Province of British Columbia
Ministry of the Environment
WATER INVESTIGATIONS BRANCH

MEMORANDUM

Mr. A. P. Kohut
Senior Geological Engineer
Groundwater Section

Date: October 5, 1979

File: NTS 92F

Re: Proposed Vancouver Island Fish Hatchery
- Groundwater Supply (Fanny Bay to Nanoose Bay)

INTRODUCTION

The following report is the result of a preliminary groundwater study of the area from Fanny Bay to Nanoose Bay (Figure 1). This study includes an office review of available groundwater data such as geologic maps, aerial photographs, well records and previous groundwater reports, as well as the results of a field investigation of selected areas. Cost estimates for test drilling required to prove-up the groundwater supply capability of site specific areas are also discussed.

Figure 1 shows the general region of groundwater investigation and the four specific areas in which the groundwater geology, groundwater potential and recommendations for further exploration and development are discussed in detail. These specific areas were chosen on the basis of the surface water supplies which may be available to supplement the potential groundwater source(s) in order to meet water requirement of approximately 30 cfs, needed for fish rearing.

AREA 1 - MUD BAY

A. Wilfred Creek - Waterloo Creek

Surficial Geology:

The surficial geology of the entire study area has been mapped by Fyles (1963) and serves as a basis of locating potential groundwater reserves in the area. According to Fyles (1963), "the largest groundwater reserves in the area are contained in recent alluvial deposits, terraced fluvial and deltaic deposits, glacio-fluvial deposits, and in Quadra and other sediments beneath the Vashon drift." The sand and gravel within these deposits are the principal aquifer materials that are permeable enough to transmit substantial amounts of water to wells. Figure 2 has been prepared from the surficial geology map by Fyles (1963) and outlines the principal areas of sand and gravel deposits that may contain substantial groundwater reserves.

It can be seen that the Waterloo Creek and Wilfred Creek terraced fluvial and deltaic sand and gravel deposits appear extensive and would naturally contain much groundwater. However, the amount of groundwater in storage is primarily based upon the saturated thickness of the deposit. The presence of many springs around the sloping margins of the terraced fluvial deposit suggests that the water level is at less than the 100 ft. elevation, which suggests that the water level further inland may be as deep as several hundred feet.

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. 2

Well Log Data:

The well log data for the Wilfred Creek - Waterloo Creek area is sparse. The available data shows that most wells, located in the deltaic areas are shallow dug household wells with low yields, and the water levels are near ground surface. The only outstanding groundwater anomaly in the area is a spring, locally known as "Gunter's Spring", which has a reported yield of approximately 600 USgpm.

Approximately one mile upstream of the mouth of Waterloo Creek, a test hole was drilled 20 years ago for the Village of Qualicum and penetrated 482 feet of surficial materials. According to the driller's log, the test hole encountered an excellent gravel aquifer between 265 and 325 feet below ground level, but was never pump tested to prove its potential.

Conclusions and Recommendations:

Based upon the extent of permeable sand and gravel in the area of Wilfred Creek and Waterloo Creek and the presence of springs, as well as an indication of a potentially excellent gravel aquifer at depth, the possibility of encountering a moderate to high yielding aquifer appears good. It is therefore recommended that a test hole be drilled in the location as shown on Figure 2, and a pump test performed to determine the potential yield.

B. Rosewall Creek

Surficial Geology:

The deltaic and terraced fluvial sand and gravel deposits as outlined in Figure 2 contain the greatest potential groundwater reserve for this watershed.

Well Log Data:

The Federal Department of Fisheries have two medium capacity wells in the Rosewall Creek delta, not far from the east shore of Mud Bay. The logs of the wells show sand and gravel to approximately 60 feet depth and a static water level less than 15 feet below ground level. The wells were pump tested up to 610 USgpm.

Conclusions and Recommendations:

The potential for further groundwater development within the deltaic and terraced fluvial deposits of Rosewall Creek is very good. A tentative site for a test well is shown in Figure 2. This site is based upon accessibility by a drilling rig.

C. Chef (Cook) Creek - McNaughton Creek

Surficial Geology:

According to Fyles (1963), Chef Creek has incised the unconsolidated terrace deposits and exposed tills overlying older sands which in places overlies bedrock. In a recent site investigation, small springs were seen flowing from the base of the older sands along the Chef Creek valley; thereby, indicating that the sub-till deposits seem to contain some groundwater. The amount of groundwater, however, depends upon the thickness of the water-bearing deposits. From a site investigation of a deep gravel pit (just west of Chef Creek and the B.C. Hydro R/W) within the upper terrace deposits, it was observed that the sand and gravel deposit was dry to a depth of about 60 feet. This suggests that the terraced deposits may not be water-bearing for most of its thickness. However, the recent alluvial deposits bordering the sea may contain a substantial reserve of groundwater. The water table in these deposits lies within several feet of the surface. Depending upon the thickness of the water-bearing sands and gravels, these deposits may constitute a significant groundwater reserve in this area.

Well Log Data:

There are no records of wells drilled in this area.

Conclusions and Recommendations:

Based upon the results of wells drilled and tested in the deltaic deposits of Rosewall Creek, the possibility of similar yields from the deltaic sand and gravel deposits of the Chef - McNaughton Creeks is good. A shallow (less than 100 feet deep) test hole is suggested and its location is shown in Figure 2.

AREA 2 - QUALICUM RIVERS

A. Qualicum River

Surficial Geology:

According to Fyles (1963), "the valley of Qualicum River is cut into or through the sand unit of the Quadra sediments for much of its length. Seepages and springs emerge from the base of the sand about 150 feet above sea-level in many places along the valley walls. The sands of the Quadra sediments . . . contain large reserves of groundwater." In Figure 3, the areas which are underlain by sand and gravel deposits are outlined. These areas represent the most obvious sources of groundwater potential.

Well Log Data:

The Federal Department of Fisheries have several shallow wells, (less than 100 feet deep) that were drilled in the deltaic deposits along

. 4

the Qualicum River. These wells have reported yields of between 200 and 400 USgpm, with very little drawdown and a water table near the surface. The recharge to these wells is probably in part from the Qualicum River.

Conclusions and Recommendations:

The potential for further groundwater development in the deltaic deposits of the Qualicum River appears to be very good. However, test drilling and pumping tests to date have only proven-up medium capacity wells in the area and therefore further drilling and testing may not be any more successful.

B. Spider Lake Area

Surficial Geology:

According to Fyles (1963), Spider Lake is situated on a kame-ice contact delta deposit which consists of very permeable sands and gravels. The deposit may locally exceed 50 feet in thickness and therefore, contain substantial amounts of groundwater. The level of the water table is probably about the same level as the lake, which occupies the largest kettle in the area.

The source of recharge to this gravel terrace, other than precipitation, is not known yet. The level of Spider Lake appears to be somewhat higher than the Qualicum River or Horne Lake, thus suggesting that the natural groundwater gradient is from Spider Lake toward Horne Lake. There is also the possibility that the gravel terrace is very thin and overlies a till deposit thus causing localized high water table conditions.

Conclusions and Recommendations:

There is no available subsurface data from drilled wells or geophysical surveys in the area of Spider Lake and hence the subsurface conditions are not definitely known. By virtue of the high permeability and large extent of the deposit, as well as the large potential reserve for groundwater, it is suggested that a test hole be drilled in the area to ascertain the subsurface conditions of the gravel deposit and possibly whether any hydraulic continuity exists between Horne Lake and Spider Lake. A tentative drill site is shown in Figure 3.

C. Qualicum River fan at Horne Lake

Surficial Geology:

The Qualicum River fan at the western end of Horne Lake is an extensive deposit of sand, gravel and cobbles which potentially contains a very substantial amount of groundwater. It is expected that large yields can be obtained from shallow wells (less than 100 feet deep) penetrating the fan deposit. The water table is probably at or near the level of the river.

. 5

Comments and Recommendations:

Since there is no subsurface data available for this area, it is recommended that a test hole be drilled in the fan to ascertain the nature and depth of the subsurface material and a pump test performed to determine aquifer parameters. The source of recharge to the fan is from the Qualicum River and possibly from Horne Lake. The site of a test hole is shown in Figure 3.

AREA 3 - LITTLE QUALICUM RIVER

A. River Delta Area

Surficial Geology:

The surficial geology of the area (Fyles, 1963) indicates that the Little Qualicum River delta area is underlain by coarse-textured alluvium in which the water table lies within a few feet of the surface. The delta is underlain for the most part by thick water-bearing sands and gravels and large yields of water can generally be obtained from shallow wells.

Well Log Data:

Most of the wells in the Little Qualicum River area are shallow dug wells of low yields. The Village of Qualicum had several shallow wells drilled adjacent to the Little Qualicum River and about a mile upstream from its mouth. Pump test proved-up 360 USgpm with very low drawdowns.

Comments and Recommendations:

A proven groundwater potential exists in the delta. A tentative test drilling site (see Figure 4) has been located across the river from the Village of Qualicum well, for further proving-up of the groundwater reserve.

B. Little Qualicum River - Whisky Creek Confluence

Surficial Geology:

The area between the Little Qualicum River and Whisky Creek is underlain by a large terraced fluvial deposit which may contain a substantial amount of groundwater. According to aerial photographs, there appears to be some very large springs issuing from the terraced deposits and probably contributing flow to the Little Qualicum River.

Comments and Recommendations:

Without any subsurface data, it is difficult to determine the thickness of the aquifer and thus the actual potential in this area. According to a local driller, a well is presently being drilled in the area for the Federal Department of Fisheries and until the results of

. 6

a pumping test are available no action by way of test drilling or further exploration is recommended in this area at this time.

C. Little Qualicum Falls Park Area

Surficial Geology:

According to Fyles (1963), terraced and knob-and-kettle gravel deposits including delta-like forms similar to the Spider Lake terrace, occupy the Little Qualicum Valley northeast of Cameron Lake. The ice-contact deposits consist, typically, of well-sorted and rounded pebble and cobble gravel and pebbly sand.

Well Log Data:

Only one well is known to have been drilled in the Little Qualicum Falls Park area (Figure 4). Bedrock was encountered at 120 feet and the water level at about 70 feet below the ground.

Comments and Recommendations:

The available data suggests that there is a great abundance of permeable materials in the area. However, according to the log of the Little Qualicum Falls Park well, the terraced gravel and sand deposit is mostly dry. Further groundwater exploration for high capacity wells in this area is not suggested at this time.

AREA 4 - ENGLISHMAN RIVER

A. Deltaic Area

Surficial Geology:

The Englishman River delta (see Figure 5) consists largely of gravel and sand several tens of feet in thickness. This coarse-textured recent alluvium may contain a substantial amount of groundwater if the deposit is thick (greater than 50 feet).

Well Logs:

Several shallow wells, yielding in excess of 200 USgpm have been constructed in the delta. The water table is within 10 feet of the surface.

Comments and Recommendations:

Moderate yields of water have been obtained from shallow drilled wells in the delta. Similar to the Rosewall Creek deltaic deposit, larger yields may be obtained from properly developed drilled wells where the alluvium is thicker. However, drilling deeper may encounter salt water, or bedrock, which seems to occur at shallow depths. The probability of finding a thick water-bearing section of the alluvium is very low; therefore no further groundwater development is suggested for this area, at this time.

. 7

B. Area Between Highway and Railway Bridge

Surficial Geology:

This area is underlain by coarse-textured deltaic and fluvial sands and gravels which may contain substantial amounts of groundwater.

Well Log Data:

The yields from drilled wells in this area is generally low (less than 50 USgpm). One well encountered bedrock at 91 feet and is simply reported to yield "lots" of water.

Comments and Recommendations:

Based upon the well log data, it appears that the deltaic and fluvial deposits in this area are not very productive. Further exploration is not suggested at this time for this area.

C. Area Between Old Bridge and Confluence of Englishman River and South Englishman River

Surficial Geology:

According to Fyles (1963) this area is underlain by fluvial sands and gravels which may contain substantial amounts of groundwater.

Comments and Recommendations:

As there is a lack of subsurface data for this area, it is difficult to predict how thick the surficial sediments are, and hence the potential groundwater reserve. In a recent field investigation of the area, it appeared that the water table in the alluvium area was close to the surface, which suggests that the sands and gravels in this area are water-bearing. Further testing is needed to ascertain the subsurface conditions and potential. It is suggested that a seismic survey in conjunction with test drilling be undertaken in the alluvial area. A tentative drill site is shown in Figure 5.

COST ESTIMATES FOR TEST DRILLING

The following list of estimated costs for a 150 feet well is based upon the cost in drilling and testing an observation well near Qualicum Beach earlier this year. According to several drilling contractors, the cost of drilling is presently increasing due to increased casing costs, and therefore, a 15% contingency has been added to determine the final estimated cost.

. 8

	ITEM	UNIT COST	EST. COST
1.	Mobilization, set-up, demobilization	Lump Sum	$ 200.00
2.	10 ft. surface casing (8-inch diam., drilled)	$24/ft.	$ 240.00
3.	150 ft, cased drilling (6-inch diam.)	$18/ft.	$2,700.00
4.	Drive shoe (6-inch diam.)	Lump Sum	$ 40.00
5.	8 ft., 6-inch diam. Screen (installed)	$100/ft.	$ 800.00
6.	Well development (24 hours)	$45/hr.	$1,080.00
7.	Standby & hourly work (8 hours)	$40/hr.	$ 320.00
8.	Pump equip. mob., set-up, demob.	Lump Sum	$ 350.00
9.	Pumping & Recovery test (30 hours)	$35/hr.	$1,050.00
		TOTAL =	$6,780.00
		+ 15% contingencies ≈	$1,020.00
		TOTAL ESTIMATED COST =	$7,800.00

PROPOSED TEST DRILLING SITES

In three of the four areas discussed in this report, test drilling in specific areas was recommended. The following list of proposed test drilling sites gives the order of priority (based upon available data) as to the best potential sites for obtaining an adequate groundwater supply to meet an estimated demand of 5 cfs.

1) Qualicum River fan (at Horne Lake)
2) Rosewall Creek delta
3) Wilfred Creek - Waterloo Creek delta
4) Englishman River Floodplain (between the old bridge and confluence of Englishman River and South Englishman River, i.e. area 4C)
5) McNaughton - Chef Creek delta
6) Little Qualicum River delta
7) Spider Lake - Horne Lake area

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Hydrology Division

References

Fyles, J.G. (1963). Surficial Geology of Horne Lake and Parksville Map-Areas, Vancouver Island, British Columbia. Geological Survey of Canada. Memoir 318.

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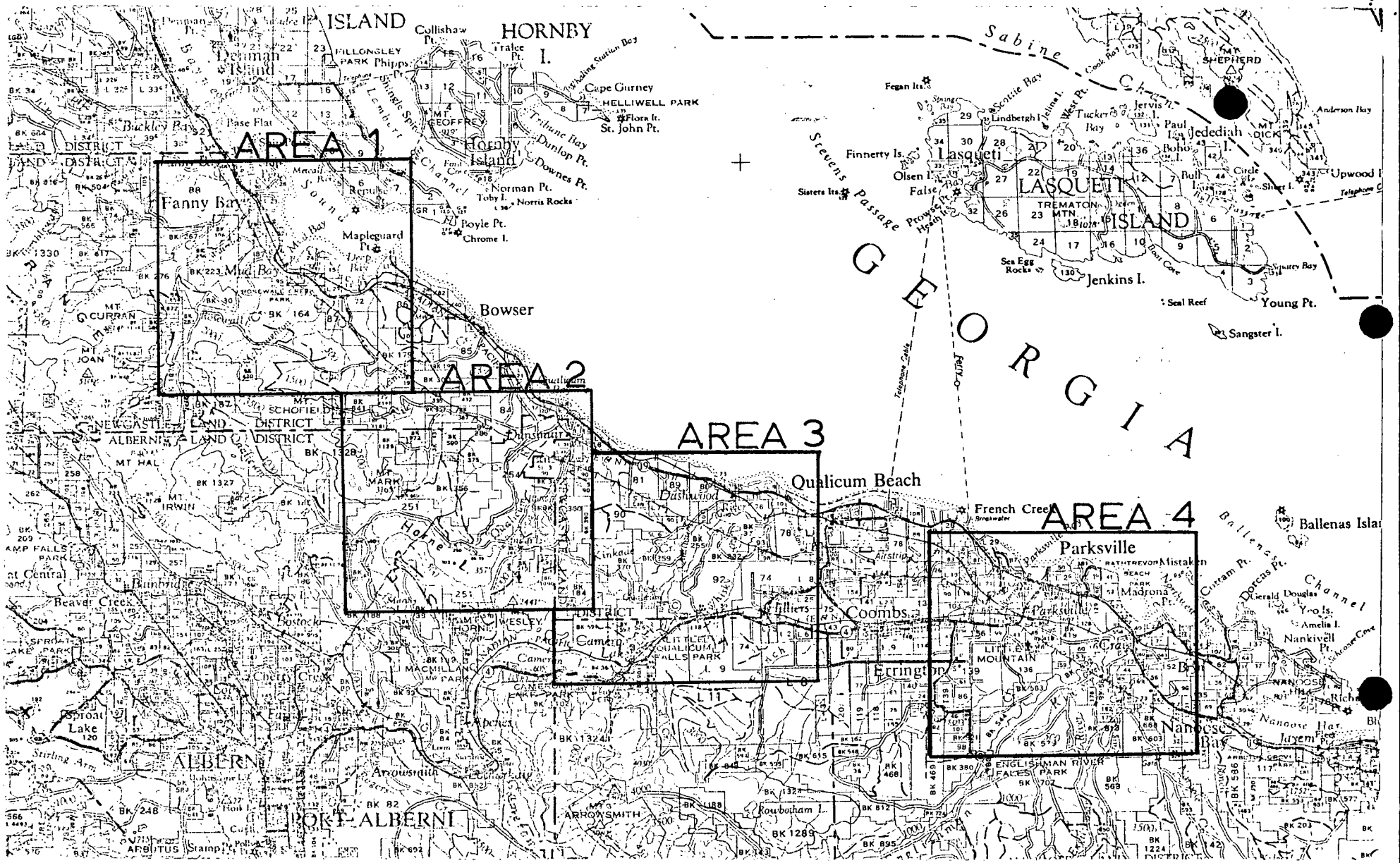

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GENERAL LOCATION PLAN OF AREAS OF GROUNDWATER INVESTIGATION

SCALE: 1 inch = 4 miles

DATE

M. Zubel — ENGINEER

FILE No. NTS-92F DWG. No. FIGURE 1

bcil 6661 wrs

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POTENTIAL GROUNDWATER RESERVES
AREA 1 - MUD BAY

SCALE: VERT. N/A
HOR. 1:50,000

DATE
Oct. 1979

M. Zubel ENGINEER

FILE No. 92-F DWG. No. FIGURE 2

bcil 6660 wrs

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POTENTIAL GROUNDWATER RESERVES
AREA 2 - QUALICUM RIVER

SCALE: VERT. N/A
HOR. 1"=5,000' approx.

DATE Oct. 1979

M. Zubel ENGINEER

FILE No. 92F DWG. No. FIGURE 3

bcil 6660 wrs

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POTENTIAL GROUNDWATER RESERVES
AREA 3 - LITTLE QUALICUM RIVER

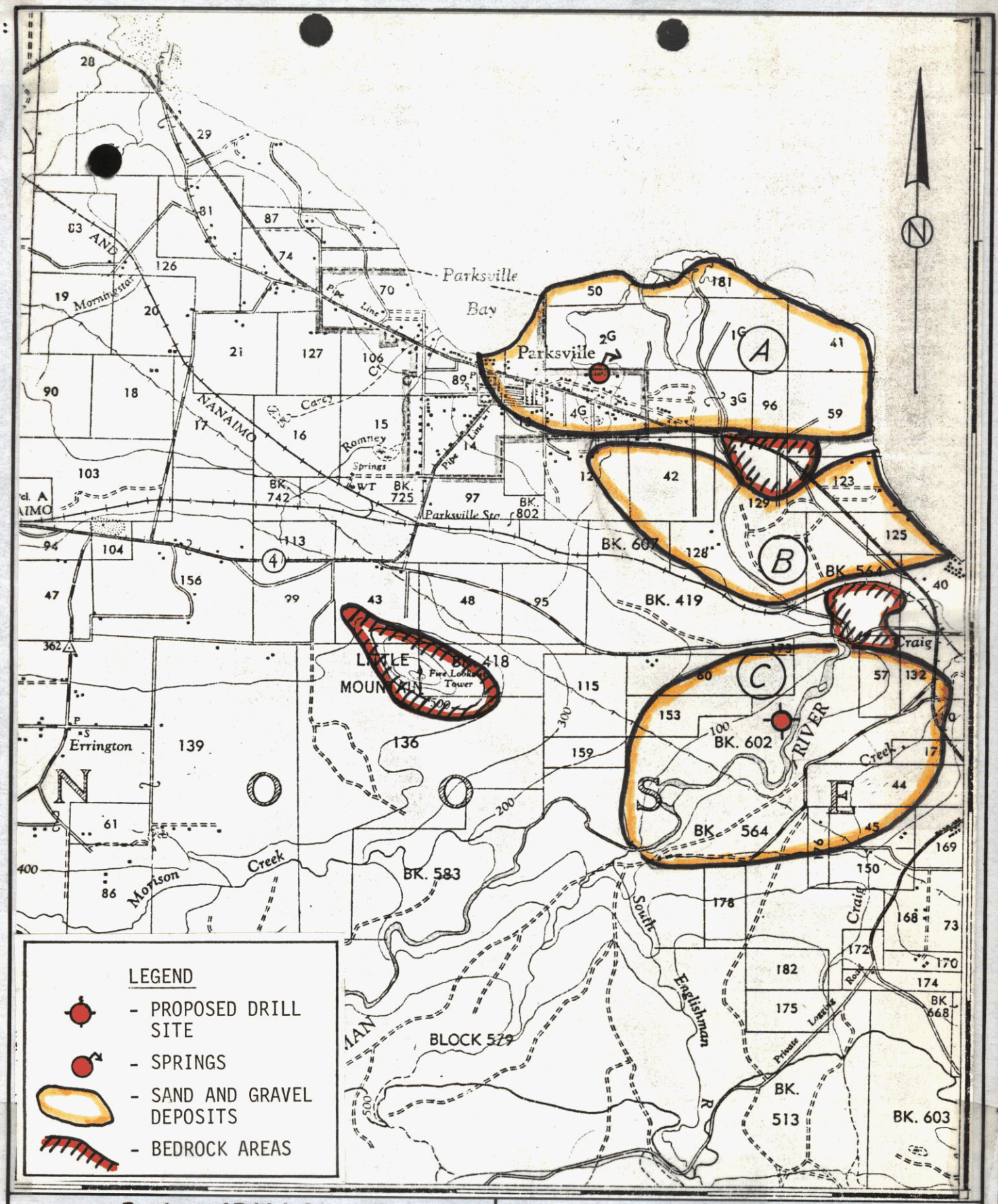
SCALE: VERT. N/A
HOR. 1:50,000

DATE
Oct. 1979

M. Zubel ENGINEER

FILE No. 92 F DWG. No. FIGURE 4

bcil 6660 wrs



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POTENTIAL GROUNDWATER RESERVES
AREA 4 - ENGLISHMAN RIVER

SCALE: VERT. N/A
HOR. 1:50,000

DATE Oct. 1979

M. Zubel ENGINEER

FILE No. 92 F DWG. No. FIGURE 5

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cc John Shirley 15/5/87 BF