4 Data Gaps and Recommended Data Collection

The following discussion addresses the most important data gaps in the conceptual model and presents a prioritized listing of data collection that could be used for future assessments. This recommended data would improve the hydrogeological conceptual model as well as water budget accuracy. The costs of collecting data vary and, as a result, some of the suggestions may be prohibitive depending on budget availability; others can be done at relatively low cost and provide good value. A summary of prioritized data collection suggestions is provided at the end of this section (Table 2).

4.1 Properties of Hydrogeological Units

Pumping tests of new test wells are needed to obtain additional hydrogeological unit properties. However, the cost would depend on the type of testing selected because of the drilling and equipment required.

For example, long-duration pumping tests are preferable because they impose a larger stress on the aquifer and provide a better estimate of hydraulic parameters, but these tests are also more expensive. In contrast, short-duration pumping or injection tests are less expensive and obtain results that can be scaled up and that show the relative differences of transmissivity between different locations and hydrogeological units. In this case, a number of smaller tests in multiple locations would prove more useful than one or two large tests that would not be representative of the whole island and would not, therefore, add significantly to the existing model.

Tidal analysis can be done but it requires a second test to determine storativity property of fractured rocks, before a reliable transmissivity value can be estimated. A different test can be done in the same well (pumping test, slug test) to estimate transmissivity and the tidal analysis can then be used to estimate the storativity value.

All methods of testing have limitations and there is some uncertainty in the calculated values of hydraulic parameters.

4.2 Water Levels

On Mudge and DeCourcy Islands, more static water level measurements are needed from wells. These wells should be surveyed or their locations matched closely to nearest topographic contour to obtain the needed measurements.

On Gabriola Island, a large number of static water levels (of varying accuracy) have been measured near the ground surface, however, there are no hydraulic head measurements at large depth and below the Spray mudstone layer. New observation wells could be installed with screens below and above this unit to determine groundwater conditions below the unit.

Additional observation wells would also be useful in areas with high water demand in the western part of Gabriola Island, south of Descanso Bay and in eastern part of the island. Unused residential wells could be used in place of dedicated observation wells. Monitoring could be done as short-term,

frequent measurements to observe the effects of local drawdowns and recharge after rain events to improve understanding of the different regions.

Also on Gabriola Island, some residents are concerned about effects on their wells by commercial water users. If commercial extraction continues in the future, some additional effort should be made to monitor the largest commercial water users using nearby residential wells or new observation wells. If there is any effect, the drawdown could be detected in residential wells that are closest to the commercial pumping wells. The monitoring would need to be done over a long period of time—at least one year—to observe the seasonal effects of water table variation.

4.3 Salt Water Intrusion and Depth of Freshwater

Salt water intrusion should be monitored in many residential wells near ocean shores and should be compiled from reports containing well water quality measurements. More long-term observation wells may not detect salt water intrusion because it may be localized near pumping wells in the form of "up-coning" salt water. The fresh-saltwater interface is very steep, and the mixing zone is very narrow. Therefore, observation wells away from shorelines would not detect salt water intrusion occurring near shores.

The saltwater intrusion may be focused along discrete fractures rather than across the aquifer. Near-shore wells will be connected differently to the ocean and some wells may draw in salt water long time before nearby wells experience any change in salinity.

To determine the amount of useful water storage, some effort could be made to verify the depth of fresh water under the islands and water quality variation with depth.

4.4 Water Budget

Water balance estimates are described using the best available data, but there are data gaps for each land-use type that would have to be addressed to improve the estimates. The following are the uncertainties and assumptions that affect the reliability of the study:

- The number of survey respondents from West Degnen Bay, Northumberland, and Mudge Island is very low. To acquire more representative information for these sub-regions, further work needs to be done with a greater number of respondents.
- Water usages for many commercial and farming establishments are unknown and are only estimated. Further study needs to be undertaken to target specific commercial and farming establishments to acquire reasonable water use estimates.
- There is insufficient data to calculate the amount of drainage from surface runoff and groundwater discharge. The volume of groundwater recharge to the bedrock aquifers from surface water needs to be quantified because current estimates are uncertain. Small streams do not have any monitoring devices or any recent observations. Some spot measurements and gauges would be very useful for understanding surface-groundwater interactions.

Table 2: Recommended data collection.

Priority	Data Type	Purpose	Difficulty and Timing
1	Water use surveys in all regions	To improve the water demand component of water budget and water stress assessment in sub-regions.	This can be on-going annual surveys or more focussed surveys as needed. More volunteer participation is required. Water metering is also an option.
2	Long-term observation wells in commercial & residential areas	To monitor drawdown because of water demand and natural water level variation and to monitor water salinity trends	1 – 5 years. There is high cost of drilling of new wells and installation of monitoring equipment.
3	Drawdown in residential wells around large production wells	To assess impacts of large water users on residential wells	Immediate to 1 year. Easily done with small sensors. Require volunteers.
4	Short-duration monitoring of water levels in residential wells	To perform tidal analysis for aquifer properties and effects of pumping on aquifer, relative to fracture connectivity	Immediate to 1 year. Easily done with small sensors. Require volunteers.
5	Survey and measurements of surface water flows	To improve the runoff component of water balance.	1 – 5 years. A proper hydrologic study of surface water and groundwater interactions.
6	Additional hydraulic tests in representative locations in different hydrogeological units	To improve the hydrogeological conceptual model	1 – 5 years. Design a test plan for testing different hydrogeological units in appropriate test wells. Some appropriate existing wells can be used.
7	Improved geological map along island steep slopes/cliffs	To improve the geological model	1 year. There are inconsistencies between different maps. This is a desk study with some field surveying checks.
8	Data quality control of existing wells database.	To improve data quality of existing well logs, water levels, screen positions, collar locations, etc.	1 year. This needs to be done before any numerical modeling is started.
9	Deep water levels and water quality	To assess groundwater resource in deep portion of Gabriola Island below Spray mudstone	> 5 years. High cost of drilling a deep test well. Deep water is likely not needed for water supply in near future.