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Hydrogeologic study for the town of Sweet

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INTRODUCTION

The town of Sweet, located within the Squaw Creek Valley, has a population of approximately 50 people. It is unincorporated, so each household derives domestic water from a well or spring. Most wells penetrate a shallow gravel or sand aquifer. A spring for which the community is named discharges in the center of town from the same gravel aquifer.

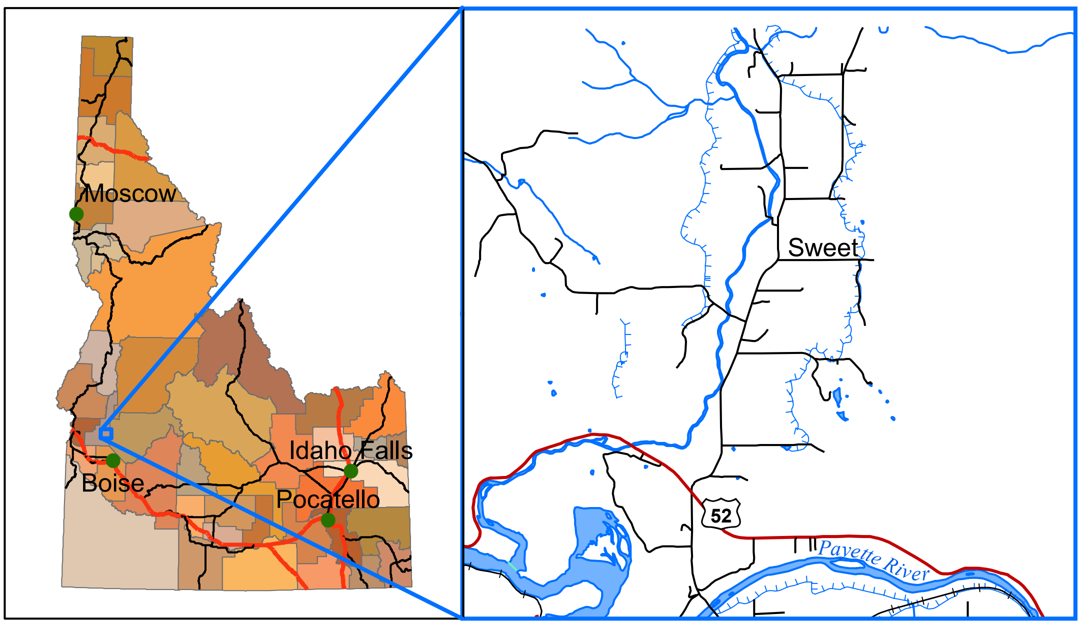

Figure 1 - Location map of the town of Sweet.

STATEMENT OF PROBLEM

The Idaho Department of Environmental Quality (DEQ) measured fecal coliform in Sweet Spring. Additionally, fecal coliform occurs in a supply well of Sweet Service, a local restaurant that serves the valley. DEQ has asked the IWRRI Community Water Project team to determine the source of fecal coliform and provide possible solutions.

PURPOSE AND OBJECTIVES

This study provides hydrogeologic information to support decisions about continued use and development of ground water in the Sweet area. Specific objectives include:

- Delineate the ground water flow system supplying water to Sweet Spring and to the Sweet Service well.
- Determine a possible cause of contamination to the spring and Sweet Service well.
- Provided possible solutions to alleviate the pollution problems to the Sweet Service well.

GROUND WATER DEVELOPMENT AND CONCEPTS

Ground water occurs and moves through interconnected fractures and intergranular pore space in an aquifer. It moves under the force of gravity in an aquifer from higher elevation recharge areas to lower elevation discharge areas. Recharge results from infiltration of precipitation and irrigation, leakage of canals, and from streams and lakes. Typical discharge areas include springs, streams, and lakes. Ground water moves slowly, generally less than 10 feet per day.

Subsurface geology provides strong controls on water movement within an aquifer. Therefore, an understanding of the subsurface distribution of unconsolidated sediment, lithified rock, faults, and their physical properties generally leads to a commensurate understanding of ground water flow systems. Mapping surface rock outcrops and reviewing logs of material penetrated by wells helps interpret these features.

Ground water pumping impacts the balance between natural recharge and natural discharge within an aquifer. Well operation lowers ground water levels, which in turn reduces natural discharge. The basis for proper ground water development requires characterizing natural ground water discharge from springs and seeps, knowing the discharge of interconnected streams, and understanding the quantity and location of annual aquifer recharge. Additionally, municipal water supplies need a recharge zone protected from contamination because pollutants can mix with ground water and contaminate the municipal supply.

PROJECT AREA GEOLOGY

Figure 2, Photograph of coarse-grained upper Gravel near the Sweet Service well

Squaw Creek flows through a fault-controlled valley within basaltic lavas of the Columbia River Group. The lavas are exposed on both sides of the valley and occur at depth within its central part. Clay-rich sediments and local shoe-string sand beds lie above the basaltic lavas and fill the valley in the Sweet area. The clay-rich sediments were deposited in a prehistoric lake and the shoestring sand beds by meandering streams during low lake levels. A variably thick accumulation of coarse gravels lies above the clay beds. These gravels were probably deposited from ancestral meandering channels of Squaw Creek and its tributaries after the lake dried up. The gravels and clay beds form the modern-day topographic surface in Squaw Creek Valley. The clay beds form the surface where the gravels are not present, such as in the central part of the valley, and the gravels form lands surface where present, primarily along the valley margins.

The shoe-string sand beds form the aquifers tapped by some of the deeper wells in the area (Figure 2). The coarser, overlying gravels where present, form the shallow aquifer through which Sweet Spring discharges. Other springs and shallow wells including the Sweet Service well utilize this aquifer.

PROJECT AREA HYDROGEOLOGY

A field examination and a review of well logs within the study area indicate that wells and springs obtain ground water from either sand beds in the clay sequence or from the overlying gravel (Figures 2 and 3). The gravel aquifer is the source for the Sweet Service well and the Sweet spring. The shoe-string sands in the clays are the source for the deeper wells in the area, such as the GTE well (Figure 3).

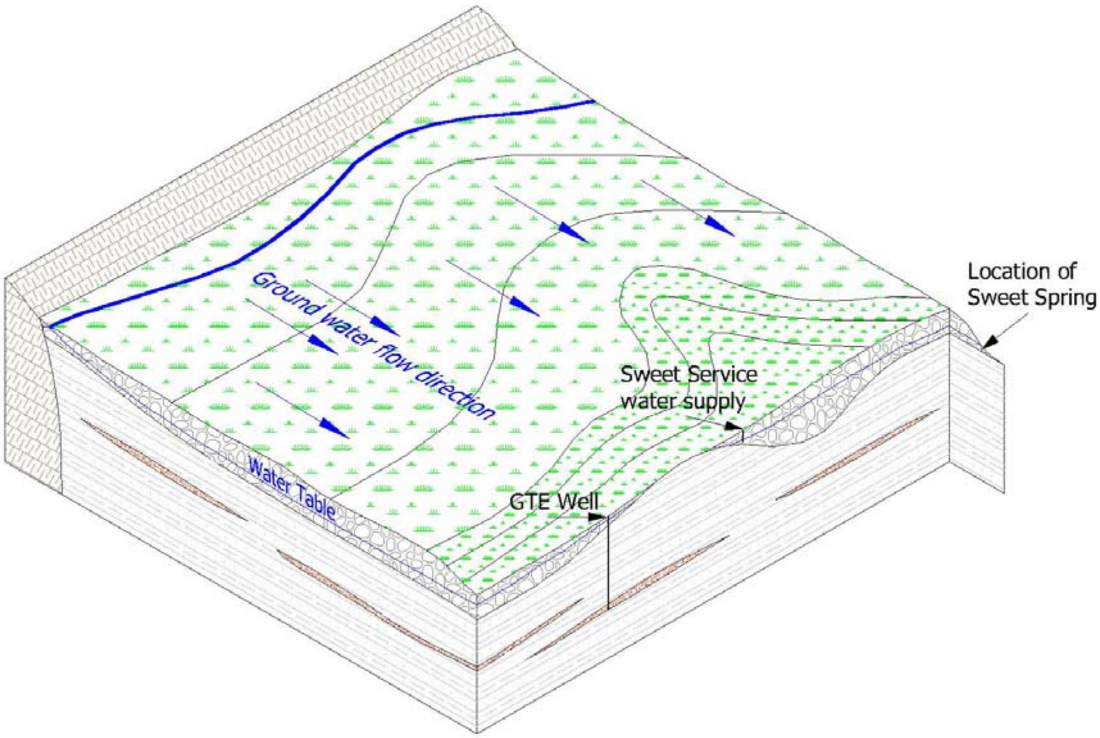

Figure 3 - Conceptual block diagram of the Sweet study area.

Well yields are not large for the area and do not depend on whether it obtains water from the shallow gravel aquifer or the deeper shoe string sands (Figure 4). The shallow gravel aquifer likely receives recharge from the irrigation canal east of town, from irrigated water unused by plants, precipitation, and from the marshy area east of town. Recharge to the shoe string sand beds is uncertain, but may be from slow, downward percolation of water through the clay beds.

Our inspection of the Sweet Service well and a two-hole well on the Sweet Service property shows the shallow gravel aquifer is close to land surface. The depth to water of the Sweet Service well was approximately 8 feet below ground surface, and the two-hole well was roughly 5 feet.

There are no temporal water level data for the area. This indicates the uncertainty of the long-term viability of either aquifer. However, local people told us that the spring yields constant throughout the year, perhaps indicating adequate recharge. Our calculations indicate that the Sweet spring yields approximately 10 gallons per minute.

Figure 4 - Well yield data in gpm for the Sweet area.

Discussion and Conclusions

The shallow gravel aquifer likely receives recharge from agricultural sources to the west. Recharge occurs from excess water applied to irrigated fields, canal seepage, and precipitation. These recharge areas indicate that the ground water flow direction is east-west, though we have no hard data to confirm this.

DEQ has measured fecal coliform in the Sweet Service well and Sweet Spring. Both of these sources derive water from the shallow gravel aquifer. Since the town is unincorporated, each household in town and the surrounding area utilizes a septic tank and drain-field system to treat waste. The water table is close to land surface allowing a short travel path from the drain field to the aquifer. Some of the discharged effluent probably enters the shallow aquifer, and we believe that this is the primary source of fecal coliform.

Short of incorporating the town and removing the septic tanks, there are two options to solve the fecal coliform contamination. The first is to treat the water from the current well. The other alternative is to drill a new well to a greater depth and derive water from the shoe-string sand aquifers. The second choice has several drawbacks. The Sweet Service property adjoins the Sweet-Ola highway, so a well may not meet DEQ well-construction standards pertaining to the required setback from roads. Also, it is possible that a new well might not penetrate one of the shoe-sting sand aquifers. Even if it does, data from surrounding wells indicate low yields. Additionally, the long term viability of these aquifers is uncertain.

Because of the risk, expense, and legality involved in drilling a new well into the deeper aquifers we recommend the first option, to treat the water from the current supply well. Possible treatment methods include filtration, and disinfection by chlorination, ozonation, or ultraviolet radiation.