REGIONAL GROUNDWATER POTENTIAL FOR SUPPLYING IRRIGATION WATER: 1986 NORTH SAANICH, B.C.

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1. INTRODUCTION

The Ministry of Agriculture and Food in conjunction with the Agricultural Land Commission are involved in a detailed assessment of the agricultural capability of the east coast of Vancouver Island. An analysis of the hydrological data was identified as an important requirement in the above assessment with groundwater being a major component.

This report and accompanying maps provides a discussion and analysis of developed and potential aquifers, for the North Saanich area (Figure 1), based on presently available groundwater and geologic data. The map sheet which covers the study area is 92B.063 (1:20,000 scale) and is identified as Figure 2.

The hydrogeological information, thematically presented on the maps and fence diagram, are based on the tabulated data from approximately 1,500 water well records, water well location maps (both on file with the Groundwater Section, Ministry of Environment), published surficial geology maps and reports (Halstead, 1967; Leaming, 1968; Muller, 1977), terrain maps (Ministry of Environment, British Columbia) and soil maps and reports (Ministry of Agriculture and Food and Ministry of Environment, British Columbia).

Tabulated data from water well records (e.g., aquifer characteristics, depth to bedrock, etc.) were transferred to water well location maps (scale 1:5,000) which were used as a working base. Surficial geology/terrain units and glacial features (e.g., glacial outwash) which were considered hydrogeologically significant in terms of groundwater potential were transferred to these same maps. A synthesis of this data was then transferred to the final 1:20,000 scale base map.

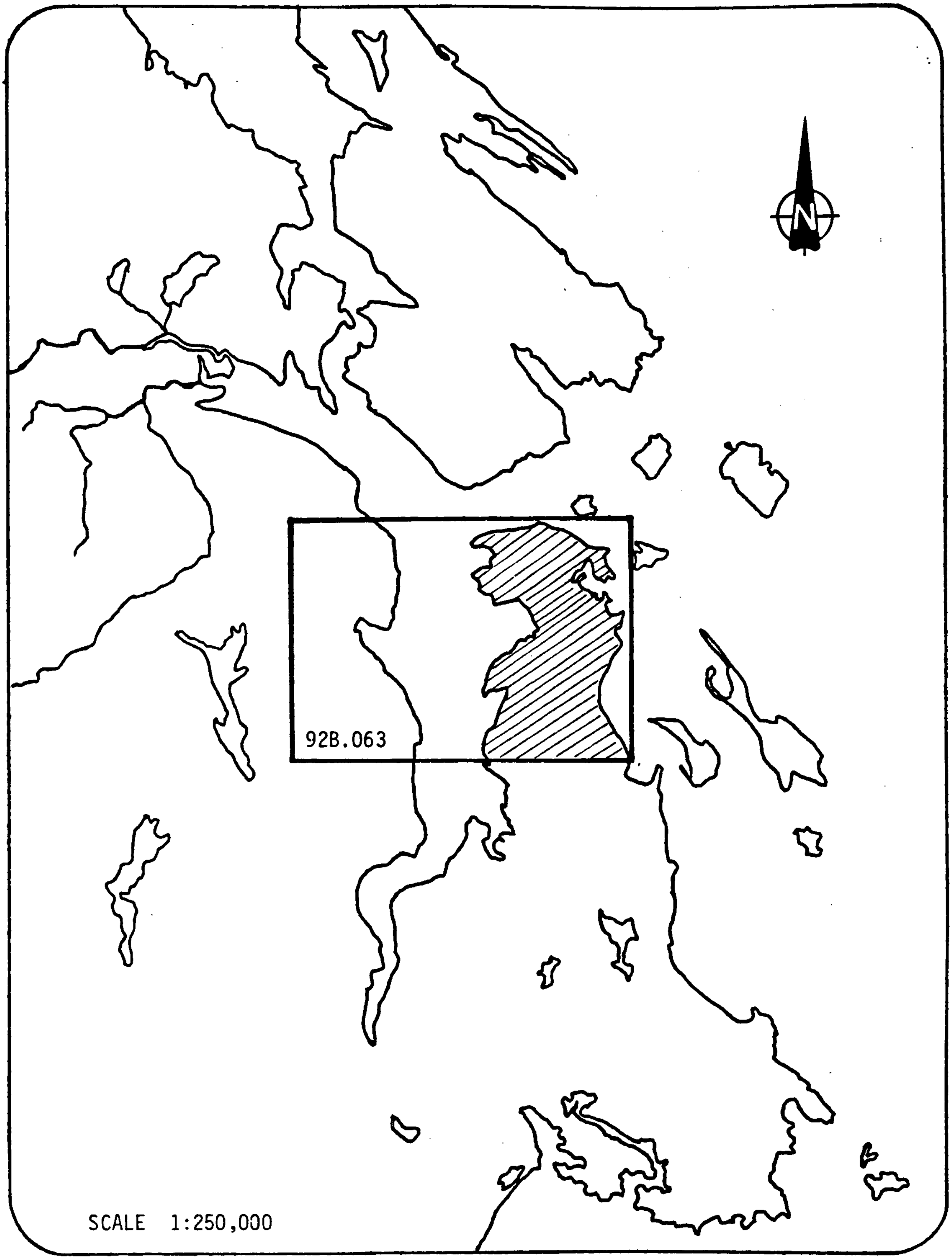


FIGURE 1: Index Map of Study Area

2. PHYSIOGRAPHY

The major geomorphic features of the study area are the result of structural, erosional and depositional processes. Folding and faulting of the bedrock, erosion and repeated glaciation, isostatic and eustatic changes of sea level have all contributed to the physiographic features of the Saanich Peninsula. The topography of the study area consists of a saddle shaped lowland of rolling farmland, marsh and tidal flats bounded by uplands to the north (Cloake and Horth Hills) and south (Mount Newton), and salt water to the east (Haro Strait) and west (Saanich Inlet).

3. BEDROCK GEOLOGY

According to Muller (1977), Vancouver Island is the main component of the Insular Belt, the westernmost major tectonic subdivision of the Canadian Cordillera. The study area contains Lower Mesozoic rocks (Bonanza Volcanics from the Vancouver Group) which are intruded by Middle Mesozoic rocks (stocks of granodiorite of the Island Intrusions). These granodiorites are unconformably overlain by Lower Mesozoic rocks (a succession of conglomerate, sandstone, shale, siltstone, mudstone and coal strata of the Late Cretaceous Nanaimo Group).

4. UNCONSOLIDATED DEPOSITS

Most of the unconsolidated materials found in the study area may be attributed to the regimen and wasting of glacial ice during the Late Pleistocene. Though some of the unconsolidated deposits are the result of interglacial (Cowichan Head Sediments) activity, the majority of the deposited sediments are from the Fraser Glaciation. The Fraser Glaciation probably represents the same geologic-climatic time period as the classical Late Wisconsin Glaciation of the mid-continent region (Alley and Chatwin, 1979). Clapp, (1913), the Ministry of Environment (1961), Halstead (1967), and Fyles (1963) have mapped the surficial unconsolidated sediments within the study area at a scale of 1:62,500, 1:50,000 and 1:25,000 respectively.

A stratigraphic framework of unconsolidated sediments and a chronology of Late Pleistocene environments in the study area, is shown in Figure 3.

5. GROUNDWATER POTENTIAL

5.1 Bedrock

Groundwater within bedrock can be found in fractures, along bedding plane partings, in the inter-flow zones of lava, in the inter-granular openings in the rock, and in the case of limestone, in the channels formed by the dissolution of the rock by water. Water wells drilled on Vancouver Island, indicate fractures, bedding plane partings and solution channels are probably the main sources of groundwater from the bedrock. Of the 1,286 known bedrock wells in the study area, 239 were reported to be completed in sedimentary rocks (shales and/or sandstones) and 969 in granitic rocks (Saanich granodiorite of the Island Intrusions). The bedrock type in 78 wells was not reported.

The rapid accumulation of sediments which make up the sedimentary rocks, accounts for their being poorly sorted, massive and, in general, lacking in pore spaces and conduits for the transmission of water (Halstead and Treichel, 1966). Water wells drilled in these rocks indicate fractures and bedding plane partings are the main sources of groundwater.

The major bedrock groundwater supplies in the study area come from the granitic rocks. Clapp (1913) reported that all intrusive rocks on the Saanich Peninsula are highly fractured and that the Saanich Granodiorite has regular and large joints and fracturing. These large, open fractures

CLIMATIC-GEOLOGIC UNITS, STRATIGRAPHY AND LATE PLEISTOCENE ENVIRONMENTS OF THE STUDY AREA

YEARS BEFORE PRESENT (Not to Scale)	CLIMATIC UNITS	GEOLOGIC UNITS	ENVIRONMENT	STRATIGRAPHY
Present -				
5,000 -	HOLOCENE	SALISH SEDIMENTS	FLUVIAL	Gravel, sand, silt, clay, peat; alluvial fan deposits; blocks and rubble; peat and muck
10,000 -		CAPILANO SEDIMENTS	MARINE AND GLACIO-MARINE GLACIO-LACUSTRINE	Silt, clay, stony clay, sandy gravel generally underlain by clay; stony gravel, stony loam Sand and gravel, laminated silty and clay
15,000 -	FRASER GLACIATION	VASHON DRIFT	GLACIO-FLUVIAL GLACIAL	Gravel, sand and silty forming ice-contact deltas Grey till, sand to clayey texture
20,000 -		QUADRA SAND	GLACIO-FLUVIAL	Sand, gravel and silt
25,000 -				
30,000 -	OLYMPIA NON-GLACIAL INTERNAL	COWICHAN HEAD FORMATION	FLUVIAL ESTURINE MARINE	Silt, gravel, sand, peat, peaty soil, and driftwood Clay, stony clay, silt containing marine shells, local basal laminated clay and silt
60,000 -				
	SALMON SPRINGS GLACIATION ?	DASHWOOD DRIFT ?	GLACIO-MARINE GLACIAL	Grey till, silty to sandy texture contains silty and gravel lenses
? -	PUYALLUP NON-GLACIAL ? INTERVAL	MAPLEGUARD SEDIMENTS ?	FLUVIAL LACUSTRINE	Sand, silt, minor clay and gravel

Figure 3: after Clague (1981, 1977 & 1976) Alley & Chatwin (1979), Armstrong et al (1965) & Halstead (1966)

in the granodiorite extend to depths beyond 200 metres (Al-Mooji, 1982). It is through this network of joints and fractures that groundwater is stored and transmitted. Based on water well log information, the yields from wells constructed in the bedrock are generally low (less than 1 L/s) and large capacity wells are the exception (Zubel, 1980). In places, however, the fracturing can be so great, the rock is unfit for building purposes (Clapp, 1913), in fact, some wells must be screened (the way sand is screened in wells constructed in unconsolidated deposits) (Brown et al, 1976). According to Al-Mooji (1982), there is a general increase of well yields with depth, with the greatest yields observed between 40 and 80 metres, the second highest yields reported between 80 and 140 metres and the lowest yields found between 0 and 40 metres. The higher producing wells are currently located in the lowland areas adjacent to Mt. Newton.

Some bedrock aquifers within the study area are capable of yielding sufficient supplies of groundwater for irrigation purposes. One well is reported to yield over 15 L/s and able to meet irrigation demands. Eight other wells report yields greater than 3 L/s (3 L/s is significant when considering irrigation requirements). One out of every 10 wells report yields between 1 and 3 L/s. By conducting more detailed studies (e.g., on fracture and yield patterns) some of these wells could be targeted for deepening into the 40 to 80 metre zone discussed previously and possibly increasing their productivity. If greater yields were obtained longer duration pumping tests would be required to verify if these bedrock aquifers are capable of a sustained high withdrawal rate.

5.2 Unconsolidated Deposits

Most of the groundwater used on Vancouver Island comes from unconsolidated deposits which receive water from infiltration of either precipitation or surface water sources. The amount of water obtainable from these materials, depends on the permeability of the aquifer material, the thickness and extent of the aquifer, the rate of aquifer recharge and on well construction. Though the majority of the wells in the study area are constructed in bedrock, there are regions where unconsolidated deposits are hydrogeologically significant in terms of groundwater potential for irrigation purposes.

The unconsolidated deposits which are significant are primarily comprised of sand and/or gravel. Thickness of any saturated sand and/or gravel deposit 0.3 metres or greater are considered significant in terms of groundwater potential. The main deposits which fall into this category are listed and discussed below:

1) The glaciofluvial deposits of the Quadra Sediments known as the Quadra Sand (Clague, 1977). The groundwater potential of this geologic unit merits an expanded understanding of its distribution and origin. Overlain by sediments of the Olympia Interglacial interval the current theory on the origin of Quadra Sand is summarized by Clague (1977) below:

   > "The sand was deposited, in part, as distal outwash aprons at successive position in front of and perhaps along the margins of glaciers moving from the Coast Mountains into the Georgia Depression and Puget Lowland during Late Wisconsin time. After deposition at a site, but before burial by ice, the sand was dissected by meltwater and the eroded detritus was transported farther down the basin to sites where aggradation continued."

   The Quadra Sediments are the oldest exposed surficial deposits in the study area. Consisting mainly of horizontally and cross-stratified, well sorted, fine to coarse grained sands with minor gravels and silt (Porter, 1980), the nearest radio-carbon date to the study area shows these sediments were deposited appoximately 22,600 + 300 years before present.

2) The Cowichan Head Formation which underlies the Quadra Sediments. This unit consists of stratified fluvial, estuarine, and marine sediments deposited during an interglacial interval [chronologically placed in the Olympia non-glacial interval (Figure 3)]. Clague (1977) has described this unit as "horizontal beds of silt, sand and gravel, commonly oxidized to reddish hues and containing abundant organic matter. There are occasional known occurrences of this unit in the study area (Porter, 1980).

Units one and two would be hydrogeologically significant in terms of groundwater potential for irrigation purposes. Two major unconsolidated aquifers exist within the study area. For purposes of this report they are referred to as the North Saanich Aquifer and the Sidney Aquifer.

The North Saanich Aquifer is located immediately north of the Victoria International Airport. Consisting mainly of Quadra Sediments (Porter, 1980), drill holes have encountered gravelly material underlying the Quadra Sand which may belong to the Cowichan Head Formation. Wells drilled in this area encountered 20 metres of saturated sand and/or gravel. Though most wells drilled in the study area reported low to moderate yields, greater yields with improved well development are possible. Porter (1980) estimates this aquifer receives approximately 170,000,000 U.S. gallons of recharge yearly. This aquifer is not being extensively utilized and may have good potential for further development.

The Sidney Aquifer is located southeast of Sidney and west of Bazan Bay. Marine erosion has removed the stony clay, till and probably much of the sand in certain areas, and produced a number of distinct terraces in the area. The total thicknesses of the sand and/or gravel deposits exceed 22 metres and the water saturated sands and/or gravels exceeding 6 metres. Refer to the fence diagram in Figure 4 to observe the stratigraphic nature of the deposits and the thickness of the sands and/or gravels found here. Recharge is mainly from precipitation from the northeast slope of Mt. Newton. The experimental farm and local residents which use water from outside the region may contribute a small amount to the recharge of this aquifer through irrigation and septic fields. The main users of this aquifer was the Town of Sidney (which pumped an estimated 30 million gallons per year), a number of farmers and local residents. Sidney and probably a number of the other users are currently supplied with water from the Greater Victoria Water District. With 7 wells reporting yields between 1 and 3 litres per second from this aquifer and many of the former users not utilizing this aquifer there is potential for future development for irrigation purposes. It should be noted that a number of unused wells are already constructed in the aquifer or into the underlying bedrock and may be available for use.

Inset map "A" and "B" of Figure 2 and the fence diagram of Figure 4 reveal some of the complexity of the Sidney Aquifer Area. Please note that blank spaces exist around some water wells in Figure 4 when the lithology was not recorded on the well log. As previously stated 7 wells reported yields between 1 and 3 L/s from the sands and/or gravels and are probably capable of higher yields. In the same area, 25 wells completed in the bedrock aquifer reported yields greater than 1 L/s with 18 wells reporting between 1 and 3 L/s and 7 wells greater than 3 L/s. There may be some interest in investigating the possibility of combining these already developed sources of groundwater (estimated 50 to 100 L/s) for irrigation purposes.

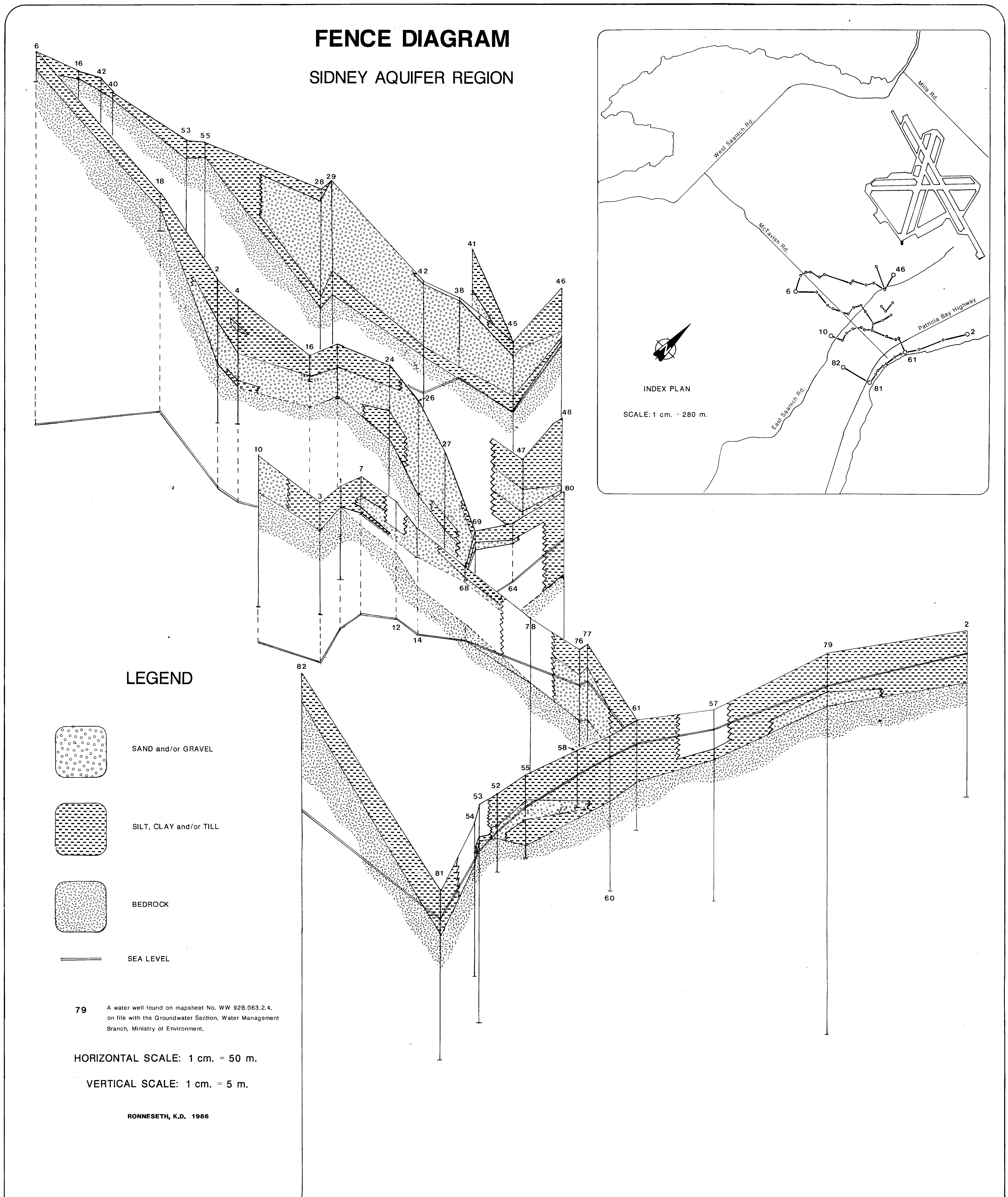
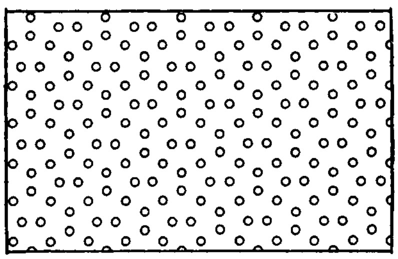


FIGURE 4: Fence Diagram

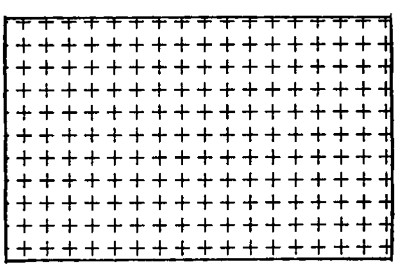
6. EXTENT OF DEVELOPED AND POTENTIAL AQUIFERS

The following is a description of each component shown on the 1:20,000 scale base map (Figure 2).

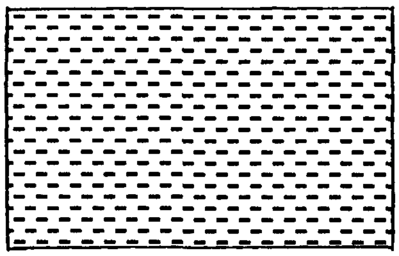


POTENTIAL UNCONSOLIDATED UNCONFINED AQUIFERS: These areas outline the surficial extent of unconsolidated deposits primarily comprised of sand and/or gravels. They outine areas where there is a high probability of locating water-bearing sand and/or gravel aquifers but does imply the existence of water-bearing sand and/or gravel aquifers. In some areas for example the sand and gravel deposits may be very thin and dry throughout their entire thickness.

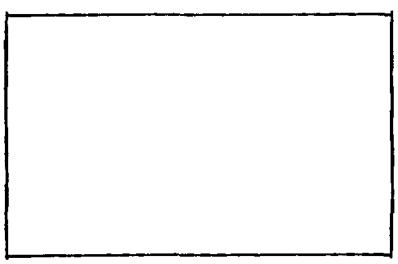
These areas outline potential unconfined aquifers at surface, it does not show distribution at depth. This is especially relevant to the Quadra Sand and possibly to some pre-Fraser Glaciation unconsolidated sediments (e.g., Cowichan Head sediments) which may underlie younger deposits (marine clays for example) in the region.



DEVELOPED UNCONSOLIDATED AQUIFERS: These areas outline where sand and/or gravel aquifers (greater than 0.3 metres in thickness) have been identified at depth based on water well lithology records. These aquifers may be either confined or unconfined. The boundaries of these areas were arbitrarily set at a 100 metre radius from a data point (water well) which identified a sand and/or gravel aquifer greater than 0.5 metres in thickness. Where two wells, located within 400 metres of each other, show similar lithologies and the geomorphology of the area was homogeneous, the boundaries were extended to include the area between the two wells.



LOW PERMEABLE UNCONSOLIDATED DEPOSITS: These areas outline where the unconsolidated deposits at surface (predominantly tills, silts and/or clays) are generally unsuitable as aquifer materials due to their low permeability. However, suitable aquifer materials may and do exist at depth as evidenced throughout these areas where site specific data are available.. Where ground moraine deposits have been mapped in these areas, locally there may be sand and/or gravel deposits found at surface or in lenses at depth. Also, older geologic units (e.g., Quadra Sand) that are significant aquifers may be overlain by the marine and moraine deposits. Productive aquifers may be found in these older geologic units.



BEDROCK AQUIFERS: These areas identify where bedrock is located at or near ground surface and/or where well logs indicate bedrock aquifers. The boundaries for these areas were also arbitrarily set at 100 metre radius from a data point (e.g., bedrock well or rock outcrop). This distance was extended to 400 metres between data points if water well lithology and the surface morphology so warranted.

Water wells where yields greater than 3 L/s have been repoted. When found in known developed unconsolidated aquifer regions, these areas show the highest potential for obtaining groundwater supplies to meet irrigation requirements.

△ Water wells where yields between 1 and 3 L/s are reported. These areas also show high potential for obtaining irrigation supplies of groundwater.

7. WATER QUALITY

The concentration and composition of dissolved constituents in a water determine its quality for irrigation use. Three of the characteristics of an irrigation water appear to be the most important in determining its quality are the total concentrations of soluble salts, the relative proportion of sodium to other cations and the concentrations of boron and other elements that may be toxic.

The total concentration of soluble salts can be expressed in terms of its electrical conductivity and is often expressed as micromhos/cm at 25°C. The higher the concentration of soluble salts and minerals the higher the conductivity. The electrical conductivity of the three laboratory analyses of groundwaters from unconsolidated aquifers were 176, 200 and 200 micromhos/cm. All three of these waters are in the low salinity hazard class (Richards, 1969).

According to Richards (1969):

> "Low salinity water can be used for irrigation with most crops with little likelihood that soil salinity will develop. Some leaching is required, but this occurs under normal irrigation practices except in soils of extremely low permeability."

The electrical conductivity of the 103 laboratory analyses of groundwaters from bedrock aquifers ranged from 167 to 4 780 micromhos/cm. Six of these waters are in the low salinity hazard class, 65 are in the medium salinity hazard class, 28 are in the high salinity hazard class and 6 are in the very high salinity hazard class (Richards, 1969). Figure 5 shows locally the salinity hazard based on groundwater analyses.

According to Richards:

> "Medium salinity water can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control. High salinity water cannot be used on soils with restricted drainage. Even with adequate drainage, special management of salinity control may be required and plants with good salt tolerance should be selected. Very high salinity water is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching, and very salt tolerant crops should be selected."

The concentration of chlorides is another important element in determining the quality of irrigation waters. The chloride levels of five laboratory analyses of the groundwaters from unconsolidated materials ranged from 14 to 32 mg/L. These concentrations would be considered very suitable for agricultural purposes (Anderson, 1973). The chloride levels of the 134 laboratory analyses of groundwaters from bedrock aquifers ranged from 2.35 to 1 500 mg/L. One hundred and eleven of the 134 analyses reported chloride levels less than 150 mg/L, 21 analyses reported levels between 150 and 500 mg/L and 7 reported greater than 500 mg/L. According to Anderson (1973) waters with chloride readings less than 150 mg/L are safe for most crop plants, chloride levels between 150 and 500 will require special practices

LEGEND

1 (LOW): Water considered safe for most crops. Extremely low permeable soils may require special irrigation practices.

2 (MEDIUM): Water considered safe for plants with moderate salt tolerance. Plants can be grown in most cases without special practices for salinity control.

3 (HIGH): Water cannot be used on soils with restricted drainage. With adequate drainage, special management for salinity control and the selection of salt tolerant crops are required.

4 (VERY HIGH): Water not suitable for irrigation under most conditions. Require very permeable soils, excess irrigation water to provide considerable leaching and very salt tolerant crops should be selected.

Ratings based on Richards (1969).

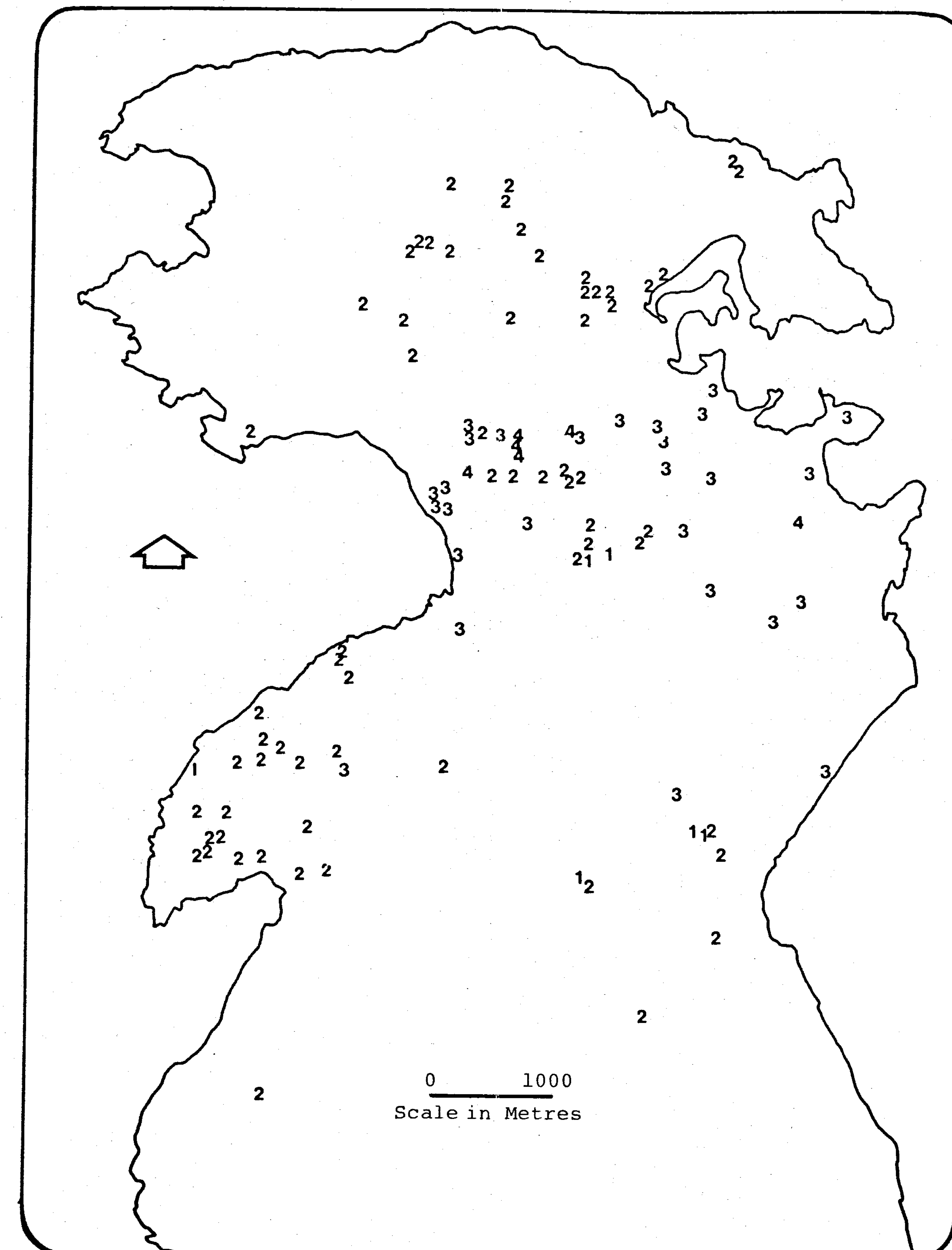


FIGURE 5: Salinity Hazard Based on Groundwater Analyses.

for salinity control, chloride levels greater than 500 mg/L are generally unsafe for irrigation purposes. Figure 6 shows the location of groundwaters where chloride levels greater than 300 mg/L were measured. The majority of these brackish groundwaters occur along a major structural lineament in the fractured granitic bedrock. The areal distribution of the chloride and other constituents in the groundwaters and potentiometric head distribution indicate the zone is within a regional groundwater discharge area, the flow system of which originates on the upland north of the zone (Kohut and Petrie, 1978). This study indicates that seawater intrusion is not the source of these brackish waters.

The relative proportion of sodium to other cations (usually calcium and magnesium) in groundwaters may make some waters undesirable for some crops. This relationship is usually expressed as the sodium absorption ratio (SAR) where SAR = $Na^{+}/\sqrt{(CA^{++}+Mg^{++})/2}$ and can be used for identifying the suitability of groundwaters for irrigation purposes. The formula applies where all concentrations are expressed in epm. Applying the SAR formula to three laboratory analyses of groundwaters from unconsolidated aquifers revealed the sodium hazard level as being low. Applying the SAR formula to 103 laboratory analyses of groundwaters from bedrock aquifers revealed the sodium hazard level as being low in 96 water samples, medium in 8 samples, high in 1 sample and very high in 1 sample. Figure 7 shows locally the sodium hazard based on groundwater analyses. Please note that some of the high sodium values may be due to the use of water softeners.

According to Richards (1969):

> "Low sodium water can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium. However, sodium sensitive crops such as stone-fruit trees and avacados may accumulate injurious concentrations of sodium. Medium sodium water will present

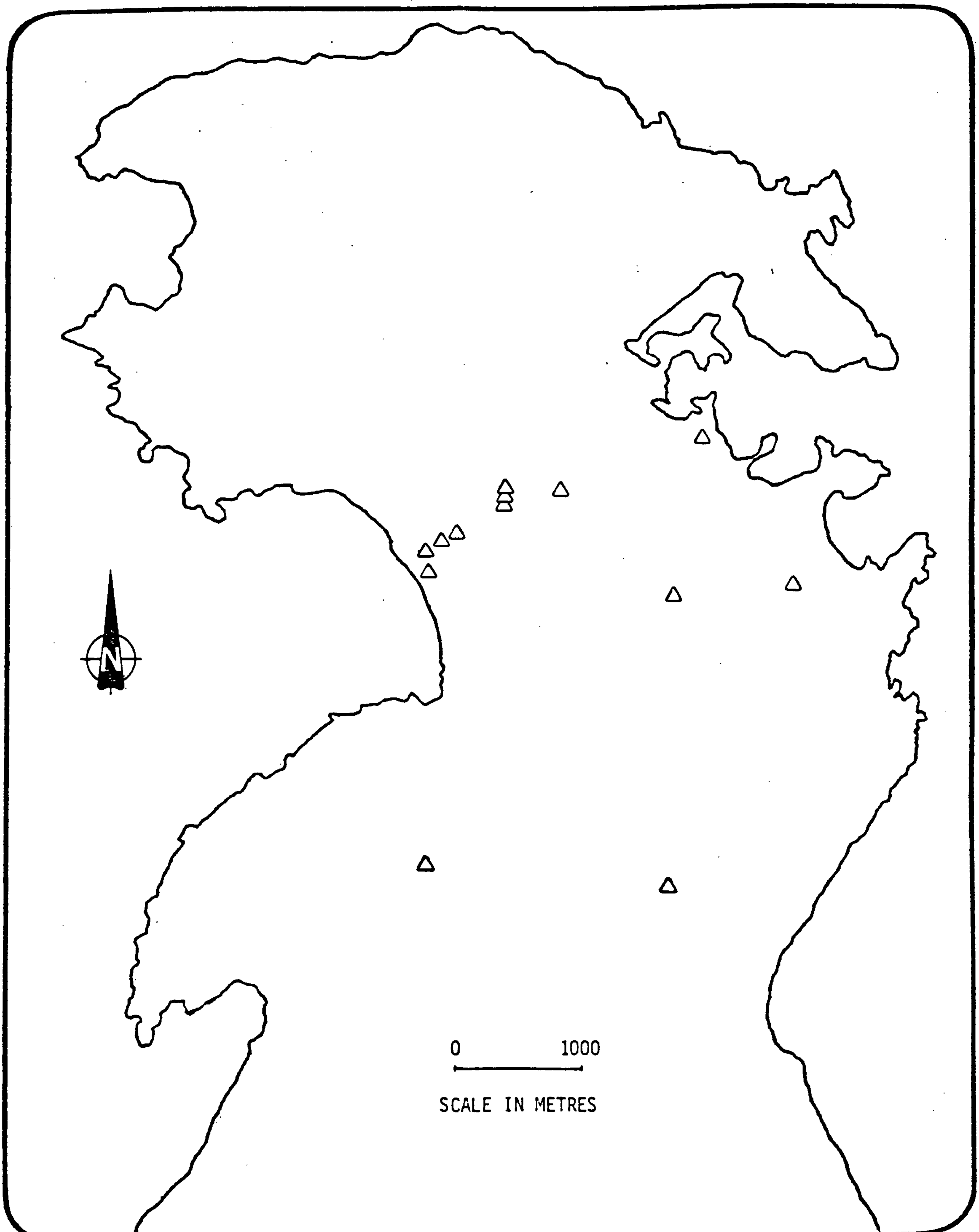


FIGURE 6: Water Wells Where Chloride Levels Greater Than 300 mg/L Were Reported.

an appreciable sodium hazard in fine textured soils having high cation exchange capacity, especially under low leaching conditions, unless gypsum is present in the soil. This water may be used on coarse textured or organic soils with good permeability. High sodium water may produce harmful levels of exchangeable sodium in most soils and will require special soil management - good drainage, high leaching and organic matter additions. Gypsiferous soils may not develop harmful levels of exchangeable sodium from such waters. Chemical amendments may be required for replacement of exchangeable sodium, except that amendments may not be feasible with waters of very high salinity. Very high sodium water is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity, where the solution of calcium from the soils or the use of gypsum or other amendments may make the use of these waters feasible. Sometimes the irrigation water may dissolve sufficient calcium from calcareous soils to decrease the sodium hazard appreciably, and this should be taken into account in the use of low salinity-high sodium and low salinity-very high sodium waters. For calcareous soils with high pH values or for non-calcareous soils, the sodium status of waters in classes low salinity-high sodium, low salinity-very high sodium and medium salinity-very high sodium may be improved by the addition of gypsum to the water. Similarly, it may be beneficial to add gypsum to the soil periodically when medium salinity-high sodium and high salinity-medium sodium waters are used."

The majority of these salinity-sodium combinations are found in the study area. It should be restated that most sources of groundwater on the east coast of Vancouver Island capable of yielding quantities suitable for

LEGEND

1 (LOW): Water considered safe for most crops. Sodium sensitive plants may require soil management.

2 (MEDIUM): Water will present an appreciable sodium hazard in some soils. These soils will require extra management.

3 (HIGH): Water may produce harmful levels of exchangeable sodium in most soils and will require special soil management.

4 (VERY HIGH): Water is generally unsatisfactory for irrigation purposes. The few exceptions would require special soil management.

Ratings based on Richards (1969)

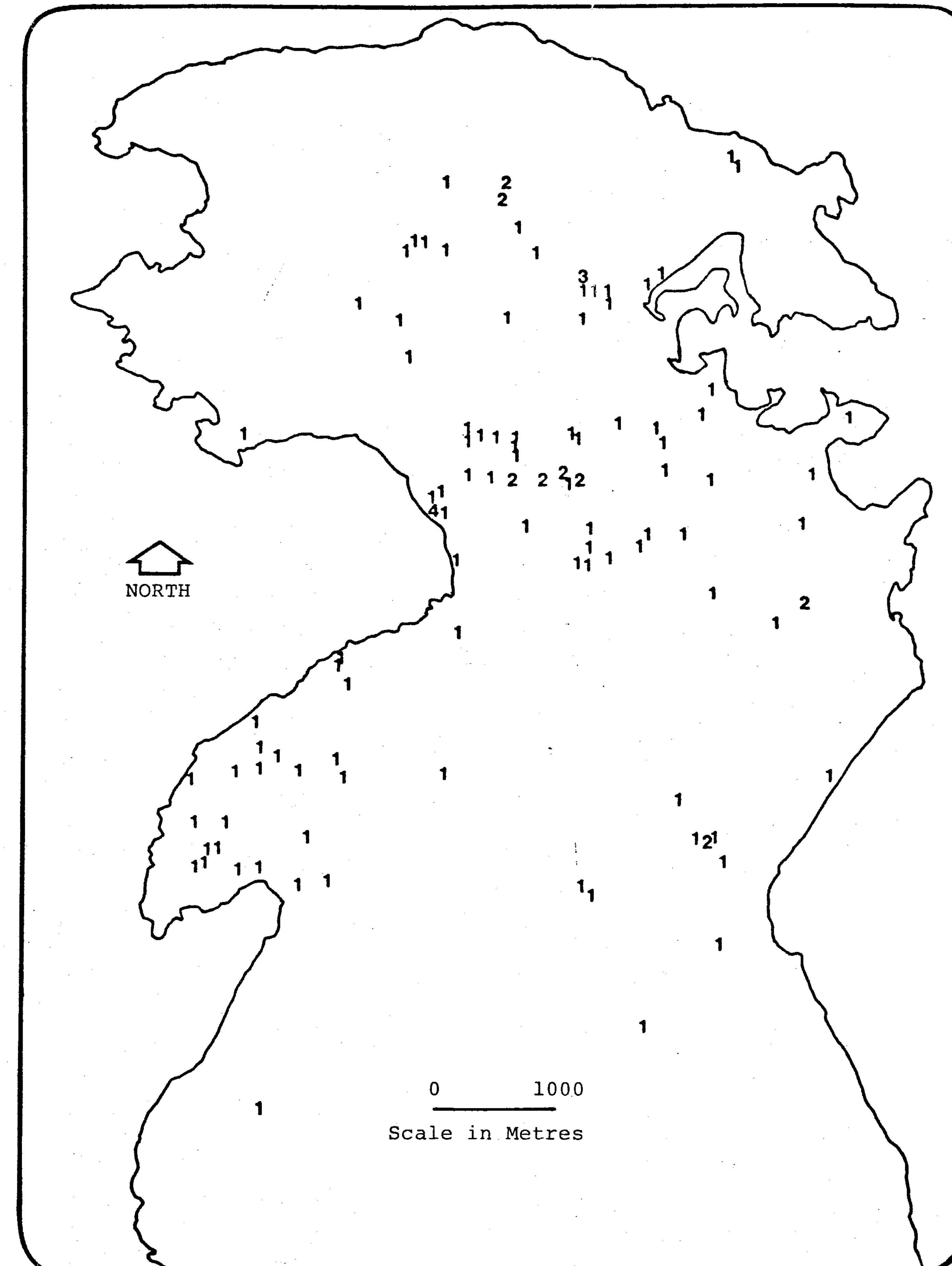


FIGURE 7: Sodium Hazard Based On Groundwater Analyses.

irrigation purposes will come from unconsolidated aquifers. The salinity and sodium hazard were generally reported to be low.

Another important characteristic of irrigation waters are concentrations of boron and other elements that may be toxic. The boron concentrations from 21 laboratory analyses of groundwater from bedrock aquifers ranged from .021 to .6 mg/L. Eighteen of these water samples would be regarded as safe (Anderson, 1973) while three samples may be safe for certain conditions or crops yet may be unsafe under other conditions or crops (Anderson, 1973). These waters would bear greater scrutiny prior to any development.

8. CONCLUSION

Locally, there is potential for locating groundwater supplies capable of meeting irrigation requirements in the study area. The unconsolidated deposits with the greatest hydrogeologic significance include the sands and/or gravels from the Quadra Sediments and the Cowichan Head Formation. The major unconsolidated aquifers are the North Saanich and the Sidney Aquifers. Well yields up to 3 L/s have been reported from these deposits. The major groundwater supplies in the study area come from the highly fractured granitic rocks. Well yields up to 15 L/s have been reported from these bedrock aquifers.

Natural water quality is expected to be acceptable from the groundwaters of unconsolidated deposits. Analyses of these waters indicate a low salinity hazard, low chloride levels and a low proportion of sodium to other cations. Special irrigation practices are usually not necessary from these water types. The analyses of groundwaters from bedrock aquifers report the salinity and sodium hazards ranging from low to very high. Chloride levels have been reported to range up to 1 500 mg/L. Boron concentrations in three analyses indicate unacceptable levels for developing these groundwaters for irrigation purposes. This variability in quality from bedrock aquifers stresses the need for adequate quality analyses to determine suitability for use. However, the majority of the analyses of groundwater from bedrock aquifers indicate waters suitable in quality for irrigation purposes.

This report is regional in scope and identifies areas which have the potential to supply irrigation water. It does not provide a quantitative assessment of water availability for a site specific location. To provide such an assessment, more accurate delineation of aquifer boundaries and estimation of groundwater recharge, movement, aquifer parameters and withdrawal would be required on a site specific basis. The extensive amounts of hydrogeologic information available for this study area would greatly facilitate future assessments.

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PROVINCE OF BRITISH COLUMBIA	MINISTRY OF ENVIRONMENT

MAPPING CONTROL: FEDERAL GOV'T.
DATUM OF ELEVATIONS: GEODETIC
AIR PHOTOGRAPHY: B.C. & FEDERAL
DATE OF PHOTOGRAPHY: 1976-81
U.T.M. GRID: ZONE 10 (1975)
SHORELINE AS AT DATE OF PHOTOGRAPHY

BASE COMPLETED:
BASE SOURCE: PHOTOGRAMMETRIC
REVISION DATE:
LATEST PLAN No.:
LAND DISTRICTS: SEE B. C. LAN
LAND TITLE DIST.: VICTORIA

[redacted]

TRIANGULATION STATION WITH ELEVATION
SURVEYED CONTROL POINT WITH ELEVATION
BENCH MARK
AIR PHOTO CENTRE
SURVEYED LOT TIE

BUILDING
CONTOURS & ELEVATION
APPROX. CONTOUR
WOODED AREA
SWAMP
CULTIVATED
DEPRESSION
SCRUB
TREED SWAMP
ORCHARD

ROADS PAVED ROUGH GRAVEL TRAIL
RAILWAY
POWER LINE ON POLE ON TOWER
FENCE
FLUME

SCALE : 1:20000
200 0 200 400 600 800
METRES
CONTOUR INTERVAL 20 METRES

PLANIMETRIC
NEG. No. 214900

CONTOUR

[redacted]

SEE INDEX 92B-C

PROJECT No. 81-023P T

92B.063