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Lake Sawyer Hydrogeologic Study
Black Diamond, Washington

Prepared for
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LAKE SAWYER HYDROGEOLOGIC STUDY
BLACK DIAMOND, WASHINGTON

EXECUTIVE SUMMARY

Lake Sawyer is a natural lake, of approximately 300 acres, located in southwest King County, 1.5 miles northwest of Black Diamond, Washington. This Lake Sawyer Hydrogeologic Study is one component of an overall lake Diagnostic Study being conducted by the Washington State Department of Ecology (Ecology). This study, and the companion Waste Load Allocation Evaluation completed last year, were prompted by recent nutrient loading increases to the lake attributed to the Black Diamond wastewater treatment system.

The objective of this hydrogeologic study was to provide data to supplement the water and nutrient budgets developed in the overall Diagnostic Study. This was accomplished by estimating groundwater inflow/outflow and nutrient loadings, incorporating an assessment of the nutrient inputs from nearshore septic systems.

Geologic conditions around Lake Sawyer were assessed by reviewing existing reports, studying available geologic logs of regional water wells, and logging four borings in which monitoring wells were installed. Based on an initial review of this information, a monitoring network was developed to provide groundwater flow and quality information. The network included the 4 monitoring wells, 15 wellpoints, 10 domestic wells, and five staff gages. The wellpoints were installed along the shore, between Lake Sawyer and residential septic systems, in order to assess leachate flow to the lake. Domestic wells were selected according to their location and availability. From August 1989 to May 1990, monthly water level measurements were obtained from the network and approximately quarterly water quality samples were collected from the monitoring wells and wellpoints. In addition, to assess the permeability of aquifer materials and potential flow volumes, aquifer testing was performed in the monitoring wells and some of the domestic wells.

The available geologic data indicate a very complex stratigraphic and hydrogeologic system around Lake Sawyer. It appears that the lake sits in a trough of low permeable till material, between bedrock to the east

and surficial till outcrops to the north and west. Higher permeable outwash deposits overlie the till to the east of the lake, but are largely absent to the west. Partly because of this condition, groundwater flow enters Lake Sawyer predominantly along its eastern shore, via the outwash deposits. The estimated groundwater inflows averaged approximately 0.1 cubic feet per second (cfs), with the bulk of the inflow occurring during the winter months.

Permeable recessional meltwater channels of sand and gravel are located in the northeast and southwest corners of the lake, and complicate hydrogeologic conditions within the basin. The meltwater channels appear to act as outflow conduits from Lake Sawyer, with such outflow likely providing recharge to a deeper aquifer system. The estimated groundwater outflows, through the lake bottom and via the meltwater channels, average approximately 3 cfs, with the highest calculated outflows occurring during the summer/fall months. The estimated monthly groundwater outflows are consistent with unexplained lake outflows calculated in Ecology's preliminary surface water budget.

The inputs of total nitrogen (TN) and total phosphorus (TP) to Lake Sawyer via the regional groundwater system were assessed by multiplying the average estimated groundwater inflow rate (0.1 cfs) by measured background concentrations of these nutrients within the basin. Because of the presence of cultural (i.e., septic tank) influences at the monitoring well locations, background water quality was assumed to be represented by water quality monitoring data within Ravensdale Creek, which drains a relatively pristine watershed in the eastern areas of the basin. Ravensdale Creek also appears to be a predominant recharge source for groundwater inputs to Lake Sawyer. Based on these data and assumptions, the estimated nutrient inputs to the lake from the regional groundwater system average approximately 50 kgTN/year and 0.8 kgTP/year. The uncertainty in these estimates is large, owing primarily to variabilities in measured and assumed flow parameters. Loading rates of these parameters may range from 5 times higher to 15 times lower than the estimated average values.

Septic system releases of nitrogen and phosphorus to Lake Sawyer were assessed by monitoring groundwater quality within approximately 100 feet of a variety of nearshore septic systems within the basin. Detectable quantities of effluent, as determined using chloride tracer data, were observed in groundwater samples collected at ten of these locations. Based on a mass balance relationship, removals of TP and TN occurring during transport from the septic tank to the groundwater monitoring locations averaged 94 $\pm$ 2 percent and 79 $\pm$ 11 percent, respectively. These measured removals are consistent with values reported from other similar studies conducted in the region. Applying these observed removals to the total number of dwellings within the "effective" Lake Sawyer catchment area results in an estimated existing (1989-1990) wastewater loading of approximately 190 $\pm$ 90 kgTN/year and 9 $\pm$ 4 kgTP/year.

Based on the available data, it is likely that the bulk of groundwater inputs of nitrogen and phosphorus to Lake Sawyer are represented by wastewater contributions. These estimated groundwater loading values, however, do not appear to be major components of the overall nutrient budget for Lake Sawyer.

INTRODUCTION

This report presents the results of a hydrogeologic study of Lake Sawyer, a natural lake (approximately 300 acres in size) located near Black Diamond, Washington. This investigation is a component of Ecology's overall Diagnostic Study, which assesses existing water quality characteristics of Lake Sawyer. Principal objectives of these efforts are 1) to evaluate the influence of the Black Diamond Wastewater Treatment Facility on the present and potential eutrophication of Lake Sawyer, recommending the discharge option which maintains acceptable Lake Sawyer water quality; and 2) to perform a comprehensive baseline water quality assessment, which includes an evaluation of nutrient inputs from a variety of sources, and their relative contribution to the trophic condition of Lake Sawyer.

Recent increases of nutrient loadings to Lake Sawyer have been reported (Pelletier, 1989). Much of the apparent increase of the most critical nutrient -- phosphorus -- has been attributed to the Black Diamond wastewater treatment system. The system presently consists of a two-cell aerated lagoon discharging into a natural wetland where nutrient removal was designed to take place utilizing natural processes. The wetland, via Rock Creek, eventually drains to Lake Sawyer.

The U.S. Environmental Protection Agency (EPA) recommended that a study be performed to assess the amount of phosphorus that needs to be removed by the Black Diamond wastewater treatment system in order to protect the water quality of Lake Sawyer. In response, Ecology developed a two-phased approach to the study. The initial phase, the Waste Load Allocation Evaluation, used primarily existing data to evaluate the sources and rates of nutrient inputs to Lake Sawyer, and considered the lake's trophic response to current and future loadings. This phase of the study was completed in the summer of 1989, and resulted in an Ecology staff recommendation to discontinue discharge of Black Diamond wastewater to the Lake Sawyer basin.

Field work for the Diagnostic Study, the second phase, began in the spring of 1989 and was completed in the spring of 1990, incorporating a year of data collection. The study consisted of monitoring limnological parameters within the lake itself, assessing the surrounding watershed, and developing lake nutrient/water budgets. This hydrogeologic study of

Lake Sawyer is one portion of the overall Diagnostic Study, supplementing the development of the nutrient and water budgets.

As stated above, one of the principal objectives of the Diagnostic Study is to provide an adequate database to evaluate nutrient inputs and trophic conditions. The assessment of residential wastewater (i.e., septic system) inputs of nutrients to the lake is presented in this report. A more general evaluation of groundwater inflow and outflow characteristics is also presented, primarily to support the limnological evaluation reported elsewhere.

Study Location

Lake Sawyer is located in southeastern King County and lies within the Big Soos Creek sub-basin of the Green River drainage near the city of Black Diamond (Figure 1). Approximately 83 percent of its 36,000-foot shoreline is developed, primarily with residential dwellings (Figure 2).

Lake Sawyer's 13-square mile watershed consists largely of forested areas or unproductive land. Two inflow streams, Rock and Ravensdale Creeks, discharge into the southeastern end of Lake Sawyer. An extensive wetland is also located in this area. Covington Creek exits the lake from the central-western shoreline. A concrete dam installed across Covington Creek controls the lake level.

Scope of Work

The data collection scope of work for the hydrogeologic portion of the Diagnostic Study was divided into the following tasks:

Task 1 - Literature Review and Well Inventory

The purpose of this task was to develop a basic understanding of the hydrogeologic system(s) around Lake Sawyer in order to orient the data collection efforts (e.g., placement of monitoring wells and wellpoints). This effort involved a review of relevant information in the South King County Groundwater Management Program database, a homeowner survey to locate regional water wells and obtain volunteers to participate in the study, and a septic leachate survey along select shoreline areas of Lake Sawyer.

Task 2 - Design and Install Monitoring Network

Based on the findings of Task 1, a monitoring network was designed which involved the installation and/or monitoring of 4 monitoring wells, 15 wellpoints, 10 domestic wells, and 4 staff gages (installed by Ecology). The purpose of the 4 monitoring wells was threefold: 1) to aid in the assessment of regional stratigraphy; 2) to provide background water quality data; and 3) to serve as water level monitoring points for the assessment of regional groundwater flow. The purpose of the wellpoints was to provide nearshore groundwater quality data to assess septic/drainfield system inputs to Lake Sawyer and to assess shallow groundwater flow near the lake. The domestic wells served as water level monitoring points and, in some instances, as water quality sampling locations. The staff gages provided lake and creek level information.

Task 3 - Aquifer Testing

To aid in the groundwater inflow/outflow assessment of Lake Sawyer, short-term pumping tests and *in situ* hydraulic conductivity tests (slug tests) were conducted to assess aquifer permeabilities.

Task 4 - Elevation Survey

The monitoring wells, wellpoints, and 4 staff gages were surveyed for elevation by a licensed surveyor. In addition, Hart Crowser conducted an elevation survey of the remaining domestic wells used in the monitoring well network.

Task 5 - Groundwater Sampling

To assess nutrient inputs to Lake Sawyer via groundwater, water samples were obtained from the monitoring wells and wellpoints on a quarterly basis. During two of the sampling rounds, samples were also obtained from two septic tanks.

Task 6 - Water Level Monitoring

To assess groundwater flow near the lake, water level measurements were obtained on a monthly basis from the monitoring network and the staff gages.

Task 7 - Public Participation

This task involved preparing a publicity article for the local newspaper (Voice of the Valley), and meeting with the public to provide information on the study and to encourage public participation.

Task 8 - Reporting

This task involved preparing monthly progress reports and developing a draft, final draft, and final report for the study. This document presents the final report. The report includes: 1) the various data collected during the study; 2) an interpretation of the hydrogeologic system in the area; 3) an assessment of septic system performance; and 4) an assessment of water and nutrient inputs to and from Lake Sawyer from groundwater and septic system sources.

Report Structure

The previously presented **EXECUTIVE SUMMARY** highlights the methodology and findings of this report - presented below in their order of appearance:

- **DATA COLLECTION METHODS;**
- **RESULTS;**
- **HYDROGEOLOGIC SYSTEM;**
- **GROUNDWATER INFLOW/OUTFLOW ESTIMATES**; and
- **SEPTIC SYSTEM PERFORMANCE EVALUATION**.

Appendix A presents the monitoring well/wellpoint installation methods along with the boring logs and as-built diagrams for the monitoring wells. Appendix B presents the groundwater sampling methods and the laboratory raw data results. Appendix C presents the aquifer testing methods and results. Appendix D contains the relevant well information/geologic logs from the South King County Groundwater Management Program database. Appendices E and F contain Entranco Engineers septic leachate survey report and Meridith Incorporated elevation survey report, respectively.

In general, tables and figures for this document are located after the text of the report and prior to the appendices.

DATA COLLECTION METHODS

To support the hydrogeologic study of Lake Sawyer, a variety of data were collected to assess groundwater quality and flow into the lake. The field activities included a septic leachate survey, the installation of monitoring wells and wellpoints, aquifer testing, groundwater level monitoring, and groundwater quality sampling. General descriptions of these activities are discussed in the following sections. Supporting information on the data collection methods can be found in Appendices A through F.

Septic Leachate Survey

A septic leachate survey was conducted by Entranco Engineers, Inc. along 1.1 miles of Lake Sawyer's eastern shoreline to assess the approximate location of leachate plume inputs to the lake. The survey was conducted using a K-V Associates Model 15 septic leachate detector in the shallow littoral zone of the shoreline. The detector is a portable fluorometer which operates at a fixed wavelength responsive to the fluorescence (specifically amino acids) in human urine and laundry whiteners (EPA, 1980). The unit was generally calibrated hourly with a one percent urine solution. A field measurement comparable to the response from the solution is generally used as the threshold value strongly indicative of an inadequately treated wastewater plume. The operator of the unit conducted the survey by sweeping the intake wand of the instrument along a 2 meter swath while wading the shallow littoral zone of Lake Sawyer.

The purpose of the survey was twofold; first, to aid in locating shoreline wellpoints within leachate plumes, and second, to provide a preliminary evaluation of leachate inputs to Lake Sawyer. The survey was originally scheduled for the entire eastern shoreline of Lake Sawyer where groundwater inflow was considered likely (confirmed with subsequent hydrogeologic data). However, instrument failure precluded surveying a portion of the southeastern shoreline. The complete report of the survey, including a more detailed account of the methods, is provided in Appendix E.

Monitoring Well and Wellpoint Installation

Monitoring Well Installation

Prior to locating the four monitoring wells installed during this study, available water well information in the South King County Groundwater Management Program database was reviewed. The database includes geologic logs, well construction information, water level, owner, and pumping test data. The water well inventory listings from the database, for wells within approximately 2 miles of Lake Sawyer, are presented in Appendix D.

Information from this database indicated that regional groundwater flow is generally to the west-northwest. It was also noted that there was considerably more stratigraphic information for the west and northwest sides of the lake as opposed to the northeast, east, and south sides. Primarily because of these geologic data gaps, and because the eastern portion of the study area was likely to contribute the majority of groundwater inflow to Lake Sawyer, monitoring wells MW-1, MW-3, and MW-4 were installed along the southeast, east, and northeast sides of the lake, respectively. MW-2 was installed along the southwest side of the lake. These locations are indicated on Figure 2.

Originally, attempts were made to drill all four wells using a hollow-stem auger rig. However, due to the cobbly subsurface materials, refusal was reached within seven feet of ground surface at all four locations. Consequently, a cable tool drilling was eventually used to drill MW-1. The remaining three monitoring wells were drilled with an air rotary drill rig. Geologic logs and detailed installation methods for these monitoring wells are presented in Appendix A.

Wellpoint Installations

The wellpoints were generally located along selected shorefront lots in suspected discharge zones to Lake Sawyer, although several wellpoints were distributed around the lake to define flow zones. Homeowners were initially identified via a house-to-house canvass and news release describing the project and the need for assistance from local homeowners. At this time, domestic wells for the water level monitoring network were also identified. The location of the wellpoints and domestic wells are shown on Figure 2.

Again, given the regional west-northwest groundwater flow direction (i.e., indicating lake outflow along the western shore), the majority of the wellpoints were placed along the eastern shore of Lake Sawyer. Their primary purpose was to assess nutrient inflow to the lake. The individual wellpoints were installed between the lake and the homeowner's septic system drainfield, within the suspected leachate plume. The general location of the drainfield was determined from the owner. Then, in six locations conducive to this approach, water samples within 0 to 15 feet of the lake were obtained from test probes. Chloride determinations were performed in the field on these samples using an Orion No. 9617 BN ion probe. Elevated levels of chloride potentially indicated the location of the drainfield leachate plume. Wellpoint placement was influenced by the ion probe readings in four of the six locations tested. General installation methods are presented in Appendix A.

Elevation Survey

The top-of-casing (TOC) elevations of the monitoring wells and wellpoints, and the staff gages were surveyed by Meridith Incorporated - a licensed surveyor in the State of Washington. They used a Wild NA-2 automatic level. They followed three wire leveling practices done to second order Class 2 accuracy as defined by NOAA (1979). Their report is presented in Appendix F. The TOC elevations for the domestic wells were surveyed by Hart Crowser using a Lietz level. The wellpoints were used as benchmarks. The accuracy of this survey, based on instrument precision, is approximately ± 0.01 feet.

Aquifer Testing

Aquifer testing was conducted in some of the monitoring and domestic wells within the monitoring network to assess the permeability of the various aquifer materials deposited around the lake. *In situ* hydraulic conductivity (slug) tests, pumping tests, and bail tests were performed.

Slug tests were conducted in MW-1 through MW-4. Both falling and rising head slug tests were performed. For the falling head slug test a rod was quickly lowered into the well causing an instantaneous rise in the water level. A Terra Systems automatic data acquisition system was used to measure the water level as it returned to the static level.

For the rising head slug test, the rod was removed causing an instantaneous drop in the water level. Again the water level was then measured with the Terra unit as it rose to the original static level. The collected data was analyzed using the Bouwer and Rice (1976) method.

Pumping tests were conducted in domestic wells No. 4 and No. 8. In each of the tests, the pump was turned on and allowed to run for 15 to 20 minutes during which drawdown in the pumping well was measured. Discharge from a garden hose was monitored by recording the time it took to fill a 4-gallon bucket. After turning off the pump, the water level recovery data was also monitored. The pumping and recovery test data were analyzed by the Cooper-Jacob (1946) method.

Bail (recovery) tests were also conducted in MW-1 through MW-4. In this instance, the water was removed from the monitoring well as rapidly as possible with a bailer, recording the volume removed and the bailing time. Then, the Terra unit was used to monitor the water level recovery to the static level. The data was then analyzed similar to pump test recovery data using the Cooper-Jacob method.

Appendix C presents a detailed description of the methods used to conduct these tests and analyze the results.

Water Level Monitoring

Water level measurements for the monitoring network were obtained on a monthly basis. Hart Crowser conducted the measurements from August through December of 1989, and in March and May of 1990. The Washington State Department of Ecology (Ecology) collected the water level data during the three intervening months.

Hart Crowser measured water levels to an accuracy of approximately 0.05 foot with an Olympic Model 150 Electric Well Probe and a decimally graduated tape measure. Ecology measured water levels to the same accuracy with a Slope Indicator well probe and tape measure.

Groundwater Sampling

Groundwater samples were collected from the 15 wellpoints and the 4 monitoring wells in accordance with the "Groundwater Sampling Plan" presented in Appendix B. Additionally, groundwater samples were collected from a community well during three sampling rounds and a domestic well during the first sampling round. A quarterly sampling schedule, beginning in August 1989, was originally projected. However, the November 1989 sampling was postponed until December 1989 due to low lake and groundwater levels, and the associated lack of water in a number of wellpoints. The December sampling was conducted after lake levels had begun to recover, and immediately following a major rain storm. Subsequent sampling events took place in March and May of 1990.

The groundwater samples were filtered in the field and submitted to the Turnbull Laboratory of Ecological Studies in Cheney, Washington for analysis of total soluble phosphorus (TSP), soluble reactive phosphorus (SRP), total soluble nitrogen (TSN), nitrate-nitrite as nitrogen (NO_2+NO_3-N), ammonia as nitrogen (NH_3-N), and chloride. Samples from the May 1990 event were analyzed for TSP, TSN, and chloride only. Temperature, pH, conductivity, and dissolved oxygen (DO) measurements were performed in the field.

The following section presents a review of the laboratory data quality.

Data Quality

Data quality control measures included field and laboratory duplicates, spike recoveries, laboratory blanks, internal QA recoveries, and field blanks and filter blanks. Generally, one to two field duplicates were submitted to the laboratory during each sampling round, in addition to one field blank and two filter blanks. Spike recoveries involved adding a known concentration of an analyte to one of the groundwater samples in the laboratory, and then performing the analysis. Given the concentration of the analyte in the spike and of the groundwater sample, the percent of recovery can then be calculated. Internal QA recoveries involve the determination of a known concentration of analyte.

Overall, the data were deemed acceptable with one qualification; several of the TSP results were flagged as estimated values due to phosphorus input from field filtering. This, and the specific quality control results for each analyte, are discussed in further detail in the remainder of this section.

Total Soluble Phosphorus. With some exceptions, quality control associated with the TSP data was generally good. Spike recoveries averaged 94 percent, ranging from 82 to 99 percent. Internal QA recoveries (omitting 5 ug/L analyses due to accuracy difficulties with relatively low concentrations) averaged 100 percent with a range from 93 to 113 percent. Lab blanks ranged from 1.1 to 3.1 ug/L, with an average of 1.9 ug/L. No sample corrections were deemed necessary based on the lab blank data.

Sample duplicate analyses indicated a high precision with an average standard deviation between lab duplicates of 0.7 ug/L. The field duplicates were somewhat more variable, with an average standard deviation between duplicates of 2.5 ug/L or a coefficient of variation of less than 25 percent for higher level samples.

Two types of 0.45 micron in-line filters were used in the field for groundwater sampling. The majority of the samples were collected using a Gelman Acro 50 A filter (termed New Filter in the raw data base). However, a larger QED Environmental Systems, Inc., Model FF-8200 was used for some of the more turbid samples because the smaller Gelman filters clogged too readily. During each sampling round both Gelman and QED filter blanks were analyzed along with a deionized water blank.

TSP increases in the QED filter blanks ranged from 2 to 12 ug/L. The average increase was statistically significant at the 90 percent confidence level ($P<0.1$; t-test, $n=4$). Consequently, TSP data for the samples filtered with the QED filters were adjusted based on filter blanks for the particular sampling round. The adjusted samples with less than a 25 percent blank correction were flagged with a "B", to denote that blank contamination had been found and a correction made. Samples for which the blank correction exceeded 25 percent of the raw data value were flagged with a "J", denoting that the associated numerical value is an estimated quantity. Overall, approximately 30 percent of the database was "B" flagged and 17 percent was "J" flagged.

Conversely, TSP increases associated with the Gelman filter were not significant ($P>0.50$, t-test, $n=4$). Samples filtered in this manner thus did not require blank corrections.

Soluble Reactive Phosphorus. Quality control associated with SRP data was generally good. With one exception, spike recoveries averaged 98 percent and ranged from 94 to 100 percent. The exception was a 148 percent recovery for the December sampling round. Potentially, calculation errors may account for the elevated recovery percentage, since 100 percent recovery was obtained for the other spike in that data set. Internal QA recoveries (again omitting 5 ug/L analyses) averaged 99 percent and ranged between 99 and 100 percent. Lab blanks averaged 2.5 ug/L, and ranged from 1.9 to 3.5 ug/L. No correction was deemed necessary based on the lab blank data.

The laboratory duplicates indicated a high degree of precision, with an average standard deviation between lab duplicates of 0.6 ug/L. Like the TSP data, the field duplicates were somewhat more variable, with an average standard deviation between duplicates of 3.5 ug/L. Differences between the deionized water field blank and both the QED and Gelman filter blanks were not significant.

TSP vs SRP. In a number of incidences throughout the data sets the concentration of SRP for a particular sample was greater than the concentration of TSP. This issue was discussed with the Turnbull Laboratory Manager. He indicated this problem is potentially attributable to differences in the calibration curves during sample runs and/or pH differences in sample aliquots (due to sample preservation) which influence instrument readings. For the purposes of this report, both TSP and SRP data were considered equally valid based on QA/QC considerations.

Total Soluble Nitrogen. Quality control associated with TSN was acceptable. Spike recoveries averaged 100 percent and ranged between 94 and 108 percent. Internal QA recoveries were somewhat more variable, averaging 107 percent and ranging between 92 and 137 percent. Lab blanks ranged from 0 to 10 ug/L, and were not statistically different from analytical "zero". No correction was deemed necessary based on the lab blank data.

The precision of the laboratory duplicates was good with an average standard deviation between duplicates of 7 ug/L. Again, the field duplicates were somewhat more variable with an average standard deviation of 46 ug/L. Differences between the deionized water field blank and both the QED and Gelman filter blanks were not significant.

Nitrate-Nitrite as Nitrogen. Quality control associated with NO_2+NO_3-N was good. Spike recoveries ranged between 99 and 108 percent and averaged 104 percent. Internal QA recoveries averaged 104 percent and ranged between 101 and 105 percent. No correction was deemed necessary due to lab blanks, which ranged from 0 to 5 ug/L.

Again, the precision of the laboratory duplicates was good. The average standard deviation between laboratory duplicates was 3 ug/L. For field duplicates, the average standard deviation between duplicates was 24 ug/L. Differences between the deionized water field blank and both the QED and Gelman filter blanks were not significant.

Ammonia as Nitrogen. Quality control associated with NH_3-N was generally good. Spike recoveries averaged 103 percent and ranged from 93 to 114 percent. Internal QA recoveries averaged 91 percent and ranged from 72 to 105 percent. No correction was deemed necessary based on lab blank data.

The precision of the NH_3-N laboratory duplicates was very good with an average standard deviation between duplicates of 1 ug/L. Again, field duplicates were somewhat more variable with an average standard deviation between duplicates of 8 ug/L. Differences between the deionized water field blank and both the QED and Gelman filter blanks were not significant.

Chloride. The quality control associated with chloride was very good. Internal QA recoveries averaged 101 percent and ranged from 96 to 103 percent. The precision for both laboratory and field duplicates was excellent. The average standard deviation was 0.08 mg/L between laboratory duplicates and 0.18 mg/L between field duplicates.

RESULTS

The results of the data collection activities are presented in this section, according to each specific collection activity performed. Then, in the final three sections of this report, these results are synthesized together to develop a model of the hydrogeologic system, estimates of groundwater inflow and outflow, and to evaluate lakeside septic system performance.

Septic Leachate Survey

In general, the survey did not detect septic leachate plume activity along the portion of shoreline monitored. And, although equipment failure caused a premature termination, more than half of the survey was conducted along shoreline areas later determined to be part of a groundwater inflow zone. The lack of detections indicates that it is likely that septic system wastewater is either being adequately treated or is undergoing sufficient vertical and/or lateral dispersion from the drainfield to: 1) reduce plume concentrations below detection levels; or 2) discharge into the lake at deeper littoral locations.

Based on the results of the septic leachate survey, locating specific points of septic system wastewater effluent discharge into Lake Sawyer appeared unlikely. The assessment of wastewater inputs from more diffusive sources was therefore initiated, based on the groundwater monitoring network program and, specifically, the wellpoints.

Because groundwater flow directions were consistent throughout the year, and since perched groundwater conditions were not indicated on the western shore, the septic leachate survey was not repeated during the winter months. The seasonal consistency of groundwater flow patterns is discussed further under the **HYDROGEOLOGIC CONDITIONS; Conceptual Model** section of this report.

Monitoring Well and Wellpoint Installation

Generally, the only soil materials encountered in MW-2, MW-3, and MW-4, which were drilled to depths of 72, 48, and 59 feet, respectively, were recessional outwash sands and gravels (Qvr). In MW-1, till (Qvt) was encountered below approximately 15 feet of sand and gravel. Bedrock (Tbr), with traces of coal, was encountered at approximately 38 feet below ground surface at this location. The location and relative extent of these geologic units will be discussed further in the **HYDROGEOLOGIC CONDITIONS** section.

The TOC elevations are indicated in Table 1, along with well/wellpoint depths and monthly water level elevation measurements. The elevation survey indicated that the Lake Sawyer surface elevation generally fluctuates between 515 and 520 feet Mean Sea Level (MSL). This approximate lake level was corroborated by information obtained from

Dave Garland of Ecology, who collected survey data on the lake and groundwater near Lake Sawyer in the early 1980s (Dave Garland, 1990). However, the USGS Quad map for the area (Black Diamond Quadrangle; 7.5 minute series; photorevised 1973) previously reported the lake surface elevation at approximately 495 feet MSL. The discrepancy between these values appears to represent an error associated with the USGS map.

Aquifer Testing

Table 2 presents the aquifer testing results. The hydraulic conductivity testing estimates ranged from 5×10^{-5} cm/sec to $>10^{-3}$ cm/sec. The varying permeabilities suggests that there are a variety of different aquifer materials located near Lake Sawyer. This issue will be discussed further in the **HYDROGEOLOGIC CONDITIONS** section. The hydraulic conductivity testing results are used in conjunction with Darcy's Law to estimate inflow to and outflow from Lake Sawyer, as described in the **GROUNDWATER INFLOW/OUTFLOW ESTIMATES** section.

Water Level Monitoring

Monthly groundwater elevation data for the various monitoring locations are presented in Table 1. Based on these data, the hydrographs on Figures 3 through 8 were developed. They present the monthly groundwater elevations, relative to the lake, for the various measurement points within the monitoring network. The newly installed monitoring wells are grouped together on one hydrograph. Generally, the wellpoint hydrographs have been grouped together according to areas of the lake which they represent (i.e., northeast, east-south, and west-northwest). Domestic wells are grouped according to the geologic unit in which they are screened.

As indicated, the water level in wellpoints no. 1 through no. 5 and in MW-4, on the northeast side of the lake, are below lake level indicating outflow to the groundwater. On the other hand, the water level in wellpoints no. 6 through no. 12, MW-1, MW-3, and domestic well numbers 1, 2, 6, and 7, located along the east and south sides of the lake, are generally near or above lake level, indicating groundwater inflow. On the west and northwest sides of the lake the water levels in wellpoints no. 13 through no. 15, MW-2, and domestic well numbers 3, 4, and 8 are also generally below lake level, indicating outflow. Domestic well no. 5 appears to be an anomaly. The lower water elevation indicates that it is either screened in deeper pre-Vashon glacial deposits (Qc), or that it is pumped regularly to serve several homes and is slow to recover due to being at least partially screened in till or lower permeable materials.

Figures 9 through 11 provide water level elevations for the monitoring network during the months of September 1989, and January and May 1990. Of note is the lake versus MW-4 groundwater elevation difference which exists during September 1989, which is different from that observed during January 1990. A strong groundwater gradient away from the northeast part of the lake appears to exist during the drier portion of the year. Conversely, in the wetter portions of the year groundwater levels northeast of the lake are only slightly lower than lake level. A similar situation exists between the lake and MW-2. This, and the overall hydrogeologic flow system around Lake Sawyer will be further discussed in the **HYDROGEOLOGIC CONDITIONS** section.

Groundwater Sampling

Field Sampling Results

Field Measurements. The field measurement readings are presented in Tables 3 through 6. Groundwater temperatures measured in the four monitoring wells ranged from 9 to 15°C over the sampling year, with only slight seasonal variations. Conversely, wellpoint groundwater temperatures ranged from 7 to 22°C for the year, showing a larger seasonal influence. This is as expected, due to the wellpoints close proximity to Lake Sawyer and the much larger seasonal temperature variations observed in surface water as compared with groundwater.

Monitoring well and wellpoint pH measurements ranged from 5.6 to 7.7 and from 5.9 to 7.8, respectively. Electrical conductivity readings in the monitoring wells generally ranged from 90 to 170 μmhos, although the readings in MW-1 ranged up to 360 μmhos. Differences in conductivity may be attributable to different geologic units screened by the monitoring well (MW-1 is partially screened in Qvt and partially in Qvr, roughly 20-feet above bedrock; the other wells are screened in Qvr). Wellpoint electrical conductivity readings ranged from 80 to 280 μmhos.

These pH and conductivity measurements were generally within the expected range for groundwater.

Dissolved oxygen measurements varied widely. Overall, DO ranged from 0.4 to 12.3 mg/L. Some of the lowest values were detected within septic leachate plume areas.

Laboratory Results

The laboratory results are presented by sampling round in Tables 7 through 10. TSP and SRP data remained relatively stable for individual sampling locations among sampling rounds. Phosphorus concentrations in the Community Well and Wellpoint No. 10 were generally near or greater than 100 ug/L for all of the sampling rounds. Phosphorus concentrations in MW-2 generally averaged around 50 ug/L, and the concentrations for the remaining sampling sites were generally below 30 ug/L for the sampling rounds. MW-1 is an anomaly to this scenario, again potentially attributable to its being partially screened in Qvt, and also to varying fine sediment concentrations in the sample, requiring additional filtering in the laboratory prior to analysis. Wellpoint no. 14 also indicates some fluctuation in phosphorus concentrations between sampling events, which may be attributed to changing precipitation and/or lake level conditions.

Nitrogen data were somewhat more variable for individual locations among sampling rounds. However, generally only the concentrations of TSN and NO_2+NO_3-N in MW-1, MW-2, MW-4, and wellpoints no. 9, no. 10, and no. 11 were near or greater than 500 ug/L for the sampling rounds. NH_3-N concentrations varied among sampling rounds for specific locations but, with one exception, were generally below 100 ug/L. NH_3-N concentrations in wellpoint no. 14 exceeded 200 ug/L during the two sampling rounds in which samples were obtained from this location.

Generally, the chloride concentrations at each of the various sampling locations were relatively stable among sampling rounds. Notable exceptions were concentrations in wellpoints no. 4 and no. 7, where concentrations varied among and between each sampling round. Variations in chloride concentration in these wellpoints likely represent changes in the volumetric fraction of wastewater present in the groundwater sample (see **SEPTIC SYSTEM PERFORMANCE EVALUATION**).

HYDROGEOLOGIC CONDITIONS

Introduction

The purpose of this section is to develop a conceptual model of the hydrogeologic system functioning around Lake Sawyer. The conceptual model is then used to estimate groundwater inflow to and outflow from the lake. The model is based on the previously mentioned data collected during this study and other information obtained from the literature. As such, the regional subsurface stratigraphy is considered first, followed by a discussion of the local aquifers which interact with Lake Sawyer. Finally, the conceptual hydrogeologic model for the system is presented and the interactions between the groundwater and the lake are discussed.

Subsurface Stratigraphy

The subsurface stratigraphy in the Lake Sawyer vicinity consists of the following sequence:

- Lake Sediments (Qs);
- Peat (Qp);
- Vashon recessional outwash deposits (Qvr);
- Vashon till (Qvt);
- Pre-Vashon glacial deposits (Qc);
- Undifferentiated till and interglacial deposits (Qi); and
- Tertiary bedrock (Tbr).

Not all units are present in all areas around the lake. For instance, as shown on the surficial geology map (Figure 12) the peat, Vashon recessional outwash, and the Vashon till all crop out at the surface at various locations around Lake Sawyer. Figures 13 through 16 are generalized subsurface cross sections that represent our interpretation of the subsurface stratigraphy in the project area. This interpretation of the subsurface stratigraphy is based on interpretation of geologic logs from Hart Crowser's four monitoring wells, information obtained from available drillers' logs for the area, published and unpublished reports on the geology and hydrology of the area, and from personal communication with individuals familiar with the local geology. It is important to note that these are interpretations. The subsurface distribution of geologic units around the lake appears to be very complex and consequently cannot be fully delineated from available data.

Each of the stratigraphic units is described briefly below.

Lake Sediments (Qs)

Sediments occur along the bottom of Lake Sawyer due to deposition of organic and inorganic matter. The relative depth and extent of these sediments is not known. It is presumed that the lake sediments have a relatively low permeability.

Peat (Qp)

Post-glacial peat deposits occur at the surface along the southeastern corner of the lake, where Rock Creek flows into Lake Sawyer. The localized peat deposits are typically saturated, but are generally very thin and have low permeability. Therefore, the peat probably has minimal influence on shallow groundwater flow into or out of Lake Sawyer.

Vashon Recessional Outwash (Qvr)

The recessional outwash consists predominantly of stratified sand and gravel with abundant cobbles and small boulders. The outwash was deposited by high energy meltwater during the retreat of the Vashon glaciation. The recessional outwash occurs along most of the east and south sides of the lake, and in the northwest corner of the lake.

Luzier (1969) maps a number of relatively large recessional meltwater channels which trend northeast-southwest across much of south King County. One of these may occur in the northeast and southwest corners of Lake Sawyer. The data indicate that monitoring well MW-4, with a depth of 59 feet, is completed within a thick sand and gravel deposit. MW-2 and MW-3 were also drilled into sand and gravel presumed to be the recessional outwash to depths of 48 and 72 feet, respectively. Approximately 14 feet of the outwash was encountered overlying till at MW-1.

Vashon Till (Qvt)

Vashon till generally occurs beneath the recessional outwash along much of the east, north, and south sides of Lake Sawyer. Where the outwash is absent, the till crops out at the surface, especially west and north of the lake (Figure 12). The till, consisting of low permeability, unsorted, silty, gravelly sands and silts, is often referred to as hardpan in the drillers' logs. Information from available drillers' logs indicate that the till is generally 40 to 60 feet thick in the Lake Sawyer vicinity.

Not enough geologic data are available to discern if the till underlies the entire lake or only portions of the lake. Our cross sections indicate that the till is probably at least present beneath the shallow parts of the lake, but whether it underlies the deeper portions is unknown (Figures 13 through 16). There also is some question as to whether the Vashon recessional meltwater channel scoured away the existing till in the northeast, leaving a direct connection between the Qvr and the underlying Qc unit.

Pre-Vashon Glacial Deposits (Qc)

Data from drillers' logs and information from the South King County Groundwater Management Program indicate that these deposits, defined as Pre-Vashon in the South King County Groundwater Management Program, underlie Lake Sawyer and the surrounding area, but are absent in the rest of South King County. The Qc unit consists of clean sand and gravel with lesser quantities of slightly silty to silty sand. The South King County Groundwater Management Program refers to this unit as Qc(2) to differentiate it from similar but older coarse-grained units (Qc(3), etc.). However, because these other older units are not distinguished for this study, the coarse-grained deposits below the till are referred to simply as Qc.

As indicated earlier, the Qc unit may intersect the deeper portions of the lake. Additionally, in the northeast corner (and possibly in the southwest) meltwater channels may have scoured away the till unit leaving recessional deposits in direct contact with the Qc unit.

Older, Undifferentiated Till/Interglacial Deposits (Qi)

Several City of Kent wells located northeast of the lake have been advanced into non-water-bearing materials beneath the Pre-Vashon glacial deposits (Qc). The Kent Springs deep test well was drilled to a depth of 695 feet and encountered 550 feet of predominantly clay and silt below the Qc deposits. The origin of the thick clay is uncertain, but may have been deposited in glacial, interglacial, and/or possibly marine environments. Since the unit does not appear to interact directly with Lake Sawyer nor is it known to produce significant groundwater in the area, all deposits below the Qc are undifferentiated and grouped as Qi for this study.

Tertiary Bedrock (Tbr)

Tertiary bedrock is encountered in wells east and southeast of Lake Sawyer, including MW-1. Because the bedrock is not encountered in wells elsewhere in the vicinity of Lake Sawyer, the full extent of the bedrock is uncertain. The bedrock consists of light gray, fine-grained sandstone. In MW-1, light gray clay containing traces of coal or lignite was encountered immediately overlying the bedrock. (A number of underground coal mines exist in the region, including one located immediately southeast of Lake Sawyer.) The clay and sandstone are found together commonly in the area, and are part of the Hammer Bluff Formation (Luzier, 1969). The bedrock is a secondary source of groundwater in some locations, but is not considered a major water-bearing unit in the project area.

Two Aquifer System - Qvr and Qc

The recessional outwash (Qvr) and Pre-Vashon deposits (Qc) are the two primary water-bearing units which potentially interact with Lake Sawyer. Available hydrogeologic data indicate that the two systems are hydraulically distinct in most areas around the lake, separated by the Vashon till (Qvt). Groundwater in the Qvr flows both into and out of Lake Sawyer. Direct interaction between the Qc and Lake Sawyer remains questionable, due to lack of information concerning the extent of till beneath the lake and lake sediments on the lake bottom. Each of these aquifers is discussed below.

Qvr

The recessional outwash is an unconfined (water table) aquifer. Data from our monitoring network indicate that the water table elevation fluctuates seasonally by up to 12 feet. Depths to water range typically from less than 5 feet in wellpoints near the lake to greater than 40 or 50 feet in monitoring wells on the east (MW-3 and MW-4) and south (MW-2) sides of the lake where the topography rises.

Qc

The Pre-Vashon glacial deposits form a confined (artesian) aquifer in the project area. The overlying Vashon till forms a low permeability confining unit above the Qc Aquifer. On the basis of available drillers' logs and our cross sections, it appears that domestic wells numbers 3, 4, and 8 are completed in the Qc. Data are not available to ascertain whether domestic well number 5 is completed in the Qvr, Qc, or possibly in a more permeable zone within the Qvt.

Available drillers' logs for City of Kent's Kent Springs wells and KCWD 105 wells (located immediately northeast of the lake) suggest that both wellfields are tapping the Qc Aquifer, as indicated in Cross Section B-B' (Figure 14). Due to water rights issues, increased pumping rates, and lower groundwater levels, several studies have investigated the aquifer system(s) in the area immediately northeast of Lake Sawyer (Robinson and Noble, 1979 and 1982; Anderson & Kelly, 1981 and 1982; James M. Montgomery, 1987). These data indicate there is considerable debate on which aquifer the wellfields tap (Qvr or Qc or other?), and whether there is hydraulic connection between the water-bearing zones tapped by the City of Kent and KCWD 105.

Pumping tests conducted in both the Kent Springs wells and the Covington Water District wells indicate that the aquifer is highly transmissive, with transmissivities of greater than 1,000,000 gpd/ft estimated. Some tests indicate the system is influenced by a significant recharge boundary - possibly Lake Sawyer. Ecology, in their ongoing review of water rights for this area, has considered a possible direct hydraulic connection between the lake and the production wells (Garland, 1990). To date, however, the information is inconclusive.

Water level elevation data with survey control are scarce for wells completed in the Qc Aquifer. Water level data collected for this study from domestic wells in the Qc Aquifer indicate a general flow direction toward the northwest. These data are supported by water level data available through the South King County Groundwater Management Program database, which indicate regional groundwater flow toward the west-northwest. Luzier (1969) also maps regional groundwater flow to the west across this area. Potentially, the combined pumping from both the City of Kent and KCWD 105 wellfields may be drawing the hydraulic gradient in the Qc toward the northwest.

Conceptual Model - Groundwater/Lake Interactions

The purpose of the conceptual model of the hydrogeologic system is to assess groundwater inflows to and outflows from Lake Sawyer. As discussed previously, the hydrogeologic system around the lake is very complex due to the irregular distribution and thickness of Qvr and Qvt. To simplify the following discussion, the lake has been divided into the following five subsections:

- East and South Sides;
- Northeast corner;
- Northwest and West Sides;
- Southwest corner; and
- Bottom.

As will become apparent, these subsections were developed based on inflow and outflow characteristics, and the particular unit (Qvr or Qvt) in contact with the lake. Figures 9, 10, and 11 indicate the approximate location of the four surficial subsections.

East and South Sides

Groundwater in the Qvr flows into Lake Sawyer along its east and south sides. This is indicated by the water level measurements from MW-1 and MW-3, from wellpoints no. 6 through no. 11, and from domestic well numbers 1, 2, 6, and 7. The relation between the lake elevation and the groundwater elevations in these wells are shown on the hydrographs on Figures 3, 5, and 7.

The groundwater elevation in MW-1, screened predominantly in Qvt and partially in Qvr, and in MW-3, screened entirely in Qvr, are consistently 5 to 15 feet above lake level. Water levels in the wellpoints, screened in Qvr, are approximately at or slightly above lake level throughout the year. The same is generally true for the domestic wells.

Wellpoint no. 12 is located on the southwest side of the lake. Its water level elevations also fluctuate with the lake, potentially indicating that it is situated in Qvr and that there is groundwater inflow. However, the actual wellpoint was placed within a few feet of the lake in what appears to be a fill area due to residential landscaping. Consequently, the looser fill material may provide a direct contact with Lake Sawyer. Thus the water levels may only reflect fluctuating lake levels and not actual groundwater flow conditions.

Northeast Corner

In the northeast corner of Lake Sawyer, water appears to flow out of the lake through the Qvr unit. This is demonstrated by the consistently lower groundwater elevations, relative to lake level, in MW-4 and in wellpoints no. 1 through no. 5. As indicated by the hydrographs on Figure 3, the groundwater elevation in MW-4 ranges from roughly 1 to 7 feet below the lake elevation, depending on the season. Similarly, the water levels in the five wellpoints (Figure 4) fluctuate seasonally with the lake, but remain consistently below lake level.

There appears to be a relatively sharp distinction between the east-south inflow area and the northeast outflow area. The boundary between the inflow/outflow zones lies between MW-3/wellpoint no. 6 on the northern edge of the inflow section, and wellpoint no. 5 situated along the southern edge of the outflow section.

It is speculated that MW-4 is located in a thicker portion (i.e., closer to the center) of the outwash channel mapped by Luzier (1969) than MW-3. This is shown schematically in Cross Section D-D' on Figure 16. Although the two monitoring wells are only 1,400 feet apart and are both screened in Qvr, the groundwater elevation at MW-3 ranges from 12 to 18 feet higher than at MW-4.

The groundwater elevation at MW-4 shows an interesting seasonal fluctuation. During the drier months of the year the groundwater elevation is as much as 7 feet below lake level. Consequently, a strong hydraulic gradient for outflow from the lake exists. Conversely, during the wetter winter months the groundwater elevation at MW-4 is similar to the lake surface elevation, and thus outflow potential is reduced due to the shallower hydraulic gradient.

Potentially, several factors may influence this seasonal phenomenon. In the summer evapotranspiration increases while recharge to the Qvr unit from precipitation decreases. Additionally, increased draining to the deeper Qc unit may result due to seasonally lower water levels in the Qc and increased regional pumping of groundwater during the summer months. During the wet season the opposite occurs. There are less drains on the unit due to decreases in evapotranspiration and discharges to the Qc. Additionally, precipitation recharge to the Qvr increases.

Northwest and West Sides

Along the northwest and west sides of Lake Sawyer little or no water flows out of the lake through Qvt because it has a very low permeability. This is indicated by the hydrographs for wellpoints no. 13 through no. 15 on Figure 6. As shown, some of these wellpoints were dry for much of the year despite the fact that they were located near the lake and screened at depths well below the lake surface level.

Substantial interflow (in the topsoil along the top of the Qvt) to Lake Sawyer is not believed to occur based on the data collected in the study. Two wellpoints (WP-13 and WP-14) on the lake's west side are completed within the surficial till. In addition, wellpoint WP-15 in the northwest corner of the lake also appears to be completed in the Qvt, based on the soil characteristics observed during wellpoint installation.

Three geologic logs are available for water wells located within the area of surficial Qvt along the west side of the lake - 21N/06E-04E01, 21N/06E-4K01, and 21N/06E-4Q02 (see Appendix D). The well locations are shown on Figure 12. The three geologic logs indicate topsoil, or weathered till ranging from 2 to 5 feet thick, overlying the Qvt. The average thickness from the three values is 4 feet. Based on field observations and available geologic logs, the surficial soils may be more permeable than the underlying unweathered till (Qvt). Therefore, the question exists as to whether this thin topsoil layer may be saturated, either seasonally or during short term storm events, and whether there is groundwater flow from this unit into the lake.

The three Qvt wellpoints (WP-13, WP-14, and WP-15) were dry during many of the monthly water level measurements. WP-13 and WP-15 were both dry on January 8, 1990, which was the second day of a major storm event. Both wellpoints contained measurable water three days later (January 11, 1990), with nearly continuous rain in the interim. Water was measured in WP-14 during most of the year. On January 11, 1990, WP-14, which is located approximately 5 feet from the lake edge, was submerged by the lake with 0.16 feet of water above the wellpoint cap. This measurement is a measurement of lake level, and is <u>not</u> a groundwater level.

Groundwater levels in wellpoints 13 through 15 were below lake level during all dates of measurement (Figure 6), indicating flow out from the lake at all times. However, the question remains whether the wellpoints are screened to intercept flow within the topsoil, if it does occur. The top of the wellpoint screens are as follows:

- 2.1 feet below ground in WP-13;
- 4.1 feet below ground in WP-14; and
- 2.8 feet below ground in WP-15.

The top of the screened intervals in all three wellpoints are within the topsoil depth range of 2 to 5 feet, and all are at or above the average thickness of 4 feet, suggesting that the three wellpoints are partially screened within the topsoil. Because the water levels in the wellpoints are always below lake level, the available data indicate that flow is <u>not</u> occurring from the topsoil to the lake.

<u>Southwest Corner</u>

Outflow is believed to occur from the southwest corner of Lake Sawyer in a seasonal manner similar to that of the Northeast corner - although on a less dramatic scale. The Qvr in this area may also have been deposited within a channel, as shown schematically in Cross Section B-B'. As indicated by the hydrograph for MW-2 shown on Figure 3, the groundwater levels in this well closely mimic the fluctuating lake level. Again, during the drier summer months the groundwater level in MW-2 is generally several feet below lake level. Then, during the wetter months the groundwater elevation approaches, but stays slightly below the lake surface elevation. Consequently, in the summer months the increased hydraulic gradient between Lake Sawyer and the Qvr results in an increased rate of recharge to the Qvr unit from the lake.

Conversely, in the wetter season, the Qvr receives additional recharge from precipitation causing the water table to rise. This causes a reduced potential head difference between the lake and the Qvr, and results in a reduced rate of recharge from Lake Sawyer.

Bottom

As discussed earlier, there are insufficient data to completely assess the extent of the Qvt underlying Lake Sawyer.

However, based on surrounding stratigraphic information and the lake bathymetry, it is speculated that much of the lake rests on the till. The potential exceptions to this would be the two deeper zones in the northeast and central portions of the lake and/or any discontinuous areas of Qvt. In this case the lake would be in direct contact with the Qc.

Given the differences between the lake surface elevation and the water level in the domestic wells screened in the Qc, and the lake bathymetry, flow from the bottom of the lake to the Qc would be primarily downward. However, despite this downward hydraulic gradient, the relatively low hydraulic conductivity of the Qvt restricts flow. Even in areas where the lake is in direct contact with the more transmissive Qc, accumulated bottom sediments would also restrict flow.

In summary, Lake Sawyer is located between bedrock to the east and till outcrops to the north and west. It appears to be situated in a till trough with major recessional meltwater channels extending out from its northeast and southwest corners. Groundwater inflow to the lake occurs along its east and south sides. Outflows to the groundwater occur predominantly through the recessional deposits in the northeast and southwest, and also through sediment and till deposits lining the lake's bottom.

GROUNDWATER INFLOW/OUTFLOW ESTIMATES

Flows to and from Lake Sawyer were estimated using Darcy's Law (Freeze and Cherry, 1979):

$$Q=KIA,$$

where;

Q = discharge;
K = hydraulic conductivity;
I = hydraulic gradient; and
A = area of flow.

Due to the lack of specific data in certain areas and for certain parameters, a number of assumptions were made in order to estimate groundwater inflow and outflow from Lake Sawyer. For instance, hydraulic conductivities (K) were only measurable in several discrete locations around the lake. Consequently, the K values used in the estimates are either based on the aquifer testing results, where appropriate, or, where there is no data (e.g., the lake bottom), assumed based on expected K values for similar media in the region.

By necessity, hydraulic gradients are often based on only the difference between the Lake Sawyer surface elevation and the water level from one well. The diverse flow system into and out of the lake generally resulted in a condition where only one well with adequate geologic data and survey control, was available to monitor a particular flow path.

One of the most difficult parameters to estimate was the cross sectional area of flow for a particular pathway to or from the lake. For instance, there is insufficient stratigraphic data to pinpoint the width and depth of the recessional meltwater channels in the northeast and southwest corners of the lake. Similarly, along the east side of the lake the depth to Qvt influences the inflow estimates through the Qvr. However, Qvt was only encountered in our explorations in MW-1, and is only poorly described in available well logs for this area. Consequently, assumptions, based on trends in the stratigraphy, needed to be made concerning the depth to Qvt and thus the cross sectional area of flow within the Qvr.

Given the assumptions inherent in the calculations, the following inflow estimates should be viewed as rough approximations, and more as indicators of relative seasonal flow patterns and discharges, rather than specific values for inflow/outflow. In each case, the assumptions used for the flow estimate are discussed.

Inflows

As indicated previously, inflows to Lake Sawyer occur in the Qvr along the east and south sides of the lake. The components of Darcy's equation were determined in the following manner. Hydraulic conductivity was based on the average test values presented in Table 2 for MW-3. The hydraulic gradient was estimated using the monthly groundwater elevations in MW-1 and MW-3 as compared to the monthly lake level elevations. Several assumptions were made in determining the area of flow. First, it was assumed that all of the groundwater flow around the south-southeast portion of the lake entered via Rock Creek, and thus was monitored by Ecology's stream gaging station. As such the width of the inflow zone was assumed to be 4,500 feet, or roughly from Ravensdale Creek to wellpoint no. 6. Second, for the east side of the lake it was assumed that the depth to till angled linearly down from where it was encountered in MW-1 northward to approximately 10 feet beneath the bottom of MW-4. Consequently the thickness of Qvr in the inflow zone varied roughly from 3 to 10 feet (depending on seasonal water levels) at MW-1, to 25 to 40 feet at MW-3.

Table 11 presents the calculated average inflows to Lake Sawyer. Maximum and minimum inflow values were also considered. The maximum inflow was estimated using the maximum K value obtained during the aquifer tests. Additionally, it was assumed that the till near MW-1 dropped off sharply to the north so that the thickness of the inflow zone varied seasonally from 25 to 40 feet along the entire eastern shoreline. The maximum inflow values were approximately five times greater than the average estimates.

The minimum inflow was estimated using the lowest K value obtained during aquifer tests. The thickness of the inflow zone was estimated by assuming that Qvt existed immediately below the bottom of MW-3 and angled linearly up to where it was encountered of MW-1. The minimum monthly inflow estimates were approximately 15 times less than the average monthly inflow values.

Outflows

Outflows from Lake Sawyer to the groundwater system occurred from the lake bottom (incorporating the northwest and west zones) and from the recessional meltwater channels located in the northeast and southwest. Again, in each case due to the lack of specific data various assumptions had to be made in order to calculate outflows.

To estimate outflows through the bottom, the lake was divided into north and south quarters, and a central section which contained half the lake area. Flow from the lake to the Qc Aquifer was assumed to go through relatively low "permeability" till and bottom sediment with a K value of approximately 10^{-5} cm/sec - a typical hydraulic conductivity value for till and silt in the area. As shown in Table 2, aquifer testing in MW-1, which is largely screened in the Qvt, indicated K values in the 10^{-5} range. The hydraulic gradient was estimated using the difference between the lake surface elevation and the water elevation for domestic wells screened in the Qc (e.g., domestic well no. 4 for the north section, domestic well no. 3 and no. 8 for the central section, and domestic well no. 5 for the south section). It was assumed that all the wells were screened near the top of the Qc unit, estimated at an average elevation of 475 feet. Maximum and minimum flows were assessed using K values of 10^{-4} and 10^{-6} cm/sec, respectively. This changed flow values, relative to the average, by a factor of ten.

Outflow via the northeast meltwater channel was estimated by assuming the channel was approximately 1,650 feet wide - roughly the distance between wellpoint no. 1 and just south of wellpoint no. 5. The thickness of the Qvr channel, and thus the interface of the channel with the lake, was estimated to extend approximately 10 feet below MW-4 to an elevation of 480 feet. The hydraulic gradient was calculated using the difference between the lake surface level and the groundwater level in MW-4. Since hydraulic conductivity testing was ineffective in this area due to high permeability of the material, an average K value of 10^{-1} was assumed. Again, maximum and minimum flows were assessed by changing the K values one order of magnitude in each direction from the average - which produced an order of magnitude change in the calculated values.

Outflow via the southwest meltwater channel was estimated by assuming a channel width of 1,200 feet, which is somewhat less than the distance between wellpoints no. 11 and no. 12. The depth of the channel was assumed to be roughly 5 feet beneath the bottom of MW-2 at elevation 495 feet. The hydraulic gradient was calculated using the difference between the lake surface level and the groundwater level in MW-2.

Again the average of the aquifer tests were used for the K value. The maximum and minimum hydraulic conductivity test values were used to calculate the maximum and minimum outflow values from this area.

The total estimated outflow from these three areas of the lake are presented in Table 11. The estimate average outflows through the bottom of Lake Sawyer remained steady throughout the seasons, ranging between 1 to 2 cfs. Conversely, the average outflow via the northeast channel showed considerable seasonal fluctuations, varying from an average of 2 cfs in August to 0.2 cfs in February. As discussed previously, a reduced hydraulic gradient between the lake and the Qvr unit in the northeast during the wet season results in reduced outflow from Lake Sawyer. Finally, based on this analysis it appears as if there is minimal outflow via the southwest channel. This appears largely due to a relatively smaller hydraulic gradient from the lake to the groundwater and a lower hydraulic conductivity.

Nutrient Loading Estimates. The inputs of total nitrogen (TN) and total phosphorus (TP) to Lake Sawyer via the regional groundwater system was assessed by multiplying the average estimated groundwater inflow rate (0.1 cfs) by measured background concentrations of soluble (and thus potentially transportable) forms of these nutrients within the basin. Because of the presence of cultural (i.e., septic tank) influences at the monitoring well locations (see Section VI), background water quality was assumed to be represented by water quality monitoring data within Ravensdale Creek, which drains a relatively pristine watershed in the eastern areas of the basin. Ravensdale Creek also appears to be a predominant recharge source for groundwater inputs to Lake Sawyer. The average TSN and TSP concentrations in Ravensdale Creek observed over the study period were 450 $\pm$ 30 ug/L and 7 $\pm$ 1 ug/L, respectively.

Based on these data and assumptions, the estimated nutrient inputs to the lake from the regional groundwater system average approximately 50 kgTN/year and 0.8 kgTP/year. The uncertainty in these estimates is large, owing primarily to variabilities in measured and assumed flow parameters discussed above. The true regional groundwater loading rates of these parameters may range from 5 times higher to 15 times lower than the estimated average values.

Summary

As indicated in Table 11, there is a net monthly groundwater discharge from the lake. This result corresponds favorably with the surface water budget developed by Ecology. Using measurements for all inflow and outflow components except groundwater, Ecology calculated a significant unexplained output for June through December, and an insignificant residual value for the January through May period. The surface water budget thus indicated that there were a number of months with unexplained outputs from the lake. Based on this hydrogeologic study of Lake Sawyer, the estimated groundwater outflows can account for at least a portion of, if not all, the unexplained output.

Figure 18 graphically displays the monthly groundwater outflows and the monthly surface water unexplained output (i.e., residuals) for Lake Sawyer. Of note, the large unexplained output in August through December are reflected in the higher groundwater outflow values. Correspondingly, as the lake residuals shrink during the wetter winter months, the estimated groundwater outflows also are considerably reduced.

SEPTIC SYSTEM PERFORMANCE EVALUATION

One of the principal objectives of this study was to evaluate performance characteristics of existing and possible future on-site wastewater disposal systems within the Lake Sawyer basin. As discussed above, fifteen (15) wellpoints and four (4) monitoring wells were installed to accomplish this objective.

Septic System Site Selection Process

The septic systems selected for evaluation were determined based on telephone surveys and interviews with homeowners. Following the homeowner interviews, septic systems were selected for monitoring if they met the following criteria:

- The system had been in operation two years or more. (New systems tend to have limited impact on groundwater because of limited use and slow travel time to downgradient monitoring points).

- The residence was occupied on a year-round basis.

- The systems were located on soil types characteristic of the basin.

Based on the above, 15 sites were identified for investigation, and covered a range of hydrogeologic settings.

At each site, a wellpoint was installed within approximately 30 m (100 ft) of the drainfield location in a suspected downgradient direction. The wells were generally completed within the first groundwater zone encountered below the depth of the drainfield (during late fall installations).

As discussed previously in the **DATA COLLECTION METHODS** section of this report, the wellpoints were located in the field in areas most likely to receive wastewater discharges. These field determinations were based on a consideration of: 1) location of the drainfield; 2) regional groundwater flow directions; and 3) field determinations of chloride concentrations (a wastewater tracer parameter) both in the nearshore lake zone and in several wellpoint test holes driven at each location.

For comparative purposes, the four monitoring wells, selected water supply wells, Ravensdale Creek, and Lake Sawyer were utilized as sampling points to assess local upgradient conditions. The specific upgradient locations used in the septic system performance analysis are described below.

Septic System Monitoring Sites: Physical Conditions

Based on available hydrogeologic and engineering data for each of the septic system monitoring sites, the generalized drainfield and groundwater flow system below each site can be described. The flow systems encountered can generally be described as a relatively simple unsaturated vertical discharge into an underlying saturated zone. In the case of drainfields located in the permeable Qvr, effluent flow to the saturated zone is relatively rapid, with minimal diffusion. The opposite is true for the Qvt, due to the considerably lower permeability in this material.

Septic System Performance Characteristics

The approach used in this investigation to assess septic system performance and potential constituent transport rates to Lake Sawyer was based on the determination of local subsurface attenuation parameters (Kerfoot and Skinner, 1981; Gilliom and Patmont, 1982; Patmont et al., 1989). Briefly, the methodology provides estimates of pollutant removals within the soil environment by comparing the relative transport of a conservative septic effluent tracer parameter (i.e., chloride) with the constituents of interest. Such an assessment of attenuation properties relies solely on water quality determinations, and not on estimated (and generally highly uncertain) flow rate estimates. This attenuation-based methodology also incorporates the effects of a variety of pertinent physical processes such as dilution and diffusion.

Estimates of subsurface attenuation evaluation were also based on the assumption that surface transport of wastewater in the vicinity (i.e., within 30 m; 100 ft) of the drainfield is negligible. The assumed absence of surficial wastewater "failures" is indicated by the results of the wastewater leachate detection survey, limited inspections conducted by the Seattle-King County Health Department (Larry Kirschener, King County, personal communication, 1990), and also by additional field reconnaissance activities performed during this study. Although septic system wastewaters ultimately discharge into basin streams and/or into Lake Sawyer, local scale transport (i.e., within 30 m of the drainfield) appears to be generally limited to subsurface groundwater components.

Previous studies of septic system performance conducted in a variety of environmental settings have demonstrated that subsurface pollutant removal is often restricted to the local, and sometimes immediate drainfield vicinity (Dillon and Kirchener, 1975; Jones and Lee, 1977; EPA, 1980a; Gilliom and Patmont, 1982; Johnson and Atwater, 1985; Patmont et al., 1989). Local scale removals of wastewater constituents have generally been attributed to attenuation processes within the unsaturated soil horizon. More limited removals of nitrogen and phosphorus would be expected in the saturated groundwater zone. Based on these data, most of the removal (i.e., attenuation) of wastewater constituents within the Lake Sawyer basin likely occurs within the local unsaturated zone. Attenuation data obtained from the wellpoint and monitoring well network installed within the saturated zone, therefore, are probably representative of removals occurring after more extended transport through the groundwater.

Wastewater Detection Based on Chloride Tracer Data

As stated above, concentrations of a relatively conservative septic effluent tracer parameter -- chloride -- were used to assess the presence and volumetric fraction of wastewater present within the groundwater samples. The utility of chloride as a tracer parameter for this application has been well established (Kerfoot and Skinner, 1981; Gilliom and Patmont, 1982; Patmont et al., 1989). Within the Lake Sawyer basin, background concentrations of chloride typically ranged from approximately 1 to 3 mg/L, based on data collected from Ravensdale Creek and from monitoring wells and water supply wells located in generally undeveloped areas. In contrast, wastewater effluent within the basin (sampled at the Black Diamond Wastewater Treatment Plant and in basin septic tanks) averaged approximately 20 mg/L.

The accuracy of the chloride tracer approach to detect the presence of wastewater effluent in a given groundwater sample is partially dependent on the determination of local upgradient chloride concentrations not affected by the septic system discharge. The rather complex hydrogeologic conditions within the Lake Sawyer basin somewhat complicate this determination. Specifically, consideration must be given to the following factors: 1) groundwater flow direction within the saturated zone (i.e., to or from Lake Sawyer); 2) possible dispersion of wastewater flows during vertical transport through the unsaturated zone; and 3) different geologic units within the basin, which may exhibit differences in background chloride concentrations. Table 12 presents a summary of the geologic units, flow directions, and measured chloride concentrations at the various monitoring points used in this study.

Recessional Outwash Inflow Zone

The first flow system considered in this analysis is discharge **to** Lake Sawyer through the Qvr. Most of the monitoring points within the basin are located within this zone along the eastern shore of Lake Sawyer. Hydrogeologic analyses of the basin suggest that much of the discharge within this unit originates in (or is otherwise represented by) flows from Ravensdale Creek, since leakage from the creek contributes to recharge of the Qvr. Little development occurs within the Ravensdale Creek watershed. Accordingly, upgradient chloride concentrations measured in Ravensdale Creek were initially assumed to be representative of upgradient (pre-septic system release) conditions within this zone.

The cumulative frequency distributions of chloride concentrations measured within Ravensdale Creek and within wells of the Qvr zone are depicted on Figure 19. The data reveal that many of the chloride concentrations measured in wellpoints (and monitoring wells) completed within this zone significantly ($P < 0.01$; t-test) exceeded creek concentrations. The presence of elevated chloride concentrations in these wells is indicative of the presence of wastewater leachate.

Elevated chloride concentrations were also consistently observed in MW-3. Although this well was initially intended to serve as an upgradient reference well, access restrictions necessitated the placement of MW-3 within 30 m (100 ft) of an existing septic system drainfield. Because chloride concentrations in MW-3 were significantly ($P < 0.01$; t-test) elevated above creek concentrations, and also above many other Qvr wells, the presence of wastewater leachate in this well is indicated. Accordingly, MW-3 was designated as a downgradient septic system monitoring well for the purposes of this study.

For the purposes of this analysis, therefore, upgradient groundwater quality in the Qvr Inflow zone to Lake Sawyer was assumed to be represented by Ravensdale Creek. The upper 99th percentile chloride concentration in the creek was approximately 2.9 mg/L (based on t-test; depicted on Figure 19). Groundwater samples collected from this zone which exhibited chloride concentrations in excess of this value were interpreted to contain a statistically significant ($P < 0.01$) volumetric fraction of wastewater.

Recessional Outwash Outflow Zone

The second flow system considered in this analysis was discharge **from** Lake Sawyer via the Qvr zone. Although chloride concentrations in most of the Qvr outflow zones were equivalent to concentrations measured in Lake Sawyer, several samples nevertheless exhibited significantly ($P < 0.01$; t-test) elevated chloride concentrations relative both to Lake Sawyer and Ravensdale Creek (Figure 20). For the purposes of this evaluation, groundwater samples collected from this zone which exhibited chloride concentrations in excess of 2.9 mg/L were interpreted to contain a statistically significant ($P < 0.01$) volumetric fraction of wastewater.

It should be noted that the concentrations of chloride, TSP, and TSN in the majority of wellpoints located in the lake **outflow** zone were nearly identical to those measured in Lake Sawyer. The correspondence of water quality conditions between these sampling locations supports the use of lake water quality data to define upgradient conditions within this flow pathway.

The primary outflow well which exhibited elevated chloride concentrations was MW-4, located downgradient of a developed residential area northeast of Lake Sawyer. One sample collected from WP-4 exceeded the chloride threshold concentration. Accordingly, this groundwater sample was interpreted as a **downgradient** observation for the purposes of the septic system performance evaluation.

Other Discharge Zones

Although other groundwater discharge zones such as the Vashon till unit exist in the Lake Sawyer area, these areas were not targeted for evaluation in this study. Based on the regional hydrogeologic evaluation, wastewater migration is most likely to occur only via the Qvr discussed above. Effluent migration via discharge through other units is not likely to be a predominant transport pathway to Lake Sawyer.

Based on the available hydrogeologic data, significant septic system discharges through or above the Qvt on the western and northern shores of Lake Sawyer is considered very unlikely. This conclusion is based on the groundwater flow direction consistently directed away from Lake Sawyer, and the lack of an identified perched groundwater zone, as discussed in the **HYDROGEOLOGIC CONDITIONS** section of this report.

Constituent Attenuation Methodology

Based on the chloride tracer data, the equivalent volumetric fraction of undiluted wastewater present at a given groundwater sampling site can be estimated as follows:

$$\text{Volumetric Fraction} = \frac{Cl_d - Cl_u}{Cl_e - Cl_u}$$

where Cl denotes chloride concentration in mg/L, and subscripts u, d, and e denote upgradient, downgradient, and effluent values, respectively. Using this formulation, the volumetric percentage of effluent at all sites which exhibited a significant local increase in chloride levels was calculated.

The wastewater volume calculations are summarized in Table 12 and reveal that some of the groundwater samples were composed of substantial quantities of septic system effluent (up to approximately 30 percent by volume). Considering the observed variability in the background chloride data, effluent levels of approximately one (1) percent by volume in the groundwater samples were generally required to reliably determine wastewater contributions. Lower volumetric fractions of effluent were not distinguishable from apparently random variations in background chloride levels. Most of the potentially downgradient monitoring locations, however, contained more than this minimum detectable effluent fraction.

For the downgradient groundwater samples which contained a significant wastewater component, fractional constituent (C) removals within the soil system were calculated as follows:

$$\text{C Removal} = 1 - \frac{[C]_d - [C]_u}{\{[C]:Cl\} * \{Cl_d - Cl_u\}}$$

where [C] denotes the measured constituent (e.g., TSP) concentration and [C]:Cl denotes the constituent to chloride ratio present in wastewater as it is discharged through the septic tank/drainfield system.

The [C]:Cl ratios were similar among a variety of septic tanks and wastewater collection systems sampled in the Lake Sawyer area, even though the concentrations of individual constituents varied by more than an order of magnitude. (Samples collected from ST-1 were excluded from this evaluation owing to sampling uncertainties -- e.g., chloride concentrations, in one instance, not significantly elevated above background; it is likely that the location receives only grey water (e.g., laundry) discharges). The relationships between TP and TN levels with chloride concentrations in the wastewater samples are depicted on

Figures 21 and 22, respectively (data are presented in Appendix B). The mean and standard error of the observed constituent ratios for these key parameters (based on regression analyses which correct for background values -- see Gilliom and Patmont, 1982) are summarized below:

TP:Cl (wt:wt) = 0.282 ± 0.027

TN:Cl (wt:wt) = 1.73 ± 0.39

The mass balance formulation presented above examines differences between upgradient and downgradient mobile constituent (e.g., TSP and TSN) concentrations, and compares the observed differences with expected (unattenuated) values based on chloride tracer data. Comparisons of downgradient ($[C]_d$) and upgradient ($[C]_u$; Ravensdale Creek; Appendix B) TSP concentrations in the Qvr **inflow** zone are depicted on Figure 23. The elevated TSP concentration in many of the downgradient samples, presumably due to wastewater contributions, is evident in this comparison.

Upgradient and downgradient TSN concentrations in the Qvr inflow zone are depicted on Figure 24. Although many of the downgradient groundwater samples exhibited TSN concentrations above those measured in Ravensdale Creek, several of the samples nevertheless contained TSN concentrations significantly ($P < 0.01$; t-test) **below** the assumed upgradient values. (A similar condition was not observed with the TSP data).

The presence of lower TSN concentrations in downgradient groundwater samples may be indicative of nitrogen removals which occurred during groundwater transport between the assumed point of recharge (Ravensdale Creek) and the various downgradient wellpoints and monitoring wells. Nitrogen uptake by plants has been reported in a variety of shallow groundwater systems in the Northwest, owing to the general deficiency of this plant nutrient in regional soil systems (Gessel et al., 1969; Harper-Owes, 1985). Based on these data, it is likely that the Ravensdale Creek TSN concentrations **overestimate** local upgradient TSN concentrations in the immediate vicinity of the septic systems evaluated in this study. The true upgradient TSN concentration in this case may range from a lower bound of zero to an upper bound defined by Ravensdale Creek. This "background" uncertainty will be assessed further in the performance calculations presented below.

Constituent Attenuation Results

Based on the available data and the mass balance removal model described above, constituent removals associated with each groundwater sample which significantly ($P < 0.01$; t-test) exceeded background chloride concentrations were calculated. The results of the calculations are presented on Figures 25 and 26, respectively.

In order to address uncertainties in the background (upgradient) concentrations of these constituents, two sets of calculations were performed. The first assumed a local upgradient concentration of zero as a lower bound. The second (upper-bound) calculation was based on the measured Ravensdale Creek or Lake Sawyer concentrations, depending upon which flow system was represented (see above discussion). Both sets of calculations are depicted on Figures 25 and 26.

The TP removal estimates were relatively insensitive to the assumed upgradient concentration (Figure 25). Individual sample TP removal estimates ranged from a low of approximately 50 percent to a high of 100 percent. Lower TP removals tended to occur in areas with a relatively shallow depth to water below the drainfield trench, although a full statistically-based analysis of this condition could not be performed with the available data. Overall, more than 60 percent of those samples with a significant ($P < 0.01$) volumetric fraction of effluent were associated with an apparent TP attenuation statistically equivalent ($P > 0.10$) to 100 percent removal. Average P removal over the study period, based on all of the attenuation calculations, was 93.8 ± 2.5 percent. Average P removals measured during this study are similar to values reported in the Pine Lake and Lake Chelan basins (Gilliom and Patmont, 1982; Patmont et al., 1989).

In contrast to the TP removal results, TN attenuation estimates varied depending upon the assumed background concentration (Figure 26). Average N removal over the study period, based on all of the attenuation calculations, was 71.8 ± 4.8 percent assuming a zero background concentration, and 85.4 ± 4.7 percent assuming the creek/lake values represent local upgradient conditions. Individual sample TN removal estimates ranged from a low of approximately 20 percent to a high of 100 percent. The overall average TN attenuation, assuming equal weight is given to both background concentration assumptions, is approximately 78.6 $\pm$ 10.7 percent. Again, these measured TN removals are similar to those observed in the Pine Lake and Lake Chelan basins (Gilliom and Patmont, 1982; Patmont et al., 1989; R. Gilliom, USGS, unpublished data).

Septic System Loadings

The wastewater characterization and attenuation data discussed above formed the basis for an assessment of constituent loadings to Lake Sawyer from on-site septic systems. In the areas of the watershed where groundwater flow is directed **toward** the lake (defined generally as the drainage area extending from wellpoint no. 6 clockwise to wellpoint no. 11; see Figure 27), approximately 80 $\pm$ 4 homes currently (1989-1990) utilize septic systems (based on Hart Crowser field observations). Most of these dwellings appeared to be full-time residences. The septic systems monitored were assumed to be representative of these basin dwellings.

Total loadings of TP and TN were calculated based on the following:

$$\text{Load} = \text{HOME} \times \text{DWEL} \times Cl_L \times [C]{:}Cl \times (1 - C_R)$$

where HOME denotes the total number of basin homes within the groundwater catchment zone (80 $\pm$ 4); DWEL denotes the average people per household in the area (3.0 $\pm$ 0.2 based on Puget Sound Council of Governments unpublished data, 1989; Census tracts #316 and #320.01); Cl_L denotes the characteristic per capita chloride excretion rate (2.2 $\pm$ 0.5 kg Cl/person-year; Metcalf and Eddy, 1972; Brandes, 1978), [C]:Cl denotes the constituent to chloride ratios discussed previously, and C_R denotes the overall average fractional constituent removal (93.8 $\pm$ 2.5 percent for TP; 78.6 $\pm$ 10.7 percent for TN). The results of these current (1989-1990) septic system loading calculations are summarized below:

TP Loading = 9 $\pm$ 4 kgP/year
TN Loading = 190 $\pm$ 90 kgN/year

Uncertainty Analysis

Overall, the total coefficients of variation (standard error divided by the mean) associated with the average annual wastewater TP and TN loading calculations were similar at approximately $\pm$ 50 percent. The various sources of uncertainty, expressed as a percentage of the total variance contributing to the loading calculations, are summarized in Table 13.

In both cases (i.e., TP and TN), the major source of uncertainty contributing to the total variance in the loading calculations was groundwater sampling variability, particularly site-to-site variations in parameter attenuation (Table 13). This variability is represented by those ten (10) septic system monitoring sites sampled during the study which contained detectable quantities of wastewater (Table 12). Variations in the per capita chloride excretion load (Cl_L) also contributed significantly to the overall loading uncertainty, representing approximately 22 to 24 percent of the total variance.

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Table 5.1

Table 1 - Groundwater and Surface Water Elevation Data (page 1 of 2)

Hart Crowser
J-2484

Station	Well Depth	TOC Elevation	8/7-8/89	9/6/89	10/3/89	11/2/89	12/5-6/89	1/8/90 (Storm Event)	1/11/90
Deep Monitoring Wells:									
MW-1	23.0	535.64	524.81	524.19	523.33	522.83	530.22	NM	529.88
MW-2	70.0	572.46	516.08	515.33	514.31	513.71	517.16	NM	519.36
MW-3	48.0	560.84	523.74	523.42	522.78	522.35	527.11	528.74	535.86
MW-4	48.0	549.29	509.32	511.06	509.84	508.90	512.78	515.54	518.29
Wellpoints:									
WP-1	6.1	521.44	<515.3	<515.3	<515.3	<515.3	517.39	517.32	518.31
WP-2	6.5	521.74	517.77	517.15	516.39	<515.2	518.64	518.55	519.40
WP-3	9.4	522.69	513.60	<513.3	<513.3	<513.3	<513.3	<513.3	518.31
WP-4	6.0	520.56	515.12	514.53	514.46	<514.6	515.49	NM	518.40
WP-5	6.7	520.64	<513.9	<513.9	<513.9	<513.9	515.53	NM	519.46
WP-6	6.5	521.13	517.97	517.37	516.56	516.10	518.83	NM	519.43
WP-7	5.2	520.68	518.28	517.38	516.54	516.08	518.96	NM	519.59
WP-8	3.9	520.90	518.01	517.34	<517.0	<517.0	518.99	NM	519.76
WP-9	5.4	521.82	518.03	517.32	516.58	<516.4	519.13	NM	519.86
WP-10	6.4	521.75	518.02	517.56	516.55	516.08	519.08	NM	519.82
WP-11	4.9	520.91	518.22	517.36	516.55	516.09	519.33	NM	519.61
WP-12	3.2	519.55	517.94	517.42	516.27	<516.4	519.05	518.97	NM
WP-13	5.1	521.93	<516.8	<516.8	<516.8	<516.8	<516.8	<516.8	515.58
WP-14	7.1	519.38	513.29	<512.3	<512.3	<512.3	516.40	516.35	NM
WP-15	4.8	520.27	<515.5	<515.5	<515.5	<515.5	518.09	<515.5	518.14
Domestic Wells:									
DOM-1	24	540.10	518.10	516.99	<516	<516	518.87	NM	519.73
DOM-2	50	526.40	517.88	517.44	516.42	516.02	518.95	NM	516.51
DOM-3	?	541.27	502.99	504.23	503.36	502.75	507.12	NM	512.76
DOM-4 (4B07)	80	530.36	NM	480.19	479.40	480.37	483.70	NM	490.65
DOM-5 (3P02)	?	540.96	513.51	512.90	512.07	511.59	514.79	NM	515.54
DOM-6	12	526.68	518.35	517.24	516.66	516.15	519.16	NM	518.74
DOM-7	?	553.23	518.14	517.54	516.66	516.22	519.46	NM	520.12
DOM-8	80	524.19	505.64	505.61	504.81	504.23	508.00	NM	511.13
Staff Gages:		**Elevation of 0.00 Mark**							
1a) Rock Creek-Old	NA	517.57	NM	519.29	518.85	519.54	>520.5	521.17	NM
1b) Rock Creek-New	NA	519.28	NM	NM	NM	NM	NM	NM	NM
2) Eaton's Dock	NA	511.37	NM	517.35	516.64	516.18	519.06	519.00	519.55
3) Covington Creek-Post*	NA	517.68	NM	515.43	515.41	515.32	517.18	516.85	>517.7
4) Covington Creek-Dam	NA	516.53	NM	517.37	516.63	516.27	519.02	518.98	519.41

Notes:
1) All elevations in feet (MSL). Well depths are relative to ground surface.
2) Elevations denoted with "<" indicate a dry wellpoint. Elevation listed is the elevation of the wellpoint bottom.
3) Elevations denoted with ">" indicate a submerged staff gage. Elevation listed is the elevation of the top of the staff gage.
4) TOC: Top of casing; NA: Not applicable; NM: No measurement taken.
5) *: Top of metal fence post is "0.00 Mark".

Table 5.1

Table 1 - Groundwater and Surface Water Elevation Data (page 2 of 2)

Hart Crowser
J-2484

Station	2/2/90	3/13-14/90	4/3/90	5/1/90
Deep Monitoring Wells:				
MW-1	528.97	528.96	528.33	528.97
MW-2	518.16	518.10	517.86	517.56
MW-3	533.31	531.56	530.25	527.14
MW-4	518.40	517.52	516.88	515.71
Wellpoints:				
WP-1	517.32	516.22	515.63	<515.3
WP-2	518.91	518.45	518.71	518.21
WP-3	518.34	517.45	517.03	515.67
WP-4	518.38	517.71	517.26	516.28
WP-5	518.83	518.09	517.95	516.62
WP-6	518.97	518.79	518.63	518.54
WP-7	519.10	518.90	518.93	518.69
WP-8	519.11	518.92	518.73	518.67
WP-9	519.62	518.92	518.88	518.35
WP-10	519.03	518.93	518.90	518.70
WP-11	519.55	518.99	518.78	518.83
WP-12	518.95	518.88	518.66	518.72
WP-13	<516.8	<516.8	515.20	<516.8
WP-14	516.77	515.64	515.48	515.63
WP-15	<515.5	<515.5	<515.5	<515.5
Domestic Wells:				
DOM-1	518.97	518.80	518.60	<516
DOM-2	518.94	518.82	518.72	518.56
DOM-3	510.13	511.06	508.27	507.26
DOM-4 (4B07)	490.61	489.69	488.96	488.26
DOM-5 (3P02)	514.79	514.57	514.39	514.28
DOM-6	519.06	518.95	518.81	518.71
DOM-7	519.29	519.23	519.01	518.96
DOM-8	510.35	510.27	509.32	509.03
Staff Gages:				
1a) Rock Creek-Old	520.71	520.67	519.97	520.29
1b) Rock Creek-New	520.72	520.68	519.91	520.29
2) Eaton's Dock	519.01	518.95	518.77	518.68
3) Covington Creek-Post*	515.23	517.5	NM	516.9
4) Covington Creek-Dam	>519.5	518.94	518.78	518.76

Notes:
1) All elevations in feet (MSL).
2) Elevations denoted with "<" indicate a dry wellpoint. Elevation listed is the elevation of the wellpoint bottom.
3) Elevations denoted with ">" indicate a submerged staff gage. Elevation listed is the elevation of the top of the staff gage.
4) TOC: Top of casing; NA: Not applicable; NM: No measurement taken.

Table 5.2

Table 2 - Aquifer Testing Results

SITE	Screened Interval	Hydraulic Conductivity in cm/sec		
		Pumping Test	Bail Test	Slug Test
Domestic Well No. 4	Qc	10^{-3}*		
Domestic Well No. 8	Qc	$5x10^{-5}$*		
MW-1	Qvr/Qvt		$3x10^{-5}$*	$5x10^{-5}$***
MW-2	Qvr		$4x10^{-5}$*	$9x10^{-4}$
MW-3	Qvr		$4x10^{-4}$*	$7x10^{-3}$
MW-4	Qvr		** ($>10^{-3}$)	** ($>10^{-3}$)

* - indicates depth of aquifer was assumed in order to convert transmissivity data to hydraulic conductivity values.

** - indicates water table recovered too rapidly to monitor, thus hydraulic conductivities are probably greater than 10^{-3} cm/sec.

*** - MW-1 is completed partially in both Qvr and Qvt. Early time slug test data indicate a higher K value of approximately 10^{-3}, and may indicate the contribution of Qvr. The complete data set indicates K = $5x10^{-5}$ cm/sec, indicative of Qvt.

Table 3 - Groundwater Field Measurements: August 1989

Location	Temperature in oC	Electrical Conductivity in umhos	pH	Dissolved Oxygen in mg/L
Monitoring Wells				
MW-1	13	120	6.3	3.9
MW-2	11	90	7.0	2.0
MW-3	11	90	6.3	7.8
MW-4	15	110	6.2	3.6
Wellpoint #				
1	Dry			
2	22	130	5.9	2.6
3	Dry			
4	Dry			
5	Dry			
6	18	140	6.4	2.8
7	19	110	5.4	1.5
8	20	80	5.6	1.6
9	16	120	5.9	2.7
10	17	110	5.9	3.0
11	15	100	7.0	2.8
12	20	130	5.9	2.0
13	Dry			
14	Dry			
15	Dry			

Table 4 - Groundwater Field Measurements: December 1989

Location	Temperature in oC	Electrical Conductivity in umhos	pH	Dissolved Oxygen in mg/L
Monitoring Wells				
MW-1	11	250	7.5	8.8
MW-2	10	150	7.7	6.8
MW-3	10	130	7.5	7.3
MW-4	10	160	7.5	8.4
Wellpoint #				
1	10	210	7.5	10.9
2	12	190	7.5	4.9
3	Dry			
4	10	210	7.8	8.8
5	11	170	7.8	12.3
6	12	120	7.2	4.7
7	11	120	6.9	2.4
8	11	90	7.1	10.4
9	11	280	7.5	3.0
10	11		7.7	4.0
11	11	150	7.0	8.3
12	9	150	7.6	6.2
13	Dry			
14	10	270	7.4	2.0
15	9	160	6.8	10.6
Others				
Community Well	10	180	8.5	2.4

Table 5 - Groundwater Field Measurements: March 1990

Location	Temperature in oC	Electrical Conductivity in umhos	pH	Dissolved Oxygen in mg/L
Monitoring Wells				
MW-1	7	360	7.2	
MW-2	8	170	7.2	
MW-3	11	90	7.2	
MW-4	10	150	7.1	
Wellpoint #				
1	7	170	6.1	2.9
2	7	150	6.1	1.2
3	8	120	5.9	6.4
4	8	140	6.1	7.2
5	7	120	6.4	4.0
6	9	160	6.0	5.2
7	10	120	6.2	1.2
8	9	100	6.0	3.7
9	8	120	6.1	3.2
10	9	110	6.1	5.6
11	8	140	7.0	
12	7	130	7.4	
13	Dry			
14	8	140	7.3	
15	Dry			
Septic Systems				
ST-1				
ST-2	9	190	5.8	4.1
Others				
Community Well	10	170	6.3	5.8

Table 6 - Groundwater Field Measurements: May 1990

Location	Temperature in oC	Electrical Conductivity in umhos	pH	Dissolved Oxygen in mg/L
Monitoring Wells				
MW-1	9	310	6.3	5.6
MW-2	9	130	5.6	2.3
MW-3	11	100	6.4	9.5
MW-4	13	120	6.4	10.3
Wellpoint #				
1	Dry			
2	11	190	6.4	2.7
3	12	260	6.7	4.2
4	12	190	7.2	4.8
5	14	160	7.5	4.2
6	11	140	7.2	0.7
7	13	110	6.8	0.4
8	12	100	7.2	0.9
9	12	160	7.0	0.5
10	13	130	7.0	0.5
11	11	80	6.1	5.9
12	13	130	6.4	2.1
13	Dry			
14	16	130	6.4	5.3
15	Dry			
Septic Systems				
ST-1	14	1080	7.8	0.8
ST-2	18	440	7.2	3.6
Others				
Community Well	10	150	8.3	6.0

2484T6

Table 7 - Groundwater Sampling Results: August 1989

Location	Total Soluble Phosphorus in ug/L	Soluble Reactive Phosphorus in ug/L	Nitrate-nitrite as N in ug/L	Ammonia as N in ug/L	Total Soluble Nitrogen as N in ug/L	Chloride in mg/L
Monitoring Wells						
MW-1	4.4 J	15.3	628	19	642	2.80
MW-2	39.0 B	56.1	10	3	50	1.85
MW-3	9.5 J	21.9	3,071	8	3,225	5.90
MW-4	8.2 J	21.0	222	11	384	2.45
Wellpoint #						
1						
2	27.4	25.6	6	295	295	2.45
3						
4						
5						
6	20.0	21.5	5	93	145	2.90
7	12.1	11.7	6	9	59	6.43
8	12.3	10.9	12	(2)	58	2.80
9	(6.0) J	10.2	223	(0)	516	5.45
10	230.4	226.6	1,529	25	1,510	3.90
11	15.7	18.7	267	(0)	378	3.13
12	14.8	12.5	6	33	118	2.53
13						
14						
15						
Others						
Domestic Well	38.5 B	12.7	422	25	574	3.30

"J" - indicates that the associated numerical value is an estimated quantity

2484T7

Table 8 - Groundwater Sampling Results: December 1989

Location	Total Soluble Phosphorus in ug/L	Soluble Reactive Phosphorus in ug/L	Nitrate-nitrite as N in ug/L	Ammonia as N in ug/L	Total Soluble Nitrogen as N in ug/L	Chloride in mg/L
Monitoring Wells						
MW-1	5.2 J	77.6	2,050	5	2,666	3.25
MW-2	50.6 B	60.5	99	16	544	2.30
MW-3	12.0 J	18.4	442	(3)	2,165	
MW-4	17 5 J	19.2	553	3	575	2.85
Wellpoint #						
1	21.8	18.7	(5)	(6)	123	2.80
2	12.5	9.7	258	21	427	2.00
3						
4	25 1 J	14.5	272	86		7.00
5	3.9	8.8	25	(3)	166	2.65
6	(6.1) J	8.9	66	(1)	246	4.08
7	5.2	4.4	20	4	94	3.40
8	(1.9) J	8.4	351	1	341	4.20
9	4.4	8.4	1,722	47	1,507	5.85
10	160.3 B	165.3	2,019	92	1,924	5.28
11	6.2	8.4	1,132	1	690	1.75
12	9.7 J	9.7	51	(2)	305	3.05
13						
14	18.8	23.5	35	371	505	4.25
15	13.5	8.1	24	(1)	175	2.60
Others						
Domestic Well						
Community Well	112.4	116.2	39	13	38	1.35

"J" - indicates that the associated numerical value is an estimated quantity

2484T8

Table 9 - Groundwater Sampling Results: March 1990

Location	Total Soluble Phosphorus in ug/L	Soluble Reactive Phosphorus in ug/L	Nitrate-nitrite as N in ug/L	Ammonia as N in ug/L	Total Soluble Nitrogen as N in ug/L	Chloride in mg/L
Monitoring Wells						
MW-1	318.6 B	72.0	590	21	1,280	5.30
MW-2	48.9 B	48.2	87	50	233	1.85
MW-3	12.8 B	16.0	733	3	3,249	5.25
MW-4	28.8 B	19.6	488	21	821	2.35
Wellpoint #						
1	7.1	6.4	28	6	116	1.85
2	24.5	10.3	107	33	186	2.10
3	5.1	5.4	459	2	505	2.15
4	3.0	3.9	385	7	443	2.20 *
5	4.2	4.6	286	(1.3)	349	1.83
6	3.3 J	4.6	163	3	198	3.25
7	9.3	10.0	816	20	782	7.75
8	7.6 B	7.4	15	23	33	2.75
9	1.6	8.4	747	30	701	4.25
10	91.5 B	81.2	782	4	709	3.60
11	4.2	9.2	1,040	38	1,106	2.85
12	4.7	10.5	267	2	378	1.95
13						
14	89.8 B	16.5	73	239	464	2.70
15						
Septic Systems						
ST-1	22,892 B	21,900	(3)	57,348	63,980	12.35 J
ST-2	378 B	348	1,530	9,817	14,105	5.40
Others						
Domestic Well						
Community Well	105	119	43	13	29	1.00

"J" - indicates that the associated numerical value is an estimated quantity

Table 10 - Groundwater Sampling Results: May 1990

Location	Total Soluble Phosphorus in ug/L		Total Soluble Nitrogen as N in ug/L	Chloride in mg/L
Monitoring Wells				
MW-1	197.7	B	750	1.79
MW-2	47.3	B	1,250	2.40
MW-3	18.3	B	3,652	5.45
MW-4	24.2	B	1,463	3.40
Wellpoint #				
1				
2	12.7		120	2.15
3	10.0		445	2.70
4	9.3		374	2.15
5	26.9		284	2.15
6	12.4		105	2.50
7	21.2		201	9.25
8	10.5		56	2.65
9	5.6		236	2.88
10	133.4	B	743	4.08
11	7.1		1,139	3.30
12	6.3		135	2.30
13				
14	31.5	B	461	2.70
15				
Septic Systems				
ST-1	10,812	B	65,382	0.85
ST-2	4,180	B	30,556	15.65
Others				
Domestic Well				
Community Well	108.3		71	1.90

2484T10

Table 5-3

Table 11 - Average Groundwater Inflow and Outflow Estimates

Month	Average Inflow in cfs	Average Outflow in cfs
August	0.05 (0.01 - 0.3)	4 (0.5 - 40)
September	0.05 (0.01 - 0.3)	3 (0.5 - 35)
October	0.05 (0.01 - 0.3)	4 (0.5 - 35)
November	0.05 (0.01 - 0.3)	4 (0.5 - 35)
December 1989	0.1 (0.01 - 0.5)	3 (0.5 - 35)
January 1990	0.2 (0.01 - 1)	2 (0.2 - 15)
February	0.2 (0.01 - 1)	1 (0.1 - 15)
March	0.2 (0.01 - 1)	2 (0.2 - 15)
April	0.1 (0.01 - 0.5)	2 (0.2 - 20)
May	0.1 (0 01 - 0.5)	2 (0.2 - 20)

( ) - indicates potential range of flows

Table 5.4

Table 12 – Summary of Lake Sawyer Septic System Phosphorus and Nitrogen Removal Calculations

Location	Geologic Unit	Flow to Lk. Sawyer	Chloride in mg/L Mean	+/-	S.E.		Average Effluent Fraction(a)	TSP in ug/L Mean	+/-	S.E.	TSP Removal Mean	+/-	S.E.	TSN in ug/L Mean	+/-	S.E.	TSN Removal Mean	+/-	S.E.
RAV-CK	Qvr	In	2.16	+/-	0.08			7.0	+/-	0.8				453	+/-	31			
LK SAWYER		-	2.24	+/-	0.05			13.0	+/-	1.1				295	+/-	79			
MW-1	Qvt	In	3.29	+/-	0.74			131.5	+/-	77.2				1,335	+/-	465			
MW-2	Qvr	Out	2.10	+/-	0.15			46.5	+/-	2.6				519	+/-	264			
MW-3	Qvr	In	5.53	+/-	0.19	*	21%	13.2	+/-	1.9	99%	+/-	0%	3,073	+/-	318	46%	+/-	9%
MW-4	Qvr	Out	2.76	+/-	0.24	*	3%	19.7	+/-	4.5	94%	+/-	0%	811	+/-	235	47%	+/-	5%
WP-1	Qvr	Out	2.33	+/-	0.47			14.5	+/-	7.3				120	+/-	4			
WP-2	Qvr	Out	2.18	+/-	0.10			19.3	+/-	3.9				257	+/-	67			
WP-3	Qvr	Out	2.43	+/-	0.27			7.6	+/-	2.4				475	+/-	30			
WP-4	Qvr	Out	3.78	+/-	1.61	*	10%	12.5	+/-	6.6	99%	+/-	n=1	392	+/-	26	97%	+/-	n=1
WP-5	Qvr	Out	2.21	+/-	0.24			11.7	+/-	7.6				266	+/-	54			
WP-6	Qvr	In	3.18	+/-	0.34	*	6%	7.4	+/-	5.6	100%	+/-	1%	174	+/-	31	100%	+/-	6%
WP-7	Qvr	In	6.71	+/-	1.24	*	28%	12.0	+/-	3.4	99%	+/-	0%	284	+/-	169	100%	+/-	7%
WP-8	Qvr	In	3.10	+/-	0.37	*	6%	7.1	+/-	3.2	100%	+/-	n=1	122	+/-	73	97%	+/-	n=1
WP-9	Qvr	In	4.61	+/-	0.67	*	15%	1.4	+/-	2.6	100%	+/-	0%	740	+/-	273	87%	+/-	9%
WP-10	Qvr	In	4.22	+/-	0.37	*	13%	153.9	+/-	29.2	73%	+/-	6%	1,222	+/-	298	73%	+/-	11%
WP-11	Qvr	In	2.76	+/-	0.35	*	4%	8.3	+/-	2.5	97%	+/-	2%	828	+/-	182	72%	+/-	24%
WP-12	Qvr	Out	2.46	+/-	0.23			8.9	+/-	2.2				234	+/-	64			
WP-13	Qvt	Out		Dry					Dry						Dry				
WP-14	Qvt	Out	3.22	+/-	0.52	(b)		46.7	+/-	21.9				477	+/-	14			
WP-15	Qvt	Out	2.60		n=1	(b)		13.5		n=1				175		n=1			
DW-6	Qvr	In	3.30		n=1	*	7%	38.5		n=1	89%		n=1	574		n=1	82%		n=1
CW	?	In	1.42	+/-	0.26			108.6	+/-	2.1				46	+/-	13			

NOTES:

a) Average effluent fraction calculated based on an average effluent chloride concentration of approximately 18 mg/L (see Figures 21 and 22).

b) Relative to the Qvt background well (MW-1), chloride concentration in these wells are not significantly elevated.

"*" denotes that the measured chloride concentration was significantly (P<.05; t-test) greater than the corresponding reference value, indicating a detection of wastewater at that location.

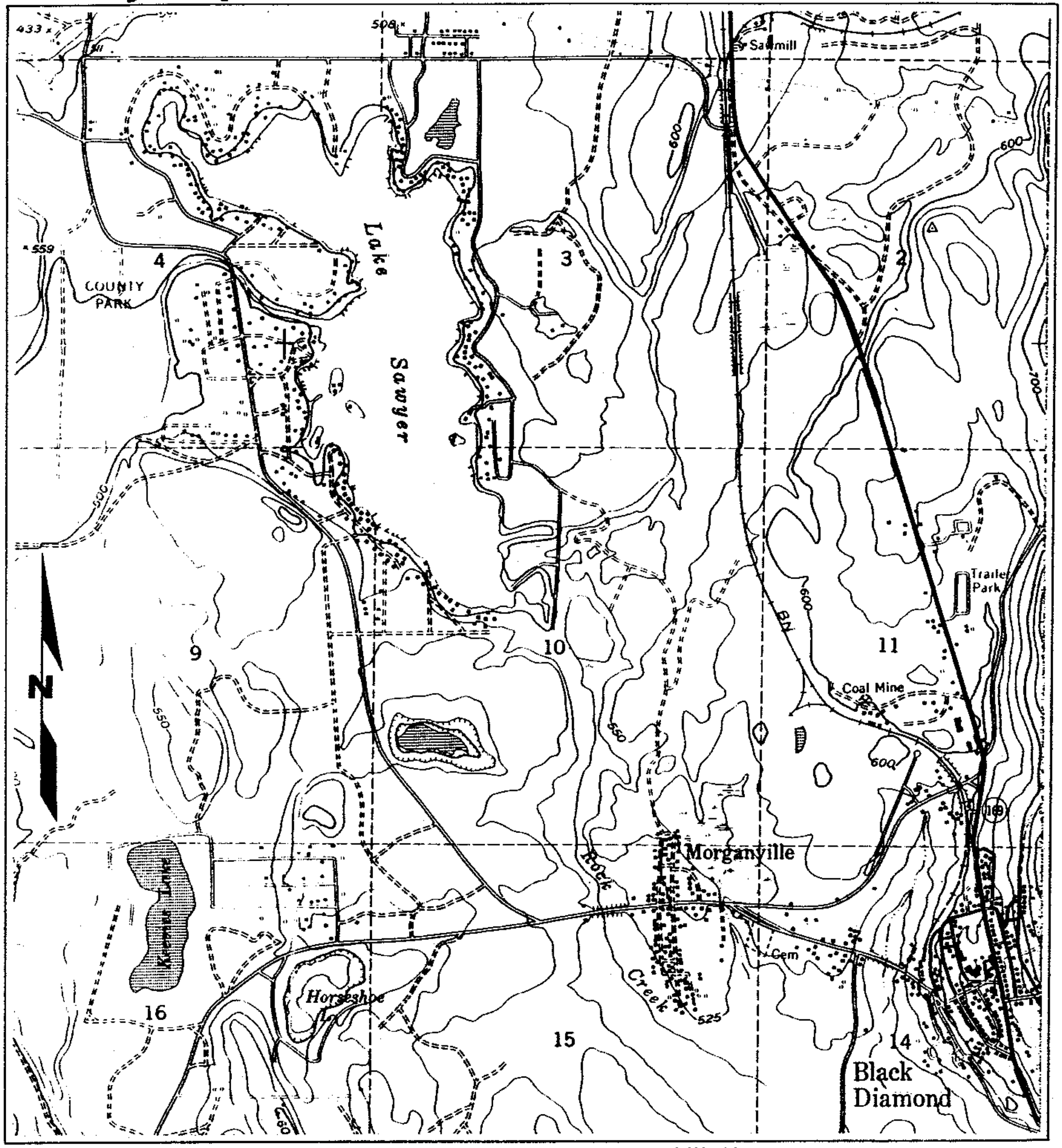
2484T12

Table 5.5

Table 13 - Septic System Loading Uncertainties

Parameter	Percent of TSP Loading Uncertainty	Percent of TSN Loading Uncertainty
Removal: Background Estimate	3	17
Sampling Variability	67	31
[C]:Cl Ratio	4	23
Chloride Load (Cl_L)	22	24
People/Dwelling (DWEL)	1	1
Total Dwellings (HOME)	4	4

Vicinity Map

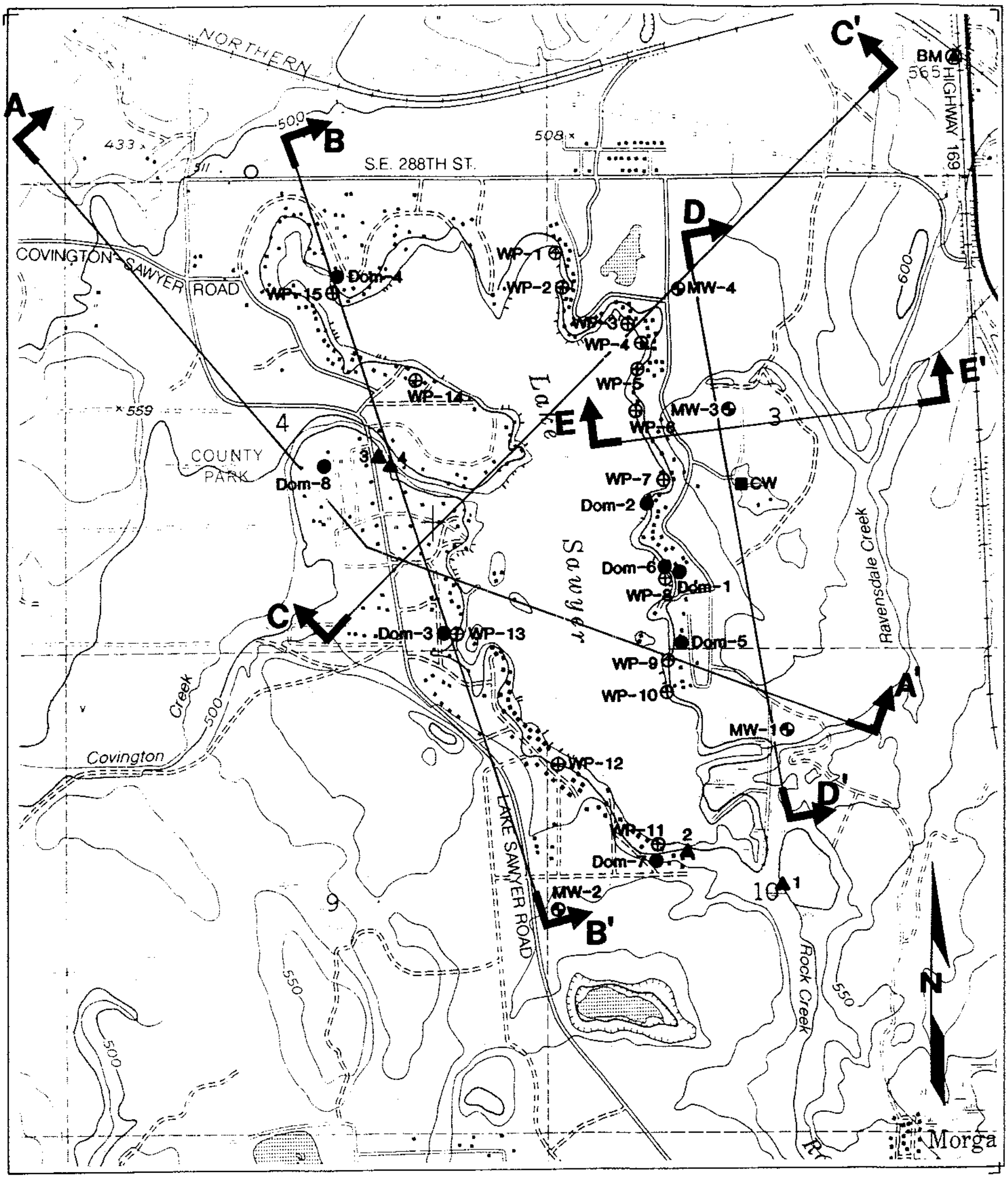


Note: Base map prepared from USGS 7.5-minute quadrangle of Black Diamond, Washington

0 2000 4000
Scale in Feet

HARTCROWSER
J-2484 7/90
Figure 1

Well Location Map



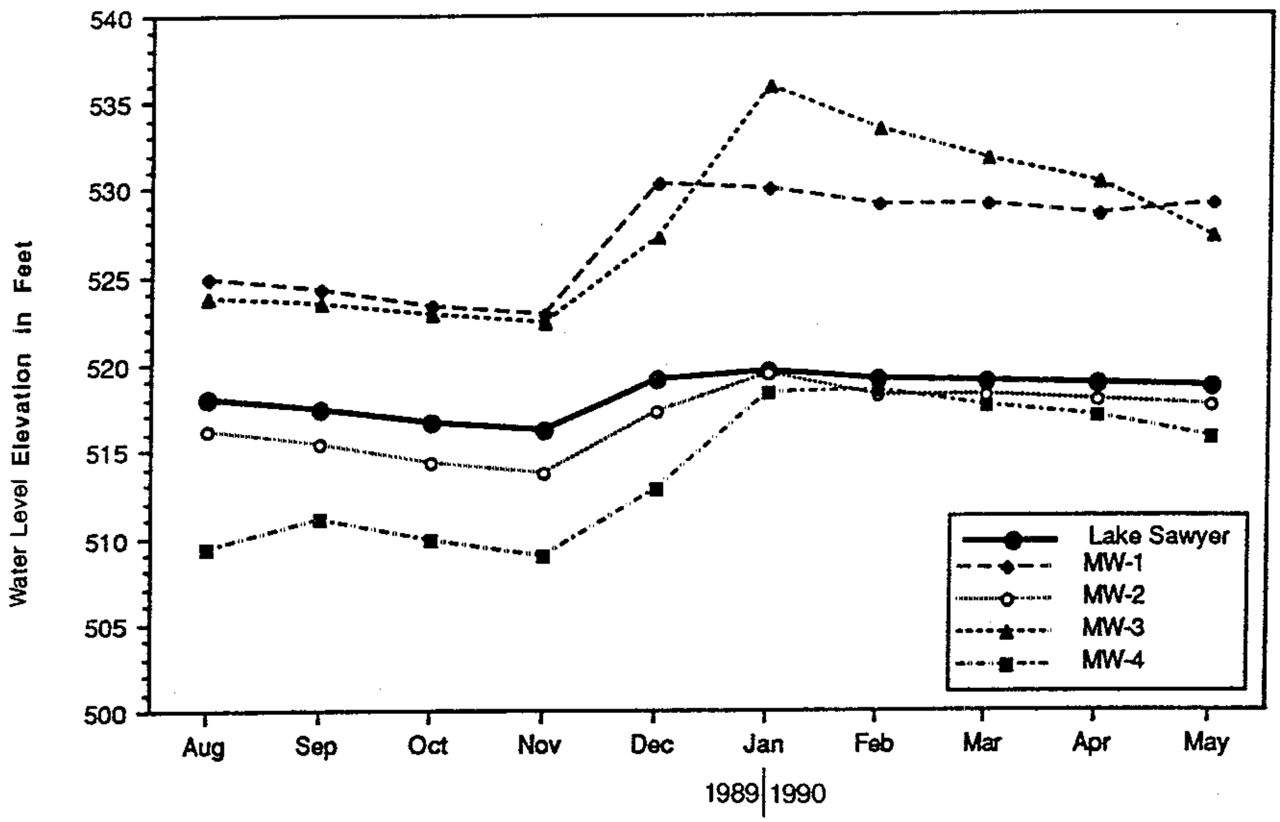
MW-1 Monitoring Well Location and Number
WP-1 Wellpoint Location and Number
▲1 Staff Gage Location and Number
●Dom-1 Domestic Well Location and Number
■ CW Community Well Location
BM Benchmark
○ Kent Springs Well No. 1
A A' Cross Section Location and Designation

Note: Base map prepared from U.S.G.S. 7.5 minute quadrangle of Black Diamond, Washington.

0 1500 3000
Scale in Feet

HARTCROWSER
J-2484 4/90
~~Figure 2~~
Figure 3.1

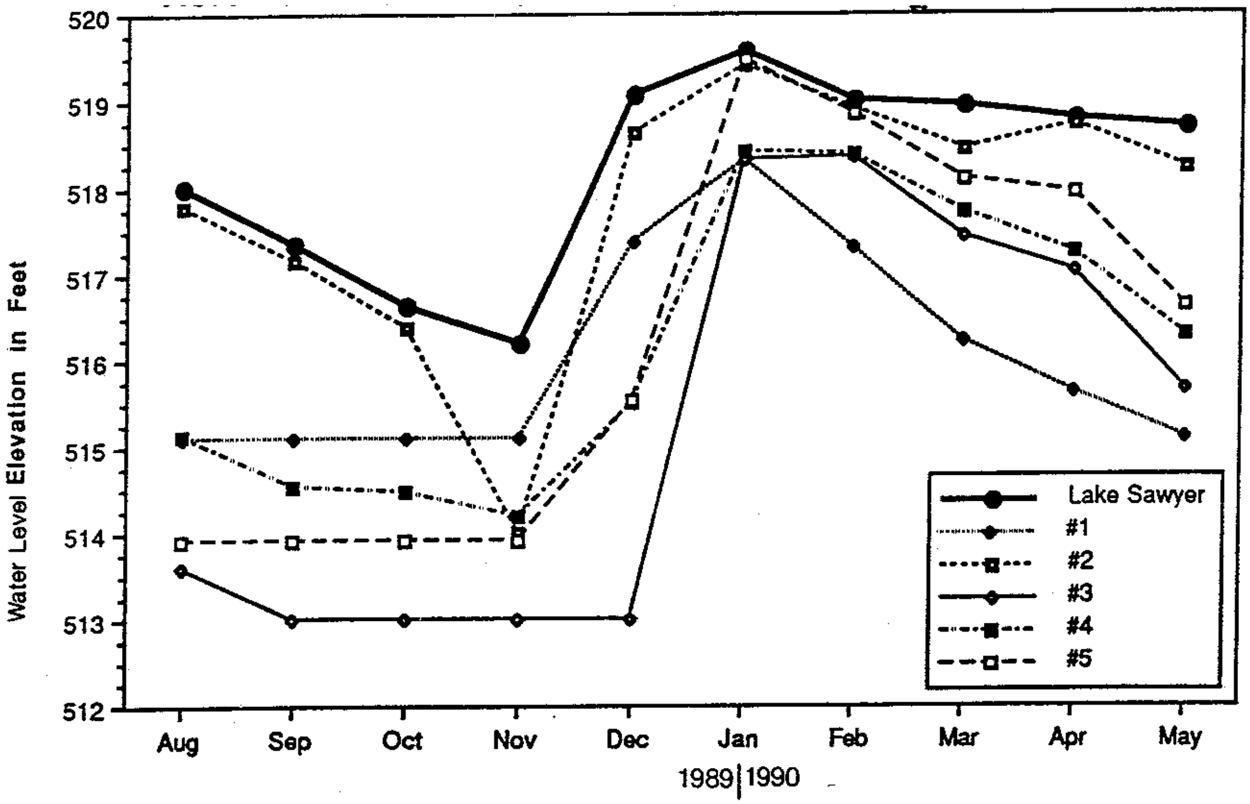
Hydrographs for Monitoring Wells



HARTCROWSER
J-2484 7/90
Figure 3

Hydrographs for Wellpoints #1 through #5

Northeast Side of Lake

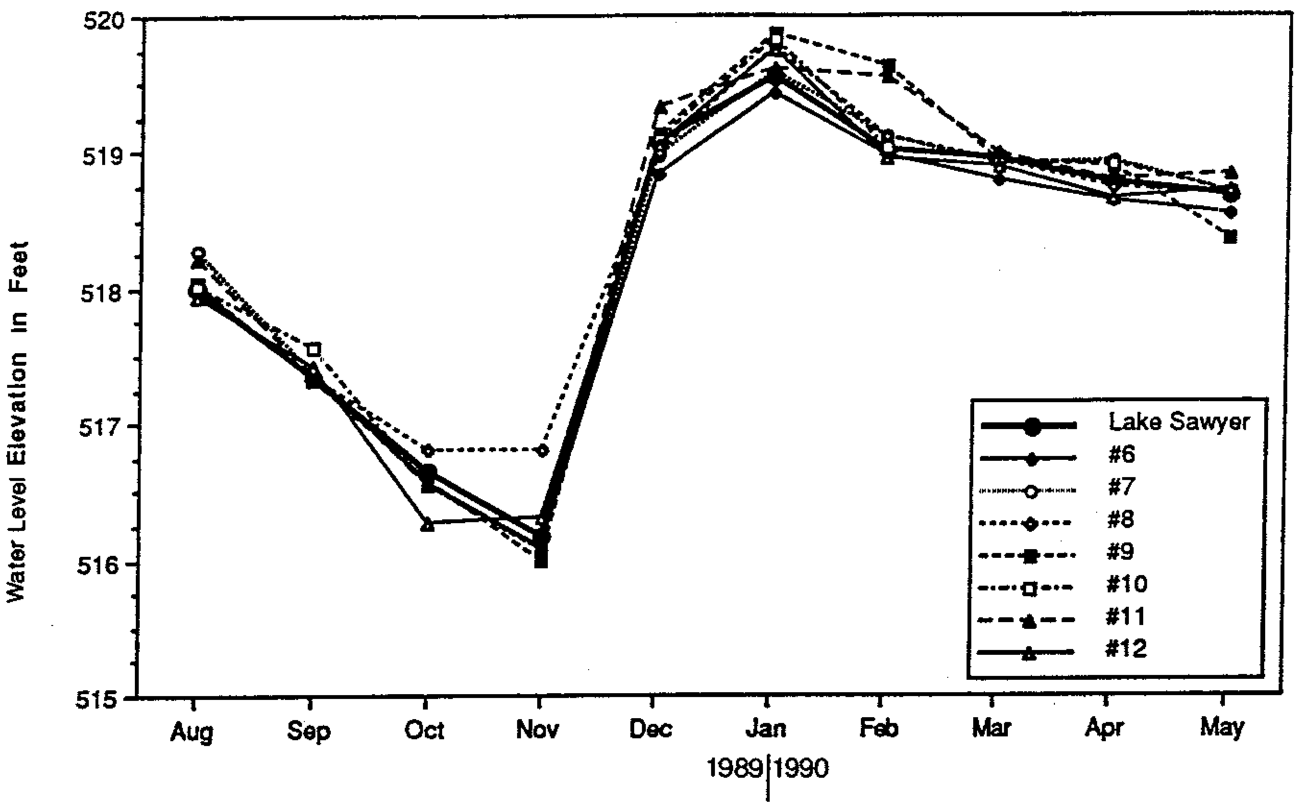


Note: For months when wellpoint was dry, groundwater elevation plotted as elevation of wellpoint bottom. Actual groundwater elevation will be lower than that plotted.

HARTCROWSER
J-2484 *7/90*
Figure 4

Hydrographs for Wellpoints #6 through #12

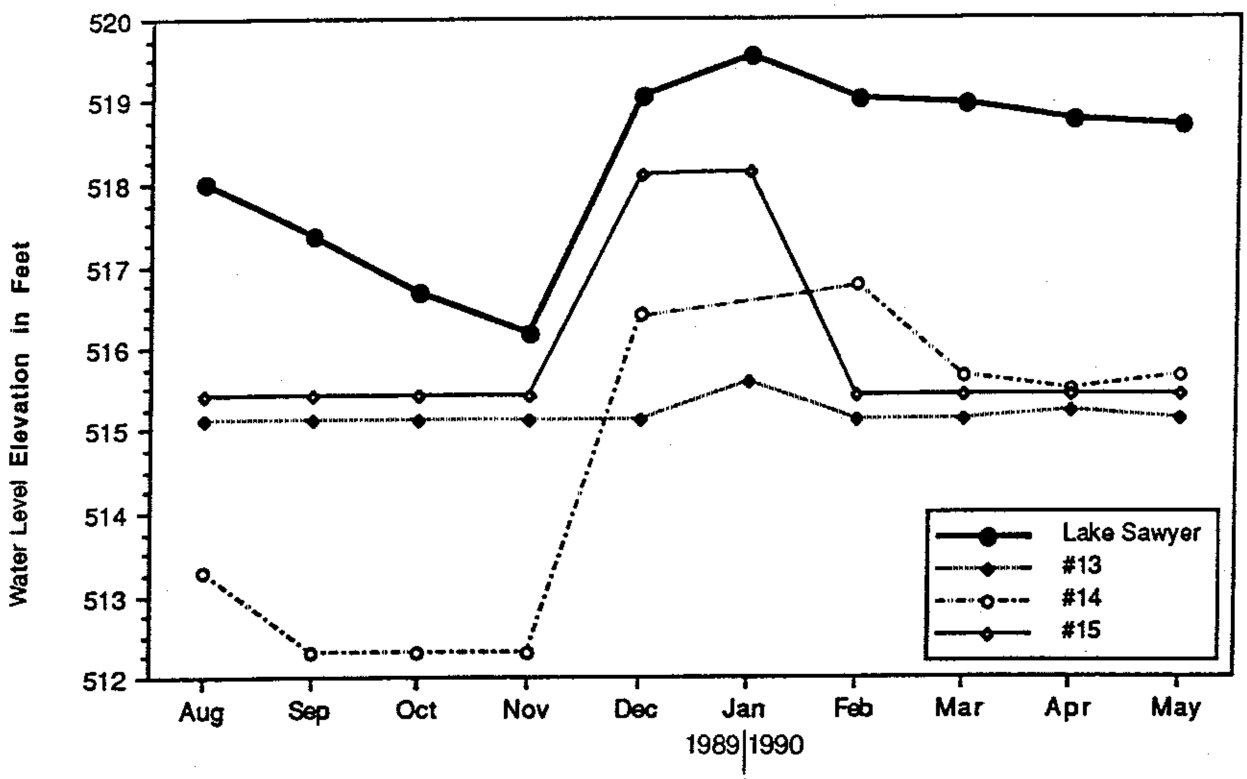
East and South Sides of Lake



Note: For months when wellpoint was dry, groundwater elevation plotted as elevation of wellpoint bottom.
Actual groundwater elevation will be lower than that plotted.

HARTCROWSER
J-2484 *7/90*
Figure 5

Hydrographs for Wellpoints #13 through #15
West Side of Lake

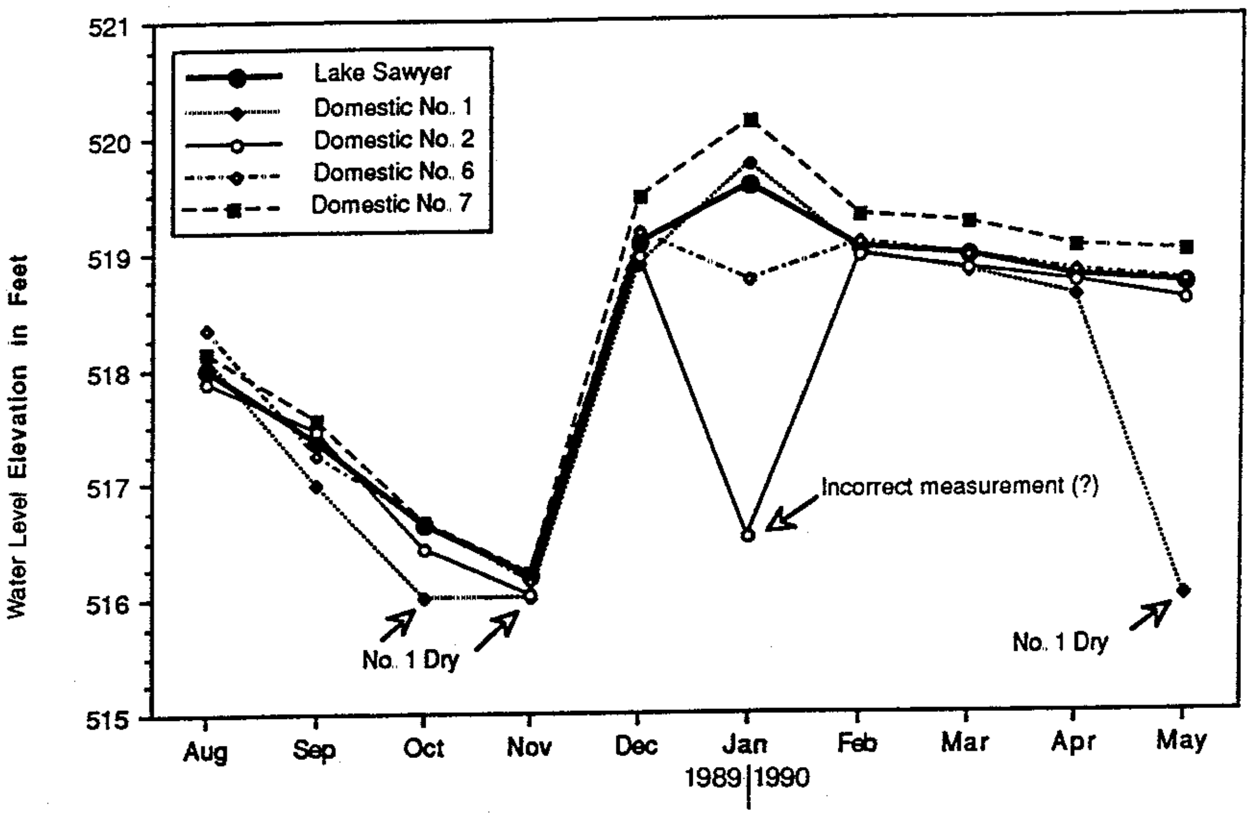


Note: For months when wellpoint was dry, groundwater elevation plotted as elevation of wellpoint bottom. Actual groundwater elevation will be lower than that plotted.

HARTCROWSER
J-2484 7/90
Figure 6

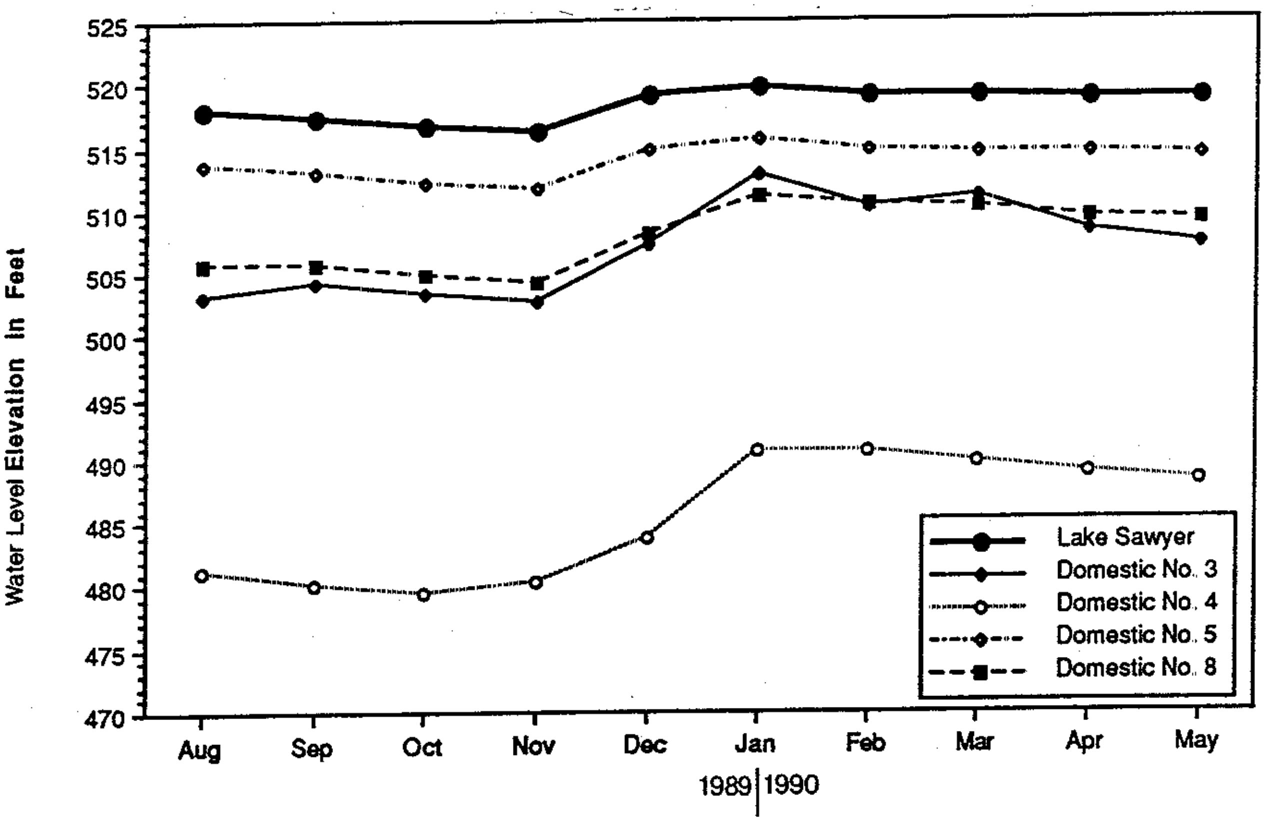
Hydrographs for Selected Domestic Wells

Wells Completed in Qvr



Note: For months when Domestic Well No. 1 was dry, groundwater elevation plotted as elevation of well bottom. Actual groundwater elevation will be lower than that plotted.

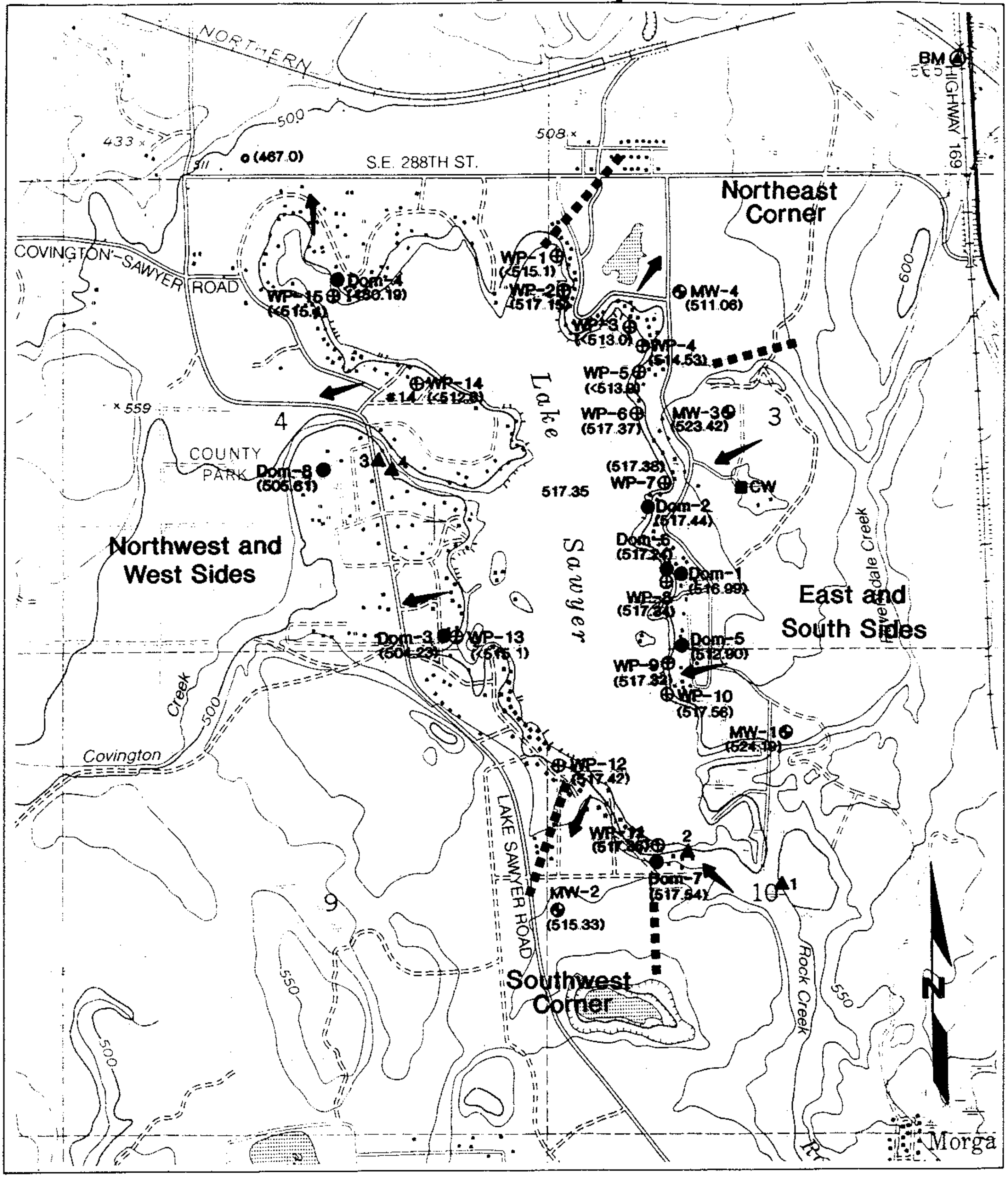
Hydrographs for Selected Domestic Wells
Wells Completed in Qc



Note: It is not known which unit Domestic Well No. 5 is completed in.

HARTCROWSER
J-2484 7/90
Figure 8

Groundwater Elevation Map – September 1989



⊕ MW-1 Monitoring Well Location and Number

⊕ WP-1 Wellpoint Location and Number

▲ 1 Staff Gage Location and Number

● Dom-1 Domestic Well Location and Number

■ CW Community Well Location

BM Benchmark

o Kent Springs Well No. 1

(517.42) Groundwater Elevation in Feet

← Generalized Groundwater Flow Direction

Note: Base map prepared from U.S.G.S. 7.5 minute quadrangle of Black Diamond, Washington

0 1500 3000

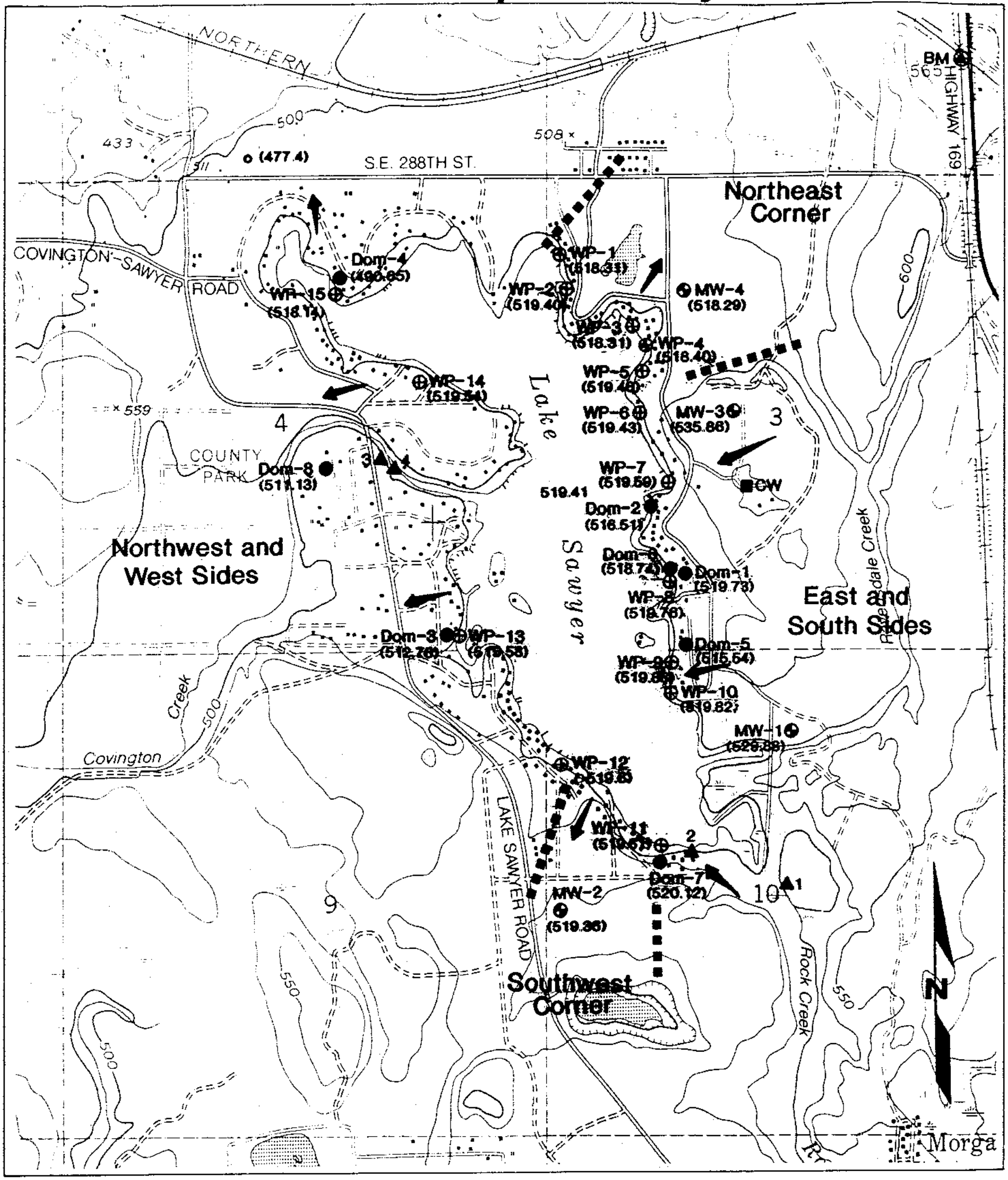
Scale in Feet

HARTCROWSER

J-2484 6/90

Figure 9

Groundwater Elevation Map - January 1990



MW-1 Monitoring Well Location and Number
WP-1 Wellpoint Location and Number
▲ 1 Staff Gage Location and Number
● Dom-1 Domestic Well Location and Number
■ CW Community Well Location
BM Benchmark
o Kent Springs Well No. 1
(519.36) Groundwater Elevation in Feet

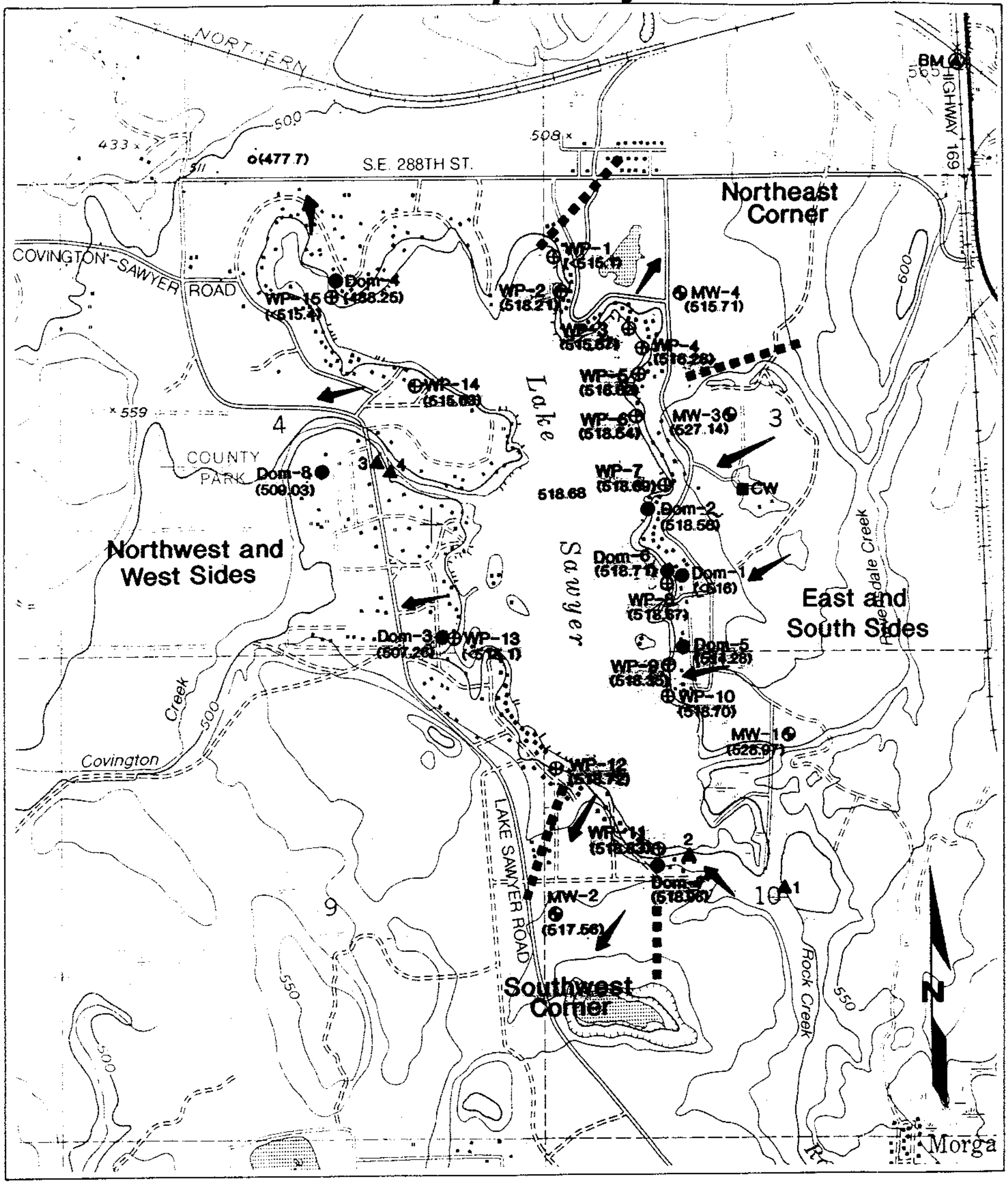
Generalized Groundwater Flow Direction

Note: Base map prepared from U.S.G.S. 7.5 minute quadrangle of Black Diamond, Washington

0 1500 3000
Scale in Feet

HARTCROWSER
J-2484 6/90
Figure 10

Groundwater Elevation Map - May 1990



● MW-1 Monitoring Well Location and Number
⊕ WP-1 Wellpoint Location and Number
▲ 1 Staff Gage Location and Number
● Dom-1 Domestic Well Location and Number
■ CW Community Well Location
Ⓐ BM Benchmark
o Kent Springs Well No. 1
(518.56) Groundwater Elevation in Feet

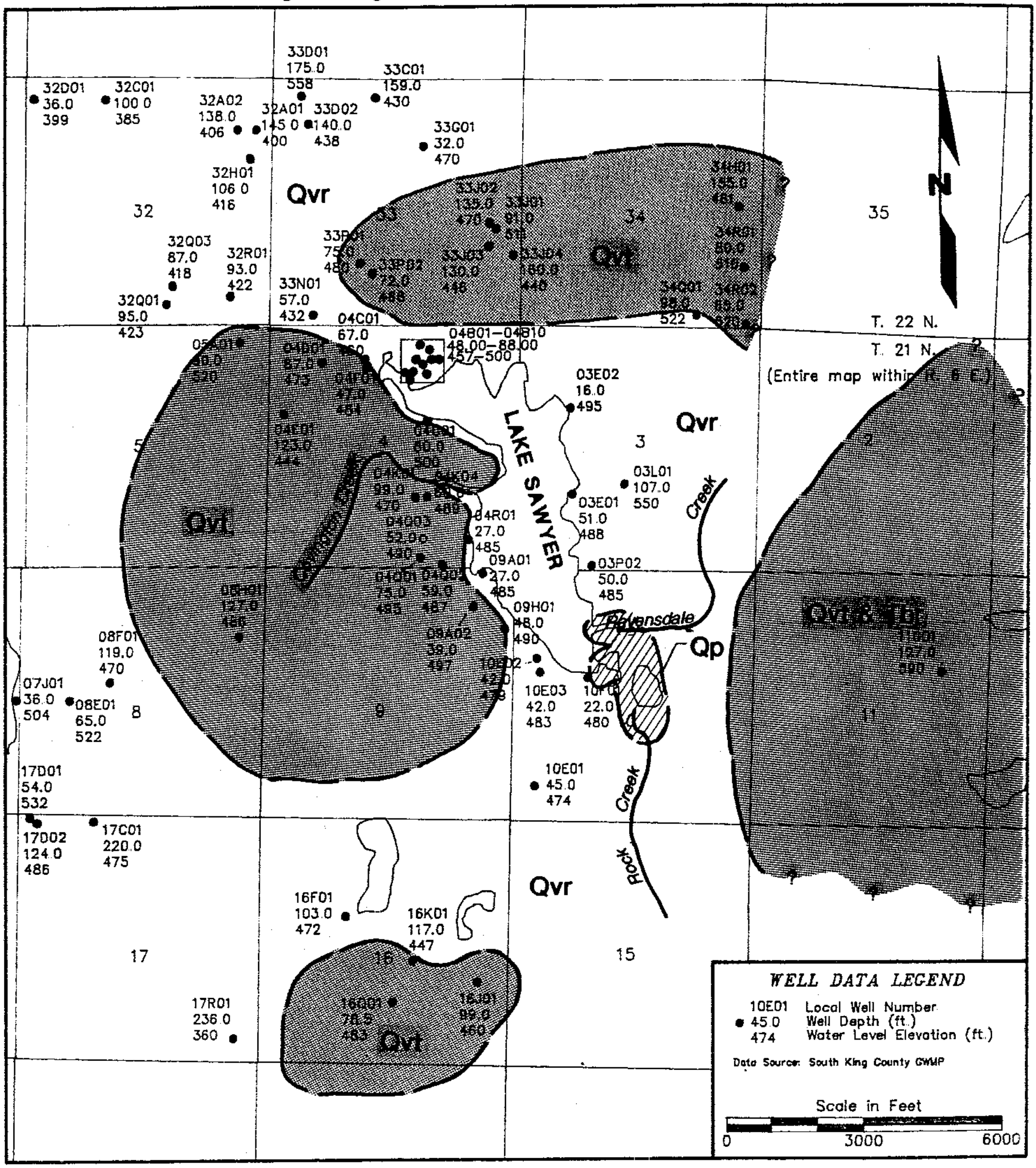
← Generalized Groundwater Flow Direction

Note: Base map prepared from U.S.G.S. 7.5 minute quadrangle of Black Diamond, Washington

0 1500 3000
Scale in Feet

HARTCROWSER
J-2484 6/90
Figure 11

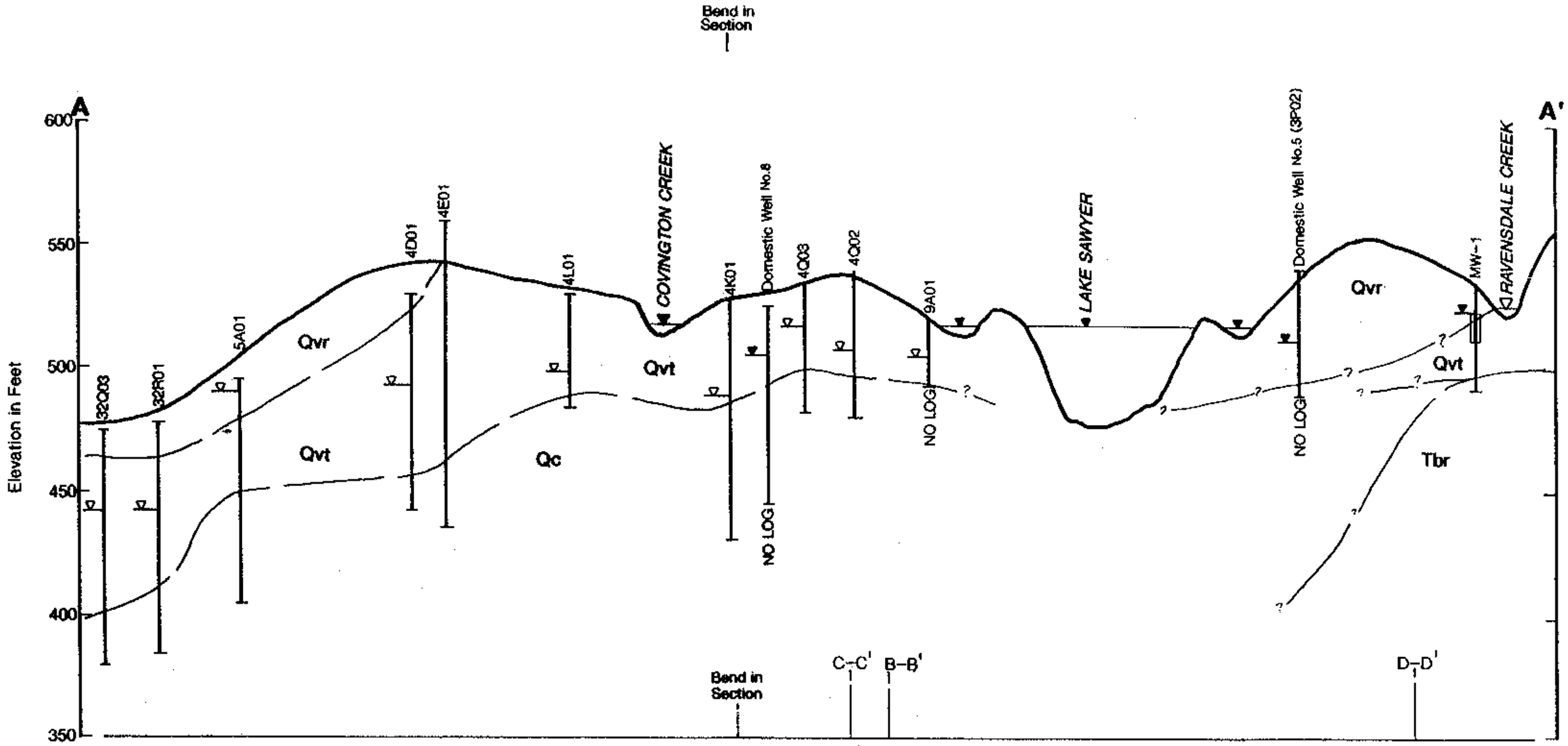
Conceptual Surface Geology and Well Inventory Map



Qp	Peat
Qvr	Vashon Recessional Outwash
Qvt	Vashon Till
Tbr	Tertiary Bedrock

HARTCROWSER
J-2484 8/90
Figure 12

Generalized Geologic Cross Section A–A'



Qvr	Vashon Recessional Outwash
Qvt	Vashon Till
Qc	Pre–Vashon Glacial Deposits
Qi	Undifferentiated Fill and Older Interglacial Deposits
Tbr	Tertiary Bedrock

Notes: 1. Elevation of land surface and of existing domestic wells (without survey control) were increased 20 feet from that indicated on USGS 7.5 minute quadrangle (Black Diamond), which was determined to be incorrect. See text for explanation

2. NO LOG indicates no geologic log available for this well.

9A01 Well Number

Well Location

Water Level with Survey Control (9/89 Measurement)

Water Level At Time of Drilling (From Drillers' Logs)

Screened Section

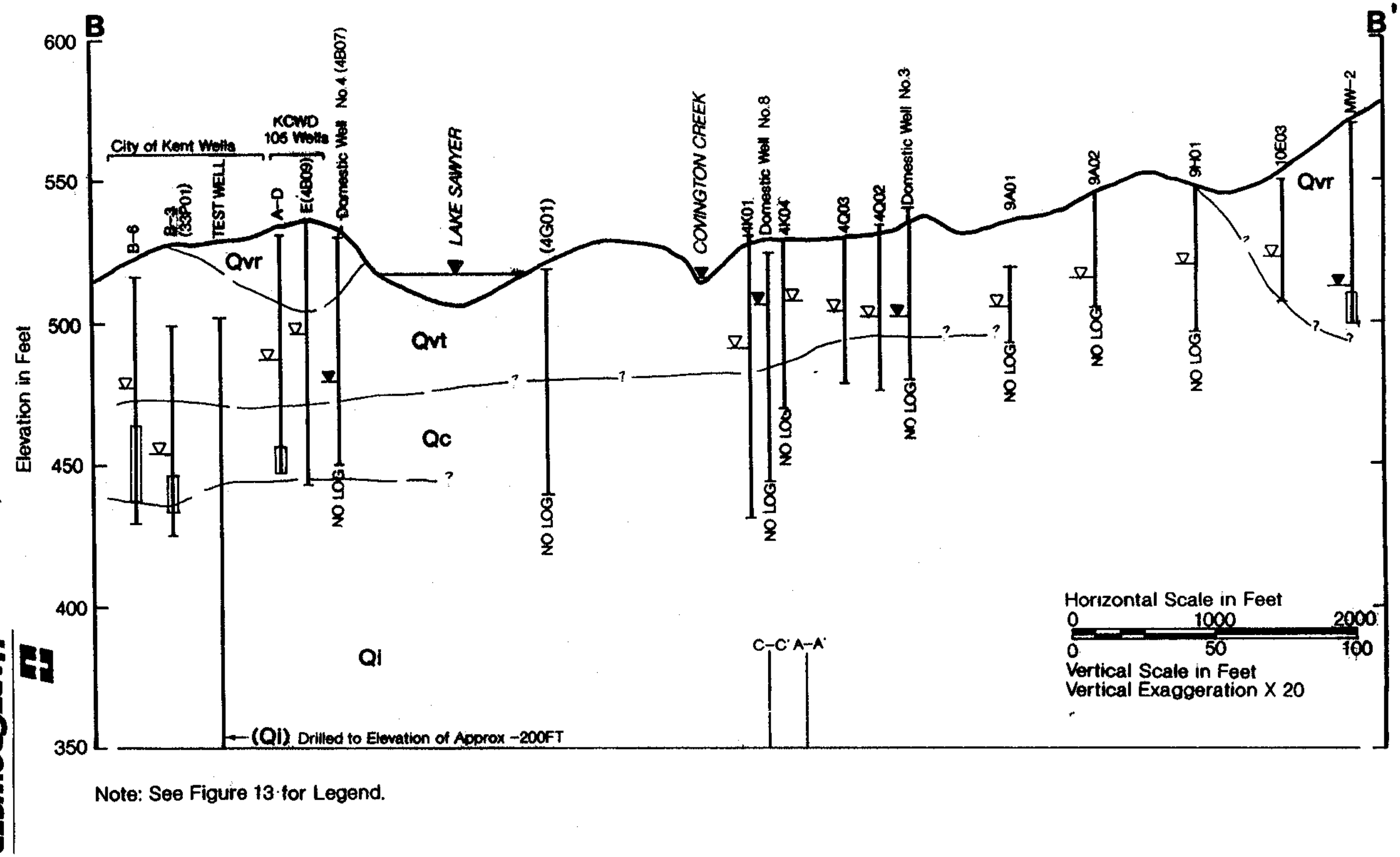
Horizontal Scale in Feet
0 1000 20

0 50 10

Vertical Scale in Feet
Vertical Exaggeration X 20

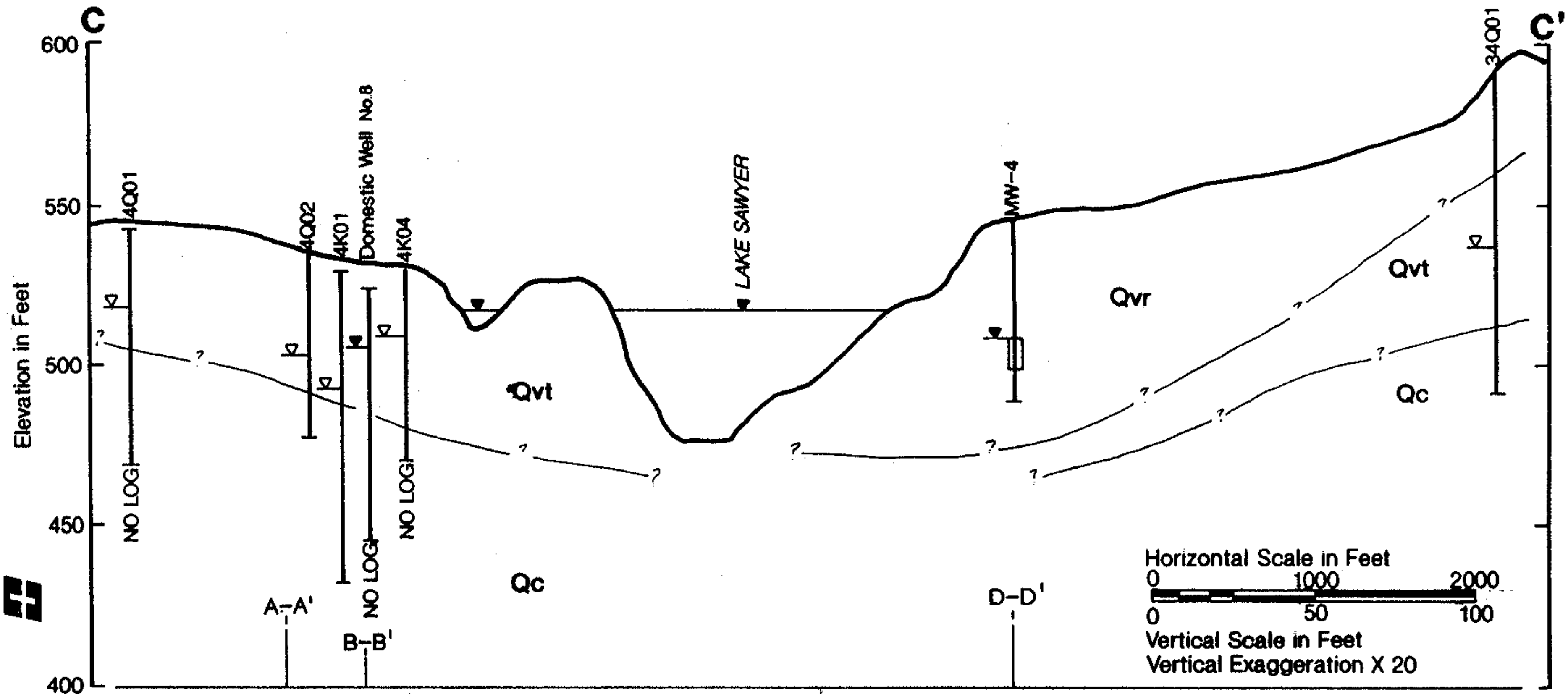
HARTCROWSER
J-2484 6/90
Figure 13

Generalized Geologic Cross Section B–B'



Note: See Figure 13 for Legend.

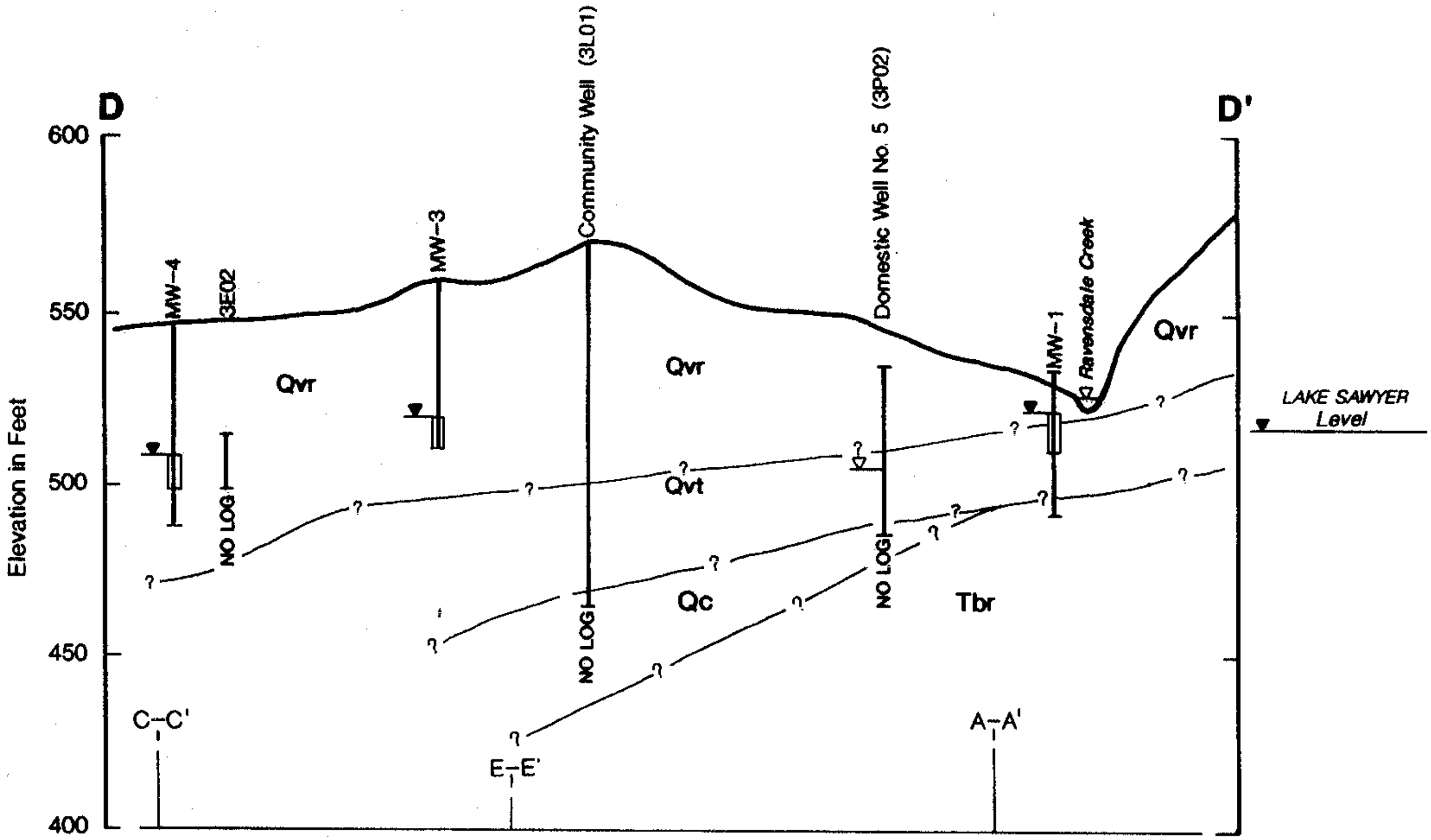
Generalized Geologic Cross Section C–C'



Note: See Figure 13 for Legend.

HARTCROWSER
J-2484 6/90
Figure 15

Generalized Geologic Cross Section D–D'

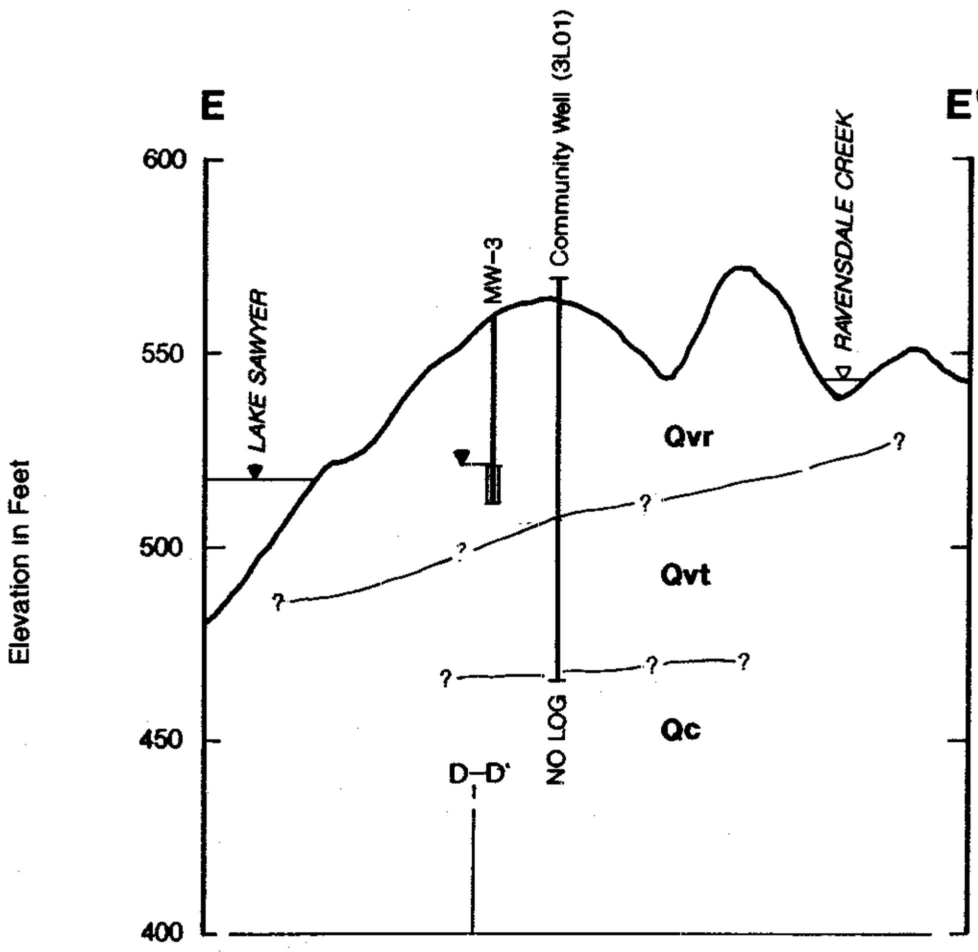


Note: See Figure 13 for legend.

Horizontal Scale in Feet
0 1000 2000
0 50 100
Vertical Scale in Feet
Vertical Exaggeration x 20

HARTCROWSER
J-2484 6/90
Figure 16

Generalized Geologic Cross Section E–E'



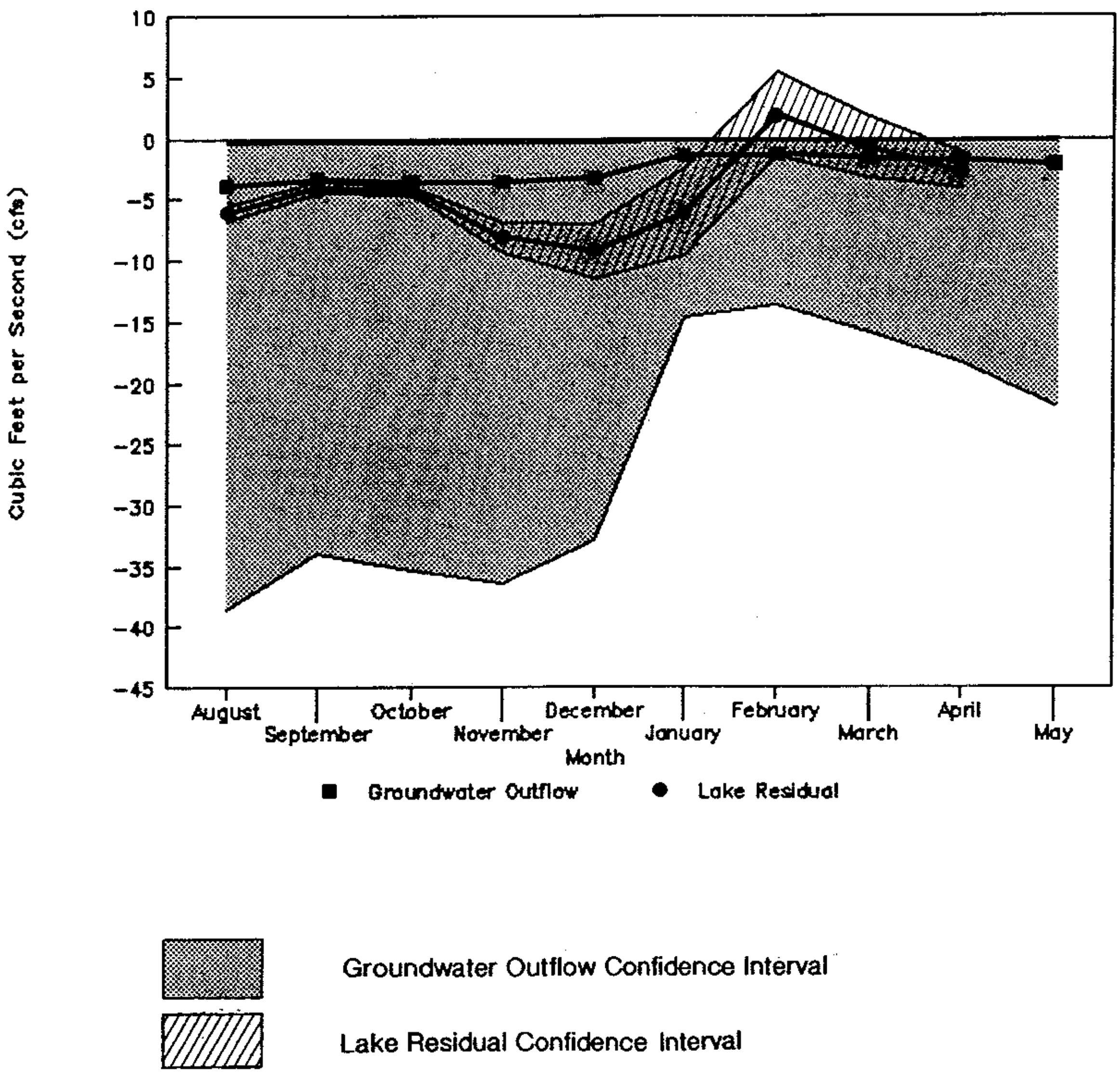
Note: See Figure 13 for legend.

Horizonatal Scale in Feet
0 1000 2000
0 50 100
Vertical Scale in Feet
Vertical Exaggeration x 20

HARTCROWSER
J-2484 6/90
Figure 17

Lake Sawyer Water Budget

Groundwater Outflow/Lake Residual

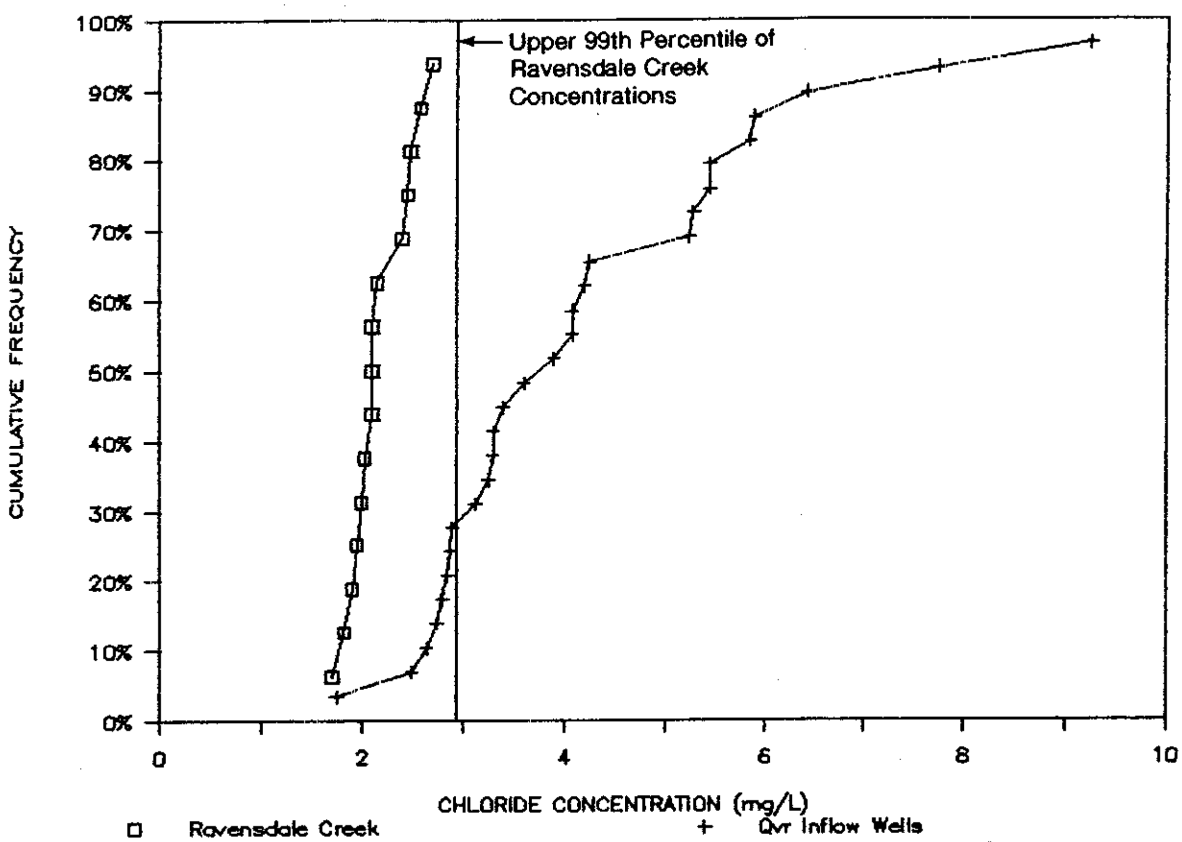


HARTCROWSER

J-2484 8/90

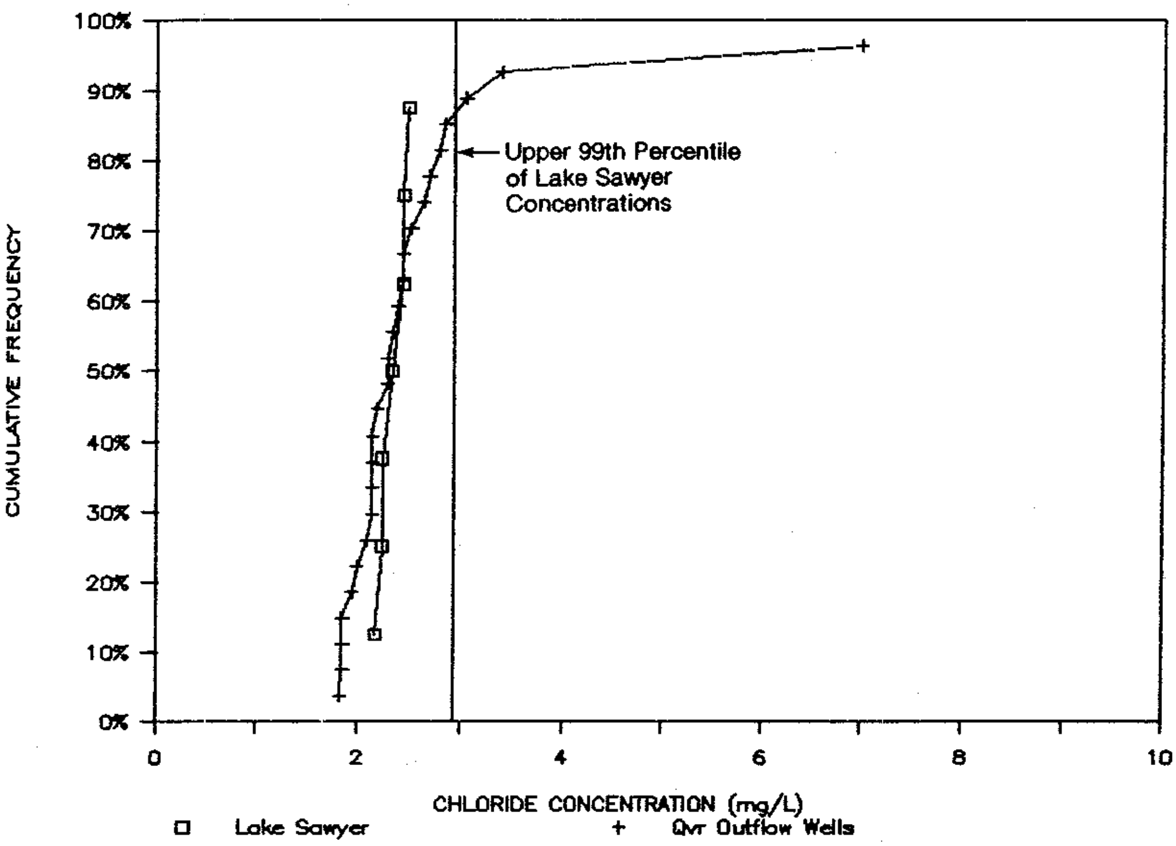
Figure 18

Chloride Frequency Distribution
Lake Inflow – Vashon Outwash Areas



HARTCROWSER
J-2484 7/90
Figure 19

Chloride Frequency Distribution
Lake Outflow - Vashon Outwash Areas



HARTCROWSER
J-2484 7/90
Figure 20

Total Phosphorus Versus Chloride
Black Diamond/Lake Sawyer Wastewater

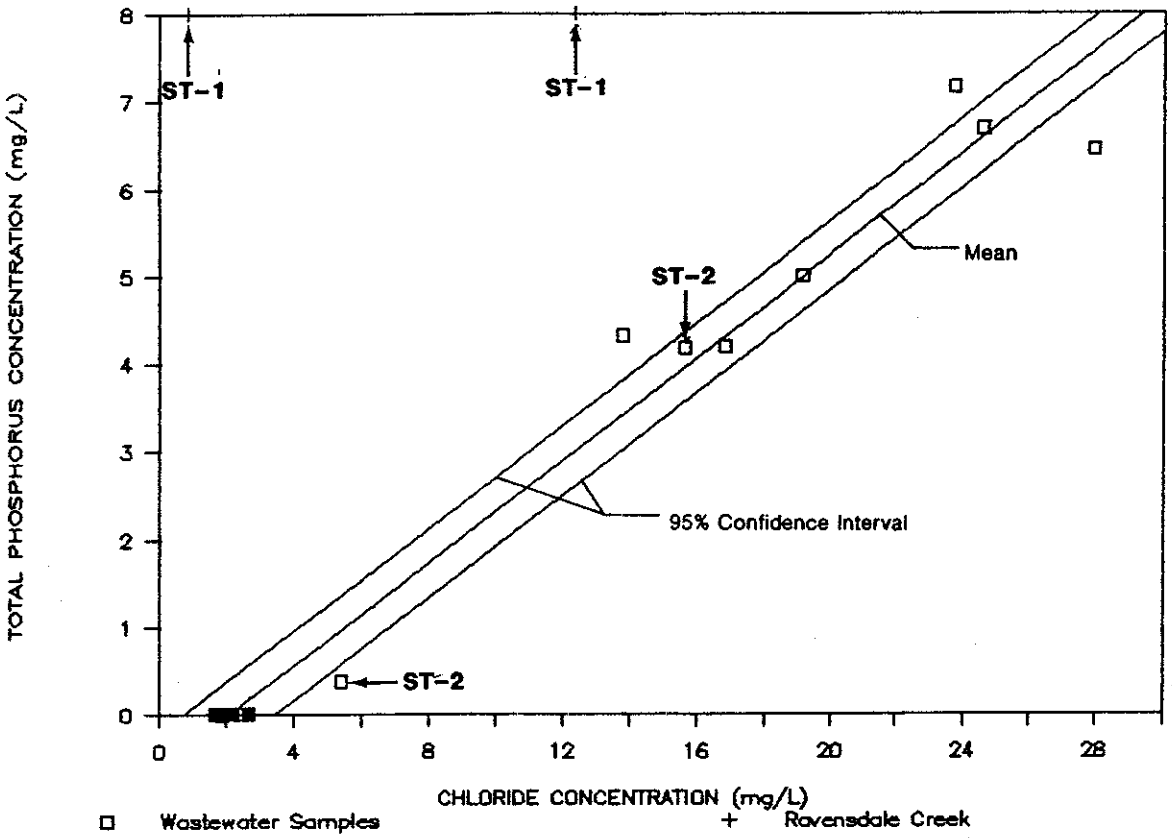


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Figure 21

Total Nitrogen Versus Chloride

Black Diamond/Lake Sawyer Wastewater

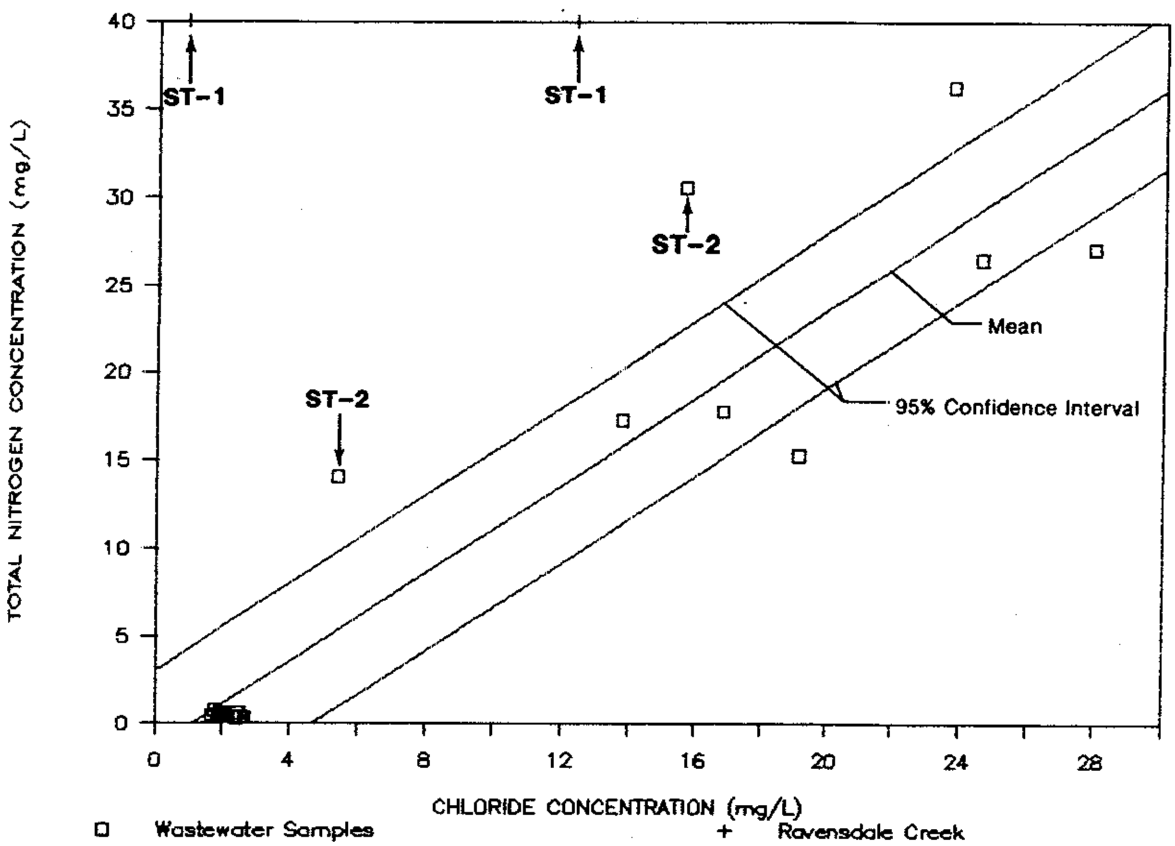

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Figure 22

Total Phosphorus Frequency Distribution

Lake Inflow - Vashon Outwash Areas

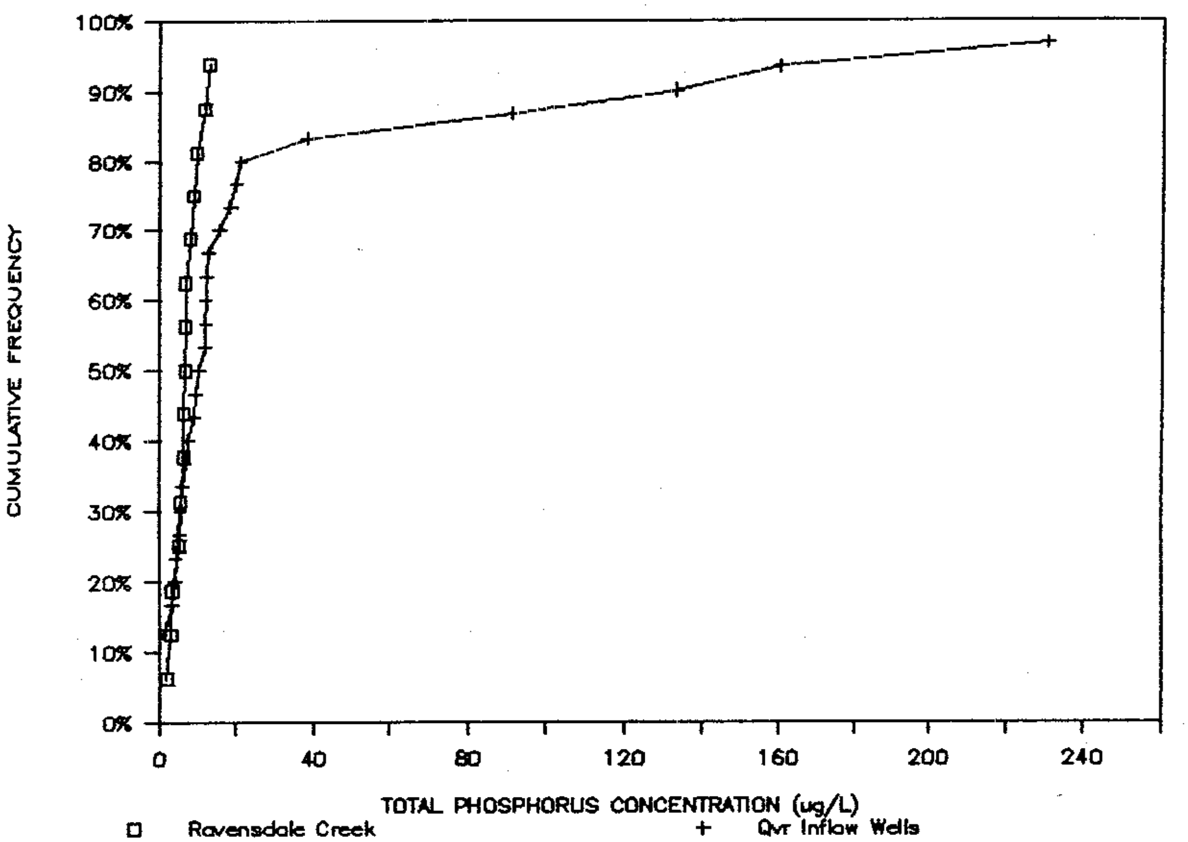

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Figure 23

Total Nitrogen Frequency Distribution

Lake Inflow - Vashon Outwash Areas

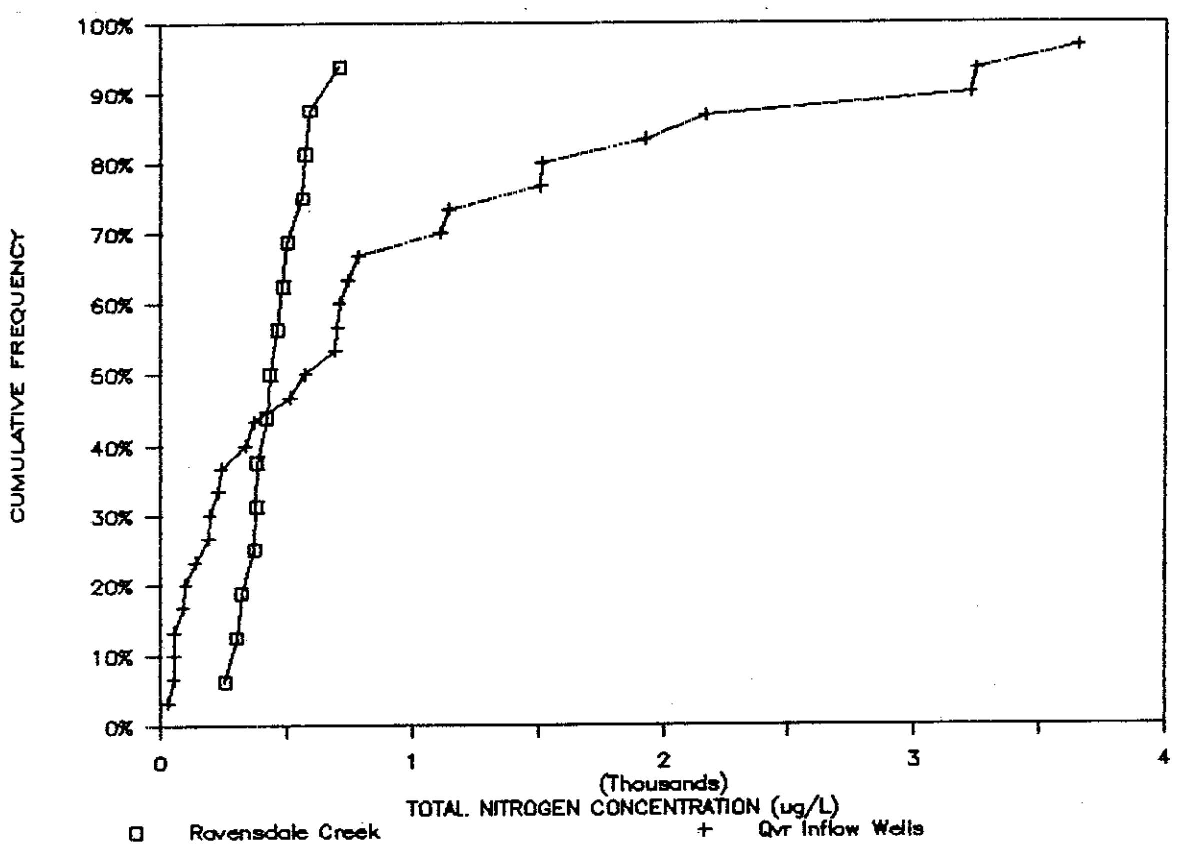

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Figure 24

Phosphorus Removal Frequency
All Wastewater Detection Samples

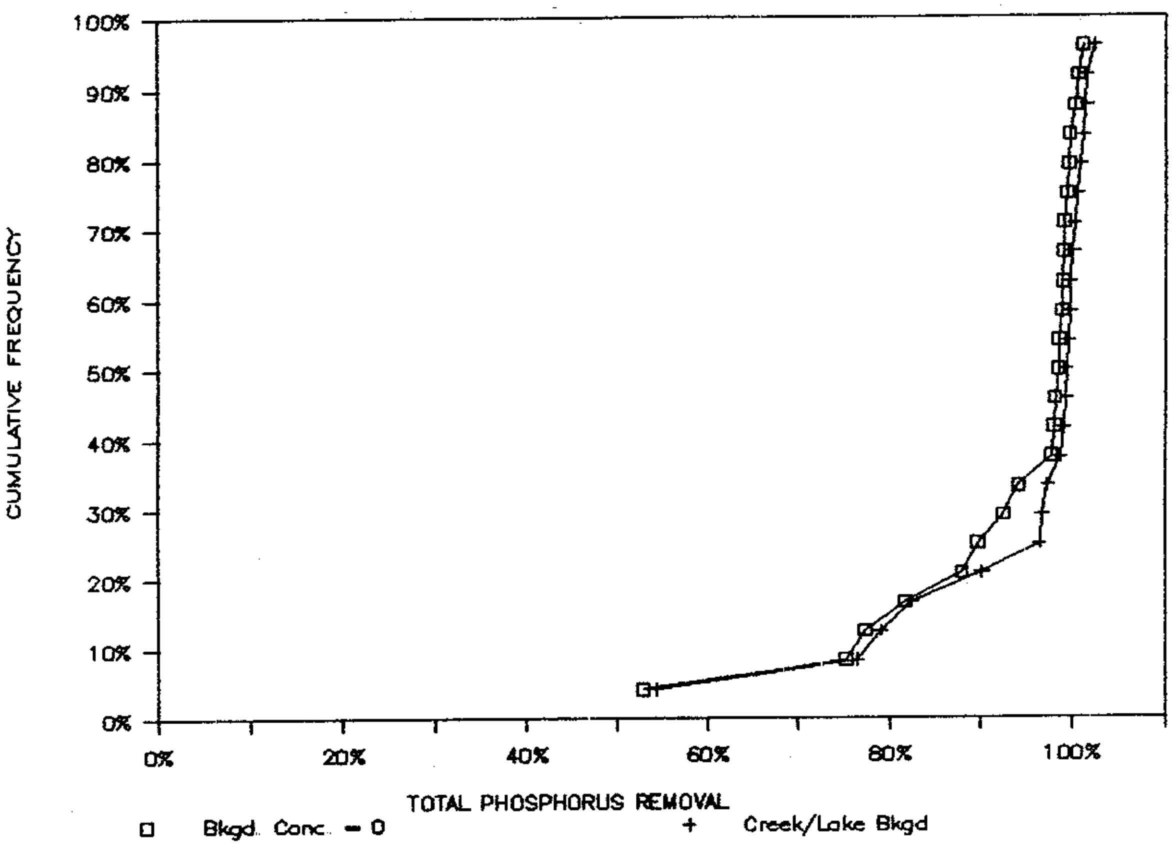

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Figure 25

Nitrogen Removal Frequency
All Wastewater Detection Samples

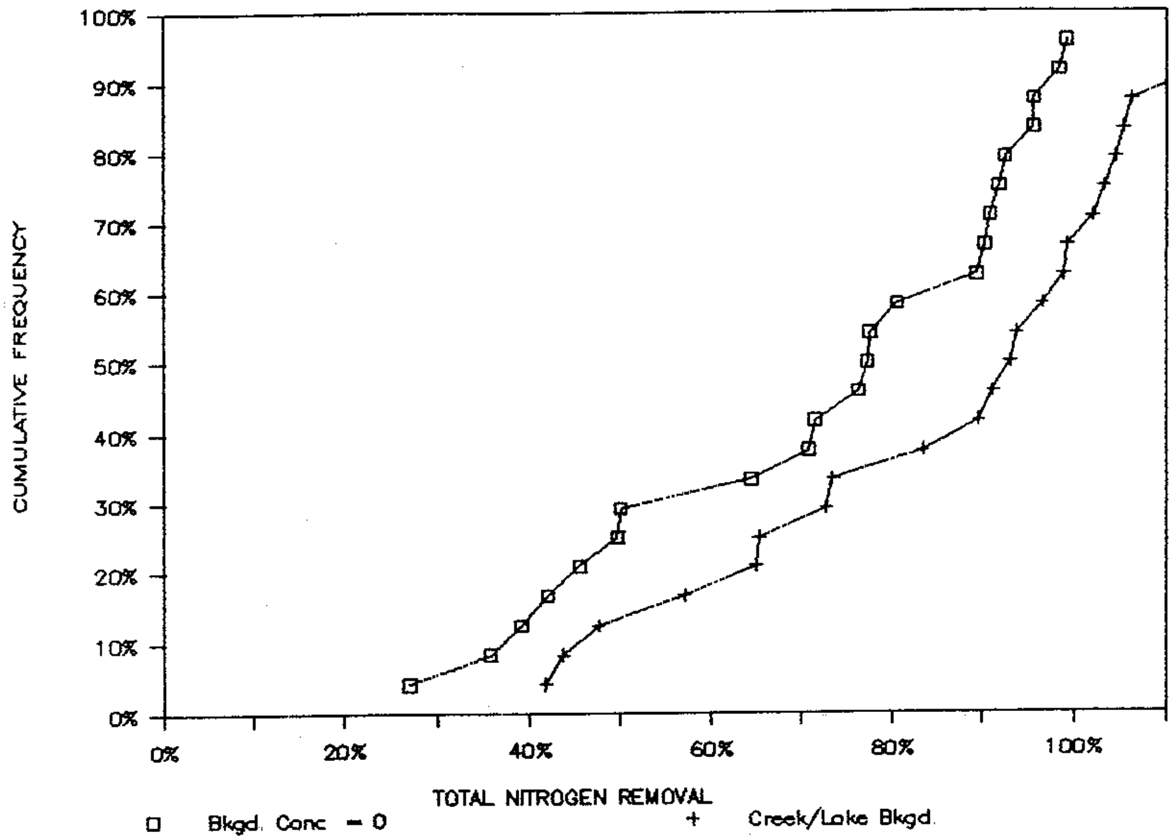

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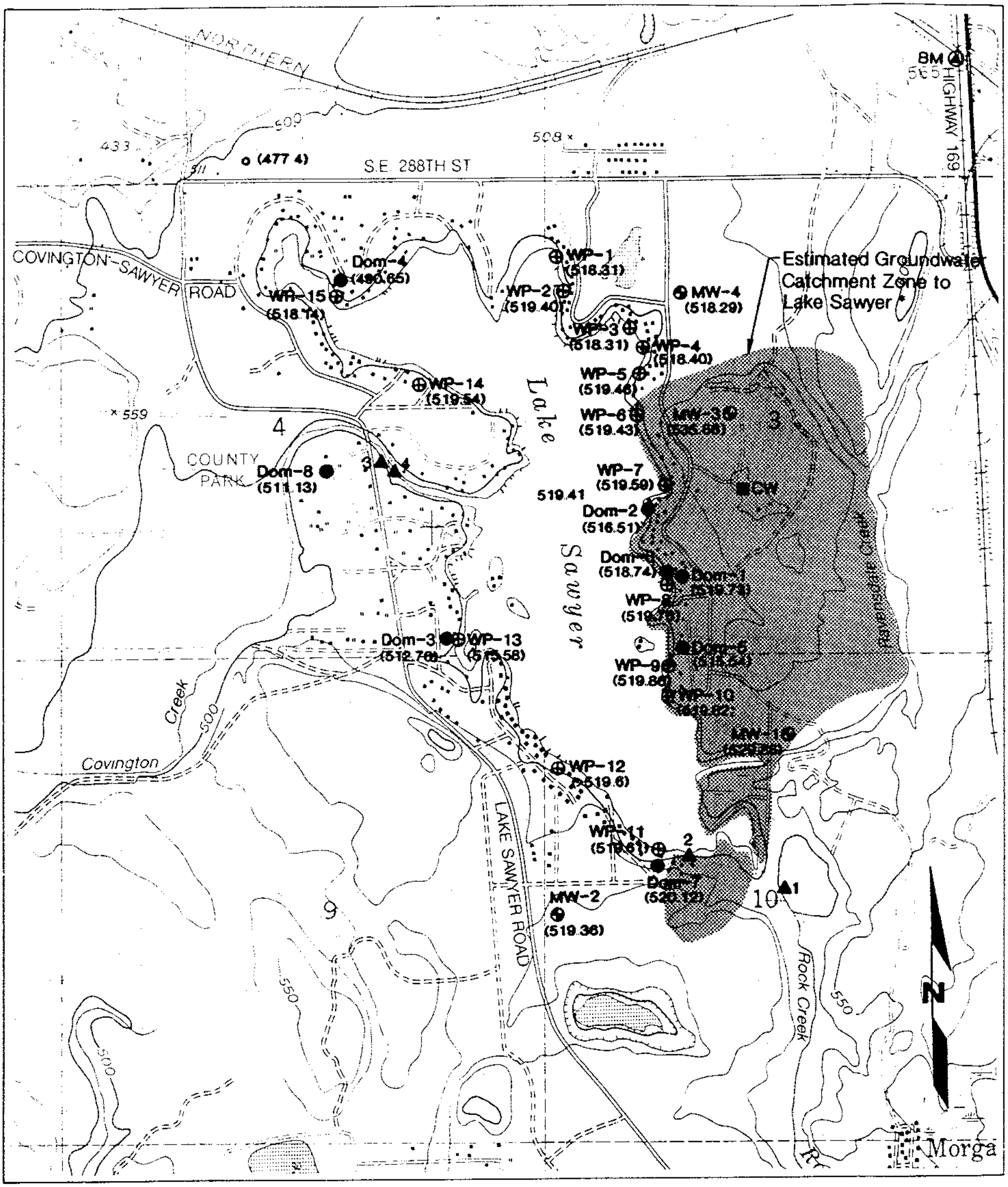
Figure 26

Groundwater Catchment Zone



MW-1 Monitoring Well Location and Number
WP-1 Wellpoint Location and Number
▲ 1 Staff Gage Location and Number
● Dom-1 Domestic Well Location and Number
■ CW Community Well Location
BM Benchmark
o Kent Springs Well No. 1
(517.42) Groundwater Elevation in Feet

Note: Base map prepared from USGS 7.5 minute quadrangle of Black Diamond, Washington.

* Not including area tributary Ravensdale and Rock Creeks

0 1500 3000
Scale in Feet

HARTCROWSER
J-2484 8/90
Figure 27

APPENDIX A
MONITORING WELL AND WELLPOINT INSTALLATION

APPENDIX A
MONITORING WELL AND WELLPOINT INSTALLATION

The field exploration program included the completion of four soil borings/monitoring well installations (MW-1 through MW-4) and fifteen wellpoint installations (no. 1 through no. 15). The drilling of the four monitoring wells was completed between June 21, 1989, and July 7, 1989. The locations of the monitoring wells and wellpoints, as well as domestic wells and staff gages used in the monitoring network, are shown on Figure 2.

Drilling was performed under continuous supervision of a Hart Crowser hydrogeologist, who prepared an exploration log for each boring (Figures A-2 through A-5). The exploration logs represent our interpretation of subsurface stratigraphy compiled from drilling and soil sampling.

Monitoring Well Drilling and Installation Methods

Initially, Hokkaido Drilling and Development, of Puyallup, Washington, mobilized a Mobile B-61 drill rig with 4-inch inside diameter hollow-stem auger for drilling and installing the monitoring wells. However, because of the cobbly subsurface materials around the lake, the auger was unable to be advanced to the desired depths. The hollow-stem auger rig was moved to all four of the proposed monitoring well locations. At each location, refusal was reached within seven feet of ground surface because of the exceptionally dense, cobbly soils.

Following the lack of success with the hollow-stem auger drill rig, Hokkaido Drilling and Development mobilized a cable tool drilling rig to the location of MW-1. The boring at MW-1 was advanced by sequentially drilling the cobbly soil, driving a 6-inch-diameter steel casing into the advancing borehole, and then removing the cuttings with a stop valve bailer. Water was added to the borehole to allow more efficient removal of the soil cuttings. Split-spoon samples could not be collected because the soils were too gravelly to allow sample recovery. Therefore, samples of the soil cuttings were collected at five-foot-depth intervals from the bailer.

Because of the time and expense involved with cable tool drilling, the remaining monitoring wells were installed with an air rotary drill rig. Borings (MW-2 through MW-4) were advanced with a truck-mounted drilling rig using a top drive percussion bit inside of a 6-inch inside diameter threaded steel casing. Following a one- to three-foot advance of the drilled borehole, the steel casing was driven approximately the same distance by means of the drill rig-mounted air hammer. Soil cuttings were removed from the casing by compressed air. The air, forced down the drill pipe, escapes through small ports in the drill bit and lifts the cuttings to the surface, where they are directed through a discharge hose. Because the subsurface soils were generally too gravelly for split-spoon samples to be collected, soil samples were collected from the air-lifted drill cuttings at approximately 5-foot-depth intervals.

Soil Descriptions

Soil samples were visually classified in the field in general accordance with the system presented on Figure A-1. The geologic logs are presented on Figures A-2 through A-5. The soil descriptions include the following properties: relative density of sands and gravels/ consistency of silts and clays, moisture, color, minor constituents, and major constituents. For both the cable tool and air rotary soil borings, relative density was determined principally from drill action and the relative ease with which the steel casing could be driven.

Monitoring Well Installation

We completed each of the four soil borings as 2-inch-diameter monitoring wells. The monitoring well construction methods were in accordance with WAC 173-160 and consistent in all four monitoring wells, regardless of the method of drilling. The wells are constructed of Schedule 40 PVC with 10-foot sections of 0.02-inch slotted screen. The monitoring wells were installed by lowering the bottom of the PVC casing to the selected depth within the cased hole. Silica sand (Colorado 10-20) was used to backfill the annulus around the screen to a level two to four feet above the top of the screen. The purpose of the sand pack is to prevent fine-grained materials from reaching and clogging the well screen. An annular seal of either bentonite chips or bentonite slurry was placed above the sand pack to a level two to three feet below ground. All wells have a concrete surface seal and are protected by a locking steel monument. The well construction details are also presented on Figures A-2 through A-5.

Monitoring Well Development

We developed the four deep monitoring wells on July 25, 1989. The wells were developed to remove fine-grained material from the well bottom and clear material from the well screen, thus improving the well's hydraulic connection with the formation. During development, we attempted to purge approximately 15 to 20 casing volumes from the well using a stainless steel bailer. MW-1 was bailed dry after approximately 16 casing volumes and subsequently recovered slowly.

Wellpoint Installation

Fifteen wellpoints, designated no. 1 through no. 15, were installed in the presumed downgradient location of the septic drainfield on each property. Once the property owner's permission was obtained for installation, the specific location of the wellpoint on the property was determined primarily by the location of the septic system drainfield. At four locations the results of chloride measurements taken in the groundwater at various locations along the property shoreline were also used to help place the wellpoints. These measurements were obtained in an attempt to delineate a chloride plume from the septic system. At these locations, a 1/2-inch-diameter, perforated hollow steel pipe was driven into the ground until groundwater was hit. Measurements were taken at each of these temporary locations by lowering a chloride probe into the perforated hollow pipe.

The wellpoints consist of a 3-foot section of 1-1/8-inch-diameter stainless steel 60 mesh screen, or 20-slot PVC screen within a steel point, attached to a 3-foot length(s) of 1-1/8-inch-diameter blank steel pipe with a threaded steel couple. To start the wellpoint installation, a post hole digger was used to dig a hole approximately two feet deep. The wellpoint was then driven with a drive hammer to a depth at which water rose to approximately 2 to 3 feet within the wellpoint, or until refusal. A 1- to 2-foot seal of bentonite chips, overlain by cement was then placed into the hole around the wellpoint. The wellpoint is protected by a locking PVC well cap.

Key to Exploration Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

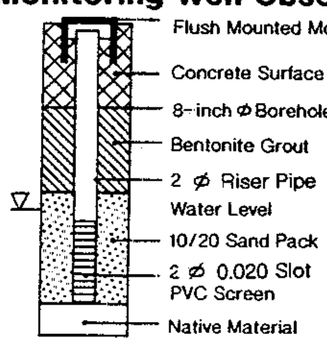
Legends

Sampling

BORING SAMPLES

- ☒ Split Spoon
- ⧅ Shelby Tube
- ▥ Cuttings
- * No Sample Recovery
- P Tube Pushed, Not Driven

Monitoring Well Observations



Test Symbols

GS	Grain Size Classification
CN	Consolidation
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits

Water Content in Percent
- Liquid Limit
- Natural
- Plastic Limit

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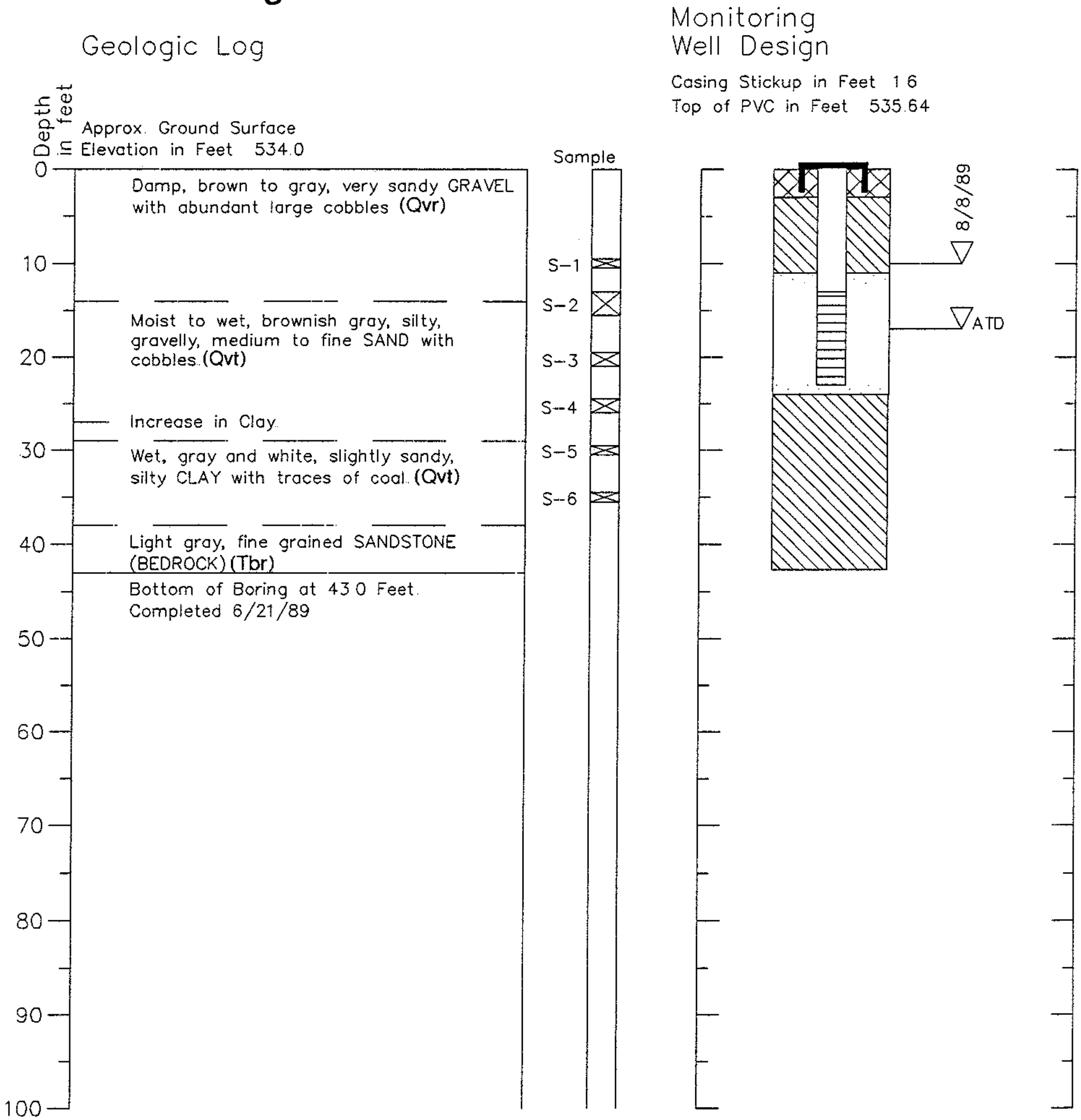
Figure A-1

Boring Log and Construction Data for Monitoring Well MW-1



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. All elevations based on record elevation of 564.684 feet at USCGS benchmark No. Z253

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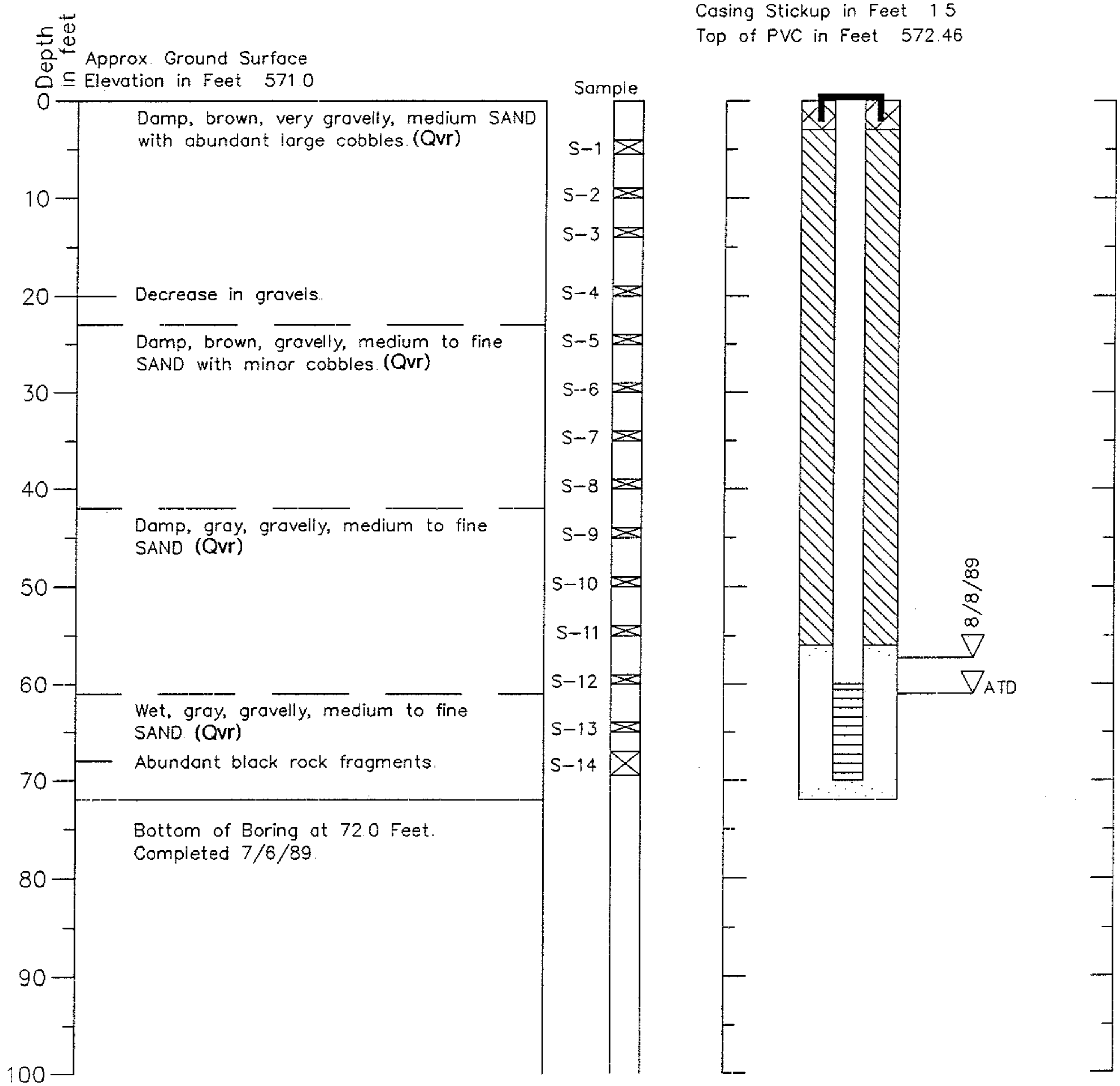
Figure A-2

Boring Log and Construction Data for Monitoring Well MW-2

Geologic Log

Monitoring Well Design

Casing Stickup in Feet 1.5
Top of PVC in Feet 572.46



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. All Elevations based on record elevation of 564.684 feet at USCGS benchmark No. Z253.

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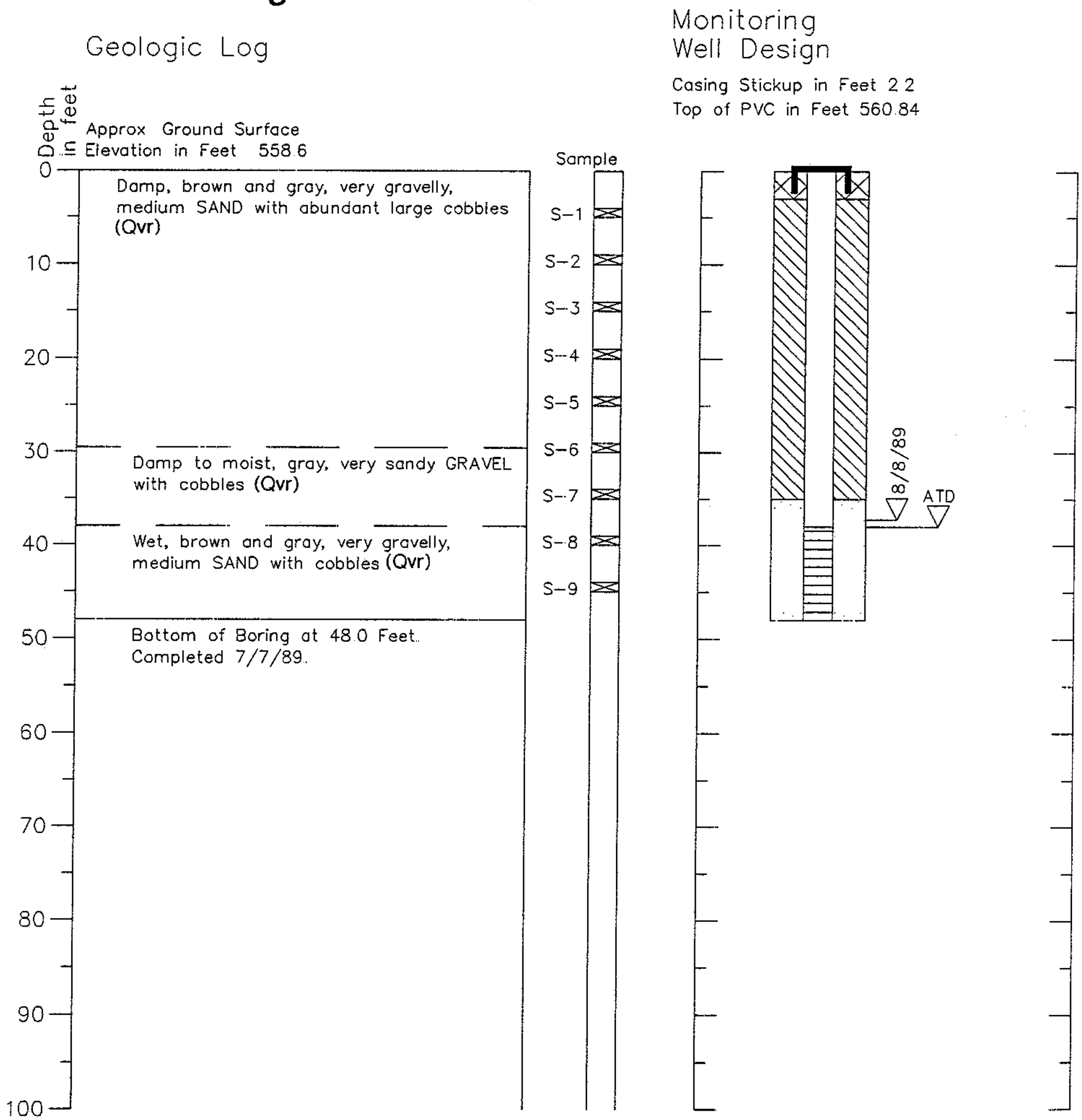
Figure A-3

Boring Log and Construction Data for Monitoring Well MW-3



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. All elevations based on record elevation of 564.684 feet at USCGS benchmark No. Z253.

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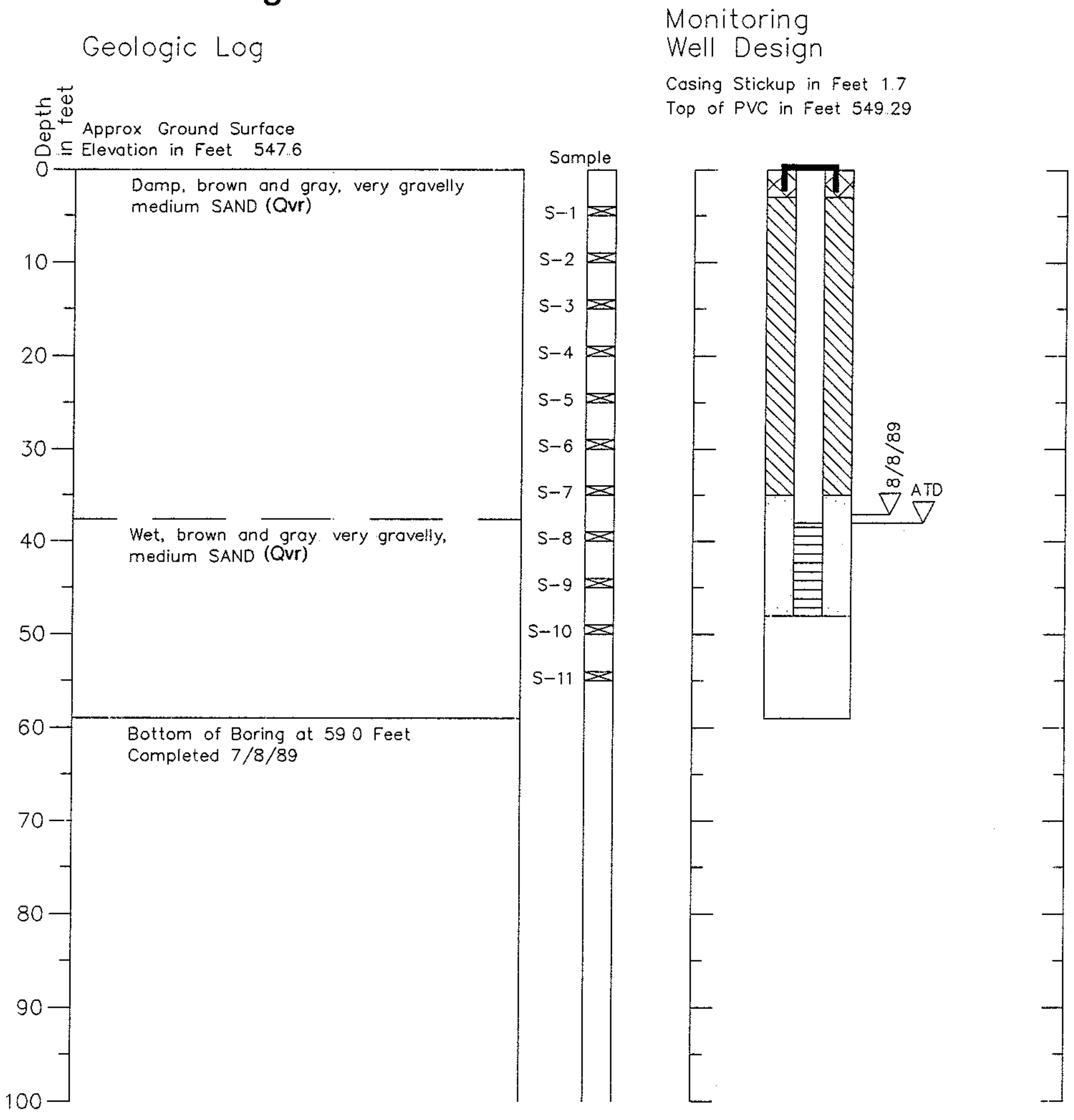
Figure A-4

Boring Log and Construction Data for Monitoring Well MW-4



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. All elevations based on record elevation of 564.684 feet at USCGS benchmark No Z253.

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J-2484 **7/89**

Figure A-5

APPENDIX B
GROUNDWATER SAMPLING

APPENDIX B
GROUNDWATER SAMPLING

This appendix presents the "Groundwater Sampling Plan for the Lake Sawyer Hydrogeologic Study" and the raw laboratory analytical data generated during the study.

GROUNDWATER SAMPLING PLAN

FOR

LAKE SAWYER HYDROGEOLOGIC STUDY

1. Introduction

The following plan details the sampling locations, analytical parameters, sampling frequency, and methodology to be used when sampling the monitoring wells and wellpoints for the Lake Sawyer Hydrogeologic Study. For a period of one year, quarterly groundwater samples and water level data will be collected from 4 background monitoring wells and 15 wellpoints located along the Lake Sawyer shoreline. Additionally, water levels will be obtained from approximately 6 to 8 domestic water wells and 4 staff gages situated around the lake.

2. Purpose

The purpose of the sampling program at the Lake Sawyer site is to assess the amount/concentration of leachate from individual septic systems which reaches Lake Sawyer. Additionally, the water level measurements will be used to define groundwater flow characteristics within the area. Samples from the 4 deep monitoring wells will be used for determination of regional background water quality conditions, for comparison with the samples from the wellpoints. The wellpoints were placed in an attempt to intercept leachate plumes emanating from individual septic systems.

The purpose of this sampling plan is to provide procedural guidance for field sampling and data collection. Tentatively, groundwater samples and water level data will be collected in August and November of 1989, and February and May of 1990.

During the November and May sampling rounds an as yet undetermined number of septic systems will also be sampled

3. Data Collection

During each sampling round there will be 3 categories of wells from which data will be collected. Groundwater quality samples and water level data will be obtained from the 4 monitoring wells and the 15 wellpoints. Concurrently with the wellpoints and monitoring wells, the water levels in several domestic wells will be determined.

4. Equipment

Groundwater will be withdrawn from the four monitoring wells with a stainless steel bailer, and braided nylon or polypropylene rope with monofilament "leaders". Groundwater will be removed from the wellpoints with a teflon bailer and/or a peristaltic pump. Additional equipment requirements include an electric well sounder, an engineer's rule, and a graduated plastic bucket for measurement of extracted well water.

Equipment used for the measurement of field parameters will be calibrated at least twice during each sampling round in accordance with the manufacturer's instructions. This equipment includes a pH meter, a specific conductance meter, dissolved oxygen (D.O.) meter, and a thermometer. A cooler packed with "blue ice" will be used to maintain the samples at approximately 4°C prior to delivery to the analytical laboratory.

5. Groundwater Sampling

The following operations will be performed at each of the monitoring wells/wellpoints:

1. Label sample containers before sampling, checking that the appropriate bottles were supplied by the laboratory. Note any significant observations for each location in the Field Notes.

2. Measure and record (to the nearest 0.01 feet) the static water level in the well with a clean electric tape to the mark on the top of the PVC casing. Record level on groundwater sampling data form. This methodology will also be used at the domestic wells monitored for water levels.

3. Purge well until at least 3 well volumes of groundwater are removed or the well pumps dry, using either a bailer or peristaltic pump. (During the first (August 1989) sampling round additional volumes of water will be removed from the wellpoints in an attempt to obtain a relatively sediment free sample.) Record purge volumes on groundwater sampling data form. Dispose of purged water away from wellhead.

4. Using either a peristaltic pump or bailer, remove water from well cautiously to minimize turbulence and prevent sediment from getting into the sample. Tubing will be dedicated for each wellpoint for use with the peristaltic pump. Four (4) bailers for the monitoring wells will be decontaminated prior to going into the field, and dedicated for the particular monitoring well during that sampling round.

5. If the peristaltic pump is used to remove groundwater, a 0.45 micron membrane filter will be placed in-line, and sample containers can be filled directly from the well. If a bailer is used, the peristaltic pump with in-line filter will be used to filter the groundwater samples prior to filling sampling containers.

6. At each monitoring well/wellpoint 5 sample containers will be filled with filtered water for analysis of:

   Total phosphorus
   Soluble reactive phosphorus
   Nitrate-nitrite as N
   Ammonia as N
   Total nitrogen as N
   Chloride

   Samples for total phosphorus, soluble reactive phosphorus, and total nitrogen will each be put in separate 125 ml bottles. One 125 ml container will be used for the sample to be analyzed for ammonia and nitrate-nitrite.

One 500 ml container will be filled for the chloride analysis. Sample jars will be rinsed with groundwater prior to filling and capping. After filling the total dissolved phosphorus container, approximately 2 drops of concentrated sulfuric acid will be added to lower the pH to < 2. Sample containers will then be placed in a cooler with "blue ice" for transport.

Two (2) extra sets of containers will be available for each sampling round in case some of the containers are contaminated. During each sampling round, 2 duplicates and 2 blanks (deionized water passed through the filters) will be collected.

7. A clean container will be filled with groundwater for temperature, pH, conductivity, and D.O. measurements. Data will be recorded on the groundwater sampling data form.

8. Well sounders and monitoring meters will be decontaminated with a triple rinse in deionized water. Bailers for the monitoring well samples and dedicated tubing for use with the peristaltic pump will be decontaminated with a dilute sulfuric acid solution, followed by a triple rinse of deionized water.

9. It is anticipated that the septic tanks will be sampled in a manner similar to the wellpoints. The peristaltic pump with in-line filter will be used to remove water from the tank and fill the containers. Septic tank samples will be analyzed for the same suite of parameters mentioned above.

6. Sample Delivery for Analysis

As discussed above, all samples will be placed in a cooler with "blue ice" to maintain an approximate 4°C and appropriate Chain of Custody forms will be filled out. The coolers will then be delivered (overnight) to the Turnbull Laboratory of Ecological Studies.

SUMMARY OF BACKGROUND, LAKE SAWYER, AND WASTEWATER WATER QUALITY DATA

Table B-1 - Summary of Background, Lake Sawyer, and Wastewater Water Quality Data

STATION	Sampling Date	Cl (mg/L)	TSP (ug/L)	TSN (ug/L)
Ravensdale Creek:				
RAV	Mar-89	2.10	3.3	561 E
RAV	Apr-89	1.90	1.8	424
RAV	May-89	2.00	2.9	484
RAV	May-89	2.03	5.3	437
RAV	Jun-89	2.15	9.8	386
RAV	Jul-89	2.10	8.2	384
RAV	Aug-89	2.45	13.2 E	263 E
RAV	Oct-89	2.70	9.0 E	311 E
RAV	Oct-89	2.58	7.0 E	329 E
RAV	Nov-89	2.40	5.7 E	378 E
RAV	Dec-89	2.48	6.4 E	591 E
RAV	Jan-90	1.82	11.9 E	708 E
RAV	Feb-90	1.95	6.8 E	572 E
RAV	Mar-90	2.10	7.0 E	505 E
RAV	Apr-90	1.70	6.3 E	466 E
Covington Creek/Lake Sawyer:				
COV	Mar-89	2.50	20.9	840
COV	Apr-89	2.25	20.9	498
COV	May-89	2.35	16.8	364
COV	May-89	2.18	18.8	287
COV	Jun-89	2.25	19.2	274
COV	Jul-89	2.45	17.8	272
COV	Aug-89	2.45	25.3	284
		Cl (mg/L)	TP (mg/L)	TN (mg/L)
Wastewater Effluent:				
WTPIN-C	Mar-89	13.80	4.31	17.27
WTPIN	Apr-89	19.15	5.00	15.30
WTPIN-C	May-89	24.60	6.68	26.49
WTPIN-C	May-89	27.95	6.44	27.09
WTPIN	Dec-89	16.85	4.20	17.79
WTPIN	Apr-90	23.75	7.16	36.22
ST-1	Mar-90	12.35	22.89	63.98
ST-1	May-90	0.85	10.81	65.38
ST-2	Mar-90	5.40	0.38	14.11
ST-2	May-90	15.65	4.18	30.56

NOTES:
"E" denotes that the total soluble concentration was estimated as the average of soluble reactive and total components.

Hart Crowser
J-2484

AUGUST 1989
RAW LABORATORY DATA

Sawyer Lake - Chloride (surface and groundwater)
Collection date: 31 July & 7,8 Aug 89
Analysis date: 2 & 10 Aug

	mg/l Cl		mg/l
WTP-EFF-COMP	29.90	Blank	0.00
RCA-A	1.85	MW-B1	2.80
RCA-B	1.90	MW-B2	1.85
RCMB-A	4.70	MW-B3	5.75
RCMB-B	4.65	MW-B4	2.45
PS-B	-0.25	11	3.05
PS-B (dup)	-0.30	11b	3.20
BDLC-B	1.35	12	2.45
RCLS-B	4.10	12 (dup)	2.60
RAV-B	2.45	2	2.45
COV-B	2.45	8	2.80
COV-B (dup)	2.45	6	2.90
15ppm (QA)	15.25	9	5.45
5 ppm (QA)	5.05	10	3.90
		7	6.40
		7 (dup)	6.45
		New filter	0.05
		Filter blank	1.65
		5 mg/l (QA)	5.15
		15 mg/l (QA)	15.25
		8b	[illegible].40
		MW-B3 Rep	6.05

Sawyer Lake - Total Phosphorus (surface and groundwater)
Collection Date: 31 July, 1,7,8 Aug 89
Analysis date: 4,7,10 Aug 89

	µg/l
Li-0	13.5
Li-3	14.2
Li-6	40.1
L2-0	12.3
L2-3	14.5
L2-6	25.1
L2-6 (dup)	25.3
L3-0	11.5
L3-3	11.1
L3-6	25.1
L3-9	16.0
L3-12	42.3
L3-15	52.6
L4-0	11.5
BLK	2.7
BLK + 50 ug/l spike	47.99 (96% rec)
L4-3	12.0
L4-6	23.8
L4-9	19.4
50 ppb (QA)	46.5
L4-12	18.4
L4-15	42.6
L5-0	11.8
L5-0 (dup)	12.8
L5-3	10.8
ST3-LWR-A	534.5
BLK	2.7
BLK + 50 ug/l spike	50.70 (101% rec)
ST3-UPR-A	241.1
ST4-LWR-B	336.9
ST4-UPR-A	207.7
ST4-UPR-B	278.3
RCA-A	42.6

	µg/l
RCA-A (dup)	42.6
RAV-B	12.5
L5-6	21.9
RCMB-B	272.9
BLK	1.0
BLK + 50 ug/l spike	51.69 (103% rec)
QA-7	11.8
250ppb (QA)	253.0
20 ppb (QA)	22.9

Y = 0.0041(X) + 0.0016
r = 0.9998

ST3-LWR-B	515.1
ST3-UPR-B	299.5
WTP-EFF-A	7223.1
WTP-EFF-COMP	7889.1
COV-A	23.6
COV-B	26.8
COV-B (dup)	23.8
BDLC-A	38.9
BDLC-B	42.9
RAV-A	15.5
QA-1	1.7
QA-1 + 50 ug/l spike	49.27 (99% rec)
QA-2	3.0
QA-3	12.5
QA-4	12.3
QA-5	1.9
QA-6	2.7
QA-8	42.4
PS-A	37.6
PS-B	36.9

Tot. & phos. continued

	µg/l
RCLS-A	253.3
RCLS-A (dup)	253.3
RCLS-B	264.1
RCA-B	44.2
RCMB-A	269.6
ST4-LWR-A	338.8
BLK	2.5
BLK + 50 ug/l spike	51.27 (103% rec)
BLK	1.7
20 ppb (QA)	20.3
20 ppb (QA)	20.8
WTP-EFF-B	7580
SOVIE PRECIP	23.1

Y = .0040(x) + 0.0133
r = .9999

MW-B1	14.8
MW-B2	49.4
MW-B3	21.0
MW-B3 Rep	18.7
MW-B4	19.0
MW-B4 (dup)	18.2
11	15.5
11B	15.8
12	14.8
2	26.9
2 (dup)	27.9
8	12.3
6	20.0
9	4.4
10	230.4
BLK	2.4

	µg/l
BLK + 50 ug/l spike	50.25 (96% rec)
5 ppb (QA)	5.9 ✓
BLK	2.2
BLK + 50 ug/l spike	50.25 (96% rec)
250 ppb (QA)	247.2 ✓
Filter blk	15.0 ✓
BLK (field)	4.6
NEW Filter	3.1 ✓
7	12.1 ✓
8b	48.9 ✓

y = .004(x) + .006
r = .999

Sawyer Lake - Soluble Reactive Phosphorus (surface and groundwater)
Collection Date: 31 July, 1,7,8 Aug 89
Analysis date: 1,2,10 Aug 89

	µg/l
L3-0	4.6
L3-3	4.1
L3-6	5.9
L3-9	7.7
L3-12	20.1
L3-12 + 50ug/l spike	49.58 (99% rec)
L3-15	33.8
L4-0	5.2
L4-0 (dup)	4.6
L4-3	4.4
L4-6	5.4
L4-9	7.5
L4-12	13.7
L4-15	25.6
BLK	3.3
5 ug/l (QA)	4.4
QA-1	3.6
QA-2	2.3
QA-2 (dup)	2.3
QA-3	3.3
QA-4	3.6
QA-4 + 50ug/l spike	50.35 (101% rec)
250 ug/l (QA)	251.2

y = .004(x) + .004
r = .999

	µg/l
WTP-EFF-COMP	6941
RCA-A	17.4
RCA-A (dup)	21.8
RCA-B	18.0
RCMB-A	188.2
RCMB-A (dup)	191.8
RCMB-B	182.5
PS-B	24.4
BDLC-B	21.6
RCLS-B	166.1
RAV-B	14.1
COV-B	8.2
QA-5	3.6
QA-5 + 50 ug/l spike	48.08 (96% rec)
QA-6	8.2
QA-6 + 50 ug/l spike	51.16 (102% rec)
QA-7	7.4
QA-8	14.6
BLK	2.8
20 ug/l (QA)	20.3
BLK	2.8
250 ug/l (QA)	245.3

y = .002(x) + .004
r = .999

MW-B1	15.3
MW-B2	56.9

	µg/l
MW-B2 (dup)	55.3
MW-B3	21.5
MW-B3 Rep	22.2
MW-B4	21.0
11	17.9
11B	19.4
12	12.7
12 (dup)	12.2
2	25.6
8	10.9
6	21.5
9	10.2
10	226.6
BLK	3.5
BLK + 50 ug/l spike	49.80 (100% re
5 ug/l (QA)	5.0
BLK	2.7
BLK + 50 ug/l spike	49.80 (100% re
100 ug/l (QA)	99.8
Filter blk	9.7
BLK (field)	5.3
NEW Filter	4.5
7	11.7
8b	12.7

y = .0039(x) - .0016
r = .9999

Sawyer Lake - Total Nitrogen (surface and groundwater)
Collection Date: 31 July, 1,7,8 Aug 09
Analysis date: 3,7,9 Aug 09

	mg/l
L1-0	0.253
.75 mg/l (QA)	0.735
L1-3	0.236
L1-6	0.308
L2-0	0.322
L2-b	0.346
L2-0 + .33 mg/l spike	.272 (82% rec)
L3-0	0.246
L3-3	0.260
L3-6	0.341
L3-6 (dup)	0.323
L3-9	0.477
L3-12	0.487
L3-15	0.337
L4-0	0.245
L4-0 + .33 mg/l spike	.309 (94% rec)
L4-3	0.235
BLK	-0.009
L4-6	0.379
L4-9	0.497
L4-12	0.537
L4-15	0.518
L4-15 (dup)	0.533
L5-0	0.264
*.30 mg/l (QA)	0.235

y = 1.03(x) + .038
r = .999

* reagent problems occurred w/this sample.

	mg/l
L2-3	0.257
L5-3	0.266
L5-3 + .33 mg/l spike	.299 (91% rec)
L5-6	0.360
BLK	-0.018
.75 mg/l (QA)	0.756
RCMB-A	0.481
RCMB-B	0.463
RAV-A	0.379
RAV-B	0.389
COV-A	0.311
COV-B	0.290
COV-B (dup)	0.278
PS-A	1.136
PS-B	1.005
BLK	-0.008
BLK + .33 mg/l spike	.317 (96% rec)
0.30 mg/l (QA)	0.317
WTP-EFF-A	13.95
WTP-EFF-B	16.39
WTP-EFF-COMP	14.79
**St3 LWR-A	1.938
**ST3-LWR-B	2.070
ST3-UPR-A	1.897
ST3-UPR-B	3.730

** Red-colored debris present after digestion. Needed filtering before reading abs.

	mg/l
**ST4-LWR-A	3.425
**ST4-LWR-B	1.668
ST4-UPR-A	1.739
ST4-UPR-B	1.683
RCLS-A	0.563
RCLS-A (dup)	0.581
RCLS-B	0.520
BLK	-0.027
BLK + 0.33mg/l spike	.320 (97% rec)
0.75 mg/l (QA)	0.705
QA-1	0.005
QA-2	0.001
QA-3	0.250
QA-4	0.245
QA-4 (dup)	0.229
QA-5	-0.003
QA-6	0.019
QA-7	0.135
QA-8	0.177

y = .982(x) + .04
r = .999

Total Nitrogen continued

	mg/l
BDLC-A	0.487
BDLC-A (dup)	0.469
BDLC-B	0.545
RCA-A	0.593
RCA-B	0.563
SOVIE PRECIP	0.253
2	0.295
6	0.145
7	0.059
8	0.058
8b	0.574
9	0.516
7-2 + .33 mg/l spike	.327 (99% rec)
BLK (field)	0.021
10	1.510
11	0.352
11b	0.403
12	0.118
BLK	-0.016
.30 mg/l (QA)	0.308
MW-B1	0.642
MW-B2	0.050
MW-B3	3.225

	mg/l
MW-B3 Rep	3.225
MW-B4	0.403
MW-B4 (dup)	0.364
.75 mg/l (QA)	0.710
BLK	0.001
BLK + .33 mg/l spike	.350 (106% rec)
Filter blk	0.061
NEW Filter	0.040

Y = 1.03(x) + .032
r = .999

Sawyer Lake - Nitrate+Nitrite (surface and groundwater)
Collection Date: 31 July, 1,7,8 Aug 89
Analysis date: 2,10 Aug 89

	mg/l
L3-0	0.003
L3-3	0.002
L3-6	0.038
L3-9	0.296
L3-9 (dup)	0.305
L3-12	0.336
L3-15	0.338
L3-15 + .40 mg/l spike	.377 (94% rec)
L4-0	0.003
L4-3	0.000
L4-6	0.022
L4-9	0.263
L4-9 + .40 mg/l spike	.368 (92% rec)
L4-12	0.373
L4-15	0.316
QA-1	0.002
QA-2	0.002
QA-3	0.001
QA-4	0.001
BLK	-0.001
0.30ppm (QA)	0.291
BDLC-B	0.011

	mg/l
RCMB-A	0.036
RCMB-B	0.046
RCA-A	0.024
RCA-A (dup)	0.024
RCA-B	0.025
RCLS-B	0.000
RCLS-B (dup)	-0.001
RAV-B	0.253
COV-B	0.005
.75 mg/l (QA)	0.703
PS-B	-0.001
WTP-EFF-COMP	11.44
Blk	0.002
BLK + .40 mg/l spike	.383 (96% rec)
QA-5	0.002
QA-6	0.003
.30 mg/l (QA)	0.303
QA-7	0.005
QA-8	0.024

Y = 1.73(x) + .013
r = .999

Nitrate/Nitrite continued

	mg/l
2	0.006
2 + .33 mg/l spike	.431 (108% rec)
6	0.005
7	0.006
8	0.012
8b	0.422
9	0.223
10	1.529
BLK (field)	0.007
11	0.180
11b	0.353
12	0.006
BLK	0.004
.30 mg/l (QA)	0.314
Filter blk	0.013
NEW filter	0.005
MW-B1	0.629
MW-B1 (dup)	0.626
MW-B2	0.010

	mg/l
MW-B3	3.043
MW-B3 Rep	3.098
BLK	0.005
BLK + .33 mg/l spike	.418 (105% rec)
.75 mg/ (QA)	0.771
MW-B4	0.224
MW-B4 (dup)	0.220

y = 1.55(x) + .002
r = .998

Sawyer Lake - Ammonia (surface and groundwater)
Collection date: 31 July, i,7,8 Aug 89
Analysis date: 2,10 Aug 89

	µg/l
L3-0	9.84
L3-3	6.04
L3-6	9.62
L3-9	10.73
L3-12	27.71
L3-12 + 100µg/l spike	102.1
L3-15	60.76
L4-0	6.71
L4-3	6.04
L4-6	8.05
L4-9	17.66
L4-12	8.28
L4-12 (dup)	8.72
L4-15	60.31
L4-15 + 100µg/l spike	102.3
QA-i	35.52
QA-2	37.08
QA-3	7.61
QA-4	6.04
BLK	4.48
25 ug/l (QA)	26.37
BLK	7.38
250 ug/l (QA)	258.4
WTP-EFF-COMP	7.16
RCA-A	63.44
RCA-B	65.00

	µg/l
RCMB-A	44.01
RCMB-B	45.35
PS-B	1523
BDLC-B	60.09
RCLS-B	57.18
RAV-B	11.40
RAV-B (dup)	12.74
COV-B	29.49
COV-B (dup)	31.05
QA-5	37.08
QA-6	48.25
QA-7	23.02
QA-8	57.18
QA-8 (dup)	55.62
BLK	-i.55
BLK + 100µg/l spike	99.60
25 ug/l (QA)	20.78
BLK + 100µg/l spike	96.92
250 ug/l (QA)	251.7
BLK	-i.55

y = .0045(x) + .0480
r = 0.998

	µg/l
MW-B1	19.2
MW-B2	3.4
MW-B3	7.i
MW-B3 Rep	9.4
BLK	-4.3
BLK + 100µg/l spike	111
MW-B4	11.1
11	-0.i
11b	-0.6
12	32.8
2	294
2 (dup)	296
8	-2.2
25 ug/l (QA)	18.i
100 ug/l (QA)	93.4 ?
6	93.0
6 + 100µg/l spike	114
9	-0.i
10	24.4
10 (dup)	24.6
8b	25.i
7	8.5
BLK	-5.3
Filter blk	12.9
NEW filter	12.9

y = .0043(x) + .0736
r = .999

Hart Crowser
J-2484

DECEMBER 1989
RAW LABORATORY DATA

Ammonia/Nitrogen - Sawyer Lake Ground Water
Collection Date: 5,6 Dec. 89
Analysis Date: 7 Dec 89

	µg/l
1	-5.54
2	21.06
4	83.66
5	-3.14
4 (dup)	88.27
6	-0.551
6 (dup)	-2.21
7	4.43
blank	-0.181
8	0.742
9	46.72
10	69.25
10B	115.23
11	1.111
12	-2.03
14	371.36
15	-1.1
com-well	13.3
mw-1	4.8
mw-1 + 100 µg/l (spike)	102.12
mw-2	18.28
mw-3	-2.95
mw-4	2.96
mw-2 (field dup)	13.85
filter blank (field)	-2.03
new filter blank (field)	-3.69
blank (field)	-2.4
25 µg/l (QA)	23.27
250 µg/l (QA)	241.73
blk	-2.95

Y = 0.0052 (x) + 0.068
r = 0.998

* Y = 0.0022(x) + 0.032
* r = 0.~~998~~ .997

TOTAL NITROGEN - Sawyer Lake Ground Water
Collection date: 5,6 Dec 89
Analysis date: 19 Dec 89

	mg/l
1	0.123
2	0.427
5	0.167
5 (dup)	0.165
6	0.246
7	0.094
7 + .33mg/l spike	.309 (94% rec)
BLK	-0.023
.30 mg/l (QA)	0.307
8	0.341
9	1.507
10	1.911
10B	1.936
11	0.69
12	0.305
14	0.505
15	0.174

	mg/l
15 (dup)	0.175
COMWELL	0.038
MW-1	2.666
MW-2	0.666
MW-3	2.165
MW-4	0.575
BLK	-0.028
.75 mg/l (QA)	0.747
MW-2 DUP (field)	0.422
Filter Blank (field)	0.032
New Filter Blank (field)	-0.013
Blank (field)	-0.015

y = 1.015(x) + .039
r = .999

CHLORIDE - Sawyer Lake Ground Water
Collection Date: 5,6 Dec. 89
Analysis Date: 8 Dec 89

	mg/l
1	2.80
2	2.00
4	7.00
5	2.65
6	4.00
6 (dup)	4.15
7	3.40
8	4.20
9	5.85
10	5.50
10B	5.05
11	1.75
12	3.05
14	4.25
15	2.60
5 mg/l (QA)	5.15
15 mg/l (QA)	15.20
com-well	1.35
mw-1	3.30
mw-1 (dup)	3.20
mw-2	2.20
mw-3	bottle broken during shipping
mw-4	2.85
mw-2 (field dup)	2.40
filter blank (field)	0.05
new filter blank (field)	0.05
blank (field)	-0.05

SOLUBLE REACTIVE PHOSPHORUS - Sawyer Lake Ground Water
Collection Date: 5,6 Dec. 89
Analysis Date: 7 Dec 89

	µg/l	
1	18.70	
2	9.71	
4	14.47	
5	9.45	
5 (dup)	8.13	
6	8.92	
7	4.43	
blank	2.31	
7 + 50 µg/l (spike)	50.21	(100% rec)
8	8.39	
9	8.39	
10	161.43	
10B	169.09	
11	8.39	
12	9.71	
14	23.46	
15	8.13	
15 (dup)	8.13	
com-well	116.23	
mw-1	77.64	
mw-1 + 50 µg/l (spike)	74.01	(148% rec)
mw-2	62.31	
mw-3	18.43	
mw-4	19.23	
mw-2 (field dup)	58.61	
filter blank (field)	3.90	
new filter blank (field)	2.05	
blank (field)	2.58	
5 µg/l (QA)	2.31	
250 µg/l (QA)	247.86	

Y = 0.004[illegible](x) + 0.[illegible]012
r = 0.999

TOTAL PHOSPHORUS - Sawyer Lake Ground Water
Collection Date: 5,6 Dec. 89
Analysis Date: 9 Dec 89

	µg/l	
1	21.77	
2	12.2	
2 (dup)	12.7	
4	37.38	
4 + 50 µg/l (spike)	41.04	(82% rec)
5	3.89	
6	6.16	
7	5.15	
blank	1.12	
5 µg/l (QA)	3.39	
8	10.44	
9	4.4	
10	171.58	
10B	173.59	
11	6.16	
12	22.02	
14	18.75	
15	13.71	
15 (dup)	13.21	
com-well	112.41	
mw-1	17.49	
mw-1 + 50 µg/l (spike)	49.35	(99% rec) ?
mw-2	61.3	
mw-3	24.29	
mw-4	29.83	
mw-2 (field dup)	64.57	
filter blank (field)	16.73	
new filter blank (field)	4.65	
blank (field)	4.4	
blank	1.37	
250 µg/l (QA)	246.61	

Y = 0.0040(x) + 0.0035
r = 0.999

Nitrate/Nitrite-Nitrogen - Sawyer Lake Ground Water
Collection Date: 5,6 Dec. 89
Analysis Date: 8 Dec 89

	mg/l	
1	-0.005	
2	0.255	
2 (dup)	0.260	
4 .40	0.272	
5 + ~~50~~ µg/l (spike)	0.418	(104% rec)
5	0.025	
6	0.066	
7	0.020	
blank	-0.005	
0.30 µg/l (QA)	0.315	
8	0.351	
9	1.722	
10	2.022	
10B	2.016	
11	1.132	
12	0.051	
14	0.035	
15	0.024	
15 (dup)		
com-well	0.039	
mw-1	2.041	
mw-1 (dup)	2.059	
mw-2	0.116	
mw-3	0.442	
mw-4	0.553	
mw-2 (field dup)	0.082	
filter blank (field)	-0.005	
new filter blank (field)	-0.004	
blank (field)	0.001	
blank	-0.006	
mw-2 + 40 mg/l (spike)	0.416	(104% rec)
0.75 mg/l (QA)	0.774	

Y = ~~1.17~~ 1.62 (x) + 0.028
r = 0.999

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J-2484

MARCH 1990
RAW LABORATORY DATA

Total PHOSPHORUS - Sawyer Lake Ground Water
Collection Date: 13,15 Mar 90
Analysis Date: 19 Mar

	µg/l
Blank	2.3
Filter Blank	4.7
New Filter	4.7
250 µg/l (QA)	245
Com Well	105
#1	7.1
#2	24.5
#3	6.2
#4	3.0
#5	4.2
#6	5.7
#7	9.3
#8	10.0
Lab Blank	2.1
20 µg/l (QA)	18.5
#9	1.6
#10	94.4
#10B	93.4
#11	4.2
#11 + 50µg/l spike	48.2 (96% rec)
#12	4.7
#14	92.2
Lab Blank	1.1
MW-B1	321
MW-B2	47.9
MW-2B DUP	54.6
MW-3	14.6
MW-3 (dup)	15.8
MW-B4	31.2
SI-1	22894
SI-2	380
#3 (dup)	4.0

$y = 0.0040(x) + 0.013$
$r = 0.999$

CHLORIDE - Sawyer Lake Ground Water
Collection Date: 14 Mar 90
Analysis Date: 16 Mar

	mg/l
Unmarked bottle	2.20
** MW-B1	5.30
#3	2.15
#1	1.85
#5	1.75
#5 (dup)	1.90
#2	2.10
#7	7.75
#8	2.75
MW-3	5.25
#6	3.25
#9	4.25
Com Well	1.00
Filter Blank	0.00
#10	3.40
#11	2.85
Blank	-0.10
#14	2.70
** ST-1	12.35
ST-2	5.4
#10B	3.65
#10B (dup)	3.75
MW-2B DUP	1.80
MW-B2	1.90
MW-B4	2.35
New Filter	-0.10
#12	1.95
5mg/l (QA)	4.80
15mg/l (QA)	14.95

** samples very cloudy; titration endpoint difficult to see

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Ammonia Nitrogen - Sawyer Lake Ground Water
Collection Date: 13,14 Mar 90
Analysis Date: 20 Mar

	µg/l	
Blank	2.6	
Filter Blank	-0.6	
New Filter Blank	1.5	
#1	5.6	
#1 + 100µg/l spike	97.0	
#2	32.6	
#3	2.4	
#4	5.6	
#4 (dup)	7.4	
Lab Blank	-0.9	/ 1.4 } 2cm cuvette readings
25µg/l (QA)	20.9	/ 22.2 }
#5	-1.3	
#6	2.6	
#7	19.9	
#8	23.2	
#8 + 100µg/l spike	93.0	
#9	29.6	
#10	4.2	
#10B	3.3	
#11	37.9	
#12	2.1	
#14	239	
#14 (dup)	238	
Lab Blank	0.3	/ 2.2 } 2cm cuvette readings
** MW-B1	21.3	
MW-B2	56.8	
MW-2B DUP	43.4	
MW-3B	2.6	
MW-B4	20.6	
Com Well	13.0	
250µg/l (QA)	262	/ 250 } 2cm reading
ST-1	57348	} 2cm cuvette
ST-2	9817	}

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5cm cuvette: Y = 0.0057(X)+0.0553
r = 0.999

2cm cuvette: Y = 0.0024(X)+0.0187
r = 0.999

** sample turbid even after refiltering using 0.45µm filter; read sample at 750nm to subtract out turbidity

[illegible] Date: 12-14 Mar
Analysis Date: 19 Mar

	mg/l
Blank	-0.006
Filter Blank	-0.006
New Filter Blank	-0.005
#1	0.028
#2	0.108
#2 (dup)	0.105
#3	0.459
#4	0.385
Lab Blank	-0.006
0.30 mg/l (QA)	0.312
#5	0.286
#6	0.163
#6 + 0.40mg/l spike	0.395 (99% rec)
#7	0.816
** #8	0.015
#9	0.747
#10	0.810
#10B	0.753
#11	1.040
#12	0.267
#14	0.073
Lab Blank	-0.005
0.75mg/l (QA)	0.759
*** MW-B1	0.590
MW-B2	0.096
MW-2B DUP	0.077
MW-3B	0.733
MW-B4	0.488
Com Well	0.043
Com Well+0.40mg/l spike	0.416 (104% rec)
ST-1	-0.003
ST-2	1.53

Y = 1.67 (x) + 0.023
r = 0.999

** Sample was not filtered when shipped
*** Sample very turbid; filtered through GF/C filter; did not filter through 0.45µm filter because of the number of filters that would've been required.

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[redacted]

TOTAL NITROGEN - Sawyer Lake Ground Water
Collection date: 13,14 Mar 90
Analysis date: 28 Mar. 90

	mg/l
Filter Blank	-0.018
New Filter	-0.017
#3	0.5
#3 (dup)	0.51
#4	0.443
Lab Blank	-0.024
0.30mg/l (QA)	0.397
#6	0.198
#6+0.33mg/l spike	.315 (95% rec)
#9 (1:2)	0.701
#11	1.106
MW-B1	1.28
MW-B2	0.204
MW-2 DUP	0.262
MW-B4	0.821
Lab blank	-0.029
0.75mg/l (QA)	0.69
#9 (dup) (1:2)	0.701

Y = 1.037(X) + 0.0404
r = 0.999

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	mg/l
MW-3B (1:5)	3.249
#1	0.116
#2	0.186
#5	0.345
#5 (DUP)	0.353
LAB BLANK	-0.030
0.30 ppm (QA)	0.412
#7 (1:2)	0.782
#8	0.033
#8 + 0.33 mg/l (spike)	0.326 (99% rec)
#10 (1:2)	0.710
#10B (1:2)	0.708
#12	0.373
#12 (dup)	0.383
#14	0.464
lab blank	-0.026
COM WELL	0.029
COM WELL + 0.33 mg/l (spike)	0.336 (102% rec)
Blank	-0.008
ST-1 (1:150)	63.98
ST-2 (1:60)	14.105
0.75 ppm (QA)	0.822

y = 1.008 (x) + 0.043
r = .999

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SOLUBLE REACTIVE PHOSPHORUS - Sawyer Lake Ground Water
Collection Date: 13,14 Mar 90
Analysis Date: 15 Mar

	µg/l
Blank	3.4
Filter Blank	3.1
New Filter Blank	2.6
#1	6.4
#2	10.0
#2 (dup)	10.5
#3	5.4
Lab Blank	1.9
50 µg/l (QA)	47.4
#4	3.9
#5	4.6
#6	4.6
#7	10.0
#8	7.4
#8 + 50µg/l spike	46.8 (94% rec)
#9	8.4
#10	77.8
#10 (dup)	77.0
#10B	88.7
Lab Blank	2.1
100µg/l (QA)	99.0
* MW-B1	72.0
MW-2	47.4
MW-2 + 50µg/l spike	47.6 (95% rec)
MW-B2	48.9
MW-B3	16.0
MW-B4	19.6
ST-1	219003
ST-2	348~~0~~
Com Well	119~~0~~
#11	9.2
#12	10.5
#14	16.5

$Y = 0.0040(X) + 0.0006$
$r = 0.999$

* required extensive refiltering with GF/C and 0.45µm filters!

Hart Crowser
J-2484

MAY 1990
RAW LABORATORY DATA

TOTAL PHOSPHORUS - Sawyer Lake Ground Water
Collection Date: 2 May 90
Analysis Date: 7 May 90

	µg/l
Field Blank	4.4
Filter Blank	7.1
New Filter Blank	2.4
250 µg/l (QA)	246.9
Com Well	108.3
#2	12.7
#3	10.0
#4	9.3
#5	26.9
#6	12.4
*#7	21.2
*#8	10.5
Lab Blank	3.1
20 µg/l (QA)	22.5
#9	5.6
#10	159.8
#10B	112.4
#11	7.1
#6 + 50µg/l spike	46.5 (93% rec)
#12	6.3
#14	34.2
Lab Blank	1.7
MW-1 (filtered)	200.4
MW-2	54.7
MW-2 (field dup)	45.2
MW-3	21.0
MW-4	26.9
ST-1	10,815
#11 (dup)	6.8
MW-2 + 50 µg/l spike	47.4 (95% rec)

$Y = 0.0041(x) + 0.0312$
$r = 0.999$

ST-2	4,183

$Y = 0.004(x) + 0.005$
$r = 0.999$

* Samples with yellow/orange tint after digestion. Filtered before reading absorbance.

NOTE: New molybdate reagent used for second curve. ABS values lower than for first curve; therefore, only used first curve for calculations.

CHLORIDE - Sawyer Lake Ground ter
Collection Date: 2 May 90
Analysis Date: 4 May 90

	mg/l
** MW-1	1.79
#2	2.15
#3	2.70
#4	2.15
#5	2.15
#6	2.50
#7	9.25
#8	2.65
#9	2.90
#9(dup)	2.85
#10B	4.15
#10	4.00
#11	3.30
#12	2.30
15 mg/l (QA)	15.10
#14	2.70
COM-WELL	1.90
MW-2	2.55
MW-2 (FIELD DUP)	2.25
MW-3	5.45
MW-4	3.40
FIELD BLANK	0.05
FILTER BLANK	0.20
NEW FILTER	0.00
ST-1	0.85
MW-4 (LAB DUP)	3.25
ST-2	15.65

** Sample very cloudy; titration endpoint difficult to see so the sample was centrifuged and test was run on supernatant.

TOTAL NITROGEN - S er Lake Ground Water
Collection date: 2 may 90
Analysis date: 7, 9 May 80

	mg/l	
#2	0.120	
#5	0.285	
#5 (dup)	0.283	
#6	0.105	
*#7	0.201	
*#8	0.056	
*#9	0.236	
filter blank	0.091	
New Filter	0.011	
#3	0.445	
#3+0.33 mg/l spike	0.356	(108% rec)
#4	0.374	
Lab Blank	-0.010	
0.30mg/l (QA)	0.290	
*#10	0.753	
*#8+0.33mg/l spike	0.313	(95% rec)
*#10B	0.732	
#12	0.135	
*#14	0.461	
COM-WELL	0.071	
MW-3 (1:5)	3.652	
FIELD BLANK	0.030	
Lab blank	-0.005	
0.75mg/l (QA)	0.747	
ST-1 (1:150)	65.382	
ST-2 (1:60)	30.556	

Y = 0.995(X) + 0.019
r = 0.999

#11 (1:2)	1.139
MW-2 (1:2)	1.307
MW-2 (field dup)	1.193
MW-4 (1:2)	1.463
**MW-1 (1:2)	0.750

Y = 0.998(x) + 0.017
r = 0.999

*Sample with red-colored debri present after digestion. Filtered before reading absorbance on spectrophotometer.

**Sample centrifuged and test ran on supernatant.

APPENDIX C
AQUIFER TESTING

APPENDIX C
AQUIFER TESTING

In Situ Hydraulic Conductivity Testing

We conducted *in situ* hydraulic conductivity tests (slug tests) in the 4 monitoring wells installed for this project. Slug tests are the typical method for estimating hydraulic conductivity (K) of subsurface soils near a well by measuring the rate of water level fall or rise in the well after the static level is suddenly displaced. In a falling head slug test, a 5- or 10-foot-long 1.5-inch-diameter rod is quickly lowered into the well, causing an "instantaneous" rise in the water level. A Terra Systems automatic data acquisition system (using a downhole pressure transducer) measures the falling water level over time as it re-equilibrates toward the static level. In a rising head test, the situation is reversed - the slug rod is withdrawn from the well, causing an "instantaneous" drop in water level, followed by a water level rise to equilibrium.

We analyzed the data from slug tests using the method of Bouwer and Rice (1976), which is applicable for unconfined (water table) conditions. The data plots for the slug tests are presented on figures C-1, C-3, C-5, and C-7. Tabulated data from the tests are presented on tables C-1 through C-9.

In addition to standard slug testing procedures, we also conducted recovery tests on the four monitoring wells. These tests were essentially conducted and analyzed like small scale pumping tests. The well was bailed as quickly as possible using a 5-foot-long bailer. The volume of water removed and the bailing time were recorded, and an equivalent pumping rate (volume/time) was calculated. For the four wells, the rate ranged from 0.6 to 1.2 gallons per minute (gpm). As the last bailer was withdrawn from the well, the automatic data acquisition system was started and the water level recovery to static was recorded.

The recovery test data were then analyzed like pump test recovery data using the Cooper-Jacob (1946) method, which plots residual drawdown versus a dimensionless recovery ratio on a semi-logarithmic plot (Figures C-2, C-4, C-6, and C-8). The tabulated data from these tests are presented in Tables C-10 through C-13. The dimensionless recovery ratio is equal to the total time since bailing began divided by the time since bailing stopped. Aquifer transmissivity was calculated by this method. If the aquifer thickness is known, hydraulic conductivity can then be calculated from the transmissivity. Since the depth to the bottom of the aquifer was unknown, it was estimated from available information in order to determine hydraulic conductivity - this estimation brings an added uncertainty to the calculated hydraulic conductivity values.

Falling and rising head slug tests and a recovery test were attempted in MW-4. However, no significant water level displacement could be created using either 10-foot-long slug rod, or by bailing with a 5-foot-long bailer. The data plots for all three tests are included (Figures C-4 and C-8). Following the two unsuccessful slug test attempts, we proceeded to take continuous readings at 3 second intervals (using the Terra System) while bailing with the 5-foot-long bailer. As can be seen from the data plot for the MW-4 recovery test, no measurable displacement could be induced by bailing as quickly as possible for 10 minutes, not even when the bailer entered and left the water. At the end of the bailing, the transducer was checked to assure that it was working properly. Although a hydraulic conductivity cannot be calculated from the test data, it is possible to say, qualitatively, that the formation at MW-4 is exceptionally permeable - much more permeable than at the other locations tested.

Pumping Tests in Selected Domestic Wells

We conducted pumping tests in the selected domestic wells which satisfied four criteria: 1) the particular well supplied a single residence and therefore the pump could be turned on and off easily and the discharge measured; 2) the depth to water in the well could be measured; 3) some information as to the well screened depth and geology was available; and 4) the well owners' permission to pump the well was obtained. After evaluating each of the eight domestic wells in the monitoring program, we concluded that only two satisfied all three criteria (No. 4 and No. 8). Pumping tests were conducted in these two wells, both of which we believe are completed in the Qc unit underlying the till.

In each of the tests, the pump was turned on and allowed to run for 15 to 20 minutes during which time drawdown in the pumping well was measured using an electric well probe and graduated tape measure. Discharge from a garden hose was measured by recording how long it took to fill a 4-gallon bucket. After the pump was turned off, we measured water level recovery in the well until it reached static. Because the data for the tests were collected in the pumping well, it is better to analyze only the recovery data, since these data are much less affected by well efficiency than are the drawdown data collected during pumping.

As with the recovery tests described in the previous section, the recovery data from the two pumping tests were analyzed by the Cooper-Jacob method - plotting residual drawdown versus the dimensionless recovery time ratio on a semi-logarithmic plot. The plots of the recovery data for the two pumping tests are presented on Figure C-9. Tabulated data for the tests are presented in Tables C-14 and C-15.

In addition to the two pumping tests, we attempted to perform a recovery test (using a bailer as described in the section above) in Domestic Well No. 6, which is a shallow 1.5-inch-diameter standpipe completed within the recessional outwash (Qvr). Unfortunately, we could not create any drawdown of the water table in the permeable outwash material using a one-inch bailer.

Table C-1 - MW-1 Falling Head Slug Test Data (page 1 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	16.657		
4.2	16.68		
8	16.68		
11.9	16.68		
15.3	16.68		
20.9	16.68		
31.8	16.703		
33.7	17.072		
34.1	18.225		
35.7	19.471		
36	19.31		
37.7	20.44		
38	20.463	0.000	3.806
39.7	20.371	0.028	3.714
40.1	20.417	0.035	3.760
41.7	19.886	0.062	3.229
42	20.809	0.067	4.152
43.7	20.44	0.095	3.783
44.1	19.817	0.102	3.160
45.7	19.817	0.128	3.160
46	20.002	0.133	3.345
47.7	19.979	0.162	3.322
49.7	19.609	0.195	2.952
51.7	19.471	0.228	2.814
53.7	19.356	0.262	2.699
55.7	19.402	0.295	2.745
57.7	19.586	0.328	2.929
59.7	19.31	0.362	2.653
61.7	19.079	0.395	2.422
63.7	19.01	0.428	2.353
65.7	18.94	0.462	2.283
67.7	18.848	0.495	2.191
69.7	18.779	0.528	2.122
71.7	18.733	0.562	2.076
73.7	18.664	0.595	2.007
75.7	18.617	0.628	1.960
77.7	18.548	0.662	1.891
82.7	18.433	0.745	1.776
87.7	18.341	0.828	1.684
92.7	18.248	0.912	1.591
97.7	18.179	0.995	1.522
102.7	18.11	1.078	1.453
107.7	18.064	1.162	1.407
112.7	18.018	1.245	1.361
117.7	17.995	1.328	1.338
122.7	17.948	1.412	1.291
127.7	17.925	1.495	1.268
137.7	17.879	1.662	1.222
147.7	17.833	1.828	1.176
157.7	17.81	1.995	1.153
167.6	17.787	2.160	1.130
177.7	17.787	2.328	1.130
187.7	17.764	2.495	1.107
197.7	17.764	2.662	1.107

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
207.7	17.764	2.828	1.107
217.6	17.741	2.993	1.084
227.7	17.741	3.162	1.084
257.6	17.718	3.660	1.061
287.7	17.718	4.162	1.061
317.6	17.695	4.660	1.038
347.6	17.695	5.160	1.038
377.6	17.672	5.660	1.015
407.6	17.672	6.160	1.015
437.6	17.672	6.660	1.015
467.6	17.672	7.160	1.015
497.6	17.649	7.660	0.992
527.6	17.649	8.160	0.992
557.6	17.649	8.660	0.992
587.6	17.649	9.160	0.992
617.6	17.649	9.660	0.992
647.7	17.625	10.162	0.968
677.6	17.625	10.660	0.968
707.6	17.625	11.160	0.968
737.7	17.625	11.662	0.968
767.6	17.625	12.160	0.968
797.7	17.602	12.662	0.945
827.7	17.625	13.162	0.968
887.6	17.602	14.160	0.945
947.6	17.579	15.160	0.922
1007.6	17.579	16.160	0.922
1067.6	17.579	17.160	0.922
1127.6	17.579	18.160	0.922

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	17.533		
2.7	17.556		
5.9	17.533		
9.2	17.533		
12.4	17.533		
15.5	17.533		
28.1	17.533		
29.7	15.434		
30.1	16.31		
31.7	14.419		
32	14.211		
33.7	13.842	0.000	3.691
34	13.934	0.005	3.599
35.7	13.98	0.033	3.553
36.1	14.119	0.040	3.414
37.7	14.096	0.067	3.437
38	14.211	0.072	3.322
39.7	14.188	0.100	3.345
40.1	14.303	0.107	3.230
41.7	14.257	0.133	3.276
42	14.373	0.138	3.160
43.7	14.326	0.167	3.207
45.7	14.396	0.200	3.137
47.7	14.442	0.233	3.091
49.7	14.511	0.267	3.022
51.7	14.557	0.300	2.976
53.7	14.603	0.333	2.930
55.7	14.673	0.367	2.860
57.7	14.719	0.400	2.814
59.7	14.765	0.433	2.768
61.7	14.811	0.467	2.722
63.7	14.857	0.500	2.676
65.7	14.88	0.533	2.653
67.7	14.926	0.567	2.607
69.7	14.972	0.600	2.561
71.7	14.995	0.633	2.538
73.7	15.042	0.667	2.491
78.7	15.134	0.750	2.399
83.7	15.203	0.833	2.330
88.7	15.272	0.917	2.261
93.7	15.342	1.000	2.191
98.7	15.411	1.083	2.122
103.7	15.48	1.167	2.053
108.7	15.526	1.250	2.007
113.7	15.595	1.333	1.938
118.7	15.641	1.417	1.892
123.7	15.688	1.500	1.845
133.7	15.78	1.667	1.753
143.7	15.872	1.833	1.661
153.7	15.941	2.000	1.592
163.7	15.988	2.167	1.545
173.7	16.057	2.333	1.476
183.7	16.103	2.500	1.430
193.7	16.149	2.667	1.384
203.7	16.195	2.833	1.338

Table C-2 - MW-1 Rising Head Slug Test Data (page 2 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
213.7	16.241	3.000	1.292
223.7	16.264	3.167	1.269
233.6	16.287	3.332	1.246
243.6	16.334	3.498	1.199
253.7	16.357	3.667	1.176
263.7	16.38	3.833	1.153
273.7	16.403	4.000	1.130
283.6	16.426	4.165	1.107
293.6	16.426	4.332	1.107
303.7	16.449	4.500	1.084
313.7	16.449	4.667	1.084
323.7	16.472	4.833	1.061
353.7	16.495	5.333	1.038
383.6	16.518	5.832	1.015
413.7	16.541	6.333	0.992
443.6	16.541	6.832	0.992
473.6	16.564	7.332	0.969
503.6	16.564	7.832	0.969
533.6	16.587	8.332	0.946
563.6	16.587	8.832	0.946
593.6	16.587	9.332	0.946
623.6	16.587	9.832	0.946
653.6	16.587	10.332	0.946
683.6	16.61	10.832	0.923
713.6	16.61	11.332	0.923
743.6	16.61	11.832	0.923
773.6	16.61	12.332	0.923
803.6	16.61	12.832	0.923
833.6	16.61	13.332	0.923
863.6	16.61	13.832	0.923
893.6	16.61	14.332	0.923
923.7	16.61	14.833	0.923
983.6	16.61	15.832	0.923
1043.6	16.633	16.832	0.900
1103.6	16.633	17.832	0.900
1163.6	16.633	18.832	0.900
1223.6	16.633	19.832	0.900
1283.6	16.633	20.832	0.900
1343.6	16.633	21.832	0.900
1403.6	16.633	22.832	0.900
1463.6	16.633	23.832	0.900

Table C-3 - MW-2 Falling Head Slug Test Data (page 1 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	15.688		
3	15.688		
5.9	15.711		
8.8	15.711		
11.6	15.711		
14.2	15.711		
17.3	15.711		
29.5	15.688		
30.9	15.734		
31.4	15.803		
33	16.195		
33.3	16.795		
35	17.695		
35.3	18.248		
37	19.056		
37.4	18.295		
39	19.932	0.000	4.244
39.3	18.94	0.005	3.252
41	19.402	0.033	3.714
41.4	19.748	0.040	4.060
43	18.779	0.067	3.091
43.3	18.594	0.072	2.906
45	18.479	0.100	2.791
47	18.456	0.133	2.768
49	18.364	0.167	2.676
51	18.295	0.200	2.607
53	18.248	0.233	2.560
55	18.179	0.267	2.491
57	18.133	0.300	2.445
59	18.087	0.333	2.399
61	18.018	0.367	2.330
63	17.972	0.400	2.284
65	17.925	0.433	2.237
67	17.902	0.467	2.214
69	17.856	0.500	2.168
71	17.81	0.533	2.122
73	17.764	0.567	2.076
75	17.695	0.600	2.007
77	17.602	0.633	1.914
79	17.51	0.667	1.822
81	17.418	0.700	1.730
83	17.349	0.733	1.661
85	17.256	0.767	1.568
90	17.095	0.850	1.407
95	16.956	0.933	1.268
100	16.841	1.017	1.153
105	16.749	1.100	1.061
110	16.657	1.183	0.969
115	16.587	1.267	0.899
120	16.518	1.350	0.830
125	16.472	1.433	0.784
130	16.403	1.517	0.715

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
135	16.357	1.600	0.669
140	16.31	1.683	0.622
145	16.287	1.767	0.599
150	16.264	1.850	0.576
155	16.218	1.933	0.530
160	16.172	2.017	0.484
170	16.126	2.183	0.438
180	16.08	2.350	0.392
190	16.057	2.517	0.369
199.9	16.011	2.682	0.323
210	15.988	2.850	0.300
220	15.964	3.017	0.276
229.9	15.941	3.182	0.253
239.9	15.918	3.348	0.230
250	15.918	3.517	0.230
259.9	15.895	3.682	0.207
270	15.872	3.850	0.184
279.9	15.872	4.015	0.184
289.9	15.849	4.182	0.161
299.9	15.849	4.348	0.161
310	15.849	4.517	0.161
339.9	15.803	5.015	0.115
369.9	15.78	5.515	0.092
399.9	15.78	6.015	0.092
429.9	15.757	6.515	0.069
459.9	15.757	7.015	0.069
489.9	15.757	7.515	0.069
519.9	15.734	8.015	0.046
549.9	15.734	8.515	0.046
579.9	15.734	9.015	0.046
609.9	15.734	9.515	0.046
639.9	15.734	10.015	0.046
669.9	15.734	10.515	0.046
699.9	15.711	11.015	0.023
729.9	15.711	11.515	0.023
759.9	15.711	12.015	0.023
789.9	15.711	12.515	0.023

Table C-4 - MW-2 Rising Head Slug Test Data (page 1 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	15.711		
3	15.711		
5	15.78		
7	15.803		
14.4	15.711		
45.9	15.711		
47.2	13.634	0.000	2.077
47.7	13.796	0.008	1.915
49.3	13.773	0.035	1.938
49.6	13.842	0.040	1.869
51.3	13.773	0.068	1.938
51.6	13.911	0.073	1.800
53.3	13.842	0.102	1.869
53.7	13.957	0.108	1.754
55.3	13.911	0.135	1.800
55.6	14.003	0.140	1.708
57.3	13.957	0.168	1.754
57.7	14.073	0.175	1.638
59.3	14.027	0.202	1.684
59.6	14.119	0.207	1.592
61.3	14.073	0.235	1.638
63.3	14.119	0.268	1.592
65.3	14.165	0.302	1.546
67.3	14.188	0.335	1.523
69.3	14.234	0.368	1.477
71.3	14.28	0.402	1.431
73.3	14.303	0.435	1.408
75.3	14.35	0.468	1.361
77.3	14.373	0.502	1.338
79.3	14.396	0.535	1.315
81.3	14.419	0.568	1.292
86.3	14.488	0.652	1.223
91.3	14.534	0.735	1.177
96.3	14.603	0.818	1.108
101.3	14.649	0.902	1.062
106.3	14.696	0.985	1.015
111.3	14.742	1.068	0.969
116.3	14.765	1.152	0.946
121.3	14.811	1.235	0.900
126.3	14.857	1.318	0.854
131.3	14.88	1.402	0.831
141.3	14.949	1.568	0.762
151.2	14.995	1.733	0.716
161.3	15.042	1.902	0.669
171.3	15.088	2.068	0.623
181.3	15.134	2.235	0.577
191.2	15.18	2.400	0.531
201.2	15.203	2.567	0.508
211.2	15.249	2.733	0.462
221.3	15.272	2.902	0.439
231.3	15.295	3.068	0.416
261.3	15.365	3.568	0.346
291.2	15.411	4.067	0.300
321.2	15.457	4.567	0.254
351.2	15.48	5.067	0.231

Table C-4 - MW-2 Rising Head Slug Test Data (page 2 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
381.2	15.503	5.567	0.208
411.2	15.526	6.067	0.185
441.2	15.549	6.567	0.162
471.2	15.572	7.067	0.139
501.2	15.595	7.567	0.116
531.2	15.595	8.067	0.116
561.2	15.595	8.567	0.116
591.2	15.618	9.067	0.093
621.2	15.618	9.567	0.093
651.2	15.641	10.067	0.070
681.2	15.641	10.567	0.070
711.2	15.641	11.067	0.070
741.2	15.641	11.567	0.070
771.2	15.641	12.067	0.070
801.2	15.641	12.567	0.070
831.3	15.665	13.068	0.046
891.2	15.665	14.067	0.046
951.2	15.665	15.067	0.046
1011.2	15.665	16.067	0.046

Table C-5 - MW-3 Falling Head Slug Test Data (page 1 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	15.111		
3.6	15.134		
6.5	15.134		
9.3	15.111		
18.1	15.111		
20	15.411		
20.4	16.749		
21.9	19.656		
22.3	21.132	0.000	6.021
23.9	18.917	0.027	3.806
24.3	17.81	0.033	2.699
26	17.995	0.062	2.884
26.4	18.202	0.068	3.091
28	18.087	0.095	2.976
28.3	17.625	0.100	2.514
30	16.657	0.128	1.546
30 3	16.795	0.133	1.684
32	16.564	0.162	1.453
32.4	16.61	0 168	1.499
34	16.357	0.195	1.246
34 3	16.426	0.200	1 315
36	16.172	0.228	1 061
36.4	16.241	0.235	1 130
37.9	16.034	0.260	0.923
38.3	16 103	0.267	0.992
40	15.895	0.295	0.784
40.3	15.988	0.300	0.877
42	15.78	0.328	0.669
42.4	15.849	0.335	0 738
43.9	15.688	0.360	0.577
44.3	15 78	0.367	0.669
46	15.595	0.395	0.484
46.3	15.688	0 400	0.577
48	15.526	0 428	0 415
48 4	15.618	0.435	0.507
51	15.434	0.478	0.323
53	15.388	0.512	0.277
55	15.342	0.545	0.231
57	15.318	0.578	0.207
59	15 295	0.612	0.184
61	15.272	0.645	0.161
63	15.249	0.678	0.138
65	15.226	0.712	0.115
67	15.226	0.745	0.115
69	15 203	0 778	0.092
71	15.203	0.812	0.092
73	15.18	0.845	0.069
75	15.18	0.878	0 069
77	15.18	0.912	0.069
79	15.18	0.945	0.069
81	15.18	0.978	0.069
83	15.157	1.012	0.046
85	15.157	1.045	0.046
87	15.157	1.078	0.046
89	15.157	1.112	0.046

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
94	15.157	1.195	0.046
99	15.157	1.278	0.046
104	15.157	1.362	0.046
109	15.157	1.445	0.046
114	15.157	1.528	0.046
119	15.157	1.612	0.046
123.9	15.157	1.693	0.046
129	15.157	1.778	0.046
134	15.157	1.862	0.046
139	15.134	1.945	0.023
149	15.134	2.112	0.023
158.9	15.134	2.277	0.023
168.9	15.134	2.443	0.023

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	15.134		
2.8	15.157		
7.5	15.134		
12.4	15.134		
39.3	14.788		
40.8	12.758		
41.2	12.366		
42.8	10.243		
43.1	10.197	0.000	4.937
44.8	11.004	0.028	4.130
45.1	11.258	0.033	3.876
46.8	11.766	0.062	3.368
47.2	12.043	0.068	3.091
48.7	12.366	0.093	2.768
49.1	12.55	0.100	2.584
50.7	12.85	0.127	2.284
51.1	13.011	0.133	2.123
52.8	13.288	0.162	1.846
53.2	13.45	0.168	1.684
54.7	13.588	0.193	1.546
55.1	13.75	0.200	1.384
56.8	13.911	0.228	1.223
57.2	14.05	0.235	1.084
58.8	14.119	0.262	1.015
59.1	14.257	0.267	0.877
60.7	14.303	0.293	0.831
61.1	14.442	0.300	0.692
62.8	14.442	0.328	0.692
63.2	14.58	0.335	0.554
64.7	14.557	0.360	0.577
65.1	14.696	0.367	0.438
66.7	14.649	0.393	0.485
67.1	14.765	0.400	0.369
68.8	14.719	0.428	0.415
69.3	14.834	0.437	0.300
71.8	14.811	0.478	0.323
73.8	14.857	0.512	0.277
75.8	14.903	0.545	0.231
77.8	14.926	0.578	0.208
79.8	14.949	0.612	0.185
81.8	14.949	0.645	0.185
83.8	14.972	0.678	0.162
85.8	14.972	0.712	0.162
87.8	14.995	0.745	0.139
89.8	14.995	0.778	0.139
91.8	14.995	0.812	0.139
93.8	15.019	0.845	0.115
95.8	15.019	0.878	0.115
97.8	15.019	0.912	0.115
99.8	15.019	0.945	0.115
101.8	15.019	0.978	0.115
103.8	15.019	1.012	0.115
105.8	15.019	1.045	0.115
107.8	15.019	1.078	0.115
109.8	15.019	1.112	0.115

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
114.8	15.019	1.195	0.115
119.8	15.019	1.278	0.115
124.8	15.019	1.362	0.115
129.8	15.019	1.445	0.115
134.8	15.019	1.528	0.115
139.8	15.019	1.612	0.115
144.8	15.019	1.695	0.115
149.8	15.019	1.778	0.115
154.8	15.019	1.862	0.115
159.8	15.019	1.945	0.115
169.8	15.019	2.112	0.115
179.8	15.019	2.278	0.115
209.8	15.091	2.778	0.043
239.8	15.091	3.278	0.043
269.8	15.091	3.778	0.043

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	16.403		
3.1	16.403		
6.2	16.403		
9.1	16.426		
13	16.403		
16.7	16.403		
26.7	16.403	0.000	0.000
28.8	16.403	0.035	0.000
29.1	16.518	0.040	0.115
30.8	16.426	0.068	0.023
31.2	16.518	0.075	0.115
32.8	16.449	0.102	0.046
33.1	16.541	0.107	0.138
34.7	16.449	0.133	0.046
35.1	16.541	0.140	0.138
36.8	16.449	0.168	0.046
37.2	16.541	0.175	0.138
38.8	16.426	0.202	0.023
39.1	16.541	0.207	0.138
40.8	16.426	0.235	0.023
41.1	16.541	0.240	0.138
42.8	16.426	0.268	0.023
43.2	16.518	0.275	0.115
44.8	16.426	0.302	0.023
45.1	16.541	0.307	0.138
46.8	16.426	0.335	0.023
47.2	16.541	0.342	0.138
48.8	16.403	0.368	0.000
49.1	16.518	0.373	0.115
50.7	16.403	0.400	0.000
51.1	16.518	0.407	0.115
52.8	16.403	0.435	0.000
53.2	16.495	0.442	0.092
54.7	16.403	0.467	0.000
55.1	16.518	0.473	0.115
56.7	16.403	0.500	0.000
57.1	16.518	0.507	0.115
59.8	16.403	0.552	0.000
61.8	16.403	0.585	0.000
63.8	16.403	0.618	0.000
65.8	16.403	0.652	0.000
67.8	16.403	0.685	0.000
69.8	16.403	0.718	0.000
71.8	16.403	0.752	0.000
73.7	16.403	0.783	0.000
75.8	16.403	0.818	0.000
77.8	16.403	0.852	0.000
79.8	16.403	0.885	0.000
81.8	16.403	0.918	0.000
83.7	16.403	0.950	0.000
85.8	16.403	0.985	0.000
87.8	16.403	1.018	0.000
89.8	16.403	1.052	0.000
91.8	16.403	1.085	0.000
93.8	16.403	1.118	0.000
95.8	16.403	1.152	0.000
97.8	16.403	1.185	0.000
102.7	16.403	1.267	0.000
107.8	16.403	1.352	0.000
112.8	16.403	1.435	0.000

Table C-8 - MW-4 Rising Head Slug Test (No. 1) Data (page 1 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	16.403		
2.3	16.426		
5.6	16.403		
8.9	16.426		
12.3	16.403		
16.7	16.403		
20.1	16.403		
37	16.38	0.000	0.023
39	16.357	0.033	0.046
39.4	16.426	0.040	-0.023
40.9	16.357	0.065	0.046
41.3	16.449	0.072	-0.046
42.9	16.357	0.098	0.046
43.3	16.449	0.105	-0.046
44.9	16.334	0.132	0.069
45.4	16.426	0.140	-0.023
46.9	16.31	0.165	0.093
47.3	16.403	0.172	0.000
48.9	16.264	0.198	0.139
49.3	16.38	0.205	0.023
51	16.241	0.233	0.162
51.4	16.334	0.240	0.069
52.9	16.403	0.265	0.000
53.3	16.495	0.272	-0.092
55	16.403	0.300	0.000
55.4	16.495	0.307	-0.092
57	16.403	0.333	0.000
57.3	16.495	0.338	-0.092
58.9	16.403	0.365	0.000
59.3	16.518	0.372	-0.115
60.9	16.403	0.398	0.000
61.4	16.518	0.407	-0.115
62.9	16.403	0.432	0.000
63.3	16.518	0.438	-0.115
65	16.403	0.467	0.000
65.3	16.518	0.472	-0.115
67	16.403	0.500	0.000
67.5	16.518	0.508	-0.115
70	16.403	0.550	0.000
72	16.403	0.583	0.000
74	16.403	0.617	0.000
76	16.403	0.650	0.000
78	16.403	0.683	0.000
79.9	16.403	0.715	0.000
82	16.403	0.750	0.000
84	16.403	0.783	0.000
86	16.403	0.817	0.000
88	16.403	0.850	0.000
90	16.403	0.883	0.000
92	16.403	0.917	0.000
94	16.403	0.950	0.000
96	16.403	0.983	0.000
97.9	16.403	1.015	0.000
100	16.403	1.050	0.000
102	16.403	1.083	0.000

Table C-8 - MW-4 Rising Head Slug Test (No. 1) Data (page 2 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
104	16.403	1.117	0.000
106	16.403	1.150	0.000
108	16.403	1.183	0.000
113	16.403	1.267	0.000
118	16.403	1.350	0.000
123	16.403	1.433	0.000
128	16.403	1.517	0.000
133	16.403	1.600	0.000
138	16.403	1.683	0.000
143	16.403	1.767	0.000
147.9	16.403	1.848	0.000
153	16.403	1.933	0.000
158	16.403	2.017	0.000
167.9	16.403	2.182	0.000

Table C-9 - MW-4 Rising Head Slug Test (No. 2) Data (page 1 of 2)

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
0	16.449		
4.8	16.449		
11.2	16.449		
16.6	16.449		
21.9	16.449		
37.2	16.449		
39.4	16.38	0.000	0.023
39.8	16.472	0.007	-0.069
41.4	16.38	0.033	0.023
41.7	16.495	0.038	-0.092
43.4	16.38	0.067	0.023
43.7	16.495	0.072	-0.092
45.4	16.38	0.100	0.023
45.8	16.472	0.107	-0.069
47.4	16.38	0.133	0.023
47.7	16.495	0.138	-0.092
49.3	16.38	0.165	0.023
49.7	16.495	0.172	-0.092
51.4	16.38	0.200	0.023
51.8	16.472	0.207	-0.069
53.3	16.38	0.232	0.023
53.7	16.495	0.238	-0.092
55.3	16.403	0.265	0.000
55.8	16.495	0.273	-0.092
57.3	16.403	0.298	0.000
57.7	16.518	0.305	-0.115
59.4	16.403	0.333	0.000
59.7	16.518	0.338	-0.115
61.4	16.403	0.367	0.000
61.8	16.495	0.373	-0.092
63.4	16.403	0.400	0.000
63.7	16.518	0.405	-0.115
65.3	16.403	0.432	0.000
65.7	16.518	0.438	-0.115
67.3	16.403	0.465	0.000
67.8	16.495	0.473	-0.092
70.4	16.403	0.517	0.000
72.4	16.403	0.550	0.000
74.4	16.403	0.583	0.000
76.4	16.403	0.617	0.000
78.4	16.403	0.650	0.000
80.4	16.403	0.683	0.000
82.4	16.403	0.717	0.000
84.4	16.403	0.750	0.000
86.4	16.403	0.783	0.000
88.4	16.403	0.817	0.000
90.4	16.403	0.850	0.000
92.4	16.403	0.883	0.000
94.4	16.403	0.917	0.000
96.4	16.403	0.950	0.000
98.4	16.403	0.983	0.000
100.4	16.403	1.017	0.000
102.4	16.403	1.050	0.000
104.3	16.403	1.082	0.000
106.4	16.403	1.117	0.000

Time in Seconds	Height of Water Above Transducer in Feet	Elapsed Time in Minutes	Head Change in Feet
108.4	16.403	1.150	0.000
113.4	16.403	1.233	0.000
118.4	16.403	1.317	0.000
123.3	16.403	1.398	0.000
128.4	16.403	1.483	0.000
133.1	16.403	1.562	0.000

Table C-10 - MW-1 Bail Test Data (page 1 of 3)

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
0	16.633				
2.4	16.68				
7.6	16.657				
11.5	16.657				
14.8	16.657				
21.5	16.657				
25.9	16.657				
414.2	4.337	3.250	0.000	#DIV/0!	12.320
416.2	4.429	3.283	0.033	98.500	12.228
416.5	4.545	3.288	0.038	85.783	12.112
418.2	4.545	3.317	0.067	49.750	12.112
418.6	4.637	3.323	0.073	45.318	12.020
420.2	4.637	3.350	0.100	33.500	12.020
420.5	4.729	3.355	0.105	31.952	11.928
422.2	4.729	3.383	0.133	25.375	11.928
422.5	4.822	3.388	0.138	24.494	11.835
424.2	4.822	3.417	0.167	20.500	11.835
424.6	4.914	3.423	0.173	19.750	11.743
426.2	4.914	3.450	0.200	17.250	11.743
426.5	5.006	3.455	0.205	16.854	11.651
428.2	5.006	3.483	0.233	14.929	11.651
428.6	5.098	3.490	0.240	14.542	11.559
430.2	5.098	3.517	0.267	13.188	11.559
432.2	5.168	3.550	0.300	11.833	11.489
434.2	5.26	3.583	0.333	10.750	11.397
436.2	5.352	3.617	0.367	9.864	11.305
438.2	5.421	3.650	0.400	9.125	11.236
440.2	5.514	3.683	0.433	8.500	11.143
442.2	5.583	3.717	0.467	7.964	11.074
444.2	5.675	3.750	0.500	7.500	10.982
446.2	5.744	3.783	0.533	7.094	10.913
448.2	5.814	3.817	0.567	6.735	10.843
450.2	5.883	3.850	0.600	6.417	10.774
452.2	5.929	3.883	0.633	6.132	10.728
454.2	5.998	3.917	0.667	5.875	10.659
456.2	6.044	3.950	0.700	5.643	10.613
458.2	6.09	3.983	0.733	5.432	10.567
460.2	6.114	4.017	0.767	5.239	10.543
465.2	6.183	4.100	0.850	4.824	10.474
470.2	6.275	4.183	0.933	4.482	10.382
475.2	6.367	4.267	1.017	4.197	10.290
480.2	6.437	4.350	1.100	3.955	10.220
485.2	6.529	4.433	1.183	3.746	10.128
490.2	6.621	4.517	1.267	3.566	10.036
495.2	6.713	4.600	1.350	3.407	9.944
500.2	6.806	4.683	1.433	3.267	9.851
505.2	6.921	4.767	1.517	3.143	9.736
510.2	7.036	4.850	1.600	3.031	9.621
520.2	7.267	5.017	1.767	2.840	9.390
530.1	7.544	5.182	1.932	2.682	9.113
540.2	7.844	5.350	2.100	2.548	8.813

Notes: 1) Well bailed at 1.2 gpm for 3.25 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began)

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
550.2	8.144	5.517	2.267	2.434	8.513
560.2	8.444	5.683	2.433	2.336	8.213
570.1	8.72	5.848	2.598	2.251	7.937
580.2	8.974	6.017	2.767	2.175	7.683
590.1	9.182	6.182	2.932	2.109	7.475
600.2	9.389	6.350	3.100	2.048	7.268
610.1	9.574	6.515	3.265	1.995	7.083
620.1	9.736	6.682	3.432	1.947	6.921
630.2	9.92	6.850	3.600	1.903	6.737
640.2	10.082	7.017	3.767	1.863	6.575
650.2	10.243	7.183	3.933	1.826	6.414
660.1	10.405	7.348	4.098	1.793	6.252
670.2	10.566	7.517	4.267	1.762	6.091
680.2	10.728	7.683	4.433	1.733	5.929
690.2	10.866	7.850	4.600	1.707	5.791
700.2	11.027	8.017	4.767	1.682	5.630
710.2	11.166	8.183	4.933	1.659	5.491
740.2	11.558	8.683	5.433	1.598	5.099
770.1	11.927	9.182	5.932	1.548	4.730
800.1	12.273	9.682	6.432	1.505	4.384
830.1	12.573	10.182	6.932	1.469	4.084
860.1	12.873	10.682	7.432	1.437	3.784
890.1	13.127	11.182	7.932	1.410	3.530
920.1	13.358	11.682	8.432	1.385	3.299
950.1	13.588	12.182	8.932	1.364	3.069
980.1	13.773	12.682	9.432	1.345	2.884
1010.1	13.957	13.182	9.932	1.327	2.700
1040.1	14.096	13.682	10.432	1.312	2.561
1070.1	14.257	14.182	10.932	1.297	2.400
1100.1	14.373	14.682	11.432	1.284	2.284
1130.1	14.488	15.182	11.932	1.272	2.169
1160.1	14.603	15.682	12.432	1.261	2.054
1190.1	14.696	16.182	12.932	1.251	1.961
1220.1	14.765	16.682	13.432	1.242	1.892
1250.1	14.834	17.182	13.932	1.233	1.823
1280.1	14.903	17.682	14.432	1.225	1.754
1310.2	14.949	18.183	14.933	1.218	1.708
1370.1	15.019	19.182	15.932	1.204	1.638
1430.1	15.065	20.182	16.932	1.192	1.592
1490.1	15.088	21.182	17.932	1.181	1.569
1550.1	15.111	22.182	18.932	1.172	1.546
1610.1	15.111	23.182	19.932	1.163	1.546
1670.1	15.157	24.182	20.932	1.155	1.500
1730.1	15.18	25.182	21.932	1.148	1.477
1790.1	15.18	26.182	22.932	1.142	1.477
1850.1	15.203	27.182	23.932	1.136	1.454
1910.1	15.226	28.182	24.932	1.130	1.431
1970.1	15.249	29.182	25.932	1.125	1.408
2030.1	15.249	30.182	26.932	1.121	1.408
2090.1	15.272	31.182	27.932	1.116	1.385
2150.1	15.272	32.182	28.932	1.112	1.385
2210.1	15.295	33.182	29.932	1.109	1.362

Notes: 1) Well bailed at 1.2 gpm for 3.25 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began).

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
2270.1	15.318	34.182	30.932	1.105	1.339
2330.1	15.318	35.182	31.932	1.102	1.339
2390.1	15.318	36.182	32.932	1.099	1.339
2450.1	15.342	37.182	33.932	1.096	1.315
2510.1	15.342	38.182	34.932	1.093	1.315
2570.1	15.342	39.182	35.932	1.090	1.315
2630.1	15.342	40.182	36.932	1.088	1.315
2690.1	15.342	41.182	37.932	1.086	1.315
2750.1	15.342	42.182	38.932	1.083	1.315

Notes: 1) Well bailed at 1.2 gpm for 3.25 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began).

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
0	15.9852				
3	16.1				
5.9	16.1				
9.2	16.1				
446.4	10.981	6.000	0.000	#DIV/0!	5.119
447.8	11.051	6.023	0.023	258.143	5.049
448.2	11.189	6.030	0.030	201.000	4.911
449.8	11.143	6.057	0.057	106.882	4.957
450.3	11.258	6.065	0.065	93.308	4.842
451.8	11.235	6.090	0.090	67.667	4.865
452.2	11.35	6.097	0.097	63.069	4.750
453.8	11.327	6.123	0.123	49.649	4.773
454.2	11.42	6.130	0.130	47.154	4.680
455.8	11.397	6.157	0.157	39.298	4.703
456.3	11.512	6.165	0.165	37.364	4.588
457.8	11.489	6.190	0.190	32.579	4.611
458.2	11.604	6.197	0.197	31.508	4.496
459.8	11.558	6.223	0.223	27.866	4.542
460.3	11.673	6.232	0.232	26.899	4.427
461.9	11.65	6.258	0.258	24.226	4.450
463.8	11.72	6.290	0.290	21.690	4.380
465.9	11.789	6.325	0.325	19.462	4.311
467.8	11.858	6.357	0.357	17.822	4.242
469.9	11.927	6.392	0.392	16.319	4.173
471.8	11.996	6.423	0.423	15.173	4.104
473.9	12.066	6.458	0.458	14.091	4.034
475.8	12.112	6.490	0.490	13.245	3.988
477.9	12.181	6.525	0.525	12.429	3.919
479.9	12.25	6.558	0.558	11.746	3.850
481.9	12.296	6.592	0.592	11.141	3.804
486.9	12.435	6.675	0.675	9.889	3.665
491.8	12.573	6.757	0.757	8.930	3.527
496.9	12.712	6.842	0.842	8.129	3.388
501.8	12.827	6.923	0.923	7.498	3.273
506.9	12.942	7.008	1.008	6.950	3.158
511.9	13.058	7.092	1.092	6.496	3.042
516.9	13.173	7.175	1.175	6.106	2.927
521.8	13.265	7.257	1.257	5.775	2.835
526.8	13.358	7.340	1.340	5.478	2.742
531.9	13.45	7.425	1.425	5.211	2.650
541.8	13.611	7.590	1.590	4.774	2.489
551.8	13.773	7.757	1.757	4.416	2.327
561.8	13.934	7.923	1.923	4.120	2.166
571.8	14.05	8.090	2.090	3.871	2.050
581.8	14.188	8.257	2.257	3.659	1.912
591.8	14.28	8.423	2.423	3.476	1.820
601.8	14.396	8.590	2.590	3.317	1.704
611.8	14.488	8.757	2.757	3.177	1.612
621.8	14.58	8.923	2.923	3.052	1.520
631.9	14.673	9.092	3.092	2.941	1.427
661.8	14.88	9.590	3.590	2.671	1.220
691.8	15.042	10.090	4.090	2.467	1.058
721.8	15.18	10.590	4.590	2.307	0.920
751.8	15.295	11.090	5.090	2.179	0.805
781.8	15.411	11.590	5.590	2.073	0.689
811.8	15.48	12.090	6.090	1.985	0.620
841.8	15.549	12.590	6.590	1.910	0.551

Notes: 1) Well bailed at 0.67 gpm for 6.0 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began)

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
871.8	15.595	13.090	7.090	1.846	0.505
901.8	15.665	13.590	7.590	1.791	0.435
931.8	15.711	14.090	8.090	1.742	0.389
961.8	15.734	14.590	8.590	1.698	0.366
991.8	15.78	15.090	9.090	1.660	0.320
1021.8	15.803	15.590	9.590	1.626	0.297
1051.8	15.826	16.090	10.090	1.595	0.274
1081.8	15.849	16.590	10.590	1.567	0.251
1111.8	15.872	17.090	11.090	1.541	0.228
1141.8	15.872	17.590	11.590	1.518	0.228
1171.8	15.895	18.090	12.090	1.496	0.205
1201.8	15.918	18.590	12.590	1.477	0.182
1231.9	15.918	19.092	13.092	1.458	0.182
1291.8	15.941	20.090	14.090	1.426	0.159
1351.8	15.964	21.090	15.090	1.398	0.136
1411.8	15.988	22.090	16.090	1.373	0.112
1471.8	15.988	23.090	17.090	1.351	0.112
1531.8	16.011	24.090	18.090	1.332	0.089
1591.8	16.011	25.090	19.090	1.314	0.089
1651.8	16.034	26.090	20.090	1.299	0.066
1711.8	16.034	27.090	21.090	1.284	0.066
1771.8	16.034	28.090	22.090	1.272	0.066
1831.8	16.057	29.090	23.090	1.260	0.043
1891.8	16.057	30.090	24.090	1.249	0.043
1951.8	16.057	31.090	25.090	1.239	0.043

Notes: 1) Well bailed at 0.67 gpm for 6.0 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began).

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
0	16.841				
3.2	16.98				
7.9	16.98				
13.4	16.98				
517.1	16.956				
518.7	16.011	7.300	0.000	#DIV/0!	0.969
519.2	16.149	7.308	0.008	877.000	0.831
520.7	16.264	7.333	0.033	220.000	0.716
521.1	16.403	7.340	0.040	183.500	0.577
522.7	16.472	7.367	0.067	110.500	0.508
523.1	16.61	7.373	0.073	100.545	0.370
524.7	16.587	7.400	0.100	74.000	0.393
525.2	16.726	7.408	0.108	68.385	0.254
526.7	16.703	7.433	0.133	55.750	0.277
527.1	16.818	7.440	0.140	53.143	0.162
528.7	16.772	7.467	0.167	44.800	0.208
529.1	16.887	7.473	0.173	43.115	0.093
530.8	16.818	7.502	0.202	37.198	0.162
531.2	16.933	7.508	0.208	36.040	0.047
532.7	16.864	7.533	0.233	32.286	0.116
533.1	16.98	7.540	0.240	31.417	0.000
534.7	16.887	7.567	0.267	28.375	0.093
535.2	17.003	7.575	0.275	27.545	-0.023
536.8	16.91	7.602	0.302	25.199	0.070
537.1	17.026	7.607	0.307	24.804	-0.046
538.7	16.933	7.633	0.333	22.900	0.047
539.1	17.026	7.640	0.340	22.471	-0.046
540.8	16.933	7.668	0.368	20.819	0.047
541.2	17.049	7.675	0.375	20.467	-0.069
542.7	16.933	7.700	0.400	19.250	0.047
543.1	17.049	7.707	0.407	18.951	-0.069
544.7	16.956	7.733	0.433	17.846	0.024
545.1	17.049	7.740	0.440	17.591	-0.069
546.8	16.956	7.768	0.468	16.587	0.024
547.2	17.049	7.775	0.475	16.368	-0.069
549.8	16.956	7.818	0.518	15.084	0.024
551.8	16.956	7.852	0.552	14.233	0.024
553.8	16.956	7.885	0.585	13.479	0.024
555.7	16.956	7.917	0.617	12.838	0.024
557.8	16.956	7.952	0.652	12.202	0.024
559.7	16.956	7.983	0.683	11.683	0.024
561.8	16.956	8.018	0.718	11.162	0.024
563.7	16.956	8.050	0.750	10.733	0.024
565.7	16.956	8.083	0.783	10.319	0.024
567.7	16.956	8.117	0.817	9.939	0.024
569.7	16.98	8.150	0.850	9.588	0.000
571.7	16.98	8.183	0.883	9.264	0.000
573.7	16.956	8.217	0.917	8.964	0.024
575.7	16.956	8.250	0.950	8.684	0.024

Notes: 1) Well bailed at 1.1 gpm for 7.3 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began).

Time in Seconds	Height of Water Above Transducer in Feet	t in Minutes	t' in Minutes	t/t'	Residual Drawdown in Feet
577.7	16.98	8.283	0.983	8.424	0.000
579.7	16.98	8.317	1.017	8.180	0.000
581.7	16.98	8.350	1.050	7.952	0.000
583.8	16.98	8.385	1.085	7.728	0.000
585.7	16.98	8.417	1.117	7.537	0.000
587.8	16.98	8.452	1.152	7.339	0.000
592.7	16.956	8.533	1.233	6.919	0.024
597.8	16.956	8.618	1.318	6.537	0.024
602.7	16.98	8.700	1.400	6.214	0.000
607.7	16.956	8.783	1.483	5.921	0.024
612.8	16.98	8.868	1.568	5.655	0.000
617.7	16.956	8.950	1.650	5.424	0.024
622.7	16.956	9.033	1.733	5.212	0.024
627.7	16.98	9.117	1.817	5.018	0.000
632.7	16.956	9.200	1.900	4.842	0.024
637.8	16.98	9.285	1.985	4.678	0.000
647.7	16.956	9.450	2.150	4.395	0.024
657.7	16.956	9.617	2.317	4.151	0.024
667.7	16.98	9.783	2.483	3.940	0.000
677.7	16.956	9.950	2.650	3.755	0.024
687.7	16.98	10.117	2.817	3.592	0.000
697.7	16.956	10.283	2.983	3.447	0.024
707.7	16.98	10.450	3.150	3.317	0.000
717.7	16.98	10.617	3.317	3.201	0.000
727.7	16.98	10.783	3.483	3.096	0.000
737.8	16.98	10.952	3.652	2.999	0.000

Notes: 1) Well bailed at 1.1 gpm for 7.3 minutes.
2) t = Elapsed total time since bailing began; t' = Elapsed time since bailing stopped (recovery began)

Time in Seconds	Height of Water Above Transducer in Feet	
0	16.38	
3.7	16.403	
7.5	16.403	
11.1	16.403	
14.7	16.403	
55.9	16.38	**BEGIN BAILING AT 0.9 GPM**
59.6	16.38	**(See text for discussion)**
62.6	16.403	
65.6	16.403	
68.6	16.403	
71.6	16.403	
74.5	16.403	
77.6	16.403	
80.6	16.426	
83.6	16.403	
86.5	16.403	
89.6	16.403	
92.6	16.403	
95.5	16.403	
98.6	16.403	
101.6	16.403	
104.6	16.403	
107.6	16.403	
110.6	16.403	
113.5	16.403	
116.6	16.403	
119.6	16.403	
122.6	16.403	
125.6	16.426	
128.5	16.38	
131.6	16.403	
134.5	16.403	
137.6	16.403	
140.6	16.403	
143.6	16.403	
146.6	16.403	
149.6	16.403	
152.6	16.403	
155.5	16.403	
158.6	16.403	
161.6	16.403	
164.6	16.403	
167.6	16.426	
170.5	16.403	
173.5	16.403	
176.6	16.403	
179.6	16.403	
182.5	16.403	
185.6	16.403	
188.6	16.426	
191.6	16.403	
194.5	16.403	
197.6	16.403	
200.6	16.403	
203.5	16.403	
206.5	16.403	
209.6	16.426	
212.6	16.403	
215.6	16.403	
218.6	16.403	
221.6	16.403	

Time in Seconds	Height of Water Above Transducer in Feet	
224.5	16.403	CONTINUE BAILING AT 0.9 GPM
227.6	16.403	
230.6	16.426	
233.6	16.403	
236.6	16.403	
239.5	16.403	
242.6	16.403	
245.6	16.403	
248.5	16.426	
251.6	16.403	
254.6	16.403	
257.6	16.403	
260.6	16.403	
263.5	16.403	
266.6	16.403	
269.6	16.426	
272.6	16.403	
275.5	16.403	
278.5	16.403	
281.6	16.403	
284.6	16.403	
287.6	16.426	
290.6	16.403	
293.6	16.403	
296.6	16.403	
299.6	16.403	
302.6	16.403	
305.5	16.403	
308.6	16.426	
311.6	16.403	
314.5	16.403	
317.5	16.403	
320.6	16.403	
323.6	16.403	
326.6	16.403	
329.5	16.426	
332.6	16.426	
335.6	16.403	
338.5	16.403	
341.6	16.403	
344.6	16.403	
347.6	16.403	
350.6	16.426	
353.5	16.426	
356.5	16.403	
359.6	16.403	
362.6	16.403	
365.6	16.403	
368.5	16.403	
371.6	16.426	
374.6	16.426	
377.6	16.403	
380.6	16.403	
383.5	16.403	
386.6	16.403	
389.5	16.403	
392.5	16.403	
395.6	16.426	
398.6	16.426	
401.6	16.403	
404.5	16.403	

Time in Seconds	Height of Water Above Transducer in Feet	
407 6	16 403	CONTINUE BAILING AT 0.9 GPM
410.6	16.403	
413.6	16.403	
416 5	16.426	
419 5	16.426	
422.6	16.426	
425.6	16.403	
428.5	16.403	
431 6	16 403	
434.6	16 403	
437.5	16.426	
440 6	16.403	
443.5	16.426	
446.6	16 426	
449.6	16.403	
452.5	16.403	
455 5	16.403	
458 6	16 403	
461 6	16.403	
464.5	16.403	
467.6	16.426	
470 6	16 426	
473 6	16.403	
476.5	16.403	
479.5	16.403	
482.6	16 403	
485.6	16.426	
488.5	16.426	
491 6	16.426	
494 5	16 426	
497.5	16.426	
500.6	16.426	
503.6	16.403	
506 5	16.403	
509.5	16 403	
512.6	16.403	
515.5	16.403	
518 5	16 426	
521.5	16.426	
524.6	16.426	
527.6	16.403	
530 5	16.403	
533.5	16 403	
536.6	16.403	
539.6	16.403	
542.6	16.403	
545 6	16 426	
548.5	16.426	
551.6	16.403	
554 5	16.403	
557.6	16 403	
560.6	16 403	
563.6	16.426	
566 6	16.426	
569 5	16 426	
572.5	16.403	
575.5	16.426	
578 6	16.403	
581 6	16.403	
584 5	16 403	
587.5	16 426	

Time in Seconds	Height of Water Above Transducer in Feet	
590.5	16.426	CONTINUE BAILING AT 0.9 GPM
593.6	16.426	
596.6	16.426	
599.5	16.426	
602.5	16.403	
605.5	16.403	
608.5	16.403	
611.6	16.403	
614.5	16.403	
617.5	16.426	
620.5	16.403	
623.5	16.426	
626.5	16.403	
629.5	16.403	
632.5	16.403	
635.6	16.403	
638.5	16.403	
641.5	16.403	
644.6	16.426	
647.6	16.426	
650.5	16.403	
653.6	16.426	
656.6	16.426	BAILING STOPPED AT 10 MINUTES
657.1	16.518	"RECOVERY"
658.5	16.426	
658.9	16.518	
660.5	16.426	
660.9	16.518	
662.6	16.426	
663	16.495	
664.5	16.426	
665	16.518	
666.5	16.426	
666.9	16.518	
668.5	16.403	
668.9	16.518	
670.5	16.426	
671	16.518	
672.5	16.426	
672.9	16.518	
674.5	16.403	
674.9	16.518	
676.5	16.426	
677	16.518	
678.5	16.426	
679	16.518	
680.5	16.426	
680.9	16.518	
682.5	16.426	
682.9	16.518	
684.5	16.426	
685	16.518	
686.6	16.426	
688.5	16.403	
690.6	16.403	
692.5	16.403	
694.5	16.403	
696.6	16.426	
698.5	16.403	
700.5	16.426	
702.6	16.403	
704.5	16.426	

Time in Seconds	Height of Water Above Transducer In Feet
706.6	16.426
711.5	16.403
716.5	16.426
721.6	16.403
726.6	16.403
731.5	16.403
736.5	16.403
741.5	16.403
746.6	16.403
751.6	16.403

Table C-14 - Pumping Test Data for Domestic Well No. 4

Elapsed Time (t) in Minutes	Depth to Water in Feet	Drawdown in Feet	t'	t/t'
1.00	46.57	4.47		
2.00	46.37	4.27		
3.00	46.56	4.46		
4.00	46.40	4.30		
5.00	46.61	4.51		
5.50	46.64	4.54		
7.00	46.45	4.35		
8.00	46.39	4.29		
9.00	46.40	4.30		
10.50	46.38	4.28		
12.00	46.43	4.33		
14.00	46.43	4.33		
15.05	46.37	4.27	0.05	301.00
15.33	46.10	4.00	0.33	46.45
15.67	44.45	2.35	0.67	23.39
16.00	44.06	1.96	1.00	16.00
16.33	43.74	1.64	1.33	12.28
16.67	43.57	1.47	1.67	9.98
17.00	43.43	1.33	2.00	8.50
17.33	43.24	1.14	2.33	7.44
17.67	43.05	0.95	2.67	6.62
18.00	42.96	0.86	3.00	6.00
18.33	42.87	0.77	3.33	5.50
18.67	42.74	0.64	3.67	5.09
19.00	42.67	0.57	4.00	4.75
19.50	42.63	0.53	4.50	4.33
20.00	42.44	0.34	5.00	4.00
21.00	42.30	0.20	6.00	3.50
22.17	42.22	0.12	7.17	3.09
23.00	42.16	0.06	8.00	2.88
24.00	42.13	0.03	9.00	2.67
25.50	42.14	0.04	10.50	2.43

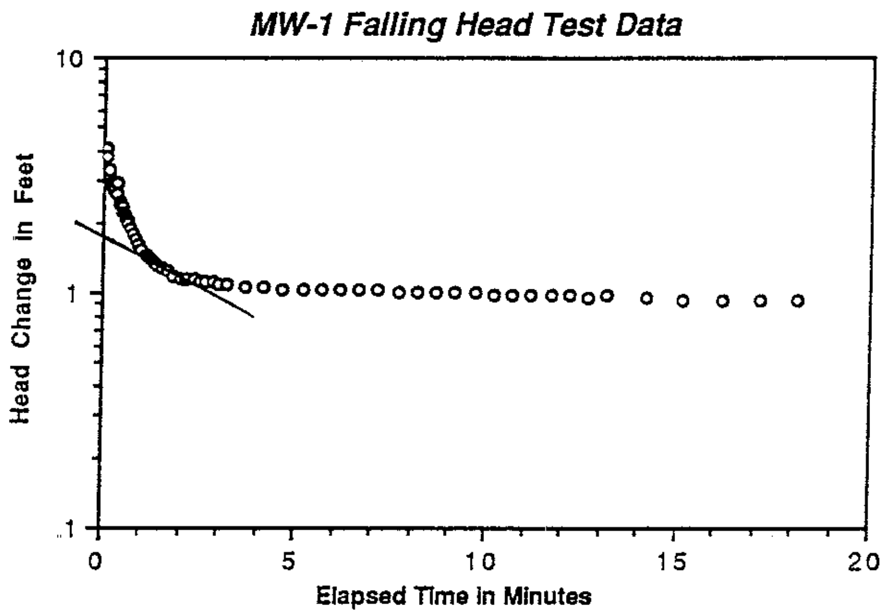
Notes:
1) Well pumped at 10.0 gpm for 15 minutes.
2) t = Elapsed total time since pump turned off; t' = Elapsed time since pump turned off

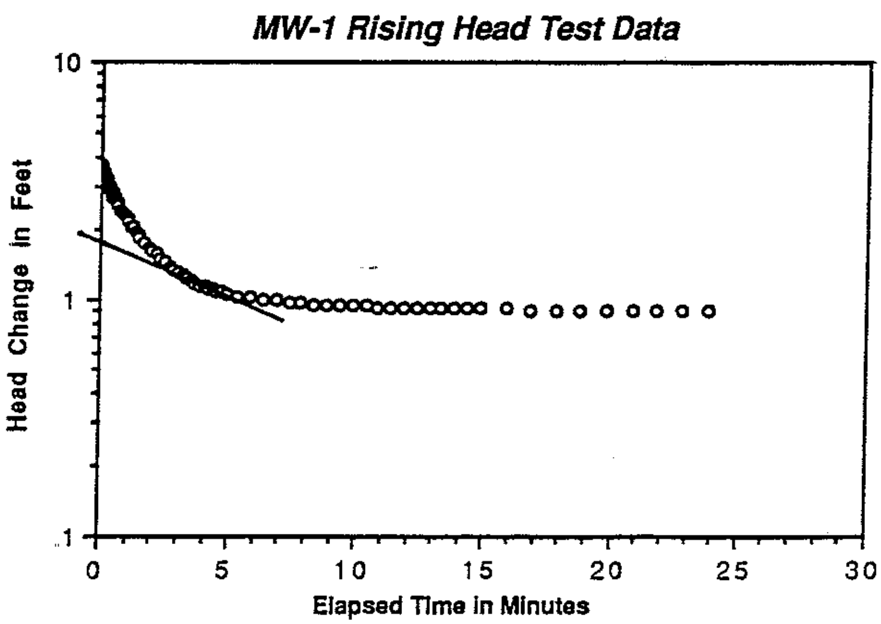
Table C-15 - Pumping Test Data for Domestic Well No. 8

Hart Crowser
J-2484

Elapsed Time (t) in Minutes	Depth to Water in Feet	Drawdown in Feet	t'	t/t'
0.50	17.06	1.18		
1.00	20.37	4.49		
1.50	22.71	6.83		
2.08	25.03	9.15		
2.75	27.63	11.75		
3.33	29.64	13.76		
4.00	31.72	15.84		
5.00	35.52	19.64		
5.50	35.54	19.66		
6.00	36.83	20.95		
7.25	39.10	23.22		
8.00	40.33	24.45		
8.50	41.32	25.44		
9.00	42.08	26.20		
9.50	42.73	26.85		
10.00	43.33	27.45		
10.50	43.95	28.07		
11.00	44.52	28.64		
12.00	45.53	29.65		
13.00	46.39	30.51		
14.00	47.16	31.28		
15.00	47.89	32.01		
16.00	48.54	32.66		
17.00	49.08	33.20		
18.33	49.80	33.92		
19.00	50.04	34.16		
20.00	50.42	34.54	0.00	#DIV/0!
20.67	48.50	32.62	0.67	30.85
21.00	46.89	31.01	1.00	21.00
21.50	44.76	28.88	1.50	14.33
22.00	42.86	26.98	2.00	11.00
22.50	41.08	25.20	2.50	9.00
23.00	39.48	23.60	3.00	7.67
24.16	36.08	20.20	4.16	5.81
24.50	35.26	19.38	4.50	5.44
25.00	33.96	18.08	5.00	5.00
25.50	32.93	17.05	5.50	4.64
26.00	31.87	15.99	6.00	4.33
26.50	30.86	14.98	6.50	4.08
27.00	29.92	14.04	7.00	3.86
28.00	28.31	12.43	8.00	3.50
29.00	26.83	10.95	9.00	3.22
30.00	25.54	9.66	10.00	3.00
31.00	24.41	8.53	11.00	2.82
32.00	23.41	7.53	12.00	2.67
33.00	22.57	6.69	13.00	2.54
34.00	21.83	5.95	14.00	2.43
35.00	21.13	5.25	15.00	2.33
36.00	20.57	4.69	16.00	2.25
37.00	20.04	4.16	17.00	2.18
38.00	19.59	3.71	18.00	2.11
40.00	18.81	2.93	20.00	2.00
42.00	18.24	2.36	22.00	1.91
44.00	17.79	1.91	24.00	1.83
46.00	17.35	1.47	26.00	1.77
48.00	17.06	1.18	28.00	1.71
50.00	16.89	1.01	30.00	1.67
52.00	16.62	0.74	32.00	1.63
54.00	16.48	0.60	34.00	1.59
56.00	16.33	0.45	36.00	1.56
58.00	16.22	0.34	38.00	1.53
60.08	16.13	0.25	40.08	1.50
65.00	15.95	0.07	45.00	1.44
67.00	15.89	0.01	47.00	1.43
70.00	15.88	0.00	50.00	1.40

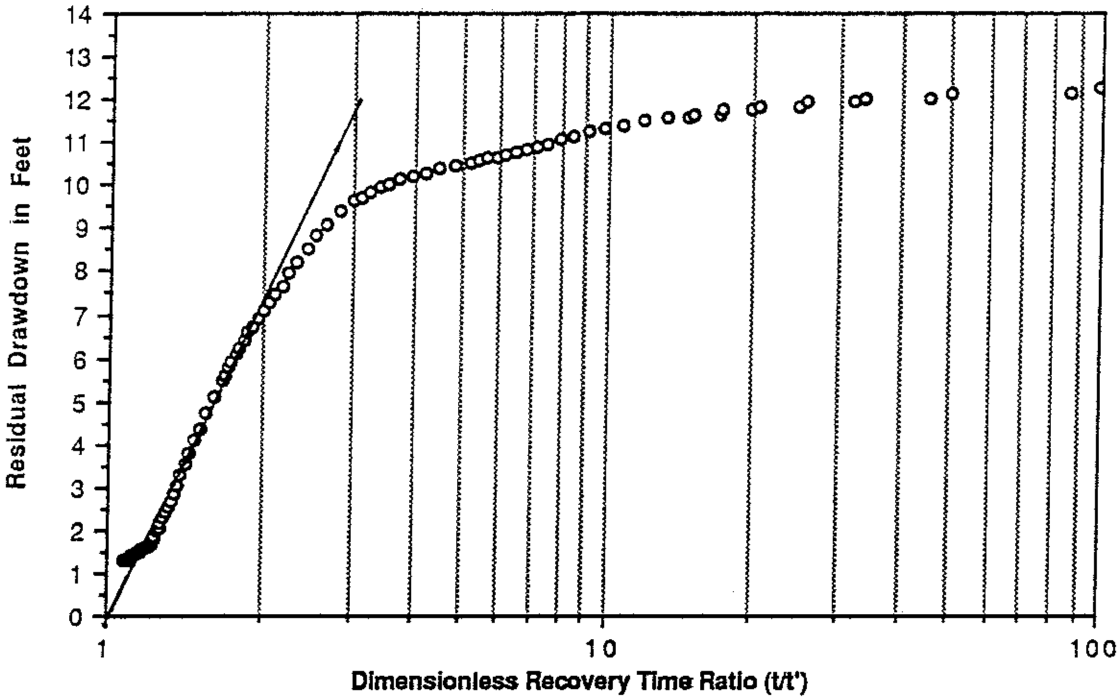
Notes: 1) Well pumped at 8.0 gpm for 20 minutes.
2) t = Elapsed total time since pump turned off; t' = Elapsed time since pump turned off.





HARTCROWSER
J-2484 7/90
Figure C-1

MW-1 Recovery Test Data



Notes: Well bailed at 1.2 gpm.

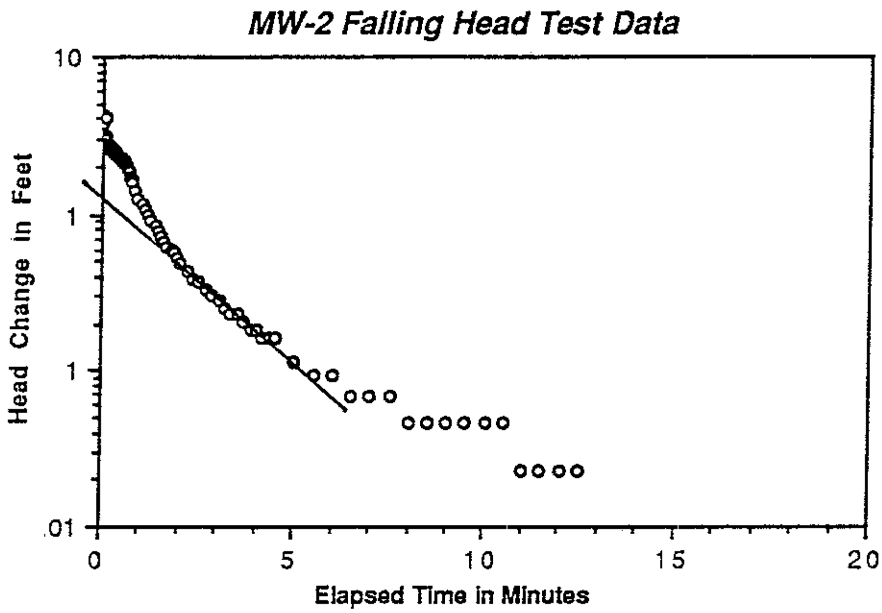
t = Total time since start of bailing.

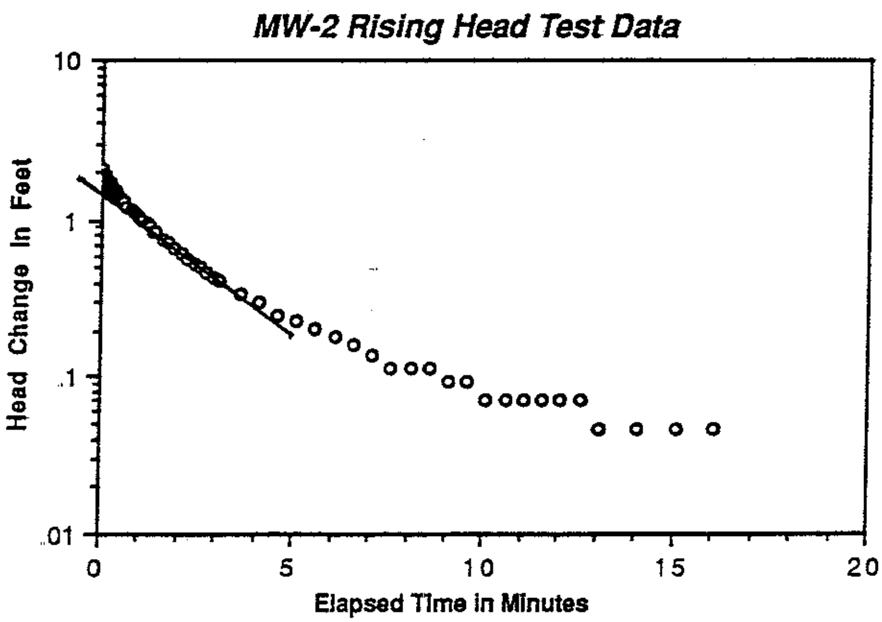
t' = Time since bailing stopped.

HARTCROWSER

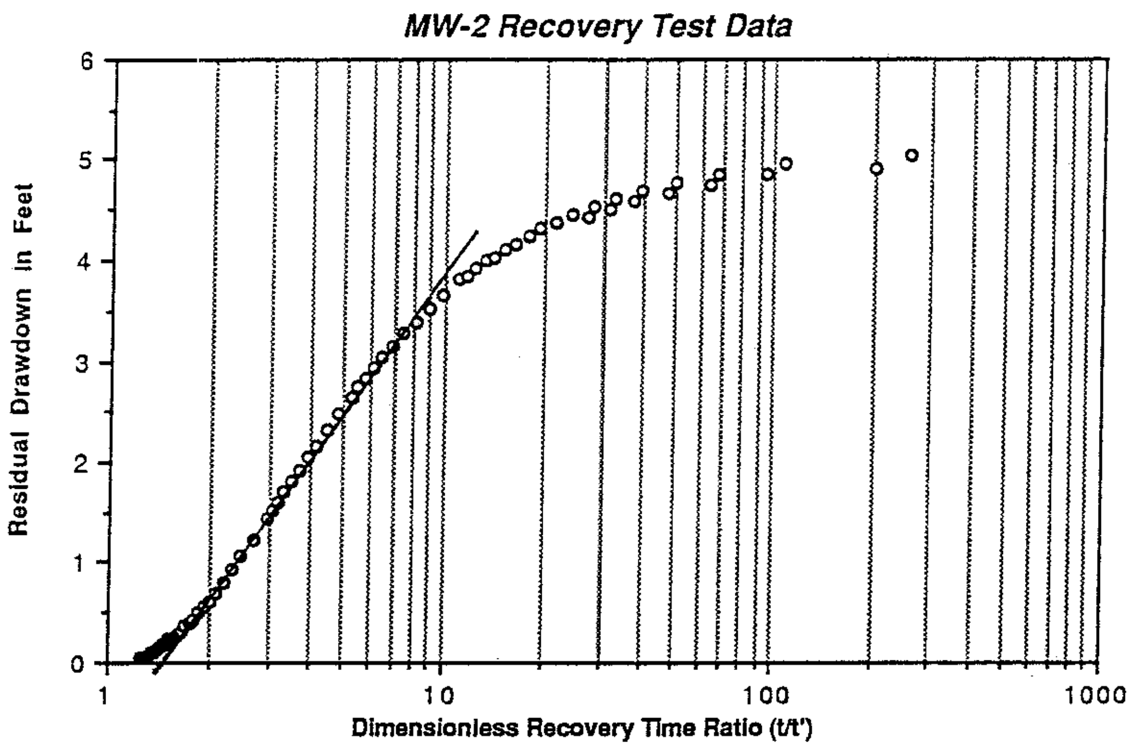
J-2484 7/90

Figure C-2





HARTCROWSER
J-2484 7/90
Figure C-3



Notes: Well bailed at 0.67 gpm.
t = Total time since start of bailing.
t' = Time since bailing stopped.

HARTCROWSER
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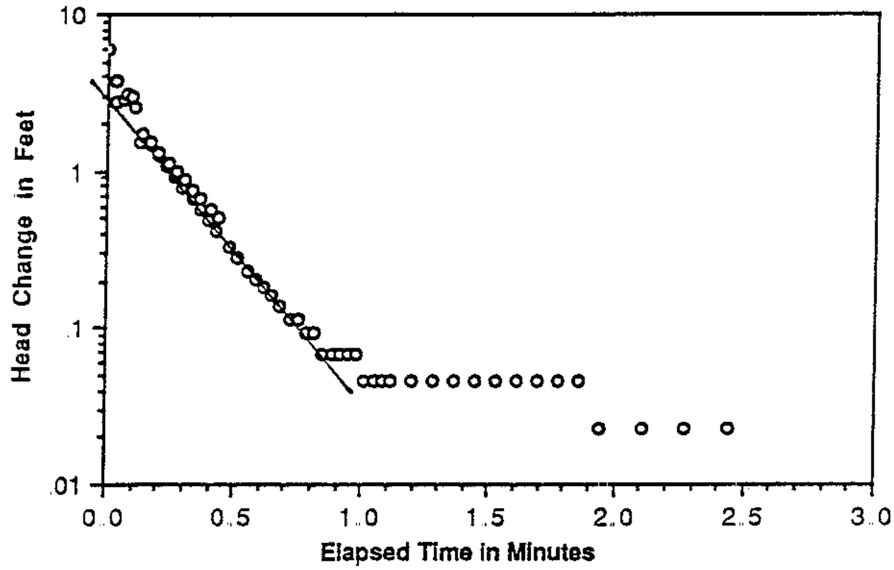
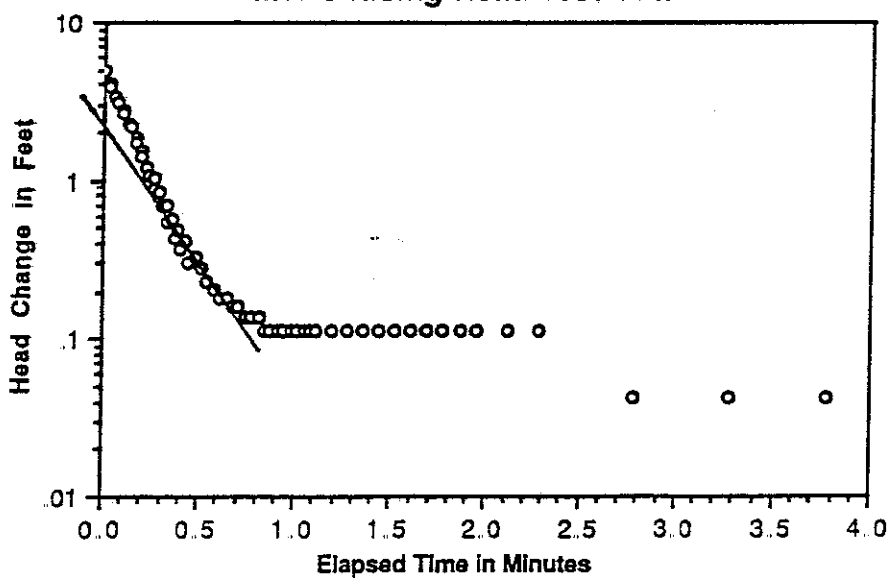
Figure C-4

MW-3 Falling Head Test Data

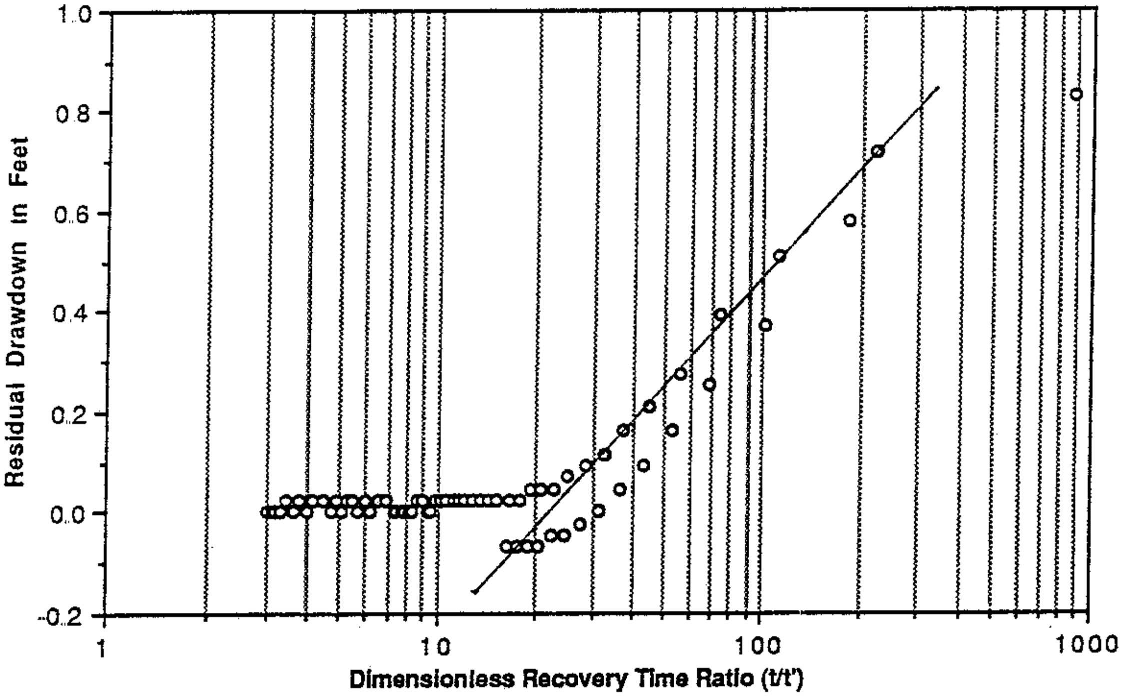


MW-3 Rising Head Test Data



HARTCROWSER
J-2484 7/90
Figure C-5

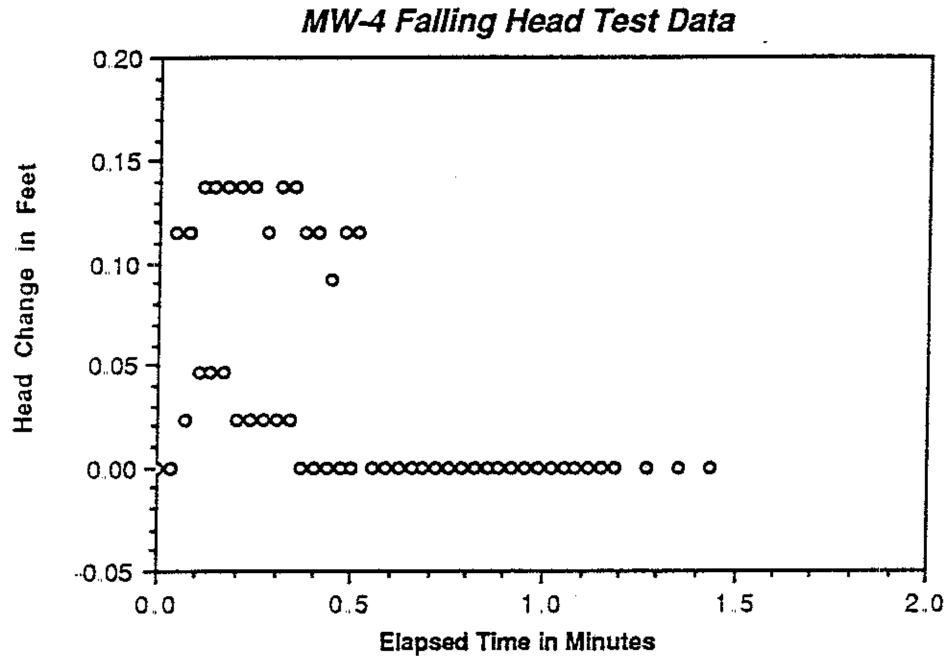
MW-3 Recovery Test Data



Notes: Well bailed at 1.1 gpm.
t = Total time since start of bailing.
t' = Time since bailing stopped.

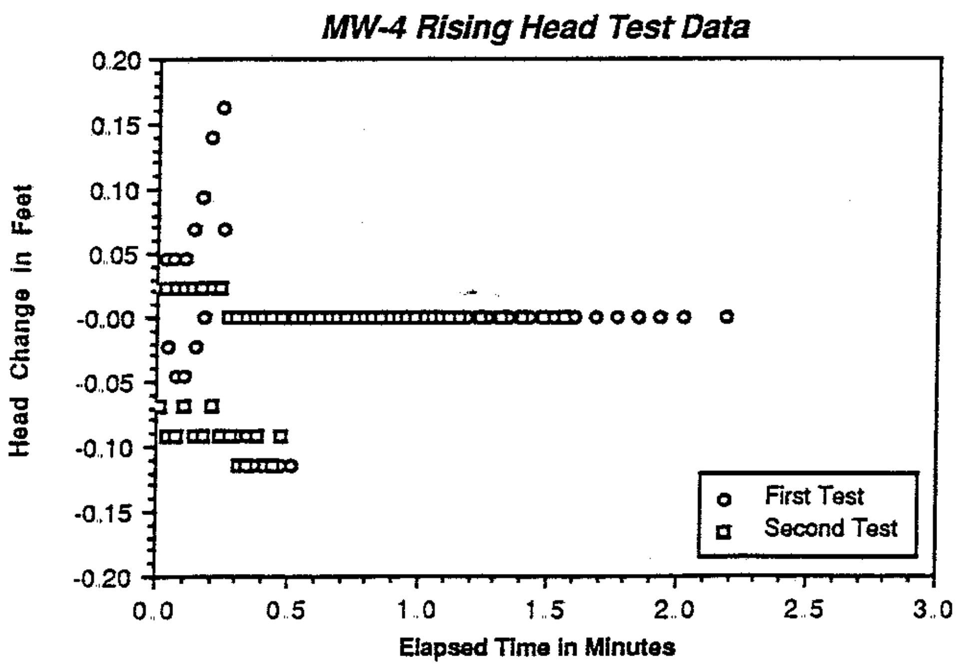
HARTCROWSER
J-2484 7/90
Figure C-6

MW-4 Falling Head Test Data



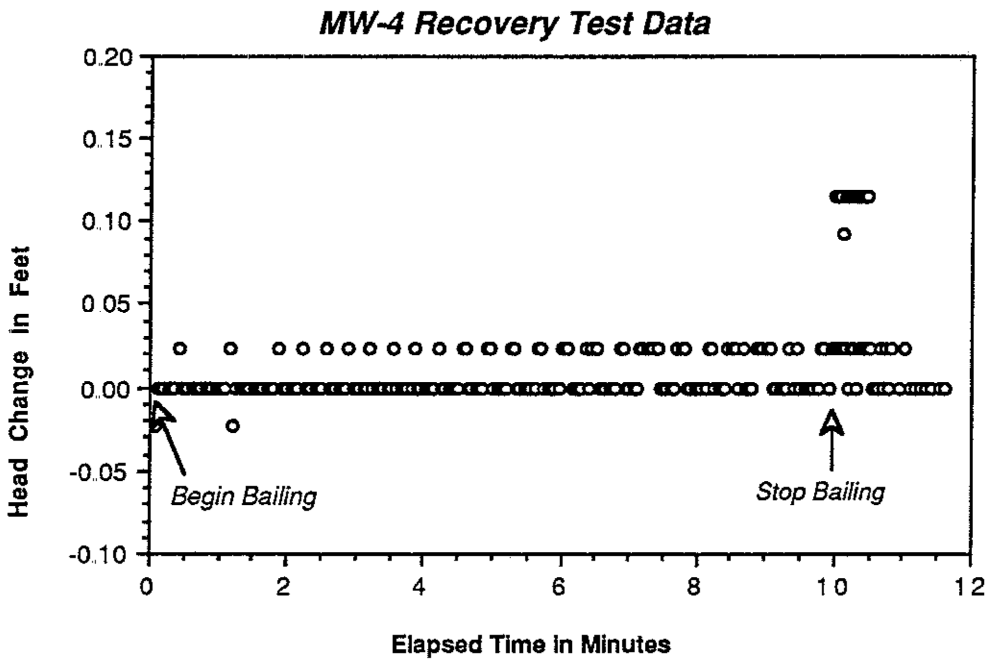
Notes: 1) Unable to analyze data.
2) Unable to plot head change data on log axis because of zero or negative values.

MW-4 Rising Head Test Data



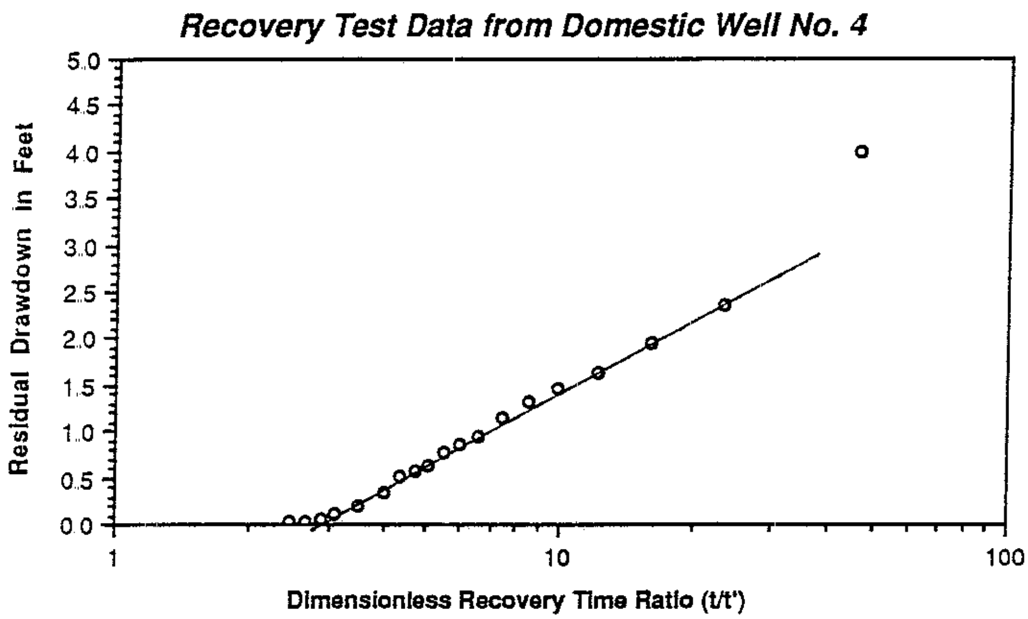
Notes: 1) Unable to analyze data.
2) Unable to plot head change data on log axis because of zero or negative values.

HARTCROWSER
J-2484 7/90
Figure C-7

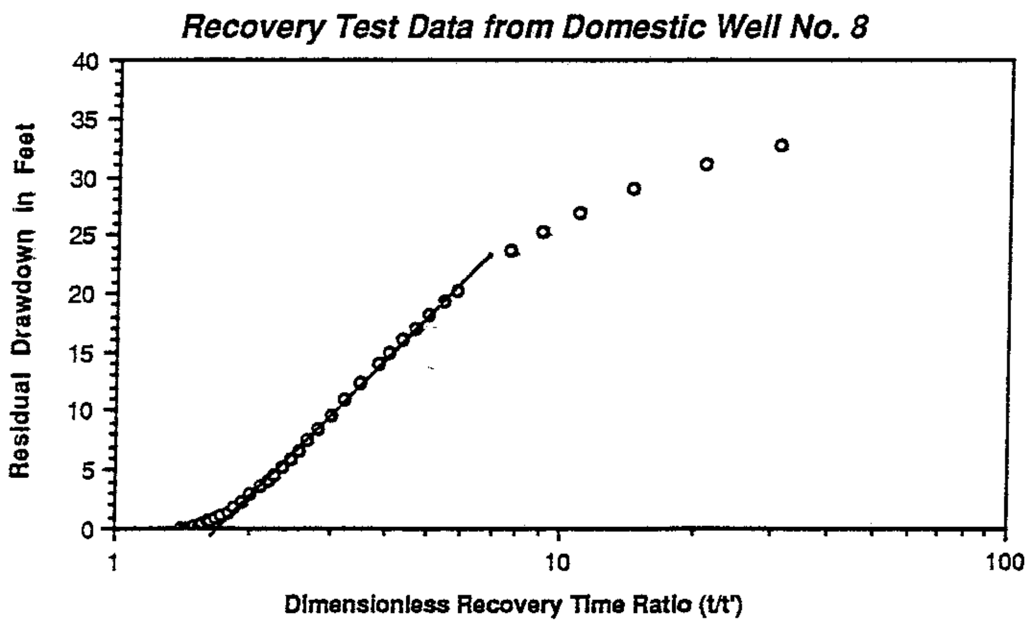


Notes: 1) Unable to analyze data.
2) Unable to plot head change data on log axis because of zero or negative values.

HARTCROWSER
J-2484 7/90
Figure C-8



Note: Well pumped at 10 gpm.
t = Total time since start of pumping.
t' = Time since pump shut off.



Note: Well pumped at 8 gpm.
t = Total time since start of pumping.
t' = Time since pump shut off.

APPENDIX D
WELL LOG INVENTORY
SOUTH KING COUNTY GROUNDWATER MANAGEMENT PROGRAM DATABASE

APPENDIX D
WELL LOG INVENTORY
SOUTH KING COUNTY GROUNDWATER MANAGEMENT PROGRAM DATABASE

This appendix contains the geologic well log reports and the well construction reports from the South King County Groundwater Management Plan database. Figure 12 displays the location of the majority of these wells, along with the approximate well depth and water level elevation at time of drilling.

The "local number" can be used to locate a particular well in the data base and on Figure 12. The local number is composed of three major terms. The first term is the township number, which provides a general north-south component to a well's location. In the case of Lake Sawyer, it is either "21N" (township 21 north) or "22N". The dividing line between these two townships is displayed on the upper right hand side of Figure 12.

The second term in the local number is the range, which provides an east-west component to a well's location. For the Lake Sawyer study, all wells are located in range 6E.

The first number of the final term is the section in which the well is located, within the specified township and range. Section numbers are included on Figure 12. Each section is alphabetically subdivided. Thus the letter component of this term provides further information on the location of the well within the section. The final number in this term is used to differentiate between wells in the same alphabetical subdivision of a section.

For example, the local number "22N/06E-32H01" specifies the following well location:

22N - Township 22 north;
06E - Range 6 east;
32 - Section 32 (within Township 22 north, Range 6 east);
H - Alphabetical subdivision within Section 32; and
01 - Number 1 well within subdivision H.

In this appendix the geologic well log reports are presented first, followed by the well construction reports. Within each of these two groups, the wells in Township 22N are presented first, followed by the wells in Township 21N. The wells in each township are arranged according to section number, starting with the lowest section and going to the highest.

The domestic wells used in the monitoring system could not always be correlated to a specific well number, as indicated in the following list:

Domestic Well Number	Local Number
1	?
2	?
3	?
4	21N/06E-04B07
5	21N/06E-03P02
6	?
7	?
8	?

Hart Crowser
J-2484

GEOLOGIC WELL LOG REPORTS

****

**** GEOLOGIC WELL LOG REPORT ****

****

SITEID 472118122033401 LOCAL NUMBER 22N/06E-32A01

LATITUDE 47 d 21 m 18 s LONGITUDE 122 d 03 m 34 s

ALTITUDE 520.00 DATE OF CONSTRUCTION 02 / 16 / 1977

DEPTH OF WELL 145.00 DEPTH OF HOLE 145.00

WATER LEVEL 120.00 DATE MEASURED 02 / 22 / 1977

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH 0

OWNER ID	SYSTEM NAME	CONTACT	PHONE
HAM149	HAMMER, LARRY		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 1	SURFACE
2 :	1- 23	BROWN GRAVEL AND BOULDERS
3 :	23- 132	BROWN HARDPAN BOULDERS
4 :	132- 141	BROWN WATER SAND AND GRAVEL
5 :	141- 145	BROWN HARDPACKED SAND AND GRAVEL
6 :	-	
7 :	-	

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$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$ GEOLOGIC WELL LOG REPORT $$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
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SITEID 472118122034001 LOCAL NUMBER 22N/06E-32A02

LATITUDE 47 d 21 m 18 s LONGITUDE 122 d 03 m 40 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 04 / 29 / 1980

DEPTH OF WELL 138.00 DEPTH OF HOLE 138.00

WATER LEVEL 104.00 DATE MEASURED 05 / 01 / 1980

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
DOD089	DODGE, JACK		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 2	SURFACE
2 :	2- 98	BROWN HARDPAN GRAVEL
3 :	98- 115	GRAY HARDPAN GRAVEL
4 :	115- 138	BROWN WATER GRAVEL
5 :	138-	GRAY CLAY AND GRAVEL
6 :	-	
7 :	-	

**** GEOLOGIC WELL LOG REPORT ****

SITEID 472124122042201 LOCAL NUMBER 22N/06E-32D01

LATITUDE 47 d 21 m 24 s LONGITUDE 122 d 04 m 22 s

ALTITUDE 415.00 DATE OF CONSTRUCTION 02 / 18 / 1980

DEPTH OF WELL 100.00 DEPTH OF HOLE 275.00

WATER LEVEL 30.00 DATE MEASURED 03 / 12 / 1980

DRILLER STORY/ARMSTR CONSTRUCTION METHOD C TYPE OF FINISH S

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 25	GRAVEL AND BOULDERS
2 :	25- 29	DIRTY BROWN SANDY GRAVEL
3 :	29- 31	DIRTY GRAVEL, WATER BEARING
4 :	31- 50	CEMENTED GRAVEL WITH BOULDERS
5 :	50- 64	BROWN TILL
6 :	64- 65	VERY DIRTY SAND, WATER BEARING
7 :	65- 66	DIRTY GRAVEL, WATER BEARING
8 :	66- 77	TIGHT DIRTY GRAVEL
9 :	77- 90	BROWN CLAY BOUND GRAVEL
10 :	90- 101	SAND AND GRAVEL, WATER BEARING
11 :	101- 103	TIGHT CEMENTED GRAVEL
12 :	103- 236	BLUE CLAY
13 :	236- 251	SILTY CLAY, WATER BEARING
14 :	251- 275	STICKY BLUE CLAY

****
**** GEOLOGIC WELL LOG REPORT ****
****

SITEID 472124122044401 LOCAL NUMBER 22N/06E-32D01

LATITUDE 47 d 21 m 24 s LONGITUDE 122 d 04 m 44 s

ALTITUDE 420.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 36.00 DEPTH OF HOLE 0.00

WATER LEVEL 21.00 DATE MEASURED / /

DRILLER MAXWELL CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$ GEOLOGIC WELL LOG REPORT $$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

SITEID 472112122033601 LOCAL NUMBER 22N/06E-32H01

LATITUDE 47 d 21 m 12 s LONGITUDE 122 d 03 m 36 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 09 / 10 / 1975

DEPTH OF WELL 106.00 DEPTH OF HOLE 106.00

WATER LEVEL 84.00 DATE MEASURED 09 / 16 / 1975

DRILLER JOHNSON CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE
GRE145	GREEN, KEN		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 8	SANDY BROWN GRAVEL AND ROCKS
2 :	8- 72	BROWN HARDPAN
3 :	72- 96	BROWN CLAY SHOCKED WITH GRAVEL
4 :	96- 106	HARDPACKED BROWN GRAVEL, WATER SEEP
5 :	-	
6 :	-	
7 :	-	

**** GEOLOGIC WELL LOG REPORT ****

SITEID 472041122040201 LOCAL NUMBER 22N/06E-32D01

LATITUDE 47 d 20 m 41 s LONGITUDE 122 d 04 m 02 s

ALTITUDE 455.00 DATE OF CONSTRUCTION 02 / 20 / 1973

DEPTH OF WELL 95.00 DEPTH OF HOLE 95.00

WATER LEVEL 32.00 DATE MEASURED 02 / 23 / 1973

DRILLER NORTHWEST CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE
BLO028	BLOOM, RONALD		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 1	TOPSOIL
2 :	1- 30	SAND AND GRAVEL (TIGHT)
3 :	30- 42	BLUE GLACIAL TILL
4 :	42- 56	BROWN GLACIAL TILL
5 :	56- 77	BR TIGHT WATER BEARING SD & GR
6 :	77- 95	SILICA SANDSTONE
7 :	95-	WATER BEARING SAND AND GRAVEL

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$ GEOLOGIC WELL LOG REPORT $$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

SITEID 472045122040001 LOCAL NUMBER 22N/06E-32B03

LATITUDE 47 d 20 m 45 s LONGITUDE 122 d 04 m 00 s

ALTITUDE 455.00 DATE OF CONSTRUCTION 10 / 22 / 1971

DEPTH OF WELL 87.00 DEPTH OF HOLE 87.00

WATER LEVEL 37.00 DATE MEASURED 10 / 25 / 1971

DRILLER NORTHWEST CONSTRUCTION METHOD C TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
262017	M&L KUSTOM KURE	MARVIN PERAULT	631-1237

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 2	TOPSOIL
2 :	2- 11	SAND AND GRAVEL
3 :	11- 50	GLACIAL TILL, BROWN
4 :	50- 53	SAND AND GRAVEL, CEMENTED
5 :	53- 75	GLACIAL TILL, GRAY
6 :	75- 87	SAND AND GRAVEL, WATER BEARING
7 :	-	

****
**** GEOLOGIC WELL LOG REPORT ****
****

SITEID 472043122034401 LOCAL NUMBER 22N/06E-32R01

LATITUDE 47 d 20 m 43 s LONGITUDE 122 d 03 m 44 s

ALTITUDE 455.00 DATE OF CONSTRUCTION 09 / 19 / 1974

DEPTH OF WELL 93.00 DEPTH OF HOLE 0.00

WATER LEVEL 33.00 DATE MEASURED / /

DRILLER JOHNSON DRIL CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 2	SURFACE
2 :	2- 14	LOOSE BROWN GRAVEL, ROCKS
3 :	14- 22	BROWN HARDPAN GRAVEL
4 :	22- 44	BROWN SANDY CLAY GRAVEL
5 :	44- 58	GRAY HARDPAN
6 :	58- 87	BROWN HARDPAN
7 :	87- 88	WATER GRAVEL
8 :	88- 93	HARDPACKED BROWN GRAVEL
9 :	-	
10 :	-	
11 :	-	
12 :	-	
13 :	-	
14 :	-	

**** GEOLOGIC WELL LOG REPORT ****

SITEID 472125122025701 LOCAL NUMBER 22N/06E-33C01

LATITUDE 47 d 21 m 25 s LONGITUDE 122 d 02 m 57 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 09 / 25 / 1979

DEPTH OF WELL 159.00 DEPTH OF HOLE 159.00

WATER LEVEL 120.00 DATE MEASURED 10 / 04 / 1979

DRILLER MUELLER CONSTRUCTION METHOD C TYPE OF FINISH S

OWNER ID	SYSTEM NAME	CONTACT	PHONE
NIE303	NIEDERKORN, P		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 20	SURFACE SOIL
2 :	20- 45	HARDPAN BROWN
3 :	45- 50	SAND
4 :	50- 88	HARDPAN GRAY
5 :	88- 140	HARDPAN BROWN
6 :	140- 159	SAND AND GRAVEL 25 GPM
7 :	-	

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

$$$$ GEOLOGIC WELL LOG REPORT $$$$

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

SITEID 472127120032401 LOCAL NUMBER 22N/06E-33D01

LATITUDE 47 d 21 m 27 s LONGITUDE 122 d 00 m 32 s

ALTITUDE 558.00 DATE OF CONSTRUCTION 01 / 01 / 1958

DEPTH OF WELL 175.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

****
**** GEOLOGIC WELL LOG REPORT ****
****

SITEID 472118122031801 LOCAL NUMBER 22N/06E-33D02

LATITUDE 47 d 21 m 18 s LONGITUDE 122 d 03 m 18 s

ALTITUDE 535.00 DATE OF CONSTRUCTION 08 / 26 / 1980

DEPTH OF WELL 140.00 DEPTH OF HOLE 140.00

WATER LEVEL 97.00 DATE MEASURED 08 / 28 / 1980

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
PED325	PEDRIN, ROBERT		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	SURFACE
2 :	3- 45	BROWN HARDPACKED GRAVEL
3 :	45- 68	GRAY GRAVEL
4 :	68- 91	GRAY HARDPAN
5 :	91- 117	BROWN HARDPAN GRAVEL
6 :	117- 140	GRAY WATER SAND AND GRAVEL
7 :	-	

****
**** GEOLOGIC WELL LOG REPORT ****
****

SITEID 472115122024201 LOCAL NUMBER 22N/06E-33B01

LATITUDE 47 d 21 m 15 s LONGITUDE 122 d 02 m 42 s

ALTITUDE 480.00 DATE OF CONSTRUCTION 01 / 01 / 1900

DEPTH OF WELL 32.00 DEPTH OF HOLE 0.00

WATER LEVEL 9.91 DATE MEASURED 01 / 28 / 1963

DRILLER CONSTRUCTION METHOD D TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

**** GEOLOGIC WELL LOG REPORT ****

SITEID 472054122022101 LOCAL NUMBER 22N/06E-33J01

LATITUDE 47 d 20 m 54 s LONGITUDE 122 d 02 m 21 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 05 / 11 / 1976

DEPTH OF WELL 130.00 DEPTH OF HOLE 130.00

WATER LEVEL 104.00 DATE MEASURED 05 / 11 / 1976

DRILLER NW PUMP & DR CONSTRUCTION METHOD A TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 2	TOPSOIL
2 :	2- 27	BROWN TILL
3 :	27- 78	BLUE TILL
4 :	78- 99	BROWN TILL
5 :	99- 110	BROWN CEMENTED SAND AND GRAVEL
6 :	110- 130	WATER BEARING SAND AND GRAVEL
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID        472058122022001   LOCAL NUMBER 22N/06E-33J01

LATITUDE      47 d 20 m 58 s            LONGITUDE     122 d 02 m 20 s

ALTITUDE       587.00          DATE OF CONSTRUCTION 09 / 03 / 1974

DEPTH OF WELL    91.00                 DEPTH OF HOLE     0.00

WATER LEVEL      76.00                 DATE MEASURED 09 / 03 / 1974

DRILLER       JOHNSON DRLG   CONSTRUCTION METHOD C     TYPE OF FINISH P

OWNER ID   SYSTEM NAME                             CONTACT              PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

         INT
          #   INTVL(FT)   DESCRIPTION
         -----------------------------------------------------

          1 :     0-   2    SURFACE
          2 :     2-  16    BROWN HARDPAN
          3 :    16-  56    GRAY HARDPAN GRAVEL
          4 :    56-  82    HARDPAN GRAVEL
          5 :    82-  83    WATER GRAVEL
          6 :    83-  91    BROWN HARDPAN
          7 :      -
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**** GEOLOGIC WELL LOG REPORT ****
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    SITEID        472059122022101    LOCAL NUMBER 22N/06E-33J02

    LATITUDE      47 d 20 m 59 s            LONGITUDE     122 d 02 m 21 s

    ALTITUDE        587.00          DATE OF CONSTRUCTION 11 / 26 / 1974

    DEPTH OF WELL   135.00                 DEPTH OF HOLE     0.00

    WATER LEVEL     117.00                 DATE MEASURED 11 / 26 / 1974

    DRILLER       NORTHWEST PU   CONSTRUCTION METHOD C     TYPE OF FINISH

OWNER ID   SYSTEM NAME                          CONTACT              PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

         INT
          #   INTVL(FT)   DESCRIPTION
         ---------------------------------------------------------

          1 :     0-   3    TOPSOIL
          2 :     3-  34    BROWN GLACIAL TILL
          3 :    34-  72    BLUE GLACIAL TILL
          4 :    72- 128    BROWN GLACIAL TILL
          5 :   128- 135    WATER BEARING SAND AND GRAVEL
          6 :       -
          7 :       -
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**** GEOLOGIC WELL LOG REPORT ****
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SITEID        472053122021601    LOCAL NUMBER 22N/06E-33J04

LATITUDE      47 d 20 m 53 s            LONGITUDE     122 d 02 m 16 s

ALTITUDE       550.00          DATE OF CONSTRUCTION 11 / 16 / 1977

DEPTH OF WELL   160.00                 DEPTH OF HOLE   160.00

WATER LEVEL     110.00                 DATE MEASURED 11 / 22 / 1977

DRILLER       NORTHWEST      CONSTRUCTION METHOD A     TYPE OF FINISH P

OWNER ID   SYSTEM NAME                          CONTACT               PHONE

WAI441      WAITE, DAN

          INT
           #   INTVL(FT)   DESCRIPTION
          ----------------------------------------------------

           1 :     0-   3    TOPSOIL
           2 :     3-  51    BROWN TILL
           3 :    51-  72    BLUE TILL
           4 :    72- 120    BROWN TILL
           5 :   120- 143    BROWN TILL W/OCC. WATER LAYERS
           6 :   143- 160    BLUE TILL
           7 :       -
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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472039122031501 LOCAL NUMBER 22N 06E-33N01

LATITUDE 47 d 20 m 39 s LONGITUDE 122 d 03 m 15 s

ALTITUDE 435.00 DATE OF CONSTRUCTION 02 / 18 / 1983

DEPTH OF WELL 57.00 DEPTH OF HOLE 57.00

WATER LEVEL 3.00 DATE MEASURED 02 / 18 / 1983

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
BAS019	BASS		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 4	GRAVEL
2 :	4- 8	BROWN SANDY CLAY
3 :	8- 18	GRAY SAND AND GRAVEL
4 :	18- 28	GRAY SAND
5 :	28- 53	BROWN SILT
6 :	53- 57	GRAY WATER SAND AND GRAVEL
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID        472049122025701    LOCAL NUMBER 20N-06E-33P

LATITUDE      47 d 20 m 49 s            LONGITUDE     122 d 02 m 57 s

ALTITUDE        525.00          DATE OF CONSTRUCTION 12 / 01 / 1977

DEPTH OF WELL    75.00                 DEPTH OF HOLE    75.00

WATER LEVEL      45.25                 DATE MEASURED 11 / 17 / 1977

DRILLER       BURT WELL DR   CONSTRUCTION METHOD C     TYPE OF FINISH S

OWNER ID   SYSTEM NAME                          CONTACT               PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

          INT
           #   INTVL(FT)   DESCRIPTION
          ----------------------------------------------------

           1 :     0-  25    TILL
           2 :    25-  47    LARGE GRAVEL AND SAND
           3 :    47-  66    GRAVEL, SAND AND WATER
           4 :    66-  75    BROWN SILTY SAND
           5 :      -
           6 :      -
           7 :      -
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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 472048122025701 LOCAL NUMBER 22N/06E-33P02

LATITUDE 47 d 20 m 48 s LONGITUDE 122 d 02 m 57 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 01 / 03 / 1978

DEPTH OF WELL 72.00 DEPTH OF HOLE 72.00

WATER LEVEL 42.00 DATE MEASURED 12 / 18 / 1977

DRILLER BURT WELL DR CONSTRUCTION METHOD C TYPE OF FINISH S

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 7	BOULDERS
2 :	7- 38	BROWN HARDPAN
3 :	38- 65	LARGE GRAVEL, SAND AND WATER
4 :	65- 72	BROWN HARDPAN
5 :	-	
6 :	-	
7 :	-	

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****** GEOLOGIC WELL LOG REPORT ******

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SITEID 472046122030301 LOCAL NUMBER 20N 06E-33F03

LATITUDE 47 d 20 m 46 s LONGITUDE 122 d 03 m 03 s

ALTITUDE 455.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 0.00 DEPTH OF HOLE 695.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER ARMSTRONG CONSTRUCTION METHOD C TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 18	BROWN CLAY WITH SAND AND GRAVEL
2 :	18- 33	BLUE GRAY CLAY W/SAND AND GRAVEL
← 3 :	33- 47	BROWN SAND AND GRAVEL WATER BEARING
4 :	47- 53	BLUE GRAY CLAY W/SAND AND GRAVEL
5 :	53- 72	BLUE SANDY CLAY WITH GRAVEL
6 :	72- 85	BROWN CLAY-BOUND SAND AND GRAVEL
7 :	85- 96	DARK BRWN CLAY-BOUND SD & GR
8 :	98- 140	BLUE GRAY SILTY SAND
9 :	140- 155	BLUE GRAY SANDY CLAY
10 :	155- 188	BLUE GRAY SILTY SAND W/SOME GRAVEL
11 :	188- 255	GRAY SLTY CLAY W/DEPTH
12 :	255- 280	GRAY CLAY W/VERY FINE SAND
13 :	280- 285	GRAY CLAY W/SAND AND GRAVEL
14 :	285- 296	GRAY SILTY SANDY CLAY
15 :	296- 315	GRAY SANDY CLAY WITH SOME GR, HARD
16 :	315- 335	GRAY SILTY CLAY
17 :	335- 344	GRAY SANDY CLAY
18 :	344- 358	GRAY SILTY CLAY
19 :	358- 362	GRAY SILTY CLAY W/ABUNDANT GRAVEL
20 :	362- 474	GRY SLTY CLY W/OCC. GRAVEL
21 :	474- 475	GRY SILTY CLAY AND GRAVEL
22 :	475- 595	GRAY SILTY CLAY W/OCC. GRAVEL
23 :	595- 652	GRAY CLAY, HARD
24 :	652- 672	GRAY SILTY CLY W/GRAVEL, GR INCREAS
25 :	672- 676	GRAY CLAYEY SLT W/FRAGMENTS OF WOOD
26 :	676- 678	GRAY SILTY VERY FINE SAND
27 :	678- 685	GRAY SANDY SILT
28 :	685- 695	GRAY SILT

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            **** GEOLOGIC WELL LOG REPORT ****
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    SITEID        472103122010201    LOCAL NUMBER 22N/06E-34H01

    LATITUDE      47 d 21 m 03 s            LONGITUDE     122 d 01 m 02 s

    ALTITUDE       600.00          DATE OF CONSTRUCTION 01 / 03 / 1980

    DEPTH OF WELL   155.00                DEPTH OF HOLE   155.00

    WATER LEVEL     119.00                DATE MEASURED 01 / 04 / 1980

    DRILLER       NORTHWEST      CONSTRUCTION METHOD A     TYPE OF FINISH O

OWNER ID   SYSTEM NAME                         CONTACT               PHONE

SVE409      SVERDARSKY, DAVE

         INT
          #   INTVL(FT)   DESCRIPTION
         ------------------------------------------------------

          1 :     0-  32    BROWN TILL
          2 :    32- 125    BLUE TILL AND COBBLES
          3 :   125- 147    BLUE SAND AND GRAVEL
          4 :   147- 155    WATER BEARING SAND AND GRAVEL
          5 :       -
          6 :       -
          7 :       -
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**** GEOLOGIC WELL LOG REPORT ****

SITEID 472040122011501   LOCAL NUMBER 22N/06E-34Q01

LATITUDE 47 d 20 m 40 s   LONGITUDE 122 d 01 m 15 s

ALTITUDE 575.00   DATE OF CONSTRUCTION 06 / 20 / 1978

DEPTH OF WELL 98.00   DEPTH OF HOLE 98.00

WATER LEVEL 53.00   DATE MEASURED 06 / 20 / 1978

DRILLER NORTHWEST   CONSTRUCTION METHOD A   TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
LAS238	LASHER, DAVE		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 2	TOPSOIL
2 :	2- 28	BROWN TILL
3 :	28- 77	BLUE TILL
4 :	77- 98	WATER BEARING SAND AND GRAVEL
5 :	-	
6 :	-	
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472050122010001 LOCAL NUMBER 22N-06E-34R01

LATITUDE 47 d 20 m 50 s LONGITUDE 122 d 01 m 00 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 06 / 17 / 1980

DEPTH OF WELL 80.00 DEPTH OF HOLE 80.00

WATER LEVEL 40.00 DATE MEASURED 06 / 17 / 1980

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
MAI257	MAIERS, LAURETTA		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 1	TOPSOIL, BROWN
2 :	1- 34	SAND AND GRAVEL, BROWN, DRY
3 :	34- 55	TILL, BLUE, DAMP
4 :	55- 80	WATER BEARING SAND AND GRAVEL
5 :	-	
6 :	-	
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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    SITEID         472037122010101    LOCAL NUMBER 22N/06E-34R02

    LATITUDE       47 d 20 m 37 s            LONGITUDE     122 d 01 m 01 s

    ALTITUDE        550.00          DATE OF CONSTRUCTION 06 / 09 / 1983

    DEPTH OF WELL    65.00                   DEPTH OF HOLE    65.00

    WATER LEVEL      30.00                   DATE MEASURED 06 / 09 / 1983

    DRILLER        JOHNSON        CONSTRUCTION METHOD A     TYPE OF FINISH O

OWNER ID   SYSTEM NAME                              CONTACT              PHONE

DRL092      DRLLEVICH, VAL                                                432-0200

          INT
           #   INTVL(FT)   DESCRIPTION
          -----------------------------------------------------

           1 :     0-   3    SURFACE
           2 :     3-  60    BROWN HARDPAN
           3 :    60-  65    GRAY WATER GRAVEL
           4 :    65-        GRAY HARDPAN
           5 :      -
           6 :      -
           7 :      -
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****** GEOLOGIC WELL LOG REPORT ******

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SITEID 472003122015701 LOCAL NUMBER 21N/06E-03E01

LATITUDE 47 d 20 m 03 s LONGITUDE 122 d 01 m 57 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 01 / 1958

DEPTH OF WELL 51.00 DEPTH OF HOLE 0.00

WATER LEVEL 12.00 DATE MEASURED 01 / 01 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 472020122015601 LOCAL NUMBER 21N/06E-03E02

LATITUDE 47 d 20 m 20 s LONGITUDE 122 d 01 m 56 s

ALTITUDE 495.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 16.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER SANDPOINT CONSTRUCTION METHOD V TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 472004122013901 LOCAL NUMBER 21N/06E-03L01

LATITUDE 47 d 20 m 04 s LONGITUDE 122 d 01 m 39 s

ALTITUDE 550.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 107.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID	SYSTEM NAME	CONTACT	PHONE
76460N	SAWYERWOOD ESTATES W. S.	DONALD FURMAN	886-2264

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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 472021122020701 LOCAL NUMBER 21N/06E-03P02

LATITUDE 47 d 19 m 46 s LONGITUDE 122 d 01 m 46 s

ALTITUDE 515.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 50.00 DEPTH OF HOLE 0.00

WATER LEVEL 30.34 DATE MEASURED 08 / 16 / 1962

DRILLER DORSTEN CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID	SYSTEM NAME	CONTACT	PHONE
56185A	MORRIS BROTHERS		

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 472030122023701 LOCAL NUMBER 21N/06E-04B01

LATITUDE 47 d 20 m 30 s LONGITUDE 122 d 02 m 37 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 50.00 DEPTH OF HOLE 0.00

WATER LEVEL 32.61 DATE MEASURED 08 / 16 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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**** GEOLOGIC WELL LOG REPORT ****

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SITEID 472027122024001 LOCAL NUMBER 21N/06E-04B02

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 40 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 01 / 1961

DEPTH OF WELL 50.00 DEPTH OF HOLE 0.00

WATER LEVEL 33.87 DATE MEASURED 08 / 15 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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****** GEOLOGIC WELL LOG REPORT ******
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SITEID 472031122023301 LOCAL NUMBER 21N/06E-04B03

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 45 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 09 / 01 / 1959

DEPTH OF WELL 54.00 DEPTH OF HOLE 0.00

WATER LEVEL 27.47 DATE MEASURED 08 / 16 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID	SYSTEM NAME	CONTACT	PHONE
LAD200	LADDERAD		

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472031122023302 LOCAL NUMBER 21N 06E-04B03D1

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 45 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 65.00 DEPTH OF HOLE 0.00

WATER LEVEL 38.17 DATE MEASURED 08 / 12 / 1986

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID	SYSTEM NAME	CONTACT	PHONE
LAD300	LADDERUND, LOIS		

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****** GEOLOGIC WELL LOG REPORT ******
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SITEID 472026122024501 LOCAL NUMBER 21N/06E-04B04

LATITUDE 47 d 20 m 26 s LONGITUDE 122 d 02 m 45 s

ALTITUDE 502.00 DATE OF CONSTRUCTION 07 / 13 / 1961

DEPTH OF WELL 48.00 DEPTH OF HOLE 0.00

WATER LEVEL 28.00 DATE MEASURED 07 / 13 / 1961

DRILLER JOHNSON CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 28	LOOSE GRAVEL
2 :	28- 48	WATER SAND AND GRAVEL
3 :	-	
4 :	-	
5 :	-	
6 :	-	
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****

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SITEID 472028122024201 LOCAL NUMBER 21N/06E-04B04

LATITUDE 47 d 20 m 32 s LONGITUDE 122 d 02 m 39 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 85.00 DEPTH OF HOLE 0.00

WATER LEVEL 43.00 DATE MEASURED 03 / 01 / 1971

DRILLER CONSTRUCTION METHOD TYPE OF FINISH 0

OWNER ID	SYSTEM NAME	CONTACT	PHONE
EC0400	ECOLOGY, DEPT OF		

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472025122024101 LOCAL NUMBER 21N/06E-04B05

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 46 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 02 / 1976

DEPTH OF WELL 83.00 DEPTH OF HOLE 83.00

WATER LEVEL 43.00 DATE MEASURED 01 / 02 / 1976

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH S

OWNER ID	SYSTEM NAME	CONTACT	PHONE
416508	KCWD 105	JUDITH NELSON	631-0565

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	SURFACE
2 :	3- 20	GRAVEL
3 :	20- 52	______ ________ GRAVEL
4 :	52- 83	WATER GRAVEL
5 :	-	
6 :	-	
7 :	-	

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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID        472030122023801    LOCAL NUMBER 21N/06E-04B07

LATITUDE      47 d 20 m 30 s            LONGITUDE     122 d 02 m 38 s

ALTITUDE       500.00          DATE OF CONSTRUCTION 08 / 01 / 1956

DEPTH OF WELL   80.00                 DEPTH OF HOLE     0.00

WATER LEVEL     40.00                 DATE MEASURED 08 / 01 / 1956

DRILLER                     CONSTRUCTION METHOD B     TYPE OF FINISH P

OWNER ID   SYSTEM NAME                         CONTACT              PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL
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**** GEOLOGIC WELL LOG REPORT ****

SITEID 472025122024501 LOCAL NUMBER 21N/06E-04B08

LATITUDE 47 d 20 m 33 s LONGITUDE 122 d 02 m 40 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 12 / 13 / 1975

DEPTH OF WELL 85.00 DEPTH OF HOLE 85.00

WATER LEVEL 43.00 DATE MEASURED 12 / 13 / 1975

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH S

OWNER ID	SYSTEM NAME	CONTACT	PHONE
416508	KCWD 105	JUDITH NELSON	631-0565

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	SURFACE
2 :	3- 20	GRAVEL
3 :	20- 52	BRN HARDPAN GRAVEL
4 :	52- 85	WATER GRAVEL
5 :	-	
6 :	-	
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472029122024101 LOCAL NUMBER 21N/05E-04B09

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 02 m 41 s

ALTITUDE 536.00 DATE OF CONSTRUCTION 03 / 24 / 1980

DEPTH OF WELL 87.00 DEPTH OF HOLE 92.00

WATER LEVEL 38.00 DATE MEASURED 04 / 03 / 1980

DRILLER STORY/ARMSTR CONSTRUCTION METHOD C TYPE OF FINISH S

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 31	BRWN SD & GR W/BOULDERS, TIGHT
2 :	31- 62	BRWN SD & GR TO 8" LOOSE, SOME WTR
3 :	62- 64	TIGHT SD & GR CONFINING LAYER
4 :	64- 70	CRS GRAVEL AND SAND
5 :	70- 78	CRSE GRAVEL, VERY LITTLE SAND
6 :	78- 82	CRSE GRAVEL AND SAND
7 :	82- 90	GRAVEL AND SAND
8 :	90- 92	CLAYBOUND SD & GR, TAN BINDER
9 :	-	
10 :	-	
11 :	-	
12 :	-	
13 :	-	
14 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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    SITEID        472029122030001    LOCAL NUMBER 21N/06E-04C01

    LATITUDE      47 d 20 m 29 s            LONGITUDE     122 d 03 m 00 s

    ALTITUDE        495.00          DATE OF CONSTRUCTION 01 / 01 / 1963

    DEPTH OF WELL    67.00                DEPTH OF HOLE     0.00

    WATER LEVEL      35.47                DATE MEASURED 08 / 15 / 1962

    DRILLER       JOHNSON DRIL   CONSTRUCTION METHOD       TYPE OF FINISH

OWNER ID   SYSTEM NAME                          CONTACT                PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL
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****** GEOLOGIC WELL LOG REPORT ******
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SITEID 472029122031201 LOCAL NUMBER 21N/06E-04D01

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 03 m 12 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 10 / 25 / 1971

DEPTH OF WELL 87.00 DEPTH OF HOLE 0.00

WATER LEVEL 37.00 DATE MEASURED 10 / 25 / 1971

DRILLER NORTHWEST PU CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

**** GEOLOGIC WELL LOG REPORT ****

SITEID 472018122032401 LOCAL NUMBER 21N/06E-04E01

LATITUDE 47 d 20 m 18 s LONGITUDE 122 d 03 m 24 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 06 / 01 / 1975

DEPTH OF WELL 123.00 DEPTH OF HOLE 0.00

WATER LEVEL 106.00 DATE MEASURED 06 / 01 / 1975

DRILLER EVERGREEN DR CONSTRUCTION METHOD C TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 5	TOPSOIL
2 :	5- 58	GRAY HARDPAN
3 :	58- 67	BROWN TILL COMPACT WITH ROCKS
4 :	67- 71	DIRTY TIGHT GRAVEL
5 :	71- 83	GRAY SANDY CLAY
6 :	83- 96	GRAY HARD COMPACT SANDY SILT
7 :	96- 103	GRAY CLAY
8 :	103- 123	W.B. SD&GR PROGRESSIVELY GET CLEANR
9 :	-	
10 :	-	
11 :	-	
12 :	-	
13 :	-	
14 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472029122025901 LOCAL NUMBER 21N/06E-04F01

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 02 m 59 s

ALTITUDE 515.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 47.00 DEPTH OF HOLE 0.00

WATER LEVEL 31.43 DATE MEASURED 08 / 15 / 1962

DRILLER CLYDE DORSTE CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472017122023901 LOCAL NUMBER 21N/06E-04G01

LATITUDE 47 d 20 m 17 s LONGITUDE 122 d 02 m 39 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 11 / 21 / 1957

DEPTH OF WELL 80.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER MARTIN R LUT CONSTRUCTION METHOD C TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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                    $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
                    $$$$ GEOLOGIC WELL LOG REPORT $$$$
                    $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

    SITEID        472001122024301    LOCAL NUMBER 21N/05E-04K01

    LATITUDE      47 d 20 m 01 s            LONGITUDE     122 d 02 m 43 s

    ALTITUDE        510.00          DATE OF CONSTRUCTION 10 / 26 / 1983

    DEPTH OF WELL    99.00                 DEPTH OF HOLE    99.00

    WATER LEVEL      40.00                 DATE MEASURED 10 / 26 / 1983

    DRILLER       NORTHWEST      CONSTRUCTION METHOD A     TYPE OF FINISH O

OWNER ID   SYSTEM NAME                              CONTACT              PHONE

284277      TOLLBER, GENE                                                 886-1176

         INT
          #   INTVL(FT)   DESCRIPTION
         --------------------------------------------------------

          1 :     0-   2    TOPSOIL, BROWN, DRY
          2 :     2-  11    GLACIAL TILL, BROWN, DRY
          3 :    11-  21    SAND AND OCC. GRAVEL, BROWN, DRY
          4 :    21-  47    GLACIAL TILL, BLUE, DRY
          5 :    47-  99    WATER BEARING SAND AND GRAVEL
          6 :      -
          7 :      -
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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 472001122023901 LOCAL NUMBER 21N/06E-04K04

LATITUDE 47 d 20 m 01 s LONGITUDE 122 d 02 m 39 s

ALTITUDE 510.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 60.00 DEPTH OF HOLE 0.00

WATER LEVEL 21.37 DATE MEASURED 07 / 23 / 1986

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID	SYSTEM NAME	CONTACT	PHONE
80466D	SMITH, CLYDE	D. & A. JOHNSON	886-1762

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 471949122024201 LOCAL NUMBER 21N/06E-04D01

LATITUDE 47 d 19 m 49 s LONGITUDE 122 d 02 m 42 s

ALTITUDE 520.00 DATE OF CONSTRUCTION 01 / 19 / 1968

DEPTH OF WELL 75.00 DEPTH OF HOLE 0.00

WATER LEVEL 25.00 DATE MEASURED 01 / 19 / 1968

DRILLER STIMSON DRIL CONSTRUCTION METHOD V TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 471947122023401 LOCAL NUMBER 21N/06E-04D02

LATITUDE 47 d 19 m 47 s LONGITUDE 122 d 02 m 35 s

ALTITUDE 520.00 DATE OF CONSTRUCTION 02 / 22 / 1967

DEPTH OF WELL 59.00 DEPTH OF HOLE 59.00

WATER LEVEL 33.00 DATE MEASURED 02 / 22 / 1967

DRILLER JOHNSON DRLL CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE
76462P	SAWYERWOOD WATER SYSTEM	DOUGLAS, H. & S.	

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 5	TOPSOIL AND ROCKS
2 :	5- 17	HARDPAN AND GRAVEL AND ROCKS
3 :	17- 43	HARDPACKED SAND AND GRAVEL
4 :	43- 59	WATER SAND AND GRAVEL COURSE
5 :	59-	LARGE GRAVEL
6 :	-	
7 :	-	

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****** GEOLOGIC WELL LOG REPORT ******

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SITEID 471958122024201 LOCAL NUMBER 21N/06E-04Q03

LATITUDE 47 d 19 m 52 s LONGITUDE 122 d 02 m 40 s

ALTITUDE 515.00 DATE OF CONSTRUCTION 09 / 18 / 1975

DEPTH OF WELL 52.00 DEPTH OF HOLE 52.00

WATER LEVEL 25.00 DATE MEASURED 09 / 18 / 1975

DRILLER JOHNSON CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE
05750H	BENSON, EDWARD		

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$ GEOLOGIC WELL LOG REPORT $$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

SITEID 471952122022601 LOCAL NUMBER 21N/06E-04R01

LATITUDE 47 d 19 m 52 s LONGITUDE 122 d 02 m 26 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 27.00 DEPTH OF HOLE 0.00

WATER LEVEL 15.17 DATE MEASURED 08 / 14 / 1962

DRILLER CONSTRUCTION METHOD D TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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****** GEOLOGIC WELL LOG REPORT ******

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SITEID 472033122033801 LOCAL NUMBER 21N/06E-05A01

LATITUDE 47 d 20 m 33 s LONGITUDE 122 d 03 m 39 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 05 / 12 / 1974

DEPTH OF WELL 90.00 DEPTH OF HOLE 0.00

WATER LEVEL 5.00 DATE MEASURED 05 / 12 / 1974

DRILLER JOHNSON DR C CONSTRUCTION METHOD C TYPE OF FINISH P

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	SURFACE
2 :	3- 15	BROWN HARDPAN
3 :	15- 46	BLUE CLAY
4 :	46- 90	FINE WATER SAND
5 :	-	
6 :	-	
7 :	-	

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**** GEOLOGIC WELL LOG REPORT ****
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    SITEID          471917122043501    LOCAL NUMBER 21N/06E-08E01

    LATITUDE        47 d 19 m 17 s            LONGITUDE      122 d 04 m 35 s

    ALTITUDE          530.00          DATE OF CONSTRUCTION 01 / 01 / 1957

    DEPTH OF WELL     65.00                DEPTH OF HOLE       0.00

    WATER LEVEL        8.00                DATE MEASURED     /     /

    DRILLER         MYRL JOHNSON   CONSTRUCTION METHOD        TYPE OF FINISH

OWNER ID   SYSTEM NAME                          CONTACT                 PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL
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**** GEOLOGIC WELL LOG REPORT ****
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    SITEID        471921122041801    LOCAL NUMBER 21N/06E-08F01

    LATITUDE      47 d 19 m 21 s            LONGITUDE     122 d 04 m 18 s

    ALTITUDE       470.00          DATE OF CONSTRUCTION 06 / 03 / 1982

    DEPTH OF WELL   119.00                 DEPTH OF HOLE   119.00

    WATER LEVEL       0.00                 DATE MEASURED    /    /

    DRILLER       STORY/DODGE    CONSTRUCTION METHOD C     TYPE OF FINISH

OWNER ID   SYSTEM NAME                            CONTACT                PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

          INT
           #   INTVL(FT)   DESCRIPTION
          --------------------------------------------------------

           1 :     0-  80    BROWN, GRY-BRWN GR W/VARYING MTRX
           2 :    80- 102    GRY SD & GR W/SLT MTRX, SOME WATER
           3 :   102- 116    SD, MED-F W/OCC. GR
           4 :   116- 119    GRAY SANDY, SILTY, CLAY
           5 :       -
           6 :       -
           7 :       -
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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 471931122033701 LOCAL NUMBER 21N/06E-08H01

LATITUDE 47 d 19 m 31 s LONGITUDE 122 d 03 m 37 s

ALTITUDE 490.00 DATE OF CONSTRUCTION 09 / 09 / 1982

DEPTH OF WELL 127.00 DEPTH OF HOLE 127.00

WATER LEVEL 4.00 DATE MEASURED 09 / 12 / 1982

DRILLER STORY/DODGE CONSTRUCTION METHOD C TYPE OF FINISH F

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 8	GRAVEL AND SAND, SILT MATRIX
2 :	8- 17	GRAY-BRWN SAND AND GRAVEL
3 :	17- 33	GRAY-BROWN TILL
4 :	33- 74	YELLOW-BRWN SANDY SLTY CLAY OCC. GR
5 :	74- 89	FINE SAND, SILT, CLAY
6 :	89- 117	GRAY, COMPACT TILL
7 :	117- 127	GRY-BLK MUDDY, CRS SD GRADING TOCLY

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$$$$ GEOLOGIC WELL LOG REPORT $$$$

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SITEID 471945122022201 LOCAL NUMBER 21N/06E-09A01

LATITUDE 47 d 19 m 45 s LONGITUDE 122 d 02 m 22 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 27.00 DEPTH OF HOLE 0.00

WATER LEVEL 14.69 DATE MEASURED 08 / 14 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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$$$$ GEOLOGIC WELL LOG REPORT $$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

SITEID 471938122022401 LOCAL NUMBER 21N/06E-09A02

LATITUDE 47 d 19 m 38 s LONGITUDE 122 d 02 m 24 s

ALTITUDE 525.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 39.00 DEPTH OF HOLE 0.00

WATER LEVEL 28.02 DATE MEASURED 08 / 16 / 1962

DRILLER MRYL JOHNSN CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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****** GEOLOGIC WELL LOG REPORT ******

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SITEID 461933122021401 LOCAL NUMBER 21N/06E-09H01

LATITUDE 47 d 19 m 33 s LONGITUDE 122 d 02 m 14 s

ALTITUDE 515.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 48.00 DEPTH OF HOLE 0.00

WATER LEVEL 25.00 DATE MEASURED / /

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 471400122020401 LOCAL NUMBER 21N/06E-10E01

LATITUDE 47 d 19 m 00 s LONGITUDE 122 d 02 m 04 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 45.00 DEPTH OF HOLE 0.00

WATER LEVEL 26.00 DATE MEASURED / /

DRILLER NORTHWEST DR CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 471927122020401 LOCAL NUMBER 21N/06E-10E02

LATITUDE 47 d 19 m 27 s LONGITUDE 122 d 02 m 04 s

ALTITUDE 510.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 42.00 DEPTH OF HOLE 0.00

WATER LEVEL 30.67 DATE MEASURED 08 / 14 / 1962

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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****** GEOLOGIC WELL LOG REPORT ******
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SITEID 471924122020301 LOCAL NUMBER 21N/06E-10E03

LATITUDE 47 d 19 m 24 s LONGITUDE 122 d 02 m 03 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 01 / 01 / 1952

DEPTH OF WELL 42.00 DEPTH OF HOLE 0.00

WATER LEVEL 27.43 DATE MEASURED 08 / 14 / 1965

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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**** GEOLOGIC WELL LOG REPORT ****
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SITEID 471924122015101 LOCAL NUMBER 21N/06E-10F01

LATITUDE 47 d 19 m 24 s LONGITUDE 122 d 01 m 51 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 01 / 1930

DEPTH OF WELL 22.00 DEPTH OF HOLE 0.00

WATER LEVEL 20.00 DATE MEASURED / /

DRILLER CONSTRUCTION METHOD V TYPE OF FINISH T

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

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****** WELL CONSTRUCTION REPORT ******

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SITEID 471820122022201 LOCAL NUMBER 21N/06E-16J01

LATITUDE 47 d 18 m 20 s LONGITUDE 122 d 02 m 26 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 06 / 09 / 1976

DEPTH OF WELL 99.00 DEPTH OF HOLE 99.00

WATER LEVEL 65.00 DATE MEASURED 12 / 20 / 1976

DRILLER JOHNSON DRIL CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS DEEPENED FROM 63 TO 99FT, 12/20/76

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	63.00	6.00
2	63.00	99.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	63.00	6.00	S	0.000
2	0.00	99.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

**** WELL CONSTRUCTION REPORT ****

SITEID 471823122024101 LOCAL NUMBER 21N/06E-16K01

LATITUDE 47 d 18 m 23 s LONGITUDE 122 d 02 m 41 s

ALTITUDE 540.00 DATE OF CONSTRUCTION 01 / 06 / 1984

DEPTH OF WELL 117 00 DEPTH OF HOLE 117.00

WATER LEVEL 93.00 DATE MEASURED 01 / 10 / 1984

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT A

DEVEL METHOD A HOURS OF DEVEL. 3

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
POZ335	POZZI, CARL		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	117.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	117.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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\$\$\$\$ GEOLOGIC WELL LOG REPORT \$\$\$\$
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SITEID 471925122000101 LOCAL NUMBER 21N/06E-11G01

LATITUDE 47 d 19 m 25 s LONGITUDE 122 d 00 m 01 s

ALTITUDE 640.00 DATE OF CONSTRUCTION 03 / 11 / 1981

DEPTH OF WELL 127.00 DEPTH OF HOLE 127.00

WATER LEVEL 50 00 DATE MEASURED 03 / 11 / 1981

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE
CHE065	CHEATHAM, RAY		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 4	SURFACE
2 :	4- 12	BROWN DECAYED ROCK
3 :	12- 70	GRAY SANDSTONE
4 :	70- 127	GRAY SANDSTONE - WATER
5 :	127-	COAL
6 :	-	
7 :	-	

**** GEOLOGIC WELL LOG REPORT ****

SITEID 471925121594801 LOCAL NUMBER 21N/06E-11H01

LATITUDE 47 d 19 m 25 s LONGITUDE 121 d 59 m 48 s

ALTITUDE 815.00 DATE OF CONSTRUCTION 02 / 04 / 1980

DEPTH OF WELL 240.00 DEPTH OF HOLE 240.00

WATER LEVEL 40.00 DATE MEASURED 02 / 04 / 1980

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH P

OWNER ID	SYSTEM NAME	CONTACT	PHONE
REI342	REICHERT, MATHEW		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	SURFACE
2 :	3- 12	BROWN DECAYED ROCK
3 :	12- 48	BLACK COAL
4 :	48- 215	WHITE SOLID ROCK
5 :	215- 240	WHITE SOLID ROCK - WATER BEARING
6 :	-	
7 :	-	

**** GEOLOGIC WELL LOG REPORT ****

SITEID 471834122030201 LOCAL NUMBER 21N/06E-16F01

LATITUDE 47 d 18 m 32 s LONGITUDE 122 d 03 m 02 s

ALTITUDE 515.00 DATE OF CONSTRUCTION 06 / 24 / 1980

DEPTH OF WELL 103.00 DEPTH OF HOLE 103.00

WATER LEVEL 43.00 DATE MEASURED 06 / 24 / 1980

DRILLER NORTHWEST PD CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 2	TOPSOIL, BROWN
2 :	2- 28	SAND AND GRAVEL, BROWN
3 :	28- 57	SILTY SAND AND GRAVEL, BLUE
4 :	57- 98	GLCL TILL, BL, SM-AMNT OF WAT.100"
5 :	98- 103	WATER BEARING SAND AND GRAVEL
6 :	-	
7 :	-	

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$$$$ GEOLOGIC WELL LOG REPORT $$$$

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SITEID 471820122022201 LOCAL NUMBER 21N/06E-16J01

LATITUDE 47 d 18 m 20 s LONGITUDE 122 d 02 m 26 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 06 / 09 / 1976

DEPTH OF WELL 99.00 DEPTH OF HOLE 99.00

WATER LEVEL 65.00 DATE MEASURED 12 / 20 / 1976

DRILLER JOHNSON DRIL CONSTRUCTION METHOD A TYPE OF FINISH 0

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	SURFACE
2 :	3- 6	BROWN HARDPAN GRAVEL
3 :	6- 30	GRAY BROWN GRAVEL
4 :	30- 46	GRAY BROWN HARDPACKED GRAVEL
5 :	46- 47	WATER GRAVEL (2GPM)
6 :	47- 63	BROWN HARDPACKED GRAVEL, W. SEEPAGE
7 :	63- 79	BROWN HARDPAN GRAVEL
8 :	79- 99	BROWN GRAVEL (WATER)
9 :	-	
10 :	-	
11 :	-	
12 :	-	
13 :	-	
14 :	-	

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$ GEOLOGIC WELL LOG REPORT $$$$
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SITEID 471823122024101 LOCAL NUMBER 21N/06E-16K01

LATITUDE 47 d 18 m 23 s LONGITUDE 122 d 02 m 41 s

ALTITUDE 540.00 DATE OF CONSTRUCTION 01 / 06 / 1984

DEPTH OF WELL 117.00 DEPTH OF HOLE 117.00

WATER LEVEL 93.00 DATE MEASURED 01 / 10 / 1984

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
POZ335	POZZI, CARL		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 6	BROWN SANDY CLAY
2 :	6- 27	GRAY HARDPAN GRAVEL
3 :	27- 90	BROWN HARDPAN GRAVEL
4 :	90- 103	GRAY GRAVEL
5 :	103- 115	BROWN WATER SAND AND GRAVEL
6 :	115- 117	GRAY GRAVEL - CLAY BINDER
7 :	-	

**** GEOLOGIC WELL LOG REPORT ****

SITEID 471814122024701 LOCAL NUMBER 21N/06E-16D01

LATITUDE 47 d 18 m 14 s LONGITUDE 122 d 02 m 47 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 04 / 15 / 1981

DEPTH OF WELL 78.50 DEPTH OF HOLE 78.50

WATER LEVEL 42.00 DATE MEASURED 04 / 15 / 1981

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

OWNER ID	SYSTEM NAME	CONTACT	PHONE
AND008	ANDERSON, JOE		

INT #	INTVL(FT)	DESCRIPTION
1 :	0- 3	TOPSOIL, DRY, BROWN, SOFT
2 :	3- 55	GLACIAL TILL, DRY, BROWN, MED. HARD
3 :	55- 60	WATER BEARING SAND AND GRAVEL
4 :	-	
5 :	-	
6 :	-	
7 :	-	

WELL CONSTRUCTION REPORTS

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472118122033401 LOCAL NUMBER 22N/06E-32A01

LATITUDE 47 d 21 m 18 s LONGITUDE 122 d 03 m 34 s

ALTITUDE 520.00 DATE OF CONSTRUCTION 02 / 16 / 1977

DEPTH OF WELL 145.00 DEPTH OF HOLE 145.00

WATER LEVEL 120.00 DATE MEASURED 02 / 22 / 1977

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 4

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
HAM149	HAMMER, LARRY		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	145.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	145.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472118122034001 LOCAL NUMBER 22N/06E-32A02

LATITUDE 47 d 21 m 18 s LONGITUDE 122 d 03 m 40 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 04 / 29 / 1980

DEPTH OF WELL 138.00 DEPTH OF HOLE 138.00

WATER LEVEL 104.00 DATE MEASURED 05 / 01 / 1980

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 3

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
DOD039	DODGE, JACK		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	138.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	138.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

**** WELL CONSTRUCTION REPORT ****

SITEID 472124122042201 LOCAL NUMBER 22N/06E-32C01

LATITUDE 47 d 21 m 24 s LONGITUDE 122 d 04 m 22 s

ALTITUDE 415.00 DATE OF CONSTRUCTION 02 / 18 / 1980

DEPTH OF WELL 100.00 DEPTH OF HOLE 275.00

WATER LEVEL 30.00 DATE MEASURED 03 / 12 / 1980

DRILLER STORY/ARMSTR CONSTRUCTION METHOD C TYPE OF FINISH S

TYPE OF SEAL B BOTTOM OF SEAL 20 METHOD OF DEVELOPMENT P

DEVEL. METHOD P HOURS OF DEVEL.

REMARKS R&N PRESENT FOR DRILLING AND TESTING

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	20.00	16.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	94.00	10.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	92.00	100.00	R	R	9.00	0.080	0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472124122044401 LOCAL NUMBER 22N/06E-32D01

LATITUDE 47 d 21 m 24 s LONGITUDE 122 d 04 m 44 s

ALTITUDE 420.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 36.00 DEPTH OF HOLE 0.00

WATER LEVEL 21.00 DATE MEASURED / /

DRILLER MAXWELL CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472112122033601 LOCAL NUMBER 22N/06E-32H01

LATITUDE 47 d 21 m 12 s LONGITUDE 122 d 03 m 36 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 09 / 10 / 1975

DEPTH OF WELL 106.00 DEPTH OF HOLE 106.00

WATER LEVEL 84.00 DATE MEASURED 09 / 16 / 1975

DRILLER JOHNSON CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 3

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
GRE145	GREEN, KEN		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	106.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	106.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	96.00	106.00	P		0.00	0.125	0.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472041122040201 LOCAL NUMBER 22N/06E-32G01

LATITUDE 47 d 20 m 41 s LONGITUDE 122 d 04 m 02 s

ALTITUDE 455.00 DATE OF CONSTRUCTION 02 / 20 / 1973

DEPTH OF WELL 95.00 DEPTH OF HOLE 95.00

WATER LEVEL 32.00 DATE MEASURED 02 / 23 / 1973

DRILLER NORTHWEST CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 20 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 1

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
BL0028	BLOOM, RONALD		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	95.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	95.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	66.00	77.00	P		0.00	0.025	2.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

****** WELL CONSTRUCTION REPORT ******

SITEID 472045122040001 LOCAL NUMBER 22N/06E-32Q03

LATITUDE 47 d 20 m 45 s LONGITUDE 122 d 04 m 00 s

ALTITUDE 455.00 DATE OF CONSTRUCTION 10 / 22 / 1971

DEPTH OF WELL 87.00 DEPTH OF HOLE 87.00

WATER LEVEL 37.00 DATE MEASURED 10 / 25 / 1971

DRILLER NORTHWEST CONSTRUCTION METHOD C TYPE OF FINISH O

TYPE OF SEAL B BOTTOM OF SEAL 20 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 2

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
262017	M&L KUSTOM KURE	MARVIN PERAULT	631-1237

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	87.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	87.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.75

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472043122034401 LOCAL NUMBER 22N/06E-32R01

LATITUDE 47 d 20 m 43 s LONGITUDE 122 d 03 m 44 s

ALTITUDE 455.00 DATE OF CONSTRUCTION 09 / 19 / 1974

DEPTH OF WELL 93.00 DEPTH OF HOLE 0.00

WATER LEVEL 33.00 DATE MEASURED / /

DRILLER JOHNSON DRIL CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	93.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

**** WELL CONSTRUCTION REPORT ****

SITEID 472125122025701 LOCAL NUMBER 22N/06E-33C01

LATITUDE 47 d 21 m 25 s LONGITUDE 122 d 02 m 57 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 09 / 25 / 1979

DEPTH OF WELL 159.00 DEPTH OF HOLE 159.00

WATER LEVEL 120.00 DATE MEASURED 10 / 04 / 1979

DRILLER MUELLER CONSTRUCTION METHOD C TYPE OF FINISH S

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT B

DEVEL. METHOD B HOURS OF DEVEL. 2

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
NIE303	NIEDERKORN, P		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	159.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	154.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	154.00	159.00	S	R	5.50	0.025	0.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472127120032401 LOCAL NUMBER 22N/06E-33D01

LATITUDE 47 d 21 m 27 s LONGITUDE 122 d 00 m 32 s

ALTITUDE 558.00 DATE OF CONSTRUCTION 01 / 01 / 1958

DEPTH OF WELL 175.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472118122031801 LOCAL NUMBER 22N/06E-33D02

LATITUDE 47 d 21 m 18 s LONGITUDE 122 d 03 m 18 s

ALTITUDE 535.00 DATE OF CONSTRUCTION 08 / 26 / 1980

DEPTH OF WELL 140.00 DEPTH OF HOLE 140.00

WATER LEVEL 97.00 DATE MEASURED 08 / 28 / 1980

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 4

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
PED325	PEDRIN, ROBERT		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	140.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	140.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 2.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472115122024201 LOCAL NUMBER 22N/06E-33G01

LATITUDE 47 d 21 m 15 s LONGITUDE 122 d 02 m 42 s

ALTITUDE 480.00 DATE OF CONSTRUCTION 01 / 01 / 1900

DEPTH OF WELL 32.00 DEPTH OF HOLE 0.00

WATER LEVEL 9.91 DATE MEASURED 01 / 28 / 1963

DRILLER CONSTRUCTION METHOD D TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	48.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472054122022101 LOCAL NUMBER 22N/06E-33J01

LATITUDE 47 d 20 m 54 s LONGITUDE 122 d 02 m 21 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 05 / 11 / 1976

DEPTH OF WELL 130.00 DEPTH OF HOLE 130.00

WATER LEVEL 104.00 DATE MEASURED 05 / 11 / 1976

DRILLER NW PUMP & DR CONSTRUCTION METHOD A TYPE OF FINISH

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	130.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	130.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

**** WELL CONSTRUCTION REPORT ****

SITEID 472058122022001 LOCAL NUMBER 22N/06E-33J01

LATITUDE 47 d 20 m 58 s LONGITUDE 122 d 02 m 20 s

ALTITUDE 587.00 DATE OF CONSTRUCTION 09 / 03 / 1974

DEPTH OF WELL 91.00 DEPTH OF HOLE 0.00

WATER LEVEL 76.00 DATE MEASURED 09 / 03 / 1974

DRILLER JOHNSON DRLG CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	91.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472059122022101 LOCAL NUMBER 22N/06E-33J02

LATITUDE 47 d 20 m 59 s LONGITUDE 122 d 02 m 21 s

ALTITUDE 587.00 DATE OF CONSTRUCTION 11 / 26 / 1974

DEPTH OF WELL 135.00 DEPTH OF HOLE 0.00

WATER LEVEL 117.00 DATE MEASURED 11 / 26 / 1974

DRILLER NORTHWEST PU CONSTRUCTION METHOD C TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	135.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT U

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****

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SITEID 472053122021601 LOCAL NUMBER 22N/06E-33J04

LATITUDE 47 d 20 m 53 s LONGITUDE 122 d 02 m 16 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 11 / 16 / 1977

DEPTH OF WELL 160.00 DEPTH OF HOLE 160.00

WATER LEVEL 110.00 DATE MEASURED 11 / 22 / 1977

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH P

TYPE OF SEAL I BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL 1

REMARKS SEAL IS BENTONITE AND CEMENT

OWNER ID	SYSTEM NAME	CONTACT	PHONE
WAI441	WAITE, DAN		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	160.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	160.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	120.00	143.00	P		6.00	0.375	3.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472039122031501 LOCAL NUMBER 22N/06E-33N01

LATITUDE 47 d 20 m 39 s LONGITUDE 122 d 03 m 15 s

ALTITUDE 435.00 DATE OF CONSTRUCTION 02 / 18 / 1983

DEPTH OF WELL 57.00 DEPTH OF HOLE 57.00

WATER LEVEL 3.00 DATE MEASURED 02 / 18 / 1983

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT B

DEVEL. METHOD B HOURS OF DEVEL. 4

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
BAS019	BASS		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	57.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	57.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472049122025701 LOCAL NUMBER 22N/06E-33P

LATITUDE 47 d 20 m 49 s LONGITUDE 122 d 02 m 57 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 12 / 01 / 1977

DEPTH OF WELL 75.00 DEPTH OF HOLE 75.00

WATER LEVEL 45.25 DATE MEASURED 11 / 17 / 1977

DRILLER BURT WELL DR CONSTRUCTION METHOD C TYPE OF FINISH S

TYPE OF SEAL G BOTTOM OF SEAL 22 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS LOC: 700FT N, 450 W OF S1/4 COR SEC 33

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	75.00	16.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	51.00	16.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	51.00	66.00	S	R	16.00	0.125	0.00
2	66.00	75.00	X		16.00	0.000	0.00

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472048122025701 LOCAL NUMBER 22N/06E-33P02

LATITUDE 47 d 20 m 48 s LONGITUDE 122 d 02 m 57 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 01 / 03 / 1978

DEPTH OF WELL 72.00 DEPTH OF HOLE 72.00

WATER LEVEL 42.00 DATE MEASURED 12 / 18 / 1977

DRILLER BURT WELL DR CONSTRUCTION METHOD C TYPE OF FINISH S

TYPE OF SEAL G BOTTOM OF SEAL 22 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS LOC: 650FT N, 450FT W OF S1/4 COR SEC 33

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	72.00	16.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	50.00	16.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	50.00	65.00	S	R	14.00	0.125	0.00
2	65.00	72.00	X		16.00	0.000	0.00

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472046122030301 LOCAL NUMBER 22N/06E-33P03

LATITUDE 47 d 20 m 46 s LONGITUDE 122 d 03 m 03 s

ALTITUDE 455.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 0.00 DEPTH OF HOLE 695.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER ARMSTRONG CONSTRUCTION METHOD C TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	375.00	16.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

**** WELL CONSTRUCTION REPORT ****

SITEID 472103122010201 LOCAL NUMBER 22N/06E-34H01

LATITUDE 47 d 21 m 03 s LONGITUDE 122 d 01 m 02 s

ALTITUDE 600.00 DATE OF CONSTRUCTION 01 / 03 / 1980

DEPTH OF WELL 155.00 DEPTH OF HOLE 155.00

WATER LEVEL 119.00 DATE MEASURED 01 / 04 / 1980

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 1

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
SVE409	SVERDARSKY, DAVE		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	155.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	155.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

****** WELL CONSTRUCTION REPORT ******

SITEID 472040122011501 LOCAL NUMBER 22N/06E-34Q01

LATITUDE 47 d 20 m 40 s LONGITUDE 122 d 01 m 15 s

ALTITUDE 575.00 DATE OF CONSTRUCTION 06 / 20 / 1978

DEPTH OF WELL 98.00 DEPTH OF HOLE 98.00

WATER LEVEL 53.00 DATE MEASURED 06 / 20 / 1978

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 1

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
LAS238	LASHER, DAVE		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	98.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	98.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

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$$$$ WELL CONSTRUCTION REPORT $$$$
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SITEID 472050122010001 LOCAL NUMBER 22N/06E-34R01

LATITUDE 47 d 20 m 50 s LONGITUDE 122 d 01 m 00 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 06 / 17 / 1980

DEPTH OF WELL 80.00 DEPTH OF HOLE 80.00

WATER LEVEL 40.00 DATE MEASURED 06 / 17 / 1980

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 1

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
MAI257	MAIERS, LAURETTA		

$$ HOLE INFORMATION $$

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	80.00	6.00

$$ CASING INFORMATION $$

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	80.00	6.00	S	0.000

$$ OPENINGS INFORMATION $$

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

$$ PUMP INFORMATION $$

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472037122010101 LOCAL NUMBER 22N/06E-34R02

LATITUDE 47 d 20 m 37 s LONGITUDE 122 d 01 m 01 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 06 / 09 / 1983

DEPTH OF WELL 65.00 DEPTH OF HOLE 65.00

WATER LEVEL 30.00 DATE MEASURED 06 / 09 / 1983

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 3

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
DRL092	DRLLEVICH, VAL		432-0200

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	65.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	65.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

****** WELL CONSTRUCTION REPORT ******

SITEID 472003122015701 LOCAL NUMBER 21N/06E-03E01

LATITUDE 47 d 20 m 03 s LONGITUDE 122 d 01 m 57 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 01 / 1958

DEPTH OF WELL 51.00 DEPTH OF HOLE 0.00

WATER LEVEL 12.00 DATE MEASURED 01 / 01 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.75

**** WELL CONSTRUCTION REPORT ****

SITEID 472020122015601 LOCAL NUMBER 21N/06E-03E02

LATITUDE 47 d 20 m 20 s LONGITUDE 122 d 01 m 56 s

ALTITUDE 495.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 16.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER SANDPOINT CONSTRUCTION METHOD V TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	4.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT P

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.25

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472004122013901 LOCAL NUMBER 21N/06E-03L01

LATITUDE 47 d 20 m 04 s LONGITUDE 122 d 01 m 39 s

ALTITUDE 550.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 107.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
76460N	SAWYERWOOD ESTATES W. S.	DONALD FURMAN	886-2264

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	0.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472021122020701 LOCAL NUMBER 21N/06E-03P02

LATITUDE 47 d 19 m 46 s LONGITUDE 122 d 01 m 46 s

ALTITUDE 515.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 50.00 DEPTH OF HOLE 0.00

WATER LEVEL 30.34 DATE MEASURED 08 / 16 / 1962

DRILLER DORSTEN CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
56185A	MORRIS BROTHERS		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	-0.62	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 1.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472030122023701 LOCAL NUMBER 21N/06E-04B01

LATITUDE 47 d 20 m 30 s LONGITUDE 122 d 02 m 37 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 50.00 DEPTH OF HOLE 0.00

WATER LEVEL 32.61 DATE MEASURED 08 / 16 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	3.00	0.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

**** WELL CONSTRUCTION REPORT ****

SITEID 472027122024001 LOCAL NUMBER 21N/06E-04B02

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 40 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 01 / 1961

DEPTH OF WELL 50.00 DEPTH OF HOLE 0.00

WATER LEVEL 33.87 DATE MEASURED 08 / 15 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	-0.30	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****

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SITEID 472031122023301 LOCAL NUMBER 21N/06E-04B03

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 45 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 09 / 01 / 1959

DEPTH OF WELL 54.00 DEPTH OF HOLE 0.00

WATER LEVEL 27.47 DATE MEASURED 08 / 16 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS WELL DEEPENED DUE TO WATER LEVEL DECLINES

OWNER ID	SYSTEM NAME	CONTACT	PHONE
LAD200	LADDERAD		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	54.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472031122023302 LOCAL NUMBER 21N/06E-04B03D1

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 45 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 65.00 DEPTH OF HOLE 0.00

WATER LEVEL 38.17 DATE MEASURED 08 / 12 / 1986

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
LAD300	LADDERUND, LOIS		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	0.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472026122024501 LOCAL NUMBER 21N/06E-04B04

LATITUDE 47 d 20 m 26 s LONGITUDE 122 d 02 m 45 s

ALTITUDE 302.00 DATE OF CONSTRUCTION 07 / 13 / 1961

DEPTH OF WELL 48.00 DEPTH OF HOLE 0.00

WATER LEVEL 28.00 DATE MEASURED 07 / 13 / 1961

DRILLER JOHNSON CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	48.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472028122024201 LOCAL NUMBER 21N/06E-04B04

LATITUDE 47 d 20 m 32 s LONGITUDE 122 d 02 m 39 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 85.00 DEPTH OF HOLE 0.00

WATER LEVEL 43.00 DATE MEASURED 03 / 01 / 1971

DRILLER CONSTRUCTION METHOD TYPE OF FINISH D

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS SCHEDULE YEAR WAS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
EC0400	ECOLOGY, DEPT OF		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472025122024101 LOCAL NUMBER 21N/06E-04B05

LATITUDE 47 d 20 m 27 s LONGITUDE 122 d 02 m 46 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 02 / 1976

DEPTH OF WELL 83.00 DEPTH OF HOLE 83.00

WATER LEVEL 43.00 DATE MEASURED 01 / 02 / 1976

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH S

TYPE OF SEAL B BOTTOM OF SEAL 20 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
416508	KCWD 105	JUDITH NELSON	631-0565

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	83.00	10.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	73.00	10.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	73.00	83.00	S	R	10.00	0.040	0.00

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472030122023801 LOCAL NUMBER 21N/06E-04B07

LATITUDE 47 d 20 m 30 s LONGITUDE 122 d 02 m 38 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 08 / 01 / 1956

DEPTH OF WELL 80.00 DEPTH OF HOLE 0.00

WATER LEVEL 40.00 DATE MEASURED 08 / 01 / 1956

DRILLER CONSTRUCTION METHOD B TYPE OF FINISH P

TYPE OF SEAL Z BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS 67= RUBBER COMPRESSED

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	80.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT C

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

****** WELL CONSTRUCTION REPORT ******

SITEID 472025122024501 LOCAL NUMBER 21N/06E-04B08

LATITUDE 47 d 20 m 33 s LONGITUDE 122 d 02 m 40 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 12 / 13 / 1975

DEPTH OF WELL 85.00 DEPTH OF HOLE 85.00

WATER LEVEL 43.00 DATE MEASURED 12 / 13 / 1975

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH S

TYPE OF SEAL B BOTTOM OF SEAL 20 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
416508	KCWD 105	JUDITH NELSON	631-0565

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	85.00	10.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	75.00	10.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	75.00	85.00	S	R	10.00	0.040	0.00

** PUMP INFORMATION **

TYPE OF LIFT T

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 800.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472029122024101 LOCAL NUMBER 21N/06E-04B09

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 02 m 41 s

ALTITUDE 536.00 DATE OF CONSTRUCTION 03 / 24 / 1980

DEPTH OF WELL 87.00 DEPTH OF HOLE 92.00

WATER LEVEL 38.00 DATE MEASURED 04 / 03 / 1980

DRILLER STORY/ARMSTR CONSTRUCTION METHOD C TYPE OF FINISH S

TYPE OF SEAL G BOTTOM OF SEAL 20 METHOD OF DEVELOPMENT S

DEVEL. METHOD S HOURS OF DEVEL. 4

REMARKS R&N PRESENT FOR DRILLING AND TESTING

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	20.00	20.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	62.00	16.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	64.00	69.00	R	R	16.00	0.150	0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472029122030001 LOCAL NUMBER 21N/06E-04C01

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 03 m 00 s

ALTITUDE 495.00 DATE OF CONSTRUCTION 01 / 01 / 1963

DEPTH OF WELL 67.00 DEPTH OF HOLE 0.00

WATER LEVEL 35.47 DATE MEASURED 08 / 15 / 1962

DRILLER JOHNSON DRIL CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	1.75	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 1.00

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****** WELL CONSTRUCTION REPORT ******

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SITEID 472029122031201 LOCAL NUMBER 21N/06E-04D01

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 03 m 12 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 10 / 25 / 1971

DEPTH OF WELL 87.00 DEPTH OF HOLE 0.00

WATER LEVEL 37.00 DATE MEASURED 10 / 25 / 1971

DRILLER NORTHWEST PU CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL B BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	87.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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$$$$ WELL CONSTRUCTION REPORT $$$$
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SITEID 472018122032401 LOCAL NUMBER 21N/06E-04E01

LATITUDE 47 d 20 m 18 s LONGITUDE 122 d 03 m 24 s

ALTITUDE 550.00 DATE OF CONSTRUCTION 06 / 01 / 1975

DEPTH OF WELL 123 00 DEPTH OF HOLE 0.00

WATER LEVEL 106.00 DATE MEASURED 06 / 01 / 1975

DRILLER EVERGREEN DR CONSTRUCTION METHOD C TYPE OF FINISH

TYPE OF SEAL B BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	123.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 472029122025901 LOCAL NUMBER 21N/06E-04F01

LATITUDE 47 d 20 m 29 s LONGITUDE 122 d 02 m 59 s

ALTITUDE 515.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 47.00 DEPTH OF HOLE 0.00

WATER LEVEL 31.43 DATE MEASURED 08 / 15 / 1962

DRILLER CLYDE DORSTE CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	-0.33	0.00	7.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.75

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472017122023901 LOCAL NUMBER 21N/06E-04G01

LATITUDE 47 d 20 m 17 s LONGITUDE 122 d 02 m 39 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 11 / 21 / 1957

DEPTH OF WELL 80.00 DEPTH OF HOLE 0.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER MARTIN R LUT CONSTRUCTION METHOD C TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472001122024301 LOCAL NUMBER 21N/06E-04K01

LATITUDE 47 d 20 m 01 s LONGITUDE 122 d 02 m 43 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 10 / 26 / 1983

DEPTH OF WELL 99.00 DEPTH OF HOLE 99.00

WATER LEVEL 40.00 DATE MEASURED 10 / 26 / 1983

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT B

DEVEL. METHOD B HOURS OF DEVEL. 1

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
284277	TOLLBER, GENE		886-1176

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	99.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	99.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

****** WELL CONSTRUCTION REPORT ******

SITEID 472001122023901 LOCAL NUMBER 21N 06E-04K04

LATITUDE 47 d 20 m 01 s LONGITUDE 122 d 02 m 39 s

ALTITUDE 510.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 60.00 DEPTH OF HOLE 0.00

WATER LEVEL 21.37 DATE MEASURED 07 / 23 / 1986

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
80466D	SMITH, CLYDE	D. & A. JOHNSON	886-1762

**** HOLE INFORMATION ****

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

**** CASING INFORMATION ****

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	0.00		0.000

**** OPENINGS INFORMATION ****

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

**** PUMP INFORMATION ****

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471949122024201 LOCAL NUMBER 21N/06E-04B01

LATITUDE 47 d 19 m 49 s LONGITUDE 122 d 02 m 42 s

ALTITUDE 520.00 DATE OF CONSTRUCTION 01 / 19 / 1968

DEPTH OF WELL 75.00 DEPTH OF HOLE 0.00

WATER LEVEL 25.00 DATE MEASURED 01 / 19 / 1968

DRILLER STIMSON DRIL CONSTRUCTION METHOD V TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 471947122023401 LOCAL NUMBER 21N/06E-04Q02

LATITUDE 47 d 19 m 47 s LONGITUDE 122 d 02 m 35 s

ALTITUDE 520.00 DATE OF CONSTRUCTION 02 / 22 / 1967

DEPTH OF WELL 59.00 DEPTH OF HOLE 59.00

WATER LEVEL 33.00 DATE MEASURED 02 / 22 / 1967

DRILLER JOHNSON DRLL CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL Z BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
76462P	SAWYERWOOD WATER SYSTEM	DOUGLAS, H. & S.	

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	59.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	59.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	49.00	59.00	P		0.00	0.125	3.00

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

**** WELL CONSTRUCTION REPORT ****

SITEID 471958122024201 LOCAL NUMBER 21N/06E-04Q03

LATITUDE 47 d 19 m 52 s LONGITUDE 122 d 02 m 40 s

ALTITUDE 515.00 DATE OF CONSTRUCTION 09 / 18 / 1975

DEPTH OF WELL 52.00 DEPTH OF HOLE 52.00

WATER LEVEL 25.00 DATE MEASURED 09 / 18 / 1975

DRILLER JOHNSON CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL. 3

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
05750H	BENSON, EDWARD		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	52.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	52.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	42.00	52.00	P		0.00	0.000	0.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471952122022601 LOCAL NUMBER 21N/06E-04R01

LATITUDE 47 d 19 m 52 s LONGITUDE 122 d 02 m 26 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 27.00 DEPTH OF HOLE 0.00

WATER LEVEL 15.17 DATE MEASURED 08 / 14 / 1962

DRILLER CONSTRUCTION METHOD D TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	0.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.33

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**** WELL CONSTRUCTION REPORT ****
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SITEID 472033122033B01 LOCAL NUMBER 21N/06E-05A01

LATITUDE 47 d 20 m 33 s LONGITUDE 122 d 03 m 38 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 05 / 12 / 1974

DEPTH OF WELL 90.00 DEPTH OF HOLE 0.00

WATER LEVEL 5.00 DATE MEASURED 05 / 12 / 1974

DRILLER JOHNSON DR C CONSTRUCTION METHOD C TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	90.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

**** WELL CONSTRUCTION REPORT ****

SITEID 471917122043501 LOCAL NUMBER 21N/06E-08E01

LATITUDE 47 d 19 m 17 s LONGITUDE 122 d 04 m 35 s

ALTITUDE 530.00 DATE OF CONSTRUCTION 01 / 01 / 1957

DEPTH OF WELL 65.00 DEPTH OF HOLE 0.00

WATER LEVEL 8.00 DATE MEASURED / /

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471921122041801 LOCAL NUMBER 21N/06E-08F01

LATITUDE 47 d 19 m 21 s LONGITUDE 122 d 04 m 18 s

ALTITUDE 470.00 DATE OF CONSTRUCTION 06 / 03 / 1982

DEPTH OF WELL 119.00 DEPTH OF HOLE 119.00

WATER LEVEL 0.00 DATE MEASURED / /

DRILLER STORY/DODGE CONSTRUCTION METHOD C TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS R&N PRESENT FOR DRILLING

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	119.00	8.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471931122033701 LOCAL NUMBER 21N/06E-08H01

LATITUDE 47 d 19 m 31 s LONGITUDE 122 d 03 m 37 s

ALTITUDE 490.00 DATE OF CONSTRUCTION 09 / 09 / 1982

DEPTH OF WELL 127.00 DEPTH OF HOLE 127.00

WATER LEVEL 4.00 DATE MEASURED 09 / 12 / 1982

DRILLER STORY/DODGE CONSTRUCTION METHOD C TYPE OF FINISH F

TYPE OF SEAL B BOTTOM OF SEAL 9 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS R&N PRESENT FOR DRILLING AND TESTING

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	20.00	12.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	127.00	8.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	12.00	17.00		P	8.00	0.000	0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471945122022201 LOCAL NUMBER 21N/06E-09A01

LATITUDE 47 d 19 m 45 s LONGITUDE 122 d 02 m 22 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 27.00 DEPTH OF HOLE 0.00

WATER LEVEL 14.69 DATE MEASURED 08 / 14 / 1962

DRILLER MYRL JOHNSON CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT P

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.25

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471938122022401 LOCAL NUMBER 21N/06E-09A02

LATITUDE 47 d 19 m 38 s LONGITUDE 122 d 02 m 24 s

ALTITUDE 525.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 39.00 DEPTH OF HOLE 0.00

WATER LEVEL 28.02 DATE MEASURED 08 / 16 / 1962

DRILLER MRYL JOHNSN CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	-0.30	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.33

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**** WELL CONSTRUCTION REPORT ****
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SITEID 461933122021401 LOCAL NUMBER 21N/06E-09H01

LATITUDE 47 d 19 m 33 s LONGITUDE 122 d 02 m 14 s

ALTITUDE 515.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 48.00 DEPTH OF HOLE 0.00

WATER LEVEL 25.00 DATE MEASURED / /

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	0.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471400122020401 LOCAL NUMBER 21N/06E-10E01

LATITUDE 47 d 19 m 00 s LONGITUDE 122 d 02 m 04 s

ALTITUDE 500.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 45.00 DEPTH OF HOLE 0.00

WATER LEVEL 26.00 DATE MEASURED / /

DRILLER NORTHWEST DR CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 1.00

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****** WELL CONSTRUCTION REPORT ******
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SITEID 471927122020401 LOCAL NUMBER 21N/06E-10E02

LATITUDE 47 d 19 m 27 s LONGITUDE 122 d 02 m 04 s

ALTITUDE 510.00 DATE OF CONSTRUCTION / /

DEPTH OF WELL 42.00 DEPTH OF HOLE 0.00

WATER LEVEL 30.67 DATE MEASURED 08 / 14 / 1962

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	0.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.33

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****** WELL CONSTRUCTION REPORT ******
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SITEID 471924122020301 LOCAL NUMBER 21N/06E-10E03

LATITUDE 47 d 19 m 24 s LONGITUDE 122 d 02 m 03 s

ALTITUDE 510.00 DATE OF CONSTRUCTION 01 / 01 / 1952

DEPTH OF WELL 42.00 DEPTH OF HOLE 0.00

WATER LEVEL 27.43 DATE MEASURED 08 / 14 / 1965

DRILLER CONSTRUCTION METHOD TYPE OF FINISH

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	6.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT J

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.50

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471924122015101 LOCAL NUMBER 21N/06E-10F01

LATITUDE 47 d 19 m 24 s LONGITUDE 122 d 01 m 51 s

ALTITUDE 500.00 DATE OF CONSTRUCTION 01 / 01 / 1930

DEPTH OF WELL 22.00 DEPTH OF HOLE 0.00

WATER LEVEL 20.00 DATE MEASURED / /

DRILLER CONSTRUCTION METHOD V TYPE OF FINISH T

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	0.00	0.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	0.00	2.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT P

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.75

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$$$$ WELL CONSTRUCTION REPORT $$$$
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SITEID 471925122000101 LOCAL NUMBER 21N 06E-11B01

LATITUDE 47 d 19 m 25 s LONGITUDE 122 d 00 m 01 s

ALTITUDE 640.00 DATE OF CONSTRUCTION 03 / 11 / 1981

DEPTH OF WELL 127.00 DEPTH OF HOLE 127.00

WATER LEVEL 50.00 DATE MEASURED 03 / 11 / 1981

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT B

DEVEL. METHOD B HOURS OF DEVEL. 3

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
CHE065	CHEATHAM, RAY		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	40.00	6.00
2	40.00	127.00	4.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	40.00	6.00	S	0.000
2	0.00	127.00	4.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	80.00	120.00	P		0.00	0.000	0.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.75

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471834122030201 LOCAL NUMBER 21N/06E-16F01

LATITUDE 47 d 18 m 32 s LONGITUDE 122 d 03 m 02 s

ALTITUDE 515.00 DATE OF CONSTRUCTION 06 / 24 / 1980

DEPTH OF WELL 103.00 DEPTH OF HOLE 103.00

WATER LEVEL 43.00 DATE MEASURED 06 / 24 / 1980

DRILLER NORTHWEST PD CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL B BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT

DEVEL. METHOD HOURS OF DEVEL.

REMARKS

OWNER ID SYSTEM NAME CONTACT PHONE

OWNER INFORMATION NOT AVAILABLE FOR THIS WELL

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	103.00	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	103.00	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT

DEPTH OF PUMP INTAKE 0

TYPE OF POWER

HORSEPOWER 0.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471814122024701 LOCAL NUMBER 21N/06E-16Q01

LATITUDE 47 d 18 m 14 s LONGITUDE 122 d 02 m 47 s

ALTITUDE 525.00 DATE OF CONSTRUCTION 04 / 15 / 1981

DEPTH OF WELL 78.50 DEPTH OF HOLE 78.50

WATER LEVEL 42.00 DATE MEASURED 04 / 15 / 1981

DRILLER NORTHWEST CONSTRUCTION METHOD A TYPE OF FINISH O

TYPE OF SEAL BOTTOM OF SEAL 0 METHOD OF DEVELOPMENT B

DEVEL. METHOD B HOURS OF DEVEL. 1

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
AND008	ANDERSON, JOE		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	78.50	6.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	-1.50	78.50	6.00	S	0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 1.00

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**** WELL CONSTRUCTION REPORT ****
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SITEID 471925121594801 LOCAL NUMBER 21N/06E-11H01

LATITUDE 47 d 19 m 25 s LONGITUDE 121 d 59 m 48 s

ALTITUDE 815.00 DATE OF CONSTRUCTION 02 / 04 / 1980

DEPTH OF WELL 240.00 DEPTH OF HOLE 240.00

WATER LEVEL 40.00 DATE MEASURED 02 / 04 / 1980

DRILLER JOHNSON CONSTRUCTION METHOD A TYPE OF FINISH P

TYPE OF SEAL C BOTTOM OF SEAL 18 METHOD OF DEVELOPMENT B

DEVEL. METHOD B HOURS OF DEVEL.

REMARKS

OWNER ID	SYSTEM NAME	CONTACT	PHONE
REI342	REICHERT, MATHEW		

** HOLE INFORMATION **

INTERVAL NUMBER	TOP OF HOLE	BOTTOM OF HOLE	DIAMETER OF HOLE
1	0.00	60.00	6.00
2	60.00	240.00	4.00

** CASING INFORMATION **

INTERVAL NUMBER	TOP CASING	BOTTOM CASING	DIAMETER CASING	CASING MATERIAL	CASING THICKNESS
1	0.00	60.00	6.00		0.000
2	0.00	240.00	4.00		0.000

** OPENINGS INFORMATION **

INTERVAL NUMBER	TOP SECTION	BOTTOM SECTION	TYPE OPENINGS	TYPE MATERIAL	DIAMETER OPENINGS	WIDTH OPENINGS	LENGTH OPENINGS
1	190.00	240.00	P		0.00	0.000	0.00

** PUMP INFORMATION **

TYPE OF LIFT S

DEPTH OF PUMP INTAKE 0

TYPE OF POWER E

HORSEPOWER 0.00

APPENDIX E
LAKE SAWYER SEPTIC LEACHATE SURVEY
ENTRANCO ENGINEERS, INC.

ENTRANCO ENGINEERS, INC.

LAKE WASHINGTON PARK BUILDING (206) 827-1300
5808 LAKE WASHINGTON BOULEVARD N E KIRKLAND WA 98033

June 27, 1989

Mr. Tom Noyes
Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

**Re: Lake Sawyer Septic Leachate Survey
Field Survey Report
Entranco Project No. 89047-60**

Dear Tom:

This letter constitutes our field report for the performance of a septic leachate survey of selected shorelines along Lake Sawyer. The letter report describes methods, results, and reasons for premature termination of the survey.

Methods

A K-V Associates Model 15 septic leachate detector was used to perform the leachate survey. The detector is a portable fluorometer which operates at a fixed wavelength responsive to fluorescence of human urine and laundry whiteners. The unit was calibrated using open water from Lake Sawyer as a source for background adjustment and standard dilutions. A one percent urine solution was used as the calibration standard; a field measurement comparable to the response from a one percent solution is generally used as the threshold value strongly indicative of an inadequately treated wastewater plume. Backgrounds were adjusted to 0.10 on the output meter (range 0.0 to 1.0), with one percent standards generating responses of 0.38 to 0.58 operating at a signal multiplier of 4. Unit calibration was generally repeated on an hourly frequency throughout the survey.

The survey was conducted along approximately 1.1 miles of the eastern shoreline of the lake (see attached map), with the operator sweeping the intake wand of the instrument along a 2 meter swath in front while wading the shallow (0.5-1.2 meter) littoral. Detector measurements were compared to concurrent chloride ion probe measurements on a reach by reach basis along the shoreline. The survey was conducted during June 12-13 until leachate detector electronic problems forced a termination of the survey.

Results

There was an absence of conclusive septic leachate plume activity observed along the shorelines surveyed. No activity indicative of concentrated effluent strength plumes was discovered. There were some indications of slight fluorometric response (from a background of 0.10 to readings of 0.14 - 0.18) which were generally corroborated by independent chloride measurements. However, these were well below the threshold one percent response level and occurred along relatively broad reaches of the shoreline.

Observed bank cuts and outcrops indicated that indigenous soils along the surveyed reach were glacial outwash gravels and cobble. Soil conditions, field results, and past experience under similar conditions suggest that wastewater is either being adequately treated, or, if inadequately treated, is undergoing sufficient vertical and/or lateral dispersion from the drainfield that plumes either: (1) disperse in a broad uniform reach at plume concentrations too low for positive detection; or (2) subtend the shoreline and erupt at a deeper littoral location beyond the reach of the detector.

Results therefore suggest that, at least for the shoreline reach surveyed, the most appropriate strategy for characterization of nutrient loadings from on-site wastewater systems would not be by site specific plume monitoring but by a randomized shallow well point monitoring of groundwater along influent reaches of the shoreline.

Instrument Performance

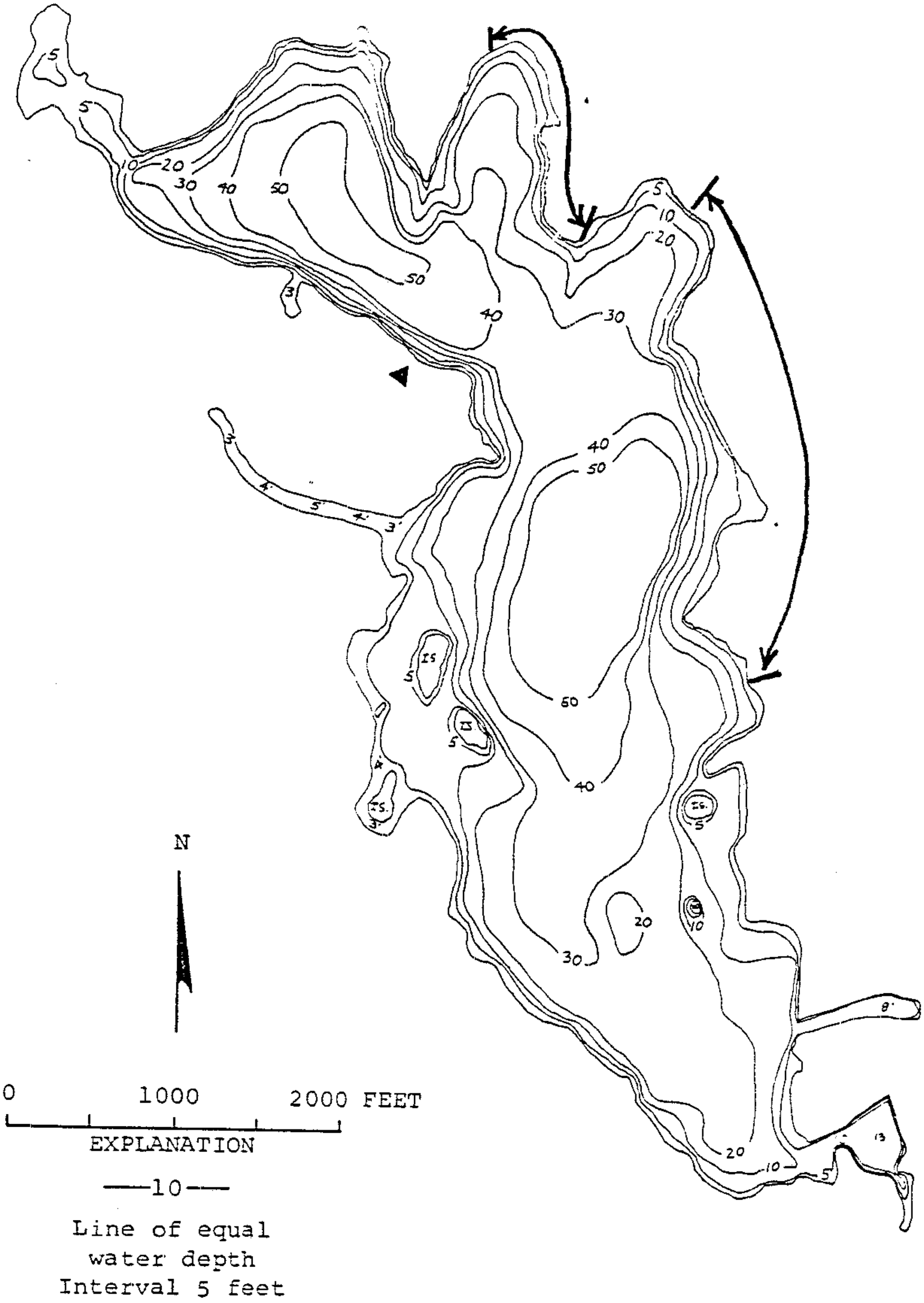
While the survey was prematurely terminated due to electronic difficulties with the leachate detector, it should be emphasized that the detector operated in a very sensitive and stable manner during the period it was operational. Based on our experience, we believe that the absence of effluent strength activity indicated by the detector during its period and reach of performance was valid.

Field failure of the leachate detector appeared to be attributed to heat fatigue of a heat resistor or the light source after a period of operation. K-V Associates was unable to identify and correct the problem when the unit was returned to their laboratory. Further repair efforts were deferred when it became apparent that the survey would not be able to be completed in time to assist in the location of shoreline monitoring wells.

While the potential for field survey delays due to instrument repair was clearly identified prior to the survey, we sincerely regret that we were not able to perform the entire survey to meet Hart Crowser's technical objectives and schedule constraints. We attempted to take all reasonable measures to minimize the potential for this occurrence. We hope that what information was obtained will assist you in the successful completion of the project.

Sincerely,

George S. Edwards, P.E.



Sawyer Lake, King County. From U.S. Geological Survey, June 6, 1973.

|←——→| SHORELINE REACH SURVEYED

a product of
J. L. DARLING CORPORATION
TACOMA, WASHINGTON 98421 U.S.A.

"Rite in the Rain"
WEATHERPROOF

TRANSIT

NOTEBOOK NO. 301

FB 1399

LAKE SAWYER SEPTIC
LEACHATE SURVEY

INDEX

DATE	PAGE	DESCRIPTION

Lake Sawyer 6/13/89

Calibration 8:30
background .1
1% Sol'n @ 4X .48

Start - moving clockwise
Lot 517 [Maps NW 3-21-[illegible]]
Dark green house, set back from beach, large windows and porch on left side of house, brick chimney on left, trees & [illegible] line both sides of yard
yellow raft on roof
Chocolate & white w/ bald head
Old cabin w/ fireplace
Mint house, cedar siding, [illegible] windows large, new, newer house, balconies, flag
lot to the left w/ snapdragons
small house set back w/ white & gray hut on water
Gray house
Gray
533 Gold house steep shoreline, fiberglass patio cover

Blue house, white trim, awning on left side, old red chair on dock
New, brown cedar, solarium
602 Cabin, sliders in front, fieldstone walls & bark in yard, windmill near flag
Seagull & windsock on dock
Map SW 3-21-[illegible]
Beige house, brown trim, pillars green & white umbrella
A-frame, reddish color
~609 Large cedar house, birdhouse hammock
Yellow house, high on bank, chain link fence everywhere, gazebo catamaran

Calibration 10:19
Background .08
190 Soln (4x) .36

Brown house, w/ balconies, divine bell
Tan & green, cedar shed, blue boat
Cabin w/ porch just inside among trees, windsock, gray
~611 Brown, square, w/ yellow picnic table
Small, old, brown w/ unpainted white

2/11399

~616 Large dark brown set up & back, shed near water, jungle gym
Tan, very small, back of lot
~618 Dark red,
Brown, set back, cement stairway
Newer, sandy gray, on flat ground near water
~620 New, gray-beige w/ blue awnings, low level
Substrate in this section has been very gravelly.
(54) Vacant lot ((looks like a park.
Small, old garage?
694 Wood & yellow, on
695 White w/ green trim, wood porch
Schindeldecker sign, red dock
696 Small yellow, sideways on the far right side of lot
Dark gray, white trim, fir tree on porch
Large, new, sandy beige, brick steps & wall w/ flowers around patio
699 Light gray, split level
412 Sandy brown, large flag, thermometer

41 Swing on point, large sandy house (Reading slightly elevated, appeared to coincide with chloride ...n)

Calibration 1:55 pm
4x power
background 0.10
1% STD 0.46

46 Large 2 story gray w/ concrete embankment, boat w/ awning, board

little white cabin w/ big fir

2:30-3:00
unit wouldnt react to 1% STD
or to 2.9% STD
* Quit for Day Inst. Down *

Calibration
4x power
Background

6/13 3/1399

8:00 Calibration
Background = 0.1
1% = 0.35

8:10 MAP NW3-21-6
Lot #12 0.06 to 0.1

8:15 Lot 10 0.08

8:17 Lot #8 0.1 to 0.4 Brown Hs. / Brown Roof
skip 2 Lots - steep - docks

8:36 Lot #6 Recalibrate = 0.08
1% = 0.56

8:50 Lot #4 0.14 pink House

9:00 Lot #2 Gray House on point.
0.18 Took Sample
then back to Background

9:10 Lot #1 0.08 Gray House

9:25 Lot #492 0.14 Gold Hs / Green old roof
Took Water Sample #4

9:35 Checked Calibration
BG = 0.08 Lot 493
1% = 0.58

6/13

9:45 Lot 494 0.2 yellow to green Train

10:00 Cal. 800.1
19. : 0.58

10:15 Lot 498 0.18 Near point of Peninsula

10:17 Lot 499

0.06 Calibration
1% - 0.35

10:39 Lot ~~499~~ 501
BG 0.08 of water near to shore
1% 0.25 of

Keeps dropping to 0.0 BG.
Survey terminated for day due to operational problems w/ leachate detector

4/1394

APPENDIX F
MONITORING NETWORK ELEVATION SURVEY

APPENDIX F
MONITORING NETWORK ELEVATION SURVEY

The monitoring wells' and wellpoints' top-of-casing elevations and the staff gage elevations were surveyed to an accuracy of 0.01 foot by Meridith, Inc. The U.S. Coastal and Geodetic Survey Benchmark Z253 (shown on Figure 2) with an elevation of 564.684 feet, relative to the USC&GS datum, was used as the reference elevation for this survey. After the elevation data were available for the monitoring wells and the wellpoints, Hart Crowser surveyed the top of casing elevations for the eight domestic wells used in the monitoring network, using the surveyed wellpoints as reference elevations. In addition, the elevations of wellpoints no. 1 and no. 2 were resurveyed due to inconsistent water level data. The original wellpoint elevations were confirmed. Meridith's elevation survey report is included in this appendix.

LAKE SAWYER ELEVATION DATA
(REVISED 2/12/90)

Point	Description	Elevation (FT)
BM Z253	3.5" brass cap in concrete abutment by the intersection of the Burlington Northern Railroad and Highway 169 marked USC&GS Z253, 1944	564.684
TBM A	PK nail on the centerline of driveway and the edge of 288th at the top of a steep downhill slope	605.532
MW 4	Top of PVC pipe	549.29
TBM B	Spike in base of power pole at the intersection of 292nd and 232nd	544.558
TBM C	Spike in base of power pole No. 28850 at 28859 229th	528.998
WP 1	Top of PVC pipe	521.44
WP 2	Top of PVC pipe	521.74
WP 3	Top of PVC pipe	522.69
WP 4	Top of PVC pipe	520.56
WP 5	Top of PVC pipe	520.64
WP 6	Top of PVC pipe	521.13
TBM D	Spike in base of tree, 10 feet from road sign, at the intersection of 298th and 232nd	570.385
WP 7	Top of PVC pipe	520.68
TBM E	Spike in base of power pole No. 30067 at 30067 232nd S.E.	546.124
WP 8	Top of PVC pipe	520.90
TBM F	Spike in base of power pole on 232nd between the Falk and Morris homes	546.957
WP 9	Top of PVC pipe	521.82
WP 10	Top of PVC pipe	521.75
TBM G	Spike in base of 30" cedar approximately 300 feet east of gate at intersection of logging roads	552.200
MW 1	Top of PVC pipe	535.64

Point	Description	Elevation (FT)
TBM H	Spike in base of 24" fir tree on West Edge Road near the southeast corner of Lake Sawyer	527.128
SG 1	Rock Creek staff gage elevation at the 2.01 foot reading on the gauge (current WS)	519.58
TBM I	Spike in base of power pole No. 6 at the end of S.E. 312th	557.474
MW 3	Top of PVC pipe	560.84
SG 2	Etton's dock staff gage elevation on top of gage, 0.24'above reading 10.12	521.73
WP 11	Top of PVC pipe	520.91
TBM J	Spike in base of power pole at the intersection of S.E. 312th and 230th Place S.E.	556.033
TBM K	Spike in base of power pole at the intersection of Lake Sawyer Road and S.E. 312th	543.442
TBM L	Spike in base of power pole at the intersection of Lake Sawyer Road and S.E. 307th	543.672
MW 2	Top of PVC pipe	572.46
TBM Eye	Top of eye bolt in edge of dock 6.65 feet east of of Well Point No. 12	519.379
WP 12	Top of PVC pipe	519.55
TBM M	Spike in base of power pole at the intersection of Lake Sawyer Road and S.E. 304th Place	537.586
TBM Nail	Spike in base of power pole No. B59E2 at 30404 225th S.E.	543.639
WP 13	Top of PVC pipe	521.93
TBM N	West head bolt of fire hydrant at 29745 224th S.E.	524.129
SG 3	Top of fence post downstream from spillway	517.68
SG 4	Top of staff gage at spillway 0.98' above the 3.0 mark on the gage	520.51
TBM O	North head bolt of fire hydrant at the intersection of S.E. 296th and 224th S.E.	538.269

Point	Description	Elevation (FT)
WP 14	Top of PVC pipe	519.38
TBM P	Southwest head bolt of fire hydrant No. 33 approximately 300 feet north of fire station	532.567
TBM Q	Spike in base of power pole at the intersection of Lake Sawyer Road and 216th S.E.	526.351
TBM R	Spike in base of power pole approximately 1,000 feet east of intersection of 216th and 292nd S.E.	525.079
WP 15	Top of metal pipe	520.27

Appendix G.1b. Sediment core data (continued).

Station	Upper Horizon Depth (cm)	Lower Horizon Depth (cm)	Percent Solids %	Average Dry Density (gDW/cm3)	Total Pb-210 (dpm/g) dry wt.	Unsupported Pb-210 (dpm/g) dry wt.	Stable Pb (ppm DW)	Total P (% DW)	Total N (% DW)	TOC (% DW)
4	0	1	3.40	0.0410	26.73	26.30		0.221	1.13	13.9
4	1	2	4.86	0.0532	29.33	28.90		0.182	1.22	12.8
4	2	3	6.04	0.0607	28.81	28.38		0.126	1.04	11.8
4	3	4	6.93	0.0751	31.02	30.59		0.111	0.99	12.1
4	4	5	7.62	0.0867	29.94	29.51		0.109	1.06	13.0
4	5	6	8.02	0.0717	31.05	30.62		0.108	1.03	12.9
4	6	7	8.50	0.0936	27.64	27.21		0.097	1.04	13.1
4	7	8	9.02	0.0931	22.92	22.49		0.090	0.99	12.6
4	8	9	9.75	0.0977	24.67	24.24		0.088	1.00	12.9
4	9	10	10.27	0.1225	23.33	22.90		0.085	0.94	12.7
4	10	11	11.25	0.1162	23.41	22.98		0.084	0.94	12.5
4	11	12	11.32	0.1225	21.27	20.84		0.083	0.94	12.2
4	12	13	11.29	0.1283	18.96	18.53		0.086	0.94	12.1
4	13	14	11.03	0.1214	19.14	18.71		0.085	0.94	12.4
4	14	15	11.49	0.1139	13.59	13.16		0.078	0.86	12.0
4	15	16	11.28	0.1249	14.715	14.29		0.074	0.89	13.3
4	16	17	10.07	0.1058	13.09	12.66		0.070	0.92	14.1
4	17	18	8.95	0.0948	10.2	9.77		0.067	0.91	14.0
4	18	19	9.66	0.1058	6.26	5.83		0.068	1.00	15.1
4	19	20	9.53	0.1012	5.29	4.86		0.073		
4	20	21	9.12	0.1006						
4	21	22	9.49	0.0902	4.63	4.20		0.070	1.14	17.8
4	22	23	9.24	0.1029						
4	23	24	9.92	0.1040	3.47	3.04		0.071	1.26	18.6
4	24	25	9.56	0.1000						
4	25	26	9.72	0.1023	3.32	2.89		0.072	1.27	18.9
4	26	27	9.08	0.0954						
4	27	28	9.56	0.0983	3.62	3.19		0.074	1.25	19.5
4	28	29	8.90	0.0931						
4	29	30	9.64	0.1006	2.91	2.48		0.075	1.26	19.4
4	30	31	8.92	0.0965						
4	31	32	9.41	0.0948	2.86	2.43		0.075	1.30	19.5
4	32	33	8.64	0.0867						
4	33	34	9.05	0.0890	2.89	2.46		0.075	1.34	20.0
4	34	35	8.46	0.0665						
4	35	36	8.96	0.1052	2.02	1.59		0.077	1.36	20.2
4	36	37	8.74	0.0792						
4	37	38	9.17	0.0988	1.68	1.25		0.082	1.34	20.5
4	38	39	8.58	0.0861						
4	39	40	9.19	0.1029	1.72	1.29		0.082	1.33	19.8
4	40	41	8.72	0.0908						
4	41	42	9.05	0.0884	1.51	1.08				
4	42	43	8.62	0.0925						
4	43	44	9.20	0.0896	1.03	0.60				
4	44	45	8.61	0.0855						
4	45	46	9.16	0.0867	1.45	1.02				
4	46	47	8.60	0.1023						
4	47	48	9.35	0.0954	1.12	0.69				
4	48	49	8.68	0.0948						
4	49	50	8.80	0.0954						
4	50	51	8.84	0.0977						
4	51	52	8.98	0.0873						
4	52	53	8.99	0.0954						
4	53	54	8.89	0.0994						
4	54	55	9.04	0.0913						
4	55	56	9.19	0.0977						
4	56	57	9.46	0.0890						
4	57	58	9.43	0.0960						
4	58	59	9.50	0.0873						
4	59	60	10.12	0.1075	0.43					

Appendix G.1a. Sediment core data.

Station	Upper Horizon Depth (cm)	Lower Horizon Depth (cm)	Percent Solids %	Average Dry Density (gDW/cm3)	Total Pb-210 (dpm/g) dry wt.	Unsupported Pb-210 (dpm/g) dry wt.	Stable Pb (ppm DW)	Total P (% DW)	Total N (% DW)	TOC (% DW)
3	0	1	4.19	0.0486	25.01	23.66		0.123	1.24	14.2
3	1	2	5.36	0.0566	25.59	24.24		0.166	1.33	13.9
3	2	3	5.96	0.0642	30.87	29.52		0.129	1.27	13.8
3	3	4	6.62	0.0728	31.96	30.61		0.117	1.18	14.9
3	4	5	6.93	0.0728	26.69	25.34	32.3	0.098	1.32	15.3
3	5	6	7.15	0.0746	25.25	23.90	46.3	0.107	1.17	15.6
3	6	7	7.34	0.0832	22.70	21.35	31.1	0.100	1.19	16.2
3	7	8	7.73	0.0798	22.00	20.65	25.7	0.098	1.13	15.2
3	8	9	8.14	0.0960	16.63	15.28	28.9	0.099	1.18	16.1
3	9	10	8.23	0.0798	17.12	15.77	24.6	0.115	1.17	16.2
3	10	11	8.91	0.0925	17.23	15.88	26.4	0.092	1.14	15.5
3	11	12	9.54	0.1127	15.49	14.14	21.2	0.096	1.08	15.7
3	12	13	8.69	0.0902	13.54	12.19	27.8	0.090	1.13	15.6
3	13	14	8.80	0.0902	11.40	10.05	23.9	0.083	1.03	16.1
3	14	15	8.58	0.1029	9.36	8.01	28.1	0.083	1.25	17.5
3	15	16	8.40	0.0850	7.76	6.41	24.3	0.082	1.17	17.8
3	16	17	7.49	0.0815	7.98	6.63	21.7	0.075	1.29	17.6
3	17	18	8.50	0.0977	5.61	4.26	15.4	0.054	1.28	19.0
3	18	19	8.89	0.0942	6.85	5.50	3.8	0.085	1.32	19.5
3	19	20	9.10	0.0983	6.40	5.05	13.1	0.082	1.26	18.9
3	20	21	9.43	0.0965			10.5	0.085	1.26	18.8
3	21	22	9.15	0.1064	5.73	4.38	15.5			
3	22	23	9.38	0.0954			9.1	0.080	1.28	19.2
3	23	24	8.88	0.0867	5.09	3.74	11.3			
3	24	25	9.09	0.0960			9.7	0.082	1.29	20.0
3	25	26	8.76	0.0908	5.39	4.04	10.1			
3	26	27	8.54	0.0896			7.2	0.082	1.43	20.5
3	27	28	8.44	0.0861	3.51	2.16	7.7			
3	28	29	8.61	0.0902			7.8	0.083	1.40	20.6
3	29	30	8.26	0.0838	3.29	1.94	8.6			
3	30	31	NA	0.0838						
3	31	32	8.25	0.0838	3.33	1.98	8			
3	32	33	8.40	0.0861			5.6	0.081	1.37	21.0
3	33	34	8.21	0.0867	2.70	1.35	4.3			
3	34	35	NA	0.0850						
3	35	36	8.21	0.0832	3.14	1.79	6.6			
3	36	37	8.60	0.0827			4.9	0.089	1.52	21.4
3	37	38	8.09	0.0867	1.83	0.48	3.3			
3	38	39	8.74	0.0850			4.5	0.085	1.52	22.0
3	39	40	8.36	0.0873	1.81	0.46	4.2			
3	40	41	8.42	0.0798			4.2	0.088	1.50	21.9
3	41	42	7.84	0.0838	1.99	0.64	2.2			
3	42	43	8.32	0.0769			4.2			
3	43	44	8.31	0.0844	2.07	0.72	3.3			
3	44	45	8.71	0.0896			3.4			
3	45	46	8.46	0.0873	1.65	0.30	3.5			
3	46	47	13.03	0.1347						
3	47	48	8.23	0.0821	1.57	0.22				
3	48	49	8.61	0.0844						
3	49	50	8.62	0.0855						
3	50	51	8.68	0.0827						
3	51	52	8.32	0.0850						
3	52	53	8.50	0.0832						
3	53	54	8.39	0.0867						
3	54	55	8.43	0.0838				0.090	1.54	21.7
3	55	56	8.68	0.0884						
3	56	57	8.68	0.0884						
3	57	58	8.68	0.0931						
3	58	59	9.05	0.0919						
3	59	60	8.98	0.0798	1.35					

LAKE SAWYER ZOOPLANKTON

Copepods

DIAPTOMUS OREGONENSIS (Skistodiaptomus oregonensis)
EPISCHURA NEVADENSIS
CYCLOPS BICUSPIDATUS Thomasii
ORTHOCYCLOPS MODESTUS

Cladocera

DAPHNIA PULICARIA (could be D. pulex need adult males to be sure)
DAPHNIA THORATA
DAPHNIA GALEATA

DIAPHANOSOMA BIRGEI (D.leuchtenbergianum)

BOSMINA LONGIROSTRIS

CERIODAPHNIA LACUSTRIS
CERIODAPHNIA RETICULATA

CHYDORUS SPHAERICUS (Littoral species)

Rotifera

KERATELLA COCHLEARIS
KERATELLA EARLINAE
KERATELLA QUADRATA
KELLICOTTIA LONGISPINA
KELLICOTTIAL BOSTONIENSIS
POLYARTHRA VULGARIS GROUP
CONOCHILUS UNICORNIS
CONOCHILUS HIPPOCREPIS
TRICHOCERCA CYCLINDRICA
TRICHOCERCA ROUSELETTI
SYNCHAETA PECTINATA
SYNCHAETA SPECIES
SYNCHAETA STYLATA
GASTROPUS STYLIFER
POMPHOLOX COMPLANATA
ASPLANCHNA PRIODONTA
HEXARTHRA MIRA
FILINIA SPP
COLLOTHECA PELAGICA
NOTHOLCA SQUAMULA
NOTHOLCA ACUMINATA
MONOSTYLA (LITTORAL)
ASCHOMORPHA OVALIS (CHROMOGASTER OVALIS)
ASCOMORPHELLA VOLVOCICOLA (preditory on volvox)

CILIATE PROTOZOA