BAINBRIDGE ISLAND SOLE SOURCE AQUIFER DESIGNATION PETITION

SUBMITTED BY:

M4 ENTERPRISES

Melanie Keenan
Malcolm Gander

August 5, 2009

We dedicate this effort to our amazing children Miles and Madeleine Gander. Trying to preserve something for you and your children. Thank you for reminding us of what matters, and never underestimate your ability to change your world.

We also dedicate this to my brother Timothy M. Keenan who lives on through us. May 20, 1961 – July 8, 2008

The frog does not drink up the pond in which he lives.
Native American Proverb

The Sole Source Aquifer Designation Petition research and report preparation by Melanie Keenan and Malcolm Gander is donated to the City of Bainbridge Island.

Motion AB 09-120 to accept this Petition was passed by Bainbridge Island City Council (5-0) on October 14, 2009.

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"Groundwater is the sole source of drinking water on Bainbridge Island." (City of Bainbridge Island website, May 2009 – www.ci.bainbridge-isl.wa.us).

"Ground water is the sole source of drinking water for the City of Bainbridge Island in Kitsap County, Washington." (United States Geological Survey Washington Water Science Center website, Bainbridge Island Ground Water Model Project, March 30, 2009 – http://wa.water.usgs.gov/projects/bainbridge/).

INTRODUCTION

The Safe Drinking Water Act in Section 1424© provides for the designation of an aquifer or aquifer system that meets certain conditions as a Sole Source Aquifer (SSA). An SSA is an aquifer that is the sole or principal drinking water source for the area overlying it and if contaminated would create a significant hazard to public health. Any individual, corporation, company, association, partnership, State, municipality or Federal agency can petition the U.S. Environmental Protection Agency (EPA) to designate an SSA. The EPA has prepared the Sole Source Aquifer Designation, Petitioners Guidance (EPA, 1995) document to help petitioners prepare SSA designation petitions.

This petition has been prepared to request that the EPA designate the primary aquifer system on Bainbridge Island, Kitsap County, Washington as an SSA. This petition conforms with the provisions of the Petitioners Guidance (EPA 1995) and presents the information that demonstrates that this aquifer system qualifies as an SSA. Moreover, the petition provides ample documentation verifying that the hydrogeologic characteristics of the Island are similar to the following islands in the Puget Sound, all of which have been designated as sole source aquifers by EPA Region 10: Camano Island, Whidbey Island, Marrowstone Island, and Vashon-Maury Island (EPA 2009).

Organization of the Petition - The Petitioners Guidance describes four main sections for the petition as follows:

SECTION 1: PETITIONER IDENTIFYING INFORMATION
SECTION 2: NARRATIVE DESCRIPTION
SECTION 3: SOLE SOURCE DATA
SECTION 4: HYDROGEOLOGICAL DATA

SECTION 1: PETITIONER IDENTIFYING INFORMATION

Aquifer	Name:	Bainbridge Island
	Location:	Kitsap County, Washington
Petitioners	Name:	Melanie Keenan Malcolm Gander (Resume of Petitioners in Appendix A)
.		
Address		10689 Falk Road NE Bainbridge Island, Washington 98110
Responsible Person		Name Melanie Keenan Phone 206-948-2596

SECTION 2: NARRATIVE DESCRIPTION

A. General Location of the Aquifer

The Bainbridge Island Sole Source Application Area (SSAA) is located in the central portion of Puget Sound in Kitsap County, 5 miles west of Seattle and 0.5 miles east of Kitsap Peninsula. The Island lies in the Puget Lowland, a trough between the Olympic Mountains to the west and the Cascade Mountains to the east. Bainbridge Island covers an area of 27.5 square miles (sq mi)(Figure 1).

The SSAA is separated from the surrounding mainland by narrow channels of Puget Sound, separating the Island from the Kitsap Peninsula to the west.

B. Groundwater Dependency in the Area and on the Particular Aquifer for which Designation is requested

Water resources of the Bainbridge Island SSAA include aquifers, springs, surface-water bodies, and streams and their associated drainage basins. Much of the available data regarding water resources on the Island is found in the Kato & Warren, Inc./Robinson & Noble, Inc. Level Assessment (K&W 2000), and this document provided the majority of information for this Petition. The following information regarding the six water-bearing units on the Island comes from this source, except as noted.

Bainbridge Island Aquifers. Six principal aquifers have been identified on Bainbridge Island:

1) Perched Aquifer System (PA) – This aquifer occurs in Vashon advance glacial outwash, which consists of fine to medium-grained silty sand with interspersed gravelly units. About 4 percent of the wells on the island are reportedly completed in this unit, and the producing zone is generally > 200 feet (ft) above mean sea level MSL (Figure 2).

2) Semi-Perched Aquifer (SPA) – This aquifer occurs in a mixture of non-glacial and glacially-derived sands and gravels. About 25 percent of the wells on the island are completed in this unit, and the producing zone is generally between 100 and -20 ft MSL (Figure 3).

3) Sea Level Aquifer (SLA) – This aquifer has been tentatively assigned to glacial deposits referred to as the Salmon Springs Drift. It is the most widely used aquifer with 53

percent of the wells completed in this unit, and the producing zone is 40 to -230 ft MSL (Figure 4).

4) Glaciomarine Aquifer System (GMA) – This aquifer ranges in composition from clay, silt, and silt-rich sand, to sand and gravel. It also contains interspersed zones of organic material, which indicates a non-glacial origin for this unit. About 2 percent of the island wells are completed in this unit. Several of the island's deep production wells are screened in the top of this aquifer, and the producing zone is typically -400 to -76- ft MSL (Figure 5).

5) Fletcher Bay Aquifer System (FBA) – This is the deepest of the six main aquifers encountered on the island. It is composed of sand and gravel with subordinate amounts of silt and silty sand. Wells in this unit are typically screened between -690 to -1,010 ft MSL. Although less than 1 percent of the island's wells are completed in this unit, the metered Kitsap Public Utility District (KPUD) and City of Bainbridge Island Fletcher Bay Aquifer (COBI FBA) wells provide approximately 30 percent of the estimated total water production on the island (Aspect 2008) (Figure 6).

6) Bedrock Aquifer System (BAS) – This aquifer is a minor source of groundwater on the island. Less than one percent of the wells are completed in this unit. The wells are screened in sedimentary rocks of the Blakely Harbor and Blakely Formations, and are located on the south end of the island (Figure 7).

A detailed discussion of the hydrogeologic conditions of the SSAA is provided in Section 4.

On-Island precipitation is the only source of aquifer recharge in the SSAA. Approximately thirty-four to thirty-eight inches of rain falls annually on Bainbridge Island, with the majority of that occurring in the winter months. All of the water from the aquifers, as well as lakes, ponds, and streams, originates from precipitation on the island.

The ability of the Island to meet water demands in the future depends largely on production from the Fletcher Bay Aquifer System, which currently produces the most for the City of Bainbridge Island (K&W 2000). The Fletcher Bay Aquifer System has been correlated with deep aquifers on Kitsap Peninsula; however, there is no evidence that the two are hydraulically connected (K&W 2000). The Fletcher Bay Aquifer System is not an unlimited source, and its recharge area and recharge rates are poorly understood (K&W 2000).

Another important source of groundwater resources on the Island is the Sea Level Aquifer System (K&W 2000). Future increases in production have been recommended to be taken from this System, particularly in the north and central portions of the Island (K&W 2000). The Sea Level Aquifer system is not an unlimited source, and its recharge area and recharge rates are unknown.

C. Availability of Other Public Water Supplies

Any other water source would be from off-island. The distance from the mainland and the depth of Puget Sound surrounding the island precludes any off-island source being utilized, as it would be cost-prohibitive. Kitsap County does not have a large public supply that could serve the Island (Vashon 1992; CWSP 2005). The City of Seattle to the east is a potential supplier. However, as is true for all possible sources, the cost to construct and maintain piping across the Sound is not feasible from a cost standpoint.

The primary motivation behind this application is the protection of the existing ground water supply on the Island. The fact that obtaining water from off-island sources is not economically feasible reinforces the need to protect existing Island groundwater sources.

D. Reasons for Interest in SSA Designation

As discussed in the previous section, the Island's only feasible source of water is the aquifer. The ability of the Island to meet water demands in the future depends largely on the supply available from the Sea Level Aquifer System and the Fletcher Bay Aquifer System, based on the current understanding of the supply characteristics of these aquifers. The City of Bainbridge Island has contracted with the United States Geological Survey (USGS) to conduct groundwater modeling to better quantify the Island's drinking water resources; this program is discussed further in Section 4. A vital component of the quantification and protection of the Island's groundwater resources is the ongoing monitoring of groundwater wells in the various producing aquifers throughout the Island. Monitoring has been in progress for several years, and the scope of a more ambitious program (begun in 2006) and findings to date are provided in Section 4.
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The Bainbridge Island community and Kitsap County are aware of, and concerned about, the fact that the Island is solely dependent upon these aquifers. The water system purveyors on the Island are also concerned about protecting the aquifer. In a 2008 survey conducted by the City of Bainbridge Island (COBI 2008), residents said protection and effective management of the

Island's groundwater resources is a high priority. Similarly, in the City of Bainbridge Island 2004 Comprehensive Plan, five overriding principles are presented. The first principle is preservation of natural features (e.g., forests, etc.) of the Island; the second principle is protection of the water resources of the Island.

E. Why the Aquifer is Vulnerable to Contamination

There are many potential sources of groundwater contamination on the Island. These include: seawater intrusion, accidental spills, petroleum products, small hazardous waste generators, household hazardous waste disposal, leachate from the closed Island landfill, leachate from the remediated Wyckoff Superfund site in Eagle Harbor, failing septic systems, fertilizers, pesticides and herbicides, improperly abandoned wells, and the impact of population growth.

A limited investigation of seawater intrusion was conducted in the course of the completion of the annual groundwater monitoring program, which is summarized in Section 4. (Aspect 2008). Isolated incidences of elevated chloride concentrations (the principal evidence of seawater intrusion) have been reported in a few wells throughout the Island (K&W 2000; Aspect 2008). Chloride concentration data is entirely lacking for many areas along the shoreline, and additional monitoring of this analyte is needed to better assess the presence and extent of seawater intrusion in Island aquifers.

The closed Island landfill in the southern portion of the Island has an adequate groundwater monitoring system in place. Monitoring wells are sampled annually and leaching of contaminants has not been detected to date.

On-site sewage disposal systems (such as septic systems) pose a potential contaminant source. A portion of the Island is serviced by the City of Bainbridge Island's (COBI) wastewater treatment system; however, the remainder of the Island relies on on-site wastewater disposal systems, primarily septic tanks.

Improperly constructed, improperly maintained, and abandoned wells can also be a source of contamination of groundwater. The number and location of improperly constructed and abandoned wells on the Island is not currently known. Although the Washington Department of Ecology has implemented a program to identify and correct problems with wells, there is currently no community program in place to locate and assess the risk posed by improperly constructed and abandoned wells.

Projected population growth is presented in Section 3. The risk to groundwater quality will increase as the population increases because the required infrastructure and business development will create additional potential sources of contamination.

F. Quality of the Water from the Aquifer

K&W 2000 and Aspect 2008 provides some information on long-term drinking water quality, although a comprehensive study of drinking water quality has never been completed due to a lack of funding. In general, groundwater (and drinking water) quality on the Island is good. A primary measure of water quality is the comparison of a given analyte to the Federal Maximum Contaminant Level (MCL), which are benchmark concentrations above which further action may be taken to bring concentrations to acceptable levels. Iron and manganese are the most common analytes found to exceed MCLs. Table 1 provides a snapshot of these exceedances in comparison to other analytes. High iron and manganese can cause a somewhat objectionable odor, taste, or color, but generally are not considered a health problem.

G. Relationship of the Petitioner to the Purveyor(s) of the Water Supply

The Petitioners are private citizens that have no affiliation with the various water purveyors that provide water to the Island.

The Kitsap County Health District (KCHD) is, by contract with the Department of Health (DOH), responsible for the enforcement of the state drinking water regulations, WAC 246-290, as they pertain to small water systems.

SECTION 3: SOLE SOURCE DATA

A. Aquifer Service Area

1. Description of the Aquifer Service Area

Bainbridge Island covers an area of 27.5 square miles. It is roughly 10 miles north-to-south and 5 miles east-to-west.

2. Map Delineating the Boundaries of the Aquifer Service Area

See Figures 1 through 7.

B. Population

Total Population Within the Aquifer Service Area and the Population Served by the Aquifer

The population of Bainbridge Island is approximately 23,290 (OFM 2009). It is estimated that the population will increase to 25,474 by 2020, and 28,195 by 2030 (CWSP 2005). This constitutes a population increase of about 8 percent by 2020, and 18 percent by 2030. The sole source aquifer system on the Island underlies the entire Island.

Future water demand is routinely predicted through the use of demographic projections and reasonable values for per-person or per-household daily consumption. Future water demand figures are then compared to the calculated production capacity of the aquifers to evaluate adequacy of the supply relative to the demand. Projected water demand in the SSAA has been estimated and is discussed in detail in Section 4.

C. Current Sources of Drinking Water

1. Information Similar to that Requested on the “Current Drinking Water Sources” Matrix

Table 2 provides the major water purveyors on the Island, and a summary of the smaller public systems and single-dwelling wells.

2. A Brief Narrative Description of Each Current Source, with the Methods Used for Calculating the Percentages Used in the Matrix

The following is a summary of the principal water purveyors or systems serving the Island:

1 Kitsap Public Utility District (KPUD)
2 City of Bainbridge Island
3 South Bainbridge Water Company
4 Meadowmeer
5 Other Water Systems

The systems discussed above represent the major water purveyors or systems in the BI SSA. According to the Kitsap County Health District records, there are approximately 170 water purveyors or systems that provide consumptive water on the Island (BI 2004 Comprehensive Plan). Table 2 provides a breakdown of the connections and related information by system type. Additionally, private wells provide water to a considerable number of houses and to several businesses across the Island. The exact number of private wells on the Island is not known. According to information compiled by the United States Geological Survey (USGS) as part of an island-wide ground water modeling project, over 1000 well logs have been collected for public and private wells on the Island.

3. Explanation of seasonal variations

Like all aquifer systems that rely solely on rainfall for recharge, water levels in production and monitoring wells in the Island aquifers decrease in the Summer and early Fall, and increase in late Fall, Winter, and Spring. The Aspect 2008 report provides a detailed summary of the impact upon water supply aquifers by long-term effects of annual variations in rainfall volumes as evidenced by monitoring data collected over the past thirty years.

4. Explanation of actual use versus potential capacity

An analysis of the best available numerical estimate of actual versus potential capacity is presented in Section 4.

5. Explanation of why the source is not used currently to its full capacity

A comprehensive study has not been completed with regard to whether the drinking water aquifers are being used to their full capacity. However, the Aspect 2008 report provides specific information from multiple large production wells indicating that the Fletcher Bay Aquifer has reached capacity and is being used beyond safe yield. Similarly, a well in the Sea Level Aquifer also exhibited a long-term decline through 2004, at which time pumping from this well was reduced. A more detailed discussion of evidence of production exceeding recharge in these aquifers is provided in Section 4 in the Groundwater Monitoring subsection.

Aside from the significant warning signs indicated by dropping water levels in multiple wells in the Fletcher Bay Aquifer, and in North Bainbridge Well 7 in the Sea Level Aquifer, the available data does not indicate concerns at this time in monitored wells in the Perched Aquifer, Semi-Perched Aquifer, Sea level Aquifer, or Glaciomarine Aquifer. Additionally, the Bedrock Aquifer System is an unimportant water supply source, and generally only serves 1-3 residences. Wells are completed in sandstone, siltstone and conglomerate, and generally draw water from interconnected fractures and joint zones (K&W 2000).

There are reports of residential wells with decreasing water levels, diminished pumping capacity and water quality, including sea water intrusion in pockets of residential areas on the Island that require further study.

D. Alternative Sources of Drinking Water

Possible scenarios include: a) piping of water across Agate Pass bridge to the Island, and b) installation of a desalinization plant, which would convert salt water to drinking water. Both of these alternatives are being considered as possible courses of action as part of the Kitsap Public Utility #1’s 2025 long-range planning activities. A detailed analysis of the economic viability of these alternatives has not been completed. However, both alternatives are considered cost-prohibitive at this time, and as such are not considered alternative sources of drinking water.

With regard to the potential for surface water bodies as a source of drinking water, there are no significant resources of this kind on the Island.

Therefore, there are no alternative sources of drinking water at this time.

SECTION 4. HYDROGEOLOGICAL DATA

A. Aquifer and its Location

Topography

The topography of the Island is well-documented through mapping provided by the U.S. Geological Survey (USGS). The Island has a total of 53 miles of seawater shoreline, some of which is located beneath steep and variably unstable slopes. From the shoreline, the Island rises to rolling interior plateaus at elevations 300 to 400 feet above mean sea level (msl). The Island can be divided into 12 drainage basins (Figure 8). The island is primarily a mixture of developed land and variably forested areas.

Climate

The Bainbridge Island SSAA has a mid-latitude, wet-coast marine climate with relatively cool, dry summers and mild, rainy winters. The Olympic Mountains, located 40 miles northwest of the Island, shield the Island from intense winter storms. The Cascade Mountains, located 50 miles to the east, shield the Island and vicinity from the higher summer and lower winter temperatures common to Eastern Washington. Summer temperatures average in the 70s during the day and 50s at night, whereas winter temperatures are generally in the 40s during the day and 30s at night.

Long-term rainfall on the Island ranges from 34 to 36 inches per year and is greater to the southwest (K&W 2000).

Geology

The following discussion summarizes the compilation of geologic history and stratigraphy found in the Level II Assessment (K&W 2000). At least six advances and retreats of Pleistocene continental glaciers over the last 300,000 years has shaped the present-day landscape and underlying hydrostratigraphy of the Island (Easterbrook 1994). This resulted in the deposition of large volumes of unconsolidated glacial and interglacial material (mixtures of sand, silt, clay and gravels), which are host to the aquifers of the Island. Other geologic units are present on the Island and have less importance from a hydrologic standpoint. These units include surficial Quaternary alluvial deposits, and Tertiary sedimentary rocks, which are exposed at the southern end of the Island on the up-thrown side of a major east-west trending fault that transects the

Island. Figure 9 presents a surficial geologic map of the Island (Deeter 1979). Figure 10 provides the locations of representative geologic cross-sections provided in Figures 11 – 14 (and coincidentally provides the locations of many Island wells).

The following is a summary description of the principal geologic (i.e., soil and bedrock) units from youngest to oldest. Table 3 provides a more detailed breakdown of the units described below, and also correlates the various Island aquifers described in Section 2 with their respective soil/bedrock unit:

Quaternary alluvium: Recent stream, lake, floodplain, beach, and peat deposits. These are generally thin and discontinuous surficial deposits that cover less than one percent of the study area.

Vashon deposits: These are the youngest glacial deposits on the Island, laid down by the Vashon glacier from 18,000 to 13,000 year before present (Easterbrook 1968; Easterbrook 1994). They consist of poorly sorted sand and gravel of the Vashon recessional outwash (Qvr). Below the Qvr is the much more extensive Vashon till (Qvt), which comprises the majority of the Island's surficial exposures. The Qvt is a mixture of unstratified clay through boulder size detritus. Below the Qvt is the Vashon advance outwash (Qva), composed of sand and silty sand with lesser amounts of gravel and occasional lenses of silt. Locally, the Lawton Clay (Qvl) lies below the Qva and consists of clay and silt deposited in lakes that formed ahead of the advancing Vashon glacier.

Below the Vashon deposits are alternating groups of nonglacial and glacial unconsolidated sedimentary deposits, which have been variably named by several earlier workers. The dissimilar nomenclature will not be detailed here. There is general agreement on the usage of the term Vashon, which represents the youngest glaciation that began 18,000 years ago. This was preceded by an interglacial period, which in turn was preceded by an earlier glacial episode 80,000 years ago. This early glacial period's deposits are not as evident as the Vashon, but are present above sea level. Delineation of the glacial units is further complicated by yet another earlier interglacial and then glacial episode that are present in some outcrops above sea level. Older glacial/interglacial episodes are evident in well logs and do not outcrop (K&W 2000).

The aforementioned east-west fault at the south end of the Island juxtaposes unconsolidated Pleistocene sediments to the north with Tertiary sedimentary bedrock in the south. The Tertiary bedrock, which is mantled by Vashon glacial deposits, is the oldest material on the Island. The bedrock consists of shale, sandstone, and conglomerate deposited in a marine environment, and have been assigned to either the Blakely Formation or the Blakely Harbor Formation (Fulmer 1975).

Ground Water Use And Occurrence

Water resources of the Bainbridge Island SSAA include aquifers and the associated drainage basins that include surface water bodies, streams, and springs. Figure 8 depicts the 12 Island watershed basins and associated streams. Only aquifers serve as sources of water for water purveyors; surface water bodies, streams, and springs are not used for this purpose.

Recharge. The Island water supply is fully dependent on groundwater recharge from precipitation (Figure 15). Therefore, the establishment of a water budget requires a calculation of recharge as the subtraction of both evapotranspiration and runoff from precipitation:

Recharge = Precipitation – Evapotranspiration - Runoff

This water balance equation was used to calculate recharge for the Island in the Initial Basin Assessment (IBA)(KPUD 1997). The IBA established a precipitation rate of 35 inches/year, based on the long-term isoheytal map prepared as part of the IBA. This annual precipitation rate is consistent with other data collected since the publication of the IBA (between 1997-2009). Evapotranspiration was calculated to be 15 inches/year in the IBA using the Blaney-Criddle method (Dunne & Leopold 1978), which uses crop, latitude, and temperature data. Runoff is assumed to be 20 percent of precipitation (Woodward and Others 1995), which equates to 7 inches/year. Therefore, the water balance equation as published in the IBA is:

Recharge = 35 in/yr – 15 in/yr – 7 in/yr
Recharge = 13 in/yr

The estimated value of 13 in/yr represents the total recharge to the ground water system. Subsurface conditions control whether the recharge either seeps downward into aquifers or discharges to local surface water streams or other water bodies. Note that groundwater is the sole source of water in streams on the Island.

Two different methods were employed to attempt to calculate a more accurate estimate of groundwater recharge: 1) a regression recharge estimate, and 2) an empirical recharge estimate (K&W 2000); details of these methods are not repeated here. The regression recharge estimate yielded an estimate of 16.4 inches of recharge annually. The empirical recharge estimate yielded an estimate of 12.9 inches of recharge annually. Both of these methods' results compare well with the 13 in/yr value generated in the IBA.

Total Groundwater Resource. Given an area of 27.5 square miles (17,600 acres) and a recharge rate of 13 inches per year, a total available groundwater resource of approximately 19,000 acre feet per year was calculated (K&W 2000). This estimate is the sum of the resource in all aquifers on the Island.

Actual Usage Estimates. For a variety of reasons, it is difficult to accurately estimate the amount of water actually used on the Island. Causes of this difficulty include the existence of inactive water rights, invalid claims, overestimation of need on the part of applicants, and the difficulty in estimating the amount of water actually used by exempt wells (K&W 2000). However, given these limitations, K&W 2000 summed the maximum permitted annual allocation for surface and groundwater on the Island. The total was 7,561 afy, and does not include applications, claims, or exempt wells (K&W 2000). Figure 16 is a groundwater rights map of the Island; Figure 17 provides a breakdown of the various categories of water rights allocation; and Figure 18 estimates groundwater resource distribution.

To estimate actual use, the 7,561 afy was used in conjunction with a population total in 1990 and a projection of a population total by the year 2014 (K&W 2000). Actual usage was calculated by multiplying population by an estimated per capita consumption rate, which includes municipal, domestic, commercial, irrigation, fish propagation, and stock watering uses, and also includes an estimate of water use from claims and users of wells that are exempt from water rights. The 1990 population number of 15,736 was multiplied by an average use per capita value of 132 gallons per day (KPUD 1997), which yielded an annual continuous consumption total of 1,442 gpm or 2,326 afy. The projected 2014 annual continuous consumption total was calculated to be 2,067 gpm or 3,329 afy.

Interestingly, the projected 2014 population (22,556) used in K&W 2000 is essentially the same as the current (2009) Island population (23,290)(OFM 2009). Therefore, the K&W 2000 projection for 2014 also provides a viable estimate of current Island water usage. An additional measure of validity applies to the 2014 number with regard to water rights, as no new water rights have been granted since 2000 (Ecology 2009) when K&W 2000 was published; thus, that aspect of the 2014 projection has not changed.

In conclusion, the current (2009) estimated annual usage (as taken from the 2014 projection) of 3,329 afy represents approximately 18 percent of the estimated total groundwater resource of

19,000 afy. Assuming this total resource amount is reasonably accurate, population increases of 8 percent by 2020 and 18 percent by 2030 (as provided in Section 3) will be adequately supplied by the existing resource. Considerable caution must be applied to the 19,000 afy resource figure, as more monitoring data and actual production data must be collected and interpreted in order to verify that a volume of 19,000 afy actually constitutes a total recoverable resource.

USGS Modeling. As the preceding discussion demonstrates, it is difficult to accurately calculate a meaningful estimate of: 1) annual usage, and 2) the total groundwater resource of the Island. In order to better estimate the Island's total current and future groundwater resource, the United States Geological Survey (USGS) is currently developing an island-wide groundwater model (USGS 2009). The USGS will characterize the groundwater flow system on the Island and its interaction with streams and other surface water features. The USGS will integrate this information into a numerical groundwater flow model to assist long-range resource planning. The results of the study are planned to be completed in July 2010.

Groundwater Monitoring. In addition to the use of the USGS model as a predictive tool in estimating the total groundwater resource, further quantification of the resource will be aided by a continuation of the ongoing groundwater monitoring program that has been in progress for several years on the Island. The Aspect 2008 report summarizes and interprets the 2008 monitoring results as well as data from previous years of monitoring. Figure 19 presents the groundwater wells currently monitored on an annual basis, and Table 4 provides a breakdown of the number of wells monitored in each water supply aquifer, respectively. Although the monitoring network must be expanded to provide more accurate information on the volume of the resource, it is a good starting point that focuses on large groundwater withdrawals, elevated chloride concentrations, and near-shoreline aquifer conditions.

The Aspect 2008 report (updated March 2009) identifies evidence of production exceeding recharge in several large production wells over the last several years. This information underscores the need for careful monitoring and management of the water supply as the population grows, as well as the need for the proper level of water supply protection that would be provided in part by the eventual acceptance of this petition.

The information in the following three paragraphs is taken from Aspect 2008. The Sands Road 1, Sands Road 2, North Bainbridge Well 9, and Island Utilities Well 1 are large production wells in the Fletcher Bay Aquifer (FBA) (Figure 19). In the past, these wells have exhibited declining water level trends that indicate production exceeded recharge. The water level in the Island Utilities Well 1 continues to decline. The Sands Road 1 and 2 and North Bainbridge Well 9 appear to have stabilized since approximately 2005. Additionally, one well in the Sea Level Aquifer (North Bainbridge Well 7) did exhibit a long-term decline through 2004, at which time pumping from this well was reduced.

As part of the monitoring program, a provisional early warning level (EWL) was defined as an observable drop in water level, at or above 0.5 foot per year for 10 years, that cannot be explained by variations in precipitation. The declining water levels in the FBA in the Eagledale area in the Island Utilities Well 1 are above the EWL for safe yield and pose a concern. Despite the fact that water levels in the North Bainbridge and Sands Road wells may have stabilized over the last three years, continued attention is warranted as these wells are large producers and have been pumped at rates that exceeded recharge in the recent past.

A series of recommendations have been made to both manage and better quantify the resource:

1. Expand the monitoring program to include more wells in each of the water-producing aquifers, and select wells that better represent the full areal extent of the Island;
2. Acquire production data for additional private well systems to build as complete a record as possible of total groundwater withdrawals;
3. Increase the frequency of the monitoring of production and water levels for several Fletcher Bay Aquifer wells (North Bainbridge Well 7, Sands Road 1, Sands Road 2, North Bainbridge Wells 9 and 10) and for one Sea Level Aquifer well (North Bainbridge 7), particularly during changes in production;
4. Closely monitor production and water levels, and chloride data in Island Utilities Well 1 to insure safe yield;
5. Evaluate chloride levels by aquifer, and focus on chloride levels in wells completed within 0.25 mile of the shoreline.

CONCLUDING STATEMENT

This petition summarizes published hydrogeologic information that amply confirms that the aquifer system on Bainbridge Island meets the criteria of a sole source aquifer as defined by the EPA. Further, Bainbridge Island's hydrogeologic characteristics are similar to the following Puget Sound islands whose aquifers have already been designated as sole source aquifers by EPA: Camano, Whidbey, Marrowstone, and Vashon-Maury.

Relatively little work has been completed to quantify the groundwater resource on Bainbridge; however, current efforts by the USGS and a city-funded groundwater monitoring program will provide additional information to address this issue. Compared to many islands in the greater Puget Sound area, Bainbridge Island is fortunate in having a reasonable water supply. However, the supply is finite and this petition has briefly described warning signs of aquifer overuse of some of the important production wells. Additionally, surface water studies conducted over the last decade on Bainbridge indicate a decline in stream flows and serves as another warning sign (e.g. Schel-Chelb Creek). Because the Island's aquifer system meets EPA's definition of a sole source aquifer, it is hoped that the eventual acceptance and designation of the Island's aquifer system into this program will serve to raise awareness of the importance of groundwater protection and conservation, as well as protect the resource in the course of the Island's receipt of federal funding, regardless of the nature of the project.

REFERENCES

Aspect 2008. Aspect Consulting. Groundwater Monitoring Program, Program Update-December 2008, City of Bainbridge Island, Bainbridge Island, Washington. Prepared for City of Bainbridge Island. Project No. 06-0016-003-02. December.

BI 2004 Comprehensive Plan. City of Bainbridge Island 2004 Comprehensive Plan.

CWSP 2004. Draft Kitsap County Coordinated Water System Update.

CWSP 2005. Kitsap County Coordinated Water System Plan. Region Supplement, 2005 Revision.

COBI 2009. City of Bainbridge Island Website. July. www.ci.bainbridge-isl.wa.gov.

COBI 2008. City of Bainbridge Island Citizen Survey. April.

Deeter, J.D.1979. Quaternary Geology and Stratigraphy of Kitsap County, Washington: MS Thesis, Western Washington University, Bellingham, 175p., 2 plates.

Dunne, T. and Leopold, L.B., 1978. Water in Environmental Planning. W.H. Freeman and Company. 818p.

Easterbrook, D.J., 1994. Chronology of Pre-Late Wisconsin Pleistocene Sediments in the Puget Lowland, Washington, Washington Division of Geology and Earth Resources Bulletin 80, 16p.

Easterbrook, D.J. and Anderson, H.W. Jr., 1968. Pleistocene Stratigraphy of Island County, Ground-water Resources of Island County, USGS Water Supply Bulletin No. 25, 317.

Ecology 2009. Personal Communication with Jay Cook, Hydrogeologist, Water Resources Division, Washington Department of Ecology, who verified that no new water rights have been granted on Bainbridge Island between the years 2000 - 2009. July 7.

EPA 2009. Sole Source Aquifer Program. United States Environmental Protection Agency Region 10 website. http://yosemite.epa.gov/r10/water.nsf/Sole+Source+Aquifers/SSA. July 30.

EPA 1995. Sole Source Aquifer Designation Petitioners Guidance, EPA Document 440/6-87-

003. http://www.epa.gov/region02/water/aquifer/petition/. September.

Fulmer, C.V. 1975. Stratigraphy and Paleontology of the Type Blakeley and Blakely Harbor Formations: in Weaver, D.W., Hornaday, G.R., and Tipton, A (eds), Conference on Future Energy Horizons of the Pacific Coast, Paleogene Symposium and Selected Technical Papers: American Association Petroleum Geologists, Society Economic Paleontologists and Mineralogists, and Society Economic Geophysicists, Annual Meeting, Pacific Sections, Proceedings, p. 210-271.

K&W 2000. Kato & Warren, Inc., and Robinson & Noble Inc. City of Bainbridge Island Level II Assessment, an element of water resources study. December.

KPUD 1997. Kitsap County Public Utility District, and others, 1997. Kitsap County Initial Basin Assessment, Open File Technical Report No. 97-04.

KPUD 1999. Kitsap Public Utility District Well Database. July.

OFM 2009. State of Washington Office of Financial Management Current Estimated Population. Published in the Bainbridge Island Review, July 3.

USGS 2009. United States Geological Survey Washington Water Science Center: Island-Wide Ground-Water Model. http://wa.water.usgs.gov/projects/bainbridge/index.htm. March 30.

Vashon 1992. Vashon-Maury Island Sole Source Aquifer Designation Petition. Submitted by Seattle-King County Health Department, Vashon-Maury Island Ground Water Advisory Committee, Vashon-Maury Island Water Utility Coordinating Committee, Vashon-Maury Island Community Council. March 30.

Woodward, D.G. and Others 1995. Occurrence and Quality of Ground Water in Southwestern King County, Washington, U.S. Geological Survey, Water-Resources Investigation Report 92-4098. 69p.

WQFMP 2006. Water Quality and Flow Monitoring Program City of Bainbridge Island, Site Evaluation Report. December.

FIGURES

Figure 1. Map of Study Area.

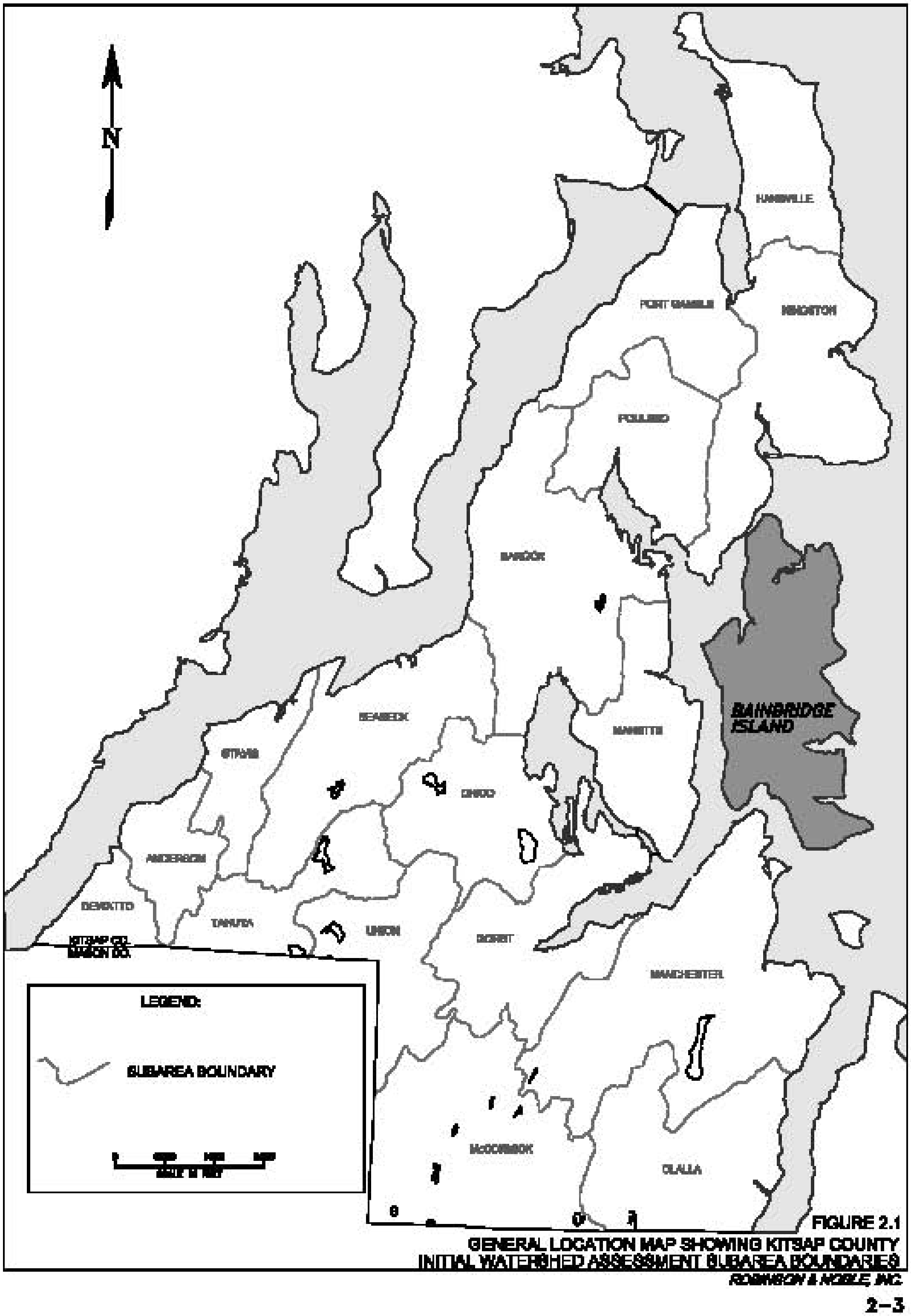


Figure 2. Perched Aquifer Boundary Map.

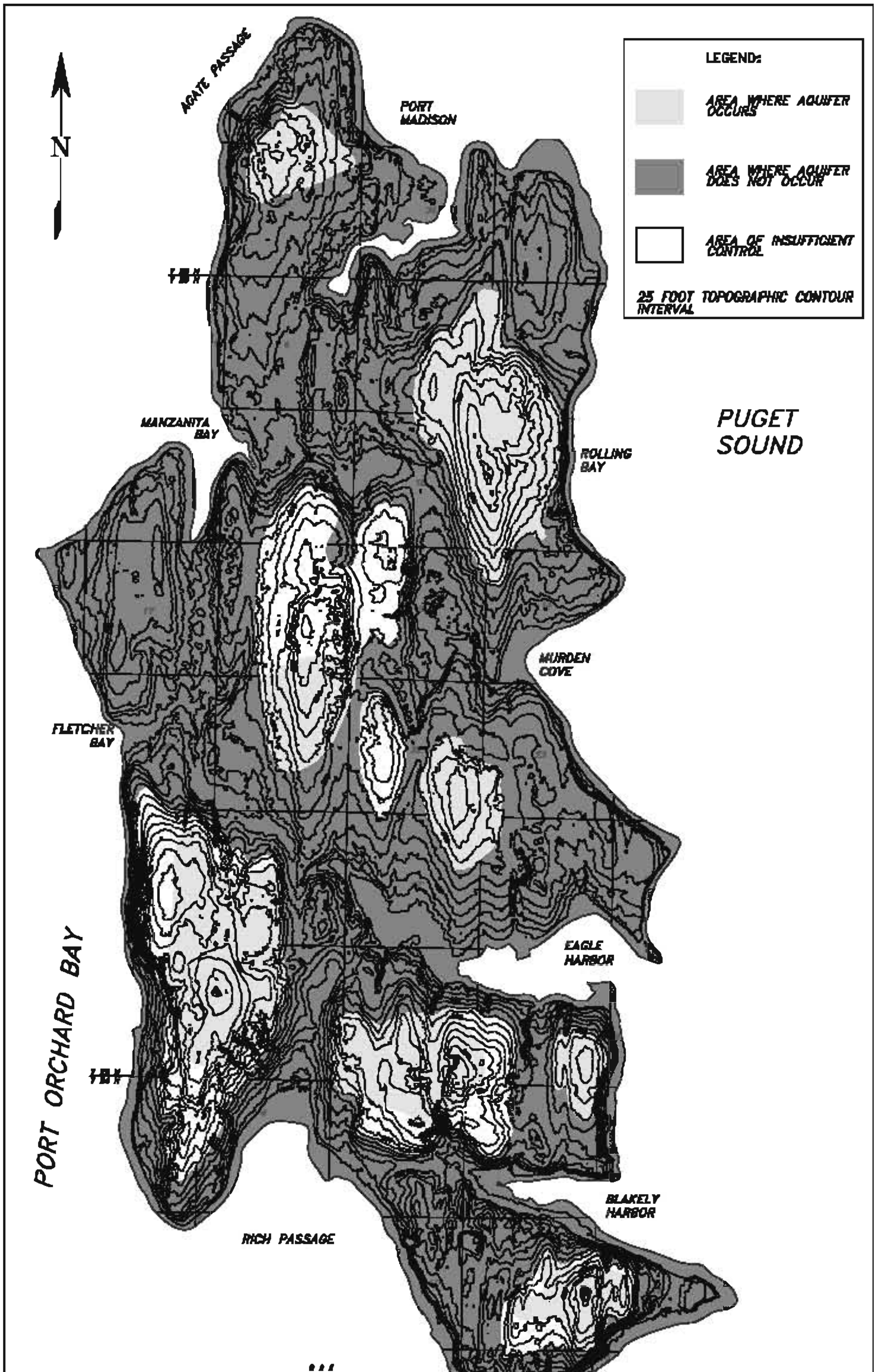


FIGURE 5.2
PERCHED AQUIFER BOUNDARY MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 3. Semi-Perched Aquifer Boundary Map.

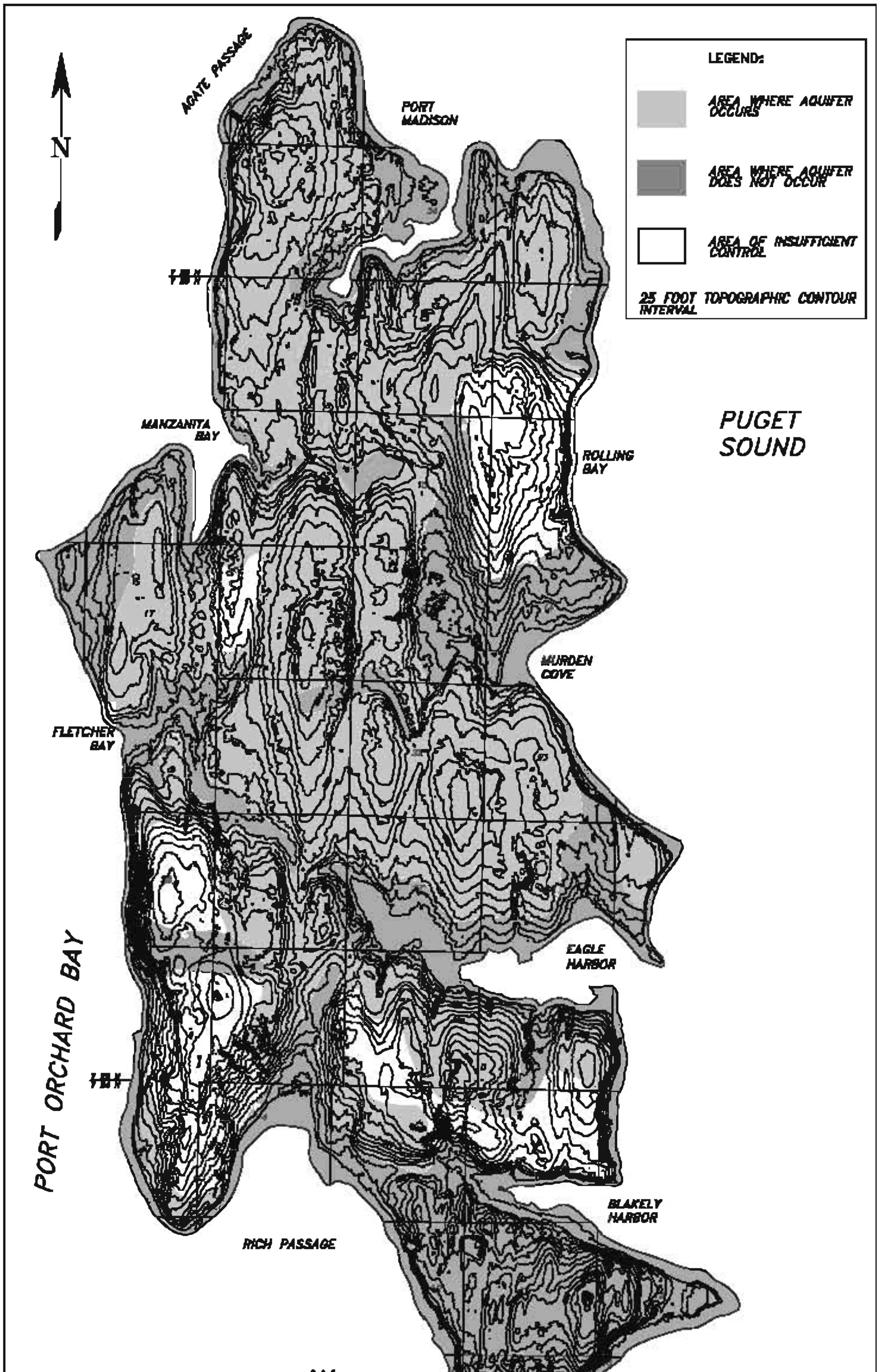


FIGURE 5.4
SEMI-PERCHED AQUIFER BOUNDARY MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 4. Sea Level Aquifer Boundary Map.

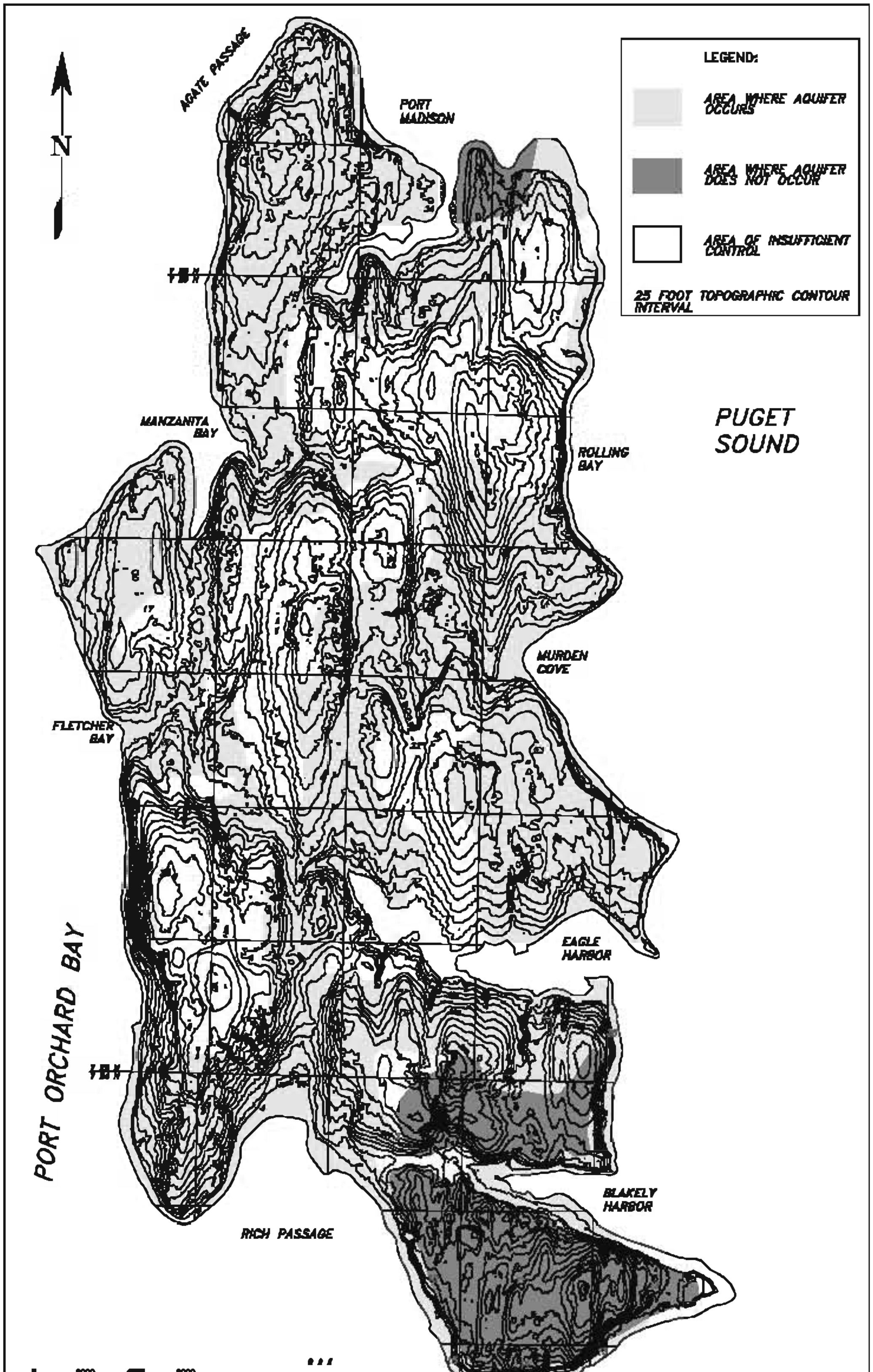


FIGURE 5.8
SEA LEVEL AQUIFER BOUNDARY MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 5. Glaciomarine Aquifer Boundary Map.

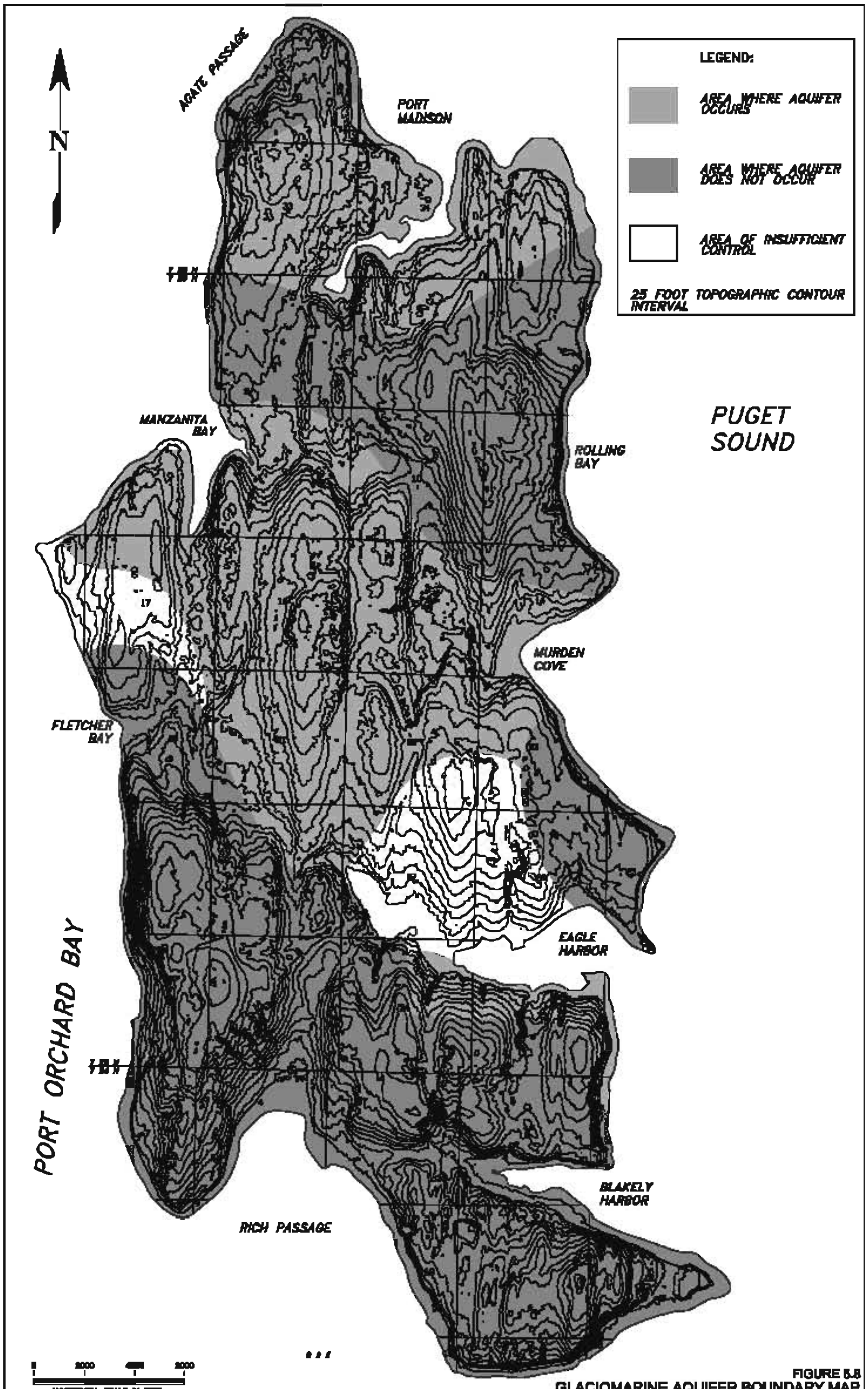


FIGURE 5.8
GLACIOMARINE AQUIFER BOUNDARY MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 6. Fletcher Bay Aquifer Boundary Map.

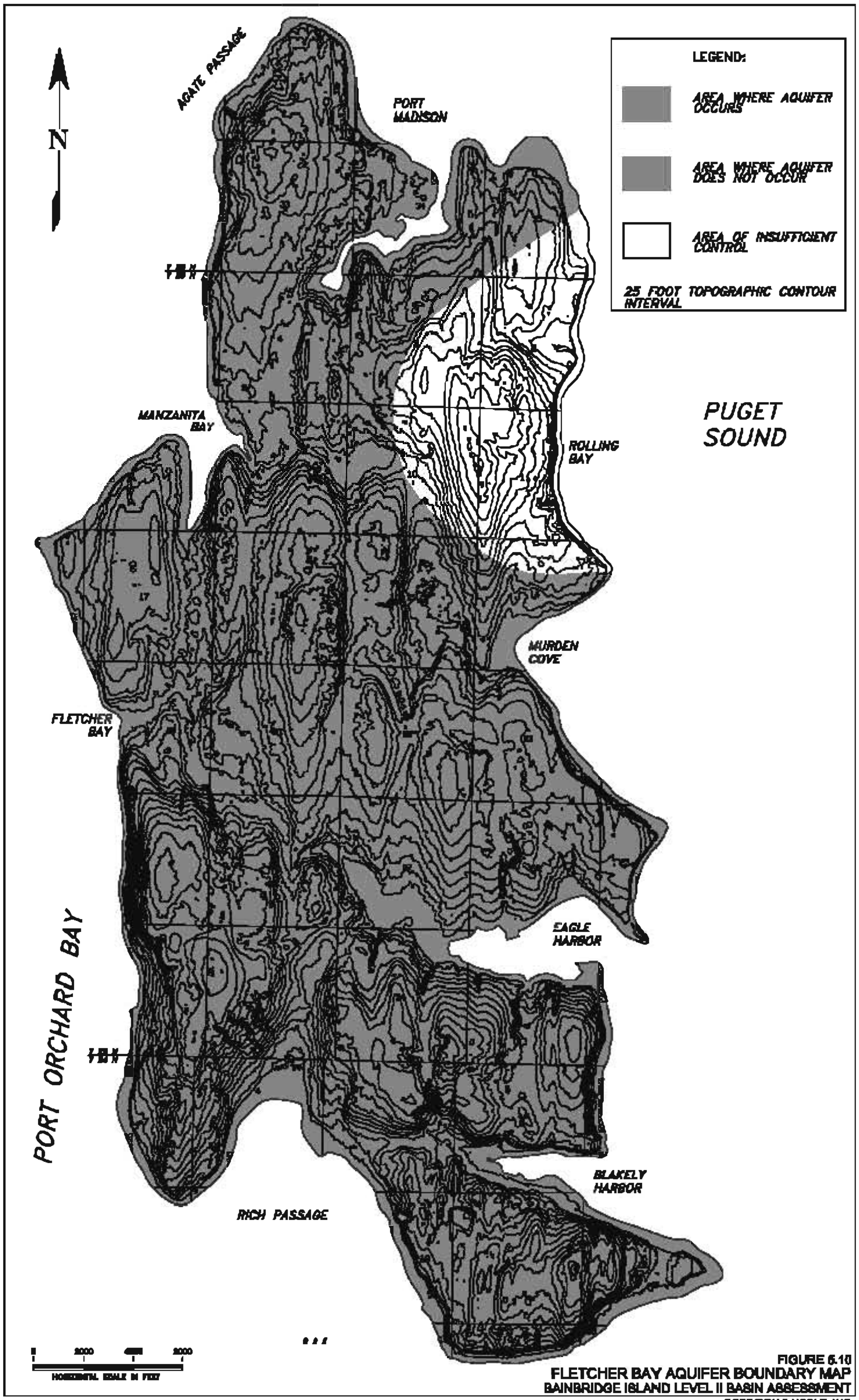


FIGURE 5.10
FLETCHER BAY AQUIFER BOUNDARY MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 7. Bedrock Aquifer Boundary Map.

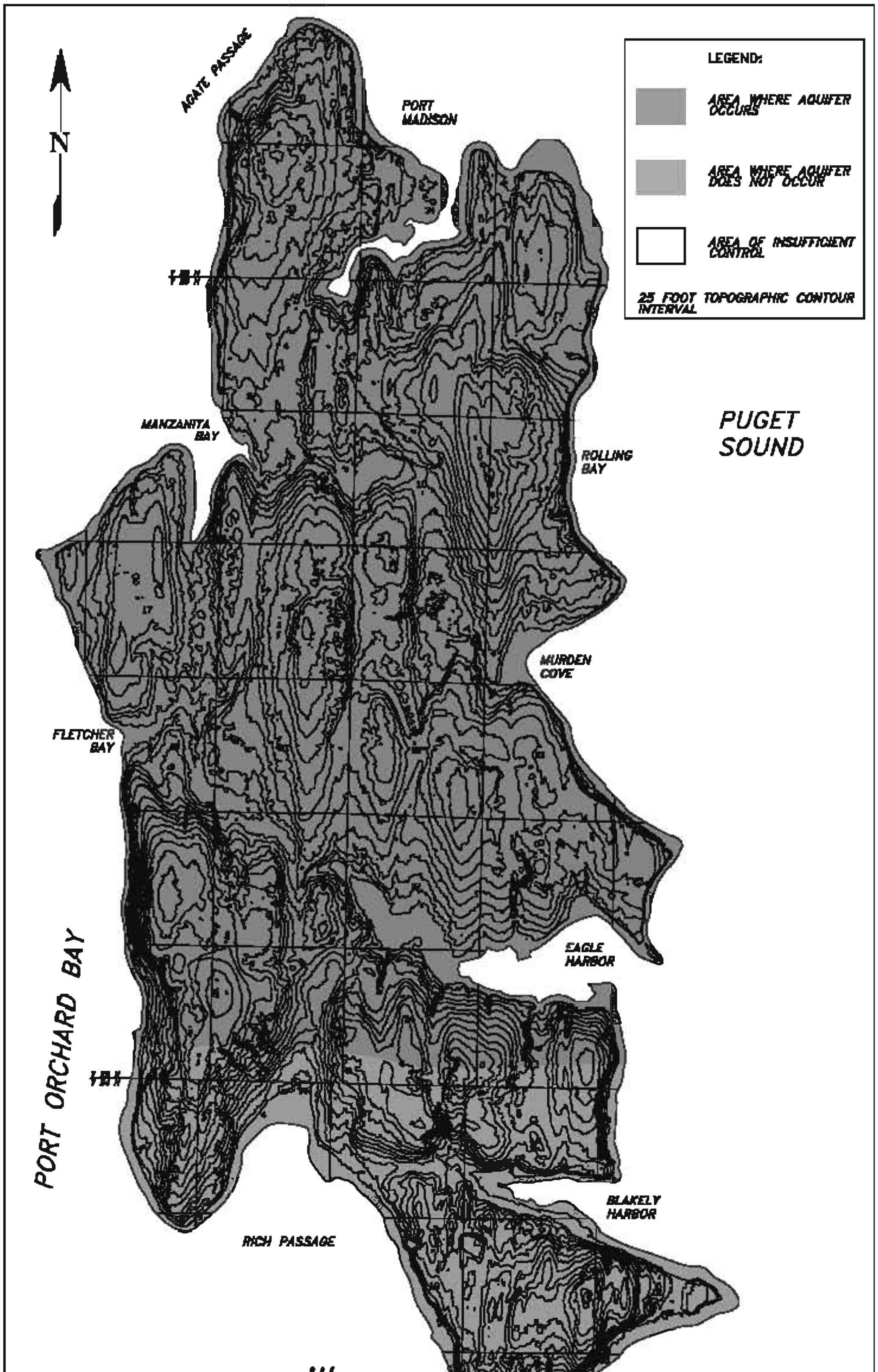
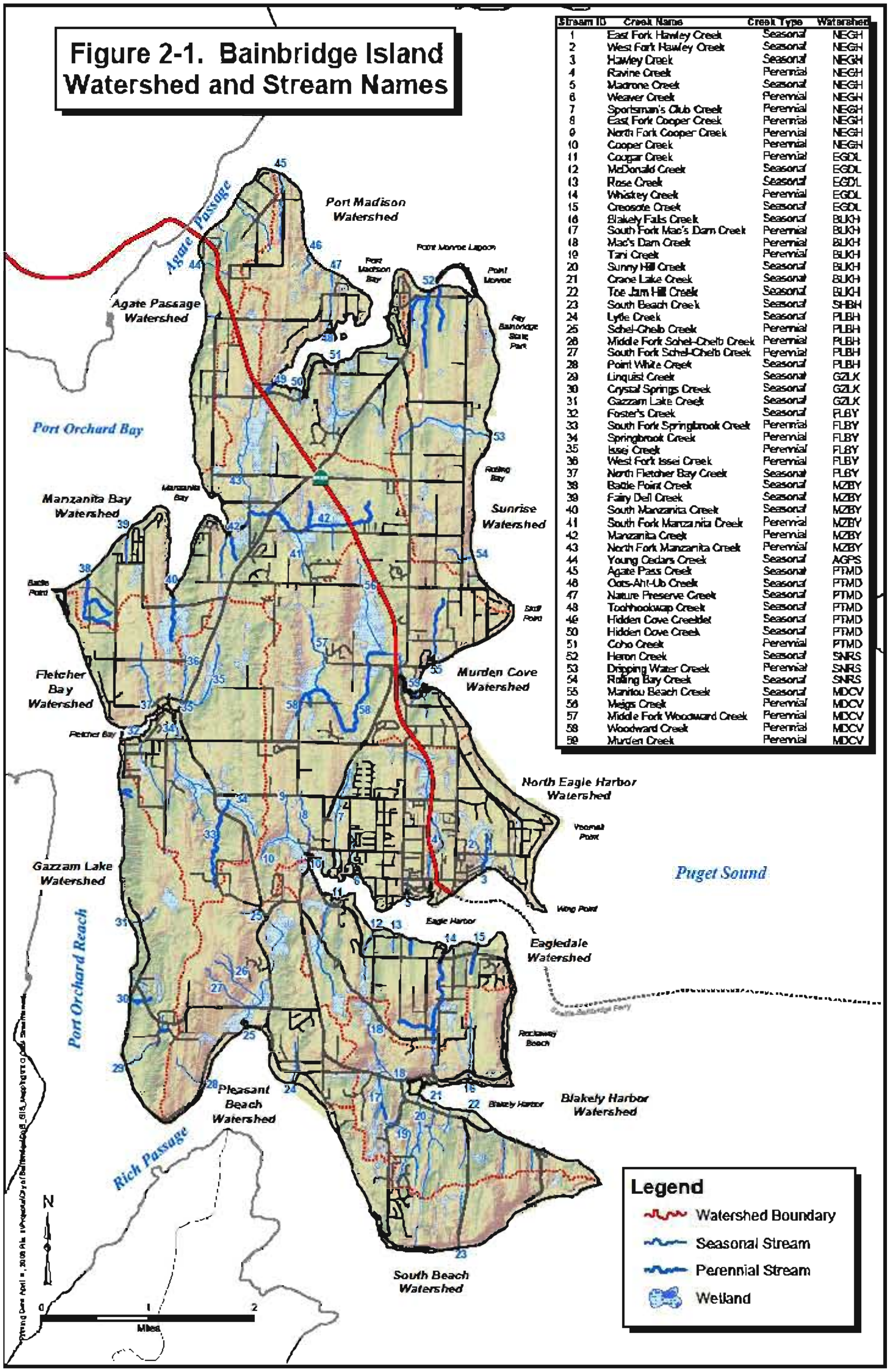


FIGURE 5.12
BEDROCK AQUIFER BOUNDARY MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 8. Bainbridge Island Watersheds and Stream Names.

Figure 2-1. Bainbridge Island Watershed and Stream Names



Stream ID	Creek Name	Creek Type	Watershed
1	East Fork Hawley Creek	Seasonal	NEGH
2	West Fork Hawley Creek	Seasonal	NEGH
3	Hawley Creek	Seasonal	NEGH
4	Ravine Creek	Perennial	NEGH
5	Madrone Creek	Seasonal	NEGH
6	Weaver Creek	Perennial	NEGH
7	Sportsman's Club Creek	Perennial	NEGH
8	East Fork Cooper Creek	Perennial	NEGH
9	North Fork Cooper Creek	Perennial	NEGH
10	Cooper Creek	Perennial	NEGH
11	Cougar Creek	Perennial	EGDL
12	McDonald Creek	Seasonal	EGDL
13	Rose Creek	Seasonal	EGDL
14	Whiskey Creek	Perennial	EGDL
15	Creosote Creek	Seasonal	EGDL
16	Blakely Falls Creek	Seasonal	BLKH
17	South Fork Mac's Dam Creek	Perennial	BLKH
18	Mac's Dam Creek	Perennial	BLKH
19	Tani Creek	Perennial	BLKH
20	Sunny Hill Creek	Seasonal	BLKH
21	Crane Lake Creek	Seasonal	BLKH
22	Toe Jam Hill Creek	Seasonal	BLKH
23	South Beach Creek	Seasonal	SHBH
24	Lytle Creek	Seasonal	PLBH
25	Schel-Chelb Creek	Perennial	PLBH
26	Middle Fork Schel-Chelb Creek	Perennial	PLBH
27	South Fork Schel-Chelb Creek	Perennial	PLBH
28	Point White Creek	Seasonal	PLBH
29	Linquist Creek	Seasonal	GZLK
30	Crystal Springs Creek	Seasonal	GZLK
31	Gazzam Lake Creek	Seasonal	GZLK
32	Foster's Creek	Seasonal	FLBY
33	South Fork Springbrook Creek	Perennial	FLBY
34	Springbrook Creek	Perennial	FLBY
35	Issei Creek	Perennial	FLBY
36	West Fork Issei Creek	Perennial	FLBY
37	North Fletcher Bay Creek	Seasonal	FLBY
38	Battle Point Creek	Seasonal	MZBY
39	Fairy Dell Creek	Seasonal	MZBY
40	South Manzanita Creek	Seasonal	MZBY
41	South Fork Manzanita Creek	Perennial	MZBY
42	Manzanita Creek	Perennial	MZBY
43	North Fork Manzanita Creek	Perennial	MZBY
44	Young Cedars Creek	Seasonal	AGPS
45	Agate Pass Creek	Seasonal	PTMD
46	Oars-Aht-Ub Creek	Seasonal	PTMD
47	Nature Preserve Creek	Seasonal	PTMD
48	Toohhoolwap Creek	Seasonal	PTMD
49	Hidden Cove Creeklet	Seasonal	PTMD
50	Hidden Dove Creek	Seasonal	PTMD
51	Coho Creek	Perennial	PTMD
52	Heron Creek	Seasonal	SNRS
53	Dripping Water Creek	Perennial	SNRS
54	Rolling Bay Creek	Seasonal	SNRS
55	Manitou Beach Creek	Seasonal	MDCV
56	Meigs Creek	Perennial	MDCV
57	Middle Fork Woodward Creek	Perennial	MDCV
58	Woodward Creek	Perennial	MDCV
59	Murden Creek	Perennial	MDCV

Figure 9. Geologic Surface Map.

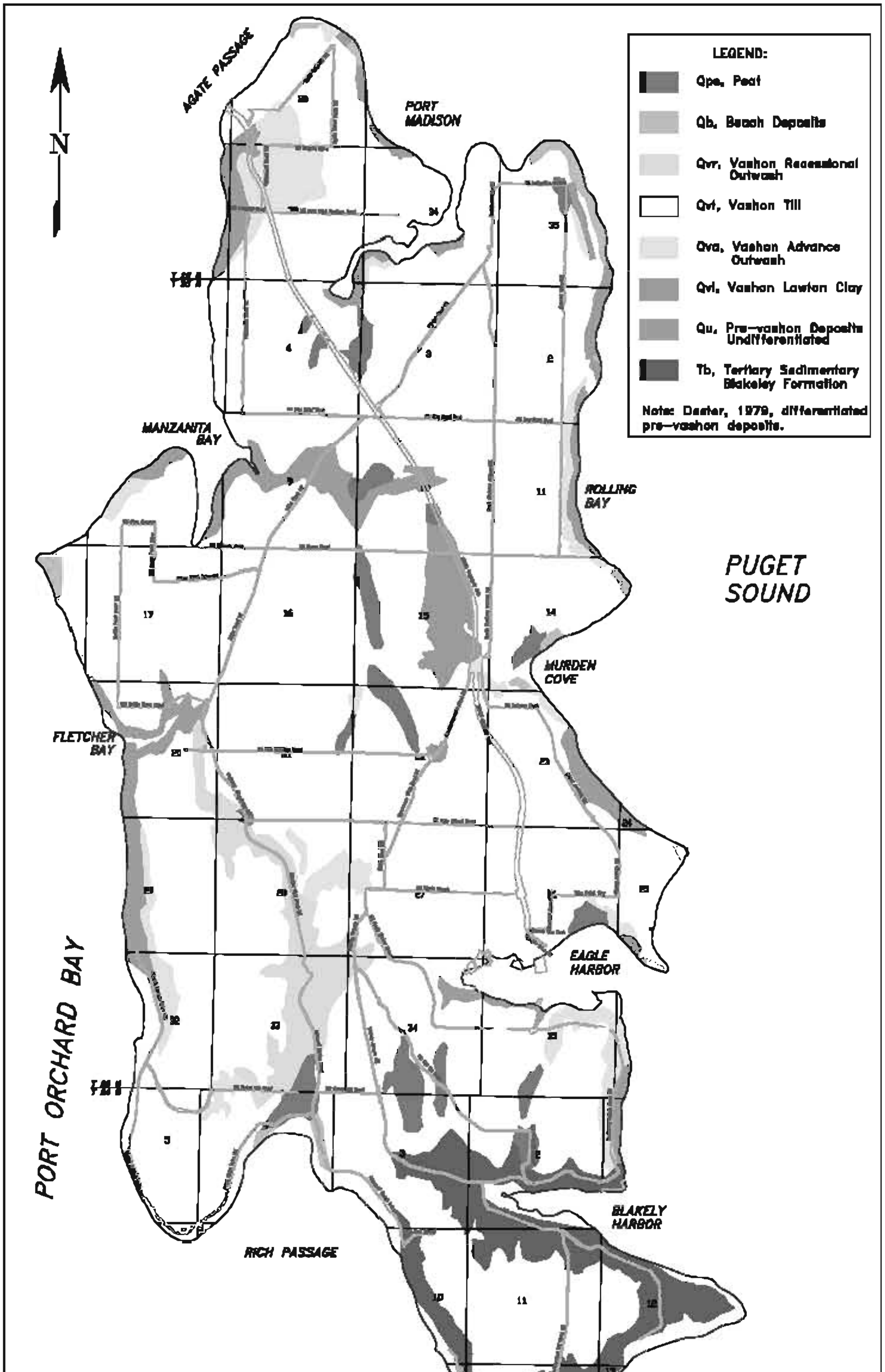


FIGURE 3.3
GEOLOGIC SURFACE MAP
MODIFIED FROM DEETER, 1979
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 10. Well and Cross Section Location Map.

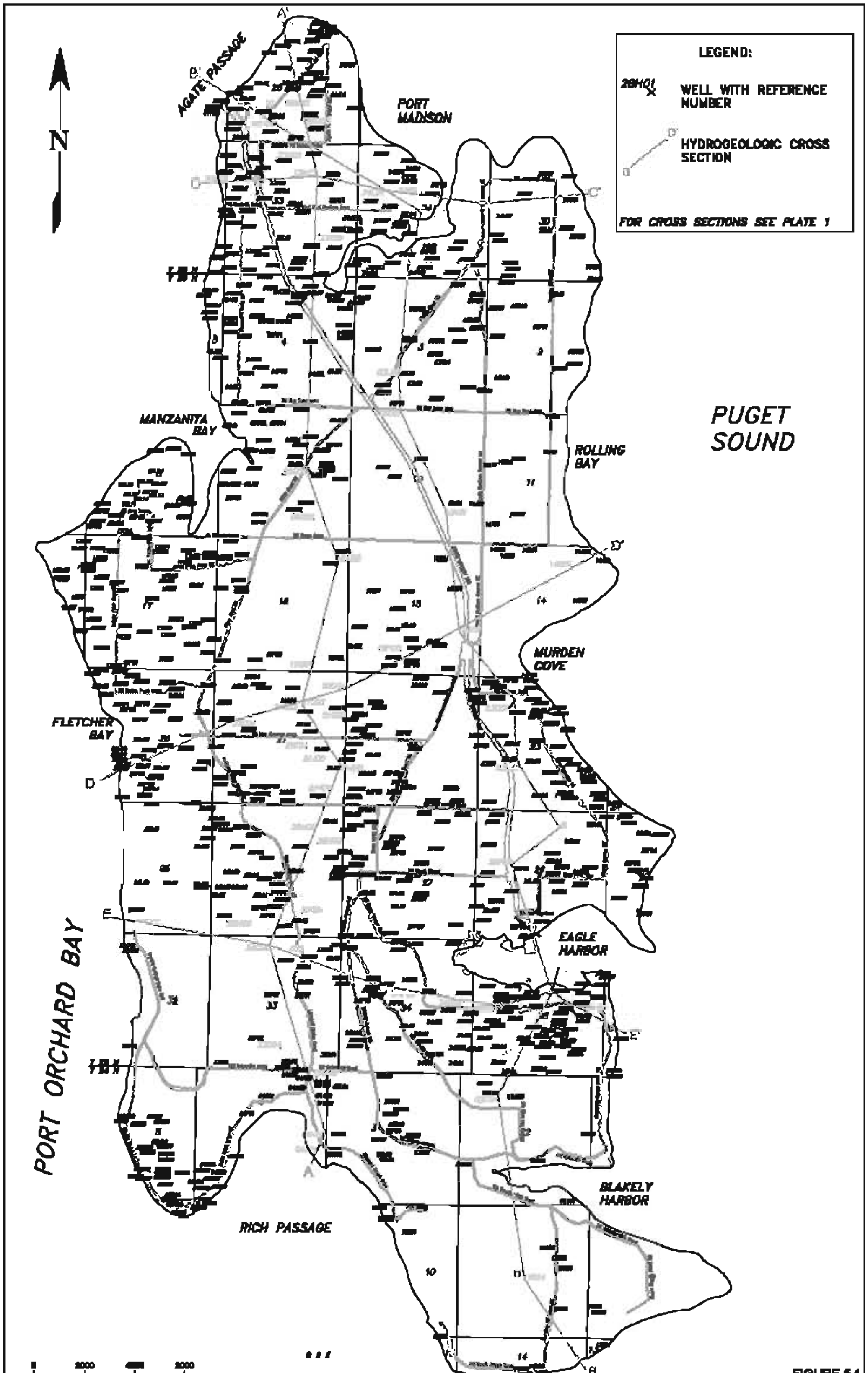


FIGURE 5.1
WELL AND CROSS SECTION LOCATION MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 11. Hydrogeologic Cross Ssection A-A'.

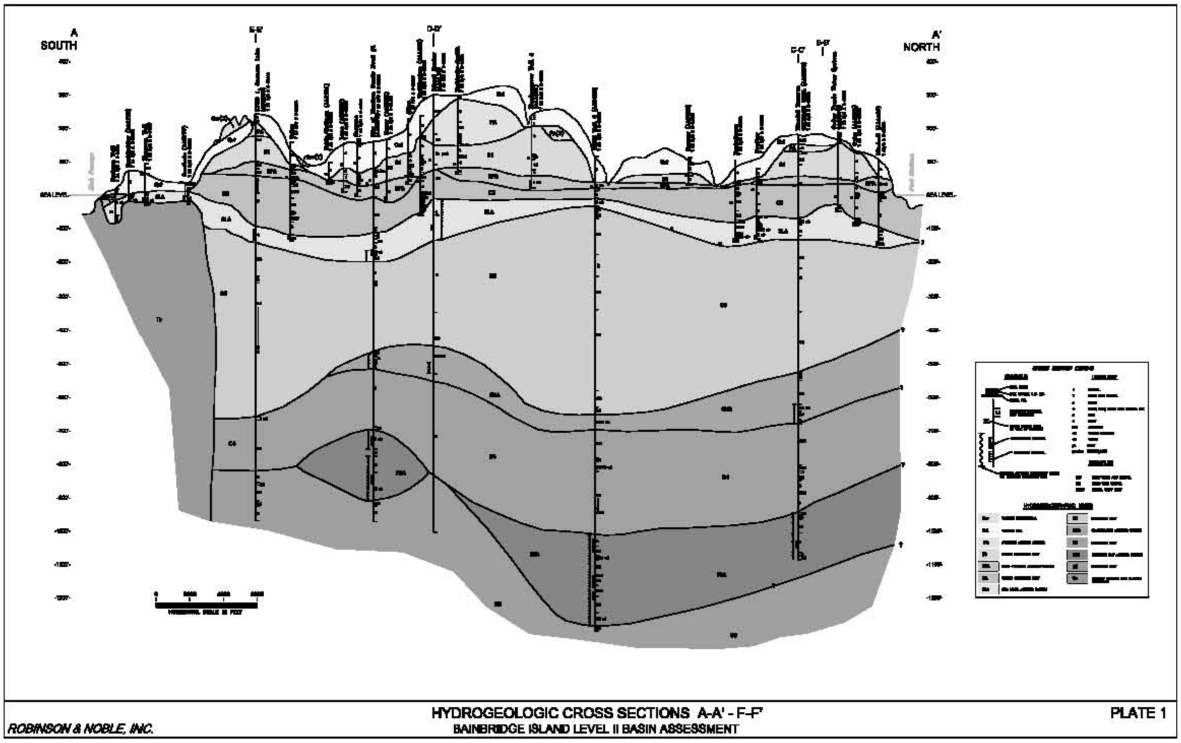


Figure 12. Hydrogeologic Cross Section B-B'.

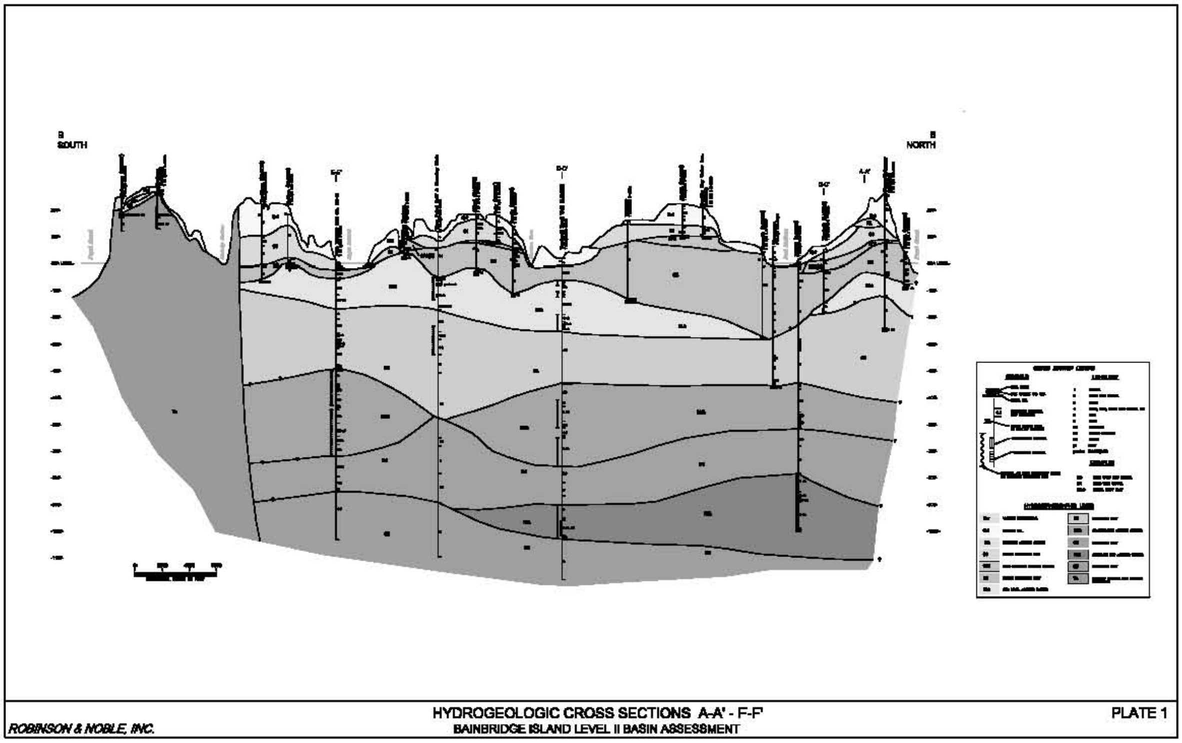


Figure 13. Hydrogeologic Cross Section C-C' and D-D'.

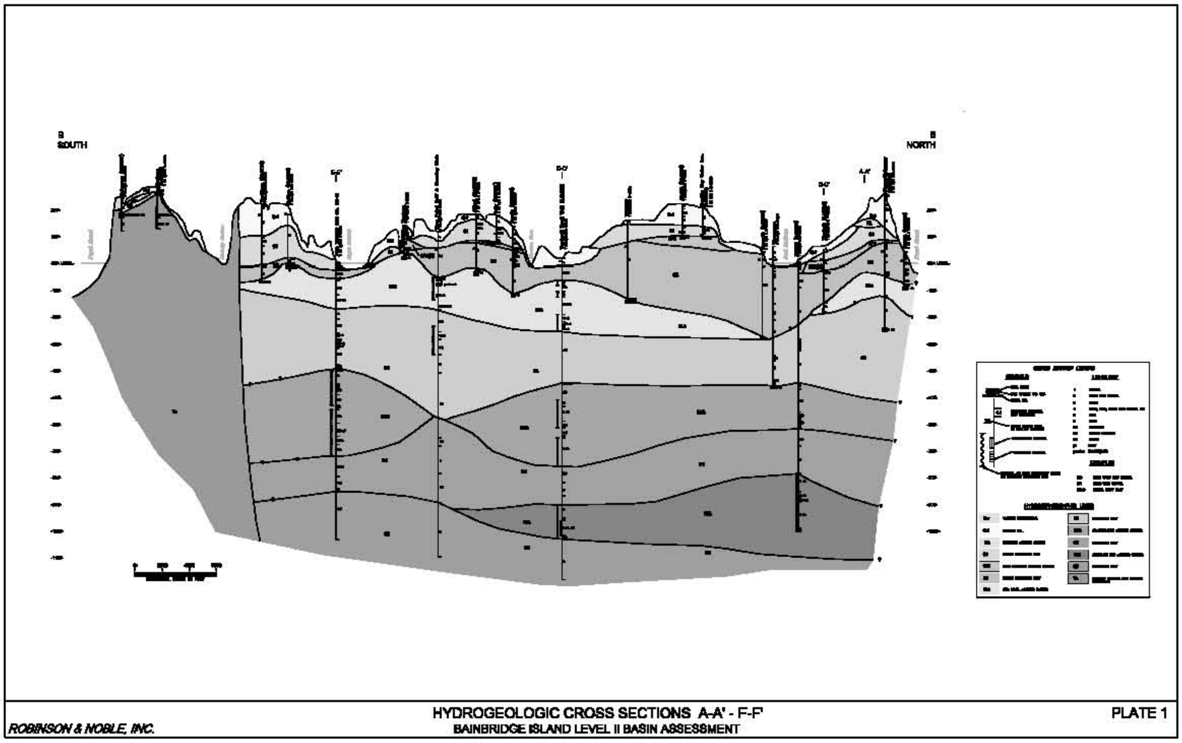


Figure 14. Hydrogeologic Cross Section E-E'.

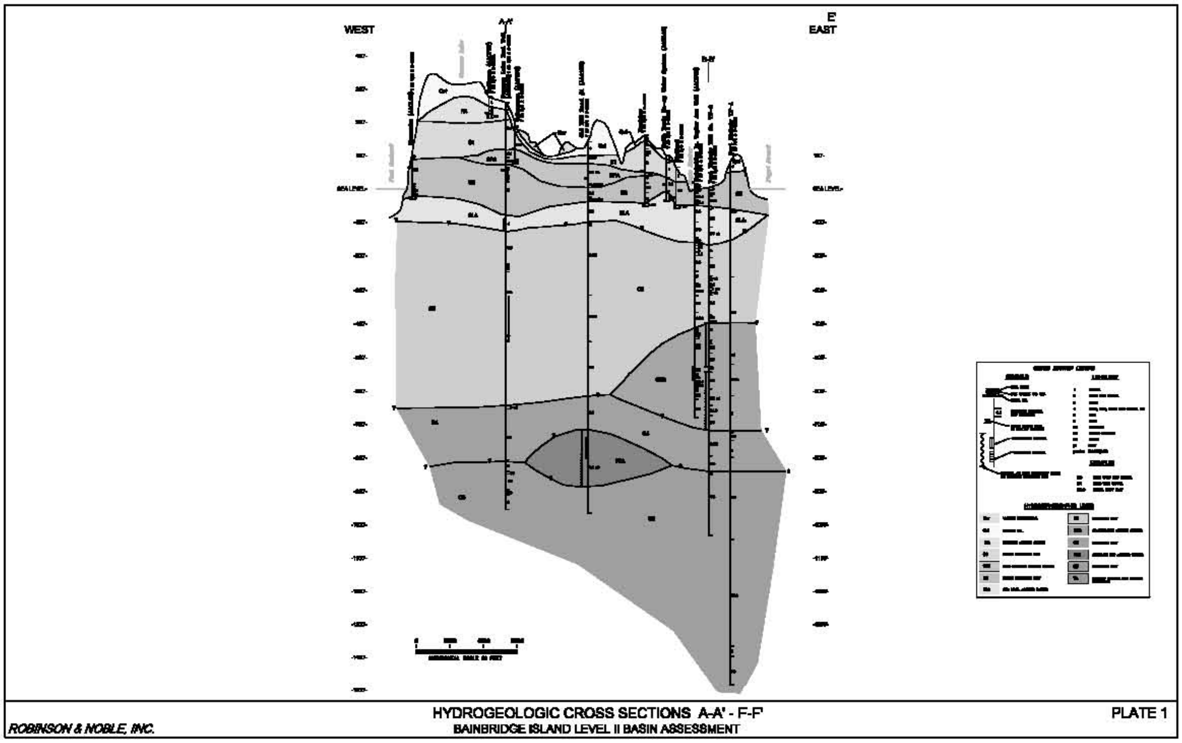


Figure 15. Bainbridge Island Aquifer Recharge Areas.

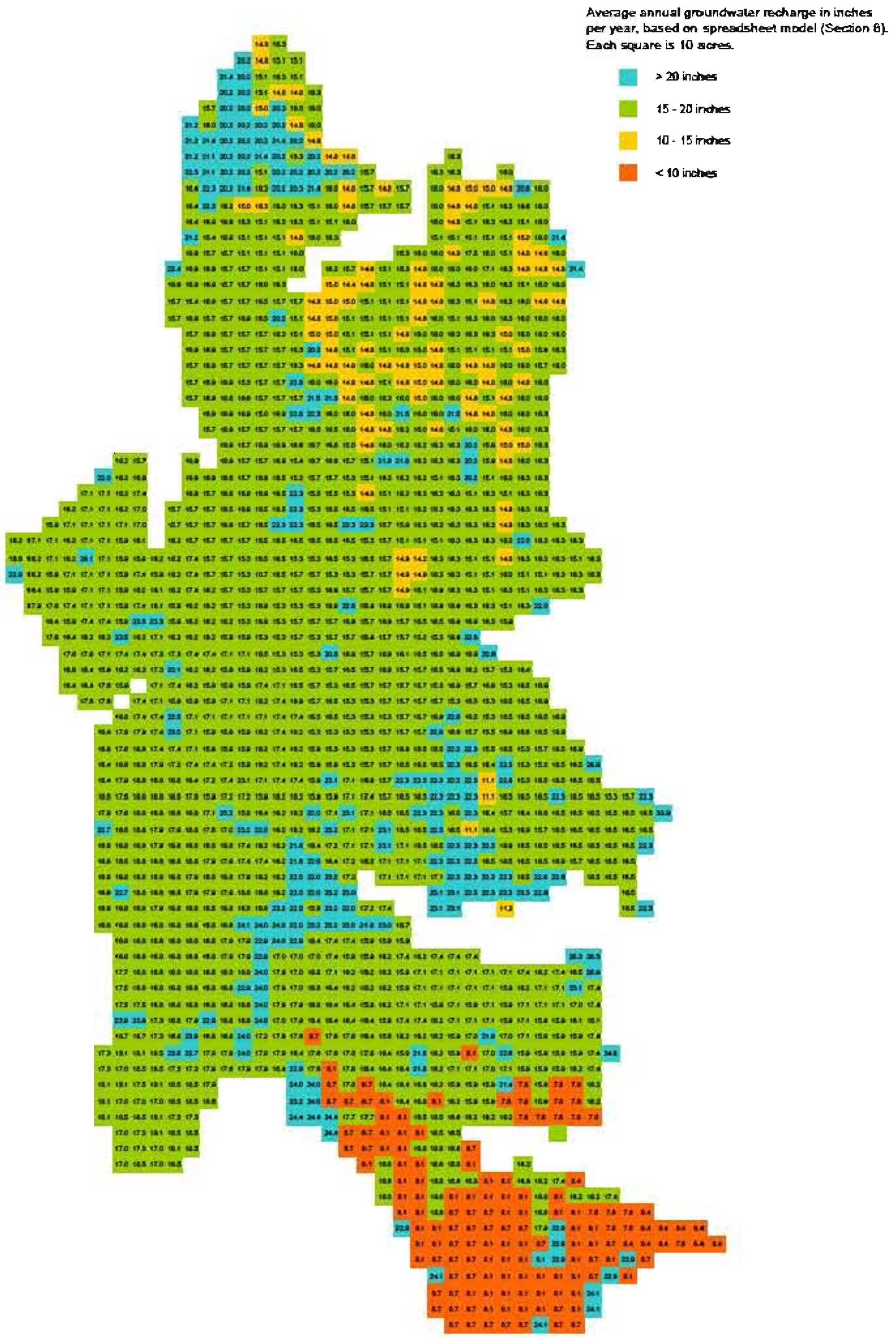


FIGURE 8.1
GROUNDWATER RECHARGE MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
Robinson & Noble, Inc.

Figure 16. Groundwater Rights Map.

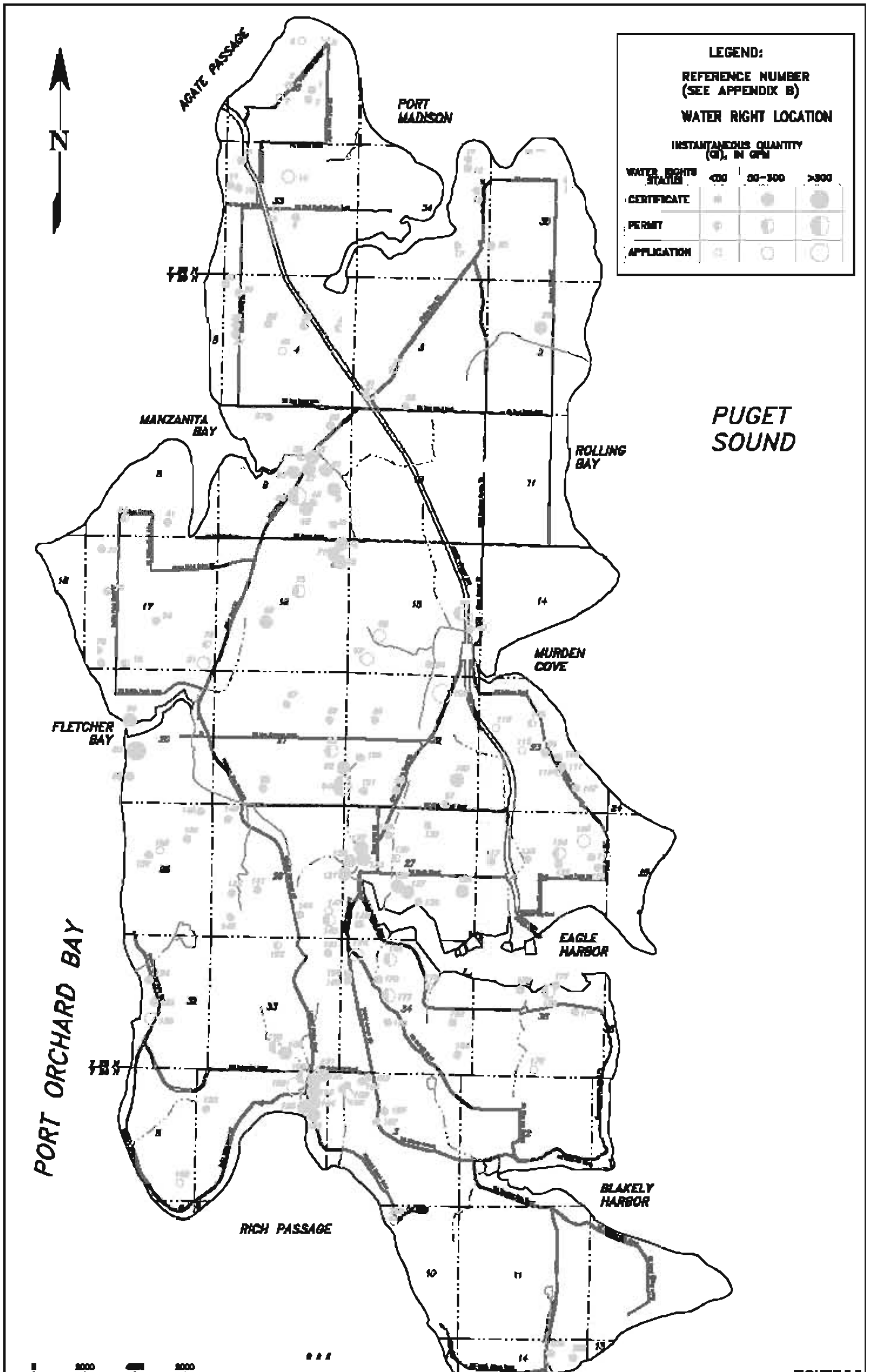
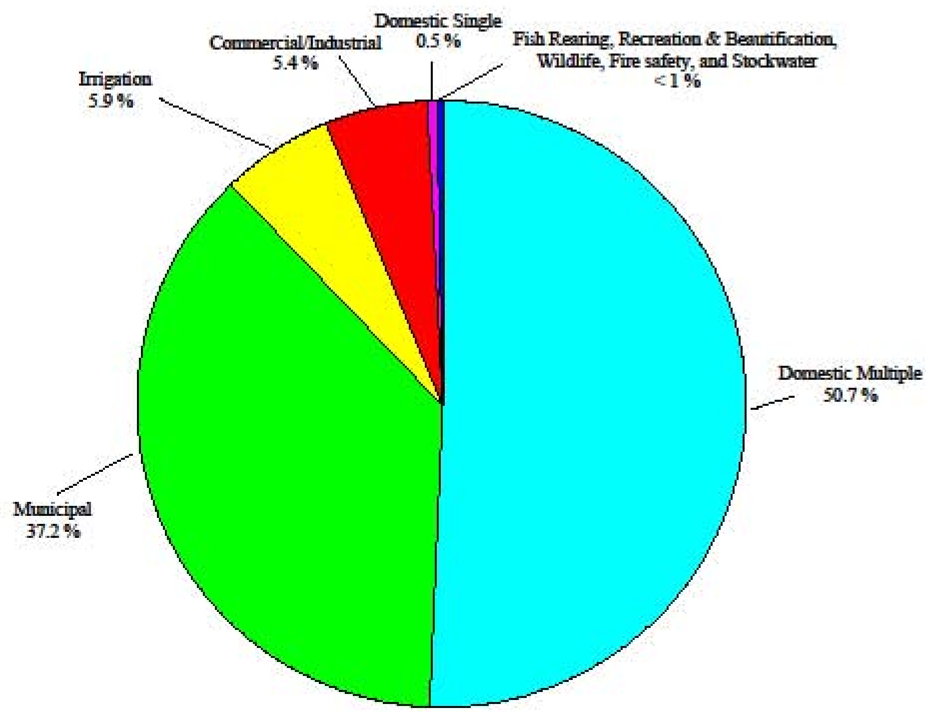


FIGURE 9.6
GROUND WATER RIGHTS MAP
BAINBRIDGE ISLAND LEVEL II BASIN ASSESSMENT
ROBINSON & NOBLE, INC.

Figure 17. Estimated Annual Allocation of Groundwater Rights.

Figure 9.7

Total Annual Allocation of Ground Water Rights by Use

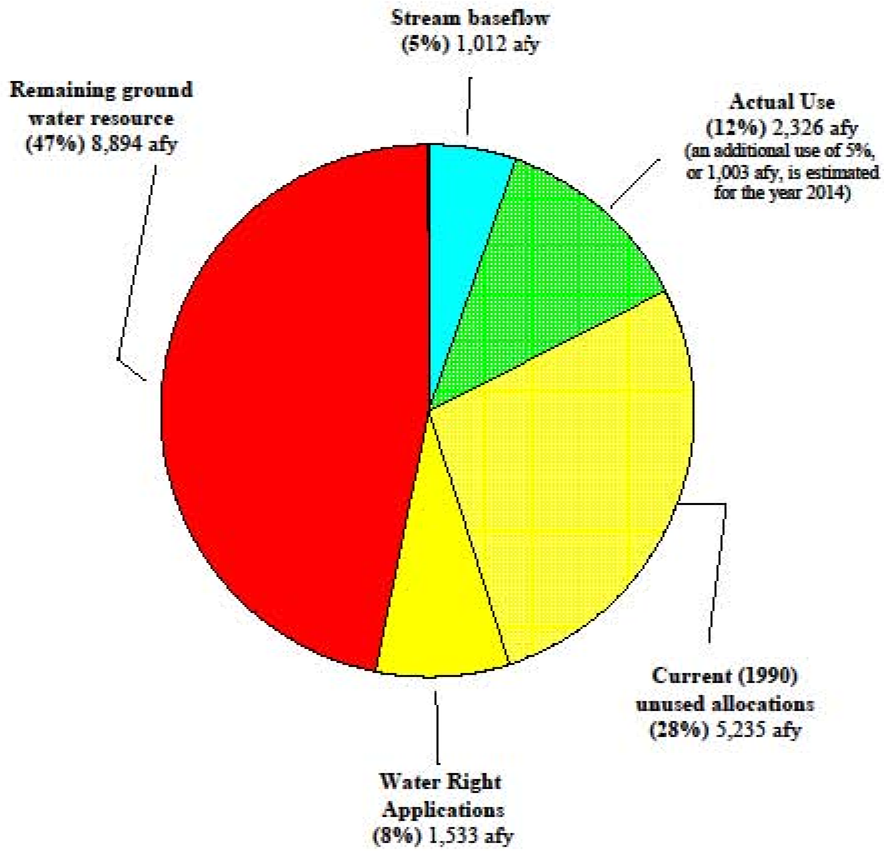


The total annual ground water right allocation for Bainbridge Island is 5,378 acre feet per year.

Figure 18. Estimated Groundwater Resource Distribution.

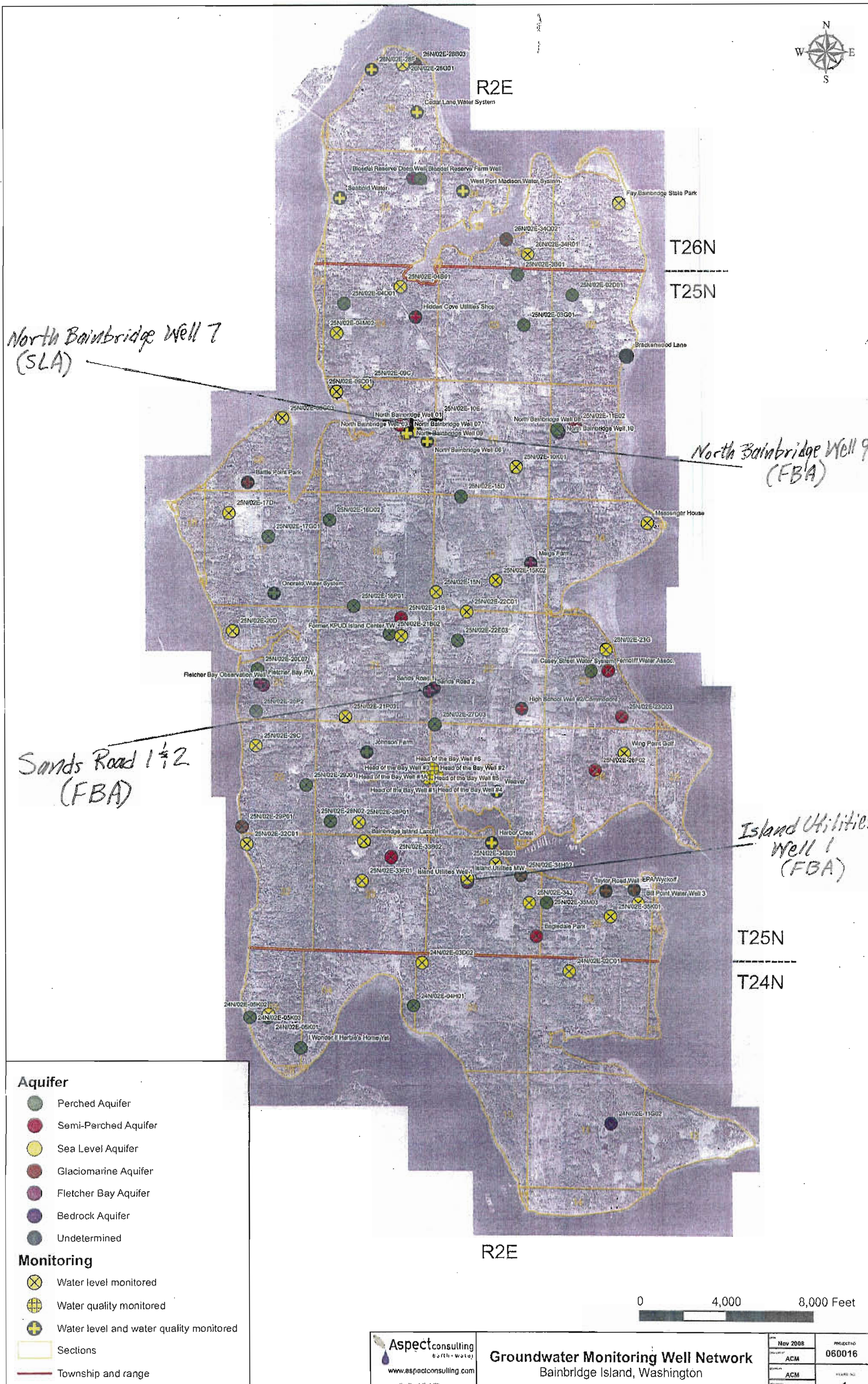
Figure 9.8

Estimated Ground Water Resource Distribution for Bainbridge Island



Total ground water resource of 19,000 afy is based on 13 in/yr of recharge over an area of 17,600 acres (27.5 square miles). The remaining ground water resource is the remainder of the total ground water resource after subtracting stream baseflow (1,012 afy), water right applications (1,533 afy), currently unused allocations (5,235 afy), and actual use (2,326 afy). Note that all catagories are estimated. See text for explanation of estimates.

Figure 19. Groundwater Monitoring Well Network.


N
W
E
S
R2E
T26N
T25N
T24N
North Bainbridge Well 7
(SLA)
North Bainbridge Well 9
(FBA)
Sands Road 1 & 2
(FBA)
Island Utilities
Well 1
(FBA)
Aquifer
Perched Aquifer
Semi-Perched Aquifer
Sea Level Aquifer
Glaciomarine Aquifer
Fletcher Bay Aquifer
Bedrock Aquifer
Undetermined
Monitoring
Water level monitored
Water quality monitored
Water level and water quality monitored
Sections
Township and range
0
4,000
8,000 Feet
Aspect consulting
earth + water
www.aspectconsulting.com
a limited liability company
Groundwater Monitoring Well Network
Bainbridge Island, Washington
Nov 2008
ACM
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MS
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1

TABLES

APPENDICES

Table 1. Water Quality Testing Results on Bainbridge Island.

Source: K & W 2000, from KPUD Well Database, July 1999.

Parameter	MCL[1]	Total number of wells sampled	Wells exceeding MCL	Percent exceeding MCL
Chloride-Cl	250 mg/l	206	1	<1
Conductivity	700 µmhos/cm	275	1	<1
Iron- Fe	0.3 mg/l	276	63	23
Manganese- Mn	0.05 mg/l	277	103	37
Nitrate- NO_3-N	10 mg/l	289	0	0

[1] MCL- Maximum Contaminant Level for nitrate; Secondary Maximum Contaminant Level for chloride, iron and manganese and conductivity, set for aesthetic, cosmetic, and technical reasons and are not considered health-threatening at the MCL.

Table 2. Water Purveyors/Systems on Bainbridge Island.

Source: BI 2004 Comprehensive Plan, from 2004 Draft Kitsap County Coordinated Water System (CWSP) Update.

System Type	Classification Criteria	Number
Group A Systems	15 or more connections	44
Group B Systems	<15 connections	124

Capacity				
System	Connections	ERU	Supply	Storage
Meadowmeer	279	335	530,000	235,000
PUD #1 (North Bainbridge)	1,646	2,028	450,000	860,000
South Bainbridge	788	1,114	900,000	562,000
City of Bainbridge Island	2,100	4,727	1,000,000	2,910,000
Total	**4,813**	**8,204**	**2,880,000**	**4,567,000**

Capacity: ERU = equivalent residential units, Supply in gallons per day (gd), Storage in gallons

Source: 2004 Draft Kitsap County Coordinated Water System (CWSP) Update

Table 3. Hydrostratigraphic Unit Terminology Used in Groundwater Studies in the Bainbridge Island Area.

Source: K & W 2000.

Sceva, 1957 (Kitsap County)	Garling and others, 1965 (Kitsap Peninsula)	Dion and others, 1988 (Bainbridge Island)	Kitsap County Groundwater Advisory Committee and others, 1991 (Kitsap County)	This Study
Alluvium	Alluvium	1	Qn1, alluvium and recessional deposits	---
A, recessional outwash	Qvr, recessional outwash			Qvr
B. till	Qvt, till	2	Qg1, till	Qvt
C, advance outwash	Qva, advance outwash	3	Qg1a, advance outwash/shallow aquifer	PA, perched aquifer system
D. Puyallup Sand	Qc, Colvos Sand			
—	---	4	Qn2, 1st nonglacial deposits	C1, upper confining unit
			Qg2, 2nd glacial deposits[1]	
ORTING GRAVEL: E, Kitsap Clay member	Qg/Qk, unnamed gravel/Kitsap Formation			SPA, semi-perched aquifer system
			Qn3, 2nd nonglacial deposits	C2, lower confining unit
ORTING GRAVEL: F, Orting gravel member	Qss, SalmonSprings (?) Drift	5	Qg3, 3rd glacial deposits/sea-level aquifer[2]	SLA, sea level aquifer
—	Qpu, pre-Salmon Springs (?) deposits	6	Qn4, 3rd nonglacial deposits	C3, confining unit
		Pleistocene deposits (undifferentiated)	Qg4, 4th glacial deposits/deep aquifer[3]; Qg4m marine/glaciomarine deposits	GMA glaciomarine aquifer system
G, Admiralty Drift			Qn5, 4th nonglacial deposits	C4, confining unit
Pre-Orting deposits, undifferentiated			Qg5, 5th glacial deposits[4]	FBA, Fletcher Bay Aquifer
			Qn6, ancient nonglacial deposits	C5, confining unit
Tertiary Blakeley Formation of Weaver, 1916	Tertiary Blakeley Formation of Weaver, 1916	Tertiary Blakeley Formation of Weaver, 1916	Tertiary Blakeley Formation of Weaver, 1916	Blakeley Harbor Formation of Fulmer, 1975
				Blakeley Formation of Fulmer, 1975

Table 4. Summary of Current Groundwater Monitoring Wells.

Source: Aspect 2008.

Aquifer	Number of Wells
Perched Aquifer	26
Semi-Perched Aquifer	10
Sea Level Aquifer	49
Glaciomarine Aquifer	7
Fletcher Bay Aquifer	9
Bedrock Aquifer	1
Undetermined	1
Total	103

APPENDIX A

Resumes of Petitioners

Melanie Keenan, L.G., L.HG.
DUE DILIGENCE/
HYDROGEOLOGIC STUDIES

EXPERIENCE SUMMARY

Ms. Keenan is a professional geologist and hydrogeologist with extensive experience conducting and managing Phase I and II environmental site assessments on behalf of Fortune 500 companies and Seattle law firms. Her experience includes providing third party oversight for hydrogeologic investigations and contaminant characterization. She has served as a technical investigator and writer for several municipal ground water management plans in king county in western Washington. Additionally, she is accomplished in the presentation of scientific information utilizing computer graphics.

KEY EXPERIENCE

- Managed and prepared dozens of Phase I Environmental Site Assessments and Compliance Audits in the western states.
- Managed or assisted with remediation of numerous commercial/industrial sites in California and Washington employing a variety of remedial technologies, and targeting cleanup of various contaminants including metals, petroleum hydrocarbons, and chlorinated solvents.
- Managed subsurface field investigations of various duration and complexity in California, Washington, and Montana.
- Provided chemical and hydrogeological data analysis for litigation cases in Washington and Southern California.
- Served as a technical investigator and contributing author on several ground water management plans in western Washington.

SELECTED PROJECTS

Project Hydrogeologist, Regulatory Research, Hanford Nuclear Reservation, Richland, Washington. As part of the resolution of overarching contamination issues at Hanford, conducted regulatory research and examined nationwide radionuclide sites such as Rocky Flats, Fernald, Monticello, and Savannah River, in order to evaluate lessons learned at other facilities farther along in the cleanup and redevelopment process. Findings aided DOE in budgeting and re-definition of long-term objectives.

Project Hydrogeologist, Contamination Assessment Oversight, Seattle, Washington. Conducted oversight of soil and ground water contamination assessment projects on behalf of downtown Seattle property owners for sites undergoing condemnation by Sound Transit. Oversight required detailed documentation of investigative activities and scrutiny of quality assurance procedures.

Project Hydrogeologist, Ground Water Management Plan Preparation, Renton, Washington. Compiled and edited draft reports for 6 plus years of input and data from the South King County Ground Water Advisory Committee. Managed the publication of the final South King County Ground Water Management Plan, which was developed to meet this area's ground water protection needs. The final plan includes: an area characterization report, identification and description of threats to ground water, recommended strategies that remedy or reduce these threats, and an implementation process and public involvement.

Project Hydrogeologist, Ground Water Management Plan Preparation and Hydrogeologic Studies, East King County, Washington. Technical contributor to the compilation and state approval of comprehensive water system plans for small water systems (e.g., Ames Lake Water System Plan in Redmond, and Sallal Water Association in North Bend). Plans include system description; water supply and water demand analysis and forecasting; evaluation of system reliability and source water protection; development of an operations & maintenance program and system improvement program; and description of funding of ongoing operations.

Conducted Ground Water under the Influence (GWI) Investigation for Riverbend Homeowners Association in North Bend. Studies assessed temperature, pH, conductivity, bacteria, and related water chemistry parameters of ground water and nearby surface water bodies to determine if surface water is adversely affecting groundwater drinking water supplies.

Project Hydrogeologist, Monitoring Well Network Installation, Tacoma, Washington. Project hydrogeologist in charge of monitoring well network placement, installation and soil and ground water sampling at a site equipped with a petroleum-contaminated soil thermal desorption unit. Chlorinated solvent contamination in ground water from a former Washington Department of Transportation facility on site was assessed. The project was completed in accordance with the requirements set forth by the Washington Department of Ecology, enabling quarterly monitoring of the treatment facility operations as well as the solvent plume.

EDUCATION

2001 Computer programming/web design, Cascadia College, Bothell WA.
1988 Post-graduate studies in hydrogeology, California State University, Fullerton
1985 Computer programming, University of Nevada, Reno
1983 B.S. Geology, Colorado State University

EMPLOYMENT HISTORY

1 Independent Consulting Geologist/Hydrogeologist, 1994 to Present. Clients include ENVIRON International Corporation, Freestone Environmental Services, Integrated

Science Solutions, Inc., and Compass Geographics

2. Project Geologist/Hydrogeologist, ATEC Associates Inc., 1990 to 1993.
3. Hydrogeologist and Computer Graphics Manager, Levine Fricke, 1987 to 1990.
4. Geologist, Land Status Researcher, Draftsman, Various Mining Companies, 1983 to 1987.

REGISTRATION

Washington Professional Geologist and Hydrogeologist #1722, August 2002.

SPECIALIZED TRAINING

OSHA 40-Hour Health and Safety Training – 29 CFR 1910
2010: OSHA 8-hour Health and Safety Refresher Training

Malcolm Gander, L.G., L.HG.

Project Manager /Technical Writer

Experience Summary

Mr. Gander is a licensed geologist and hydrogeologist with extensive experience personally conducting and managing Phase I and II environmental site assessments as well as large environmental projects and environmental construction projects (> $1,000,000 budgets with at least 20% subcontract involvement) utilizing professional staff, craft laborers, and heavy equipment. He has served as the principal hydrogeologist in groundwater contamination assessment studies on behalf of the U.S. Navy at large facilities such as Naval Air Station Whidbey Island, at Superfund sites in California on behalf of private industry, and in Idaho on behalf of the U.S. EPA. He is currently serving as the technical lead on behalf of the Department of Energy at the Hanford Nuclear Reservation's Operable Unit 200-UW-1, which involves contamination characterization of soil and groundwater contamination with radionuclides including cesium and strontium.

He is experienced in multi-year projects that require effective weekly interaction with demanding clients (e.g., Navy, Environmental Protection Agency [EPA], Port of Seattle, and Department of Energy [DOE]) and adherence to unwavering schedules, in order to earn maximum award fee (e.g., Navy and DOE contracts) on cost plus contracts. With regard to Phase I and II environmental site assessments, he has served as the lead technical investigator and point-of-contact for many Fortune 500 companies over a period of years (e.g., Bank of America, Shurgard Storage), which required the delivery of a consistently high quality work product in order to earn repeat business.

Mr. Gander gained valuable supervisory experience, including an overriding attention to safety and loss control, during the management of large projects in Washington, California, Alaska, and in mountainous Idaho in the winter months. He has 15 years' experience in profit and loss responsibility as a general manager of an engineering consulting firm office (ATEC Associates-Bellevue, WA), and line manager for URS Corporation (Seattle, WA) and Parametrix (Kirkland, WA). Mr. Gander has a proven business development track record that demonstrates an ability to maintain business relationships and secure new contracts.

He has 30 years of experience as a scientist, technical writer, office manager, line manager, and project manager, with a focus in hazardous waste services. Over the last 22 years he has managed, personally conducted, technically supported, and provided extensive litigation assistance involving contamination assessment and remediation of soil and groundwater; hydrogeologic studies, environmental compliance; human health and ecological risk assessment; asbestos identification and abatement; and environmental impact statements. He typically serves as the lead technical writer in most of the projects he is involved with, and routinely provides detailed review of technical documents prior to final production.

He has extensive experience developing environmental strategies, guiding policy, and ensuring compliance with legal and regulatory environmental requirements on behalf of Fortune 500 companies (e.g., Yellow Freight, Hertz, Union Pacific Railroad, Bank of America); Defense (U.S. Navy); and public entities (Port of Seattle, Federal Emergency Management Agency-FEMA), among others.

Much of Mr. Gander's experience includes assistance to attorneys on projects concerning legal issues associated with contaminated sites. He has provided expert witness testimony on behalf of both defendant and plaintiff before hearing examiners and judges; assisted in cost allocation projects; and negotiated with regulatory agencies on behalf of private and public sector clients. Negotiations have been conducted with the Washington Department of Ecology, Alaska Department of Environmental Conservation, California Regional Water Quality Control Board, Idaho Department of Environmental Quality, Nevada Department of Environmental Protection, and the U.S. Environmental Protection Agency (EPA) – Region 10.

Professional Expertise

1. Project and technical group management for projects ranging in size from $10K to $1.6 million
2. Hydrogeologic studies in unconsolidated deposits and fractured bedrock
3. DOE, DOD, and EPA regulations on waste disposal and environmental protection
4. DOD, DOE , ASTM, and EPA procedures for environmental site assessment and data quality
5. Negotiation of technical solutions and design approaches with clients and regulators
6. Product checking, performance evaluations, and field inspections
7. Field management for remediation and investigation activities, including training of field staff in technical, information management and documentation procedures
8. Degreed and trained in technical writing and editing
9. Geochemistry, contaminant fate and transport analysis, natural attenuation studies
10. Environmental remediation design and oversight
11. Litigation assistance/expert witness testimony regarding contaminated sites
12. Groundwater monitoring, sampling, drilling oversight, construction management, and subcontractor management
13. Precious and base metal exploration, mine siting and feasibility studies, mine reclamation
14. Thorough understanding of the geology and hydrogeology of Washington and surrounding states

Credentials

Washington Registered Professional Geologist and Hydrogeologist #2032, 2002.
California Registered Geologist #4655, 1989

Selected Projects

Senior Hydrogeologist, Hydrogeologic Assessment, Confidential Client, Jefferson County, Washington. Conducted data compilation and interpretation, field studies, and technical report preparation regarding the groundwater regimes associated with a proposed gravel mine. Synthesized existing and recent information and determined that a perched aquifer and underlying bedrock aquifer within the footprint of the site was not hydraulically connected to the nearby drinking water supply aquifers, thereby demonstrating the site's minimal risk to neighboring properties.

Senior Hydrogeologist, Site Characterization, Cleanup & Closure, Hanford Nuclear Reservation, Richland, Washington. Technical lead in charge of soil and groundwater contaminant characterization and preparation of closure documents for Operable Unit 200-UW-1 at the Hanford Nuclear Reservation. On behalf of the Department of Energy (DOE), serves as Task Manager in charge of client management and interaction with representatives from the Washington Department of Ecology and U.S. EPA.

Senior Geochemist, Feasibility Study Preparation, Hanford Nuclear Reservation, Richland, Washington. Acted as lead author for the feasibility study portion of the 200-BP-5 Operable Unit (OU) RI/FS Work Plan, which addressed the largest contaminated groundwater area at the Hanford Site. Remedial alternatives under evaluation included permeable reactive barriers such as zero valent iron, injectable apatite and injectable polyphosphate, which isolate radionuclides such as uranium, plutonium and strontium.

Under a Basic Ordering Agreement with Fluor Corporation, Mr. Gander completed a detailed technical review of the 200-PW-2 and 200-PW-4OU Feasibility Study. He was lead author on the Hanford 2006 Draft Sampling and Analysis Plan for the 200-BP-5 OU. He acted as a technical resource for Fluor on behalf of their client (the Department of Energy [DOE]), who has requested assistance in the refinement of long-term policy for cleanup strategy that will be compatible with the objectives of U.S. EPA, Washington Department of Ecology, stakeholders, and the general public. Mr. Gander served on a 4-person Freestone team that led portions of a two-day workshop in April 2006, designed to clarify DOE's position on key decision parameters such as future land use, institutional controls, remedial action objectives, and the redefinition of the existing OU CERCLA protocol with Risk Decision Units that efficiently cross OU boundaries.

Exploration Geologist, Nevada Copper Corporation, Yerington, Nevada. Interpreted voluminous historic geologic data and generated drill targets designed to expand reserves in planned open-pit and underground orebodies at the Pumpkin Hollow Cu-Fe-Au skarn, Yerington, Nevada. Evaluated the distribution of Au, Ag, Cu, Fe, and Mo throughout the skarn system and managed a historic core resampling effort that addressed the previously-undefined extent of Au mineralization in each orebody. Supervised core and reverse circulation drilling and geologic and geotechnical logging.

Exploration Geologist, Gryphon Gold Corporation, Hawthorne, Nevada. Supervised all drilling and sampling activities onsite as part of the expansion of ore reserves at this former open pit gold producer. Conducted ore reserve calculations; interpreted new and historic drilling results; planned further drilling activities; and conducted exploration for additional drill targets throughout the 28 square mile land holdings. Performed groundwater monitoring and interpretation of laboratory results; and evaluated potential areas to explore to increase water production capabilities that will be required at mine start-up.

Senior Hydrogeologist, Various Navy Superfund Sites, Washington and Alaska. Under the Navy CLEAN Contract, served as project manager and principal hydrogeologist in charge of several remedial investigations and removal actions at hazardous waste sites on Adak Island, Alaska and Naval Air Station Whidbey Island, Washington. Projects included contaminated soil removal/clean backfill and attendant removal of tanks and construction debris. Simultaneously managed projects totaling >>$1.0 million involving the preparation of project plans, site characterization reports, and contaminant impact assessments for these projects; coordinated with the client to negotiate regulatory agency approval of study plans and remediation proposals. Developed cost estimating methods and organized technical and cost proposal formats for negotiations with the client on a broad range of task orders. Served as a geosciences line manager providing senior guidance to all project managers and technical staff. Routinely received complimentary written evaluations (available upon request) from client in periodic work-product assessments.

Senior Hydrogeologist, SnyderGeneral Corporation, Visalia, California. Successfully managed a large CERCLA site characterization/remediation project in Visalia, California, which included installation of a monitoring well network in multiple aquifers, construction management and demolition of underground piping and infrastructure and solvent-contaminated soil.

Education

M.S., Geology, Colorado State University, 1982
B.A., Geology and Journalism, Double Major, George Washington University, 1979

Publications and Presentations

Immunoassay Testing to Delineate PCB Contamination in Soils, Adak Island, Alaska. M.J.Gander, J.W.Webb, and M.S. Murphy, Seattle, Washington. Superfund XVII Conference, October, 1996.

Preliminary Site Characterization by Soil Gas Surveying with a Portable Gas Chromatograph. M.J.Gander,
R.G., and M. R. Wood, ERT Corporation, Newport Beach, California. Air & Waste Management Meeting Proceedings, June 1989.

Honors and Awards

Letter of Commendation for high quality work on behalf of the Federal Emergency Management Administration (FEMA) for 2000 Seattle earthquake evaluations at Port of Seattle sites with groundwater monitoring wells and related appurtenances, Fall, 2001.

Finalist award for the SAME Technical Excellence award, December 2000. Presented by Col. Ralph Graves of the U.S. Army Corps of Engineers for work performed at NAS Whidbey Island, Washington.

Letter of Commendation for “fast track work on site closure.” Presented by Fran Allans, Project Manager, EPA, in Fall, 1999.

Specialized Training

OSHA 40-hour Health and Safety Training – 29 CFR 1910

2010: OSHA 8-hour Health and Safety Refresher Training

2006: MSHA 24-hour Surface Miner Health and Safety Training

2010: MSHA 8-hour Surface Miner Health and Safety Refresher Training

Department of Transportation/Hazardous Materials Training

2009 First Aid/CPR

Office Automation – Word, Excel, Power Point

Project Management

Project Control and Tracking Systems

Loss Control Study Course