



### Generalized Geohydrologic Setting

Whidbey and Camano Islands are composed of unconsolidated Quaternary glacial and interglacial deposits that overlie Tertiary and older bedrock. Pre-Tertiary bedrock (basalt) is exposed on the northern part of Whidbey Island at Deception Pass and at a point 5 miles to the south at Rocky Point. The bedrock is a hard, dense rock that generally yields little or no water to wells.

The thickness of the unconsolidated deposits is about 3,000 feet throughout most of Camano Island and the central region of Whidbey Island, thinning to approximately 300 feet in the northern- and southern-most parts of Whidbey Island (Fred Pessl, U.S. Geological Survey, written commun., 1982). Sand or sand-and-gravel units within the unconsolidated deposits are the main source of ground water throughout Island County. The intervening, low-permeability units are composed predominantly of till, clay, and silt.

In general, the available data indicate that at least five aquifer units are present in Island County. Thickness of individual units and elevation vary within each unit and among units, as illustrated in the cross sections (sheet 3). Thickness ranges from 5 to 440 feet and top of unit elevations range from 490 feet above to 600 feet below sea level (table 1, sheet 2). Elevation of the aquifer units tends roughly to reflect land-surface topography. As illustrated (cross sections, sheet 3), where the land surface is higher the elevation of the aquifer units is higher, and conversely, where the land surface is lower the aquifer units are lower or absent. For example, Unit E does not exist in section A-A' and in the eastern part of section B-B'. The same variation in thickness and elevation exists for the intervening units, composed of materials of lower permeability. In some areas, these intervening units can be rather thick.

A detailed study was made of the stratigraphy of Island County on the basis of geophysical data, drillers' well logs, and data from eight test wells. On the basis of this study, five major water-bearing units, or aquifers, composed primarily of sand or gravel or both, were defined and mapped. The units are lettered from A to E; A is the deepest and oldest aquifer, and E the shallowest and youngest. The two deepest units (A and B) are not well defined because few wells penetrate to these depths and are assumed to be continuous. The areal extent and locations of wells known to tap each of the five units are shown on sheets 2 and 3. A summary of that information is provided in table 1 (sheet 2).

#### GEOHYDROLOGY AND AREAL EXTENT OF AQUIFER UNIT E

Unit E is composed of sand and gravel and is as much as 160 feet thick (see map). This unit occurs in four principal areas (sheet 2):

- 1) On the southern tips of both islands;
- 2) At the higher altitudes of northern Whidbey Island;
- 3) In the central part of Whidbey Island north of Greenbank; and
- 4) In the upland areas of northwest Camano Island.

The top of unit E ranges from 20 to 490 feet above sea level on Camano Island and the northern and central regions of Whidbey Island, and from 150 to 420 feet above sea level on the southern tip of Whidbey Island. Water levels in unit E range from 20 to 355 feet above sea level. In general, water levels

are highest on southern Whidbey Island and lowest on northern Whidbey Island. This trend reflects the same general pattern as the bottom altitudes of most wells that tap the unit. Specific capacities for the three wells with available data were 10.5, 30, and 135 gallons per minute per foot of drawdown. Specific capacity, a measure of well yield, is the rate of discharge of water from a pumping well, divided by the amount the water level is drawn down as a result of pumping the well. Specific capacity is usually expressed as gallons per minute per foot of drawdown.

#### GEOHYDROLOGIC AND AREAL EXTENT OF UNITS D THROUGH A

Unit D is composed primarily of sand; its known thickness is as much as 220 feet. The top of this unit ranges from 335 feet above sea level to 80 feet below sea level. The unit is believed to be continuous on Camano Island and is present throughout most of Whidbey Island. The areas where unit D is not present are:

1. The lowland areas at Ault Field, Coupeville north of Greenbank, and Freeland;
2. The lowland areas around Miller Lake, Cultus Bay, Useless Bay, Mutiny Bay, Holmes Harbor, Admiralty Bay, and Penn Cove (sheet 3).

Water levels in unit D vary widely, ranging generally from 10 to 250 feet above sea level. Data from 36 wells indicate that specific capacities range from 0.04 to 27 (gal/min) per foot of drawdown. Generally, wells producing from this unit are in the uplands and away from the coast, with the exception of the wells located on the lowland at the northern end of Camano Island.

Unit C is composed chiefly of sand, with known thickness up to 440 feet and is assumed to be continuous throughout Island County. Because most of the wells in this unit do not fully penetrate it, its maximum thickness is not known. The top of this unit ranges from 270 feet above sea level to 150 feet below sea level.

Generally, water levels in unit C are between sea level and 50 feet above sea level, although 54 percent of the water levels in this unit were within 10 feet of sea level when measured in April and August 1980 and April 1981. Specific capacities of wells drilled in unit C range from 0.03 to 42 (gal/min) per foot of drawdown. Seventy-nine percent of the 127 wells with pump-test information had specific capacities of less than 10 (gal/min) per foot of drawdown. Wells that are producing from this unit are generally found along the coast and in lowland areas.

Unit B is composed mainly of sand and is as much as 180 feet thick; the maximum thickness of this unit and unit A are unknown. The altitude of its top ranges from 20 feet above sea level to 345 feet below sea level. This unit is known to occur in four principal areas:

1. South and east of Penn Cove;
2. Along the shores of Holmes Harbor, between Greenbank and Freeland;
3. The area immediately north of Useless Bay; and
4. The northwestern coast of Camano Island.

Fifty wells are known to tap unit B. Twenty-five drillers' logs and the data from the eight test wells were used to define the geology (sheet 3).

Water levels in unit B generally range from 25 feet below sea level to 25 feet above sea level. Most of the wells with water levels below sea level are located along the coast and (or) are completed at great depths. The range in specific capacity is from

0.3 to 25 (gal/min) per foot of drawdown. Twelve of the 16 wells with pump-test information had specific capacities of less than 10 (gal/min) per foot of drawdown.

Unit A, not shown on the geologic sections, is composed of sand and gravel. Its known thickness is as much as 50 feet. The top of unit A ranges from 300 to 600 feet below sea level. It is the deepest known aquifer to date in Island County, and its presence is based on data from two wells that are known to tap it and data from the eight test holes (sheet 3). It is possible that deeper aquifers exist beneath Island County, but currently no data are available to confirm this possibility.

The water level in one of the two wells that tap unit A was 34 feet below sea level when measured in 1980 and 1981. The water in these two wells was reported as saline by the drillers. The one well for which data are available has a specific capacity of less than 0.75 (gal/min) per foot of drawdown.

Eight test wells were drilled in Island County (sheets 2 and 3, A-H) to improve existing knowledge of the geohydrologic conditions that exist at depths greater than 200 feet below land surface, and to help evaluate interpretations of geology based on drillers' logs. Six of the test wells were drilled to 1,000 feet below land surface, and two of the wells, A and B, encountered bedrock at approximately 800 and 650 feet below land surface, respectively. Test wells B, C, D, F, and H penetrated all five aquifer units (A-E). Test wells E and G penetrated four of the five aquifer units; the uppermost aquifer, unit E, was missing. In test well A, all aquifer units were penetrated except the deepest unit, unit A.

Most of the wells in Island County tap the sand deposits of units C and D that range from near sea level to 150 feet below sea level. These two units together closely correspond to the sea-level aquifer as described in the preliminary report by Cline and others (1982). Available data indicate that these units are the most continuous and productive in the county, and that they supplied approximately 90 percent of the ground water pumped from 1979 to 1982 (sheet 4). Specific capacities of these two units range from less than 1 to 42 (gal/min) per foot of drawdown, but most of the wells finished in units C and D commonly yield 1 to 9 (gal/min) per foot of drawdown. Most of the wells completed in units C and D are located along the coastlines, paralleling residential development and areas of heaviest pumpage (sheet 4).

TABLE 1.--Summary of geohydrologic data available for water-bearing units beneath Island County

Water-bearing unit aquifer	Predominant composition	Known thickness (feet)	Altitude of aquifer unit top (reference to sea level)	Typical water levels (reference to sea level)	Known range of specific capacities (gal/min)/ft of drawdown	Number of wells with determined specific capacities	Remarks
E (youngest)	sand and gravel	up to 160	490 to 20	+20 to +355	10.5 to 135	3	Locally discontinuous; occurs in upland.
D	sand	up to 220	335 to -80	+10 to +250	0.04 to 27	36	Very productive; widely used.
C	sand	up to 440	270 to -150	0 to +50	0.03 to 42	127	Do.
B	sand	up to 180	20 to -345	-25 to +25	0.3 to 25	16	Locally contains saline water.
A (oldest)	sand and gravel	up to 50	-300 to -600	-34	----	1	Do.

## OCCURRENCE OF GROUND WATER AND POTENTIAL FOR SEAWATER INTRUSION, ISLAND COUNTY, WASHINGTON

By M. A. Jones  
1985

ITEM 1  
8-BLACK

BASE SHEET 749  
FOR PLATES 1, 2