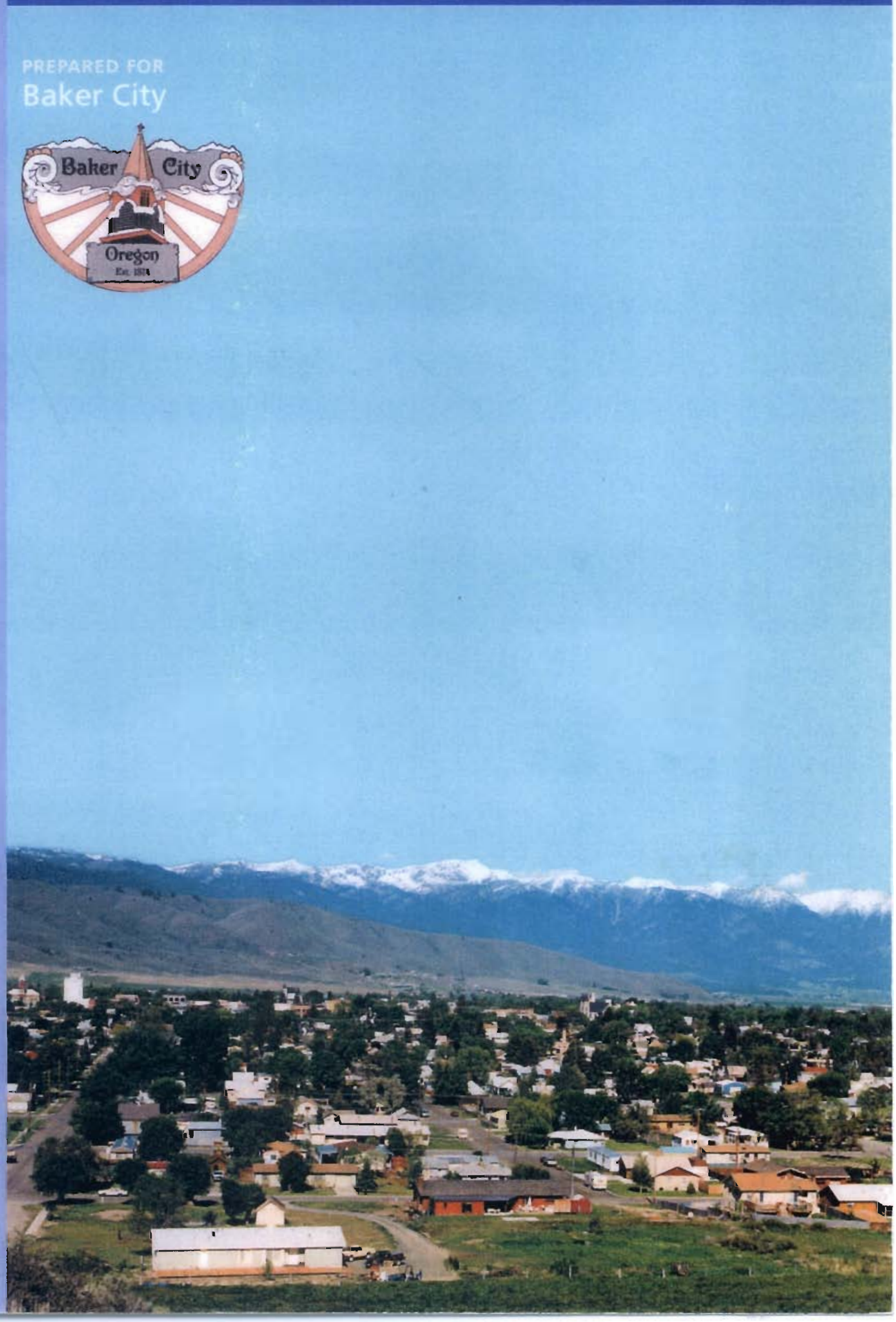
Baker City Aquifer Storage and Recovery (ASR) Feasibility Report

PREPARED FOR
Baker City



PREPARED BY
Groundwater Solutions, Inc.

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IN ASSOCIATION WITH
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and
Stettler Supply Company

JUNE 2003

Baker City
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June 2003

Table of Contents

Tables

Figures

Appendices

Executive Summary

This report presents the results of a study to investigate the feasibility of Aquifer Storage and Recovery (ASR) as a technology to provide a reliable emergency or peak supply of 2.5 million gallons per day (MGD) of potable drinking water to the City of Baker City. ASR is defined as the underground storage of treated water in a suitable aquifer during times when there is excess water available (e.g., winter and spring) and then recovery of the stored water during months when the water is needed to meet peak or emergency water demands.

Benefits of ASR

ASR offers the City a number of potential benefits including:

- Increasing the volume of water available to the City to meet peak summer water demands,
- Increasing the reliability of the backup/emergency source provided by the Reservoir Well in the event that there is a fire in the watershed,
- More effectively utilizing high quality water that would otherwise be spilled or diverted from the City's system when available supply from the watershed exceeds demand, and
- Improving the quality of the water produced by the Reservoir Well.

Implementation of ASR at the Reservoir Well site is a cost effective alternative compared with developing additional production wells elsewhere because there are substantial costs involved in finding sites, obtaining the water rights, drilling the wells, and building the pump stations and infrastructure to deliver the water. Groundwater development without ASR may not be sustainable due to the limited amount of natural groundwater recharge in this region and native groundwater quality is generally less acceptable compared to surface water sources. ASR in contrast, stores high-quality surface water from the City's watershed in the aquifer, and the quality of the recovered water is very similar.

ASR Project Scope

The study focused on a number of technical issues relating to ASR feasibility including suitability of the local aquifer for storing water, water quality compatibility between the injected source water and native groundwater, water availability for recharge, quantity of water that can be injected, stored and recovered, and the water level response at the Reservoir Well during injection and pumping. The study also presents a conceptual ASR system design, operational scheme, and updated Phase 2 pilot testing cost estimate. The work performed for the feasibility study and Phase 2 pilot testing provides the City with information necessary to prove the feasibility and effectiveness of ASR, and at the same time, provides information to the Oregon Water Resources Department (OWRD) that is required as part of the ASR permitting process.

Feasibility Study Results

The results of the feasibility study indicate that there is sufficient water available from the watershed in the winter and early summer to conduct recharge, the aquifer is capable of storing at least 115 million gallons (MG) of high quality water at the Reservoir Well site, and the well should be capable of producing water at a rate of 1800 gpm for a period of at least 45 days without overpumping the aquifer or producing poor quality water. We estimate that it maybe possible to store 165 MG and recover this water at a rate of 1,800 gpm in a given year, which will extend the summer recovery period to between 60 and 90 days, based on the following assumptions:

- The well efficiency can be maintained
- The size of the aquifer is not limited
- The aquifer does not become less permeable
- Seeps do not develop

According to historical records, the Reservoir Well production typically decreases to 1,000 gpm or less within 30 days of continuous pumping, and the quality of the water degrades to the point where residents complain. Over the last 25 years, the City has pumped approximately 560 MG from the aquifer and there has been a 73-foot decline in static water level, which indicates that even sporadic, un-sustained pumping has exceeded the natural rate of groundwater recharge. ASR will substantially improve and extend the sustainable production capacity of the well and improve the quality of water produced after extended periods of pumping. In addition, ASR will stop "mining" of the aquifer that has occurred over the past 25 years.

The quality of the recovered water will be similar to the quality of the mountain line water (which is excellent) and no adverse chemical reactions are expected as a result of mixing surface water with native groundwater. Because the watershed periodically produces water containing suspended sediment (turbidity), particularly in the early winter and spring, attention must be given to making sure that injection is not occurring when turbidity values exceed 1 NTU. Recharge water containing elevated turbidity values will clog the well and reduce injection and pumping capacity. Any reduction in pumping capacity will be a significant concern to the City. The City has an automatic turbidity monitoring system and 24-hour auto-dialer that will trigger an alarm if turbidity values exceed the target threshold. In addition, the mountain line water will be stored in a 4.5 MG contact chamber prior to being boosted to the ASR well; and because of its size and dilution capacity, the reservoir provides additional protection from turbidity events.

Even with the attention given to monitoring turbidity, ASR wells will clog over a period of time. Reduction in injection and pumping capacity caused by clogging can be managed by periodically backflushing the well (stop injection and pump to waste) in order to remove sediment from the well. Depending on the amount of observed clogging, it may be necessary to remove the pump and aggressively redevelop the well every 2 to 3 years.

Uncertainties

The feasibility study identified several uncertainties that will require further investigation during the ASR pilot testing. The uncertainties include:

1. The ability of the ASR well to maintain target injection and pumping rates. This will depend upon the well efficiency over time, storage zone size and permeability, and actual rate of clogging caused by turbidity and possibly entrained air. Several measures should be implemented to maintain the injection and pumping capacity including:

    - Flushing the water lines in the system that provide injection source water to remove particulates prior to starting injection.
    - Closely monitoring the quality of water being injected, and monitoring water levels in the well for changes in specific capacity.
    - Implementing a regular program of backflushing the well and pumping it to remove particulates introduced into the well during injection.
    - Periodically pulling the pump and aggressively redeveloping the well.

2. The long-term impact of injection and pumping of the deeper basalt aquifer zone on the shallow tuffaceous sediments beneath the valley floor north of the fault. The short-term aquifer testing showed that there is limited connection between the two aquifers and so there should be limited loss of stored water due to movement across the inferred fault boundary or due to capture by other pumping wells in the area. Monitoring of water levels in response to longer-term injection and pumping will be necessary to resolve this question.

3. It is predicted that the water level rise in the aquifer will eventually exceed the 1977 historic high water level in the basalt aquifer, potentially creating or enhancing seeps and springs. Monitoring the potential for surface discharges during pilot testing will be necessary.

Conclusions and Recommendations

On the basis of the technical analysis presented in this report, we do not see any fatal flaws for developing ASR at the Reservoir Well site and recommend proceeding with phase two of the project – ASR Pilot Testing at the Reservoir Well. The scope for Phase 2 consists of the following tasks. These activities are required by OWRD under the ASR rules.

- ***Task 1 Permitting****: Obtain 5-year Limited License from OWRD*
- ***Task 2 ASR Design and Construction:*** *Design and construct well, pump station, and system modifications to accommodate ASR at the Reservoir Well site*
- ***Task 3 ASR Work Plan:*** *Prepare pilot testing work plan for submittal to OWRD*
- ***Task 4 ASR Pilot Testing:*** *Conduct injection, storage, and recovery testing and monitoring at Reservoir Well as required by OWRD*

- ➢ ***Task 5 ASR Analysis and Report:*** *Assess sustainable injection and pumping rates, storage volume, water quality improvement and aquifer response to ASR*
- ➢ ***Task 6 ASR Operations Plan:*** *Develop operational parameters and O&M plan for City use*

A number of improvements and modifications will be required at the Reservoir Well site in order to retrofit the system for ASR. These improvements include the following:

- New booster pump at the 4.5 MG chlorine contact chamber and variable frequency drive (VFD) that allows adjustable rates of injection.
- New piping that conveys recharge water from the booster pump to the Reservoir Well.
- New recharge loop, piping, valves, and controls at the well head that permit injection down the pump column. Building modifications are required to accommodate the additional piping in the pump house.
- New pump to waste piping that permits discharge of wastewater from startup and back flushing.
- New liner casing in the well to 500 feet to protect the pump from falling rocks (there is presently only 20 feet of casing and open borehole to total depth).
- New pump, pump head, and pump column. The existing motor will be reused.
- New system controls and monitoring at the chlorine building that allow manual operation with automatic safety overrides.

The estimated cost for these improvements and associated engineering costs for permitting, system design, construction oversight, pilot testing, monitoring, and reporting are within the range presented previously. The total estimated cost for Phase 2 ranges from $425,000 to $458,000. A range of cost is presented because there are a number of elements that must be resolved during the design phase. Typical annual operation and maintenance costs during ASR pilot testing are approximately $30,000 to $40,000. These costs include the additional monitoring and laboratory testing fees required by OWRD for the Limited License. These estimates also assume that City staff will complete the majority of the data collection in the field and that they will maintain and operate the ASR system with limited technical support. It has been our experience that these costs can be reduced after the first year of successful full-scale operation, due to a reduction in monitoring, assuming OWRD approves. From past experience, the cost to pull the pump and redevelop the well every 2 to 3 years to remove sediment from the well that could not be removed by backflushing is approximately $20,000.

The initial testing can last up to 5-years under the Limited License. After sufficient data regarding aquifer response, operational data, and lack of impacts are obtained to demonstrate ASR feasibility, the City would then apply for a full-scale ASR permit. It is possible that this could be accomplished after one or two years of operation. Assuming that the results of the pilot testing are favorable, the City will have a fully functional full-scale ASR system at the conclusion of Phase 2.

The next steps of the project will include the following:

- Meet with OWRD to discuss the project (pre-application meeting July 2003)
- Complete and file a Limited License application and ASR work plan (July 2003)
- Work closely with the City to prepare design drawings and specifications for the well and pump station improvements (summer 2003)
- Obtain ASR Limited License after 30-day comment period (September 2003)
- Assess the condition of the well using a down-hole camera and install a steel liner to protect the new pump (fall 2003 after summer pumping season)
- Construct well and pump station improvements (fall 2003)
- Begin pilot recharge testing (winter 2003/2004)
- Begin recovery of stored water (summer 2004)

1.0 Introduction

1.1 Purpose and Objectives

The City would like to develop an emergency water supply source and to increase its supply of water to meet peak water demands in the summer by storing surplus water derived from its watershed using Aquifer Storage and Recovery (ASR) technology. The City's goal is to develop an ASR system with at least 2.5 million gallons per day (MGD) recovery capacity that is sustainable for at least 45 days in the summer months. If the City is able to achieve this goal, it will realize a number of benefits including:

- Increasing the volume of water available to the City to meet peak summer water demands,
- Increasing the reliability of the backup/emergency source provided by the Reservoir Well in the event that there is a fire in the watershed,
- More effectively utilizing high quality water that would otherwise be spilled or diverted from the City's system when available supply from the watershed exceeds demand, and
- Improving the quality of the water produced by the Reservoir Well.

The City has excess high-quality water available from its unfiltered surface water sources and a limited amount of above ground reservoir storage. In the past, the City has had to spill water from its reservoir during the winter months or during other times of the year when water demands are low and there is an excess supply from the surface water sources. The City would like to be able to store this excess water and avoid having to spill it. In the fall and springtime, the source water can become unusable due to turbidity events that exceed drinking water standards. During these events, the City must rely on its backup water supply well to meet distribution demands. The City intends to evaluate the feasibility of ASR by utilizing its existing backup production well as an ASR test well. Because this well is a key part of the City's water system, any modification or testing that is done must ensure that the well is not out-of-service for an extended period of time and that no chemical reactions occur that could degrade the quality of produced water or the production capacity of the well.

Implementation of ASR at the Reservoir Well site is a cost effective alternative compared with developing additional production wells elsewhere because there are substantial costs involved in finding sites, obtaining the water rights, drilling the wells, and building the pump stations and infrastructure to deliver the water. Groundwater development without ASR may not be sustainable due to the limited amount of natural groundwater recharge in this region and native groundwater quality is generally less acceptable compared to surface water sources. ASR in contrast, stores high-quality surface water from the City's watershed in the aquifer and the quality of the recovered water is very similar.

1.2 Project Scope

Figure 1-1 is a map showing the project location. The project has been broken down into two phases: Phase 1 – ASR Feasibility Evaluation and Phase 2 – ASR Pilot Testing Program. The Phase 1 feasibility evaluation described in this report was designed to provide the City with key information needed to identify fatal flaws and to determine the feasibility of ASR at its backup well location. It also provides information required by OWRD as part of the ASR permitting process and it is intended that the report will be submitted to OWRD. The Phase 2 pilot-testing program is also a required element of the ASR permitting process and it is designed to demonstrate ASR feasibility and to provide the City with needed operational data. If the City decides to proceed with Phase 2, the Reservoir Well will be retrofitted to allow ASR operation and the first year of testing and monitoring will provide important information concerning water quality compatibility, aquifer response to recharge, optimal injection and recovery rates, back flushing frequency to remove suspended solids introduced into the well, and well performance data. The Phase 2 program will be conducted to test the well at full-scale operation so that it can provide significant emergency or peaking capacity during the first year of operation.

The Phase 1 feasibility study scope of work included the following tasks:

Task 1 – Preliminary Water Quality Compatibility – Reviewed available water quality data and conducted limited sampling and analysis to determine the likelihood for a fatal flaw to exist, prior to continuing with the project.

Task 2 – Hydrogeology Characterization – Constructed geologic cross sections through the project study area to further define the nature, extent, and character of the target aquifer and to assess how recharge water will move in the subsurface.

Task 3 – Aquifer Testing – Installed a water level access tube in the Reservoir Well, monitored water levels in several nearby wells, and conducted an aquifer test at the Reservoir Well to measure well performance and aquifer characteristics including transmissivity, storage coefficient, and boundary conditions. This information was used to estimate the target recharge rate, pumping rate, and the amount of water that can be stored.

Task 4 - Water Quality Compatibility Evaluation – Conducted detailed geochemical testing and geochemical modeling to predict the likelihood for reactions to occur that might clog the well or affect taste of the recovered water. Groundwater samples were also tested for all drinking water constituents as required by the ASR rules.

Task 5 – Water Availability Analysis – Reviewed City water supply and production data to confirm that an adequate quantity of water is available for recharge in the winter and early summer.

Task 6 – Recharge Analysis – Used aquifer parameter information estimated in Task 2 to predict target injection and pumping rates, target storage volume, and water level increase during injection and drawdown during pumping.

Task 7 – Conceptual ASR System Design, Operation, and Cost – Prepared a conceptual design for the booster pump and wellhead modifications required to permit ASR operation at the Reservoir Well. Described ASR operation sequence. Reviewed previously prepared ASR construction cost estimates.

Task 8 – Preliminary ASR Feasibility Report –Prepared a report documenting findings from the preceding tasks.

Findings from each of these tasks are presented in the following sections beginning with the hydrogeologic characterization.

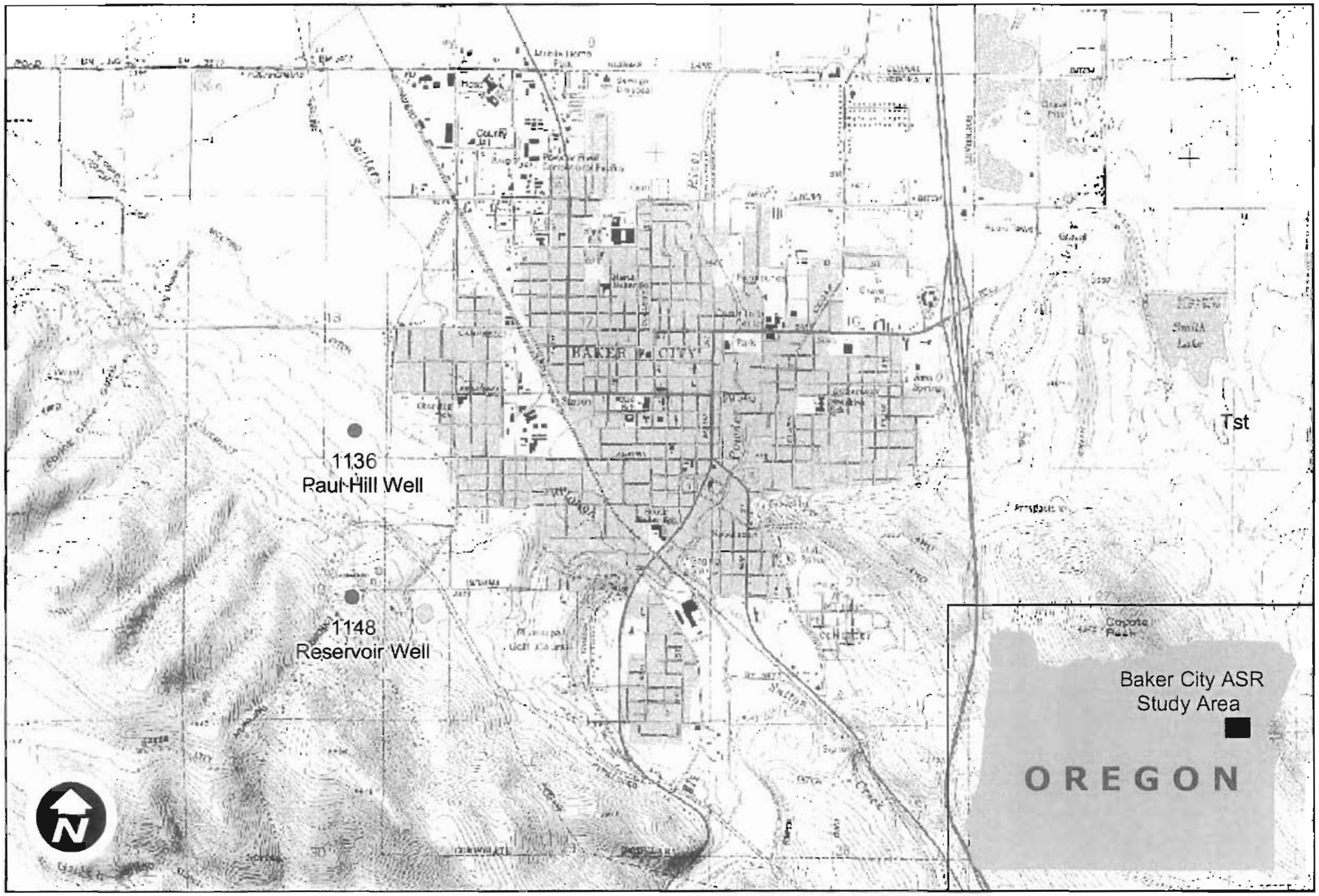

Figure 1-1
Baker City ASR
Study Area

Groundwater Solutions Inc.

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2.0 Hydrogeologic Characterization

The hydrogeologic setting, which includes the general geology, structure and hydrogeologic conditions of the City of Baker area is described in this section and is primarily based on work by the United States Geologic Survey (1976) and Brooks, McIntyre and Walker (1976). The physical setting of the area also is described in this section. Appendix A contains drillers logs for the deeper wells located in the study area.

2.1 Physical Setting

Baker City is located within the Baker Valley, which is a northwest trending valley. The elevation of the City ranges from approximately 3,400 to 3,600 feet mean sea level (msl), while the topographic highs surrounding the valley reach altitudes of around 8,900 feet msl. These highland areas supply the majority of recharge to streams and groundwater in the area from both rain and snow melt. Baker City receives on average 10.5 inches of rain per year and 27 inches of snow per year according to the National Weather Service.

2.2 Geology

The general geologic units in the Baker City region are presented in Figure 2-1 and are described from youngest to oldest below.

Alluvium - Qal

This unit consists of stream channel sands, gravels, silts, and decomposed basalt and it includes unconsolidated colluvium material (debris deposited at the base of slopes by gravity) and decomposed basalt. The decomposed basalt is commonly found near the base of hill slopes as part of the colluvium deposits. These deposits normally are less than 10 feet thick in the study area, however thicker sequences of colluvium material are present along the base of the hills.

Tuffaceous Sedimentary Rocks – Tst

This unit consists of poorly consolidated lacustrine (lake bed) and fluvial (stream) deposits. The lacustrine deposits contain tuffaceous clay, siltstones, and sandstones. The origin of the material is volcanic before it is re-worked in either a lacustrine or fluvial environment. Overall, these sediments were deposited in a low-energy environment and are up to 520 feet thick in the study area. The tuffaceous sediments also contain coarser-grained fluvial deposits consisting of gravels, pebble and cobble conglomerates, sandstones and siltstones. Locally, some thin basalt units can be found underlying the tuffaceous sedimentary layers. In general, coarse-grained tuffaceous sediments can yield sufficient quantities of water for municipal use (greater than several hundred gallons per minute). However, wells completed in the finer-grained tuffaceous sediments do not normally yield sufficient quantities of water for municipal use.

Basalt – Tb
This unit consists of a series of basalt flows. Individual basalt flows can vary greatly in thickness from several feet to greater than 100 feet thick. Groundwater in the basalt is predominantly derived from interflow zones, which represent the contract between individual basalt flows. These interflow zones are typically rubbly and porous, and thus can transmit water easily. Groundwater also is produced from fractured zones in the more massive interior flows, if sufficient structural deformation and/or fracturing has occurred. Tuffaceous sedimentary rocks are also found in the interflow zones.

Intrusive Igneous Complex – TRqd
This unit consists of intrusive igneous rocks ranging from peridotite to albite granite. The intrusive rocks in the region have been altered by regional metamorphism. Steeply dipping dikes that range from several inches to 10 feet in width are commonly found cross cutting the intrusive rocks. This unit is considered to have little groundwater development potential.

2.3 Geologic Structures

Geologic structures have an important influence on groundwater flow in the basalts as well as the basin tuffaceous sediments. Faults and folds influence groundwater flow by promoting or impeding both lateral and vertical groundwater flow. Baker Valley is structurally controlled by northwest-trending normal faults (see Figure 2-1). Geologic cross sections parallel and perpendicular to the structural fabric in the area are shown in Figures 2-2 and 2-3. The vertical scales of the cross sections were exaggerated to better display subsurface conditions. Overall faulting has down-dropped the basalts to the northeast, resulting in a graben structure. Tuffaceous sediments were deposited in the graben structure. In the Baker Valley the tuffaceous sediments (Tst) deposited in the graben are up to 520 feet thick.

The size of the faulted basalt block directly influences how much water can be withdrawn and/or stored (injected) in a particular basalt flow sequence. If a particular part of the aquifer is bounded by faults that limit its size, injection into this unit will cause water levels to rise high enough to create springs. The effects of the faults on the hydrogeology in the Baker area is not completely understood, however, aquifer test data did help to better understand its influence on the target test area – Reservoir Well. A more detailed discussion is presented in the aquifer test section of this report.

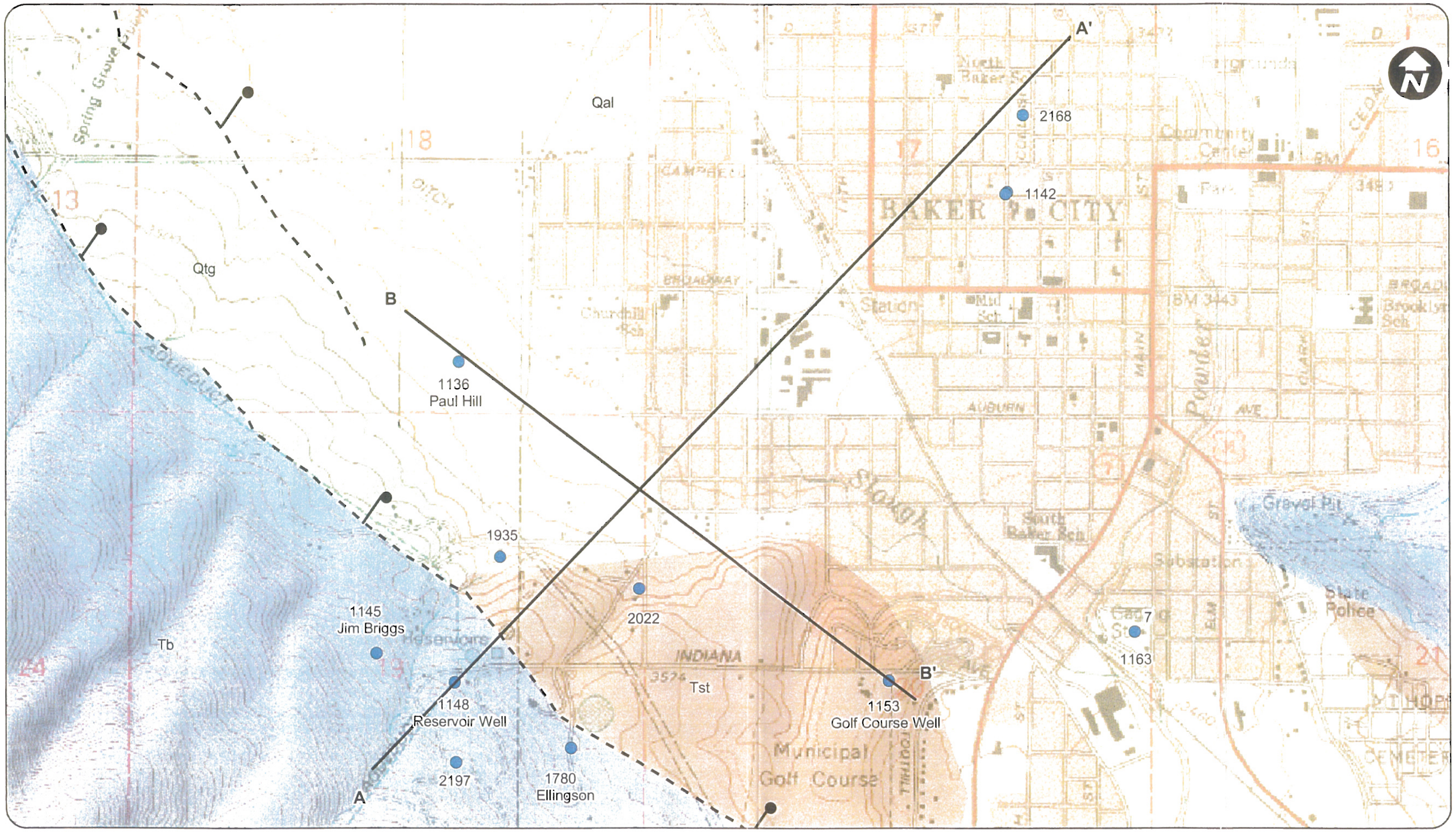
2.4 Hydrogeology

The principle aquifer in the area is hosted in the basalt unit and the majority of flow, as previously outlined, within the basalt is concentrated in interflow zones. Groundwater also is hosted in the tuffaceous sediments and alluvium units. The basalts can be highly productive if permeable interflows are encountered and/or if secondary fracturing has enhanced the basalts permeability. The potential yield of the tuffaceous sediments can vary depending on the amount of coarse-grained material encountered and also depends on the amount of cementation of the formation and its clay content.

The primary source of recharge to the aquifers is rainfall and snowmelt in the Elk Horn Range. The groundwater flow is typically to the northwest and matches the topography. The depth to groundwater in the basalts in the upland portion of the study area is around 3,560 feet msl, whereas the groundwater elevation in the valley (graben) is at 3,450 feet msl. A range fault along the base of the hill, as shown in Figure 2-1, most likely acts as a hydrogeologic barrier between the upland and valley hydrogeologic regimes, which would account for the head difference between the basalt and tuffaceous sediments. Overall, it is believed that the shallow groundwater flow path in the vicinity of the Reservoir Well is most likely supplemented by a deeper groundwater flow path, which discharges northwest to the Powder River.

Groundwater Development

An inventory of wells in the Baker City area was completed around the Reservoir Well to obtain hydraulic, as well as hydrogeologic information about local wells. The inventory was limited to wells greater than 200 feet in depth. Reported yields of wells in the inventory range from 5 to 2000 gallons per minute (gpm). Specific capacity in the area wells exhibited a wide range of values from 0.04 gpm/ft to 20 gpm/ft. Specific capacity is a ratio of a wells yield per foot of drawdown (gpm/ft). Specific capacity can be used to assess the relative performance of a well and the productivity of the aquifer. The wells with lower productivity and specific capacity could be the result of wells completed in the finer-grained tuffaceous sediments or they could represent wells completed in the basalts without significant interflow zones. The wells with higher yields in general are larger diameter and deeper, and most likely intercepted interflow zones.



Geology

- Qal - Alluvium- unconsolidated silt, sand, and gravel
- Qtg - Colluvium - unconsolidated gravel, cobbles, and boulders with intermixed clay,silt, and sand
- Tst - Tuffaceous sedimentary rocks - poorly consolidated, water laid silicic volcanic ash, clay, siltstone, and sandstone
- Tb - Basalt - composed of numerous seperate basalt flows

Legend

A ——— A'
Geologic Cross Section

0 1,000 2,000 Feet

= Well w/ ID

Normal Fault
ball on downthrown side

Note: Well ID is linked to Table 1

Figure 2-1
Geologic Map
Baker City ASR

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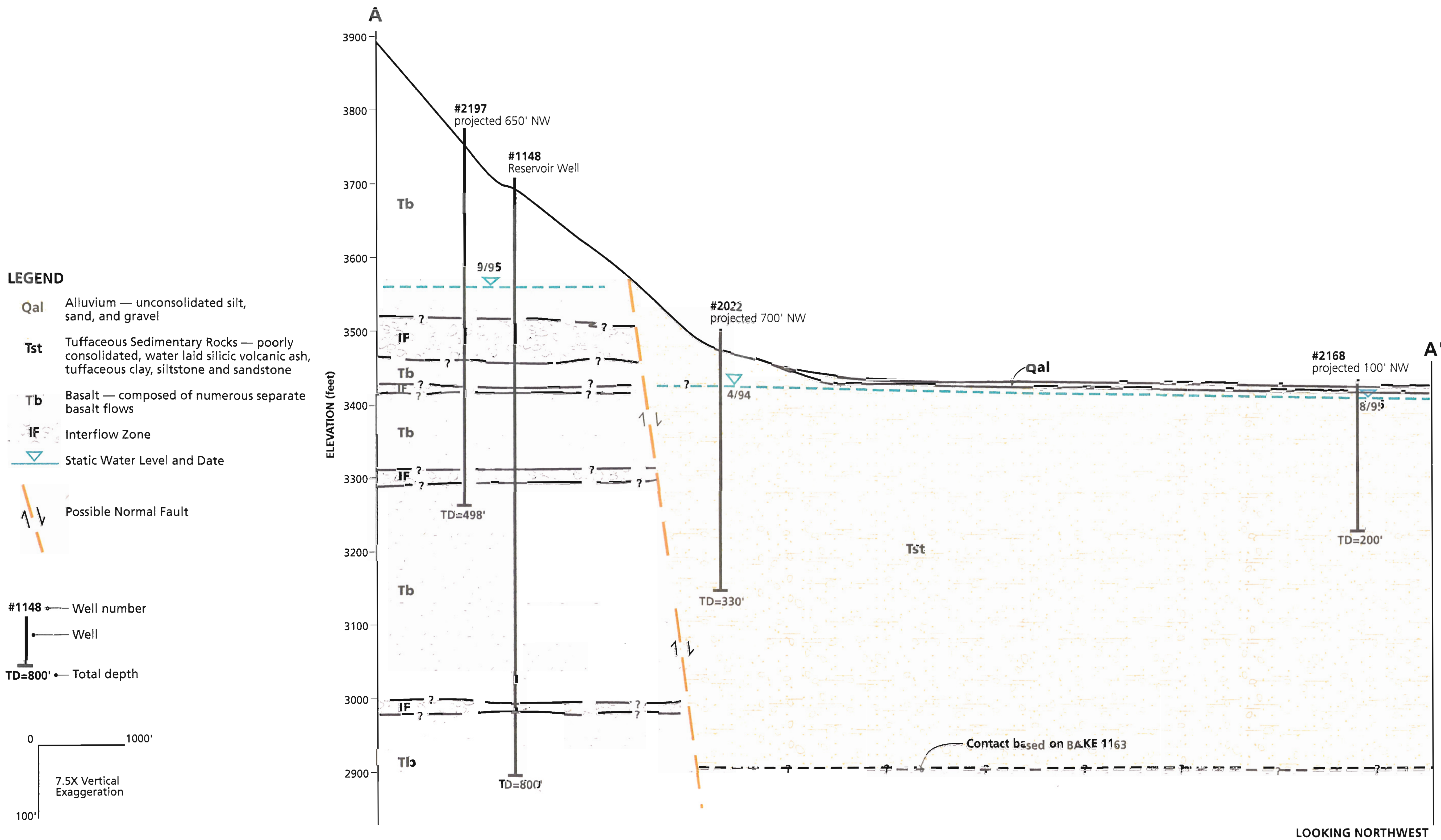

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FIGURE 2-2
Geologic Cross Section A-A'
BAKER CITY ASR PROJECT

LEGEND

- **Qal** Alluvium — unconsolidated silt, sand, and gravel
- **Tst** Tuffaceous Sedimentary Rocks — poorly consolidated, water laid silicic volcanic ash, tuffaceous clay, siltstone and sandstone
- **Tb** Basalt — composed of numerous separate basalt flows
- **TRqd** Granite — Intrusive
- **IF** Interflow Zone
- Static Water Level and Date
- Possible Normal Fault

#1136 — Well number
Well
TD=575' — Total depth

0 — 1000'
100'
7.5X Vertical Exaggeration

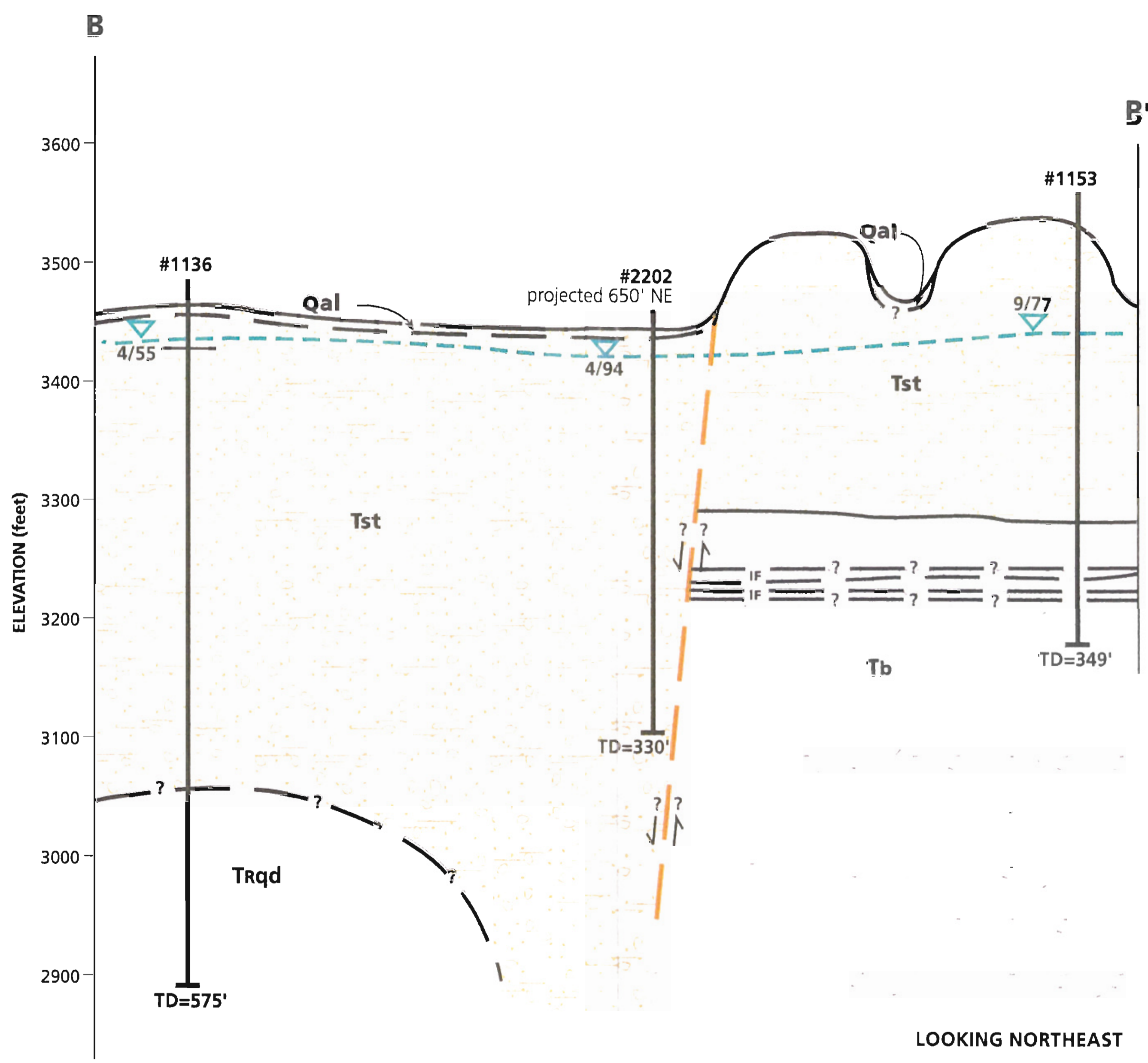

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FIGURE 2-3
Geologic Cross Section B-B'
BAKER CITY ASR PROJECT

3.0 Aquifer Testing

Aquifer testing was performed at the Baker City Reservoir Well to measure aquifer parameters including transmissivity and storage coefficient. This information was later used in the ASR recharge and pumping analysis (see Section 6.0) to predict water level draw-up (mounding) during injection and drawdown during pumping under several ASR injections and pumping scenarios.

Aquifer testing consisted of a step-rate drawdown test and a 5-day constant rate aquifer test. The step drawdown test consisted of four 1-hour consecutive steps and the constant rate aquifer test consisted of pumping the Reservoir Well at a rate of 1500 gpm for approximately 120 hours. Water levels in the Reservoir Well were monitored during pumping and also for approximately 216 hours during recovery. Water levels in the Paul Hill well and Golf Course well also were measured during the pumping and recovery phase of the test. Appendix B contains manual water level data, water level plots, and a detailed description of the methods used to calculate aquifer parameters.

Water quality sampling and testing was also completed during the aquifer testing. A water quality compatibility evaluation related to the ASR feasibility analysis is included in Section 4.0.

Drawdown and recovery data were used to compute aquifer transmissivity and storage coefficient. Transmissivity is a measure of the productivity of an aquifer in terms of thickness and permeability of the aquifer matrix. The storage coefficient is a measure of how much water can be released from the aquifer given a unit decline in the hydraulic head. Specific capacity was also computed on the basis of the pumping test data. It is an index for how a given well performs and it is calculated by dividing the discharge rate by the drawdown (or drawup during injection). The specific capacity index takes into account both the productivity of the aquifer (transmissivity) and the efficiency of the well. Specific capacity, transmissivity, and aquifer boundary conditions are used to determine what injection and pumping rates can be sustained at an ASR well because they influence the drawdown and drawup in the well for a given storage or pumping volume. A more detailed discussion of how these aquifer and well parameters were used to calculate target injection rates, pumping rates, and storage volume is presented in Section 6.0.

Prior to initiating the tests, it was necessary to lift up the pump and install a water level access tube so that water levels could be measured in the well (the existing airline was not functional). This proved problematic because the lifting ears on the pump head broke off as the crane began to lift the pump and column. Inspection of the pump head indicated that the metal casting was probably defective. In order to avoid further damage to the pump head, a lifting plate was fabricated. The pump was then lifted and a PVC access tube was installed in the well to allow measurement of the water level. Because a crack was observed in the pump head, a second support was fabricated to take the weight off of the pump head after the pump was lowered back into place following the aquifer testing.

Deep wells within the study area that could be affected by ASR testing were identified. Wells located closest to the Reservoir Well that might serve as observation wells during the testing were identified utilizing OWRD well log data and local knowledge from City staff (see Table 3-1). City staff obtained permission from several well owners to allow monitoring of water levels prior to and during the tests. Water levels were monitored for several weeks prior to the start of the aquifer tests by City staff at the Golf Course well, Paul Hill well, Reservoir Well, and Ellingson well (see Figure 2-1). Due to access limitations, consistent measurements could not be obtained at the Ellingson well and only limited data were obtained from the Golf Course well. A pressure transducer and data logger were installed at the Reservoir Well and Paul Hill well to allow automated water level monitoring (these are the only wells that had sufficient room for the transducer). A summary of the aquifer tests is presented below and Appendix B provides a more detailed description of the tests.

3.1 Step-Rate Test

In order to determine the performance of the Reservoir Well, a step-drawdown test was completed. This testing provides a baseline from which to compare future changes to well performance resulting from ASR. A step-drawdown test is conducted by pumping a well at successively higher pumping rate over an equal interval of time. For this test the Reservoir Well was pumped at 500, 1,000, 1,500, and 2,000 gallons per minute for one-hour intervals. The step test data was used to pick a pumping rate for the constant rate test and to assess head losses in the well due to laminar flow. Based on step test data, the Reservoir Well's laminar flow losses as a percentage of total head losses are approximately 59 percent. This indicates the well has moderate efficiency, which is typical of most open-hole basalt wells. On the basis of the step-test results, a constant rate of 1,500 gpm was chosen for the constant rate test.

3.2 Constant Rate Test

A constant rate test was also conducted for a period of 5 days at the Reservoir Well to determine the following:

- Calculate transmissivity of the aquifer.
- Determine the specific capacity of the well and project the specific capacity over long-term pumping.
- Identify possible boundaries to the aquifer that might limit the ASR storage volume.
- Measure the potential response in the valley fill sediments due to pumping in the basalt aquifer. This was accomplished by measuring water levels at the Paul Hill well during the constant rate test. This well is located on the opposite side of the basin fault from the Reservoir Well.

The initial pre-test static water level in the well was approximately 250 feet below ground surface (it was originally 177 feet below ground surface when the well was drilled 25 years ago). The constant rate test was conducted over a 5-day period from January 24th to January 30th, 2003. The well was pumped at a rate of 1,500 gpm and drawdown was measured in the Reservoir Well and the Paul Hill well. The maximum drawdown after 7,200 minutes (120 hours or 5 days) was approximately 90 feet. A response was not observed in the Paul Hill well during the constant rate test. Recovery data also was collected after the pump was turned off. A summary of the aquifer test data interpretation is presented below.

3.3 Aquifer Parameter Estimation

Graphs of the aquifer test data are presented in Appendix B. A transmissivity of 2,800 gallons per day per foot (gpd/ft) was calculated using drawdown data. A transmissivity value of 7,300 gpd/ft was calculated using recovery data. The transmissivity estimate from the recovery phase of the test is considered to be more representative because it is less affected by fluctuations in pumping rate. The 5-day specific capacity of the well was approximately 16.5 gpm/ft. The storage coefficient was not calculated from test data since it requires a response in an observation well; no response in the Paul Hill observation well was measured during the constant rate test. Since the aquifer test results indicate the aquifer is confined or semiconfined, a storativity estimate for the basalt at the Reservoir Well site would normally range from 1×10^{-5} to 1×10^{-3}.

The moderate transmissivity and low storativity values commonly found in basalts indicate that the formation will readily yield water to wells but the drawdown (and drawup) effects will be large and transmitted over long distances (miles). Low storativity values also mean that the basalt aquifer is vulnerable to overpumping, which can result in significant water level declines. It should be noted that ASR is particularly beneficial in this setting because it augments the naturally low rate of groundwater recharge and reduces the impacts from pumping. Because the water level in the well did not recover fully following the pumping phase, some amount of groundwater was apparently removed from storage. This indicates that recharge to the aquifer is probably limited, which is consistent with the observation that water levels have declined on the order of 70 feet since the well was drilled.

The drawdown and the recovery curves for the constant rate test do not suggest that a no-flow hydraulic boundary was intercepted during the 5-day constant rate test. Instead of a sharp rate of change in the drawdown curve, which is indicative of a no-flow boundary, the drawdown curve for the Reservoir Well shows a steady decline (see Figure B-5, Appendix B). This same type of response has been observed in pump test data collected from other basalt-hosted wells (e.g., Beaverton ASR No. 1). This is not to say that the cone of depression (or cone of head rise during injection) after more than 5-days of pumping would not encounter a no-flow boundary. However, the greatest impact on drawdown and drawup is directly related to boundaries intercepted early by the cone of depression (or cone of head rise). The cone of depression (and cone of rise) propagates less and less over time assuming a constant rate of pumping (injection).

The drawdown curve does shed some light however on the hydrogeologic regime in the Reservoir Well area. In general, the juxtaposition of the basalts and the tuffaceous sediments caused by faulting appears to have some implications on the hydrogeologic framework of the area. Constant rate pump test data from the Reservoir Well shows a diminishing transmissivity and specific capacity with time as the cone of depression expands. The data does not suggest that the fault contact between the basalt and the tuffaceous sediments acts as a no-flow boundary but behaves more like a leaky boundary. This suggests that there is some connection between the water bearing units in the basalt and the tuffaceous sediments present in the valley. However, no response was observed in the Paul Hill well and so the degree of connection is muted due to the leaky boundary. It is believed that the cone of depression during the constant rate test most likely propagated parallel to the hill and took on an elliptical shape, and as it extended, it most likely encountered less and less transmissive interflow zones. This observation highlights some of the heterogeneity of the basalt system around the Reservoir Well.

Table 3-1
Well Data for Wells Located within 1/2 mile of the Baker City Reservoir Well

Well ID	Township	Range	Section	Address	Owner	Date Drilled	Depth Drilled (feet)	Casing or Borehole diameter (inches)	Screen Interval	SWL (feet bgs)	Date of SWL	Capacity gpm	DD (feet)	Specific Capacity gpm/ft	Use	Misc. Info
1148	19	9S	40E	Reservoir Well	Baker City	Jul-77	800	16	NA	177	Jul-77	1500			Municipal	Baker City Well No. 1
1136	18	9S	40E		Paul V. Hill	Apr-55	575	12	NA	29	May-77	1100	166	6.6	Irrigation	
1163	20	9S	40E		Ellingson Timber Co.	Nov-65	650	10	122'-157', 272'-287', 538'-618'	8	Nov-65	2000	100	20.0	Irrigation	
1145	19	9S	40E		Dave Erwin (Briggs)	Jun-79	520	6	NA	287	Jun-79	200	153	1.3	Test Well	
2197	19	9S	40E	900 Story Ln	Mike Voboril	Sep-95	498	8/liner 6"	435'-495	190	Sep-95				Domestic	
1935	19	9S	40E	6770 Greenridge	Alpine Timber Corp.	Oct-92	465	8/Liner 7"	410'-450'	300	Oct-92				Domestic	No water found
1780	19	9S	40E	3975 Indiana St.	Robert P. Ellingson	Jul-89	362	6	NA	240	Jul-89	50	122	0.4	Irrigation	
1153	20	9S	40E		Baker Municipal Golf Course	Sep-77	349	8	NA	85	Sep-77	320	141	2.3	Municipal/ Irrigation	
2022	9	9S	40E	1205 17th St.	Steve Bogart	Apr-94	330	6	290'-330'	50	Apr-94	25	280	0.1	Domestic	Well in Sand and Clay
1140	19	9S	40E	1241 4th St.	Park Taylor	Mar-72	305	6" to 197' 5.75" to TD	100'-122' perf 198'-TD open	10	Feb-72	4.5	120	0.0	Domestic	
1142	19	9S	40E	2350 C St.	Serita Rasmussen	Sep-81	345	6/Liner 4"	NA	290	Sep-81				Domestic	

SWL = static water level
bgs = below ground surface

Refer to Figure _ for well locations.

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4.0 Water Quality Compatibility

This section presents a discussion of water quality compatibility between the native basalt groundwater and recharge source water for the project. This analysis was performed to assess the potential for adverse chemical reactions that could occur as a result of mixing City of Baker potable drinking water with native groundwater in the aquifer. Adverse reactions that could occur include precipitation of minerals (e.g., iron or manganese hydroxides) that could clog the aquifer or well, and dissolution of minerals in the aquifer that could mobilize metals or affect taste and odor. The analysis was conducted utilizing results of sampling the Reservoir Well and the City of Baker water system at the clear well.

Samples collected from the Reservoir Well and clear well (referred to here as the mountain line source) were tested for geochemical parameters relating to water quality compatibility and potability. In addition, the sample from the Reservoir Well was tested for the full suite of regulated and unregulated drinking water parameters as outlined in the ASR rules. Analytical testing conducted on the well sample included:

- Field parameters, including pH, electrical conductivity (EC), and temperature
- Disinfection by-products
- Total and Fecal Coliform
- Geochemical constituents (anions and cations)
- Metals
- Miscellaneous constituents – e.g., color, odor, etc.
- Radionuclides – Gross Alpha and Gross Beta
- Synthetic Organic Compounds
- Volatile Organic Compounds

Results from the testing are presented in Table 4-1. Because chemical testing for metals and organic compounds was not performed on the mountain line sample, the table includes historical data for certain parameters collected at the clear well in the past. Laboratory analytical data sheets for samples collected for this project are presented in Appendix C. The following sections present a discussion of native groundwater quality, recharge water quality, and the results of a mixing analysis utilizing the geochemical model PHREEQC.

4.1 Native Groundwater Quality

General Chemistry

In general, the native groundwater quality is good with a moderate amount of dissolved minerals (184 mg/L total dissolved solids [TDS]). The water is considered hard (154 mg/L) relative to what most people consider hard (greater than 50 mg/L). The water has a slightly alkaline pH (8.01), and is relatively low temperature (14.7 °C). The water had no color and is also considered to be non-corrosive (corrosivity = 0.23).

Figures 4-1 and 4-2 are Stiff and Piper diagrams that illustrate the chemical signature of the groundwater compared with the Baker City mountain line water. These diagrams are commonly used to graphically illustrate the dominant cations and anions dissolved in the water and to aid in comparing two water samples. The groundwater is a calcium-magnesium-bicarbonate type water. As can be seen from the shape and size of the polygon on the Stiff diagram, the native groundwater is significantly more mineralized than the recharge source water and has a different chemical signature based on the relative proportions of dissolved cations and anions. This difference in chemical signature will be important during future ASR pilot testing as we track the recovery of the stored water. As discussed later in this section, we expect the recovered ASR water to be more like the recharge source water and so ASR will actually improve the water quality near the ASR well by reducing the concentration of dissolved ions.

The groundwater has a total organic carbon content (6.7 mg/l), which suggests this water will have a low potential to promote the formation of disinfection by-products when chlorinated water is injected into the aquifer or when it is recovered and then rechlorinated.

Iron and manganese is often elevated in basalt/volcanic groundwater; however, the iron concentration measured at the Reservoir Well was less than 0.1 mg/L (the detection limit). The manganese concentration was above the secondary drinking water standard (0.05 mg/L) at a concentration of 0.09 mg/L. Manganese does not pose a risk to human health; it is an aesthetic standard that can affect taste and can discolor laundry and bathroom fixtures.

Figure 4-3 presents a plot of several water quality parameters measured at the well during a 30-day pumping period in 1999. The plot shows that water quality changed at different times during the period but that there was not a significant increase in concentration of any of the parameters, including iron and manganese, as pumping continued. These results are inconsistent with past observations whereby the City reports that the water quality produced by the well tends to degrade and produces a light brown floc in the chlorine contact chamber after extended periods of continuous pumping (within about 10 days). This is not uncommon in aquifers that experience substantial drawdown caused by pumping and where zones that contain poor quality groundwater contribute an increasing percentage of the total production from the well. The reasons for this apparent discrepancy are not understood and this emphasizes the importance of doing water quality monitoring during a later full-scale field-testing phase.

No direct measurement of dissolved oxygen or oxidation/reduction potential was made in the field at the wellhead. However, we expect the native groundwater to be somewhat deficient in oxygen and in a reduced state given that layers of volcanic rock and clay confine the groundwater system.

Regulated Constituents

Parameters that have regulatory standards (e.g., metals, nitrate, volatile organic compounds, pesticides) and are indicative of contamination were either not detected or were detected at levels below the applicable regulatory criteria. Unregulated organic parameters and Total and Fecal Coliform also were not detected in the native groundwater sample.

Mineral Stability

A geochemical model (PHREEQC) was used to assess the equilibrium state of the native groundwater with respect to common minerals associated with basalt/volcanic aquifers. The analysis is used to determine whether the water is undersaturated, supersaturated, or at equilibrium with a particular mineral in solution. Undersaturated means that there is a tendency for this water to dissolve minerals present in the subsurface. Supersaturated means that the water has a tendency to precipitate the mineral. Equilibrium means that the water does not have a tendency to either dissolve or precipitate a mineral. Understanding the equilibrium state of the water helps us to understand what will occur when recharge water and native groundwater are mixed.

Based on the geochemical modeling, native groundwater at the Reservoir Well is undersaturated with respect to calcite (calcium carbonate) and dolomite (calcium magnesium carbonate). Iron oxyhydroxide is not a concern in the groundwater due to the absence of iron in the water. The groundwater is undersaturated with respect to manganese-containing minerals (e.g., tendency to dissolve rather than precipitate), which explains why there is somewhat elevated dissolved manganese in the groundwater. The very low level of dissolved aluminum in the groundwater indicates that clay minerals in the aquifer (including kaolinite, montmorillonite, illite) are insoluble and will tend to stay in solid form.

4.2 Recharge Source Water Quality

General Chemistry

The water sample collected from the clear well (mountain line source) has excellent quality with a low dissolved mineral content (TDS) of 42 mg/L that is typical of a surface water origin. The water is a calcium-magnesium bicarbonate type water. The water is considered slightly hard (51 mg/L) relative to what most people consider hard (greater than 50 mg/L). The water has a slightly alkaline pH (7.4) and has an alkalinity of 24.6 mg/L.

Metals and organic compounds that have regulatory standards (e.g., MCLs) have either been not detected in previous sampling episodes or were detected at levels below the applicable regulatory criteria. Total iron and dissolved iron were not detected in the source water.

The concentration of total organic carbon is also considered low (0.98 mg/L) and so the formation potential for disinfection by-products is expected to be low.

Suspended Sediment

Suspended solids or turbidity present in recharge source water can be a significant concern because it can clog the ASR well and reduce its efficiency and pumping/injection capacity. The City has a long history of carefully tracking turbidity in the mountain line source. During periods of elevated turbidity, typically during the spring snowmelt period, the City may shut down the mountain line source and operate its well. Figure 4-4 presents a plot of clear well turbidity versus time and Reservoir Well pumping data for 2001. As can be seen from the 2001 data plot, elevated turbidity has been observed in both the late fall and during the spring and summer. In order to minimize the chance for turbidity events to impact the City's water system, the City has since been shutting down flow to the mountain line from lower elevation drainages when turbidity begins to increase. This practice has significantly decreased the frequency of turbidity events reaching the clear well.

The turbidity of the ASR source water should be less than 1.0 NTU, and preferably less than 0.5 NTU. Because the watershed is subject to unpredictable turbidity events that can occur if the weather becomes suddenly warmer, the City monitors incoming mountain line turbidity on a continuous basis. An alarm sounds if the turbidity exceeds 1 NTU. Because the ASR source water will be drawn from the 4 mg reservoir, there will be adequate time to shut down ASR injection before the turbidity in the reservoir reaches 1 NTU.

Even very good quality recharge water will gradually clog an ASR well. With proper monitoring of the source water and well performance and proper design of the system, impacts from clogging can be effectively managed. The well can be back flushed (pumped to waste) on a periodic basis to remove sediment from the well. In order to maximize the removal of fines that have accumulated in the well, we recommend that the target injection rate be 60 to 70 percent of the pumping rate. The optimal back flushing frequency can be established during the pilot-testing phase of the project.

Mineral Stability

The geochemical modeling results show that the mountain line source water is undersaturated with respect to most mineral assemblages; meaning that it is not at equilibrium and it has a tendency to dissolve minerals like calcite, dolomite or quartz minerals, if these minerals are present in the aquifer. Because iron and manganese were not detected in the mountain line source water, there is little or no iron or manganese mineral (hydroxides) to be concerned with.

4.3 Mixing Analysis

An analysis of water quality compatibility was performed for the ASR source water (Baker City water derived from the mountain line) and native groundwater (represented by the Reservoir Well). The purpose of this assessment was to determine if chemical reactions could occur as a result of mixing the recharge water with the native groundwater that might adversely affect ASR well performance, flow properties of the basalt aquifer, or recovered water quality. The evaluation was conducted by interpreting Stiff (Figure 4-1) and Piper (Figure 4-2) geochemical diagrams and by performing an analysis of the equilibrium status of a theoretical mixture of the source water and native groundwater using the PHREEQC geochemical model. The modeling was performed to predict possible geochemical effects, such as mineral precipitation or dissolution, that might occur when the recharge water and native groundwater are mixed. The modeling was performed using a theoretical 50:50 mixture of native groundwater and ASR source water. This is the worst-case mixing relationship that could produce adverse chemical reactions. Due to a lack of Eh (oxidation-reduction potential) data for these samples, values were assumed for the mixing analysis. To be conservative, we assumed that the recharge source water (mountain line water) was highly oxidized (especially after chlorination) and that the native groundwater was reduced. This is commonly the case and represents a worst-case scenario for assessing whether or not iron or manganese containing minerals are likely to precipitate and clog the well when the two waters are mixed in the aquifer.

As the recharge water is introduced into the ASR well, some native groundwater will be displaced and some will mix with the recharge water. The TDS immediately adjacent to the ASR well will be approximately the same value as the recharge water. Near the outer limits of the recharge water bubble, the water quality will gradually become a mixture between recharge water and native groundwater. The pH in the mixed zone is predicted to remain alkaline (pH = 8). Outside the mixed zone further away from the ASR well, the water quality will be identical to native groundwater. Because most of the recharge water will be withdrawn soon after it is injected every year, there will be no long-term change in water quality within the aquifer. If for some reason the native groundwater quality becomes unacceptable, the City would likely store more water than it would pump so that the recovered water more closely resembles the mountain line water quality.

Geochemical Modeling Results

Based on the available water chemistry data and geochemical modeling results (using PHREEQC), the recharge source water and receiving native groundwater appear to be chemically compatible and do not appear to present any fatal flaws for ASR. When the relatively oxidized recharge water mixes with non-oxidized (reduced) native groundwater in the aquifer near the ASR well, precipitation of calcite and dolomite that could clog the well is not predicted to occur. In fact, the geochemical modeling results indicate that these mineral assemblages are at equilibrium and do not have a tendency to either dissolve or precipitate. We anticipate that the recovered water chemistry will resemble the recharge water chemistry with each subsequent ASR cycle (injection, storage and recovery), particularly if additional recharge water is left in the aquifer from year to year.

Manganese in the mixed water is undersaturated with respect to manganese minerals and therefore is more likely to dissolve than to precipitate. Manganese dissolution and precipitation rates are very slow in natural systems and we are uncertain how much and in what form the manganese minerals are in. While not considered a fatal flaw to ASR implementation, manganese concentrations should be monitored closely during the pilot study phase to confirm these findings and to assess whether manganese concentrations increase above present levels and cause taste or staining problems. This will be particularly important in this case given the water quality degradation that has been observed in the past when the well is pumped for an extended period of time.

Because iron and manganese precipitation and dissolution reactions are pH dependent, iron and manganese equilibrium, and hence the resultant concentration of dissolved iron and manganese in recovered water can often times be managed through pH adjustment (adding caustic to keep the pH elevated) at the ASR wellhead.

Well performance during injection should be monitored to determine if turbidity is beginning to clog pore openings near the well. If this is observed, the well can be periodically back flushed to remove the material. Aggressive redevelopment (pull the pump and physically and chemically treat the well) may also be needed periodically. For budgeting purposes, the City should plan do this aggressive redevelopment every 2 - 3 years until pilot testing results indicate otherwise. If iron precipitation or manganese dissolution is found to be a problem during the pilot phase, consideration should be given to storing more water than is recovered each year so that the mixing zone where this reaction is most likely to occur is kept away from the ASR well. This should improve the quality of the recovered water over a longer time period and substantially reduce losses in well efficiency that might be caused by precipitation reactions.

If more than approximately 80 to 90 percent of the stored water is recovered, there will likely be a noticeable change in hardness and taste (probably related to dissolved manganese in the groundwater) at locations closest to the ASR well source. This change is very gradual but may be noticed by industries relying on a constant water quality or by residents who notice water spots on windows. This condition will not be any worse than what the City already experiences when it runs the well during turbidity events. Leaving more stored water in the aquifer can minimize these effects. From past experience, we have found that operation of the ASR system over many recharge cycles will improve the quality of the water produced by the well.

Disinfection By-Products

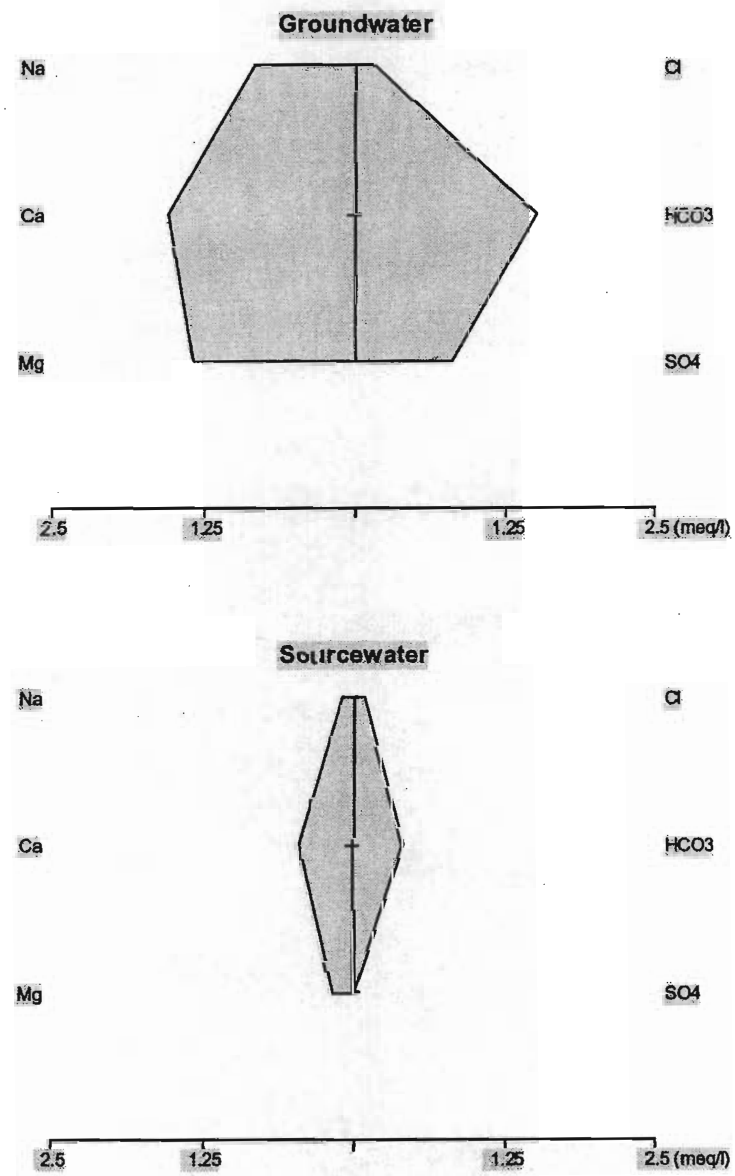
Chlorine and disinfection by-products will be introduced into the aquifer because the City water supply is disinfected. Residual chlorine concentrations will dissipate quickly (hours) as the recharge water comes into contact with the aquifer matrix. Disinfection by-products (DBPs) are produced as a result of chemical reactions between organic carbon present in the surface water or groundwater and chlorine. Disinfection by-products include haloacetic acids (HAAs) and trihalomethanes (THMs). Because the TOC of the native groundwater is low there is a lower potential for DBP formation after the chlorinated recharge water is introduced into the aquifer. It is anticipated that HAA concentrations will dissipate quickly in the aquifer (within days of storage) as a result of aerobic microbial degradation. THM concentrations may increase slightly after injection as a result of the reaction between the TOC present in the recharge water and chlorine; however, THM concentrations should decrease with time (within weeks of storage) due to anaerobic microbial activity. Dilution caused by mixing between recharge water and native groundwater is also expected to reduce DBP concentrations.

Table 4-1
Summary of Native Groundwater and ASR Source Water Quality Testing
Baker City ASR Evaluation

	Analyte	Lowest Regulatory Standard	Units	Regulatory Criteria	MDL	Native Groundwater Reservior Well	Source Water Old Mountain Line
					Date	29-Jan-03	29-Jan-03 & 14-Oct 02
Bacteriological	Fecal Coliforms/E.Coli					<1	NT
	Total Coliform	<1/100 ML	CFU/100 ml	MML		<1	NT
Disinfection By-Products							
THM	Chloroform (Trichloromethane)	None	mg/L	URC	0.0005	ND	NT
THM	Bromodichloromethane	None	mg/L	None	0.0005	ND	NT
THM	Chlorodibromomethane	None	mg/L	None	0.0005	ND	NT
THM	Bromoform (Tribromomethane)	None	mg/L	URC	0.0005	ND	NT
	Total Trihalomethanes	0.08	mg/L	MCL		ND	NT
HAA	Dibromoacetic Acid	None	mg/L	None	0.001	ND	NT
HAA	Dichloroacetic Acid	None	mg/L	None	0.001	ND	NT
HAA	Monobromoacetic Acid	None	mg/L	None	0.001	ND	NT
HAA	Monochloroacetic Acid	None	mg/L	None	0.002	ND	NT
HAA	Trichloroacetic Acid	None	mg/L	None	0.001	ND	NT
	Total Haloacetic Acids	0.06	mg/L	MCL		ND	NT
Field Parameters	Temperature	None	Celsius	None	NA	14.7	7*
	Conductivity	None	mS/cm	None	NA	315	NT
	Dissolved Oxygen	None	mg/L	None	NA	NT	NT
	pH	6 - 8.5	Units	SMCL	NA	8.01	7.4*
	Turbidity	1 NTU	mg/L	MCL, MML	NA	NT	NT
	ORP	None	mV	None	NA	NT	NT
Geochemical	Bicarbonate	None	mg/L	None	2	92	246*
	Calcium	None	mg/L	None	0.1	30.9	8.95*
	Carbonate	None	mg/L	None	2	<1	<1*
	Chloride	250	mg/L	SMCL	1	6	3*
	Hardness (as CaCO3)	250	mg/L	SMCL	4	154	51*
	Magnesium	None	mg/L	None	0.05	16.3	2.18*
	Nitrate as N	10	mg/L	MML	0.05	<0.05	<0.05*
	Nitrite as N	1	mg/L	MCL	0.002	<0.002	<0.002*
	Potassium	None	mg/L	None	0.1	1.8	ND*
	Silica	None	mg/L	None	0.2	38.1	11.1*
	Sodium	20	mg/L	URC, SMCL	0.05	19	2.1*
	Sulfate	250	mg/L	URC, SMCL	5	39	ND*
	Total Alkalinity	250	mg/L	SMCL	2	92	246*
	Total Dissolved Solid	500	mg/L	SMCL	0.7	184	42*
	Total Organic Carbon	None	mg/L	None	0.5	6.7	0.98*
	Total Suspended Solids	None	mg/L	None	2	<1	2*
Metals	Aluminum	0.05	mg/L	SMCL	0.05	0.0071	0.0489*
	Antimony	0.006	mg/L	MCL	0.001	ND	ND*
	Arsenic	0.05	mg/L	MCL, MML	0.002	0.006	ND*
	Barium	1	mg/L	MCL, MML	0.05	ND	ND*
	Beryllium	0.004	mg/L	MCL	0.0005	ND	ND*
	Cadmium	0.005	mg/L	MCL, MML	0.001	ND	ND*
	Chromium	0.05	mg/L	MCL, MML	0.002	ND	ND*
	Copper	1.3	mg/L	MCL	0.005	ND	0.02*
	Iron (Total)	None	mg/L	None	0.05	<0.1	ND*
	Iron (Dissolved)	0.3	mg/L	SMCL	0.05	<0.1	ND*
	Lead	0.015	mg/L	MCL, MML	0.001	0.005	ND*
	Manganese (Total)	None	mg/L	None	0.002	0.12	ND*
	Manganese (Dissolved)	0.05	mg/L	SMCL	0.002	0.09	ND*
	Mercury	0.002	mg/L	MCL, MML	0.0004	ND	ND*
	Nickel	0.1	mg/L	MCL	0.004	ND	ND*
	Selenium	0.01	mg/L	MCL, MML	0.002	ND	ND*
	Silver	0.05	mg/L	MML, SMCL	0.005	ND	ND*
	Thallium	0.002	mg/L	MCL	0.0006	ND	ND*
	Zinc	5	mg/L	SMCL	0.01	ND	ND*
Miscellaneous	Odor	3	TON	SMCL	1 ton	ND	NT
	Color	15	ACU	SMCL	5 color units	ND	NT
	Methylene Blue Active Substance	0.5	mg/L	SMCL	0.05	NT	NT
	Corrosivity (Langelier Saturation Index)	Non-Corrosive	mg/L	SMCL	--	0.23	NT
	Fluoride	2	mg/L	MCL, MML, SMCL	0.5	0.3	NT
Radionuclides	Gross Alpha	15	pCi/L	MML	1	1.1	NT
	Gross Beta	50	pCi/L	MML	1.9	12.2	NT
	Radon	300	pCi/L	MML	80.7	466	NT
Synthetic Organic Compounds (SOCs)							
Regulated SOCs	2,4,5-TP (Silvex)	0.01	mg/L	MCL, MML	0.0004	ND	ND**
	2,4-D	0.07	mg/L	MCL, MML	0.0002	ND	ND**
	Alachlor (Lasso)	0.002	mg/L	MCL, MML	0.0004	ND	ND**
	Atrazine	0.003	mg/L	MCL, MML	0.0002	ND	ND**
	Benzo(a)Pyrene	0.0002	mg/L	MCL	0.00004	ND	ND**
	BHC-gamma (Lindane)	0.0002	mg/L	MCL, MML	0.00002	ND	ND**
	Bis(2-ethylhexyl)adipate	0.4	mg/L	MCL	0.001	ND	ND**
	Bis(2-ethylhexyl)phthalate	0.006	mg/L	MCL, MML	0.001	ND	ND**
	Carbofuran	0.04	mg/L	MCL	0.001	ND	ND**
	Chlordane	0.002	mg/L	MCL	0.0004	ND	ND**
	Dalapon	0.2	mg/L	MCL	0.002	ND	ND**
	Dibromochloropropane (DBCP)	0.0002	mg/L	MCL	0.00002	ND	ND**
	Dinoseb	0.007	mg/L	MCL	0.0004	ND	ND**
	Diquat	0.02	mg/L	MCL	0.0004	ND	ND**
	Ethylene Dibromide (EDB)	0.00005	mg/L	MCL, MML	0.00001	ND	ND**
	Endothall	0.1	mg/L	MCL	0.01	ND	ND**
	Endrin	0.0002	mg/L	MCL, MML	0.00002	ND	ND**
	Glyphosate	0.7	mg/L	MCL, MML	0.01	ND	ND**
	Heptachlor	0.0004	mg/L	MCL, MML	0.00004	ND	ND**
	Heptachlor Epoxide	0.0002	mg/L	MCL, MML	0.00002	ND	ND**
	Hexachlorobenzene	0.001	mg/L	MCL, MML	0.0001	ND	ND**
	Hexachlorocyclopentadiene	0.05	mg/L	MCL, MML	0.0002	ND	ND**
	Methoxychlor	0.04	mg/L	MCL, MML	0.0002	ND	ND**
	Polychlorinated Biphenyls (PCBs)	0.0005	mg/L	MCL, MML	0.0002	ND	ND**
	Pentachlorophenol	0.001	mg/L	MCL, MML	0.00008	ND	ND**
	Picloram	0.5	mg/L	MCL, MML	0.0002	ND	ND**
	Simazine	0.004	mg/L	MCL, MML	0.0001	ND	ND**
	Toxaphene	0.003	mg/L	MCL, MML	0.001	ND	ND**
	Vydate (Oxamyl)	0.2	mg/L	MCL	0.002	ND	ND**
Unregulated SOCs	3-Hydroxycarbofuran	None	mg/L	None	0.004	ND	ND**
	Aldicarb	None	mg/L	None	0.002	ND	ND**
	Aldicarb Sulfone	None	mg/L	None	0.001	ND	ND**
	Aldicarb Sulfoxide	None	mg/L	None	0.003	ND	ND**

	Analyte	Lowest Regulatory Standard	Units	Regulatory Criteria	MDL	Native Groundwater Reservior Well	Source Water Old Mountain Line
					Date	29-Jan-03	29-Jan-03 & 14-Oct 02
	Aldrin	None	mg/L	None	0.0001	ND	ND**
	Benzyl Butylphthalate	None	mg/L	None	0.001	ND	NT
	Butachlor	None	mg/L	None	0.001	ND	ND**
	Carbaryl	None	mg/L	None	0.004	ND	ND**
	Di-n-Butylphthalate	None	mg/L	None	0.001	ND	NT
	Dicamba	None	mg/L	None	0.0005	ND	ND**
	Dieldrin	None	mg/L	None	0.00001	ND	ND**
	Diethylphthalate	None	mg/L	None	0.001	ND	NT
	Dimethylphthalate	None	mg/L	None	0.001	ND	NT
	Di-n-octylphthalate	None	mg/L	None	0.001	ND	NT
	Methomyl	None	mg/L	None	0.004	ND	ND**
	Metolachlor	None	mg/L	None	0.002	ND	ND**
	Metribuzin	None	mg/L	None	0.001	ND	ND**
	Propachlor	None	mg/L	None	0.001	ND	ND**
Volatile Organic Compounds (VOCs)							
Regulated VOCs	1,1,1-Trichloroethane	0.2	mg/L	MCL, MML	0.0005	ND	ND**
	1,1,2-Trichloroethane	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	1,1-Dichloroethylene	0.007	mg/L	MCL, MML	0.0005	ND	ND**
	1,2,4-Trichlorobenzene	0.07	mg/L	MCL, MML	0.0005	ND	ND**
	1,2-Dichlorobenzene	0.6	mg/L	MCL, MML	0.0005	ND	ND**
	1,2-Dichloroethane (EDC)	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	1,2-Dichloropropane	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	1,4-Dichlorobenzene	0.075	mg/L	MCL, MML	0.0005	ND	ND**
	Benzene	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	Carbon Tetrachloride	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	Chlorobenzene	0.1	mg/L	MCL, MML	0.0005	ND	ND**
	cis-1,2-Dichloroethylene	0.07	mg/L	MCL, MML	0.0005	ND	ND**
	Ethylbenzene	0.7	mg/L	MCL, MML	0.0005	ND	ND**
	Dichloromethane (methylene chloride)	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	Styrene	0.1	mg/L	MCL, MML	0.0005	ND	ND**
	Tetrachloroethylene	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	Toluene	1	mg/L	MCL, MML	0.0005	ND	ND**
	trans-1,2-Dichloroethylene	0.1	mg/L	MCL, MML	0.0005	ND	ND**
	Trichloroethylene	0.005	mg/L	MCL, MML	0.0005	ND	ND**
	Vinyl chloride	0.002	mg/L	MCL, MML	0.0005	ND	ND**
	Total Xylenes	10	mg/L	MCL, MML	0.0005	ND	ND**
Unregulated VOCs	1,1,1,2-Tetrachloroethane	None	mg/L	None	0.0005	ND	ND**
	1,1,2,2-Tetrachloroethane	None	mg/L	None	0.0005	ND	ND**
	1,1-Dichloroethane	None	mg/L	None	0.0005	ND	ND**
	1,1-Dichloropropene	None	mg/L	None	0.0005	ND	ND**
	1,2,3-Trichloropropane	None	mg/L	None	0.0005	ND	ND**
	1,2,4-Trimethylbenzene	None	mg/L	None	0.0005	ND	NT
	1,3-Dichloropropane	None	mg/L	None	0.0005	ND	ND**
	2,2-Dichloropropane	None	mg/L	None	0.0005	ND	ND**
	Bromobenzene	None	mg/L	None	0.0005	ND	ND**
	Bromodichloromethane	None	mg/L	None	0.0005	ND	ND**
	Bromoform	None	mg/L	None	0.0005	ND	ND**
	Bromomethane	None	mg/L	None	0.0005	ND	ND**
	Chloroethane	None	mg/L	None	0.0005	ND	ND**
	Chloroform	None	mg/L	None	0.0005	ND	ND**
	Dibromochloromethane	None	mg/L	None	0.0005	ND	ND**
	Dibromomethane	None	mg/L	None	0.0005	ND	ND**
	o-Chlorotoluene	None	mg/L	None	0.0005	ND	ND**
	p-Chlorotoluene	None	mg/L	None	0.0005	ND	ND**

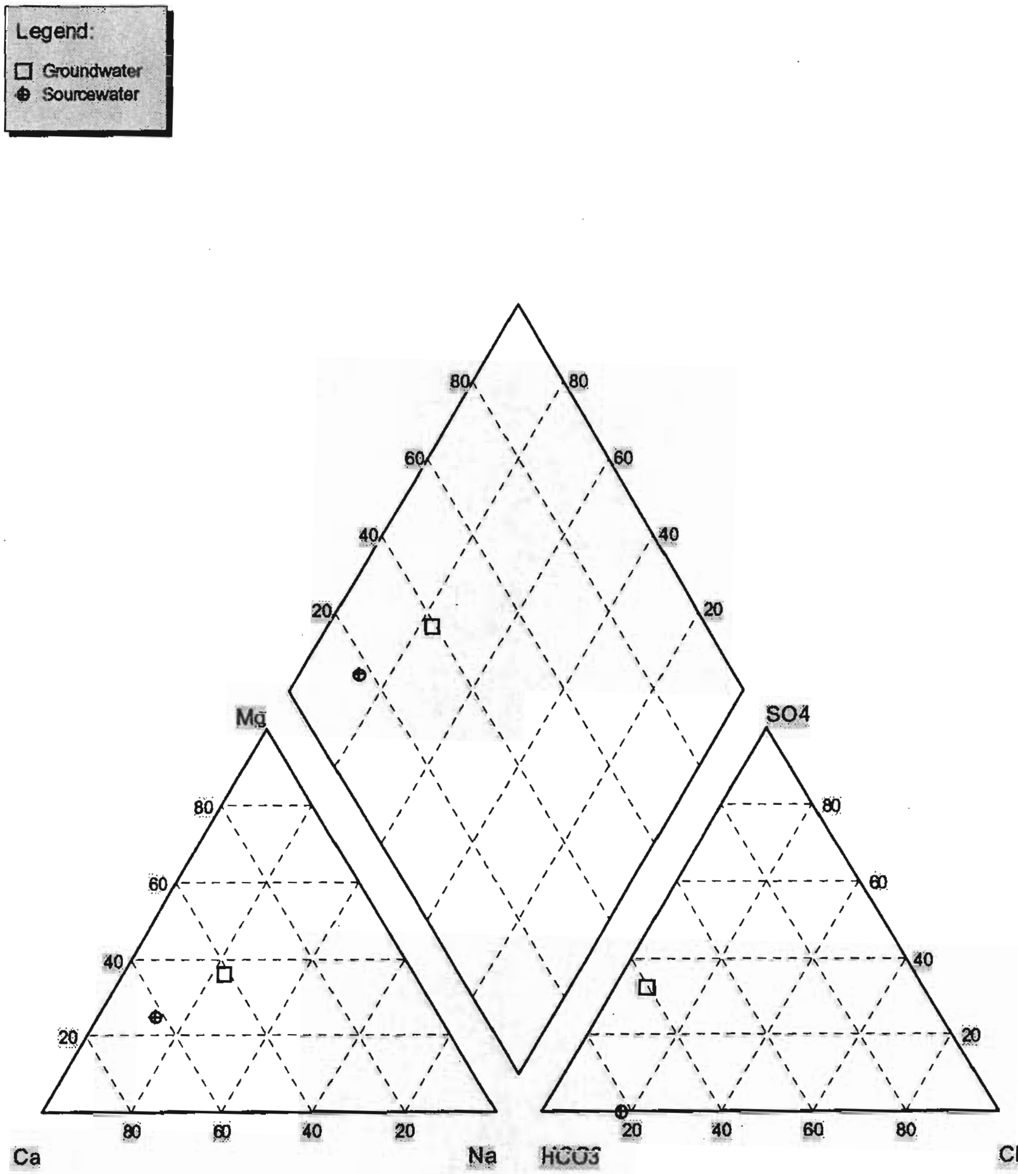
NOTE
mg/L = milligram per liter
MDL = Method Detection Limit
ND = Not detected at concentrations greater than the MDL
NT = Analyte not tested
MCL = Federal maximum contmainant level for drinking water
MML = DEQ's maximum measurable levels for groundwater
SMCL = Federal secondary maximum contaminant levels for drinking water
URC = Oregon Health Division unregulated contaminants for drinking water
* = 29-Jan-03 Sample Date
** = 14-Oct-02 Sample Date



DESCRIPTION: Stiff Diagram Illustrating Major Cations & Anions

Groundwater Solutions Inc.	CLIENT: Baker City	
	PROJECT: ASR Feasibility Study	
	PROJ. #: 145.001	DATE: May 2003

Figure 4-1
Stiff Diagram Illustrating Major Cations & Anions



DESCRIPTION: Piper Diagram Illustrating Water Quality Signatures	
Groundwater Solutions Inc.	CLIENT: Baker City
	PROJECT: ASR Feasibility Study
	PROJ. #: 145.001 — DATE: May 2003

Figure 4-2
Piper Diagram Illustrating Water Quality Signatures

Figure 4-3
Baker City Reservoir Well
Water Quality Trends

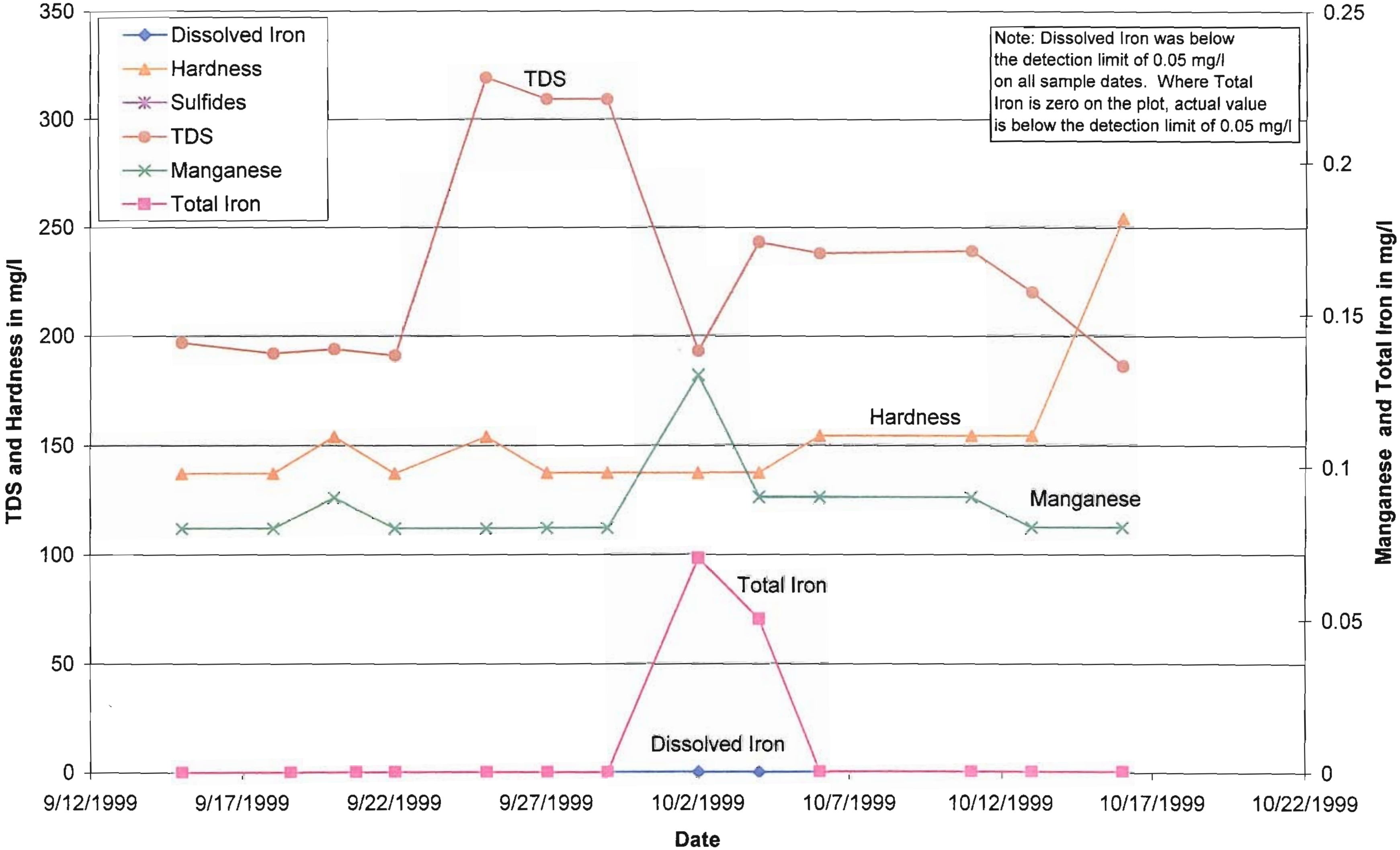
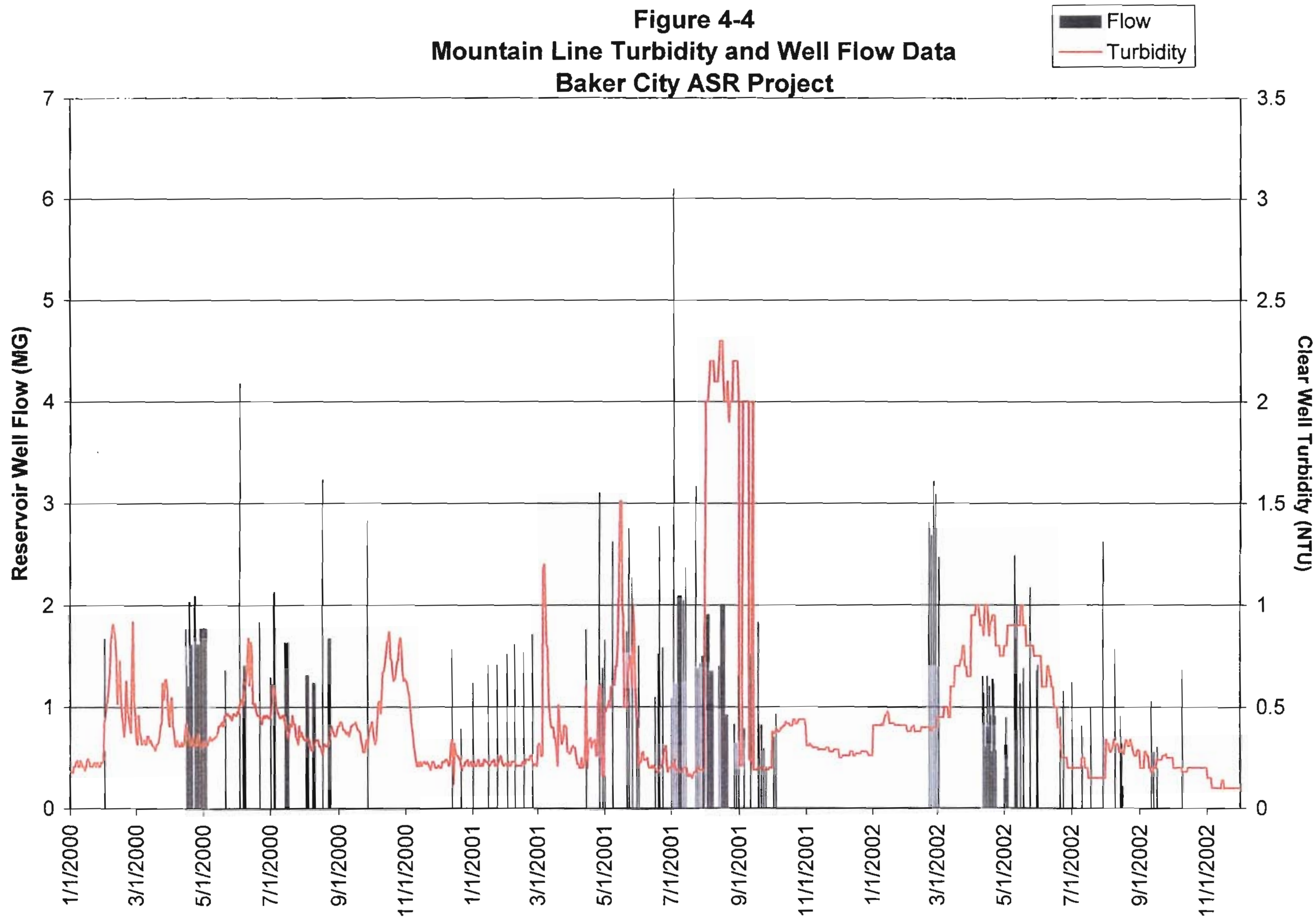


Figure 4-4
Mountain Line Turbidity and Well Flow Data
Baker City ASR Project



5.0 Recharge Water Availability

5.1 General

Water availability for recharge is one of the essential components of the ASR project. Also, the length of continuous availability is important. Minimizing the start/stop operation of injection will minimize the potential for air intrusion into the aquifer. The City of Baker City has targeted two time periods for injection: winter and early summer after springtime runoff. These two seasons appear to be the most effective time periods for continuous recharge. The winter season will most likely be the most reliable period for continuous recharge.

Water source for recharge will come from diversions located within the City's watershed. These diversions vary in capacity depending on the time of year, weather patterns, and snow pack. The major diversions are Mill Creek, Little Mill Creek, Marble Springs, Elk Creek, Little Marble Creek, Little Salmon Creek, Big Salmon Creek, and the Goodrich Reservoir. There are other minor diversions that produce less water and are very seasonal.

5.2 Winter Season

During winter, the City staff utilizes Mill Creek, Little Mill Creek, and Marble Springs to meet average use. Additionally, Elk Creek is used for peak periods during the winter, but only approximately once every two weeks.

Historical flow data from the City's reservoir outlet for the years 2000, 2001, and 2002 indicate an average water system demand of approximately 800 to 900 gallons per minute (gpm). This would mean that approximately 850 gpm of water supply is obtained from the combination of Mill Creek, Little Mill Creek, and Marble Springs. Based on review of the fall/winter data logging at Mill Creek and Little Mill Creek and discussions with staff, the approximate distribution of water supply from these sources is as follows:

Primary Source to Meet Wintertime Demand:		
	Mill Creek	500 gpm
	Little Mill Creek	150 gpm
	Marble Springs	200 gpm
Total Estimated Water Supply		**850 gpm**

As previously mentioned, Elk Creek is also used in the winter but very sparingly. The estimated water supply from Elk Creek, based on staff observation, is approximately 400 gpm. Little Marble Creek produces approximately 100 gpm in the winter. Little and Big Salmon Creeks produce approximately 100 and 200 gpm, respectively, based on staff observation. Therefore, from secondary sources the following water supply is available for recharge during most of the winter season.

Secondary Source Available for Wintertime Recharge:		
	Elk Creek	400 gpm
	Little Marble Creek	100 gpm
	Little Salmon Creek	100 gpm*
	Big Salmon Creek	200 gpm*
Total Estimated Water Supply		**800 gpm**

* These sources may taper off depending on snow pack and weather conditions.

Additionally, the Goodrich Reservoir basin may be a source of water supply during winter months. It has been reported that there is approximately 200 to 300 gpm available from reservoir leakage and immediate downstream creeks and springs that are between the reservoir and the point of diversion. Also if in the future valving and piping were installed in order to operate the reservoir outlet during winter months, more water supply would be available -- approximately 400 to 500 gpm.

5.3 Winter Recharge

In summary, there appears to be enough water supply during winter to provide sufficient continuous recharge water for the ASR project. The amount of available supply could range from approximately 750 to 1,100 gpm based on the above data. Although this would mean that approximately 108 to 158 MG could be stored for a 100-day recharge period, it should be noted that these values could vary depending on snow pack and weather conditions. A very cold winter could have a major influence on water availability. Also, water system demands for Baker City could have an impact on the availability of recharge. As the population of Baker City increases, availability of recharge water during this time period will decrease. Refer to Table 5-1 for the projected future water system demands.

5.4 Summer Season

Early summer recharge water availability is more uncertain and will be highly dependent on weather conditions and turbidity levels. Average water system demand for June through July is approximately 2,300 to 3,100 gpm. The average water system demand for June alone is approximately 1,940 to 2,700 gpm. From discussions with staff and review of data log readings, water supply from the watershed is approximately as follows:

Available Water Supply During Early Summer:		
	Estimated Supply *	**Water Rights**
Mill Creek	1,500 gpm	2,805 gpm
Little Mill Creek	500 gpm	2,244 gpm
Marble Springs	400 gpm	2,244 gpm
Elk Creek	800 gpm	1,683 gpm
Little Marble Creek	100 gpm	561 gpm
Little Salmon Creek	---	561 gpm
Big Salmon Creek	800 gpm	2,244 gpm
Totals	**4,100 gpm**	**12,343 gpm**

* These flows can vary significantly. Additionally, Goodrich Reservoir water is used during this time period when demand in the system increases and/or when available water is not as much as shown.

Given the fact that the mountain line can carry only approximately 3,100 gpm, historic peak system demands during June and July are met by using the mountain line, the Marble Springs intertie line, and, on a less frequent basis, the City well.

Based on the data, it appears that approximately 1,000 to 2,160 gpm can be available for recharge in early summer. During a 28-day period, there would be approximately 40 to 50 MG (maximum recharge of 1,250 gpm) available.

Table 5-1
Projected Future Water System Demands

		Future Demand*		
	Existing Demand (gpm)	**Low**	**Medium**	**High**
Winter	850**	900	1,030	1,210
Spring	1,180	1,260	1,420	1,650
Early Summer	2,700	2,890	3,280	3,860
Summer	4,530	4,980	5,660	6,660

* Future water system demands are based on low, medium, and high population projections for a 20-year planning period as shown within the Baker City, Oregon, Water Facility Plan.

** Updated with current historical data. Current data was more accurate than previous data used within the Facility Plan.

6.0 Recharge Analysis

6.1 Introduction

This section presents a detailed evaluation ASR injection and pumping at the Baker City's Reservoir Well based on aquifer test results and other data gathered during the initial ASR feasibility evaluation. The general criteria used as guidelines for evaluating the hydrogeologic feasibility of ASR for the City's Reservoir Well includes the following:

1. A confined aquifer with a transmissivity greater than 10,000 gallons per day per foot that is not significantly bounded; lower transmissivities are permissible if headroom (area above the static water level) is available in the aquifer.
2. The target aquifer can store in excess of 100 MG of water at the well site, can sustain the injection rates necessary to achieve this storage volume during an injection season, and can support well yields of at least 500 to 700 gpm (0.7 to 1.0 MGD) during recovery.
3. The water level in the recharge well does not rise above ground surface during injection and does not drop below the pump intake during pumping.
4. The target aquifer does not have other wells that could capture stored water.

The analysis of ASR feasibility with respect to these criteria is presented in the following sections.

6.2 Aquifer Characteristics

The Reservoir Well is completed in a volcanic basalt aquifer consisting of numerous individual lava flows. The aquifer is considered to be confined or semiconfined with a transmissivity ranging from approximately 2,500 to 7,300 gpd/ft. A storativity estimate was not calculated since a response in the observation well was not seen during the aquifer test. However, storativity estimates for the basalt aquifers generally range from 1×10^{-5} to 1×10^{-3}. Groundwater flow within the aquifer occurs through permeable layers between individual lava flows and fractures in the rock. The nearby mountain-front fault appears to be a leaky boundary between the basalt aquifer and the volcanic sedimentary aquifer beneath the valley floor. This is inferred because there was no abrupt change in the drawdown slope during the aquifer test. Instead the drawdown curve gradually steepend with time (refer to drawdown plots in Appendix B), which suggests that the fault is leaky. This increasing slope also suggests a diminishing transmissivity and a reduction in specific capacity as the cone of depression propagates away from the well. Overall, even though the transmissivity is less than 10,000 gpd/ft, the specific capacity at the end of a prolonged pumping period (flow rate divided by the drawdown or drawup in the well) appears high enough (16.5 gpm/ft) to support continued pumping and/or injection at lower rates than where used during the constant rate test.

6.3 Target Injection and Pumping Rates and Storage Volume

Based on discussions with the City, the following operational scenarios for the proposed ASR project were developed and are described below. These parameters were used during the ASR evaluation process. The scenarios also include target injection/recovery rates and estimated storage volumes. In general, injection will occur using mountain-line water during the wintertime when turbidity is acceptable. Summer time injection will occur after the spring turbidity events and its primary purpose is to store excess mountain-line water that may otherwise be spilled.

Winter-time Injection Criteria

The following represents general ASR evaluation criteria for a wintertime recharge scenario.

- A total of **100 days** of injection were assumed based on:
  - Injection period from December 1 to April 30th each year (about 150 days).
  - A total of 40 days where assumed for shutdown due to turbidity events.
  - Back flushing will occur every three weeks, which results in an additional 10-days of lost injection time.
- The injection rate was assumed at 800 gpm, which is 44 percent of the maximum pumping rate for the well.
- Recharge water turbidity is less than 0.5 NTU during injection.
- Head buildup in the well casing cannot exceed a threshold criterion of 25 feet below ground surface.

Summer-time Injection Criteria

The following represents general ASR evaluation criteria for a summer time recharge scenario.

- A total of **28 days** of injection were assumed based on:
  - Injection period from June 15th to July 30th each year (about 45 days).
  - A total of 4 days where assumed for shutdown due to turbidity events.
  - Back flushing will occur every three weeks, which results in an additional 3-days of lost injection time.
  - An additional 10 days of lost injection time will occur due to cycling the system on and off due to changes in the water level in the clear well.
- The injection rate was assumed at 1250 gpm, which is 70 percent of the maximum pumping rate for the well.
- Recharge water turbidity is less than 0.5 NTU during injection.
- Head buildup in the well casing cannot exceed a threshold criterion of 25 feet below ground surface.

Pumping Criteria

The following represents general ASR evaluation criteria for pumping (recovery).

- Head buildup calculations from year-to-year assume that 100% of the stored water is removed; otherwise the head buildup in the injection well will exceed the ground surface during year 2 injection.
- The pumping rate assumed at 1800 gpm.

6.4 Assessment of Target Injection and Recovery Rates

ASR well injection and recovery rates are controlled by a number of factors including pressure available in the recharge piping, the available headroom (drawup) and drawdown in the well, aquifer transmissivity, well efficiency, and boundary conditions as they affect drawup and drawdown. Aquifer and well performance data were used to evaluate if target injection and recovery rates are feasible based on predictions of drawup and drawdown during typical ASR operations in the City's proposed ASR well. These predictions were based on projections of specific capacity changes and water level trends over time. Specific capacity is the injection rate or pumping rate divided by the water level drawup or drawdown. It provides a simple and convenient index for how the well is performing and for the extent to which clogging is reducing well efficiency. For example, if the well is becoming clogged, we will see a reduction in specific capacity over time. For the purposes of this analysis, the constant rate drawdown test data were used to estimate the specific capacity at the end of winter- and summer time injection periods. Table 6-1 summarizes the head buildup and drawdown in the proposed ASR well for wintertime and summer time injection. The predictions are shown graphically in Figure 6-1. Appendix D presents detailed assumptions and calculations of the ASR evaluation.

Table 6-1
Estimated Drawup and Drawdown During ASR Operation at the Reservoir Well

Scenario	Year 1 Water Level (bgs)	Year 2 Water Level (bgs)	Year 3 Water Level (bgs)
Winter Time Injection (800 gpm)	113 feet	89 feet	61 feet
Summer-Time Injection (1250 gpm)	71 feet	32 feet	[illegible]
Recovery (1800 gpm)	398 feet	360 feet	315 feet

bgs = below ground surface

Scenario assumes that the stored water (winter- and summer-time) is fully recovered each year.

Head buildup in summer assumes no water removed during wintertime storage.

Drawdown is less from year-to-year since the water level is higher each year due to injection (mounding).

This assessment is based on an assumed maximum water level buildup that is 25 feet bgs in the ASR well during injection. This threshold was used because it is assumed that injection will be driven by a booster pump, and that the wellhead is not sealed to prevent water from discharging from the top of the casing. It is possible to design the wellhead for injection under pressure, but it is generally not desirable if it can be avoided because of design and construction costs. The threshold of 25 feet bgs provides a buffer between the water level in the well and the wellhead in case of unexpected fluctuations during injection.

The assessment of injection and recovery rates incorporate a number of assumptions involving short-term and long-term decreases in injection and pumping specific capacities due to head changes in the well and clogging. The key assumptions are documented in Appendix D. The most critical of these assumptions involves estimates of the injection and recovery specific capacities. The assumptions regarding differences between injection and pumping specific capacities, and reductions in specific capacity over time are based on analysis of trends observed during ASR operation in Beaverton, Oregon and based on direct ASR project experience with other basalt-hosted systems.

The specific capacity of an ASR well is expected to decrease with time because of clogging of the skin around the borehole due to the introduction of suspended particulates during injection. Regular backflushing (pumping to waste) is an important operational tool for reducing the decline in specific capacity by removing particulates from the aquifer in the immediate vicinity of the well. However, declines in specific capacity can be expected even with a regular program of back flushing because short-term backflushing typically will not completely restore the specific capacity of the well. Thus, the need to redevelop an ASR well to reverse long-term specific capacity declines should be expected as part of the operation and maintenance of an ASR system. Redevelopment entails removing the wellhead and pump assembly, and aggressively cleaning out the well by some combination of scrubbing, jetting and pumping. The interval between redevelopment episodes will depend on the initial specific capacity of the ASR well and the long-term rate of specific capacity decline.

Air entrainment also is another factor that can result in loss of specific capacity of the well. At the startup of injection, as the water is injected down the pump column, cascading water causes air to become entrained. If the entrained air is forced out into the aquifer it can cause the formation to be air-locked and thus result in a loss of the aquifer's ability to transmit water, which is translated into a loss in well specific capacity. Since the summer time injection plan includes cycling injection (many starts and stops) possible air entrainment becomes an even greater concern. Designing the ASR system to minimize or ideally eliminate possible air entrainment of the injection water should be a high priority in the design and operation of the proposed Reservoir ASR well.

Our analysis indicates that target ASR recovery and injection rates are feasible at the site under the most conservative scenario used for this analysis and given the assumptions outlined above for wintertime and summer time injection. The analysis also indicates that the Reservoir ASR well may need to be redeveloped every 2 to 3 years to restore specific capacity so that the final injection water level during summer time is maintained below the threshold level of 25 feet bgs.

6.5 Evaluation of Available Storage Volume

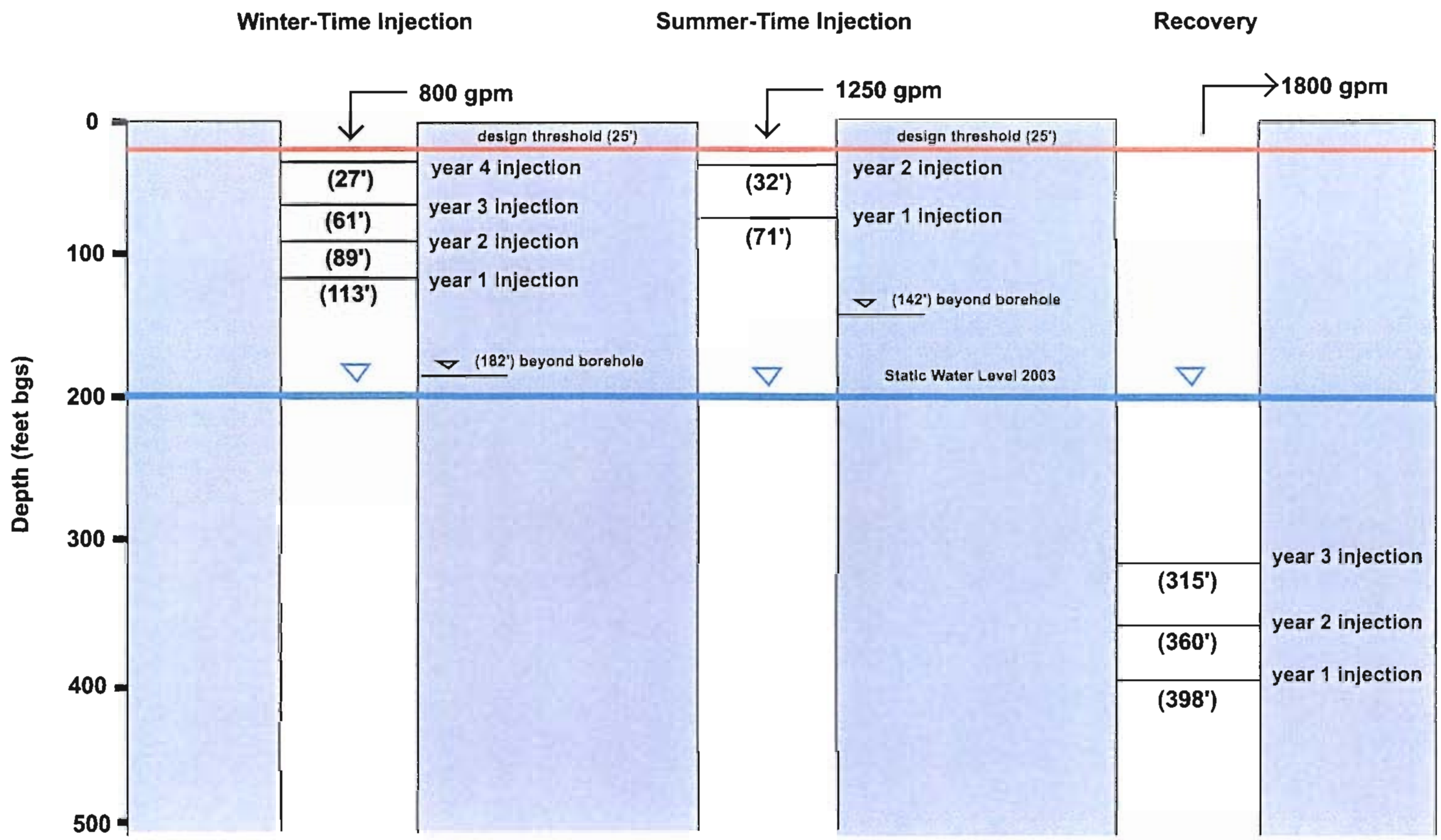
Evaluation of the projected well and aquifer response during injection indicates at least 115 MG can be stored in the aquifer during the wintertime and that an additional 50 MG can be stored during the summer injection period for a total of 165 MG. If the stored water is recovered at a rate of 1,800 gpm, pumping could be sustained for 60 to 90 days without depleting the aquifer or causing water quality degradation. This assumes that the total volume is removed each year. If the stored water is not removed, then it is anticipated that only a limited amount of water can be injected during the subsequent recharge period until the water levels drop back down.

The water level in the aquifer after the winter and summer injection period (with 165 MG in storage) is predicted to reach 142 feet bgs. The static water level in 1977 was 177 feet bgs. Since the water level in the aquifer will be higher than what was recorded when the well was drilled, there is the possibility that seeps could occur along the slope of the hill if a preferential pathway (e.g., fracture) exists between the deeper confined aquifer and the ground surface. As is common in any ASR project, monitoring for the possibility of losing water through seeps will need to be done during pilot testing of the ASR system.

According to historical records, the Reservoir Well production typically decreases to 1,000 gpm or less within 30 days of continuous pumping and the quality of the water degrades to the point where residents complain. Over the last 25 years, the City has pumped approximately 560 MG from the aquifer and there has been a 73-foot decline in static water level, which indicates that even sporadic, un-sustained pumping has exceeded the natural rate of groundwater recharge. ASR will substantially improve and extend the sustainable production capacity of the well and improve the quality of water produced after extended periods of pumping. In addition, ASR will stop "mining" of the aquifer that has occurred over the past 25 years of operating the Reservoir Well.

6.6 Capture of Stored Water by Other Wells

Three large-capacity (>100 gpm) wells completed in the deep basalt that could capture stored ASR water have been identified in the general vicinity of the site. Baker 1145 (Erwin well) is located approximately 0.2 miles northwest of the Reservoir Well and has a capacity of 200 gpm. Baker 1163 (Ellingson Timber well) is located approximately 1.4 miles east of the Reservoir Well and has a capacity of 2,000 gpm. It is not known if these two wells are still in operation or what rate they are pumped. Baker 1153 (Golf Course well) is located approximately 0.9 miles east of the Reservoir Well and has a capacity of 320 gpm. Both Baker 1163 and 1153 are located on the opposite side of the fault boundary from the Reservoir Well. Because we did not see a water level response in the Golf Course well (Baker 1153) or Paul Hill well (Baker 1136) during the 5-day aquifer test, we do not believe that wells located north of the fault will capture stored water.



NOTE:
(1) Head buildup in summer assumes no stored water removed during winter-time injection
(2) Drawdown based on summer storage
(3) Head buildups assume stored volume recovered each year
(4) Since head buildup is higher each year the drawdown in the well relative to bgs is less each year

Figure 6-1
Assessment of Target Injection and Recovery Rates

Groundwater Solutions Inc.

P:\145 - Baker City\001\ASR_Assessment

7.0 Conclusions, Uncertainties, and Recommendations

7.1 Conclusions

The analysis of the results of the aquifer tests, water quality compatibility analysis, and ASR recharge evaluation indicate that an ASR well system providing up to 2.5 MGD (1800 gpm) of peaking and or emergency capacity appears to be feasible at the site. With a target winter storage volume of 115 MG and recovery rate of 1,800 gpm, the well will provide about 45 days of peak or emergency supply. It also appears feasible to store an additional 50 MG during the early summer months if demand remains low and flow is available in the watershed. This will extend the summer peak pumping period to 60 to 90 days without overpumping the aquifer or causing water quality degradation. Our conclusions are based on a number of hydrogeologic factors including:

Aquifer Characteristics: The aquifer is confined or semiconfined and the transmissivity of the aquifer is estimated to be between 2,500 to 7,300 gpd/ft, which is less than the minimum criterion proposed in the initial ASR evaluation. However, the estimated specific capacity at the end of a proposed injection period, coupled with the large available headroom in the aquifer, indicate that ASR is still feasible at this site. The projected effects of aquifer boundaries observed during the aquifer test do not appear to be a significant limitation to achieving target injection and recovery rates and the target storage volume.

Injection Rates, Pumping Rates and Storage Volume: The thickness of the basalt unsaturated zone and relatively low groundwater levels in the aquifer provide for sufficient available drawdown and headroom (drawup) in the aquifer to achieve the target injection and recovery rates and storage volume.

Capture of Stored Water by Other Wells: No large capacity deep basalt wells were identified on the south side of the fault boundary that could capture stored ASR water. The potential effects of pumping wells located north of the fault should be further assessed through monitoring during pilot testing at the Reservoir Well.

These conclusions are based on use of data obtained from relatively short-term aquifer tests. Thus, the validity of these conclusions for a long-term ASR operational scenario is subject to some uncertainties that are discussed in the following section.

7.2 Uncertainties

The results of the Reservoir Well recharge evaluation indicate that ASR is feasible at this site; however, there are still some basic uncertainties about what the long-term injection and recovery capacity of the ASR system will be. ASR field-testing will be required to resolve these uncertainties. The key uncertainties are listed below:

1. The ability of the ASR well to maintain target injection and pumping rates. This will depend upon the well efficiency over time, storage zone size and permeability, and

actual rate of clogging caused by turbidity and possibly entrained air. High quality recharge water that is free of suspended sediment and air is a key factor for maintaining well efficiency. Recharge water with turbidity exceeding 0.5 NTU will clog the aquifer matrix and quickly reduce the specific capacity of the well. The result will be decreased injection and potentially decreased recovery rates. In addition, since the summer time injection scenario will include cycling on and off, the system should be designed to minimize air entrainment of the injection water. Maintaining the emergency production capacity of the Reservoir Well is a high priority. Several measures should be implemented to maintain the injection and pumping capacity including:

- Flushing the water lines in the system that provide injection source water to remove particulates prior to starting injection.
- Closely monitoring the quality of water being injected, and monitoring water levels in the well for changes in specific capacity.
- Implementing a regular program of backflushing the well and pumping it to remove particulates introduced into the well during injection.
- Periodically pulling the pump and aggressively redeveloping the well.

2. The long-term impact of injection and pumping of the deeper basalt aquifer zone on the shallow tuffaceous sediments beneath the valley floor north of the fault is not well understood. The data from the aquifer test indicate that the boundary fault is leaky; however, no response was observed in the Paul Hill well. Consequently, there is some uncertainty associated with the potential for ASR operation to affect water levels in shallow wells in the tuffaceous sediments.

3. Since the head rise in the aquifer is anticipated to exceed the 1977 historic water level in the basalt aquifer, creating or enhancing seeps and springs due to increased water levels in the basalt aquifer is a possibility. Monitoring the potential for surface discharges during pilot testing will be important. The monitoring would include measuring water levels in the Reservoir Well and other wells in the area, such as the close by domestic wells, the Paul Hill well, and the golf course well. Periodic visual surveys of potential seep areas also should be conducted during the wet season prior to and during pilot testing.

7.3 Recommendations

On the basis of the technical analysis presented in this report, we do not see any fatal flaws for developing ASR at the Reservoir Well site and recommend proceeding with phase two of the project – ASR Pilot Testing at the Reservoir Well. The scope for Phase 2 consists of the following tasks. These activities are required by OWRD under the ASR rules.

- ***Task 1** – Permitting- Obtain 5-year Limited License from OWRD*
- ***Task 2** – ASR Design and Construction – Design and construct well, pump station, and system modifications to accommodate ASR at the Reservoir Well site*

- ***Task 3** – ASR Work Plan – Prepare pilot testing work plan for submittal to OWRD*
- ***Task 4** – ASR Pilot Testing – Conduct injection, storage, and recovery testing and monitoring at Reservoir Well as required by OWRD*
- ***Task 5** – ASR Analysis and Report – Assess sustainable injection and pumping rates, storage volume, water quality improvement and aquifer response to ASR*
- ***Task 6** – ASR Operations Plan – Develop operational parameters and O&M plan for City use*

A number of improvements and modifications will be required at the Reservoir Well site in order to retrofit the system for ASR. These improvements include the following:

- New booster pump at the 4.5 MG chlorine contact chamber and variable frequency drive (VFD) that allows adjustable rates of injection.
- New piping that conveys recharge water from the booster pump to the Reservoir Well.
- New recharge loop, piping, valves, and controls at the well head that permit injection down the pump column. Building modifications are required to accommodate the additional piping in the pump house.
- New pump to waste piping that permits discharge of wastewater from startup and back flushing.
- New liner casing in the well to 500 feet to protect the pump from falling rocks (there is presently only 20 feet of casing and open borehole to total depth).
- New pump, pump head, and pump column. The existing motor will be reused.
- New system controls and monitoring at the chlorine building that allow manual operation with automatic safety overrides.

The estimated cost for these improvements and associated engineering costs for permitting, system design, construction oversight, pilot testing, monitoring, and reporting are within the range presented previously. The total estimated cost for Phase 2 ranges from $425,000 to $458,000. A range of cost is presented because there are a number of elements that must be resolved during the design phase. Typical annual operation and maintenance costs during ASR pilot testing are approximately $30,000 to $40,000. This includes the additional monitoring and laboratory testing fees required by OWRD under the Limited License. This estimate assumes that City staff will complete the majority of the data collection in the field and that they will maintain and operate the ASR system with limited technical support. It has been our experience that these costs can be reduced after the first year of successful full-scale operation, due to a reduction in monitoring assuming OWRD approves. From past experience, the cost to pull the pump and redevelop the well every 2 to 3 years to remove sediment from the well that could not be removed by backflushing is approximately $20,000.

The initial testing can last up to 5-years under the Limited License. After sufficient data regarding aquifer response, operational data, and lack of impacts are obtained to demonstrate ASR feasibility, the City would then apply for a full-scale ASR permit. It is possible that this could be accomplished after one or two years of operation. Assuming that the results of the pilot testing are favorable, the City will have a fully functional full-scale ASR system at the conclusion of Phase 2.

The next steps of the project will include the following:

- Meet with OWRD to discuss the project (pre-application meeting July 2003)
- Complete and file a Limited License application and ASR work plan (July 2003)
- Work closely with the City to prepare design drawings and specifications for the well and pump station improvements (summer 2003)
- Obtain ASR Limited License after 30-day comment period (September 2003)
- Assess the condition of the well using a down-hole camera and install a steel liner to protect the new pump (fall 2003 after summer pumping season)
- Construct well and pump station improvements (fall 2003)
- Begin pilot recharge testing (winter 2003/2004)
- Begin recovery of stored water (summer 2004)

8.0 Conceptual ASR System Design, Operation, and Cost Update

This section of the report presents a description of the conceptual ASR system design and operation and an update of the costs for implementing Phase 2 – pilot testing. Pilot testing is required by OWRD to prove ASR feasibility and it will provide important operational data to be used by the City during full-scale operation. The system will be designed and the pilot program developed so that the system will deliver up to 2.5 MGD during the first summer following the first recharge season (summer of 2004).

8.1 Conceptual ASR Design and Operation

A preliminary site plan illustrating the planned ASR system layout is presented in Figure 8-1. Figure 8-2 presents the hydraulic profile for the system as it relates to the existing infrastructure at the Reservoir Well site. The ASR system components and well improvements consist of the following:

- New booster pump at the 4.5 MG chlorine contact chamber and variable frequency drive (VFD) that allows adjustable rates of injection.
- New piping that conveys recharge water from the booster pump to the Reservoir Well.
- New recharge loop, piping, valves, and controls at the well head that permit injection down the pump column. Building modifications are required to accommodate the additional piping in the pump house.
- New pump to waste piping that permits discharge of wastewater from startup and back flushing.
- New liner casing in the well to 500 feet to protect the pump from falling rocks (there is presently only 20 feet of casing and open borehole to total depth).
- New pump, pump head, and pump column. The existing motor will be reused.
- Existing supply line from the well back to the chlorine building.
- New system controls and monitoring at the chlorine building that allow manual operation with automatic safety overrides.

The ASR system will consist of two individual and separate operations: 1) recharge, and 2) withdrawal. The control and safety functions for each operation will utilize equipment with parallel capability, when possible, to simplify the system and avoid duplication of cost and/or control function. The following narratives outline the preliminary concept of operational and safety functions for each operation:

Recharge

Recharge operation will consist of delivering water from the chlorine contact chamber through a new booster pump. This water will be diverted to the well via a new 10-inch diameter buried recharge line to be installed from the proposed booster pump location to the well. Water will be delivered into the well through a series of control valves and ultimately down the pump column, through the bowl assembly and out the pump inlet. Adequate pressure is required to fill the pump column as quickly as possible in order to minimize the amount of air that is pushed down the well and out into the aquifer. This is accomplished by a combination of the booster pump pressure and frictional losses developed as the recharge water flows down the pump column and through the bowl assembly. The rate of flow will be controlled by a variable frequency drive at the booster pump that will allow the injection rate to be adjusted. For example, the initial flow rate will be high in order to fill the pump column and then gradually reduced so that it matches the available supply coming in from the mountain line. The system is intended to be controlled manually at the chlorine building and there will be a number of automatic safety overrides that will shut down the system if a problem develops.

Withdrawal

Normal operation of the well will not differ appreciably from the current operation, except for operation of the control valves and a short duration pump to waste sequence prior to pumping the water to the chlorine building. Well operation will be based on normal withdrawal of water from the existing well using a new vertical turbine pump (which will also be used for recharge purposes). Operation of the well pump is also intended to be a manual operation with appropriate operational and safety controls.

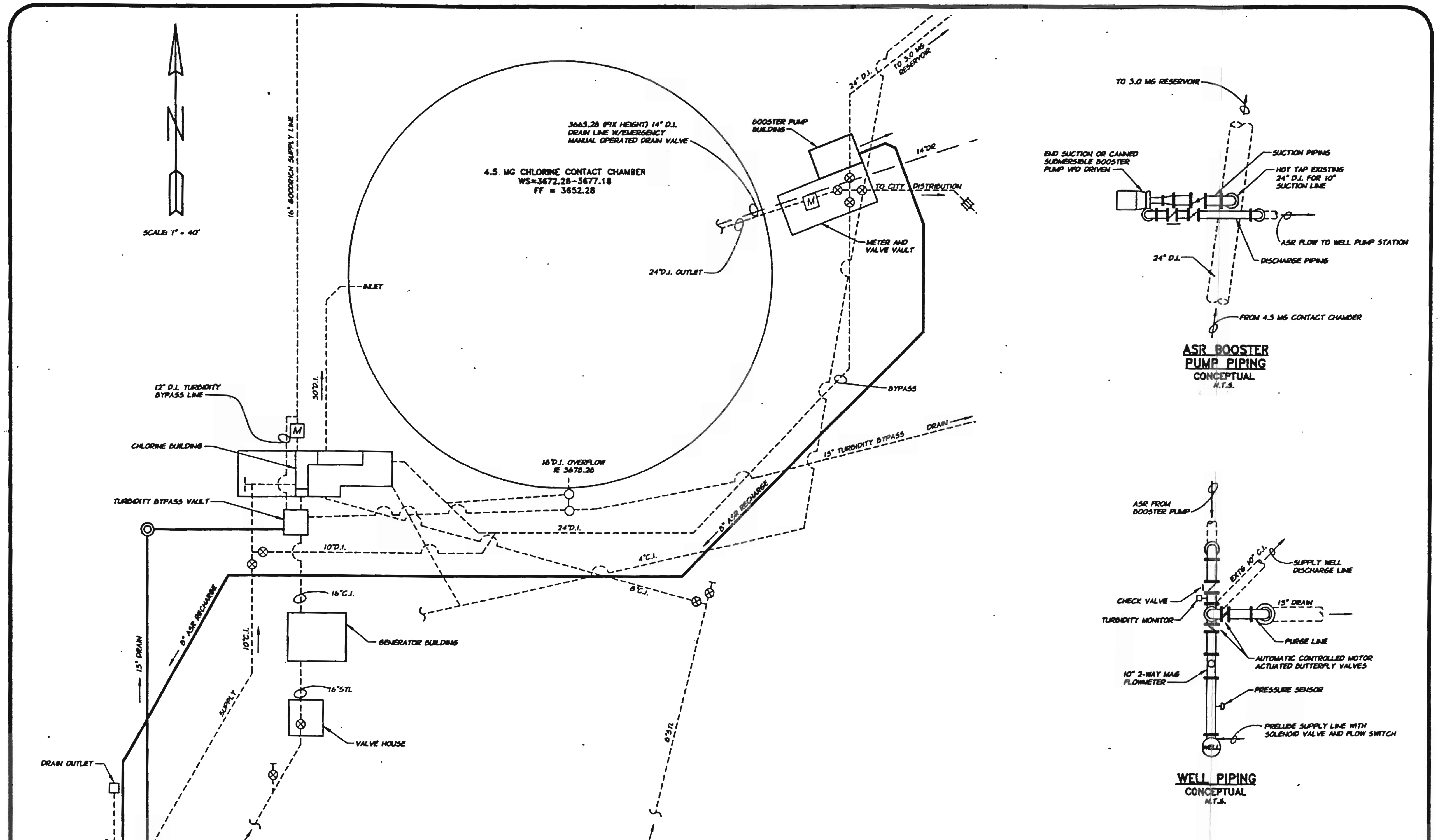
A more detailed description of the ASR system operation and schematic of the system prepared by Stettler Supply Company are presented in Appendix F.

8.2 ASR Program Cost Update

Phase 1 of the project was completed on budget except for additional expenditures relating to addressing the broken pump discharge head. The cost estimate prepared previously for Phase 2 of the project was reviewed using information developed for the ASR conceptual design and information obtained when the existing well pump was lifted and tested. The updated cost estimate for Phase 2 is within the range of costs presented in our original proposal even though items have been added to the project, including a steel liner casing to protect the new pump. Table 8-1 presents our cost estimate for the engineering and construction elements of the Phase 2 pilot project. We have presented a range of costs for the ASR construction activities because there are a number of elements in the design that have not been finalized. When the next level of preliminary design is completed, the construction cost estimate will again be updated. On the basis of what we know now, the estimated budget presented in Table 8-1 will be adequate to complete the project.

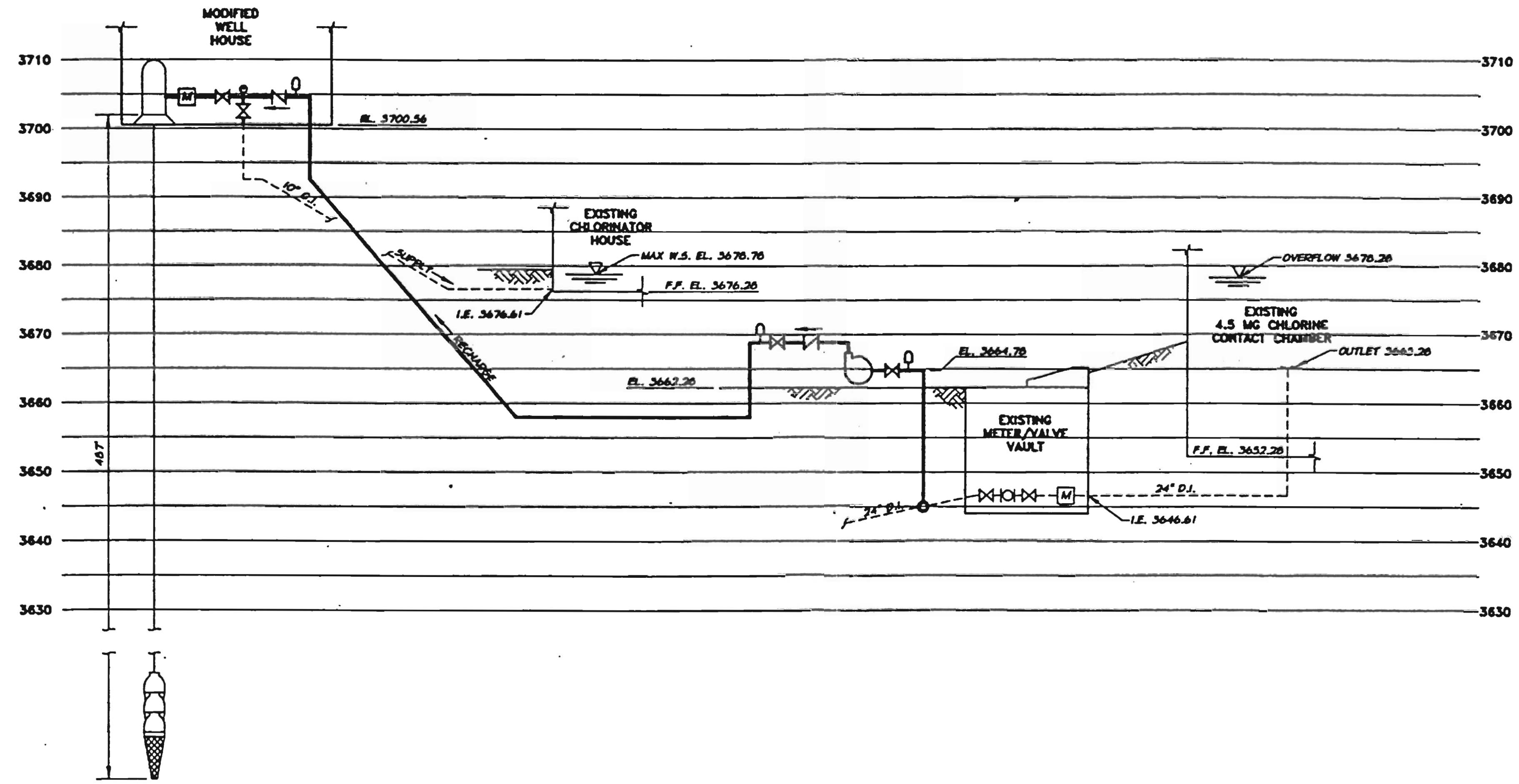
Table 8-1
Phase 2 Pilot Project Cost Summary
Baker City ASR Project

Phase 2 – Engineering		
Task 1 Permitting -- ASR Limited License		$15,000
Task 2 Well and Pump Condition		$8,000
Task 3 ASR Work Plan		$6,000
Task 4 ASR Design and Construction Management		$57,000
Task 5 ASR Pilot Testing		$60,000
Task 6 ASR Analysis and Reporting		$20,000
Task 7 ASR Operational Plan		$9,000
Subtotal		**$175,000**
Phase 2 – Construction Costs	**$250,000**	**--- $283,000**
TOTAL PHASE 2	**$425,000**	**-- $458,000**



CITY OF
BAKER CITY, OREGON
ASR FEASIBILITY STUDY
ASR PRELIMINARY SITE PLAN

FIGURE
8-1



anderson perry & associates, inc.

CITY OF
BAKER CITY, OREGON
ASR FEASIBILITY STUDY
HYDRAULIC PROFILE

FIGURE
8-2

References

U.S. Geologic Survey, 1976, Geologic Map of the Oregon Part of the Baker 1° by 2° Quadrangle.

Brooks, H.C., McIntyre, J.R., Walker, G.W., 1976, Geology of the Oregon Part of the Baker 1° by 2° Quadrangle.

Baker City 50 year climate averages, www.weatherbase.com.

Cooper, H.H., Jr., Jacob, C.E., 1946, A generalized graphical method for evaluating formation constants and summarizing well field history. Trans. American Geophysical. Union, 27, p. 526-534.

Appendix A

Appendix A: Well Logs

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this [illegible] are to be filed with the

WATER RESOURCES DEPARTMENT
SALEM, OREGON 97310
within 30 days from the date of well completion.

RECEIVED
AUG 3 1977
WATER RESOURCES DEPT
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

Baker 1148

State Well No. 9S/40E-1[illegible]
State Permit No. G-7635

(1) OWNER: #1
Name CITY OF BAKER
Address BAKER, OREGON

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED: Threaded ☐ Welded ☑
16" Diam. from +2 ft. to -20 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS: Perforated? ☐ Yes ☑ No.
ype of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☑ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☑ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
EST. 1500 GPM AIR-LIFT "
UMP TEST WILL BE MADE LATER) "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
perature of water 68 Depth artesian flow encountered NONE ft.

(9) CONSTRUCTION:
Well seal—Material used NEAT CEMENT
Well sealed from land surface to 20 ft.
Diameter of well bore to bottom of seal 20 in.
Diameter of well bore below seal 16 in.
Number of sacks of cement used in well seal 15 sacks
How was cement grout placed?

Was a drive shoe used? ☐ Yes ☑ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County BAKER Driller's well number 024-7[illegible]
NW ¼ SE ¼ Section 19 T. 9S. R. 40 E. W.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 195
Static level 177 ft. below land surface. Date 7-30
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 16" TO 500 FT. 10" [illegible]
Depth drilled 800 ft. Depth of completed well 800

Formation: Describe color, texture, grain size and structure of materia[ls] and show thickness and nature of each stratum and aquifer penetrat[ed] with at least one entry for each change of formation. Report each change [in] position of Static Water Level and indicate principal water-bearing stra[ta]

MATERIAL	From	To	SWL
SILT, SOIL	0	2	
MED HARD BROWN BASALT	2	68	
GREY BASALT	68	110	
BROWN BASALT	110	173	
BROKEN BROWN W/SOAPSTONE	173	195	W.
* SOFT, BROWN W/SOAPSTONE	195	236	<
BROWN BASALT	237	270	
* RED BASALT	270	276	W.[illegible]
BROWN BASALT	276	316	
BROKEN BROWN "	316	320	W.[illegible]
BROKEN W/SOAPSTONE	320	355	
HARD GREY BASALT	355	381	
* RED BROKEN BASALT	381	400	W.[illegible]
GREY "	400	505	
HARD GREY BROKEN	505	528	
GREY W/SOAPSTONE	528	633	
HARD GREY BASALT	633	700	
* SOFT GREY & BROKEN	700	711	W.[illegible]
SOFT GREY	711	800	

Work started 7-18 1977 Completed 7-30 19[illegible]
Date well drilling machine moved off of well 8-1 19[illegible]

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] D. Wallace (Drilling Machine Operator) Date 8-1, 19[illegible]
Drilling Machine Operator's License No. 886

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name WALLACE WELL DRLG. CO (Person, firm or corporation) (Type or print)
Address 6 SKYLINE DR. PENDLE[TON]
[Signed] D. Wallace (Water Well Contractor)
Contractor's License No. 583 Date 8-1, 19[illegible]

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

COPY

Baker 1136

OBSERVATION WELL

WATER WELL REPORT

STATE OF OREGON

U-781

State Well No. 9/40 - 18Q(1)

State Permit No. U-696

(1) OWNER:

Name Paul V. Hill

Address 1045 Riverside Drive

Reno, Nevada

(2) LOCATION OF WELL:

County Baker Owner's number, if any— "Charlie"

SW ¼ SE ¼ Section 18 T. 9S R. 40E W.M.

Bearing and distance from section or subdivision corner

568 feet North and 671 feet East of the S¼ corner, Section 18

(3) TYPE OF WORK (check):

New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐

Irrigation ☒ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐

Cable ☐ Jetted ☐

Dug ☐ Bored ☐

(6) CASING INSTALLED:

Threaded ☐ Welded ☐

12 " Diam. from 0 ft. to 575 ft. Gage

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(7) PERFORATIONS:

Perforated? ☒ Yes ☐ No

Type of perforator used

SIZE of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

(8) SCREENS:

Well screen installed ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Was well gravel packed? ☐ Yes ☐ No Size of gravel:

Gravel placed from ft. to ft.

Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.

Material used in seal—

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? Depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 29 ft. below land surface Date April 1955

Artesian pressure lbs. per square inch Date

Log Accepted by:

[Signed] Date , 19
(Owner)

(11) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☐ No If yes, by whom?

Yield: 1100 gal./min. with 166 ft. drawdown after hrs.

" 980 " 147 " "

" 750 " 119 " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m. Date

Temperature of water 60 Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG:

Diameter of well 12 inches

Depth drilled 575 ft. Depth of completed well 575 ft.

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Soil and Clay	0	38
Shale Gravel and Sand	38	60
Gravel and red clay, cemented gravel	60	180
Gravel & Shale, clay, gravel	180	286
Gravel and Clay	286	408
Granite, hard & Soft, soapstone	408	488
Clay, Soapstone, gravel	488	538
Granite	538	565
Clay, Soapstone	565	575

Work started September 7 1954 Completed April 12 1955

(13) PUMP:

Manufacturer's Name Fairbanks Morse

Type: Turbine H.P. 50

Well Driller's Statement:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Roy French
(Person, firm, or corporation) (Type or print)

Address Pendleton, Oregon

Driller's well number

[Signed]
(Well Driller)

License No. Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

RECEIVED
NOV 17 1965
STATE ENGINEER
SALEM OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

Bake 1163

State Well No. 9/40-~~20J~~ 20

State Permit No. ....

(1) OWNER:

Name ELLINGSON TIMBER Co.

Address BAKER OREGON PLYWOOD DIVISION

(2) LOCATION OF WELL:

County BAKER Driller's well number

NE ¼ SE ¼ Section 20 T. 9-S R. 40E W.M.

Bearing and distance from section or subdivision corner

330' DUE EAST OF POWDER RIVER NEXT TO STEAM ROOM. IN SAW MILL GROUNDS

(3) TYPE OF WORK (check):

Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐

andonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☑ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☑ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☑

12" Diam. from -1 ft. to 28' ft. Gage 1/4
10" Diam. from -1 ft. to 623 ft. Gage 1/4
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☑ Yes ☐ No

Type of perforator used STAR DRIVE DOWN

Size of perforations 3/16 in. by 1 in.

1540 perforations from 122 ft. to 157 ft.
660 perforations from 272 ft. to 287 ft.
2040 perforations from 538 ft. to 618 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed? ☐ Yes ☑ No

Manufacturer's Name

Model No.

Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal BENTONITE

Depth of seal 25 ft. Was a packer used? CEMENT

Diameter of well bore to bottom of seal 16 in.

Were any loose strata cemented off? ☐ Yes ☑ No Depth

Was a drive shoe used? ☑ Yes ☐ No

Was well gravel packed? ☐ Yes ☑ No Size of gravel:

Gravel placed from ft. to ft.

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 8' ft. below land surface Date NOV. 5

Artesian pressure lbs. per square inch Date

(11) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☑ Yes ☐ No If yes, by whom? DRILLER

Yield: 2000 gal./min. with 100 ft. drawdown after 7 hrs.
" " " "
" " " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m. Date

Temperature of water 60° Was a chemical analysis made? ☐ Yes ☑ No

(12) WELL LOG: Diameter of well below casing 9 3/4"

Depth drilled 650' ft. Depth of completed well 650' ft.

Formation: Describe by color, character, size of material and structure, and show thickness of aquifiers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
CLAY & BOULDERS	0	25
CLAY & GRAVEL	25	28
CLAY BROWN	28	40
GRAVEL MEDIUM WATER	40	41
CLAY BLUE	41	149
ROCK SHALE	149	155
SAND WHITE WATER	155	157
CLAY BLUE & BROWN	157	272
CLAY SANDY	272	278
CLAY CAVING SOME	278	435
CLAY SANDY	435	442
CLAY BLUE STICKY	442	480
CLAY SANDY	480	485
CLAY CAVING	485	505
PUT IN 500 - 10" CASING		
SAND WHITE	505	519
ROCK CAVING	519	558
CINDERS & CLAY	558	561
ROCK BROKEN	561	605
ROCK RED POROUS	605	621
ROCK HARD BLACK	621	645
ROCK BROKEN	645	650

Work started Sept 15 1965 Completed Nov. 9 1965

Date well drilling machine moved off of well NOV 10 1965

(13) PUMP:

Manufacturer's Name NO PUMP YET

Type: H.P.

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME HOLLOWAY DRILLING Co
(Person, firm or corporation) (Type or print)

Address ONTARIO OREGON

Drilling Machine Operator's License No. 101

[Signed] Max Holloway
(Water Well Contractor)

Contractor's License No. 16 Date Nov 15 1965

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

pg 1 of 2

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

BAKE 1145

State Well No. 9S/40E-19bb

State Permit No. ....

NEW owner said SE NW Sec 19

(1) OWNER:
Name Dave Erwin
Address Box 773 Baker, Oregon 97814

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☒ Other ☐

(5) CASING INSTALLED:
Threaded ☐ Welded ☐
8" Diam. from +1 ft. to 20 ft. Gage .250
...." Diam. from .... ft. to .... ft. Gage ....
...." Diam. from .... ft. to .... ft. Gage ....

(6) PERFORATIONS:
Perforated? ☐ Yes ☒ No.
Type of perforator used ....
Size of perforations .... in. by .... in.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name ....
Type .... Model No. ....
Diam. .... Slot size .... Set from .... ft. to .... ft.
Diam. .... Slot size .... Set from .... ft. to .... ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: 200 gal./min. with 153 ft. drawdown after 4 hrs.
" " "
" " "
Bailer test .... gal./min. with .... ft. drawdown after .... hrs.
Artesian flow .... g.p.m.
Temperature of water .... Depth artesian flow encountered .... ft.

(9) CONSTRUCTION:
Well seal—Material used See item #12
Well sealed from land surface to .... ft.
Diameter of well bore to bottom of seal .... in.
Diameter of well bore below seal .... in.
Number of sacks of cement used in well seal .... sacks
How was cement grout placed? ....

RECEIVED
AUG 9 - 1979
WATER RESOURCES DEPT
SALEM, OREGON

Was a drive shoe used? ☐ Yes ☒ No Plugs .... Size: location .... ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? .... depth of strata ....
Method of sealing strata off ....
Was well gravel packed? ☐ Yes ☒ No Size of gravel: ....
Gravel placed from .... ft. to .... ft.

(10) LOCATION OF WELL:
County BAKER Driller's well number 79E30
NW SE ¼ NW ¼ Section 19 T. 9S R. 40E W.M.
Bearing and distance from section or subdivision corner ....

(11) WATER LEVEL: Completed well.
Depth at which water was first found 441 ft.
Static level 287 ft. below land surface. Date 6-25-79
Artesian pressure .... lbs. per square inch. Date ....

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 520 ft. Depth of completed well .... ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Sandy Boulders	0	6	
Basalt Weathered	6	90	
Basalt BK Hard	90	102	
Basalt BK	102	160	
Basalt Brown	160	179	
Basalt Dark Brown	179	195	
Basalt Red	195	254	
Basalt BK	254	284	
Basalt BK Hard Streak	284	297	
Basalt BK	297	345	
Basalt Red	345	356	
Basalt BK	356	390	
Basalt BK Hard Streak	390	396	
Basalt BK	396	441	
Basalt Red	441	445	287
Basalt BK	445	520	
Temporary Sealed			
900 lbs Bentonite Mixed			
& pump around 8" Casing 18'			

Work started 6-15 1979 Completed 6-25 1979
Date well drilling machine moved off of well 6-25 1979

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Ernest Johnson (Drilling Machine Operator) Date 7-25 1979
Drilling Machine Operator's License No. 604

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Jobe Drilling Inc (Person, firm or corporation) (Type or print)
Address Prairie City, Oregon
[Signed] Bond Jobe (Water Well Contractor)
Contractor's License No. 382 Date 7-Aug 1979

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310
within 30 days from the date of well completion.

pg 2 of 2

Bake 1145

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

(Do not write above this line)

Per WWC: Range should be 42E

State Well No. 9s/42E-19b

State Permit No.

(1) OWNER:

Name Dave Erwin

Address Box 773 Baker, Oregon 97814

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☒ Other ☐

(5) CASING INSTALLED: Threaded ☐ Welded ☐

8" Diam. from +1 ft. to 20 ft. Gage .250

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☐ Yes ☒ No.

Type of perforator used

Size of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom?

Yield: 200 gal./min. with 153 ft. drawdown after 4 hrs.

" " "

" " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m.

Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal—Material used See item #12

Well sealed from land surface to ft.

Diameter of well bore to bottom of seal in.

Diameter of well bore below seal in.

Number of sacks of cement used in well seal sacks

How was cement grout placed?

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SALEM, OREGON

Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County BAKER Driller's well number 79E30

NW ¼ NW ¼ Section 19 T. 9S R. 40E W.M.

Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found 441 ft.

Static level 287 ft. below land surface. Date 6-25-79

Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6

Depth drilled 520 ft. Depth of completed well ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Sandy & Boulders	0	6	
Basalt Weathered	6	90	
Basalt BK Hard	90	102	
Basalt BK	102	160	
Basalt Brown	160	179	
Basalt Dark Brown	179	195	
Basalt Red	195	254	
Basalt BK	254	284	
Basalt BK Hard Streak	284	297	
Basalt BK	297	345	
Basalt Red	345	356	
Basalt BK	356	390	
Basalt BK Hard Streak	390	396	
Basalt BK	396	441	
Basalt Red	441	445	287
Basalt BK	445	520	
Temporary Sealed			
900 lb bentonite Mixed			
& pump around 8" Casing			

Work started 6-15 1979 Completed 6-25 1979

Date well drilling machine moved off of well 6-25 1979

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Ernest Johnson (Drilling Machine Operator) Date 7-25, 1979

Drilling Machine Operator's License No. 604

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Name Jake Drilling Inc (Person, firm or corporation) (Type or print)

Address Prairie City, Oregon

[Signed] Bernard Jake (Water Well Contractor)

Contractor's License No. 382 Date 8-Aug, 1979

(USE ADDITIONAL SHEETS IF NECESSARY)

BAKE 3197

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OCT 13 1995

WATER RESOURCES DEPT.
SALEM, OREGON

95/40E/19

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

(START CARD) # 56240

Instructions for completing this report are on the last page of this form.

(1) OWNER: Well Number

Name Mike Voboril
Address 900 Story Ln.
City Baker City State OR Zip 97814

(2) TYPE OF WORK

[X] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:

[X] Rotary Air [ ] Rotary Mud [ ] Cable [ ] Auger
[ ] Other

(4) PROPOSED USE:

[X] Domestic [ ] Community [ ] Industrial [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [ ] Other

(5) BORE HOLE CONSTRUCTION:

Special Construction approval [ ] Yes [X] No Depth of Completed Well 498 ft.
Explosives used [ ] Yes [X] No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
10	0	20	Holeplug	0	20	13 bags
8	20	498				

How was seal placed: Method [ ] A [ ] B [ ] C [ ] D [ ] E
[X] Other Poured into water
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+2	498	.250	[X]	[ ]	[X]	[ ]
Liner:								

Final location of shoe(s) 5 1/2" shoe @ 498'

(7) PERFORATIONS/SCREENS:

[X] Perforations Method downhole
[ ] Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
435	495'	1/8x1"	600			[X]	[ ]

(8) WELL TESTS: Minimum testing time is 1 hour

[ ] Pump [ ] Bailer [X] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
22		480	1 hr.

Temperature of water 57°F Depth Artesian Flow Found
Was a water analysis done? [ ] Yes By whom
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other
Depth of strata:

(9) LOCATION OF WELL by legal description:

County Baker Latitude Longitude
Township 9S N or S Range 40E E or W. WM.
Section 19 SW 1/4 SE 1/4
Tax Lot 5005 Lot Block Subdivision
Street Address of Well (or nearest address) Same

(10) STATIC WATER LEVEL:

190 ft. below land surface. Date 9/18/9
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 150'±

From	To	Estimated Flow Rate	SWL
150'±		1	11[illegible]
255'		5	14[illegible]
450'	498'	~~30~~ 20	19[illegible]

(12) WELL LOG:

Ground Elevation

Material	From	To	SWL
Clay w/broken rock	0	3	
Broken rock	3	15	
Fractured rock	15	25	
Broken/Fractured rock	25	80	
Hard rock w/a few fractures	80	90	
Broken/Fractured rock	90	370	1[illegible]
Hard rock w/ fractures	370	376	19[illegible]
Broken/Fractured rock	376	450	19[illegible]
Hard rock w/fractures	450	457	19[illegible]
Broken/Fractured rock	457	498	19[illegible]

Date started 9/8/95 Completed 9/18/95

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number 1312
Signed [signature] Date 9/18/95

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 494
Signed [signature] Date 9-25-

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BAKE 1935

JAN 19 1993
WATER RESOURCES DEPT.
SALEM, OREGON

9S/40E/19

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

(START CARD) # 30067

(1) OWNER: Well Number:
Name Alpine Timber Corp.
Address PO Box 228
City Baker City State Or Zip 97814

(2) TYPE OF WORK:
☐ New Well ☐ Deepen ☒ Recondition ☐ Abandon

(3) DRILL METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval Yes ☐ No ☒ Depth of Completed Well 440 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
12	0	32	Cement	0	32	24
8	32	465				

How was seal placed: Method ☐ A ☐ B ☐ C ☒ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	8	+2	32	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	7	15	450	.125	☒	☐	☒	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☒ Perforations Method Torch
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
450	410	1/8	50	7		☐	☒
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
75		420	1 hr.

Temperature of water 58 Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County Baker Latitude Longitude
Township 9S N or S. Range 40 E E or W. WM.
Section 19 SE ¼ NW ¼
Tax Lot Lot Block Subdivision
Street Address of Well (or nearest address) 6770 Greenridge
Baker City Or 97814

(10) STATIC WATER LEVEL:
300 ft. below land surface. Date 10-12
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found

From	To	Estimated Flow Rate	

(12) WELL LOG: Ground elevation

Material	From	To	
Soil + Clay + Rocks	0	20	
Rock Brown	20	135	
Broken Rock	135	200	
Rock	200	410	
Rock Blue Carry	410	465	

Date started 10-5-92 Completed 10-12-92

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to my knowledge and belief.
Signed [signature] WWC Number 49
Date 10-13-92

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 49
Signed [signature] Date 10-13-92

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(Bake 1780)

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JUL 10 1989

WATER RESOURCES DEPT
SALEM, OREGON

9S/40E/19

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

(START CARD) # 7296

(1) OWNER: Well Number:
Name Robert P Ellingson - III
Address P.O. Box 866
City Baker State ORE Zip 97814

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☒ Irrigation
☐ Thermal ☐ Injection ☐ Other Test well

(5) BORE HOLE CONSTRUCTION:
Special Construction approval Yes ☐ No ☒ Depth of Completed Well 360 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
10	0	19	Cement	0	19	8
6	19	362				

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+1	19	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) NO-19

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
50	122	362	1 hr.

Temperature of water 52 Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☒ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata: 265

(9) LOCATION OF WELL by legal description:
County Baker Latitude Longitude
Township 9S N or S Range 40 E or W, WM
Section 19 NE ¼ SE ¼
Tax Lot 5004 Lot Block Subdivision
Street Address of Well (or nearest address) 3975 Indiana ...

(10) STATIC WATER LEVEL:
240 ft. below land surface. Date 7-12
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 265

From	To	Estimated Flow Rate	S
265	267	2	2
285	292	48	2

(12) WELL LOG: Ground elevation

Material	From	To	S
Clay + Rock	0	5	
Basalt + Clay	5	75	
Basalt -	75	265	
Scori - W-B	265	267	2
Basalt	267	285	
Gravel - Med - W-B	285	292	2
Basalt	292	360	
Granite	360	362	

Date started 6-27-89 Completed 7-12-89

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration abandonment of this well is in compliance with Oregon well construc standards. Materials used and information reported above are true to my knowledge and belief.

WWC Number
Signed Date

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonm work performed on this well during the construction dates reported above work performed during this time is in compliance with Oregon construction standards. This report is true to the best of my knowledge belief.

WWC Number 591
Signed Kelsey Dennis Date 7-12-89

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NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT,
SALEM, OREGON 97310
within 30 days from the date of well completion.

RECEIVED
SEP 22 1977
WATER RESOURCES DEPT
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

NC

Baker 1153

State Well No. 9S/40E-20b
State Permit No.

(1) OWNER:
Name Baker Municipal Golf Course
Address Baker, Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☒ Test Well ☐ Other ☐

CASING INSTALLED: Threaded ☐ Welded ☒
" Diam. from 2¼ ft. to 349 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS: Perforated? ☒ Yes ☐ No.
ype of perforator used Factory Mill
Size of perforations 1/8 in. by 2 3/4 in.
1530 perforations from 249 ft. to 349 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: 320 gal./min. with 141 ft. drawdown after 3 hrs.
Compressor " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
perature of water 48 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement Grout
Well sealed from land surface to 20 ft.
Diameter of well bore to bottom of seal 15 in.
Diameter of well bore below seal 12 in.
Number of sacks of cement used in well seal 14 sacks
How was cement grout placed?
Pumped Thru Drill pipe

Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
id any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel 3/8 pea
Gravel placed from 20 ft. to 349 ft.

(10) LOCATION OF WELL:
County Baker Driller's well number
SE ¼ NW ¼ Section 20 T. 9S R. 40E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 248 ft.
Static level 85 ft. below land surface. Date 9-15
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 0
Depth drilled 349 ft. Depth of completed well 349 ft.
Formation: Describe color, texture, grain size and structure of materials and show thickness and nature of each stratum and aquifer penetrated with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Top Soil	0	1	
Fractured Basalt	1	12	
Sand Stone Dark Br with Br. Clay	12	55	
Sand Stone Red	55	70	
Sand Stone Blk	70	248	
Basalt Fractured	248	288	85
Basalt with Streaks Clay Blue white	288	314	↑
Basalt Red Cap	314	321	
Basalt Fractured Streaks of Clay Blue	321	328	
Basalt Red Cap	328	334	↓
Basalt Blk	334	349	85

Work started 9-10 1977 Completed 9-15 1977
Date well drilling machine moved off of well 9-15 1977

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Ernest Hinson (Drilling Machine Operator) Date 9-18, 1977
Drilling Machine Operator's License No. 604

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Northwest Drilling (Person, firm or corporation) (Type or print)
Address Prairie City, Oregon
[Signed] Bond Jole (Water Well Contractor)
Contractor's License No. 577 Date 9-19, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

8

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

BAKE 2022

APR 28 1994

WATER RESOURCES DEPT. SALEM, OREGON

98/40E/9a

(START CARD) #52830

DRAFT

(1) OWNER: Well Number:

Name Steve Bagabi
Address 1205 17th St
City Baker City State ORE Zip 97814

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval Yes ☐ No ☒ Depth of Completed Well 330 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
10	0	19	Bentonite	0	19	750
6	19	330				

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other Dry Bentonite
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+2	259	.250	☒	☐	☒	☐
Liner:	4 1/2	250	330	SDR 21	☐	☒	☐	☐

Final location of shoe(s) 259

(7) PERFORATIONS/SCREENS:
☒ Perforations Method Slotted Pipe
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
290	330	1/8	69	1/4	4 1/2	☐	☒

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
25	280	330	1 hr.

Temperature of water 54 Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☒ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata: 73-100

(9) LOCATION OF WELL by legal description:
County Baker Latitude Longitude
Township 9 N or S Range 40 E or W, WM
Section 9 SE 1/4 NE 1/4
Tax Lot 100 Lot Block Subdivision
Street Address of Well (or nearest address) 1205 17th St

(10) STATIC WATER LEVEL:
50 ft. below land surface. Date 4-8-9
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 73

From	To	Estimated Flow Rate
73	100	2
117	119	2
195	210	3
325	330	25

(12) WELL LOG: Ground elevation

Material	From	To
Top Soil	0	3
Clay yellow	3	23
" Red	23	46
" yellow	46	73
Sand & Gravel - W - B	73	100
Clay Blue	100	117
Sand Fine - W - B	117	119
Clay Blue	119	195
Sand - W - B	195	210
Clay Blue	210	325
Sand - W - B	325	330

Date started 3-29-94 Completed 4-8-94

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to my knowledge and belief.

WWC Number
Signed Date

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 59
Signed [signature] Date 4-8-9

ORIGINAL & FIRST COPY - WATER RESOURCES DEPARTMENT SECOND COPY - CONSTRUCTOR THIRD COPY - CUSTOMER 980

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

RECEIVED
JUL 3 1972
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

BAKE 1140

State Well No. 9S/40-19

State Permit No.

(1) OWNER:
Name Park Taylor
Address 1241 4th St.; Baker, Ore.

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐.
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:
Threaded ☐ Welded ☐
6" Diam. from 11 ft. to 197.6 ft. Gage 250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☒ Yes ☐ No.
Type of perforator used Mel's Perforator
Size of perforations 2.5 in. by 5/16 in.
88 perforations from 100 ft. to 122 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.
Static level 10 ft. below land surface Date 2/16/72
Artesian pressure lbs. per square inch Date

(9) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Bailer test 4.5 gal./min. with 120 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 50° Was a chemical analysis made? ☐ Yes ☒ No

(10) CONSTRUCTION:
Well seal—Material used Benzonite
Depth of seal 20 ft.
Diameter of well bore to bottom of seal 9 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Baker Driller's well number
¼ ¼ Section 19 T. 9 S. R. 40 E. W.M.
Bearing and distance from section or subdivision corner

(12) WELL LOG:
Diameter of well below casing 5.75"
Depth drilled 305 ft. Depth of completed well 305 ft.
Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Top soil	0	2	
Broken rock; clay	2	10	
Broken rock; clay	10	15	
Hard yellow clay	15	22	
Broken rock; clay	22	26	
Broken rock; clay; sand	26	30	
Broken rock; clay; sand	30	35	
Hard brown rock	35	37	
Clay	37	40	
Hard rock	40	43	
Hard clay; Broken rock	43	50	
Hard Clay; Broken rock	50	68	
Hard blue shale	68	80	
Hard blue shale	80	88	
Brown rock; clay	88	90	
Brown rock; clay	90	100	
Brown rock; clay	100	105	1.2
~~105~~ Brown rock; clay	105	120	
Brown rock; clay; gravel	120	121	10'
Brown rock; clay; gravel	121	126	
Brown rock; clay; gravel	126	131	34'
(continued on extra page)			

Work started Jan. 20, 1972 Completed March 30, 197
Date well drilling machine moved off of well May 15, 197

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Wilbur C. Skinner (Drilling Machine Operator) Date June 30, 197
Drilling Machine Operator's License No. 20

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME Wilbur C. Skinner (Person, firm or corporation) (Type or print)
Address 305 2nd St.; Baker, Ore.
[Signed] Wilbur C Skinner (Water Well Contractor)
Contractor's License No. 68 Date 19

WATER WELL REPORT
STATE OF OREGON

Baker 1142

RECEIVED
FEB 16 1982
WATER RESOURCES DEPT
SAL....., OREGON

State Well No. 9/40-19 aa
State Permit No.
C

(1) OWNER:
Name Serita Rasmussen
Address 2350 C St. Apt. B
City Baker State Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary Air ☒ Driven ☐
Rotary Mud ☐ Dug ☐
☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐
Thermal: Withdrawal ☐ Reinjection ☐

CASING INSTALLED: Steel ☒ Plastic ☐ Threaded ☐ Welded ☒
6 " Diam. from +1 ft. to 19 ft. Gauge .250
" Diam. from ft. to ft. Gauge

LINER INSTALLED:
4 " Diam. from -1 ft. to 329 ft. Gauge 1120

(6) PERFORATIONS: Perforated? ☐ Yes ☒ No
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot Size Set from ft. to ft.
Diam. Slot Size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
d: gal./min. with ft. drawdown after hrs.
" " " "
Air test 18 gal./min. with drill stem at 330 ft. 1 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
sian flow g.p.m.
perature of water 53 Depth artesian flow encountered ft.

(9) CONSTRUCTION: Special standards: Yes ☐ No ☒
Well seal—Material used Cement
Well sealed from land surface to 19 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 12 sacks
How was cement grout placed? GROUT PUMP

Was pump installed? NO Type HP Depth ft.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Baker Driller's well number [redacted]
NE ¼ NE ¼ Section 19 T. 9 R. 40 W
Tax Lot # Lot Blk Subdivision
Address at well location:

(11) WATER LEVEL: Completed well.
Depth at which water was first found 320
Static level 290 ft. below land surface. Date 9-8
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6
Depth drilled 345 ft. Depth of completed well 330
Formation: Describe color, texture, grain size and structure of materials; and sh thickness and nature of each stratum and aquifer penetrated, with at least one en for each change of formation. Report each change in position of Static Water Le and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
BASALT - Red	0	325	
BASALT - SCORIA W-B	325	345	29

Work started 8-28 1981 Completed 9-8-[redacted] 198
Date well drilling machine moved off of well 9-8 198

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials use and information reported above are true to my best knowledge and belief
[Signed] Kelsey Dennis (Drilling Machine Operator) Date 9-8, 198
Drilling Machine Operator's License No. 950

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true t the best of my knowledge and belief.
Name K. Dennis (Person, firm or corporation) (Type or print)
Address Sumpter Stg. Bx 30-D
[Signed] Kelsey Dennis (Water Well Contractor)
Contractor's License No. 591 Date 9-8, 198

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the

WATER RESOURCES DEPARTMENT,
SALEM, OREGON 97310
within 30 days from the date of well completion.

SP*12658-69

Appendix B

Appendix B: Aquifer Test Analysis and Results

Appendix B

Aquifer Test Analysis and Results

Step Drawdown Test Analysis

The step drawdown test consisted of four 1-hour consecutive steps with discharge rates of 500 gpm, 1000 gpm, 1500 gpm and 2000 gpm, respectively. The drawdown data for each step are presented in Figure B-1.

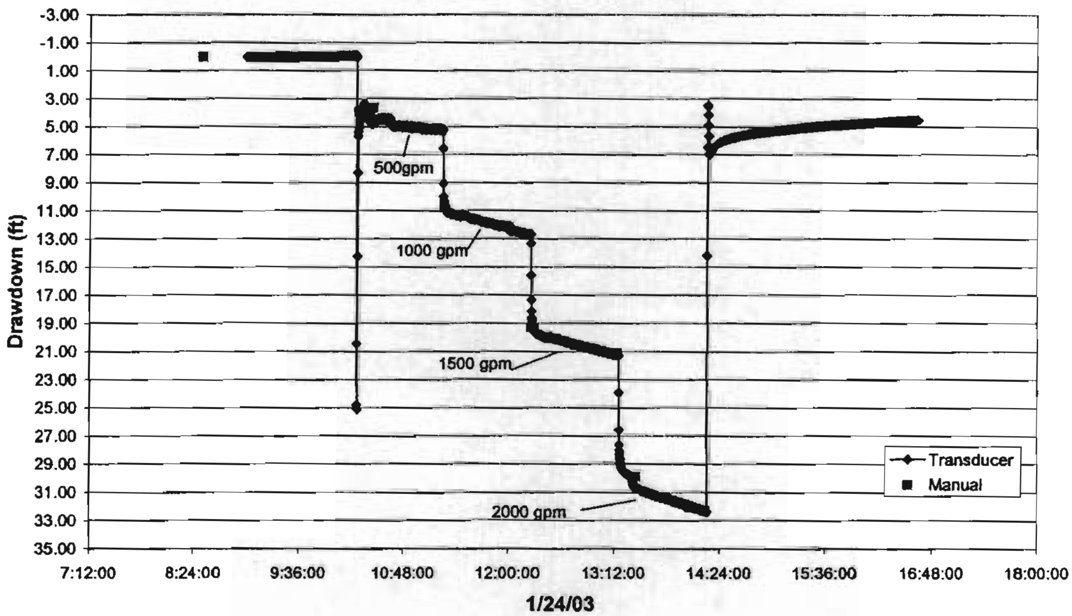

Figure B-1

Step Drawdown Test Hydrograph
Baker City ASR Reservoir Well Study

The Hantush-Bierschenk (1964) method was used to analyze the data in order to pick a pumping rate for the constant rate test and to assess head losses in the well due to laminar flow. The governing equation for evaluating the step drawdown test data is:

$$s = BQ + CQ^2$$

where:

s is the drawdown
Q is the pumping rate
B is the laminar flow loss constant
C is the turbulent flow loss constant

Solving for laminar flow losses as a percentage of total head loss the equation becomes:

$$Lp = \frac{BQ}{BQ + CQ^2}$$

The data analysis is summarized in Table B-1 and figure B-2.

Table B-1

Step Drawdown Test Analysis
Baker City ASR Reservoir Well Project

Step	S (60 min)	Q (gpm)	S/Q	
1	5.23	500	0.01034	Slope (C)= 4E-6
2	7.5	1000	0.01267	Y Intercept (B)= 0.0086
3	8.38	1500	0.01403	Q = 1500
4	11.17	2000	0.01611	Laminar Flow Losses = 58.9

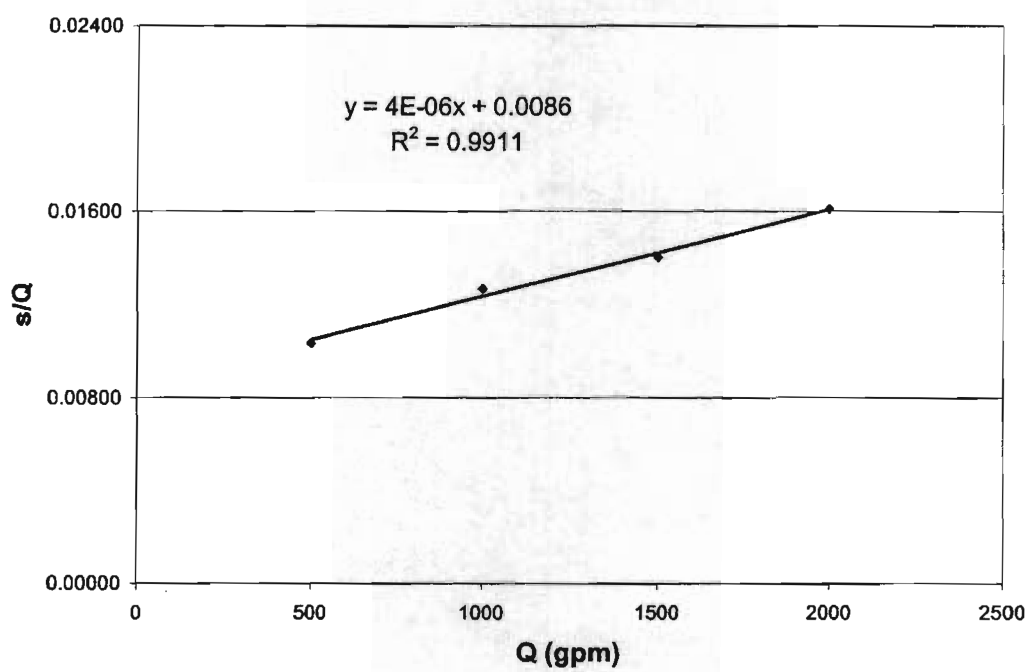

Figure B-2

Hantush Bierschenk Analysis
Baker City ASR Reservoir Well

Constant Rate Test Analysis

The constant rate aquifer test included pumping the Reservoir Well at a rate of 1500 gpm for approximately 120 hours. Water levels in the Reservoir Well were monitored during pumping and also for approximately 216 hours during recovery. Water levels in the Paul Hill Well and Golf Course Well also were measured during the pumping phase of the test. Figure B-3 shows a hydrograph of water level changes in the Reservoir well during the pumping and recovery phases of the test. Figure B-4 shows a hydrograph of water levels in the Paul Hill Well during the pumping phase of the test. No change in water level was observed in the Golf Course Well and so no hydrograph was prepared.

The test data for the Reservoir Well were plotted on semi-log graphs and assessed for potential boundary conditions. The aquifer transmissivity was calculated from the early time pumping phase water level data and from the recovery data using the Cooper-Jacob (1946) method. The Cooper-Jacob equation for calculating transmissivity using English units is:

$$T = \frac{264 \cdot Q}{\Delta s}$$

where:

T = transmissivity of the aquifer in gallons per day per foot of aquifer thickness

Q = pumping rate in gallons per minute (gpm)

Δs = the change in drawdown over one log cycle of t (time in minutes) on a plot of drawdown versus log time (minutes since the beginning of pumping)

Using projected late time pumping phase data shown on Figure B-5 to calculate the aquifer transmissivity gives:

$$T_1 = \frac{264 \cdot 1500 \text{ gpm}}{140 \text{ feet}}$$

$$T_1 = \sim 2800 \text{ gpd/ft}$$

The equation is the same for calculating transmissivity from recovery data except Δs is taken as the drawdown over one log cycle of time plotted as t/t' where t is the elapsed time in minutes since the beginning of pumping and t' is the time since pumping stopped. If the projected late time recovery data (t/t' < 10) are used to calculate transmissivity (Figure B-6), the results are as follows:

$$T_2 = \frac{264 \cdot 1500 \text{ gpm}}{54 \text{ feet}}$$

$$T_2 = \sim 7300 \text{ gpd/ft}$$

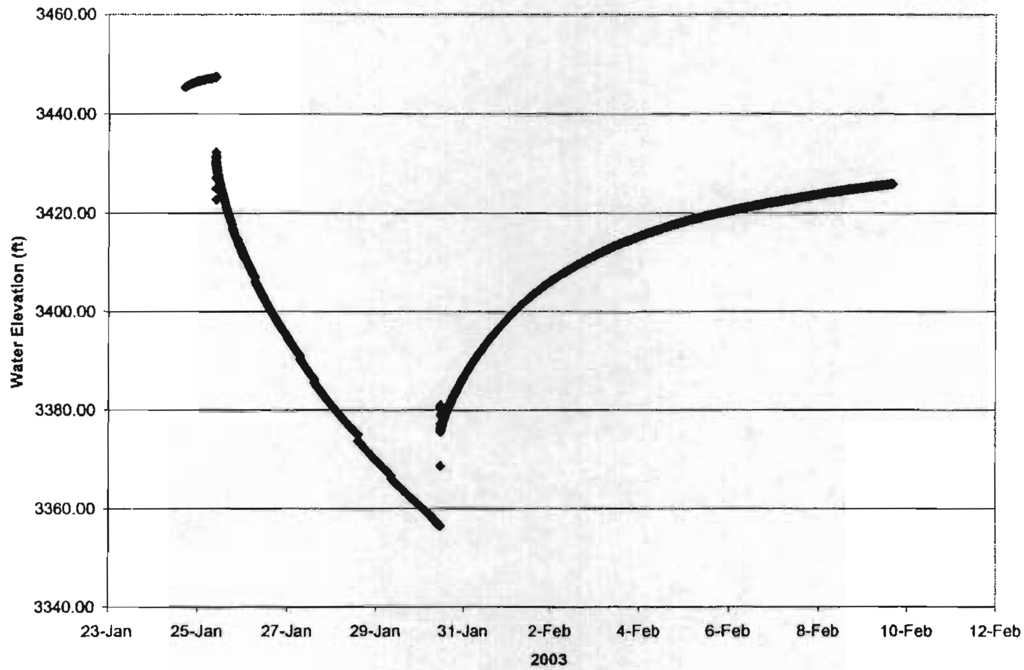

Figure B-3
Reservoir Well Hydrograph
Constant Rate Aquifer Test
Baker City ASR Reservoir Well Study

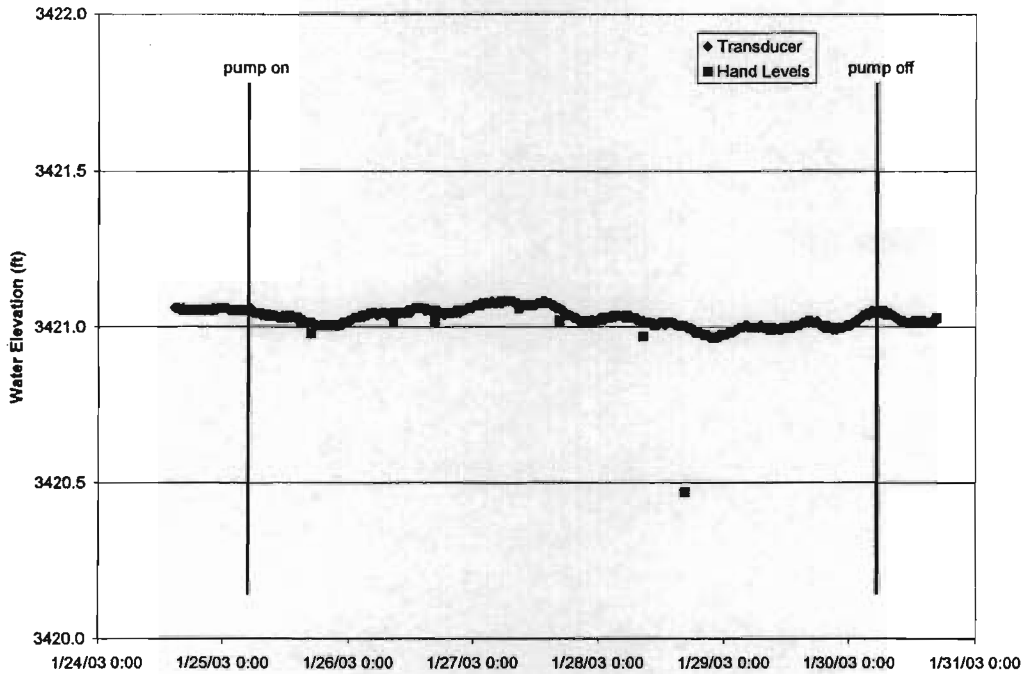

Figure B-4
Hydrograph of Paul Hill Well
Constant Rate Aquifer Test
Baker City ASR Reservoir Well Study

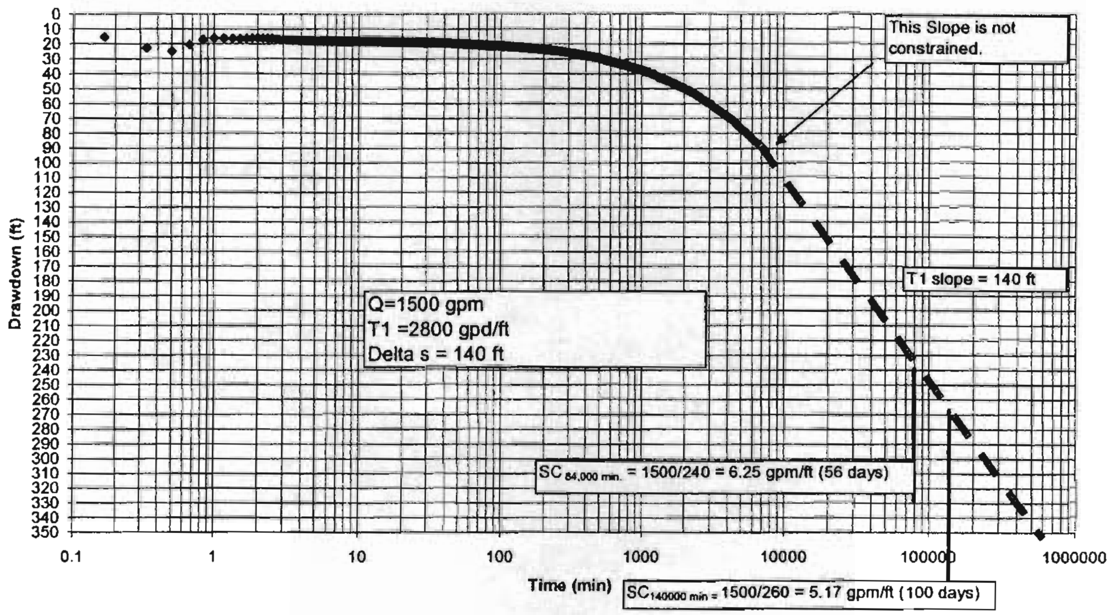

Figure B-5
Pumping Phase Data Analysis - Reservoir Well
Constant Rate Aquifer Test
Baker City ASR Reservoir Well Study

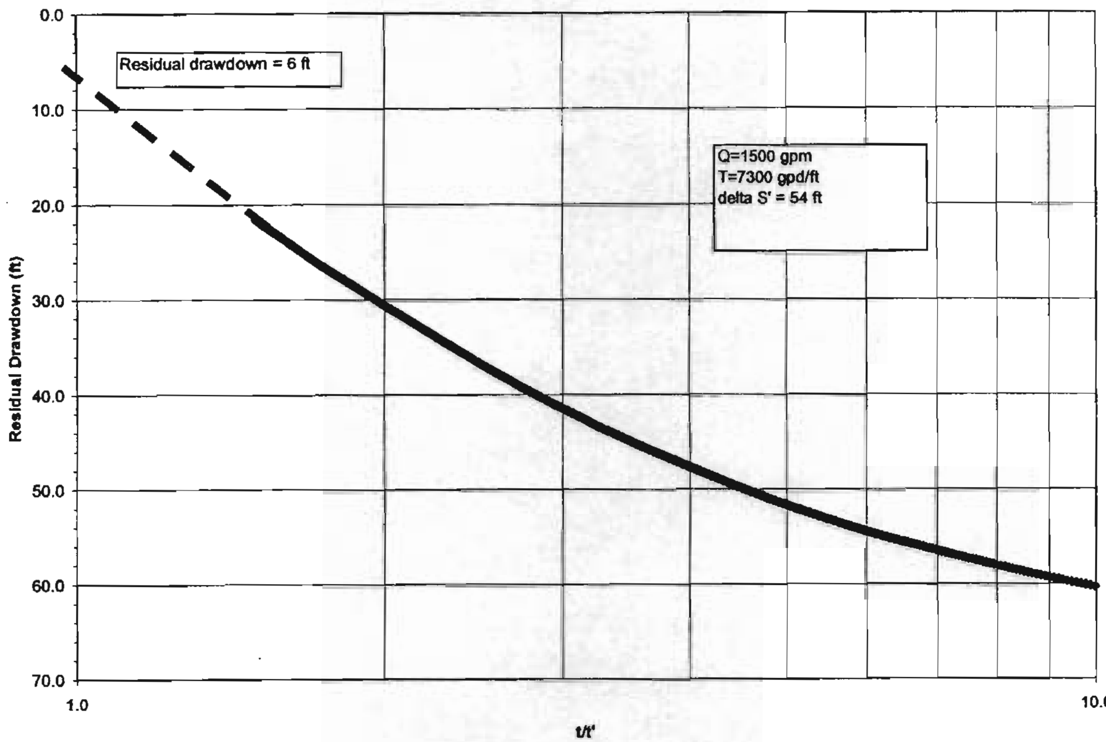

Figure B-6
Reservoir Well Recovery Data Analysis
Constant Rate Aquifer Test

Water Level Measurements

Project Baker City ASR Project Page 1 of 10
Well Id Reservoir Well

Date 1/23/03

Pump Test Id Step Test
Dist. From pumping well Ø ft Well Depth ____ ft
Start of Pump Test 10:15 AM Screen Interval ____
Stop of Pump Test ____
Initial Water Level ____
Final Water Level ____
Reference Point Description Top of 1.5" PVC access tube. Stickup 2.97' above floor
Remarks
100 PSI transducer set at ~ 225' below static (vented)
INW 1522 logger
aqua 4 software

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
1/23/03	3:43p	JB	248.30					Ø	
1/23	6:45p	JB	248.12						
1/24	08:30	JB	247.94		file reserw1.DAT				
1/24	10:15							500	
	10:17		251.85					↓	
	10:20		251.56		file: restep1.dat				
	10:25		251.73						
	10:37		252.38					↓	
	10:49		252.94					500	
	10:58		253.05					↓	
	11:14		253.17					↓	
	11:15							1000	
	11:16		258.74					↓	
	12:00		260.10					↓	
	12:11		260.63					1000	
	12:14		260.67					1000	
	12:15							1500	
	12:16		267.20					↓	
	12:45		268.48						
	13:14		269.05					↓	
	13:15							2000	
	13:20								pH 7.97
									T=15.5
									EC=376

µS
↑
not calculated

Water Level Measurements

Project Baker City ASR Project

Well Id Reservoir Well

Page 2 of 10

Date 1/24/03

Pump Test Id Step Test

Dist. From pumping well ____ ft

Well Depth ____ ft

Start of Pump Test ____

Screen Interval ____

Stop of Pump Test ____

Initial Water Level ____

Final Water Level ____

Reference Point Description ____

Remarks ____

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
1/24	13:27		277.81					2000	
	14:04		279.97						
	14:14		280.22						
	14:15							Ø	
	16:05		252.63						

Water Level Measurements

Project BAKER CITY ASR
Well Id RESERVOIR WELL

Date 1/25/03

Pump Test Id CONSTANT RATE
Dist. From pumping well ∅ ft
Start of Pump Test
Stop of Pump Test
Initial Water Level
Final Water Level
Reference Point Description TOP OF 1.5" PVC ACCESS TUBE, 2.97' ABOVE FLOOR
Remarks 100 PSI TRANSDUCER SET AT ~ 225' BELOW STATIC (VENTED)
INW 1522 LOGGER
AQUA4 SOFTWARE
file rescons.DAT, RESCONS1.DAT

Well Depth ft
Screen Interval

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
1/25/03	8:02	JLZ	250.36				092954	0	
	8:51		250.27						
					file: rescons.DAT				
	9:20		250.17				92954	0	
	9:21:00		266.13					1500	
	9:21:30		266.50						
	9:22:00		266.23						
	9:22:30		267.42						
	9:23:00		267.58						
	9:23:30		267.65						
	9:24:00		267.74						
	9:24:30		267.84						
	9:25:00		267.86						
	9:25:30		267.92						
	9:26:00		267.98						
	9:31		268.21			9:32	092972	1500	
	9:36		268.52						
	9:41		268.67						
	9:46		268.87						
	9:51		269.04						
	9:56		269.19						
	10:01		269.30						
	10:06		269.73						
	10:11		269.83						
	10:16		269.95						
	10:21	JLZ	270.10				093048	1500	

Water Level Measurements

Project
Well Id Res Well

Date

Pump Test Id
Dist. From pumping well ft
Well Depth ft
Start of Pump Test
Screen Interval
Stop of Pump Test
Initial Water Level
Final Water Level
Reference Point Description
Remarks

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
1-28-03	20:21		326.37						
	20:23								EC 313
									Temp 57.5
									PH 8.15
1-29-03	6:21		330.17						
	6:22						101346	1500	
	6:25								EC 324
									Temp 59.6
									PH 8.09
	8:21		330.90						
	8:22						101523	1500	
	10:21		332.23				101706	1500	
	10:22								
	12:21		332.99						
	12:22						101889	1500	EC 315
									Temp 58.5
									PH 8.01
	14:21		333.74						
	14:22						102071	1500	
	16:21		334.41						
	16:22						102257	1500	PSI 25
	18:21		335.18						
	18:22						102434	1500	PSI 25
	20:21		335.83						
	20:22						102624	1500	PSI 25

Water Level Measurements

Project____________________ Page 8 of 10

Well Id Reservoir Well

Date________________

Pump Test Id________________

Dist. From pumping well________________ft

Well Depth________________ft

Start of Pump Test________________

Screen Interval________________

Stop of Pump Test________________

Initial Water Level________________

Final Water Level________________

Reference Point Description________________

Remarks________________

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
1-29-03	20:24								EC 314
									Temp 58
									PH 8.05
1-30-03	6:20						103505	1500	PSI 21
	6:21		338.94						
	6:25								EC 323
									Temp 60.2
									PH 8.00
	9:22		340.32						
	9:23						103779	1500	
	10:18						103862	1500	
	10:21		340.87						

Water Level Measurements

Project BAKER CITY ASR
Well Id RESERVOIR Well

Date

Pump Test Id CONSTANT RATE RECHARGE.
Dist. From pumping well ft
Start of Pump Test
Stop of Pump Test
Initial Water Level
Final Water Level
Reference Point Description
Remarks

Well Depth ft
Screen Interval

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
1/30/03	11:14		341.15				103946	1500	
	11:15:00		316.77					0	
	15:30		318.19						
	16:00		318.19						
	16:30		321.80						
	17:00		321.89						
	17:30		321.89						
	18:00		321.92						
	18:30		321.94						
	19:00		321.91						
	19:30		321.86						
	11:20:00		321.83						
	11:25:00		321.55						
	11:30		321.39						
	11:35		321.22						
	11:40		321.12						
	11:45		320.97						
	11:50		320.83						
	11:55		320.73						
	12:00		320.64						
	12:05		320.52						
	12:10		320.41						
	12:15		320.29						
	12:35		319.99						
	12:55		319.59						

Water Level Measurements

Project ____________ Page 10 of 10

Well Id Reservoir Well

Pump Test Id CONSTANT RATE RECHARGE Date ____________

Dist. From pumping well ____________ ft Well Depth ____________ ft

Start of Pump Test ____________ Screen Interval ____________

Stop of Pump Test ____________

Initial Water Level ____________

Final Water Level ____________

Reference Point Description ____________

Remarks ____________

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate				Field Parameters
					Date	Time	Flow Meter Reading	Discharge Rate gpm	
1/30/03	1:15		319.20						
	2:15		318.16						
	3:15		317.30						
	4:15		316.38						
	6:15		314.87						
	8:15		313.40						
1-31-03	6:15		307.18						
	8:15		306.10						
	10:10		305.15						
	12:15		304.10						
	14:15		303.16						
	16:13		302.27						
	18:35		301.33						
	20:15		300.56						
2-1-03	6:17		296.81						
	8:13		296.20						
	10:10		295.58						
	12:16		294.89						
	14:15		294.25						
	16:16		293.72						
	18:15		293.15						
	20:12		292.59						
2-2-03	6:22		290.02						
	8:19		289.58						
	10:19		289.09						
	12:27		288.61						

Water Level Measurements

Project________________ Page____of______

Well Id Res. Well Recharge

Date________________

Pump Test Id______________

Dist. From pumping well______________ft

Well Depth________________ft

Start of Pump Test______________

Screen Interval______________

Stop of Pump Test______________

Initial Water Level______________

Final Water Level______________

Reference Point Description______________

Remarks______________

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	Discharge Rate Time	Flow Meter Reading	Discharge Rate gpm	Field Parameters
2-2-03	1444		288.21						
	16:19		287.84						
	18:10		287.45						
	20:06		287.05						
2-3-03	6:23		285.08						
	8:12		284.80						
	10:15		284.46						
	12:12		284.09						
	14:20		283.99						
	16:21		283.43						
	18:15		283.22						
	20:15		282.96						
2-4-03	6:15		281.63						
	8:13		281.34						
	12:16		280.84						
2-5-03	7:14		278.82						
2-6-03	8:30		276.67						
2-7-03	8:08		274.97						

Water Level Measurements

Project BAKER CITY ASR

Well Id PAUL HILL WELL

Date ____________

Pump Test Id CONSTANT RATE

Dist. From pumping well ____________ ft

Start of Pump Test ____________

Stop of Pump Test ____________

Initial Water Level ____________

Final Water Level ____________

Reference Point Description ____________

Well Depth ____________ ft

Screen Interval ____________

Remarks 100' PSI TRANSDUCER AT ~60' below STATIC (VENTED)

file : P.

BRP = below reference point

Date	Time	Initials	Depth to Water ft BRP	Drawdown ft	Discharge Rate Date	 Time	 Flow Meter Reading	 Discharge Rate gpm	 Field Parameters
1/25/03	8:33	JLZ	43.18						
	11:34	JLZ	43.19						
	14:40	JJ	43.20						
1-25-03	16:37	JJ	43.24						
1-26-03	8:35	JJ	43.20						
1-26-03	16:31	JJ	43.20						
1-27-03	8:41	JJ	43.16						
1-27-03	16:32	JJ	43.20						
1-28-03	8:31	JJ	43.25						
1-28-03	16:31	JJ	43.75						
1-29-03	8:47	JJ	43.23						
1-30-03	7:18	JJ	43.18						
1-30-03	16:32	JJ	43.19						
1-31-03	9:11	JJ	43.18						
1-31-03	4:27	JJ	43.18						
2-1-03	8:23	JJ	43.18						
2-1-03	16:30	JJ	43.19						

Appendix C

Appendix C: Laboratory Data Sheets

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

BAKER CITY OF

P.O. BOX 650
BAKER CITY OR 97814

Collection Date	1/29/2003	**Received Date**	1/30/2003	**Location**	
Collection Time	12:00 PM	**Received Time**	8:10 AM	SURFACE	

Sample #	Test / Method Code	Results in mg/L	Date Analyzed	Analyst
309841	CHLORIDE	3	1/31/2002	RB
309842	IRON	ND	2/12/2003	RB
309843	DISSOLVED IRON	ND	2/12/2003	RB
309844	MANGANESE	ND	3/11/2003	RB
309845	DISSOLVED MANGANESE	ND	3/11/2003	RB
309846	TDS	42	1/31/2003	RB
309847	ZINC	ND	1/31/2003	RB
309848	ALKALINITY	~~246~~ 25	1/29/2003	EB
309849	CARBONATE	<1	1/29/2003	EB
3098410	BICARBONATE	~~246~~ ~~24.6~~ 25	1/29/2003	EB

correction from MVL 5/6/03 JK

Signature [signature]

Report Date: Wednesday, March 26, 2003

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

CHUCK EVERSON
BAKER CITY OF

P.O. BOX 650
BAKER CITY OR 97814

Collection Date	12/18/2002	Received Date	12/18/2002	Location
Collection Time	7:30 AM	Received Time	6:00 PM	RESERVOIR A.S.R

Sample #	Test / Method Code	Results in mg/L	Date Analyzed	Analyst
302471	BICARBONATE	38	12/19/2002	EB
302472	CARBONATE	<1	12/19/2002	EB
302473	ALKALINITY	38	12/19/2002	EB
302474	CALCIUM	18.6	1/24/2003	RB
302475	CHLORIDE	2	12/20/2002	RB
302476	HARDNESS	86	12/20/2002	RB
302477	MAGNESIUM	5.72	1/28/2003	RB
302478	NITRATE/N SM4500D	0.19	12/19/2002	JK
302479	NITRITE/N SM4500E	<0.002	12/19/2002	JK
3024710	NITRATE/N + NITRITE/N	0.19	12/19/2002	JK

Signature

Report Date: Friday, January 31, 2003

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

3024711	POTASSIUM	0.7	1/29/2003	RB
3024712	SILICA	16.8	12/24/2002	JH
3024713	SODIUM	5.03	1/22/2003	RB
3024714	SULFATE	11	12/20/2002	RB
3024715	TDS	79	12/20/2002	RB
3024716	TOC	0.71	12/26/2002	MDM
3024717	TSS EPA160.2	<1	12/19/2002	EB
3024718	ALUMINIUM	<0.10	12/30/2002	JH
3024719	ARSENIC	<0.005	1/8/2003	JMR
3024720	DISSOLVED IRON	<0.1	1/16/2003	RB
3024721	TOTAL IRON	<0.1	1/16/2003	RB
3024722	DISSOLVED MANGANESE	<0.05	1/14/2003	RB
3024723	TOTAL MANGANESE	<0.05	1/14/2003	RB
3024724	FILTER	*		..

Signature

Report Date: Friday, January 31, 2003

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

3098411	CALCIUM	8.95	2/12/2003	RB
3098412	HARDNESS	51	1/31/2003	RB
3098413	MAGNESIUM	2.18	2/12/2003	RB
3098414	pH EPA150.1	6.2	1/29/2003	EB
3098415	POTASSIUM	ND	2/8/2003	RB
3098416	SILICA	11.1	2/10/2003	JH
3098417	SULFATE	ND	2/5/2003	RB
3098418	TSS EPA160.2	2.	1/31/2003	EB
3098419	TOC	0.98	2/7/2003	MDM

Signature **Report Date:** Wednesday, March 26, 2003

Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

To be Filled in by Person Submitting Sample:

Public Water System ☐ Realty Transaction ☐

Pws ID #: 4100073 Source ID: Source name:

Public Water System or Property Owner Name

BAKER CITY OF

Address P.O. BOX 650

City, State, Zip BAKER CITY OR 97814

Sampled at: GROUNDWATER Sampled by:

Date Collected: 1/29/2003 Time collected: 12:00:00 PM

Sample Composition: Plant Tap | Single

To be Completed by Laboratory

Date received in lab: 1/30/2003	Nitrate MDL = 0.06mg/L Nitrite MDL = 0.003mg/L Date analyzed NO3: Date analyzed NO2: 1/31/20031/31/2003
Lab sampled ID #: 309821	Sample composited in lab: N

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
Nitrate	1040	10.	<0.05	SM4500D	RB
Nitrate-Nitrite	1038	10.			
Nitrite	1041	1.0	<.002	SM4500E	RB

Signature / date: [signature]

Magic Valley Labs, Inc.
210 Addison Ave
Twin Falls ID 83301

Baker city of
PO Box 650
Baker City OR 97814

Date	Time	Name	Sample #	Total coliform mpn/100ml	E-coli mpn/100ml	Completed	Initials
1/29/2003	12:00pm	Groundwater		<1	<1	1/31/2003	EB

Signature & date: Colla Rass 2-3-03

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

BAKER CITY OF

P.O. BOX 650
BAKER CITY OR 97814

Collection Date	1/29/2003	**Received Date**	1/30/2003	**Location**	
Collection Time	12:00 PM	**Received Time**	8:10 AM	GROUNDWATER	

Sample #	Test / Method Code	Results in mg/L	Date Analyzed	Analyst
309811	CHLORIDE	6	1/31/2003	RB
309812	COLOR	ND	2/7/2003	MDM
309813	IRON	<0.1	2/12/2003	RB
309814	DISSOLVED IRON	<0.1	2/12/2003	RB
309815	MANGANESE	0.12	2/11/2003	RB
309816	DISSOLVED MANGANESE	0.09	2/11/2003	RB
309817	ODOR	ND	2/7/2003	MDM
309818	SURFACTANTS	ND	2/15/2003	MDM
309819	TDS	184	1/31/2003	RB
3098110	ZINC	ND	2/8/2003	RB

Signature **Report Date:** Wednesday, March 26, 2003

MAGIC VALLEY LABS

210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

3098111	ALUMINIUM	ND	2/12/2003	RB
3098112	ALKALINITY	92	1/29/2003	EB
3098113	CARBONATE	<1	1/29/2003	EB
3098114	BICARBONATE	92	1/29/2003	EB
3098115	CALCIUM	30.9	2/12/2003	RB
3098116	HARDNESS	154	1/31/2003	RB
3098117	MAGNESIUM	16.3	2/12/2003	RB
3098118	POTASSIUM	1.8	2/8/2003	RB
3098119	SILICA	38.1	2/10/2003	JH
3098120	SULFATE	39	2/5/2003	SK
3098121	TSS EPA160.2	<1	1/31/2003	EB
3098122	TOC	6.7	2/7/2003	MDM
3098123	LANGELIER INDEX	0.23	2/18/2003	RB

Signature **Report Date:** Wednesday, March 26, 2003

ENERGY LABORATORIES
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LABORATORY ANALYTICAL REPORT

Client: Magic Valley Labs Inc
Project: Baker City
Lab ID: C03010962-001
Client Sample ID: Ground Water

Report Date: 03/11/03
Collection Date: 01/29/03
Date Received: 01/30/03
Matrix: Drinking Water

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Fluoride	0.3	mg/L		0.1	2	A4500-F C	02/03/03 14:30 / slb
METALS - TOTAL							
Sodium	19	mg/L		1.0		E200.7	02/05/03 13:13 / cp
RADIONUCLIDES - TOTAL							
Gross Alpha	1.1	pCi/L		1.0	15	E900.0	02/03/03 12:00 / rs
Gross Alpha Precision (±)	1.0	pCi/L				E900.0	02/03/03 12:00 / rs
Gross Beta	12.2	pCi/L		2.0	50	E900.0	02/03/03 12:00 / rs
Gross Beta Precision (±)	1.9	pCi/L				E900.0	02/03/03 12:00 / rs
Radon 222	465	pCi/L	*	100	300	D5072-92	01/31/03 17:05 / db
Radon 222 precision (±)	80.7	pCi/L				D5072-92	01/31/03 17:05 / db
INORGANIC COMPOUNDS							
Aluminum	0.0071	mg/L		0.0001	0.2	E200.8	02/05/03 22:15 / smd
Antimony	ND	mg/L		0.001	0.006	E200.8	02/05/03 22:15 / smd
Arsenic	0.006	mg/L		0.005	0.01	E200.8	02/05/03 22:15 / smd
Barium	ND	mg/L		0.1	2	E200.8	02/05/03 22:15 / smd
Beryllium	ND	mg/L		0.0005	0.004	E200.8	02/05/03 22:15 / smd
Cadmium	ND	mg/L		0.0005	0.005	E200.8	02/05/03 22:15 / smd
Chromium	ND	mg/L		0.05	0.1	E200.8	02/05/03 22:15 / smd
Copper	ND	mg/L		0.01	1.3	E200.8	02/05/03 22:15 / smd
Lead	0.005	mg/L		0.001	0.015	E200.8	02/05/03 22:15 / smd
Mercury	ND	mg/L		0.0005	0.002	E200.8	02/05/03 22:15 / smd
Nickel	ND	mg/L		0.02	0.1	E200.8	02/05/03 22:15 / smd
Selenium	ND	mg/L		0.005	0.05	E200.8	02/05/03 22:15 / smd
Silver	ND	mg/L		0.0009	0.05	E200.8	02/05/03 22:15 / smd
Thallium	ND	mg/L		0.0004	0.002	E200.8	02/05/03 22:15 / smd
VOLATILE ORGANIC COMPOUNDS							
1,1,1,2-Tetrachloroethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,1,1-Trichloroethane	ND	ug/L		0.50	200	E524.2	01/31/03 23:02 / rh
1,1,2,2-Tetrachloroethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,1,2-Trichloroethane	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
1,1-Dichloroethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,1-Dichloroethene	ND	ug/L		0.50	7	E524.2	01/31/03 23:02 / rh
1,1-Dichloropropene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,2,3-Trichloropropane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
* - The result exceeds the MCL.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. • 2393 Salt Creek Highway (82601) • P.O. Box 3258 • Casper, WY 82602
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LABORATORY ANALYTICAL REPORT

Client: Magic Valley Labs Inc | Report Date: 03/11/03
Project: Baker City | Collection Date: 01/29/03
Lab ID: C03010962-001 | Date Received: 01/30/03
Client Sample ID: Ground Water | Matrix: Drinking Water

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
VOLATILE ORGANIC COMPOUNDS							
1,2,4-Trichlorobenzene	ND	ug/L		0.50	70	E524.2	01/31/03 23:02 / rh
1,2,4-Trimethylbenzene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,2-Dichlorobenzene	ND	ug/L		0.50	600	E524.2	01/31/03 23:02 / rh
1,2-Dichloroethane	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
1,2-Dichloropropane	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
1,3-Dichlorobenzene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,3-Dichloropropane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
1,4-Dichlorobenzene	ND	ug/L		0.50	75	E524.2	01/31/03 23:02 / rh
2,2-Dichloropropane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
2-Chlorotoluene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
4-Chlorotoluene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Benzene	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
Bromobenzene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Bromodichloromethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Bromoform	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Bromomethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Carbon tetrachloride	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
Chlorobenzene	ND	ug/L		0.50	100	E524.2	01/31/03 23:02 / rh
Chlorodibromomethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Chloroethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Chloroform	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Chloromethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
cis-1,2-Dichloroethene	ND	ug/L		0.50	70	E524.2	01/31/03 23:02 / rh
cis-1,3-Dichloropropene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Dibromomethane	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Ethylbenzene	ND	ug/L		0.50	700	E524.2	01/31/03 23:02 / rh
Methylene chloride	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
Styrene	ND	ug/L		0.50	100	E524.2	01/31/03 23:02 / rh
Tetrachloroethene	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
Toluene	ND	ug/L		0.50	1000	E524.2	01/31/03 23:02 / rh
trans-1,2-Dichloroethene	ND	ug/L		0.50	100	E524.2	01/31/03 23:02 / rh
trans-1,3-Dichloropropene	ND	ug/L		0.50		E524.2	01/31/03 23:02 / rh
Trichloroethene	ND	ug/L		0.50	5	E524.2	01/31/03 23:02 / rh
Vinyl chloride	ND	ug/L		0.50	2	E524.2	01/31/03 23:02 / rh
VOC pH	7	s.u.		0.10		E524.2	01/31/03 23:02 / rh
Xylenes, Total	ND	ug/L		1.0	10000	E524.2	01/31/03 23:02 / rh
Trihalomethanes, Total	ND	ug/L		2.0	80	E524.2	01/31/03 23:02 / rh
Surr: Dibromofluoromethane	101	%REC			70-130	E524.2	01/31/03 23:02 / rh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

TRACKING NO. PAGE NO.

ENERGY LABORATORIES

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LABORATORY ANALYTICAL REPORT

Client: Magic Valley Labs Inc
Project: Baker City
Lab ID: C03010962-001
Client Sample ID: Ground Water

Report Date: 03/11/03
Collection Date: 01/29/03
Date Received: 01/30/03
Matrix: Drinking Water

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
VOLATILE ORGANIC COMPOUNDS							
Surr: p-Bromofluorobenzene	97.6	%REC			80-120	E524.2	01/31/03 23:02 / rh
Surr: Toluene-d8	104	%REC			80-120	E524.2	01/31/03 23:02 / rh
SYNTHETIC ORGANIC COMPOUNDS							
1,2-Dibromo-3-chloropropane	ND	ug/L		0.02	0.2	E504.1	02/05/03 15:47 / rlo
1,2-Dibromoethane	ND	ug/L		0.01	0.05	E504.1	02/05/03 15:47 / rlo
Surr: 1,1,1,2-Tetrachloroethane	96.0	%REC			70-130	E504.1	02/05/03 15:47 / rlo
Alachlor	ND	ug/L		0.20	2	E505	02/06/03 01:36 / rlo
Aldrin	ND	ug/L		0.010		E505	02/06/03 01:36 / rlo
Chlordane	ND	ug/L		0.20	2	E505	02/06/03 01:36 / rlo
Dieldrin	ND	ug/L		0.10		E505	02/06/03 01:36 / rlo
Endrin	ND	ug/L		0.010	2	E505	02/06/03 01:36 / rlo
gamma-BHC (Lindane)	ND	ug/L		0.020	0.2	E505	02/06/03 01:36 / rlo
Heptachlor	ND	ug/L		0.040	0.4	E505	02/06/03 01:36 / rlo
Heptachlor epoxide	ND	ug/L		0.020	0.2	E505	02/06/03 01:36 / rlo
Hexachlorobenzene	ND	ug/L		0.10	1	E505	02/06/03 01:36 / rlo
Hexachlorocyclopentadiene	ND	ug/L		0.10	50	E505	02/06/03 01:36 / rlo
Methoxychlor	ND	ug/L		0.10	40	E505	02/06/03 01:36 / rlo
Toxaphene	ND	ug/L		1.0	3	E505	02/06/03 01:36 / rlo
PCBs, Total	ND	ug/L		0.50	0.5	E505	02/06/03 01:36 / rlo
Surr: Decachlorobiphenyl	92.8	%REC			60-130	E505	02/06/03 01:36 / rlo
Surr: Tetrachloro-m-xylene	94.6	%REC			70-130	E505	02/06/03 01:36 / rlo
Buffer pH	5.0	s.u.		0.10		E531.1	02/10/03 19:27 / wen
Aldicarb	ND	ug/L		0.50	3	E531.1	02/10/03 19:27 / wen
Aldicarb sulfone	ND	ug/L		0.50	2	E531.1	02/10/03 19:27 / wen
Aldicarb sulfoxide	ND	ug/L		0.50	4	E531.1	02/10/03 19:27 / wen
Carbaryl	ND	ug/L		0.50		E531.1	02/10/03 19:27 / wen
Carbofuran	ND	ug/L		0.50	40	E531.1	02/10/03 19:27 / wen
3-Hydroxycarbofuran	ND	ug/L		0.50		E531.1	02/10/03 19:27 / wen
Methomyl	ND	ug/L		0.50		E531.1	02/10/03 19:27 / wen
Oxamyl	ND	ug/L		0.50	200	E531.1	02/10/03 19:27 / wen
Surr: BDMC	92.1	%REC			70-130	E531.1	02/10/03 19:27 / wen
Glyphosate	ND	ug/L		5.0	700	E547	02/07/03 15:27 / wen
Diquat	ND	ug/L		0.40	20	E549.2	02/18/03 18:37 / wen

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Magic Valley Labs Inc
Project: Baker City
Lab ID: C03010962-002
Client Sample ID: Surface Water

Report Date: 03/11/03
Collection Date: 01/29/03
Date Received: 01/30/03
Matrix: Aqueous

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - TOTAL							
Sodium	2.1	mg/L		1.0		E200.7	02/05/03 13:16 / cp
INORGANIC COMPOUNDS							
Aluminum	0.0489	mg/L		0.0001	0.2	E200.8	02/05/03 22:20 / smd
Antimony	ND	mg/L		0.001	0.006	E200.8	02/05/03 22:20 / smd
Arsenic	ND	mg/L		0.005	0.01	E200.8	02/05/03 22:20 / smd
Barium	ND	mg/L		0.1	2	E200.8	02/05/03 22:20 / smd
Beryllium	ND	mg/L		0.0005	0.004	E200.8	02/05/03 22:20 / smd
Cadmium	ND	mg/L		0.0005	0.005	E200.8	02/05/03 22:20 / smd
Chromium	ND	mg/L		0.05	0.1	E200.8	02/05/03 22:20 / smd
Copper	0.02	mg/L		0.01	1.3	E200.8	02/05/03 22:20 / smd
Lead	ND	mg/L		0.001	0.015	E200.8	02/05/03 22:20 / smd
Mercury	ND	mg/L		0.0005	0.002	E200.8	02/05/03 22:20 / smd
Nickel	ND	mg/L		0.02	0.1	E200.8	02/05/03 22:20 / smd
Selenium	ND	mg/L		0.005	0.05	E200.8	02/05/03 22:20 / smd
Silver	ND	mg/L		0.0009	0.05	E200.8	02/05/03 22:20 / smd
Thallium	ND	mg/L		0.0004	0.002	E200.8	02/05/03 22:20 / smd

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Magic Valley Labs Inc
Project: Baker City
Lab ID: C03010962-003
Client Sample ID: Trip Blank

Report Date: 03/11/03
Collection Date: 01/09/03 12:00
Date Received: 01/30/03
Matrix: Aqueous

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
VOLATILE ORGANIC COMPOUNDS							
1,1,1,2-Tetrachloroethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,1,1-Trichloroethane	ND	ug/L		0.50	200	E524.2	01/31/03 17:10 / rh
1,1,2,2-Tetrachloroethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,1,2-Trichloroethane	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
1,1-Dichloroethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,1-Dichloroethene	ND	ug/L		0.50	7	E524.2	01/31/03 17:10 / rh
1,1-Dichloropropene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,2,3-Trichloropropane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,2,4-Trichlorobenzene	ND	ug/L		0.50	70	E524.2	01/31/03 17:10 / rh
1,2,4-Trimethylbenzene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,2-Dichlorobenzene	ND	ug/L		0.50	600	E524.2	01/31/03 17:10 / rh
1,2-Dichloroethane	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
1,2-Dichloropropane	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
1,3-Dichlorobenzene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,3-Dichloropropane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
1,4-Dichlorobenzene	ND	ug/L		0.50	75	E524.2	01/31/03 17:10 / rh
2,2-Dichloropropane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
2-Chlorotoluene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
4-Chlorotoluene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Benzene	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
Bromobenzene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Bromodichloromethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Bromoform	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Bromomethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Carbon tetrachloride	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
Chlorobenzene	ND	ug/L		0.50	100	E524.2	01/31/03 17:10 / rh
Chlorodibromomethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Chloroethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Chloroform	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Chloromethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
cis-1,2-Dichloroethene	ND	ug/L		0.50	70	E524.2	01/31/03 17:10 / rh
cis-1,3-Dichloropropene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Dibromomethane	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Ethylbenzene	ND	ug/L		0.50	700	E524.2	01/31/03 17:10 / rh
Methylene chloride	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
Styrene	ND	ug/L		0.50	100	E524.2	01/31/03 17:10 / rh
Tetrachloroethene	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
Toluene	ND	ug/L		0.50	1000	E524.2	01/31/03 17:10 / rh

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LABORATORY ANALYTICAL REPORT

Client: Magic Valley Labs Inc
Project: Baker City
Lab ID: C03010962-003
Client Sample ID: Trip Blank

Report Date: 03/11/03
Collection Date: 01/09/03 12:00
Date Received: 01/30/03
Matrix: Aqueous

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
VOLATILE ORGANIC COMPOUNDS							
trans-1,2-Dichloroethene	ND	ug/L		0.50	100	E524.2	01/31/03 17:10 / rh
trans-1,3-Dichloropropene	ND	ug/L		0.50		E524.2	01/31/03 17:10 / rh
Trichloroethene	ND	ug/L		0.50	5	E524.2	01/31/03 17:10 / rh
Vinyl chloride	ND	ug/L		0.50	2	E524.2	01/31/03 17:10 / rh
Xylenes, Total	ND	ug/L		1.0	10000	E524.2	01/31/03 17:10 / rh
Trihalomethanes, Total	ND	ug/L		2.0	80	E524.2	01/31/03 17:10 / rh
Surr: Dibromofluoromethane	103	%REC			70-130	E524.2	01/31/03 17:10 / rh
Surr: p-Bromofluorobenzene	98.9	%REC			80-120	E524.2	01/31/03 17:10 / rh
Surr: Toluene-d8	104	%REC			80-120	E524.2	01/31/03 17:10 / rh

Report Definitions:
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MCL - Maximum contaminant level.
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QA/QC Summary Report

Client: Magic Valley Labs Inc
Project: Baker City

Report Date: 03/11/03
Work Order: C03010962

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A4500-F C									Batch: O-020303-2
Sample ID: DI-BLANK	Method Blank								02/03/03 13:47
Fluoride	ND	mg/L	0.100						
Sample ID: C03010931-006A	Matrix Spike								02/03/03 13:56
Fluoride	1.60	mg/L	0.100	106	90	110			
Sample ID: C03010931-006A	Matrix Spike Duplicate								02/03/03 14:00
Fluoride	1.58	mg/L	0.100	104	90	110	1.3	10	
Method: D5072-92									Batch: R18599
Sample ID: C03010962-001JDUP	Sample Duplicate								01/31/03 17:05
Radon 222	483	pCi/L	100				3.8	30	
Sample ID: MB-R18599	Method Blank								01/31/03 17:05
Radon 222	ND	pCi/L	100						
Method: E200.7									Batch: R18662
Sample ID: C03010813-001DMS1	Matrix Spike								02/05/03 10:32
Sodium	81	mg/L	1.0	87.4	80	120			
Sample ID: C03010813-001DMSD1	Matrix Spike Duplicate								02/05/03 10:41
Sodium	90	mg/L	1.0	106	80	120	11	20	
Sample ID: C03010955-001CMS1	Matrix Spike								02/05/03 12:29
Sodium	538	mg/L	1.00	106	80	120			
Sample ID: C03010955-001CMSD1	Matrix Spike Duplicate								02/05/03 12:38
Sodium	524	mg/L	1.00	104	80	120	2.6	20	

Qualifiers: ND - Not Detected at the Reporting Limit
R - RPD outside of recommended recovery limits
S - Spike Recovery outside of recommended recovery limits

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QA/QC Summary Report

Client: Magic Valley Labs Inc **Report Date:** 03/11/03
Project: Baker City **Work Order:** C03010962

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8									Batch: ICPMS1-C020503a
Sample ID: LRB	Method Blank								02/05/03 17:05
Aluminum	ND	mg/L	0.00100						
Antimony	ND	mg/L	0.00100						
Arsenic	ND	mg/L	0.00100						
Barium	ND	mg/L	0.00100						
Beryllium	ND	mg/L	0.00100						
Cadmium	ND	mg/L	0.00100						
Chromium	ND	mg/L	0.00100						
Copper	ND	mg/L	0.00100						
Lead	ND	mg/L	0.00100						
Mercury	ND	mg/L	0.00100						
Nickel	ND	mg/L	0.00100						
Selenium	0.00119	mg/L	0.00100						
Silver	ND	mg/L	0.00100						
Thallium	ND	mg/L	0.00100						
Sample ID: C03010881-001AMS	Matrix Spike								02/05/03 19:00
Aluminum	0.0661	mg/L	0.00100	107	70	130			
Antimony	0.0541	mg/L	0.00100	108	70	130			
Arsenic	0.0582	mg/L	0.00100	109	70	130			
Barium	0.274	mg/L	0.00100	113	70	130			
Beryllium	0.0586	mg/L	0.00100	117	70	130			
Cadmium	0.0539	mg/L	0.00100	108	70	130			
Chromium	0.0503	mg/L	0.00100	98.8	70	130			
Copper	0.0543	mg/L	0.00100	107	70	130			
Lead	0.0528	mg/L	0.00100	105	70	130			
Mercury	0.00507	mg/L	0.00100	101	70	130			
Nickel	0.0584	mg/L	0.00100	111	70	130			
Selenium	0.0603	mg/L	0.00100	111	70	130			
Silver	0.0191	mg/L	0.00100	95.3	70	130			
Thallium	0.0520	mg/L	0.00100	104	70	130			
Sample ID: C03010881-001AMSD	Matrix Spike Duplicate								02/05/03 19:06
Aluminum	0.0657	mg/L	0.00100	106	70	130	0.6	20	
Antimony	0.0537	mg/L	0.00100	107	70	130	0.6	20	
Arsenic	0.0574	mg/L	0.00100	107	70	130	1.5	20	
Barium	0.278	mg/L	0.00100	120	70	130	1.3	20	
Beryllium	0.0573	mg/L	0.00100	115	70	130	2.3	20	
Cadmium	0.0522	mg/L	0.00100	104	70	130	3.2	20	
Chromium	0.0495	mg/L	0.00100	97.3	70	130	1.5	20	
Copper	0.0537	mg/L	0.00100	106	70	130	1.1	20	
Lead	0.0516	mg/L	0.00100	102	70	130	2.4	20	
Mercury	0.00510	mg/L	0.00100	102	70	130	0.7	20	
Nickel	0.0585	mg/L	0.00100	112	70	130	0.2	20	

Qualifiers: ND - Not Detected at the Reporting Limit S - Spike Recovery outside of recommended recovery limits
R - RPD outside of recommended recovery limits

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QA/QC Summary Report

Client: Magic Valley Labs Inc
Project: Baker City

Report Date: 03/11/03
Work Order: C03010962

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8									Batch: ICPMS1-C020503a
Sample ID: C03010881-001AMSD	Matrix Spike Duplicate								02/05/03 19:06
Selenium	0.0587	mg/L	0.00100	107	70	130	2.6	20	
Silver	0.0175	mg/L	0.00100	87.6	70	130	8.4	20	
Thallium	0.0526	mg/L	0.00100	105	70	130	1.0	20	
Method: E504.1									Batch: 2889
Sample ID: MB-2889	Method Blank								02/05/03 09:55
1,2-Dibromo-3-chloropropane	ND	ug/L	0.0200						
1,2-Dibromoethane	ND	ug/L	0.0100						
Surr: 1,1,1,2-Tetrachloroethane			0.0200	98	70	130			
Sample ID: C03010962-001G	Matrix Spike								02/05/03 16:55
1,2-Dibromo-3-chloropropane	0.221	ug/L	0.0200	88.4	65	135			
1,2-Dibromoethane	0.237	ug/L	0.0100	94.8	65	135			
Surr: 1,1,1,2-Tetrachloroethane			0.0200	99	70	130			
Sample ID: C03010997-001H	Matrix Spike								02/05/03 17:31
1,2-Dibromo-3-chloropropane	0.227	ug/L	0.0200	90.8	65	135			
1,2-Dibromoethane	0.232	ug/L	0.0100	92.8	65	135			
Surr: 1,1,1,2-Tetrachloroethane			0.0200	99	70	130			

Qualifiers: ND - Not Detected at the Reporting Limit
R - RPD outside of recommended recovery limits
S - Spike Recovery outside of recommended recovery limits

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QA/QC Summary Report

Client: Magic Valley Labs Inc
Project: Baker City

Report Date: 03/11/03
Work Order: C03010962

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E505									Batch: 2890
Sample ID: MB-2890	Method Blank								02/05/03 18:36
Alachlor	ND	ug/L	0.200						
Aldrin	ND	ug/L	0.0100						
Chlordane	ND	ug/L	0.200						
Dieldrin	ND	ug/L	0.100						
Endrin	ND	ug/L	0.0100						
gamma-BHC (Lindane)	ND	ug/L	0.0200						
Heptachlor	ND	ug/L	0.0400						
Heptachlor epoxide	ND	ug/L	0.0200						
Hexachlorobenzene	ND	ug/L	0.100						
Hexachlorocyclopentadiene	ND	ug/L	0.100						
Methoxychlor	ND	ug/L	0.100						
Toxaphene	ND	ug/L	1.00						
PCBs, Total	ND	ug/L	0.500						
Surr: Decachlorobiphenyl			0.100	96.6	60	130			
Surr: Tetrachloro-m-xylene			0.100	94.4	70	130			
Sample ID: C03010962-001G	Matrix Spike								02/06/03 03:00
Alachlor	3.10	ug/L	0.200	124	65	135			
Aldrin	0.255	ug/L	0.0100	102	80	140			
Dieldrin	0.285	ug/L	0.100	114	65	135			
Endrin	0.288	ug/L	0.0100	115	65	135			
gamma-BHC (Lindane)	0.276	ug/L	0.0200	110	75	135			
Heptachlor	0.281	ug/L	0.0400	112	75	135			
Heptachlor epoxide	0.248	ug/L	0.0200	99.2	65	135			
Hexachlorobenzene	0.308	ug/L	0.100	123	65	135			
Hexachlorocyclopentadiene	0.359	ug/L	0.100	144	65	135			S
Methoxychlor	1.33	ug/L	0.100	106	65	125			
Surr: Decachlorobiphenyl			0.100	108	60	130			
Surr: Tetrachloro-m-xylene			0.100	115	70	130			
- HCCPD and Simazine were slightly over range. Since the samples affected had no reportable responses for the analytes and the batch has an acceptable alternate MS result, this batch was approved.									
Sample ID: C03010997-001I	Matrix Spike								02/06/03 03:42
Alachlor	2.59	ug/L	0.200	104	65	135			
Aldrin	0.180	ug/L	0.0100	72	70	130			
Dieldrin	0.232	ug/L	0.100	92.8	65	135			
Endrin	0.239	ug/L	0.0100	95.6	65	135			
gamma-BHC (Lindane)	0.244	ug/L	0.0200	97.6	75	135			
Heptachlor	0.207	ug/L	0.0400	82.8	75	135			
Heptachlor epoxide	0.220	ug/L	0.0200	88	65	135			
Hexachlorobenzene	0.235	ug/L	0.100	94	65	135			
Hexachlorocyclopentadiene	0.329	ug/L	0.100	132	65	135			
Methoxychlor	1.03	ug/L	0.100	82.7	65	125			
Surr: Decachlorobiphenyl			0.100	90.8	60	130			

Qualifiers: ND - Not Detected at the Reporting Limit
R - RPD outside of recommended recovery limits
S - Spike Recovery outside of recommended recovery limits

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QA/QC Summary Report

Client: Magic Valley Labs Inc
Project: Baker City

Report Date: 03/11/03
Work Order: C03010962

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E505									Batch: 2890
Sample ID: C03010997-001I	Matrix Spike								02/06/03 03:42
Surr: Tetrachloro-m-xylene			0.100	86.6	70	130			

Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside of recommended recovery limits
R - RPD outside of recommended recovery limits

Environmental Health Laboratories
The Nation's Drinking Water Laboratory

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South Bend, IN 46617
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LABORATORY REPORT

Client: Energy Laboratories
Attn: Jim Yocum
P.O. Box 3258
Casper, WY 82602

Report: 845351-54

Priority: Standard Written

Status: Final

Sampling Point: C03010962-001A, 001B, 001E & 001F

Samples Submitted: Four drinking water samples

Copies to: None

Collected: 01/29/03 By: Client Received: 01/31/03

REPORT SUMMARY

None of the analytes included in the detailed parameter list were detected in the sample submitted for analysis.

Note: Sample containers were provided by the client.

Note: See attached page for additional comments.

Detailed quantitative results are presented on the following page.

We appreciate the opportunity to provide you with this analysis. If you have any questions concerning this report, please do not hesitate to call us at 574-233-4777.

Note: This report may not be reproduced, except in full, without written approval from Environmental Health Laboratories (EHL). EHL is accredited by the National Environmental Laboratory Accreditation Program (NELAP).

Reviewed By: Steve Dungy Date: 2/17/03

Finalized By: Matt Hayes Date: 2-18-03

TRACKING NO. PAGE NO.
010962R0016

A Division of Underwriters Laboratories Inc.

Client: Energy Laboratories

Report: 845351-54

Sampling Point: C03010962-001A, 001B, 001E & 001F

PARAMETER	SDWA Method	MRL * (ug/L)	Result (ug/L)	MCL (ug/L)	Analysis Date	Lab Number
2,4-D	515.3	0.1	< 0.1	70	02/05/03	845351
Dalapon	515.3	1.0	< 1.0	200	02/05/03	845351
2,4-DB	515.3	2.0	< 2.0	---	02/12/03	845351
Dicamba	515.3	0.1	< 0.1	---	02/05/03	845351
Dichlorprop	515.3	2.0	< 2.0	---	02/05/03	845351
Dinoseb	515.3	0.1	< 0.1	7	02/05/03	845351
Pentachlorophenol	515.3	0.04	< 0.04	1	02/05/03	845351
Picloram	515.3	0.1	< 0.1	500	02/05/03	845351
2,4,5-TP (Silvex)	515.3	0.1	< 0.1	50	02/05/03	845351
Atrazine	525.2	0.1	< 0.1	3	02/06/03	845352
Benzo[a]pyrene	525.2	0.02	< 0.02	0.2	02/06/03	845352
Butachlor	525.2	0.1	< 0.1	---	02/06/03	845352
Butylbenzylphthalate	525.2	1.0	< 1.0	---	02/06/03	845352
Di-n-butylphthalate	525.2	2.0	< 2.1	---	02/06/03	845352
Di(2-ethylhexyl)adipate	525.2	0.6	< 0.6	400	02/06/03	845352
Di(2-ethylhexyl)phthalate	525.2	0.6	< 0.6	6	02/06/03	845352
Diethylphthalate	525.2	1.0	< 1.0	---	02/06/03	845352
Dimethylphthalate	525.2	1.0	< 1.0	---	02/06/03	845352
Metolachlor	525.2	0.1	< 0.1	---	02/06/03	845352
Metribuzin	525.2	0.1	< 0.1	---	02/06/03	845352
Propachlor	525.2	0.1	< 0.1	---	02/06/03	845352
Simazine	525.2	0.07	< 0.07	4	02/06/03	845352
Endothall	548.1	9.0	< 9.0	100	02/06/03	845354
Bromochloroacetic Acid	552.2	1.0	< 1.0	NA	02/06/03	845353
Dibromoacetic Acid	552.2	1.0	< 1.0	¥	02/06/03	845353
Dichloroacetic Acid	552.2	1.0	< 1.0	¥	02/06/03	845353
Monobromoacetic Acid	552.2	1.0	< 1.0	¥	02/06/03	845353
Monochloroacetic Acid	552.2	2.0	< 2.0	¥	02/06/03	845353
Trichloroacetic Acid	552.2	1.0	< 1.0	¥	02/06/03	845353

NA = Not applicable

¥ MCL for total haloacetic acids(5) is 60 ug/L in Stage I of the D/DBP Rule

* EHL has demonstrated it can achieve these report limits in reagent water, but can not document them in all sample matrices.

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010962R0017

A Division of Underwriters Laboratories Inc.

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

CHUCK EVERSON
BAKER CITY OF

P.O. BOX 650
BAKER CITY OR 97814

Collection Date 12/11/2002 **Received Date** 12/11/2002 **Location**
Collection Time **Received Time** 6:00 PM RESERVOIR

Sample #	Test / Method Code	Results in mg/L	Date Analyzed	Analyst
301431	BICARBONATE	51	12/11/2002	BE
301432	CARBONATE	<1	12/11/2002	BE
301433	ALKALINITY	51	12/11/2002	BE
301434	CALCIUM	13.4	12/17/2002	RB
301435	CHLORIDE	15	12/12/2002	JK
301436	HARDNESS	34	12/13/2002	RB
301437	MAGNESIUM	2.39	12/17/2002	RB
301438	NITRATE/N SM4500D	0.14	12/12/2002	BE
301439	NITRITE/N SM4500E	<0.002	12/12/2002	JK
3014310	NITRATE/N + NITRITE/N	0.14	12/12/2002	BE

Signature **Report Date:** Monday, December 30, 2002

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

3014311	POTASSIUM	<0.5	12/17/2002	RB
3014312	SILICA	.		..
3014313	SODIUM	1.93	12/17/2002	RB
3014314	SULFATE	0.4	12/12/2002	JK
3014315	TDS	50	12/12/2002	JK
3014316	TOC	0.37	12/18/2002	MDM
3014317	TSS EPA160.2	<1	12/12/2002	EB
3014318	ALUMINIUM	<0.10	12/17/2002	JH
3014319	ARSENIC	<0.005	12/13/2002	RB
3014320	DISSOLVED IRON	<0.1	12/14/2002	RB
3014321	IRON	<0.1	12/14/2002	RB
3014322	DISSOLVED MANGANESE	<0.05	12/14/2002	RB
3014323	MANGANESE	<0.05	12/14/2002	RB
3014324	FILTER	*		..
3014325	DIGESTION	*		..

Signature

Report Date: Monday, December 30, 2002

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

CHUCK EVERSON
BAKER CITY OF

P.O. BOX 650
BAKER CITY OR 97814

Collection Date 12/11/2002 **Received Date** 12/11/2002 **Location**
Collection Time **Received Time** 6:00 PM WELL

Sample #	Test / Method Code	Results in mg/L	Date Analyzed	Analyst
301441	BICARBONATE	133	12/11/2002	BE
301442	CARBONATE	<1	12/11/2002	BE
301443	ALKALINITY	133	12/11/2002	BE
301444	CALCIUM	30.8	12/17/2002	RB
301445	CHLORIDE	19	12/12/2002	JK
301446	HARDNESS	205	12/13/2002	RB
301447	MAGNESIUM	18.4	12/17/2002	RB
301448	NITRATE/N SM4500D	0.17	12/12/2002	BE
301449	NITRITE/N SM4500E	<0.002	12/12/2002	JK
3014410	NITRATE/N + NITRITE/N	0.17	12/12/2002	BE

Signature

Report Date: Monday, December 30, 2002

MAGIC VALLEY LABS
210 Addison Ave / PO Box 1867
Twin Falls ID 83303-1867
Phone: (208) 733-4250
Fax: (208) 734-2539

3014411	POTASSIUM	1.9	12/17/2002	RB
3014412	SILICA	*		..
3014413	SODIUM	16.3	12/17/2002	RB
3014414	SULFATE	38	12/12/2002	JK
3014415	TDS	179	12/12/2002	JK
3014416	TOC	0.93	12/18/2002	MDM
3014417	TSS EPA160.2	<1	12/12/2002	EB
3014418	ALUMINIUM	<0.10	12/17/2002	JH
3014419	ARSENIC	<0.005	12/13/2002	RB
3014420	DISSOLVED IRON	<0.1	12/14/2002	RB
3014421	IRON	<0.1	12/14/2002	RB
3014422	DISSOLVED MANGANESE	0.11	12/14/2002	RB
3014423	MANGANESE	0.11	12/14/2002	RB
3014424	FILTER	*		..
3014425	DIGESTION	*		..

Signature

Report Date: Monday, December 30, 2002

Magic Valley Labs, Inc. 210 Addison Ave. PO Box 1867 Twin Falls Id 83301

System ID #: 4100073 Entry Point or Source ID: Source name(s):

Water System BAKER CITY OF

AddressP.O. BOX 650

City, State, ZipBAKER CITY OR 97814

Sample Identification

Sampled at: RESEVOIR WELL Sampled by: KEN ELLIS

Date Collected: 10/14/2002 Time collected: 8:10:00 AM

Date recieved: 10/14/2002 Date analyzed:

Sample: | Single
(Circle appropriate descriptors above)

Lab sample ID #: 28941 Composite Sample:

Inorganic Chemicals

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	MDL	Analyst
Antimony Total	1074	0.006	ND	200.9	0.003	Umpqua
Arsenic	1005	0.05	0.006	200.9	0.005	Umpqua
Asbestos	1094	7 MF/l[3]				
Barium	1010	2	ND	SM3113B	0.1	Umpqua
Berylium Total	1075	0.004	ND	200.9	0.0002	Umpqua
Cadmium	1015	0.005	ND	200.9	0.001	Umpqua
Chromium	1020	0.1	ND	200.9	0.02	Umpqua
Cyanide	1024	0.2	ND	SM4500CN	0.02	Umpqua
Fluoride	1025	4.0	0.47	300.1		Umpqua
Lead	1030	0.015	ND	200.9	0.002	Umpqua
Mercury	1035	0.002	ND	245.1	0.001	Umpqua
Nickel	1036		ND	200.9	0.02	Umpqua
Nitrate	1040	10.				
Nitrate-Nitrite	1038	10.				
Nitrite	1041	1.0				
Selenium	1045	0.05	ND	200.9	0.003	Umpqua
Sodium[2]	1052		21.0	SM3111B		Umpqua
Sulfate	1055		38.8	300.0		Umpqua
Thallium Total	1085	0.002	ND	200.9	0.001	Umpqua

pH = 7.7
Conductivity = 334 umho/cm

[2] Community systems only
[3] Million Fibers/liter >10um

Signature / Date: Brenda Ellis 12-10-02

Magic Valley Labs, Inc. 210 Addison Ave. PO Box 1867 Twin Falls Id 83301

System ID #: 4100073 Entry Point or Source ID: Source name(s):

Water System BAKER CITY OF

AddressP.O. BOX 650

City, State, ZipBAKER CITY OR 97814

Sample Identification

Sampled at: OLD MOUNTAIN LINE Sampled by: KEN ELLIS

Date Collected: 10/14/2002 Time collected: 8:30:00 AM

Date recieved: 10/14/2002 Date analyzed:

Sample: | Single
(Circle appropriate descriptors above)

Lab sample ID #: 28945 Composite Sample:

Inorganic Chemicals

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	MDL	Analyst
Antimony Total	1074	0.006	ND	200.9	0.003	Umpqua
Arsenic	1005	0.05	ND	200.9	0.005	Umpqua
Asbestos	1094	7 MF/l[3]				
Barium	1010	2	ND	SM3113B	0.1	Umpqua
Berylium Total	1075	0.004	ND	200.9	0.0002	Umpqua
Cadmium	1015	0.005	ND	200.9	0.001	Umpqua
Chromium	1020	0.1	ND	200.9	0.02	Umpqua
Cyanide	1024	0.2	ND	SM4500CN	0.02	Umpqua
Fluoride	1025	4.0	4.9	300.1		Umpqua
Lead	1030	0.015	ND	200.9	0.002	Umpqua
Mercury	1035	0.002	ND	245.1	0.001	Umpqua
Nickel	1036		ND	200.9	0.02	Umpqua
Nitrate	1040	10.				
Nitrate-Nitrite	1038	10.				
Nitrite	1041	1.0				
Selenium	1045	0.05	ND	200.9	0.003	Umpqua
Sodium[2]	1052		2.21	SM3111B		Umpqua
Sulfate	1055		3.85	300.0		Umpqua
Thallium Total	1085	0.002	ND	200.9	0.001	Umpqua

pH = 7.3
Conductivity = 104 umho/cm

[2] Community systems only
[3] Million Fibers/liter >10um

Signature / Date: Brenda Ellis 12-10-02

Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

Water System ID #: 4100073	Source ID:	Source name(s):

Water System BAKER CITY OF

Address PO BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: RESERVOIR WELL	Sampled by: KEN ELLIS
Date Collected: 10/14/02	Time collected: 8:10:00AM
Date received: 10/14/02	Date analyzed: 11/05/02
Sample Composition: |	Single
Lab sample ID #: 28954	Sample Composited : No

UCMR

Regulated VOCs

Contaminant	Code	MDL mg/l	Analysis mg/l	Method	Analyst
Perchlorate		4.0	ND	314.0	*Umpqua
DCPA-mono + di acid		1.0	ND	515.2	
Methyl-tert butyl ether (MTBE)		5.0	ND	524.2	
Nitrobenzene		10.0	ND	524.2	
2,4-Dinitrotoluene		2.0	ND	525.2	
2,6-Dinitrotoluene		2.0	ND	525.2	
Acetochlor		2.0	ND	525.2	
4,4'-DDE		0.8	ND	525.2	
EPTC		1.0	ND	525.2	
Molinate		0.9	ND	525.2	
Terbacil		2.0	ND	525.2	

Brenda Ellis 12-10-02

Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

Water System ID #: 4100073 Source ID: Source name(s):

Water System BAKER CITY OF

Address P.O. BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: RESERVOIR WELL Sampled by: KEN ELLIS

Date Collected: 10/14/2002 Time collected: 8:10:00 AM

Date received: 10/14/2002 Date analyzed: 11/16/2002

Sample Composition: | Single

Lab sample ID #: 28954 Sample Composited : No

Volatile Organic Chemicals MDL for all test = 0.0005

Regulated VOCs

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
1,1-Dichloroethylene	2977	0.007	ND	524.2	*Umpqua
1,1,1-Trichloroethane	2981	0.2	ND		
1,1,2-Trichloroethane	2985	0.005	ND		
1,2 Dichloroethane	2980	0.005	ND		
1,2 Dichloropropane	2983	0.005	ND		
1,2,4-Trichlorobenzene	2378	0.07	ND		
Benzene	2990	0.005	ND		
Carbon Tetrachloride	2982	0.005	ND		
Cis-1,2-Dichloroethylene	2380	0.07	ND		
Methylene Chloride	2964	0.005	ND		
Ethylbenzene	2992	0.7	ND		
Chlorobenzene	2989	0.1	ND		
1-2-Dichlorobenzene	2968	0.6	ND		
1-4-Dichlorobenzene	2969	0.075	ND		
Styrene	2996	0.1	ND		
Tetrachloroethylene	2987	0.005	ND		
Toluene	2991	1.0	ND		
Total Xylenes	2955	10.0	ND		
Trans-1,2-Dichloroethylene	2979	0.1	ND		
Trichloroethylene	2984	0.005	ND		

Vinyl Chloride	2976	0.002	ND		

Unregulated

Contaminant	Code	Analysis mg/l	Method 524.2	Analyst * Umpqua
1,1-Dichloroethane	2978	ND		
1,1-Dichloropropene	2410	ND		
1,1,1,2-Tetrachloroethane	2986	ND		
1,1,2,2,-Tetrachloroethane	2988	ND		
1,2,3,-Trichloropropane	2414	ND		
1,3-Dichloropropane	2412	ND		
Trans-1,3-Dichloropropene	2224			
Cis-1,3-Dichloropropene	2413	ND		
2,2-Dichloropropane	2416	ND		
Bromobenzene	2993	ND		
Bromodichloromethane	2943	ND		
Bromoform	2942	ND		
Bromomethane	2214	ND		
Chloroethane	2216	ND		
Chloroform	2941	ND		
Chloromethane	2210	ND		
Dibromochloromethane	2944	ND		
Dibromomethane	2408			
1-3-Dichlorobenzene	2967			
2-Chlorotoluene	2965	ND		
4-Chlorotoluene	2966	ND		

BAKER CITY OF 28954

Comments:

Signature / Date: Brenda Ellis 12-10-02

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Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

Water System ID #: 4100073 Source ID: Source name(s):

Water System BAKER CITY OF

Address PO BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: OLD MOUNTAIN LINE Sampled by: KEN ELLIS

Date Collected: 10/14/02 Time collected: 8:00:00AM

Date received: 10/14/02 Date analyzed: 11/05/02

Sample Composition: | Single

Lab sample ID #: 28953 Sample Composited : No

UCMR

Regulated VOCs

Contaminant	Code	MDL mg/l	Analysis mg/l	Method	Analyst
Perchlorate		4.0	ND	314.0	*Umpqua
DCPA-mono + di acid		1.0	ND	515.2	
Methyl-tert butyl ether (MTBE)		5.0	ND	524.2	
Nitrobenzene		10.0	ND	524.2	
2,4-Dinitrotoluene		2.0	ND	525.2	
2,6-Dinitrotoluene		2.0	ND	525.2	
Acetochlor		2.0	ND	525.2	
4,4'-DDE		0.8	ND	525.2	
EPTC		1.0	ND	525.2	
Molinate		0.9	ND	525.2	
Terbacil		2.0	ND	525.2	

Brenda Ellis 12-10-02

Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

Water System ID #: 4100073	Source ID:	Source name(s):

Water System BAKER CITY OF

Address P.O. BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: OLD MOUNTAIN LINE	Sampled by: KEN ELLIS
Date Collected: 10/14/2002	Time collected: 8:00:00 AM
Date received: 10/14/2002	Date analyzed: 11/16/2002
Sample Composition: |	Single
Lab sample ID #: 28953	Sample Composited : No

Volatile Organic Chemicals — MDL for all test = 0.0005

Regulated VOCs

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
1,1-Dichloroethylene	2977	0.007	ND	524.2	*Umpqua
1,1,1-Trichloroethane	2981	0.2	ND		
1,1,2-Trichloroethane	2985	0.005	ND		
1,2 Dichloroethane	2980	0.005	ND		
1,2 Dichloropropane	2983	0.005	ND		
1,2,4-Trichlorobenzene	2378	0.07	ND		
Benzene	2990	0.005	ND		
Carbon Tetrachloride	2982	0.005	ND		
Cis-1,2-Dichloroethylene	2380	0.07	ND		
Methylene Chloride	2964	0.005	ND		
Ethylbenzene	2992	0.7	ND		
Chlorobenzene	2989	0.1	ND		
1-2-Dichlorobenzene	2968	0.6	ND		
1-4-Dichlorobenzene	2969	0.075	ND		
Styrene	2996	0.1	ND		
Tetrachloroethylene	2987	0.005	ND		
Toluene	2991	1.0	ND		
Total Xylenes	2955	10.0	ND		
Trans-1,2-Dichloroethylene	2979	0.1	ND		
Trichloroethylene	2984	0.005	ND		

Vinyl Chloride	2976	0.002	ND		

Unregulated

Contaminant	Code	Analysis mg/l	Method	Analyst
1,1-Dichloroethane	2978	ND	524.2	* Umpqua
1,1-Dichloropropene	2410	ND		
1,1,1,2-Tetrachloroethane	2986	ND		
1,1,2,2,-Tetrachloroethane	2988	ND		
1,2,3,-Trichloropropane	2414	ND		
1,3-Dichloropropane	2412	ND		
Trans-1,3-Dichloropropene	2224			
Cis-1,3-Dichloropropene	2413			
2,2-Dichloropropane	2416	ND		
Bromobenzene	2993	ND ND		
Bromodichloromethane	2943	ND		
Bromoform	2942	ND		
Bromomethane	2214	ND		
Chloroethane	2216	ND		
Chloroform	2941	ND		
Chloromethane	2210	ND		
Dibromochloromethane	2944	ND		
Dibromomethane	2408			
1-3-Dichlorobenzene	2967			
2-Chlorotoluene	2965	ND		
4-Chlorotoluene	2966	ND		

BAKER CITY OF 28953

Comments:

Signature / Date: Brenda Ellis 12-10-02

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Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

Water System ID #: 4100073 Source ID: Source name(s):

Water System BAKER CITY OF

Address P.O. BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: OLD MOUNTAIN LINE Sampled by: KEN ELLIS

Date Collected: 10/14/2002 Time collected: 8:30:00 AM

Date received: 10/14/2002 Date analyzed: 10/23/2002

Sample Composition: | Single

Lab sample ID #: 28947 Sample Composited : No

Volatile Organic Chemicals MDL for all test = 0.0005

Regulated VOCs

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
1,1-Dichloroethylene	2977	0.007	ND	524.2	*Umpqua
1,1,1-Trichloroethane	2981	0.2	ND		
1,1,2-Trichloroethane	2985	0.005	ND		
1,2 Dichloroethane	2980	0.005	ND		
1,2 Dichloropropane	2983	0.005	ND		
1,2,4-Trichlorobenzene	2378	0.07	ND		
Benzene	2990	0.005	ND		
Carbon Tetrachloride	2982	0.005	ND		
Cis-1,2-Dichloroethylene	2380	0.07	ND		
Methylene Chloride	2964	0.005	ND		
Ethylbenzene	2992	0.7	ND		
Chlorobenzene	2989	0.1	ND		
1-2-Dichlorobenzene	2968	0.6	ND		
1-4-Dichlorobenzene	2969	0.075	ND		
Styrene	2996	0.1	ND		
Tetrachloroethylene	2987	0.005	ND		
Toluene	2991	1.0	ND		
Total Xylenes	2955	10.0	ND		
Trans-1,2-Dichloroethylene	2979	0.1	ND		
Trichloroethylene	2984	0.005	ND		

Vinyl Chloride	2976	0.002	ND		

Unregulated

Contaminant	Code	Analysis mg/l	Method 524.2	Analyst * Umpqua
1,1-Dichloroethane	2978	ND		
1,1-Dichloropropene	2410	ND		
1,1,1,2-Tetrachloroethane	2986	ND		
1,1,2,2,-Tetrachloroethane	2988	ND		
1,2,3,-Trichloropropane	2414	ND		
1,3-Dichloropropane	2412	ND		
Trans-1,3-Dichloropropene	2224			
Cis-1,3-Dichloropropene	2413	ND		
2,2-Dichloropropane	2416	ND		
Bromobenzene	2993	ND		
Bromodichloromethane	2943	ND		
Bromoform	2942	ND		
Bromomethane	2214	ND		
Chloroethane	2216	ND		
Chloroform	2941	ND		
Chloromethane	2210	ND		
Dibromochloromethane	2944	ND		
Dibromomethane	2408			
1-3-Dichlorobenzene	2967			
2-Chlorotoluene	2965	ND		
4-Chlorotoluene	2966	ND		

BAKER CITY OF 28947

Comments:

Signature / Date: Brenda Ellis 12-10-02

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Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

Water System ID #: 4100073 Source ID: Source name(s):

Water System BAKER CITY OF

Address P.O. BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: RESEVOIR WELL Sampled by: KEN ELLIS

Date Collected: 10/14/2002 Time collected: 8:10:00 AM

Date received: 10/14/2002 Date analyzed: 10/23/2002

Sample Composition: | Single

Lab sample ID #: 28943 Sample Composited : No

Volatile Organic Chemicals MDL for all test = 0.0005

Regulated VOCs

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
1,1-Dichloroethylene	2977	0.007	ND	524.2	*Umpqua
1,1,1-Trichloroethane	2981	0.2	ND		
1,1,2-Trichloroethane	2985	0.005	ND		
1,2 Dichloroethane	2980	0.005	ND		
1,2 Dichloropropane	2983	0.005	ND		
1,2,4-Trichlorobenzene	2378	0.07	ND		
Benzene	2990	0.005	ND		
Carbon Tetrachloride	2982	0.005	ND		
Cis-1,2-Dichloroethylene	2380	0.07	ND		
Methylene Chloride	2964	0.005	ND		
Ethylbenzene	2992	0.7	ND		
Chlorobenzene	2989	0.1	ND		
1-2-Dichlorobenzene	2968	0.6	ND		
1-4-Dichlorobenzene	2969	0.075	ND		
Styrene	2996	0.1	ND		
Tetrachloroethylene	2987	0.005	ND		
Toluene	2991	1.0	ND		
Total Xylenes	2955	10.0	ND		
Trans-1,2-Dichloroethylene	2979	0.1	ND		
Trichloroethylene	2984	0.005	ND		

Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

System ID #: 4100073	Entry Point or Source ID:	Source name(s):
Water System BAKER CITY OF		
Address P.O. BOX 650		
City, State, Zip BAKER CITY OR 97814		
Sample Identification		
Sampled at: RESEVOIR WELL		Sampled by: KEN ELLIS
Date Collected: 10/14/2002		Time collected: 8:10:00 AM
Date recieved: 10/14/2002		Date analyzed:
Sample Composition:	Single	
Lab sample ID #: 28942		Sample Composited: No

Synthetic Organic Chemicals

Regulated

Contaminant	Code	MCL mg/l	Analysis mg/l	MDL	Method	Analyst
2,4-D	2105	0.07	ND	0.0002	515.1	Umpqua
2,4,5-TP Silvex	2110	0.05	ND	0.0004	515.1	Umpqua
Adipates	2035	0.4	ND	0.001	506	Umpqua
Alachlor (Lasso)	2051	0.002	ND	0.0004	505	Umpqua
Atrazine	2050	0.003	ND	0.0002	507	Umpqua
Benzo(A)Pyrene	2306	0.0002	ND	0.00004	550.1	Umpqua
BHC-gamma (Lindane)	2010	0.0002	ND	0.00002	505	Umpqua
Carbofuran	2046	0.04	ND	0.001	531.1	Umpqua
Chlordane	2959	0.002	ND	0.0004	508	Umpqua
Dalapon	2031	0.2	ND	0.002	515.1	Umpqua
Dibromochloropropane	2931	0.0002	ND	0.00002	504.1	Umpqua
Dinoseb	2041	0.007	ND	0.0004	515.1	Umpqua
Dioxin	2063	$3x10^{-8}$				
Diquat	2032	0.02	ND	0.004	549.2	Umpqua
Endothall	2033	0.1	ND	0.01	548.1	Umpqua
Endrin	2005	0.002	ND	0.00002	505	Umpqua
Ethylene Dibromide (EDB)	2946	0.00005	ND	0.00001	504.1	Umpqua
Glyphosate	2034	0.7	ND	0.01	547	Umpqua
Heptachlor Epoxide	2067	0.0002	ND	0.00002	505	Umpqua

CORRECTED

Heptachlor	2065	0.0004	ND	0.00004	505	Umpqua
Hexachlorobenzene (HCB)	2274	0.001	ND	0.0001	505	Umpqua
Hexachlorocyclopentadiene	2042	0.05	ND	0.0002	505	Umpqua
Methoxychlor	2015	0.04	ND	0.0002	505	Umpqua
Pentachlorophenol	2326	0.001	ND	0.00008	515.1	Umpqua
Phthalates	2039	0.006	ND	0.002	506	Umpqua
Picloram	2040	0.5	ND	0.0002	515.1	Umpqua
Polychlorinated Biphenyls	2383	0.0005	ND	0.0002	508	Umpqua
Simazine	2037	0.004	ND	0.0001	507	Umpqua
Toxaphene	2020	0.003	ND	0.001	508	Umpqua
Vydate	2036	0.2	ND	0.002	531.1	Umpqua

Unregulated

Contaminant	Code	Analysis mg/l	Method	MDL	Analyst
3-Hydroxycarbofuran	2066	ND	531.1	0.004	Umpqua
Aldicarb	2047	ND	531.1	0.002	Umpqua
Aldicarb Sulfoxide	2043	ND	531.1	0.003	Umpqua
Aldicarb Sulfone	2044	ND	531.1	0.001	Umpqua
Aldrin	2356	ND	505	0.0001	Umpqua
Butachlor	2076	ND	507	0.001	Umpqua
Carbaryl	2021	ND	531.1	0.004	Umpqua
Dicamba	2440	ND	515.1	0.005	Umpqua
Dieldrin	2070	ND	505	0.0001	Umpqua
Methomyl	2022	ND	531.1	0.004	Umpqua
Metolachlor	2045	ND	507	0.002	Umpqua
Metribuzin	2595	ND	507	0.001	Umpqua
Propachlor	2077	ND	507	0.001	Umpqua

BAKER CITY OF 289421

Signature / Date: Brenda Ellis 1-4-07

CORRECTED

Magic Valley Labs, 210 Addison Box 1867, Twin Falls, ID 83301

System ID #: 4100073 Entry Point or Source ID: Source name(s):

Water System BAKER CITY OF

Address P.O. BOX 650

City, State, Zip BAKER CITY OR 97814

Sample Identification

Sampled at: OLD MOUNTAIN LINE Sampled by: KEN ELLIS

Date Collected: 10/14/2002 Time collected: 8:30:00 AM

Date recieved: 10/14/2002 Date analyzed:

Sample Composition: | Single

Lab sample ID #: 28946 Sample Composited: No

Synthetic Organic Chemicals

Regulated

Contaminant	Code	MCL mg/l	Analysis mg/l	MDL	Method	Analyst
2,4-D	2105	0.07	ND	0.0002	515.1	Umpqua
2,4,5-TP Silvex	2110	0.05	ND	0.0004	515.1	Umpqua
Adipates	2035	0.4	ND	0.001	506	Umpqua
Alachlor (Lasso)	2051	0.002	ND	0.0004	505	Umpqua
Atrazine	2050	0.003	ND	0.0002	507	Umpqua
Benzo(A)Pyrene	2306	0.0002	ND	0.00004	550.1	Umpqua
BHC-gamma (Lindane)	2010	0.0002	ND	0.00002	505	Umpqua
Carbofuran	2046	0.04	ND	0.001	531.1	Umpqua
Chlordane	2959	0.002	ND	0.0004	508	Umpqua
Dalapon	2031	0.2	ND	0.002	515.1	Umpqua
Dibromochloropropane	2931	0.0002	ND	0.00002	504.1	Umpqua
Dinoseb	2041	0.007	ND	0.0004	515.1	Umpqua
Dioxin	2063	$3x10^{-8}$				
Diquat	2032	0.02	ND	0.004	549.2	Umpqua
Endothall	2033	0.1	ND	0.01	548.1	Umpqua
Endrin	2005	0.002	ND	0.00002	505	Umpqua
Ethylene Dibromide (EDB)	2946	0.00005	ND	0.00001	504.1	Umpqua
Glyphosate	2034	0.7	ND	0.01	547	Umpqua
Heptachlor Epoxide	2067	0.0002	ND	0.00002	505	Umpqua

CORRECTED

Heptachlor	2065	0.0004	ND	0.00004	505	Umpqua
Hexachlorobenzene (HCB)	2274	0.001	ND	0.0001	505	Umpqua
Hexachlorocyclopentadiene	2042	0.05	ND	0.0002	505	Umpqua
Methoxychlor	2015	0.04	ND	0.0002	505	Umpqua
Pentachlorophenol	2326	0.001	ND	0.00008	515.1	Umpqua
Phthalates	2039	0.006	ND	0.002	506	Umpqua
Picloram	2040	0.5	ND	0.0002	515.1	Umpqua
Polychlorinated Biphenyls	2383	0.0005	ND	0.0002	508	Umpqua
Simazine	2037	0.004	ND	0.0001	507	Umpqua
Toxaphene	2020	0.003	ND	0.001	508	Umpqua
Vydate	2036	0.2	ND	0.002	531.1	Umpqua

Unregulated

Contaminant	Code	Analysis mg/l	Method	MDL	Analyst
3-Hydroxycarbofuran	2066	ND	531.1	0.004	Umpqua
Aldicarb	2047	ND	531.1	0.002	Umpqua
Aldicarb Sulfoxide	2043	ND	531.1	0.003	Umpqua
Aldicarb Sulfone	2044	ND	531.1	0.001	Umpqua
Aldrin	2356	ND	505	0.0001	Umpqua
Butachlor	2076	ND	507	0.001	Umpqua
Carbaryl	2021	ND	531.1	0.004	Umpqua
Dicamba	2440	ND	515.1	0.005	Umpqua
Dieldrin	2070	ND	505	0.0001	Umpqua
Methomyl	2022	ND	531.1	0.004	Umpqua
Metolachlor	2045	ND	507	0.002	Umpqua
Metribuzin	2595	ND	507	0.001	Umpqua
Propachlor	2077	ND	507	0.001	Umpqua

BAKER CITY OF 289461

Signature / Date: Brenda Ellis 1-4-03

CORRECTED

Appendix D

Appendix D: ASR Head Buildup/Drawdown Calculations

Appendix D: ASR Head Buildup/Drawdown Calculations

Assumptions
Baker City ASR Head Buildup/Drawdown Calculations

Operational Assumption

General –

Wintertime (long term) injection event

Summer time injection event to offset spilling

Target injection volume is 100 MG +

Wintertime

- **Wintertime injection period: December 1st to April 30th**
- **Assume injection shutdown due to turbidity events. Assume two events at 20 days per event, which is equal to 40 days of no injection**
- **Assume back flushing every 3 weeks (loss of 10 days of injection)**
- **Total days of injection = 100 days**
- **Assume 800 gpm (gallons per minute) for wintertime injection rate.**

Summer Time

- **Summer-time injection period: June 15th to July 30th**
- **Assume shutdown due to turbidity events. Assume two events at 2 days per event, which is equal to 4 days of no injection.**
- **Assume back flushing which will result in 3 days loss of injection**
- **Assume a loss of 10 days during injection due to cycling on and off the clear well.**
- **Total days of injection = 28 days**
- **Assume 1250 gpm for summer-time injection rate**

Pumping

- **Head buildup calculations from year-to-year assume that 100% of the stored water is removed from storage; otherwise the head buildup in the injection well will exceed the ground surface during Year 2 injection.**
- **Pumping rate is 1800 gpm**
    - **Winter-time storage volume is 115 MG, which is equal to a 44 day supply assuming 1800 gpm.**
    - **Summer-time storage volume is 50 MG, which is equal to a 19 day supply assuming 1800 gpm.**

Key Assumption

➢ *Aquifer characteristics further away from the well are uncertain. We have assumed no negative boundary(s)(e.g., faults that limited the size of the storage), which is based on results of 5-day constant rate test data. As such, we used specific capacity at 100 days based on projection of constant rate test drawdown curve. If the aquifer permeability is lower than estimated, the assumed injection rate of 800 gpm may not be sustainable over the entire injection period (100 days). Options for reducing the injection rate and keeping the pump column full without air include: 1) down-hole control valve, 2) periodically stopping injection to allow head buildup to dissipate, and 3) injecting under pressure in order to maintain a full pipe-column at a lower injection rate.*

Other Conservative Assumptions

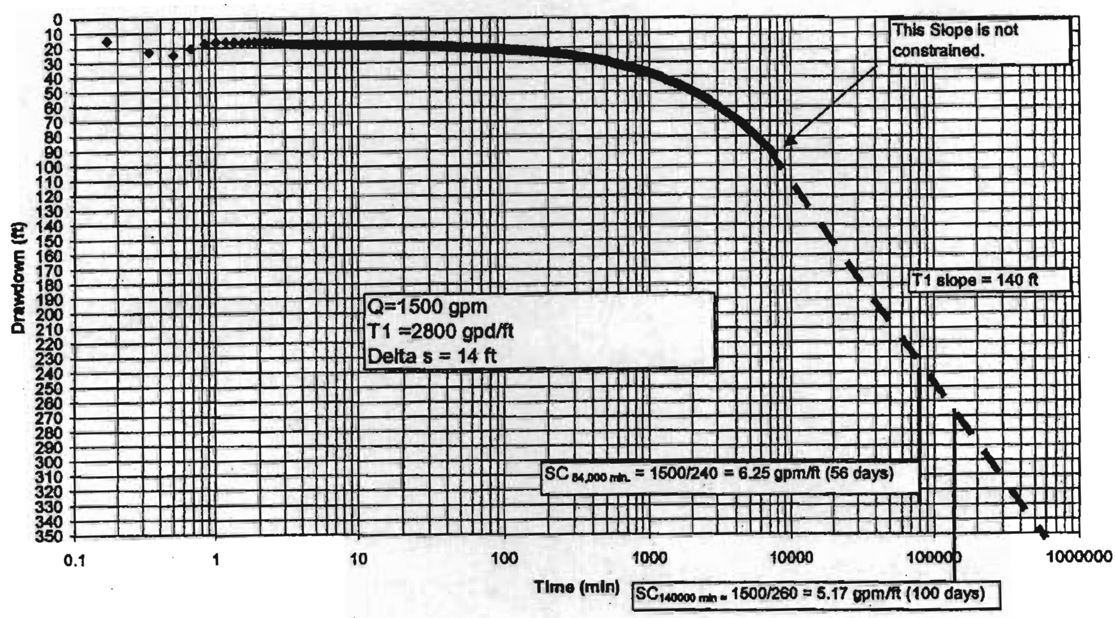
1) Threshold water level rise in ASR well during injection to be maintained 25 feet below ground surface (bgs).
2) Assume back flushing will help control the head buildup due to clogging in the ASR well.
3) Assume a 15% reduction in specific capacity between injection and pumping (based on early cycle testing data for the Beaverton Project). Year 2002 data for Beaverton showed little or no reduction between the injection and pumping specific capacity.
4) Assume a 15% reduction in injection specific capacity from year-to-year (based on early cycle testing data for Beaverton).
5) Assume no reduction in pumping specific capacity from year-to-year.
6) Assume a well efficiency of 50%, which is typical for basalt wells (e.g., Hanson Well).
7) Water level rise in aquifer will be used to predict seeps. If the water level in the aquifer is less than 177 feet bgs (which was the depth to water when the well was drilled) then assume no likelihood of seeps.
8) Specific capacity at 100 days based on constant rate test which was run at 1500 gpm – starting point.
9) Change in specific capacity at either higher or lower pumping rates calculated using step test data.
10) Wintertime head rise will begin to decay prior to start of summer-time injection. Decay rate calculated based on recovery curve of constant rate test. Trend line and equation fitted to test data to calculate decay rate for greater time span.
11) Since there was 6 feet of residual drawdown after the constant rate test, assume that all of the water pumped was taken out of storage.
12) Assume summer-time injection specific capacity is 30% lower than wintertime injection specific capacity since the aquifer has already been loaded with approximately 100 MG.
13) Incorporate turbidity events into the injection cycle.
14) Incorporate cycling of the clear well for summer-time injection cycle.

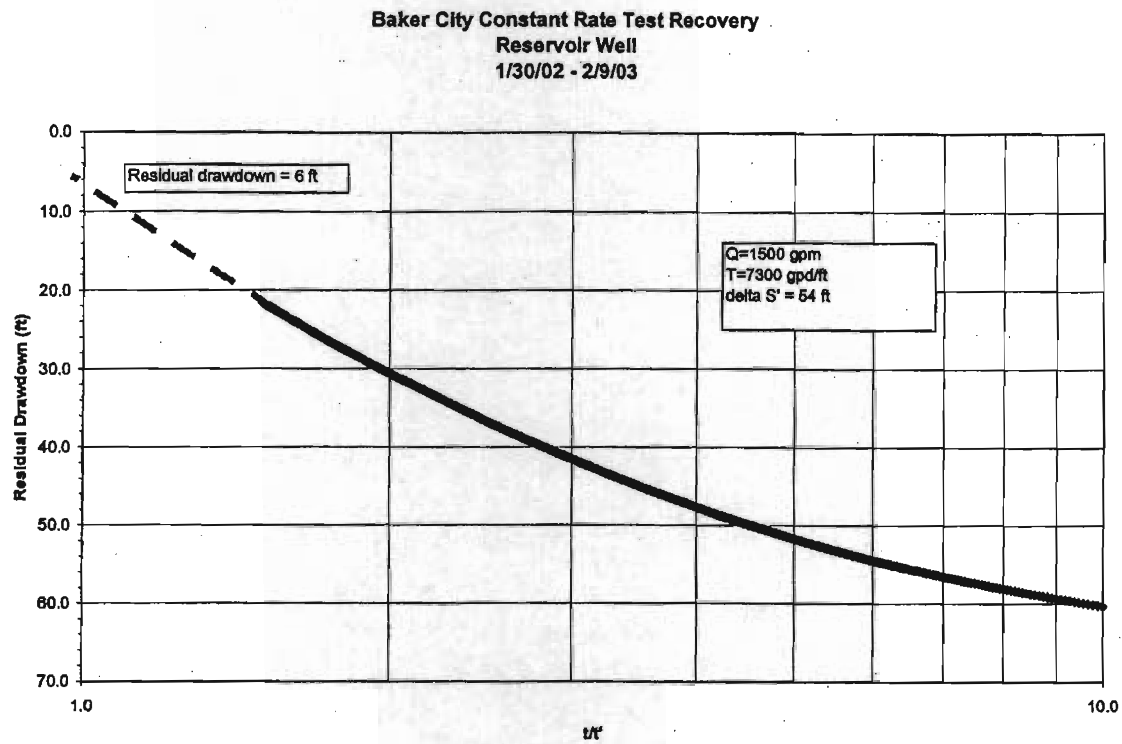
15) Head build up for summer injection period starts from where the wintertime head build in injection well ended up minus decay amount (which is 36 feet).

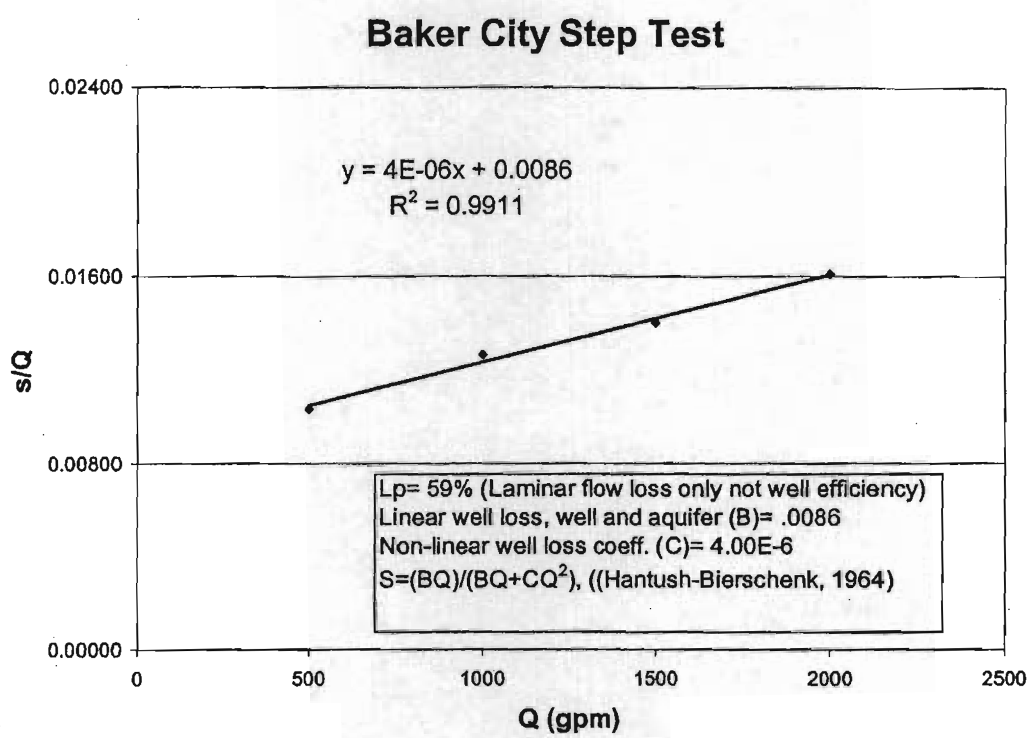
16) Assume the head rise in the aquifer is the same from year to year starting from the pre-ASR static water level, which is based on the assumption that 100 percent of stored water is removed. No reduction in aquifer transmissivity beyond the borehole skin.

17) Drawdown is based on where the head is after injection and not based on pre-injection static water level.

Baker City Constant Rate Aquifer Test
Reservoir Well
1/24/03 - 1/27/03




Baker City Constant Rate Test Recovery
Reservoir Well
1/30/02 - 2/9/03
Residual drawdown = 6 ft
Q=1500 gpm
T=7300 gpd/ft
delta S' = 54 ft
Residual Drawdown (ft)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
1.0
10.0
t/t'


Baker City Step Test
y = 4E-06x + 0.0086
R2 = 0.9911
Lp= 59% (Laminar flow loss only not well efficiency)
Linear well loss, well and aquifer (B)= .0086
Non-linear well loss coeff. (C)= 4.00E-6
S=(BQ)/(BQ+CQ2), ((Hantush-Bierschenk, 1964)
s/Q
0.02400
0.01600
0.00800
0.00000
0
500
1000
1500
2000
2500
Q (gpm)

Estimating Changes in Specific Capacity at different injection/pumping rates

Use Step Test Equation

4X10-6 Q + 00.86

Where y = s/Q ft/gpm

Thus 1/y = Q/s gpm/ft (same as Specific Capacity (SC))

Drawdown at different pumping rates from step tests

SWL = 248 ft bgs

500 gpm = 253 ft dd

1000 gpm = 261 ft dd

1500 gpm = 269 ft dd

SC @ 1500 gpm = 1500/(269-248) = 71.41 gpm/ft

<u>SC from 1500 gpm to 800 gpm</u>

Y = 4X10-6 (800 gpm) + 0.0086

Y = 0.0118

1/y = 84.75 gpm/ft

SC @ 1500 gpm = 71.42 gpm/ft to SC @800 gpm = 84.75 gpm/ft or 19% increase

Assume 20% increase in SC when going from 1500 gpm to 800 gpm

SC from 1500 gpm to 1250 gpm

Y = 4X10-6 (1250 gpm) + 0.0086

Y = 0.0136

1/y = 73.52 gpm/ft

Assume a 3% increase in SC when going from 1500 gpm to 1250 gpm

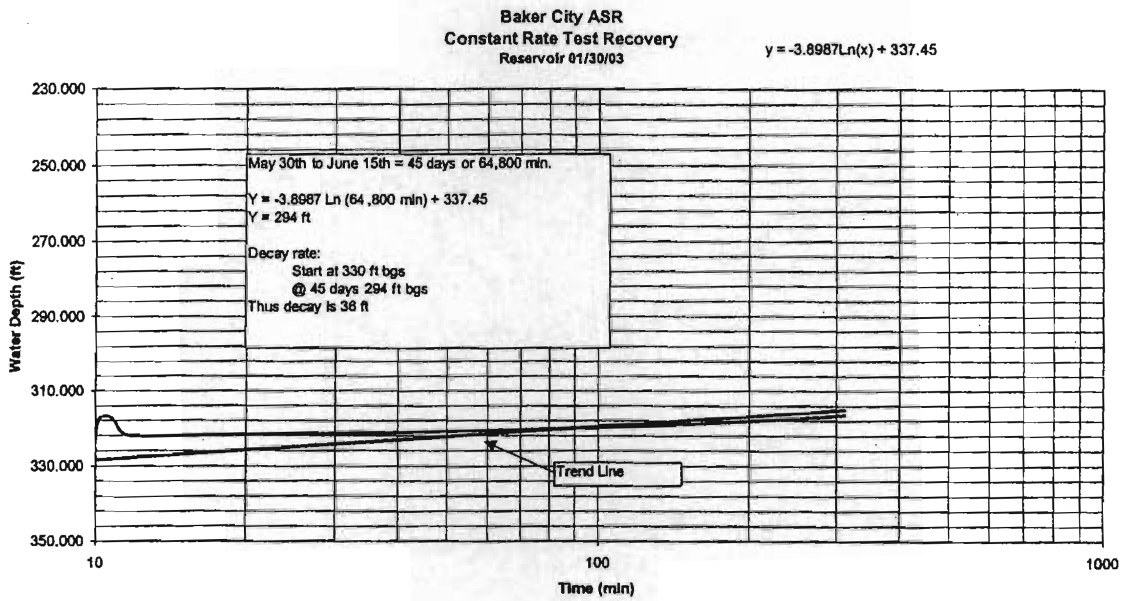
SC from 1500 gpm to 1800 gpm

Y = 4X10-6 (1800 gpm) + 0.0086

Y = 0.0158

1/y = 63.3 gpm/ft

Assume a 10% reduction in SC when going from 1500 gpm to 1800 gpm


Baker City ASR
Constant Rate Test Recovery
Reservoir 01/30/03
y = -3.8987Ln(x) + 337.45
May 30th to June 15th = 45 days or 64,800 min.
Y = -3.8987 Ln (64,800 min) + 337.45
Y = 294 ft
Decay rate:
Start at 330 ft bgs
@ 45 days 294 ft bgs
Thus decay is 36 ft
Trend Line
Water Depth (ft)
Time (min)

Baker City Head Buildup Calculations -- Winter Time

Assumptions												
	SWL								[redacted]	SWL bgs		
	Start Injection				1-Dec	Each year			[redacted]			
	Stop Injection				30-Apr	Each year			[redacted]			
	Total Days				150	days			[redacted]			
	Back flush 20 weeks every 3 weeks 7 days				-10	days			[redacted]			
	NTU events greater than 0.5								[redacted]			
		2 events at 20 days per			-40	days			[redacted]			
				Total Days	100				[redacted]	days		
	Assume a 50% well efficiency -- typical for basalt wells								[redacted]	well eff		
	Volume estimates:								[redacted]			
	At 800 gpm		115,200,000	MG					[redacted]	gpm injection rate		
	At 1300 gpm		187,200,000	MG					[redacted]	gpm injection rate		
	At 1800 gpm pumping assuming winter and summer time storage of 147 MG						57	days	[redacted]	gpm pumping rate		
	Maintain head buildup in well at 25 bgs -- threshold								[redacted]	bgs threshold		
	Assume 800 gpm since target is only 100 MG								[redacted]	gpm injection rate		
									[redacted]			
	Constant rate SC @ 1500 gpm at 100 days								[redacted]	gpm/ft		
	Pumping SC @ 800 gpm at 100 days is 20% greater based on step test data								[redacted]			
							20%	1.2	[redacted]	gpm/ft		
	Pumping SC at 1500 at 56 days								[redacted]	gpm/ft		
	Pumping SC at 1800 at 56 days assuming 15 % reduction based on step test data						-15%		[redacted]	gpm/ft		
	Injection SC is 15% less than pumping SC						-15%	0.85	[redacted]	gpm/ft		
	Assume 15% reduction in SC between successive years								[redacted]	15% reduction		
Head Buildup Estimates (800 gpm injection rate)												
		Inside Well Casing				*Outside Borehole in Aquifer*						
	Year 1	136.40	ft of head buildup									
SC yr 1	5.865	113.60	bgs			181.80	bgs					
	Year 2	160.47	ft of head buildup									
SC yr 2	4.99	89.53	bgs			181.80	bgs	Same since water recovered from storage and SC				
								in aquifer is not reduced with each injection cycle				
	Year 3	188.79	ft of head buildup									
SC yr 3	4.24	61.21	bgs			181.80		Ditto				
	Year 4	222.11	ft of head buildup									
SC yr 4	3.60	27.89	bgs			181.80		Ditto				
	Year 5	261.30	ft of head buildup									
SC yr 5	3.06	-11.30	bgs			Head Buildup in Well Above Ground Surface -- Redevelopment Needed						
Drawdown Estimates												
Pumping rate of 1800 gpm -- prior to summer time injection												
		Inside Well Casing				*Outside Borehole in Aquifer*						
	Year 1	327.27	ft drawdown			345.44	bgs					
SC yr 1	5.50	440.87	bgs									
	Year 2	327.27	ft drawdown			345.44	bgs	*Same since water recovered from storage and SC in*				
SC yr 2	5.50	416.80	bgs	*Note: Since Head Building is*				*aquifer is not reduced with each injection cycle.*				
				higher each year the drawdown								
	Year 3	327.27	ft drawdown	*in the well in terms of bgs is less*		345.44	bgs					
SC yr 3	5.50	388.48	bgs	*each year assuming no*								
				reduction in pumpng SC								
	Year 4	327.27	ft drawdown			345.44	bgs					
SC yr 4	5.50	355.16	bgs									
	Year 5	327.27	ft drawdown			345.44	bgs					
SC yr 5	5.50	315.97	bgs									
SC = specific capacity = injection or pumping rate divided by drawup or drawdown = gpm/ft												
bgs = below ground surface												
SWL = static water level bgs												

Baker City Head Buildup Calculations -- Summer Time

Assumptions										
	Start injection after one winter injection season									
	Start injection				15-Jun	Each year			[redacted]	
	Stop injection				30-Jul	Each year				
	Total Days				45	days				
	Back flush 3 times				-3	days				
	NTU events greater than 0.5									
		2 events at 2 days per event			-4	days				
	Cycling of Clear Well results in lost days				-10					
				Total Days	28					days
	Assume 50% well efficiency which is typical for basalt wells									% well eff
	Volume estimates:									
	At 800 gpm		32,256,000	MG						gpm injection rate
	At 1250 gpm		50,400,000	MG						gpm injection rate
	Pumping Rate									gpm pumping
	Maintain head buildup in well at 25 bgs -- threshold									bgs threshold
	Assume 1250 injection rate per Baker request									gpm injection rate
	Constant rate SC @ 1500 gpm for 30 days									gpm/ft
	Pumping SC @ 1250 gpm for 30 days is 3% greater based on step test data									
							3%	1.03		gpm/ft
	Pumping SC at 1800 at 56 days assuming 15 % reduction based on step test data									gpm/ft
	Summer time injection specific capacity is 30% less due to winter-time loading of aquife						-30%	0.7		gpm/ft
	Assume 15% reduction in SC between successive years									15% reduction
	Based on recovery curve trend the winter-time head rise will decay 36 ft after 45 days									ft decay of winter-time head rise
Head Buildup Estimates (1250 gpm injection rate)										
		Inside Well Casing				***Outside Borehole in Aquifer***				
	Year 1	78.80	ft of head buildup							
SC yr 1	15.862	70.79	bgs			142.40	bgs			
	Year 2	92.71	ft of head buildup							
SC yr 2	13.48	32.82	bgs			142.40	bgs	Same since water recovered from storage and SC		
								In aquifer is not reduced with each injection cycle		
	Year 3	109.07	ft of head buildup							
SC yr 3	11.46	-11.86	bgs			Head Buildup in Well Above Ground Surface -- Redevelopment Needed				
Drawdown Estimates										
		Inside Well Casing					***Outside Borehole in Aquifer***			
	Year 1	327.27	ft of drawdown				306.03	bgs		
SC yr 1	5.50	398.07	bgs		*Note: Since Head Building is*					
					higher each year the drawdown					
	Year 2	327.27	ft of drawdown		*in the well in terms of bgs is less*		306.03	bgs	Same since water recovered from storage and SC	
SC yr 2	5.50	360.09	bgs		*each year assuming no*				In aquifer is not reduced with each injection cycle	
					reduction in pumpng SC					
	Year 3	327.27	ft of drawdown				306.03	bgs		
SC yr 3	5.50	315.41	bgs							
SC = specific capacity = injection or pumping rate divided by drawup or drawdown = gpm/ft										
bgs = below ground surface										

Baker City Storage Volume Estimate

Volume removed during constant rate test @ 1500 gpm for 5 days

Volume = 10,800,000

SWL 1977	177 bgs
SWL 2003	250 bgs
Difference	73

Residual Recovery 6 ft
(see recovery curve)

Assuming all water pumped during constant rate test was from storage

Gallons per foot of residual drawdown 1,800,000

Assume that there is 73 feet of available head room in the aquifer to allow the water level to rise to the 1977 level and assume that the 1977 SWL is in equilibrium with the system with no anomalies.

Thus: 73 X 3.6 MG 1.8 131,400,000

Available storage volume based on 1977 SWL level is 131.4 MG

Appendix E

Appendix E: Phase 2 ASR Pilot Project Scope of Work

Appendix E

Phase 2 Aquifer Storage and Recovery Pilot Project

If the City chooses to move forward with the ASR project based on the findings from the feasibility study, an ASR pilot project will be conducted as required by the OWRD ASR rules. The project will include permitting the well according to State ASR regulations and will include completing an ASR pilot test under an ASR limited license. The following specific scope of services will be provided.

Task 1 – Permitting. Meet with the Oregon Water Resources Department (OWRD) to discuss the City's plans for implementing ASR. Discuss with OWRD any concerns they may have with the program to make sure there are no fatal flaws prior to proceeding. Prepare an ASR limited license application on behalf of the City and submit it to OWRD. Follow-up with OWRD to ensure a limited license is issued for the project. We assume that the City will be intimately involved in this task and that GSI will provide support in agency meetings and that GSI will prepare the limited license application. Dick Fleming will be task lead.

Task 2 – ASR Design and Bidding. AP will prepare plans and specifications for retrofitting the well and will prepare a bid document that the City can use to solicit bids from qualified contractors for retrofitting the ASR well. We will work closely with the City during the design phase to be sure that the system equipment, controls and operation meet expectations. Because the well cannot be out-of-service for an extended period of time, the work must be well planned; this will be accomplished through frequent communications with the City, the selected contractor and the GSI-AP team. An evaluation of the best way to control injection will be performed. Methods that will be evaluated include injection through the pump bowls and the use of a down-hole control valve. In most cases, injection through the pump bowls is preferred due to the high cost and complexity of down-hole control valves. The recharge source water will come from the reservoir via a new booster pump. The booster pump will permit the City to recharge at a constant rate whenever there is additional capacity in the system. The injection system will be controlled via telemetry using the level in the reservoir, which will eliminate the need to spill excess water delivered from the watershed. The design will include a pump to waste system for wastewater generated during pump startup and periodic back flushing episodes. A SCADA system will be developed to allow the City to remotely monitor (including City Hall) and data log important operating characteristics of the ASR system. These operating characteristics will include reservoir level, flow rate, injection/recovery volume, turbidity, well water level, temperature, and alarm status. AP will provide the general conditions and technical specifications for the contract documents. The City will bid, advertise and manage the retrofit of the ASR well; AP will be involved in bid evaluation and will be available to answer technical questions related to the retrofit. Because this is a municipal water system, the Oregon Health Division must approve plans for the ASR system. If desired by the City, we would also be willing to discuss doing the ASR design and construction as a turnkey project utilizing Ed Butts and Stettler Supply as the ASR system construction contractor. Robin Harris and Jess Holt of AP will lead this task.

Task 3 – ASR Work Plan. GSI will prepare an ASR Work Plan and submit it to OWRD for approval following City review and acceptance. The work plan will present a groundwater monitoring plan, water quality sampling plan, ASR pilot testing plan, and ASR system design. GSI will address agency comments on the work plan. Jeff Barry of GSI will be task lead.

Task 4 – ASR Pilot Testing. Complete a pilot test program based on the approved ASR work plan. The pilot test program will consist of a short-term (1 week) injection and recovery test followed by an extended injection period (4 to 6 months depending upon available recharge water supply and turbidity levels). Well efficiency will be monitored closely during injection (utilizing water level and injection rate data) to determine the rate of clogging and to identify when back flushing should occur in order to remove sediment introduced during injection. Beginning in June or July, the well will be pumped to recover the stored water. Prior to introduction of the water to the City's system, a water sample will be collected to confirm that it meets all drinking water standards and that it has acceptable taste and odor. Additional water samples will be collected periodically during recovery to assess water quality changes. The testing program will last approximately one year. As a cost saving measure, we have assumed that the City will collect the majority of the field data with support from GSI and local AP staff. Jeff Barry of GSI will be task lead with support from Larry Eaton. Specific work elements include the following:

1) GSI will install dataloggers and direct collection of base line groundwater elevation data by City staff prior to ASR testing.
2) AP will assist the City during initial injection and recovery startup and testing to make sure that the system is functioning properly.
3) GSI will direct monitoring of the injection well and up to three groundwater wells during ASR testing based on the approved ASR Work Plan. City staff will collect the water level and injection/pumping rate data. Periodically, local AP staff will download dataloggers and forward the data to GSI. The City will collect water quality samples according to the ASR work plan and ship them to the laboratory for testing. GSI will evaluate the data and enter it into a project database.
4) GSI will analyze the water level and water quality data and present bi-weekly updates to the City during the injection phase of the ASR pilot test program. GSI will recommend when the City should perform back flushing.

Task 5 – ASR Analysis and Report. We will complete a review of the ASR pilot study and determine if the project is feasible and whether or not the City should apply for an ASR Permit for full-scale operation. Treatment requirements will be evaluated. A realistic ASR expansion plan will be provided that includes preliminary engineering cost estimates and cost/benefits and associated risk of adding additional ASR wells to the system. This analysis will include a review of how an expanded ASR system can be beneficially incorporated into the City's existing water supply system. Pilot testing results will be presented in a final ASR report and submitted to the City and OWRD for review. Jeff Barry of GSI will be task lead.

Task 6 – ASR Operations Plan. We will develop an ASR operational plan that the City staff can use to run the ASR system. The plan will include target injection and pumping rates, injection and recovery schedule, recharge turbidity criteria, injection efficiency monitoring, recommended back flushing frequency, and injection startup, injection shutdown, and pumping startup procedures. We have assumed City involvement in this task to ensure that the operational plan meets the City's expectations and that ASR operational protocols fit well with the City's current water supply operational plan. Jeff Barry and Robin Harris will collaborate with the City on this task.

Appendix F

Appendix F: ASR Process Narrative (Stettler Supply Company

City of Baker City Oregon
Well #1
ASR Program

Process Narrative

Introduction: The Aquifer Storage and Recovery (ASR) system contemplated for the Baker City Well #1 will consist of two individual and separate operations: 1) Recharging, and 2) Withdrawal. The control and safety functions for each operation will utilize equipment with parallel capability, when possible, to simplify the system and avoid duplication of cost and/or control function. The following narratives outline the preliminary concept of operational and safety functions for each operation:

Recharging

Recharge operation will consist of extraction of potable and treated water from the chlorine contact chamber through use of a new booster pump. This water will be diverted to Well #1 via a new 10" buried recharge line to be installed from the proposed booster pump location to Well #1. Water will be delivered into the well and aquifer by direct discharge through a series of control valves and ultimately down the column, through the bowl assembly and pump inlet, and into the well. Adequate pressure to prevent cascading or air entrainment will be accomplished through wellhead pressure developed through a combination of the booster pump, gravity head developed from the wellhead down to the standing water level in the well, and frictional losses developed from the column/lineshaft and the bowl assembly. Flow control will be the primary control threshold with safety overrides capable of disabling the system at any time. The system is intended to be controlled as a manual operation with automatic safety overrides.

Control: The following control functions, in the order listed, will operate the recharge process:

Beginning Status: All pumps off----valving and control logic in normal operational position for withdrawal----Safeties in normal configuration----No alarms

Control Valve "A"---open; Control Valve "B"----closed; Control Valve "C"----open

1) Operator rotates selector switch to "Recharge" position from "Off" position (Selector switch positions: "Off"-----"Recharge"----"Well Pump")
2) Operator selects desired recharge rate: 800 GPM------1500 GPM
3) Operator presses "Start" button
4) Well pump is immediately "locked out of service"
5) Blowoff control valve "C" remains open
6) Discharge line control valve "B" remains closed
7) Well Discharge valve "A" closes
8) Recharge booster pump starts

9) Initial recharge water discharged through blowoff for pre-determined interval or until turbidity is within acceptable range.
10) Well Discharge control valve "A" opens
11) Blowoff control valve "C" closes
12) Booster pump operates at full rate until column is filled
13) Pressure sensor on well discharge line reports adequate recharge pressure at wellhead
14) Booster pump, via variable frequency drive, lowers flow rate and controls flow rate at selected rate after receipt of appropriate signal from pressure sensor using analog comparator from flowmeter.

<Normal shutdown sequence>

1) Operator returns selector switch to "Off" position
2) Control valve "C" opens
3) Booster pump shuts down
4) Control valve "B" remains closed

<system now at normal "off" state>

Control: The following controls will regulate the recharge process:
1) Flowmeter-----Controls preselected recharge flow rate via analog feedback
2) Analog pressure sensor-------Insures maintenance of adequate wellhead pressure during recharge
3) Variable Frequency Drive------Modulates motor speed to regulate and maintain pre-determined recharge flow rate.

Safety Overrides: The following safety controls will immedialtely shutdown the recharge process
1) Analog pressure sensor: Will shutdown and lockout the recharge process should wellhead pressure fall below 10 psi or above 100 psi - "Alarm output"
2) Flowmeter: Will shutdown and lockout the recharge process should recharge flow vary more than 20% above or below the selected flow rate.-------- "Alarm output"
3) Turbidity: Will send alarm (but not shutdown) should turbidity rise above selected value.---"Alarm output"
4) Power failure: System will not restart until manually restarted "Alarm output"
5) Well water level—Will send alarm (but not shutdown system) should water level in well exceed or fall below predetermined levels.
6) Valve failure: Any valve that fails to operate (open or close) to it's required location will result in system shutdown via microswitches-- "Alarm output"

Withdrawal

Normal operation of the well will not differ appreciably from the current operation, except for operation of the control valves and a predetermined blowoff period. Well operation will be based on normal withdrawal of water from the existing well using a new vertical turbine pump (which will also be used for recharge purposes). Operation of the well pump is also intended to be a manual operation with appropriate operational and safety controls.

Control: The following functions, in the order listed, will control normal well pump operation:

Beginning status: All pumps "off"-----Valving and controls in normal withdrawal position----All safeties in normal configuration-----No alarms

Control Valve "A"---open; Control Valve "B"-----closed; Control Valve "C"----open

1) Operator rotates selector switch to "Well Pump" from "Off" position
2) Operator presses "Start" button"
3) Pre-lube injection valve opens and prelubricates lineshaft bearings for 10-15 minutes.
4) At end of prelube interval, well pump starts and delivers water to surface
5) Initial water from well discharges through Control Valve "C" for predetermined period.
6) Control valve "B" opens
7) Control valve "C" closes
8) Well pump delivers water to system

<Normal Shutdown Sequence>

1) Operator returns selector switch to "Off" position
2) Control valve "C" opens
3) Control valve "B" closes
4) Pump and motor shutdown occurs when control valve "C" is fully open

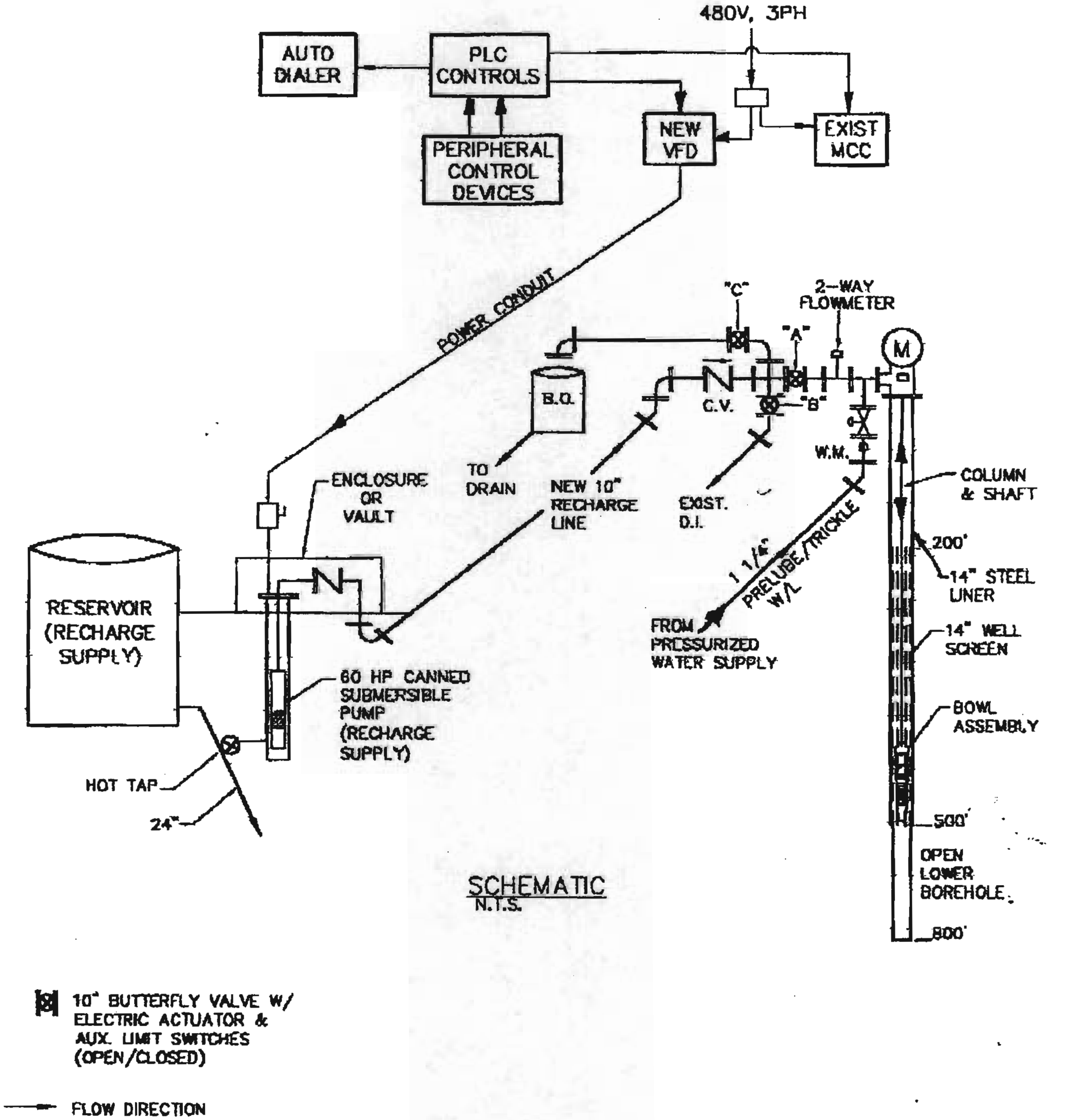
<System is now at normal "Off" state>

Safety Functions: The following safety controls will shutdown the well pump operation:

1) Analog pressure sensor: Will shutdown and lockout the well pump should operating pressure fall below or rise above predetermined levels—"Alarm output"
2) Flowmeter: Well pump will shutdown if analog signal is not received at adequate levels to PLC, indicates broken shaft—"Alarm output"
3) Power failure: System will not restart until manually restarted-"Alarm output"

4) Valve failure: Any valve that fails to operate to it's required location (open or closed) will prompt shutdown and lockout of system—"Alarm output"
5) Well water level: Water level below predetermined level (10'-20' above the bowl intake) will prompt shutdown and lockout of pump----"Alarm output"

BAKER CITY WELL #1
FOR
G.S.I.



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