

Seawater Intrusion - Process and Potential

PROCESS OF SEAWATER INTRUSION

In Island County, as on most islands, freshwater occurs as a lens-shaped layer on top of seawater (fig. 1); this occurs because the freshwater is less dense than the underlying seawater. The contact between fresh ground water and seawater is called the freshwater-seawater interface. However, because the density difference between seawater and freshwater is slight and the water is continuously in motion in response to recharge and discharge, the interface is not a sharp one. Instead, a zone of mixing develops between the two water types (fig. 1).

Seasonal changes in pumpage and water levels also can result in intrusion of some wells. As indicated previously, the largest withdrawals of ground water occur during the months June through August which corresponds to the time period of lowest water levels because of seasonal changes in recharge. As water levels begin to fall during this time the freshwater-seawater interface moves landward and upward. Locally, some wells begin to experience an increase in chloride concentration (fig. 2), based on the proximity of the well intake to the freshwater-seawater interface.

In the late fall months, when precipitation increases and pumpage decreases, the water levels begin to recover. As a result, the chloride concentrations of water in the wells generally decline.

The probability that seawater intrusion will occur in a well finished below sea level is increased whenever the water level in the well approaches or drops below sea level for prolonged periods.

CURRENT CONDITIONS

Based on water-level measurements made in April and August 1980, at least 43 wells penetrating aquifer units B, C, and D in Island County have pumping or non-pumping water levels at or below sea level. The map at left shows water-level conditions for April or August 1980, and (or) April 1981, and is based on both measured and estimated water levels.

An analysis of chloride-concentration data collected in 1980 indicated a correlation between wells in areas where water levels are near or below sea level, and wells with chloride concentrations indicative of seawater intrusion (sheet 6). Intrusion is particularly evident in the northern and southern parts of Camano Island and in an area along the east coast of Whidbey Island near Greenbank. In these three areas, water levels are near sea level, and chloride concentrations are generally above 100 mg/L. The hachured areas on the map (at left) represent areas where seawater intrusion has already occurred in wells that are finished at or below sea level.

Other areas, shown by strippling on the map, not currently intruded but considered sensitive to seawater intrusion are located close to shore, at low altitude, and where the land mass is relatively narrow.

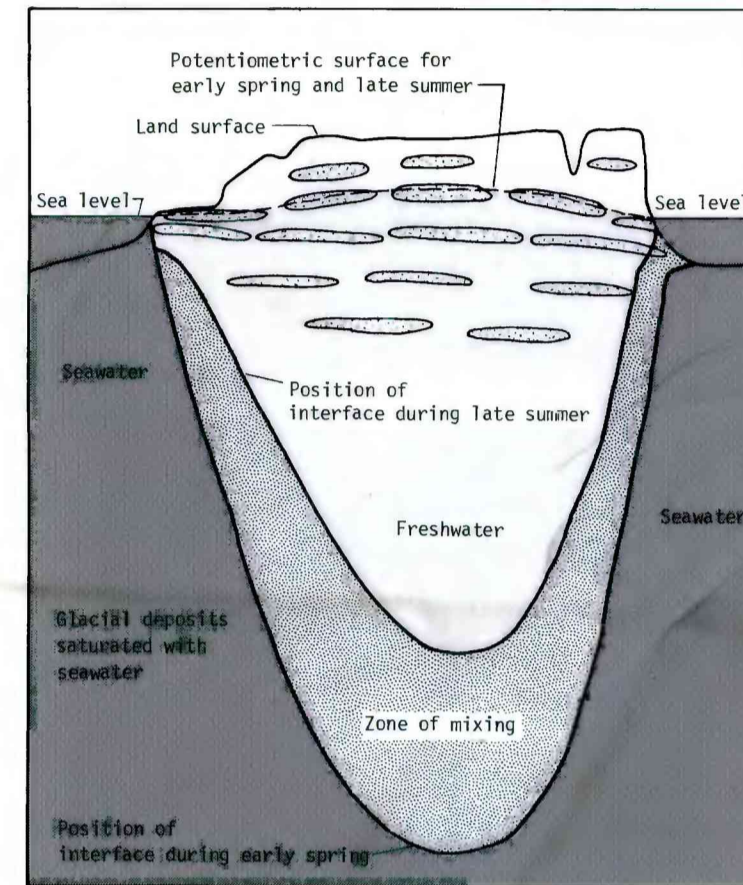


FIGURE 1.--Generalized occurrence of the fresh water - seawater interface for early spring and late summer.

The position of the freshwater-seawater interface depends on the altitude of the water table, recharge-discharge relationships, and the permeability of the aquifer. Because of differences and changes in these conditions, the position of the interface will differ from one location to another on the island, and it will also differ with time at a single location.

Withdrawal of ground water from wells drilled below sea level in coastal areas can decrease and even reverse the seaward flow of fresh ground water, thus allowing seawater to intrude the aquifer. Figure 2 illustrates the effects of pumping on the position of the freshwater-seawater interface.

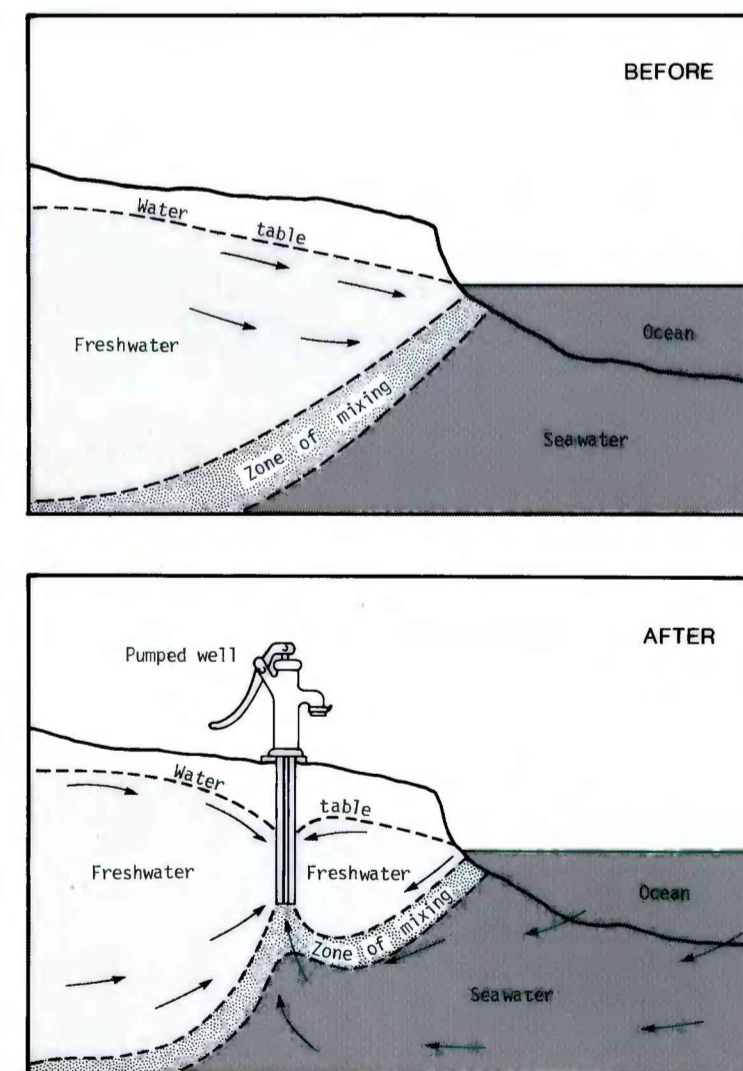


FIGURE 2.--Idealized effects of pumping from coastal aquifers on the freshwater-seawater interface.

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

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ITEM 1
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BASE SHEET FOR PLATES 1, 2