD: 1200 GAL./MIN. WITH 31.6 FT. DRAW DOWN AFTER 48 HRS.

TEMPERATURE OF WATER WAS A CHEMICAL ANALYSIS MADE [X] YES [ ] NO

WAS ELECTRIC LOG MADE OF WELL? [ ] YES [X] NO

(11) WELL LOG:

TOTAL DEPTH FT. DEPTH OF COMPLETED WELL 160 FT.

FORMATION: DESCRIBE BY COLOR, CHARACTER, SIZE OF MATERIAL AND STRUCTURE.

FT. TO FT.	
0 - 23	DRY GRAVEL
23 - 71	CSE SAND & GRAVEL - PLENTY WATER
71 - 77	FINE - MED. SAND
77 - 101	SOLID BLUE CLAY SOME LARGE ROCK
101 - 109	CSE GRAVEL
109 - 114	CSE. SAND & GRAVEL 30% GRAVEL
114 - 124	MED. - CSE SAND 50% GRAVEL (CSE)
124 - 128	CSE. SAND & SMALL GRAVEL
128 - 136	SMALL, MED, CSE. GRAVEL W/CSE. SAND
136 - 139	VERY CSE SAND W/ 10% GRAVEL
139 - 160	VERY CSE SAND GRADING TO FINE

WORK STARTED 1976 COMPLETED 1976

WELL DRILLER'S STATEMENT:

THIS WELL WAS DRILLED UNDER MY JURISDICTION AND THIS REPORT IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS

[SIGNED] J. J. SHELMAN (WELL DRILLER)

SOLDOTNA DRILLING

DAMES & MOORE

BY CWC DATE 7/22/77

SB 1-12-21-ADDD 2-9

Well Identification Number PRODUCTION WELL #6 Potable Water System Well

Drilling Co. Soldotna Drilling USGS no.

Driller J. Shellman Type of rig Cable Date well completed 8/76

Well owner Nearest community Kenai

Well location: (address & legal description 2779.7' North & 62.6' W of S.E. Corner of Sec. 21,T7N,R12W Longitude 1512247 Latitude 604102

Depth of well 160 ft. Casing: Depth 151 ft. Diameter 16 in.

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Describe screen intervals and size: 101-136" = 0.125 Slot 136-151 =0.035 Slot

Well yield tested by (pumping, bailing, air) at 1200 gal/min.

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128 to 136	Small, Medium, Coarse Gravel with Coarse Sand
136 to 139	Very Coarse Sand with 10% Gravel
139 to 160	Very Coarse Sand Grading to Fine
to	
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REPORT
GROUND WATER INVESTIGATION
INTERRELATIONSHIP BETWEEN AQUIFERS AND
SURFACE WATER REGIMES
NORTH KENAI AREA, ALASKA
FOR COLLIER CARBON AND CHEMICAL CORPORATION

GW INVESTIGATION
RELATIONSHIP BETWEEN
AQUIFERS & SURFACE WATER

EO
AN
RLM - LA
JRM - BR
AM - CR
WAT - AN
WAE - AN
RPB - AN

DAMES & MOORE
JOB NO. 4828-016-20
MAY 28, 1976

SUMMARY

The adequacy of existing areal and historic hydrologic data is limited. The U.S. Geological Survey (USGS) is the primary source of data.

Numerous well logs are available but are scattered over wide areas. Many domestic well logs have not been filed with the State of Alaska or the USGS.

Lakes and swamps in the North Kenai region contain large quantities of water. A large proportion of the lakes are part of the general water table. Annual and long-term variations in precipitation are the principal causes of fluctuations in the water levels.

Surface runoff, over most of the North Kenai area, is minimal. In the North Kenai ground water basin, only Bernice Lake has a visible outlet to Cook Inlet. Sources of runoff are snowmelt and rain.

Streams draining the northeast portion of the North Kenai area are Bishop Creek and Beaver Creek. Both have sustained flow, receiving discharge from lakes and ground water.

The water-bearing deposits underlying the study area are glacial outwash deposits and drift of Quaternary age.

Ground water supplies are abundant in the North Kenai area. Two aquifer systems are present -- unconfined water table aquifers and the deeper confined artesian aquifers. The water table aquifer water is high in iron and much of the artesian water in deeper aquifers contains tanin and lignin.

Water use during 1975 is estimated to be on the order of 1,100 million gallons, entirely supplied from wells. Of this amount, industry is estimated to have pumped 950 million gallons during 1975.

Precipitation and seepage from lakes are the principal sources of recharge to the water table aquifers. Precipitation is the principal source of recharge to the artesian aquifers. Precipitation at the Kenai Airport averaged 18.97 inches over the 30-year base period (1945-1975).

Evapotranspiration, pumping and flow of aquifer water to Cook Inlet account for large quantities of ground water discharge.

Based on USGS measurements of high water marks in lakes, the water level has declined as much as 6 feet. This is primarily due to drought conditions and evapotranspiration.

The hydrostatic head of the artesian aquifer has been reduced approximately 6 feet since 1967 due to pumping and reduction of recharge during periods of low precipitation. Indications are that the artesian water level started to stabilize during 1975.

Chemical analyses indicate the water table aquifer to be much higher in iron than the artesian aquifer. A low iron concentration has remained constant in the artesian aquifer.

Hydraulic characteristics of aquifers of the North Kenai area are highly variable. There are high variances in transmissivity, storage characteristics and hydraulic conductivity.

A 5-year drought period occurred during 1946-1950 with another drought starting in 1968 and continuing through 1975. The surface water drainage basins in the North Kenai area have had an estimated net loss, related to precipitation, of 45,080 acre-feet of water for the period 1968-75.

A photogrammetric study of five lakes and evaluation of USGS data indicated that water level elevations in the North Kenai area were at very high levels in 1963. These data indicate that between 1963 and 1968 most lake levels in the area dropped about 3 to 4 feet. This water level lowering may have been due to water seeking its long-term natural level or a consequence of the 1964 earthquake. Further decreases occurred during the extreme drought period of 1968 and 1969. Since 1970, lake levels have had no large changes despite the low level of rainfall. Available information indicates that Cabin Lake dropped about 3.3 feet during the period between 1963 and late 1968 and dropped another 3 feet by late 1974. Since late 1974, the lake has raised about 1 foot.

Computer modeling results indicate that approximately 3.7 feet of water level reduction in the Cabin Lake area has occurred between late 1968 and late 1974 (correlating reasonably well with 3 feet of reduction indicated above). The primary cause of this drop may be attributed to the severe drought of 1968 and 1969 in combination with a succession of years of below normal precipitation. Other causes, including residential and industrial pumping, may be responsible for additional reductions. Because the Cabin Lake level has remained essentially constant since 1971, a period when precipitation was below normal every year, it is doubtful that pumping reduced the lake level significantly. The correlation between

measured lake level reduction and the computer results are considered to be reasonable. Further attempts at exact duplication of historical data are impractical.

Results of the computer simulation indicate that about 15 percent of approximately 2.5 feet, or 0.4 feet, of lake level drawdown since Collier started pumping in late 1968 may be attributed to the pumping activities. Photogrammetric data indicate that an additional 2.5 to 3 feet of water level decline occurred prior to the start of Collier's pumping activities.

It is our opinion that water level loss due to pumping is minor when compared to the overall losses in the water resource region. It is also our opinion that water levels may continue to be reduced unless natural recharge in the area return to levels that are normal or above normal.

GENERAL CONCLUSIONS

Ground water is abundant in the North Kenai area even though drought conditions have persisted since 1968. The lowering of the water table and lake levels is principally due to lack of precipitation and, consequently, reduction of recharge to lakes and aquifers. Although contributing to these conditions, withdrawals from water wells are a less significant factor.

The seemingly stabilized water levels and apparent reversal of downward trends during 1975 may indicate that discharge is no longer exceeding recharge. However, continuation of drought conditions and increasing localized withdrawals of ground water are of concern. Pumping from water table aquifers has a direct effect on lake levels. Proper planning and management of water resources and continued monitoring of water levels and water usage can avert adverse effects on the hydrologic systems. Pumping from deeper confined aquifers will minimize any possible effects on lake levels.

TABLE 1

SUMMARY OF LAKE LEVELS IN KENAI AREA, ALASKA[a]

Lake Name	Summer 1970	7/13&14 1971	10/13 1971	6/22&23 1972	9/28 1972	10/18 1973	10/15 1974	10/13&14 1975
(No name) Sec. 23 T7N R12W	10.17	9.43	9.87	10.33	10.54	10.25	9.08[b]	10.55
Cabin	11.29	10.47	10.22	10.68	10.63	10.52	9.25	10.29
Bernice	16.95	16.64	16.72	17.45	17.53	17.95	16.90	17.54
Island	10.10	10.15	10.67	11.36	11.66	11.61	10.41	11.19
Dogbone	4.96	4.65	4.64	5.24	5.11	5.17	4.45	5.02
Kidney	10.43	10.78	11.31	11.67	12.02	11.60	10.83	12.22
Wick	13.08	13.54	14.10	14.91	15.09	14.97	14.18	15.41
Douglas	14.12	14.19	14.37	15.00	15.17	15.18	--	15.79
Laura	2.25	2.62	3.23	4.15	4.34	4.37	3.61	4.71
Konovalof	14.72	14.95	--	--	--	--	--	17.07
Shadura	15.00	15.60	--	--	--	--	--	16.50
Daniels	16.86	16.82	--	--	--	--	--	17.53

[a]Source: U.S. Geological Survey, arbitrary reference point.
[b]Revised 1975.

TABLE 2

INDUSTRIAL GROUND WATER USAGE

(Yearly Total Gallons x 10^6)

User	1967	1968	1969	1970	1971	1972	1973	1974	1975
Collier Carbon	--	92.0	501.0	549.2	526.0	599.0	571.0	599.0	586.0
Phillips Petroleum	--	--	33.4	156.0	167.0	193.0	154.0	163.0	192.0
Tesoro	--	--	6.3	72.2	73.0	80.0	100.0	65.0	72.0
Standard Oil	52.6[a]	52.6[a]	52.6[a]	53.0[b]	53.0[b]	53.0[b]	53.0[b]	53.0[b]	53.0[b]
Rig Tenders	281.0	242.4	123.4	70.2	48.0[a]	48.0	48.0	48.0[b]	30.0[b]
Chugach Electric	15.8	15.8[a]	15.8[a]	15.8	16.0[b]	16.0[b]	16.0[b]	16.0[b]	16.0[b]

[a]Estimated by USGS.

[b]Estimated by Dames & Moore.

TABLE 3

DOMESTIC WATER USE, NORTH KENAI AREA

Year	Estimated Population[a]	Ground Water Use (million gallons/year)[b]
1968	2,500	91.2
1970	2,800	102.2
1975	3,100	113.2

[a]Population estimate from the Kenai Comprehensive Plan, Alaska State Housing Authority, 1969.

[b]Based upon 100 gpd/person.

HYDROLOGIC SETTING

SURFACE WATER AND DRAINAGE

The hydrology of the North Kenai region is controlled by the climatic and terrain features. Topographic relief is variable, ranging from low, swampy areas to the undulating morainal deposits. Streams are generally small and meander through extensive swamp and muskeg areas. With the exception of Bishop Creek, the streams are generally short and discontinuous. Drainage basin boundaries are difficult to define due to the low relief and isolated lakes. However, surface water basin boundaries have tentatively been delineated and divided into major and minor basins by Anderson and Jones (1972) and modified by Dames & Moore for this report (Figure 3). Drainage areas of selected basins have been calculated by planimeter and are presented in Table 5. The area measurement of Bishop Creek surface water basin, as indicated on Figure 3, was terminated at the northernmost boundary of USGS topographic map sheets Kenai C-3 and C-4. Bishop Creek is a perennial stream and drains northward to Cook Inlet. The mean annual peak discharge from streams draining the low swamps east of Nikiski average about 1 cfs per square mile. The mean annual low runoff at Nikiski averages about 0.5 cfs per square mile (Feulner, Childers, and Norman, 1971).

Lakes and swamps in the North Kenai region contain large quantities of water. Some small lakes are perched on relatively impermeable silt above the water table, while others fill topographic lows and are a part of the general water table. Annual and long-term variations in precipitation cause water levels of some lakes to fluctuate considerably.

Most lakes within the study area are closed basins or seepage lakes. That is, there is no visible inlet or outlet to the lake, but ground water enters and leaves by seeping through the confines of the lake basin. Cabin, Wick, and Douglas Lakes are examples of closed basin or seepage lakes. Other lakes, such as Bernice, Salamatof, and Daniels have outlets but no visible inlet; these are semi-closed lake systems.

GROUND WATER

Assumed ground water basin boundaries have been developed by the USGS corresponding with either surface water drainage or known impermeable subsurface boundaries. The areas of the ground water basins are presented in Table 6. The basins are indicated on Figure 4. Confined and unconfined ground water aquifers are found over much of the North Kenai area.

Four subsurface geologic sections (Figures 5 through 8) have been compiled from existing well and boring log information. Location of the sections are indicated on Plate 2 (in pocket). The wells are too few and widely spaced in some areas to accurately map the subsurface units and the static surfaces of the water table and artesian aquifers. Broad correlations between the well locations are the basis for a description of general stratigraphy.

To depths of approximately 300 feet, four major stratigraphic units are present. The upper unit consists of outwash sand and gravel in thin alternating discontinuous layers which occur to depths of 125 feet below the surface. In this unit, ground water occurs under water table conditions. The depth to water in the water table aquifer, as indicated in the subsurface sections, varies between 5 and 70 feet below land surface.

Near the Cook Inlet bluffs, the surface of the static water table decreases in elevation and appears at the surface near the base of the sea cliff.

Beneath the upper sand and gravel unit is a confining stratum consisting of clay and silt which locally alternates with thin layers of silty sand and sand. The clay stratum varies in thickness from 5 to 40 feet and appears to pinch out beneath the Collier plant site near the Cook Inlet bluffs (Figure 6). The clay stratum also appears to pinch out to the north of the plant site in the vicinity of Bernice Lake (Figure 7).

Beneath the clay stratum, which acts as a confining layer to the artesian ground water, are more variable strata consisting of silty sand containing coal fragments interbedded with discontinuous strata or lenses of water bearing sand and, more rarely, gravel. The sand and gravel aquifers, being discontinuous, are difficult to locate but are differentiated in the subsurface sections where possible, as the third geologic unit. North of the plant site toward Bernice Lake, the silty sand grades to poorly graded sands and gravels with fewer fines.

In the deeper wells and borings, a second (lower) clay stratum is encountered at depths of 170 to 240 feet below the surface. The clay is interbedded with thin layers of sand and gravel containing water under artesian conditions. The lower clay unit varies in thickness from 60 to 130 feet and was encountered in borings drilled to a maximum depth of 450 feet below the ground surface.

Recharge

Water table aquifers of the North Kenai area are recharged primarily by precipitation and seepage from lakes. Most of the area studied lies in a

soils region of good recharge potential. The region encompasses well-drained soils underlain by glacial drift. Precipitation is the principal source of recharge to the confined aquifers, although the major portion of water contribution is considered to originate east of the area of study. Data on the area to the east is extremely scarce or non-existent.

Based upon climatological, vegetated area, and soils data, net recharge from normal amounts of precipitation is estimated to range from 7 to 9 inches per year. Ground water underflow, entering the study area from the east, is also a contributing recharge factor. The flow rate is not known but is believed to be slow due to barriers of low permeabilities and gentle water table gradient.

Discharge

Ground water of the water table aquifer in the North Kenai area is discharged primarily by evapotranspiration, pumping, and seeps and/or springs from the coastal bluffs.

Discharge from the artesian aquifer occurs by pumpage and upward movement of the water through semi-confining beds where the artesian water level is higher than the water table aquifer. It is generally believed that artesian aquifers discharge large quantities of water into Cook Inlet.

Total evapotranspiration for the North Kenai area is estimated to be on the order of 5 to 10 inches per year, due to the high percentage of forested area and the numerous bodies of lake water. Although total ground water loss through evapotranspiration is not known, it is considered to be a significant portion of the total evapotranspiration.

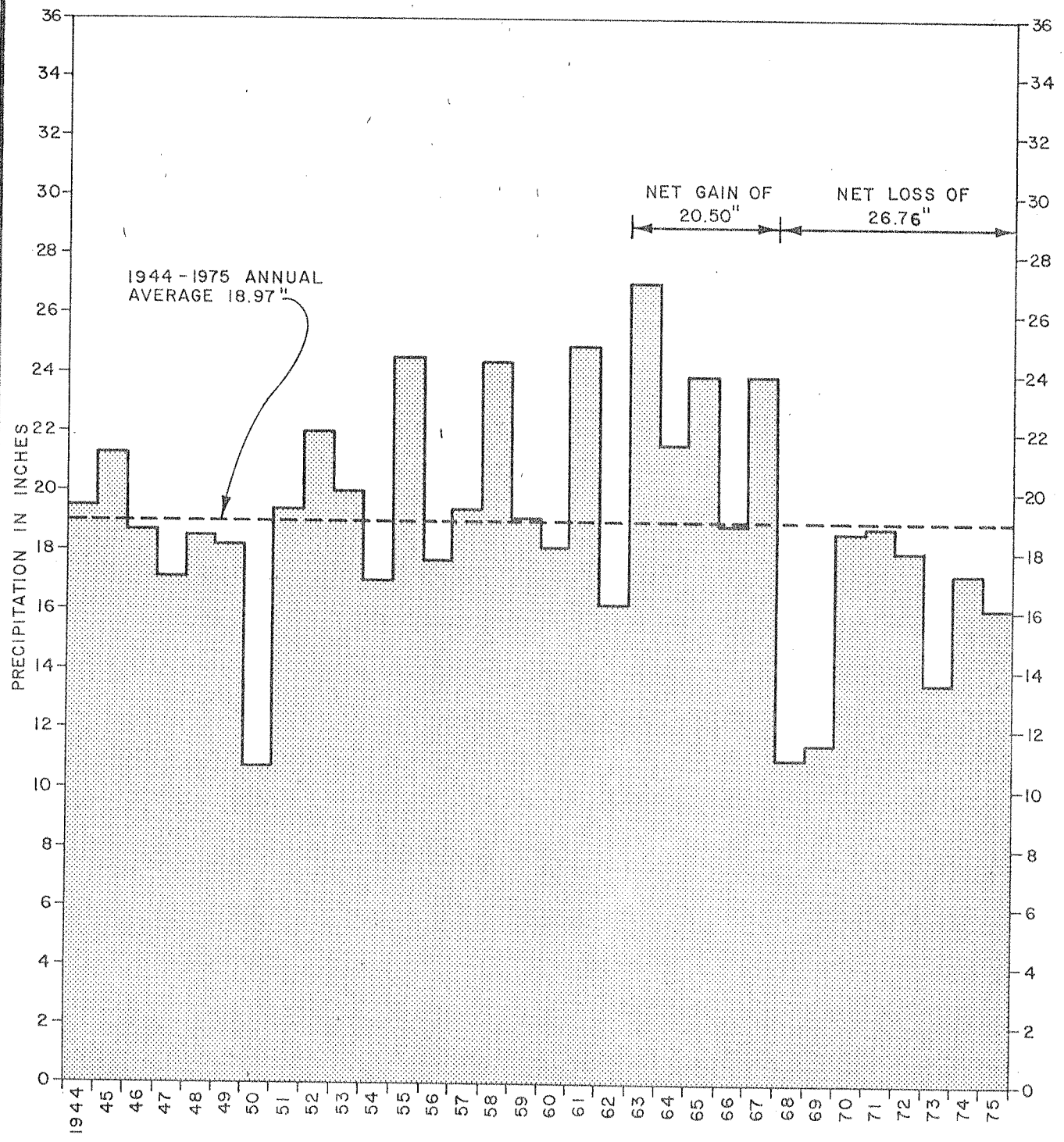
Pumpage of ground water in the system consumes an estimated 2.9 mgd.

Water Level Fluctuations

Fluctuation of water well levels are indicated on Figure 9 for an artesian aquifer and a water table aquifer in the North Kenai area. Water level fluctuations can be caused externally by tidal movements, changing atmospheric pressures, wind over an open well, and by earthquakes. Internally, varying amounts and rates of recharge and discharge will cause water level fluctuations.

Review of available hydrographs indicate that the water table aquifer responds to seasonal changes. The aquifer reaches its highest levels in August, September, and part of October. Once the ground freezes, there is about 6 to 7 months' lag time before winter precipitation percolates to the water table. The water levels reach their lowest point during February or March. Based on USGS hydrographs, the water level of the water table aquifer has varied as much as 5 feet (see Figure 9). This is primarily due to natural causes such as evapotranspiration and drought conditions.

Artesian aquifers generally have a greater lag time in their response to precipitation. Under drought conditions, the amount of recharge is reduced also to the artesian aquifer. Fluctuation of water levels under artesian conditions are primarily caused by changes in pressure rather than changes in storage volume. The confined aquifer serves mainly as a conduit for moving water from recharge areas to locations of natural or artificial discharge. Reduction of recharge and increased pumpage have caused the



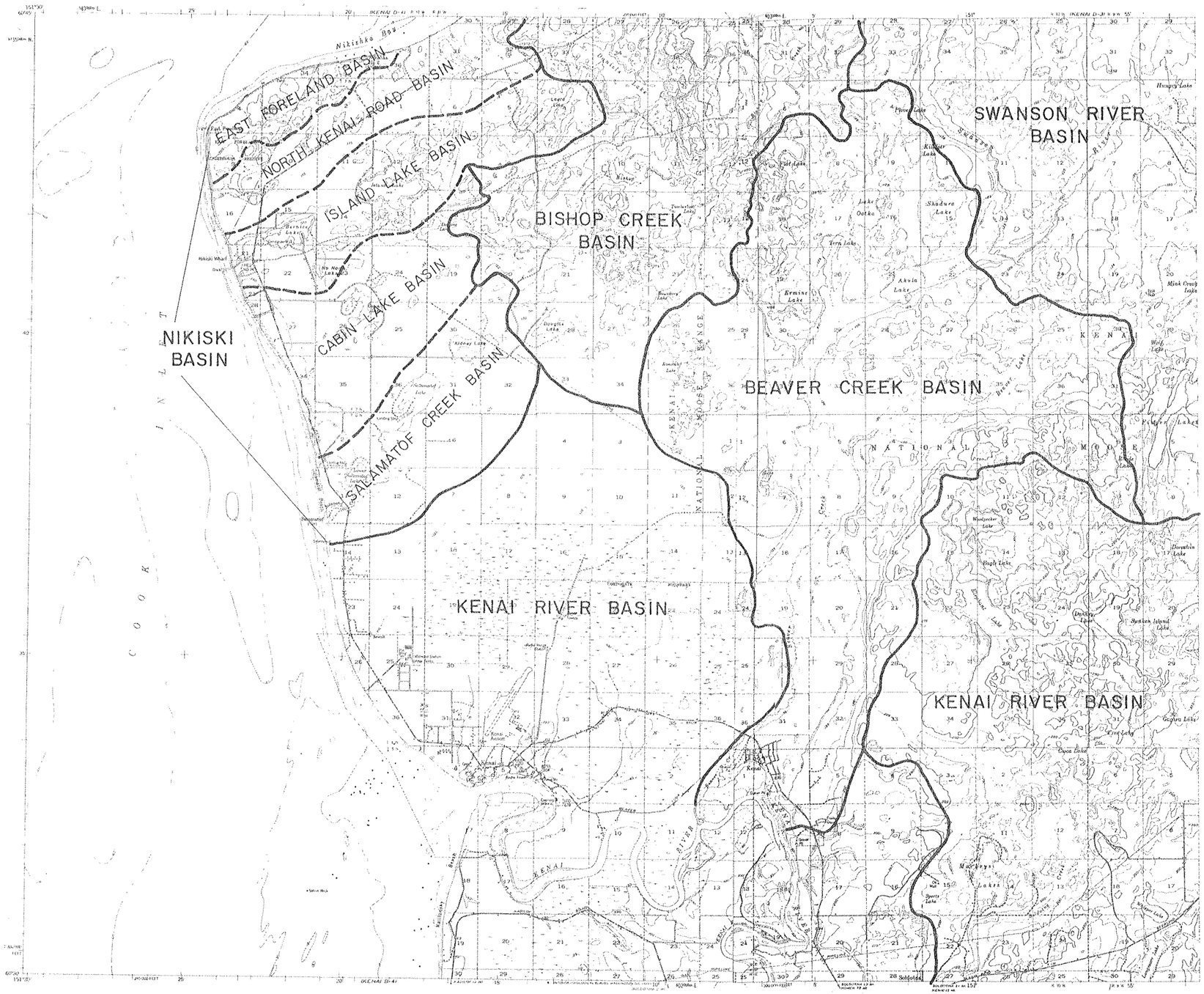
ANNUAL PRECIPITATION
AT KENAI MUNICIPAL AIRPORT
1944-1975

REFERENCE:

U.S. ENVIRONMENTAL DATA SERVICE,
1944-75. CLIMATOLOGICAL DATA-ALASKA,
NATIONAL CLIMATIC CENTER, ASHEVILLE, N.C.

DAMES & MOORE

FIGURE 17



N

KEY

MAJOR BASIN BOUNDARY

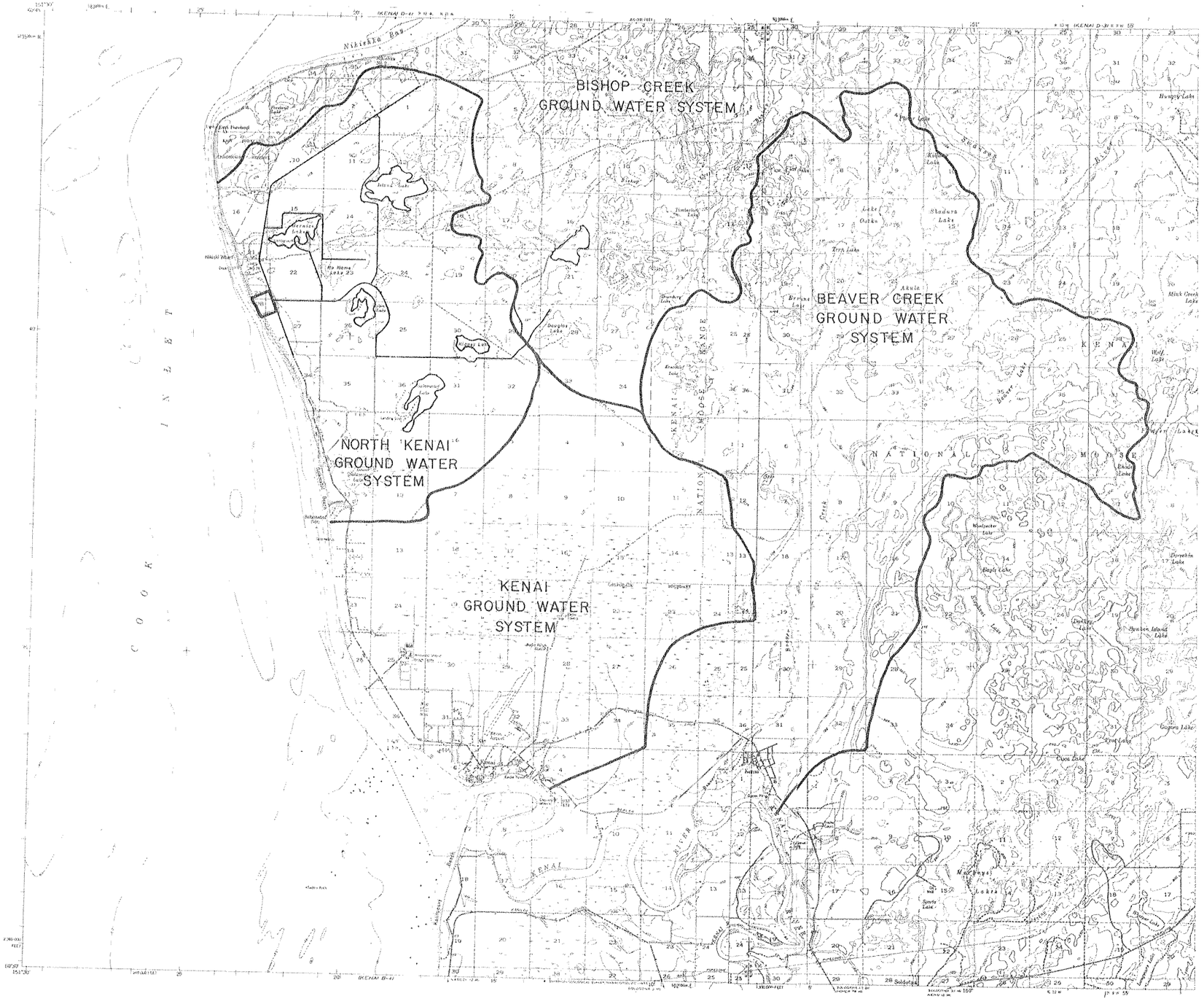
SUB-BASIN BOUNDARY

SURFACE WATER DRAINAGE BASINS

MILES
0 1 2 3 4

REFERENCE:
ANDERSON & JONES, 1972
MODIFIED BY DAMES & MOORE, 1976

DAMES & MOORE



N

KEY

BASIN BOUNDARY

GROUND WATER BASINS

MILES
0 1 2 3 4

REFERENCE:
ANDERSON & JONES, 1972

DAMES & M

NOTES

1. TIME FROM START OF COMPUTER SIMULATION, MAY 1, 1965: 3717 DAYS
2. PUMPING; LEAKY BOUNDARY
3. RECHARGE = 40% ACTUAL ANNUAL PRECIPITATION

UNCONFINED AQUIFER WATER LEVEL CONTOURS & LAKE ELEVATIONS FOR JULY 1975

(FROM COMPUTER MODEL)

FEET 0 400 800 1600

REFERENCE
NORTH KENAI AREA MAP, PRODUCED FOR KENAI BOROUGH, 1968

DAMES & MOORE

FIGURE 20

INSUFFICIENT LEGAL

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

RECEIVED
JUN 4 1982
Div. Of Geological Survey
Anchorage

1344

DRILLING LOG

Well Owner Union Chemical Use of Well Exploratory

Location (address of: Township, Range, Section, if known; or distance main road
½ mile North of Wellhouse 7m
Test Well 13/6

Size of casing 8" Depth of Hole 170 feet Cased to 160 feet

Static water level 50 ft. (above) (below) land surface. Finish of well (check one) open end (X);
Screen ( ); Perforated ( ).

Describe screen or perforation N/A

Well pumping test at N/A gallons per (hour) (minute) for - hours with - ft. of drawdown from static level.

Date of completion April 11, 1982

WELL LOG

Depth in feet from ground surface			Give details of formations penetrated, size of material, color and hardness
0	TO	2	Casing Stick up.
2	TO	58	Sandy Cobble Gravel.
58	TO	70	Sandy Gravel; Water Bearing.
70	TO	75	A/A:Silty.
75	TO	99	Grey Clay: Slightely Gravely.
99	TO	106	Gravely Clay: Sandy, Medium Hard.
106	TO	110	Silty Sand: Gravely.
110	TO	112	Grey Clay: Sandy, Soft.
112	TO	115	Sticky Clay.
115	TO	135	Sandy Clay: Semi, Consol
135	TO	140	A/A, Wet & Heaving.
140	TO	160	Fine Sand: Silty, Wet-Heaves.
160	TO	167	Very Fine Sand; Brown, Silty/ Clayey, Holds open hole.
167	TO	~~170~~ 168	Sandy Grey Clay.
	TO		

Wayne E. Kuntz
NWWA Certified Contractor
Certificate No's. 814 & 873

INSUFFICIENT LEGAL INFORMATION

RECEIVED 1345
JUN 4 1982
Div. Of Geological Survey
Anchorage

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

DRILLING LOG

Well Owner Union Chemical 276-8121 Use of Well Commercial

Location (address of: Township, Range, Section, if known; or distance main road
7m pump house

Size of casing 8" Depth of Hole 153'9" feet Cased to 150' feet

Static water level 48' ft. ~~(above)~~ (below) land surface. Finish of well (check one) open end (X);
Screen ( ); Perforated ( ).

Describe screen or perforation

Well pumping test at gallons per (hour) (minute) for hours with ft. of drawdown from static level.

Date of completion 3/15/82

WELL LOG

Depth in feet from ground surface			Give details of formations penetrated, size of material, color and hardness
0	TO	2	Top soil
2	TO	13	Cemented gravel: some water brn., loose stratas w/6"-8" rocks at 10' level.
13	TO	44	Cemented gravel: brown, medium, hard & crumbles
44	TO	62	Sand & gravel: water bearing
62	TO	78	Sand & gravel: loose, caving, water bearing
78	TO	100	Clay: blue-grey some gravel
100	TO	103	Blue-grey clay
103	TO	105	Clayey gravel
105	TO	113	Silty sand & gravel: water bearing
113	TO	120	Very silty sand & gravel: water bearing
120	TO	125	Sand & gravel: heaving, cleaner, water bearing
125	TO	131	Silty sand & gravel; water bearing
131	TO	141	Silty sand & gravel: Clayey
141	TO	153	Fine silty sand
151	TO		Grey Clay

Wayne E. Kuebler
NWWA Certified Contractor
Certificate No's. 814 & 873

Wayne E. Kuebler
NWWA Certified Contractor
Certificate No's. 814 & 873

1562-G

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

DRILLING LOG

Well Owner Union Chemical Use of Well COM

Location (address of: Township, Range, Section, if known; or distance main road
Test Well 13/7 North of 7M

Size of casing 8 Depth of Hole 150½ feet Cased to 150½ feet

Static water level 59 ft. (XXXX) (above) (below) land surface. Finish of well (check one) open end (XXXX);
Screen ( ); Perforated ( ).

Describe screen or perforation
TEST WELL
Well pumping test at gallons per (hour) (minute) for hours with ft.
of drawdown from static level.

Date of completion May 14, 1982

WELL LOG

Depth in feet from ground surface	Give details of formations penetrated, size of material, color and hardness
0 TO 39	Dirt, Cobbels, Gravel
39 TO 40	Sand & Gravel - Very Little H2O
40 TO 44	Sand & Gravel, Clay, some H2O
44 TO 60	Sand & Gravel - H2O
60 TO 78	Sand & Gravel - Clean, Heaving H2O
78 TO 83	Grey Clay & Gravel
83 TO 90	Grey Gravelly Clay
90 TO 92	Grey Gravelly Clay - Medium Hard
92 TO 98	Grey Sandy Clay - Hard
98 TO 101	Grey Clay - Soft
101 TO 120	Grey Silty Clay - Soft
120 TO 140	Formation Gradually Clay - Sandy Clay - Very Silty Sand
140 TO 150	Very Silty Sand - Some Clay
TO	
TO	

Wayne E. Westberg
NWWA Certified Contractor
Certificate No's. 814 & 873

State
5788

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

* Log Rev. 10/25/85

DRILLING LOG

Well Owner Union Chemical Use of Well Exploratory

Location (address of: Township, Range, Section, if known; or distance main road
Test Well 13/4

Size of casing 8" Depth of Hole 160 feet Cased to *121.0* feet

Static water level *66.5* ft. ~~(above)~~ (below) land surface. Finish of well (check one) open end (X);
Screen (X); Perforated ( ).

Describe screen or perforation * 8" Tel. S.S. Screen 145 to 117 Top Wind, Bal. #25 slot 2' Tight

Well pumping test at *300* gallons per ( ) (minute) for *24* hours with *38.8 ft. of drawdown from static level.

Date of completion January 15, 1982

WELL LOG

Depth in feet from ground surface	Give details of formations penetrated, size of material, color and hardness
0 TO 2	Casing Stick up.
2 TO 23	Sandy Gravel: Semi Consol, Water @ 20'.
23 TO 25	Sandy Gravel: Clayey.
25 TO 41	Sandy Gravel: Cemented, Water seaps in sand stringers.
41 TO 72	Gravely Sand: loose, slightely clayey, Wet.
72 TO 81	Water Sand: Heaving, Slightely sandy.
81 TO 105	Grey Clay: Sticky, Slightely sandy.
105 TO 115	Gravel & Sand: Silty/Clayey, dense.
115 TO 147	Silty Sand & Gravel: wet (would not hold water from 127-147'
147 TO 160	Silty Grey Clay.
TO	
TO	
TO	
TO	
TO	

1 — CUSTOMER

1494

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

LOCAL NO SD 1-17-63 WHH 1-17
USGS SITE ID 604044151200501

DRILLING LOG

No. of nearest deep

Well Owner Union Chemical Use of Well Commercial

Location (address of: Township, Range, Section, if known; or distance main road
Test Well 13/8 7N 12W 23
North of 7m 150-200 ft. N/NW of 7p

Size of casing 6" Depth of Hole ~~151~~ 149 feet Cased to ~~151~~ 149 feet

Static water level ~~20~~ 18 ft. (above) (below) land surface. Finish of well (check one) open end (x);
Screen ( ); Perforated ( ). 50.½ of sec 23 right on the ¼ sec. line half way down

Describe screen or perforation None

Well pumping test at 0 gallons per (hour) (minute) for 0 hours with 0 ft. of drawdown from static level.

Date of completion June 23, 1982

WELL LOG

Depth in feet from ground surface		Give details of formations penetrated, size of material, color and hardness
-2 ~~-2~~ TO	~~2~~ 0	Casing Stick-up
~~+~~ 0 TO	~~39~~ 37	Sandy Cobble Gravel
~~39~~ 37 TO	~~69~~ 60	Sandy & Gravel (damp)
~~69~~ 60 TO	~~89~~ 78	Sand & Gravel
~~+~~ 78 TO	~~81~~ 79	Gray Clay
~~81~~ 79 TO	~~89~~ 87	Gray Gravelly Clay - Soft
~~89~~ 87 TO	~~91~~ 89	Gray Sandy Clay - Medium Hard
~~91~~ 89 TO	~~101~~ 101	Variations of Gray Clay - Very Silty Sandy
~~103~~ 101 TO	~~105~~ 103	Silty Sand & Gravel (Formation Sample # 1)
~~105~~ 103 TO	~~111~~ 109	Silty Sand & Gravel (Formation Sample # 2)
~~110~~ 109 TO	~~111~~ 111	Silty Sand & Gravel (Formation Sample # 3)
~~112~~ 111 TO	~~115~~ 113	Silty Sand & Gravel (Formation Samole # 4)
~~115~~ 113 TO	~~140~~ 138	Silty Sand & Gravel (Formation Sample # 5-9)
~~140~~ 138 TO	~~151~~ 149	Gray Clay, Dry. Open Hole Drilling Possible.
TO		

Wayne E. Westlund
NWWA Certified Contractor
Certificate No's. 814 & 873

Dave Rice

2—STATE

2599

SB 7-12-23 CDDC3-4
7 12 26 BAAB
ROD GILGE

M-W DRILLING, Inc.
P.O. Box 10-378 • 10300 Old Seward Highway
(907) 349-8535
ANCHORAGE, ALASKA 99511

DRILLING LOG

1.2 MI OF N KENAI RD on Miller Loop Rd

Well Owner Union Chemical 776-8121 Use of Well Commercial

Location (address of: Township, Range, Section, if known; or distance main road
400' north of 7M, Kenai, Alaska (13-9 production well

Size of casing 10" Depth of Hole ~~134~~ 138 ~~135~~ 140 feet Cased to ~~111.81~~ 109.81 feet BAAB

Static water level 65 ft. (above) (below) land surface. Finish of well (check one) open end ( ); Screen (XX); Perforated ( ).

Describe screen or perforation *24' of 10" telescope Johnson 304 Stainless Steel screen w/2' tialpipe (6 5/8" OD) set from ~~130'~~ 134' ~~140'~~ 138' varying slot sizes *See as built

Well pumping test at 520 gallons per ~~(hour)~~ (minute) for 20.75 hours with 35.5 ft. of drawdown from static level.

Date of completion October 21, 1982 started in Sept.

WELL LOG

Depth in feet from ground surface		Give details of formations penetrated, size of material, color and hardness
~~-2~~	TO ~~0~~	Casing stickup
~~0~~	TO ~~4~~	Brown cemented gravel
~~4~~ 9	TO ~~11~~ 12	Gray silty gravel
~~11~~ 12	TO ~~38~~	Gravelly with gray clay
~~38~~	TO ~~46~~ 46	Gravel with gray clay, not so cemented
~~46~~	TO ~~51~~ 52	Clean gravel
~~51~~ 52	TO ~~82~~	Sand & gravel; heaving somewhat
~~82~~	TO ~~96~~ 96	Gray clay with some sand and wood chips
~~96~~	TO ~~103~~ 103	Gray clay with wood chips
~~103~~	TO ~~108~~ 108	Clay with sand and small gravel; waterbearing
~~108~~	TO ~~133~~ 133	Sand and gravel; waterbearing
~~133~~	TO ~~134~~ 134	Sand and gravel with fine silty gray clay
~~134~~	TO ~~138~~ 138	Sand, silt and clay
	TO	
	TO	

Wayne Wood
NWWA Certified Water Well Contractor No. 814 E. 87th

LOCAL NO. SB7-12-23CDDC3-4
USGS SITE ID 60 40351512013002

2—STATE

no log

ADL# 40059*

Owner: Better Concrete Products (Kenai) ~~SB 7-12-27 ACAA1-9~~

USGS SITE ID 604016151212401

LOCAL NO. 5800701227 ACAA1-9

BORING AND WELL DATA

Owner / Boring or Well Number	Boring or Well Diameter (inches)	Maximum Depth Drilled (feet)	Original Surface Elevation MLW (feet)	Static Water Table Elevation (feet)	Approximate Elevation of Screenable Water Bearing Soils Top (feet)	Approximate Elevation of Screenable Water Bearing Soils Bottom (feet)	Test Well Screen Size Dia. (in.)	Test Well Screen Size Length (ft.)	Test Well Screen Size Slot (in.)	Maximum Production (gpm)	Test Well Drawdown (ft)	Specific Capacity (gpm/ft of drawdown)	Radial Influence of Well (ft.)	Coef. of Perm. (gals/day per sq.ft.)	Remarks
ON SITE BORINGS AND WELLS															
Observation #1	6	140	132.5	+36.5	+18.5	- 6.5	5-5/8	5	.018	--	2.2	--	--	--	Located 80 feet from TW 4
Observation #2	6	175	128.0	+38.0	--	--	--	--	--	--	--	--	--	--	
Observation #3	6	143	128.0	+36.5	+ 7	-12	5-5/8	5	.020	--	13.0	--	--	--	Located 30 feet from TW 4
Observation #4	6	164	128.0	+33.5	- 2	- 8	--	--	--	--	--	--	--	--	
Observation #5	6	151	128.0	+40.5	+17	+ 3	5-5/8	5	.050	--	1.6	--	--	--	Located 30 feet from TW 3
Observation #6	6	148	130.0	+39.0	+10		--	--	--	--	--	--	--	--	
Observation #7	6	137	134.0	+38.0	+19	+ 4	5-5/8	5	.018	--	1.0	--	--	--	Located 50 feet from TW 2
Observation #8	6	120	130.0	+39.0	+18	--	5-5/8	5	.018	--	1.3	--	--	--	Located 30 feet from TW 2
Test Well 1	10	135	128.0	+38.0	--	--	--	--	--	NG (not tested)	--	--	--	--	
Test Well 2	10	130	133.0	+35.0	+19	+ 6	9-5/8	3 10	.050 .016	94	27.5	3.4	100-150	214	Radius of influence extrapolated
Test Well 3	10	122	129.0	+39.0	+25	+11	9-5/8	5 6 3	.050 .030 .020	104 104 104	28.5	3.6	100-150	218	Radius of influence extrapolated
Test Well 4	10	146	129.5	+35.5	+ 5.5	-14.5	9-5/8	20	.018	183	47.0	3.9	100	194	Radius of influence extrapolated
VICINITY BORINGS AND WELLS															
Standard Oil (1) (2) (3)	6	171	150±	+26	+ 2	-21	5-5/8	10 10	.010 .014	100	10	10.0	--	--	Wells 1 and 3 reportedly same as 2. Water has high iron content.
Chugach Electric (1)	10	173	150±	+28	-13	--	9-5/8	10	.010	60	14	4.3	--	--	Reportedly started pumping hot water after earthquake.
(2)	10	173	150±	+28	-13	--	9-5/8	10	.010	60	16	3.8	--	--	
(3)	10	183	150±	+28	-12	--	9-5/8	10	.010	150	--	--	--	--	This well was acidized in 1965 when screen became clogged. Water has high iron content.
Rig Tenders (1)	6	200	30	+19	-25	-40	5-5/8 5-5/8	5 10	.014 .020	135	22	6.1	--	--	Water high in iron.
(2)	10	60	30	+10	-10 -22	-18 -30	9-5/8 9-5/8	8 8	.012 .020	200	38	5.3	--	--	Same as above.
(3)	10	70	30	+15	- 3	-16	9-5/8	13	.012	100	28	3.6	--	--	Same as above.
(4)	10	80	30	+12	0	-26	9-5/8	26	.016	--	--	--	--	--	Pump test not completed to date.
Phillips Petroleum (1)	6	245	115±	+72 +70	+72 -11	+38 -100	--	--	--	800-1000 (est.)	--	--	--	--	No pump test to date. Water high in iron. Not tested.
(2)	6	287	132±	--	+38	+31	--	--	--	N.G.	--	--	--	--	Not tested.
(3)	6	--	--	--	--	--	--	--	--	N.G.	--	--	--	--	Not tested.
(4)	6	245	--	--	--	--	--	--	--	600-800 (est.)	--	--	--	--	Not tested.
Kenai Pipeline	6	79	135±	+96	+67	+56	5-5/8	10	.020	70	7	10.0	--	--	Red brass screen used.
Cement Plant	8	69	130± 118± MSL	+80	+75	+65	7-5/8	10	.030	150	--	--	--	--	Water high in iron.
Tee Pee	6		130±	--	-80	-81	Perforated Casing			4	--	--	--	--	Took two weeks of pumping to clear water.

* Case closed 9/12/80 for lack of continuous H_2O use in last 5 years however well is still functioning.

NOTES:

1. THE FIGURE NEXT TO THE WELL LOCATION INDICATES THE WELL YIELD
2. NG INDICATES THAT THE CONDITIONS ENCOUNTERED IN THE BORING ARE NOT SUITABLE FOR WELL DEVELOPMENT
3. ON-SITE WELL DATA HAS BEEN ESTABLISHED BY RECORDS TAKEN UNDER DAMES & MOORE SUPERVISION.
4. VICINITY WELL DATA WAS OBTAINED FROM VARIOUS SOURES, VERBALLY AND IN WRITING. THIS INFORMATION MAY NOT REFLECT A HIGH DEGREE OF ACCURACY BUT SHOULD INDICATE GENERAL CONDITIONS.
5. ESTIMATES OF POTENTIAL YIELD OF BORINGS ARE BASED ON INTERPRETATION OF BORING INFORMATION. ACTUAL YIELDS MAY VARY CONSIDERABLY FROM THE ESTIMATES.
6. REFER TO THE WELL INVESTIGATION PLAN, PLATE 2, FOR ADDITIONAL LOCATION INFORMATION OF OBSERVATION AND TEST WELLS.
7. REFER TO THE APPENDIX FOR STAGE PUMP TEST DATA FOR ON-SITE WELLS.

location see following page

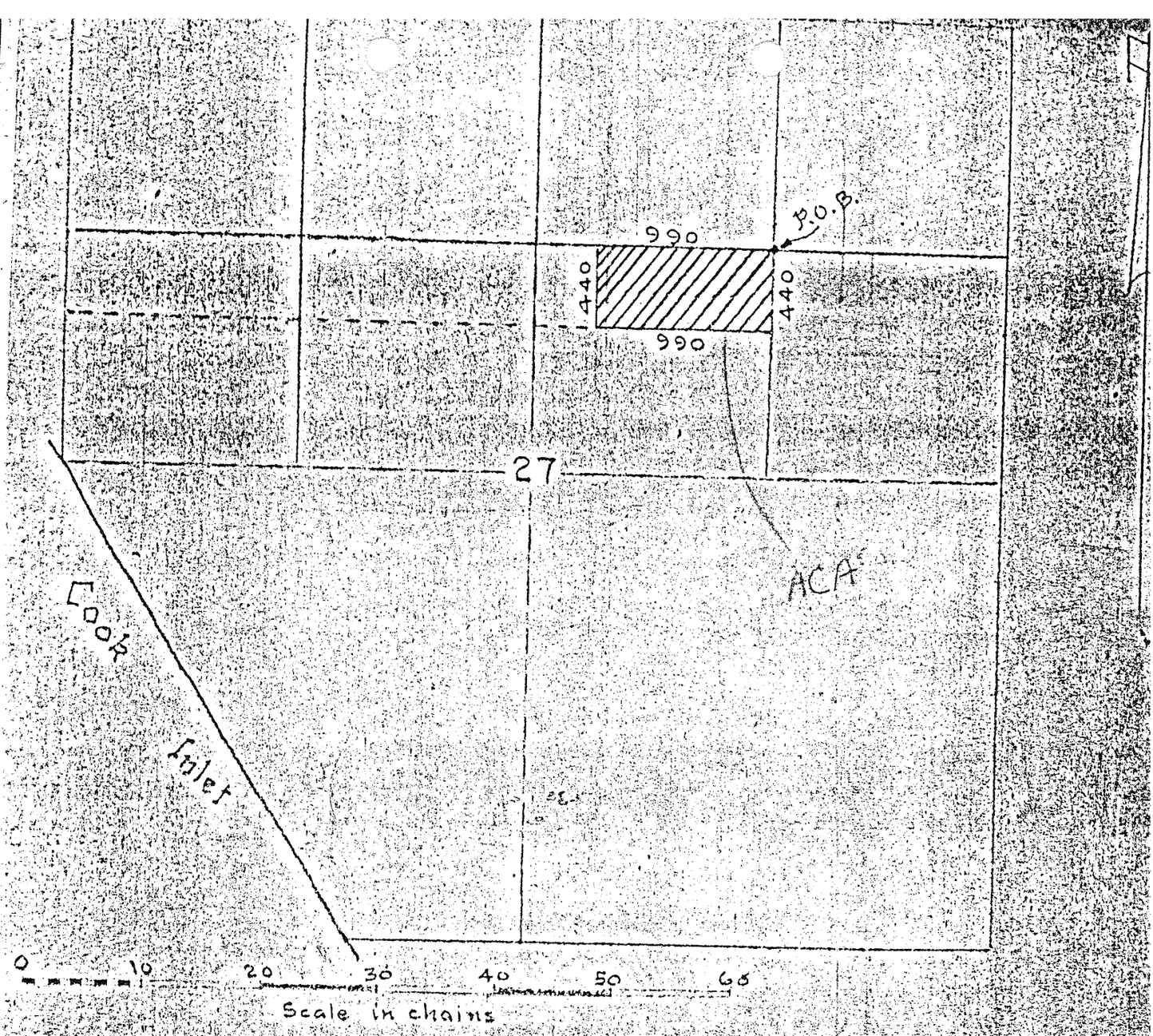
SB 7-12-27 ACAA1-9

DATA SUMMARY

WELLS AND EXPLORATIONS AT THE SITE AND IN THE VICINITY OF THE SITE

FEET

350 0 350 700



A tract of land lying in the SW¼NE¼ Sec. 27 T. 7 N. R. 12 W. of S. M., Alaska more particularly described as follows:

"From the NE corner of said SW¼NE¼ run Westerly along the North line of said SW¼NE¼ for 990 feet; thence Southerly for 440 feet; thence Easterly parallel to said North line of said SW¼NE¼ for 990 feet to the East line of said SW¼NE¼ thence Northerly along said East line for 440 feet to the Point of Beginning, containing in all 10 acres more or less."

Please Copy & Return for our files.

February 19, 1965

FOR CHESTER H. SO

SHEET No. 2 OF 3 SHEETS

LOCAL #SB-12-14-AACC 1-7
SITE ID 6042071519310 1

(AHL 80178)

"SGS SITE ID
LOCAL NO. SB 7-12-14 A ~~AD~~ CC 672

got ADL # from John in Kenai DNR office

Post Office Box 158
Kenai, Alaska 99611
June 7, 1977

Douglas Olson
Post Office Box 58
Kenai, Alaska 99611

Dear Mr. Olson:

Block 1 GOVT LOT 3

The following is a log of the well dug on your Island Lake property, Lake Shore Estates, Lot 15, E½ NW¼ NE¼ Section 14 Township 7N Range 12W Seward Meridian. ↑wrong

5/27/77	0-31'	0-12'	Gravel
		12-14'	Gravel & small amount of clay
		14-31'	Gravel
		31'	water
5/28/77	31-36'	31-36'	water with gravel
		36'	finished here in order to have a 5' head of water.

Pumped over an hour at 15 gallons a minute and the well never went dry.

Thank you very much for the opportunity to be of service.

Yours very truly,

DNRC Enterprises

Rex D. Bennett

RDB/esb

CUSTOMER'S COPY

11188

WELL CONSTRUCTION LOG

Drilling Co. Northland Drilling USGS no.

Driller Roger Hicks Type of rig B-E Cable Date well completed 7-13-77

Well owner Jerry May Nearest community

Well location: (address & legal description) ~~Lot 6 Block 1~~

Lot 6, Block 1, Lakeshore Estates Subd, well w/in SW¼ SE¼ NE¼ NE¼ Sec. 14, T 7N, R12W, SM.

Location sketch or remarks

N63-0604206.7
W07-1511917.0

Depth of well 59 ft. Casing: depth 60.6 ft. diam. 6 in.

Static water level 48 ft. (above, (below) land surface. Date 7-13-77

Finish of well: (open-end, screen, perforated, open-hole, other)

Describe intervals and size: Good Bottom

Well yield tested by (pumping (bailing, air) at 1.2 gal/min.

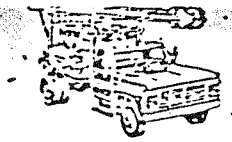
for 1 hours with 4 ft. of drawdown from static level.

DRILLER'S MATERIAL LOG

Depth below land surface in feet	Give description of strata penetrated (size of material, color, hardness of drilling, and water content)
0 to 7	Top soil w/ Rocks
7 to 10	Rocks w/ Sand
10 to 18	gravel
18 to 21	gravel
25 to 39	gravel w/ Sand
39 to 41	clay w/ rock
41 to 53	small amount of water in gravel
53 to 55	clay
55 to 59	good gravel water
to	
to	
to	
to	
to	
to	
to	
to	
to	
to	
to	
to	
to	

cc: DGGS 7/85

CAS 2955



13635

WS & S Co.

WATER SYSTEMS & SERVICE

Rt. 1, Box 1517 Kenai, Alaska 99611

Dated this 29th day of July, 1982

Veal Construction
Box 8306 NRB
Kenai, AK 99611

Owner: John + Debra Yanek

Dear Sir;

The following is a well log located on Lot 1 Block 1
BELUGA SHORES No 2
in the Kenai Recording District. The owner at the time water well was requested TIM VEHL.

0	to	3	feet topsoil
3	to	33	feet gravel no water
33	to	43	feet sand and gravel water formation
	to		feet

Submersible pump was ~~wasn't~~ installed as requested
Screen ~~was~~ wasn't installed as requested and/or necessary
Well yield ~~was~~ wasn't tested by ~~pumping,~~ bailing at 20 gpm

We have been pleased to serve your water needs and if you have any further questions, problems, or comments please don't hesitate to call or write.

Sincerely,

Kenneth D. Dyer

KENNETH D. DYER
Owner

kd/dd

SB 07-12-26 DBAA

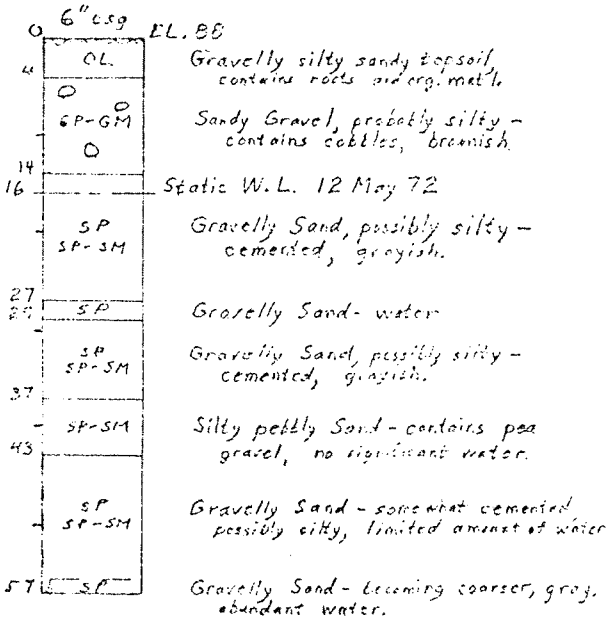
LAS 9968

cc: DGGS 11/86

1788

WELL - BERNICE LAKE CAMPGROUND

SW¼ of SE¼ of Sec. 15, T 7 N, R 12 W, S.M.



Well drilled 10-12 May 1972

by Alaskan Enterprises (Floyd Howell, driller).

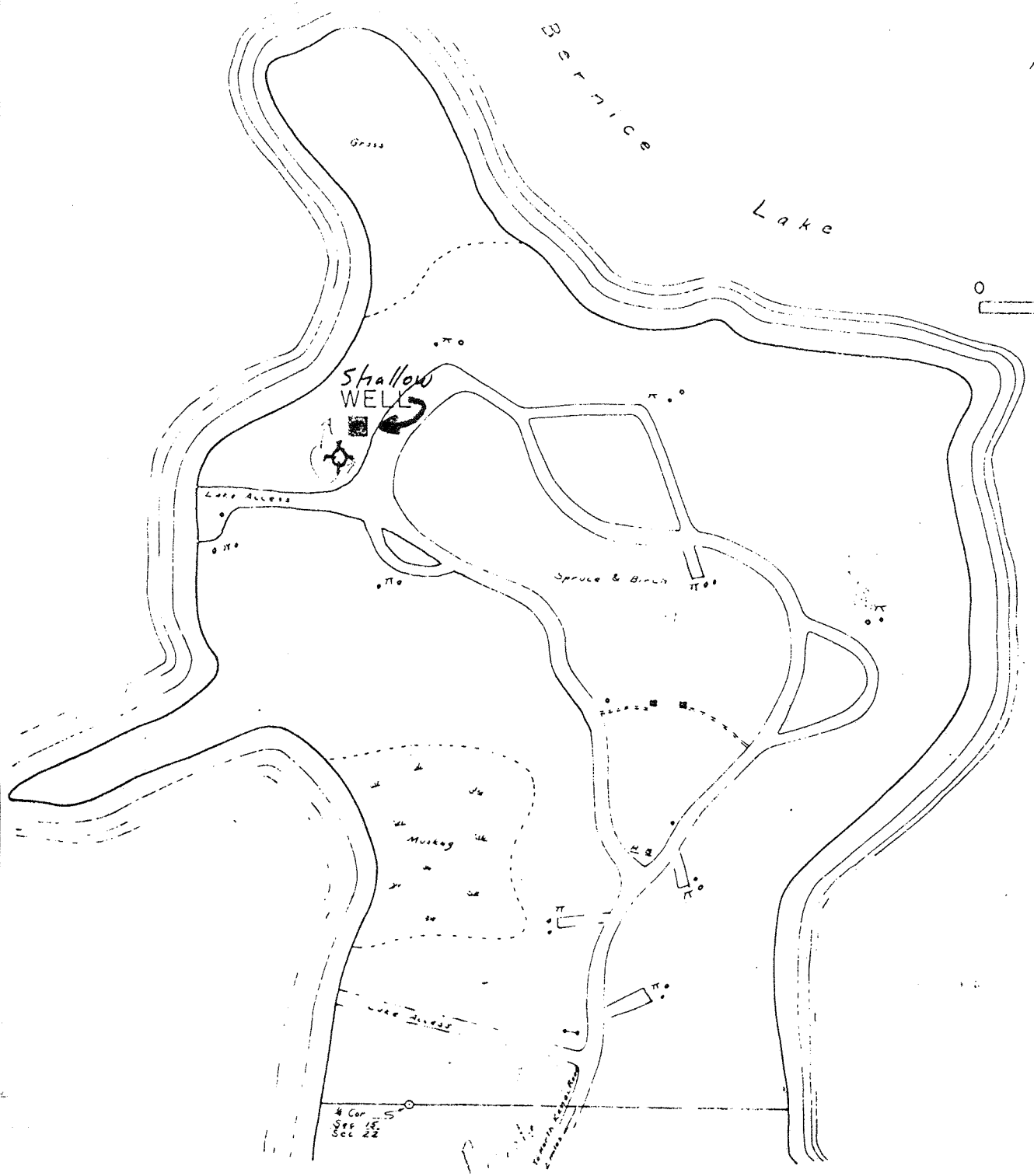
Open end casing. Well developed by cleaning out with a sand pump, then bailing until bottom stabilized at lower end of casing. Well was pumped at 20 gpm for an hour - water discharged clean, with only a few scattered sand grains.

Bail-tested at 38 gpm, 5 ft. drawdown.

SB 7-12-15 DcBC 1-4
604133 1512148

88L1

NK20



BERNICE LAKE CAMPGROUND

Lot 6, Section 15, T 7N, R 12W, S.M.
7.35 Acres
June 1962 Drawn by - A. Olson

0 300 FEET

Legend

- Brass Cap Monument
- Campground Boundary
- Entrance Sign
- Table
- Fireplace
- Toilet
- Registry Box
- Bulletin Board
- Trash Barrel
- Timber Type Line
- Roads
- Foot Trail
- Muskeg
- Lake Shore

deep well

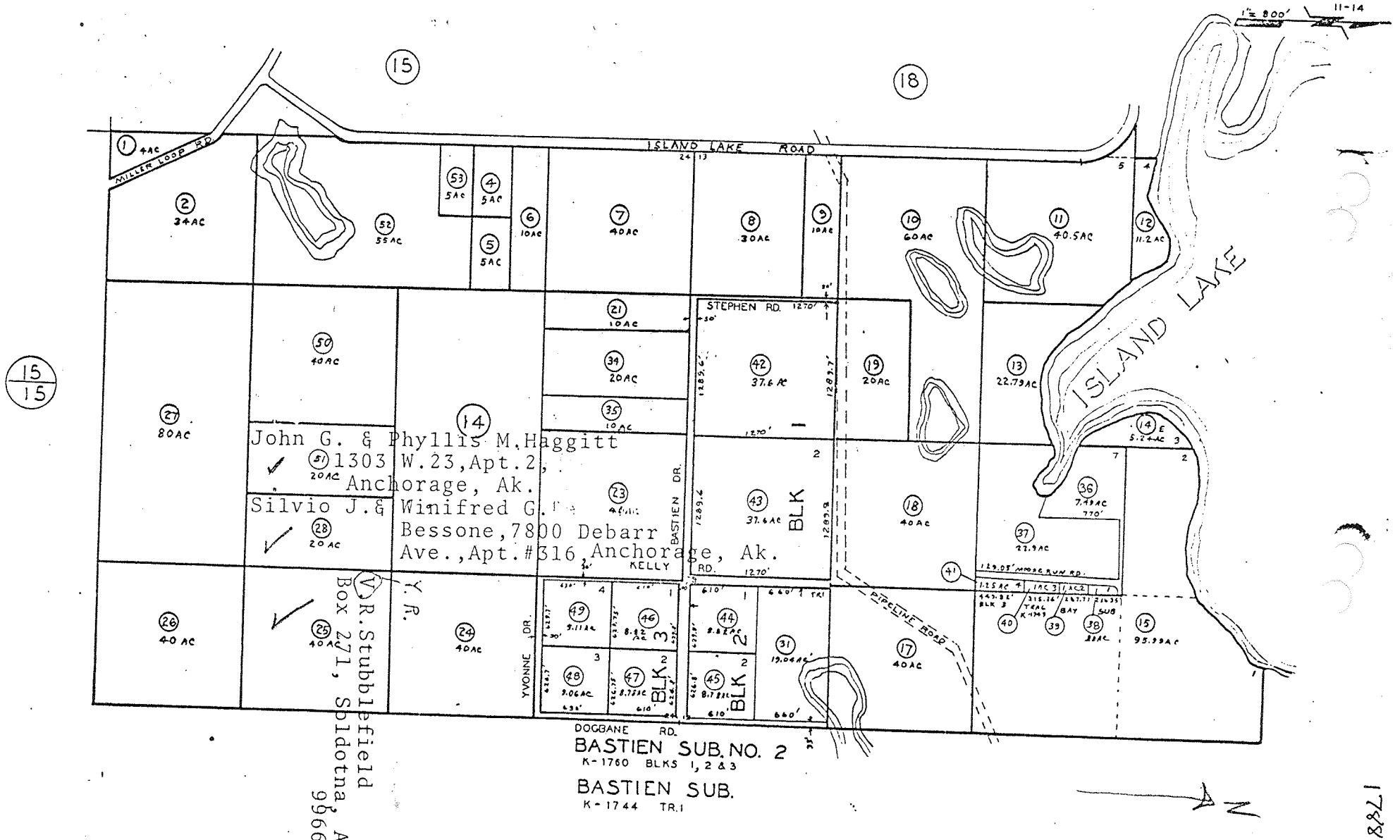
shallow well

N

SB 7-12-24 ADC = (25)
ACD = (28), 5A

SEC. 13 & (24) T. 7 N. - R. 12 W. - S. B. & M.

14-13



John G. & Phyllis M. Haggitt
1303 W. 23, Apt. 2,
Anchorage, Ak.

Silvio J. & Winifred G. De Bessone, 7800 Debarr Ave., Apt. #316, Anchorage, Ak.

V. R. Stubblefield
Box 271, Soldotna, Ak. 99669

Y. R.

BASTIEN SUB. NO. 2
K-1760 BLKS 1, 2 & 3

BASTIEN SUB.
K-1744 TR. 1

NOTE — Assessor's Block Numbers Shown in Ellipses
Assessor's Parcel Numbers Shown in Circles

Kenai Peninsula Borough, Alaska
NIKISKI 26

8821

INSUFFICIENT LEGAL INFORMAT

1343

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

RECEIVED
JUN 4 1982
Div. Of Geological & Geophysical Surveys
Anchorage

DRILLING LOG

Well Owner Union Chemical Use of Well Commercial

Location (address of: Township, Range, Section, if known; or distance main road

Well # 13/2-8

Size of casing 8" Depth of Hole 153 feet Cased to 153 feet

Static water level 70 ft. (above) (below) land surface. Finish of well (check one) open end (X); Screen ( ); Perforated ( ).

Describe screen or perforation None

Well pumping test at gallons per (hour) (minute) for hours with ft. of drawdown from static level.

Date of completion November 24, 1981 Well abandoned for insufficient yield

WELL LOG

Depth in feet from ground surface	Give details of formations penetrated, size of material, color and hardness
0 TO 2	Casing stickup
2 TO 10	Tan silty gravel
10 TO 45	Brown silty gravel (damp)
45 TO 67	Sand and gravel (damp)
67 TO 80	Gray clay and gravel
80 TO 84	Sand and gravel (damp)
84 TO 98	Gray clay with traces of gravel
98 TO 99	Gray clay sand and gravel (damp)
99 TO 102	Sand, clay and gravel (damp)
102 TO 104	Sand and gravel (damp)
104 TO 106	Silty sand clay, waterbearing
106 TO 109	Wet silty sand
109 TO 112	Silty sand, some gravel, waterbearing
112 TO 113	Wet sand and gravel
113 TO 115	Wet sand and gravel

Wayne E. Matthews
NWWA Certified Contractor
Certificate No's. 814 & 973

776-8121
Union Chemical

INSUFFICIENT LEGAL INFORMA

1242

M-W DRILLING, Inc.
P. O. Box 4-1224 • 1310C International Airport Road
(907) 274-4611
ANCHORAGE, ALASKA 99509

DRILLING LOG

Well Owner Union Chemical (page 2) Use of Well Commercial

Location (address of: Township, Range, Section, if known; or distance main road

Size of casing Depth of Hole feet Cased to feet

Static water level ft. (above) (below) land surface. Finish CONTINUATION ( );

Screen ( ); Perforated ( ).

Describe screen or perforation

Well pumping test at gallons per (hour) (minute) for ft. of drawdown from static level.

Date of completion

WELL LOG

Depth in feet from ground surface			Give details of formations penetrated, size of material, color and hardness
115	TO	117	Wet gravel
117	TO	127	Gray silty sand, waterbearing
127	TO	138	Gray silty clay, some gravel, waterbearing
138	TO	140	Gray silty sand w/traces of gravel, waterbearing
140	TO	~~153~~ 151	Gray silty sand and gravel, waterbearing
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		

Wayne E. Westberg

NWWA Certified Contractor
Certificate No's. 814 & 973

SOLDOTNA DRILLING CO.
WATER WELL CONTRACTORS
P. O. Box 351
SOLDOTNA, ALASKA 99669

OCT 3 1974 DJW

DATE October 3 19 74

Collier Carbon & Chemical Corporation

Well Logs for Test Bores

	Test Bore # 8	
0'	12'	Silty Sand & Gravel
12'	34'	Gravely Sand
34'	58'	Sandy Gravel--Slightly Cemented
58'	66'	Silty Fine Sand
66'	70'	Fine Sand w/Lignite chunks--water
	Test Bore #9	
0'	31'	Gravely Sand
31'	56'	Sandy Gravel--cemented
56'	64'	Sand w/Lignite bits
64'	70'	Fine Sand--water
	Test Bore #10	
0'	10'	Gravely Silty Sand
10'	30'	Gravely Sand
30'	62'	Sandy Gravel--Cemented
62'	70'	Fine Silty Sand w/Lignite--water
	Test Bore #11	
0'	4'	Top Soil
4'	36'	Gravely Sand
36'	69'	Sandy Gravel
69'	75'	Fine Silty Sand--water
	Test Bore #12	
0'	4'	Top Soil
4'	35'	Gravely Sand
35'	61'	Sandy Gravel
61'	70'	Med.-Coarse Sand
70'	75'	Fine Silty Sand--water

SOLDOTNA DRILLING CO
WATER WELL CONTRACTORS
P. O. Box 351
SOLDOTNA, ALASKA 99669

DATE August 28, 19 74

Well Logs for Test Borings

#1 Test Bore		
0	31'	Gravely Sand
31'	48'	Sandy Gravel-partially cemented with iron oxide--reddish brown
48'	61'	Gray sand & Lignite Particle
61'	66'	Silty Sand
66'	73'	Fine Sand--water bearing
73' 6"		Clay--Blue Gray
#2 Test Bore		
0	27'	Gravely Sand
27	55	Sandy Gravel--Cemented-Red-Brown
55	63	Sand W/lignite Particale
63	71	Med. to course sand-water
# 3 Test Bore		
0	36'	Gravely Sand
36	57'	Sandy Gravel--Cemented--Red
57	64	Sand & Lignite
64	70	Water Bearing find Sand
71		Solid Clay
Test #4 Bore		
0	6'	Over burden Soil
6	34	Gravely Sand
34	46	Sandy Gravely-Partly cemented
46	61	Grey Sand-Small gravels & Lignite bits
61	72	Find Sand-greyish Water
73		Clay Blue Grey

SOLDOTNA DRILLING CO
WATER WELL CONTRACTORS
P. O. BOX 351
SOLDOTNA, ALASKA 99669

DATE August 28 19 74

Well Logs for Test Bore

# 5 Test Bore		
0	33'	Gravely Sand
33	48	Sandy Gravel -- Cemented with Iron
48	62	Gravely Sand
62	68	Fine Silty sand--water
69		Clay Blue--Grey

SOLDOTNA DRILLING CO
WATER WELL CONTRACTORS
P. O. Box 351
SOLDOTNA, ALASKA 99669

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0'	31'	Gravely Sand	
31'	56'	Sandy Gravel--cemented	
56'	64'	Sand w/Lignite bits	
64'	70'	Fine Sand--water	
		Test Bore #10	
0'	10'	Gravely Silty Sand	
10'	30'	Gravely Sand	
30'	62'	Sandy Gravel--Cemented	
62'	70'	Fine Silty Sand w/Lignite--water	
		Test Bore #11	
0'	4'	Top Soil	
4'	36'	Gravely Sand	
36'	69'	Sandy Gravel	
69'	75'	Fine Silty Sand--water	
		Test Bore #12	
0'	4'	Top Soil	
4'	35'	Gravely Sand	
35'	61'	Sandy Gravel	
61'	70'	Med.-Coarse Sand	
70'	75'	Fine Silty Sand--water	

SOLDOTNA DRILLING CO.
WATER WELL CONTRACTORS
P. O. Box 351
SOLDOTNA, ALASKA 99669

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55	63	Sand W/lignite Particale
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36	57'	Sandy Gravel--Cemented--Red
57	64	Sand & Lignite
64	70	Water Bearing find Sand
71		Solid Clay
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0	6'	Over burden Soil
6	34	Gravely Sand
34	46	Sandy Gravely-Partly cemented
46	61	Grey Sand-Small gravels & Lignite bits
61	72	Find Sand-greyish Water
73		Clay Blue Grey

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# 5 Test Bore		
0	33'	Gravely Sand
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48	62	Gravely Sand
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69		Clay Blue--Grey

[illegible] - [illegible] Press, Inc., North Chicago, Ill.