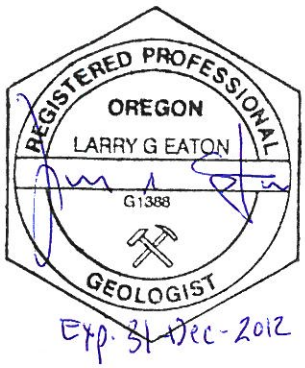
GSI Water Solutions, Inc.



Memorandum

To: Niki Iverson – City of Hillsboro
Peter Martin – City of Hillsboro
Kevin Hanway – City of Hillsboro

Cc: Jeff Barry, RG, CWRE – GSI Water Solutions, Inc. (Peer Review)

From: Larry Eaton, RG – GSI
Rachael Peavler – GSI
Jason Melady, RG – GSI

Date: February 21, 2012

Re: Groundwater Development Potential, Hillsboro, Oregon

Executive Summary

This memorandum summarizes the groundwater development potential in the Hillsboro, Oregon, area and includes a review of aquifer storage and recovery (ASR) in light of the groundwater development potential. The study area encompasses the City of Hillsboro water service area. The initial goal of the evaluation was focused on native groundwater development. However, as more data became available (e.g., native groundwater quality data), developing ASR as a supply option proved to be the best path forward. With that said, the following summarizes the key findings of this memorandum:

- Based on our review of Oregon Water Resources Department (OWRD) regulations, a new native groundwater right is not precluded from the rules and it could be obtained; however, because of observed water level declines in select wells in the study area, it is less certain in, our opinion, that a permit would be issued. A native groundwater permit coupled with ASR most likely would gain more support from OWRD.
- The target aquifer is the Columbia River Basalt Group (CRBG), which is more than 1,000 feet below ground surface and is up to 1,000 feet thick. Yields from wells that penetrate more than just a couple of hundred feet of the CRBG have yields greater

than 1 million gallons per day, but are very site specific. The best well in the study area is the Dawson Creek Park well, which also happens to be the deepest well drilled in the area and penetrates more than 500 feet of the CRBG and has a yield of 1,000 (+) gallons per minute.

- Because the target aquifer is confined, water quality data indicate that the target aquifer is relatively isolated from sources of natural recharge, and because hydrograph data have shown water level decline conditions in some basalt wells, the long-term sustainability of pumping native groundwater is questionable.
- The static water level in the study area is shallow and ranges from 20 to 130 feet below ground surface. For ASR to be considered, the wells will need to be designed to inject under pressure.
- ASR calculations for select sites based on potential head rises in nearby basalt wells show that few, if any, wells would be within the area of influence (e.g., pressure response) assuming a transmissivity close to the Dawson Creek Park well and storing up to 100 million gallons.
- Based on recent sampling results, the native groundwater quality is poor, several secondary maximum contaminant levels are exceeded, and some maximum contaminant levels were detected at 50 percent of their regulatory thresholds. Moreover, the native groundwater is anomalously warm at about 20 degrees Celsius (68 degrees Fahrenheit); typical groundwater is 13 degrees Celsius (56 degrees Fahrenheit)
- Based on recent sampling, treatment of native groundwater is necessary to meet acceptable potable standards. The treatment options presented include reverse osmosis and are costly to capitalize and expensive to operate in comparison to existing surface water sources or ASR.
- Capital cost for the treatment options, annualized for 20 years at net 5 percent, is roughly $650,000, (non-annualized capital cost ranges from $9-$13 M) whereas the capital cost for an ASR well with the same yield, annualized for 20 years at net 5 percent, is $225,000 (non-annualized capital cost is roughly $2.9M).
- Given the high treatment cost of developing a stand-alone native groundwater source, ASR without native groundwater development, is the recommended option for the City to pursue.
- An ASR system would need to have a buffer zone of water to separate poor native groundwater from better quality stored water in order to maintain high stored water recovery efficiency. Thermal modeling of the impact of injecting cool surface water into the aquifer that hosts the warm native groundwater would be needed.
- Assuming the City would like to pursue ASR, an exploration plan is recommended that includes siting work, test well drilling, planning-level design, detailed costing, and final pump station construction assuming that all phases of the project are positive.

Introduction

This memorandum summarizes the groundwater development potential for water supply in the Hillsboro, Oregon, area and reviews the feasibility of aquifer storage and recovery (ASR) in light of the groundwater development potential in the Hillsboro area. For the purpose of this evaluation, the study area includes the City of Hillsboro's (City) retail water supply service area in the Tualatin Basin, and approximately 1 mile beyond its jurisdictional boundaries (Figure 1).

Background and Objectives

The City's water demands are increasing, especially among many of its large and growing industrial customers. Future industrial, as well as residential growth, will add to daily and peak demands, even with a low-growth scenario at some existing water service areas: Evergreen and South Hillsboro. Although the City is pursuing multiple long-term future water supply options, including the JWC ASR project on Cooper Mountain, the City also would like to explore the potential of developing native groundwater in its service area, possibly in conjunction with ASR, to help meet future demands. Based on the forgoing, the following are questions answered by this study:

1. What is the potential of developing native groundwater in the Hillsboro area and what is the target aquifer?
2. What is the general water quality of the target aquifer and is treatment needed? If so, what is the basic cost to treat the native groundwater to potable standards?
3. Could a groundwater right be obtained to develop native groundwater?
4. What is the planning-level cost to develop native groundwater, including general operations and maintenance considerations and treatment, if necessary?
5. Is ASR feasible for the City and how does the development of an ASR system compare to a native groundwater system with treatment?

With these questions in mind, this memorandum is organized into the following main sections:

- **Groundwater Evaluation –** What is the target aquifer and what are the average yields?
- **Water Rights Summary –** Would the Oregon Water Resources Department (OWRD) issue a new native groundwater right in the study area?
- **ASR Potential –** What is the ASR potential of select sites and can ASR be used in concert with a native groundwater development program?
- **Water Quality –** What is the quality of the native groundwater?
- **Water Treatment –** What treatment of native groundwater is necessary to meet potable standards?
- **Costing –** What are planning-level costs for developing a native groundwater well? What is the planning-level cost for a stand-alone treatment system? How does ASR costs compare to native groundwater development with treatment?
- **Conclusions and Recommendations**

- **References**

Tables, figures, and attachments are presented at the end of this memorandum.

Groundwater Evaluation

Geology

This section summarizes the general geologic setting in the study area to provide context for developing a native source or developing an ASR well. A geologic map is provided in Figure 3. Two geologic cross sections through the study area are provided in Figures 4 and 5, and the cross section lines are shown in Figure 3. Cross section A to A′ (Figure 4) bisects the entire study area from the west to the east. Cross section B to B′ (Figure 5) is oriented north to south, and is perpendicular to cross section A to A′ to provide a complementary perspective of the subsurface conditions beneath the study area.

The study area is located in the Tualatin Valley, which is a broad, sediment-filled, synclinal basin. It is elongated northwest to southeast and is generally flat. The predominant geologic units of the area from youngest to oldest include the Willamette Silt, Troutdale Formation, CRBG, and older marine sediments. The older marine sediments and the CRBG generally dip toward the center of the valley (Hillsboro area) and bow upward toward the Coast Range to the west, the Portland Hills anticline to the west and northwest, and toward the Cooper Mountain-Bull Mountain anticline (southeast of the study area). A description of the key units in the valley from youngest to oldest is presented below.

Willamette Silt and Troutdale Formation

The Pleistocene Willamette Silt Formation generally is composed of fine-grained sand, silt, and clay. The Willamette Silt is up to about 120 feet thick and is the primary surficial deposit throughout the Tualatin Valley (Wilson, 1998). The upper Miocene to Pleistocene Troutdale Formation underlies the Willamette Silt, and is composed of poorly sorted clay, silt, and sand, and is up to about 950 feet thick. The combined thickness of the Willamette Silt and the Troutdale Formation, which overlie the CRBG, is about 1,000 feet in the center of the Tualatin Valley (e.g., near the Dawson Creek Park well). In the northern and southern portions of the study area, the combined thickness of the sediments is about 400 feet (e.g., WASH 58884 and WASH 52316). For municipal purposes, the Willamette Silt and Troutdale Formation in this area are not considered target aquifers for either native groundwater development or for ASR purposes because of their low permeabilities and the low sustainable yields typical encountered for wells completed in these formations in the study area.

Columbia River Basalt Group

The CRBG consists of Miocene-age, areally extensive, basalt lava flows originating from linear fissures in eastern Washington and Oregon and western Idaho. The CRBG crops out west and east of the Tualatin Valley in the Coast Range and Tualatin Mountains, respectively, and dips toward the center of the Tualatin Valley. The total thickness of the CRBG in the study area has not been explored; however the Dawson Creek Park well penetrated 549 feet of CRBG. A detailed geologic log and an as-built for Dawson Creek Park

well are presented in Figures 6a and 6b, and Figure 7, respectively. A deep gas exploratory well, drilled on top of Cooper Mountain in 1947, penetrated more than 1,000 feet of the CRBG before intercepting the underlying marine sediments. It is possible that the CRBG in the study area also is up to 1,000 feet thick; equivalent to an additional 451 feet below the total depth of the Dawson Creek Park well. As many as five or more interflow zones could be present in the 400-plus feet of CRBG that has yet to be explored.

As illustrated in Figure 8, individual CRBG flows typically consist of a three-part structure that originated during emplacement and cooling of the lava and consisting of a flow top, flow interior, and flow bottom. The combination of the flow top and flow bottom is commonly referred to as the "interflow zone" (Tolan et al., 2008). Interflow zones tend to be porous and permeable, and when saturated, may be highly productive aquifers. The CRBG is the target aquifer for this groundwater evaluation. Yields for wells completed in the CRBG would be site specific and yields also would depend on the number of productive interflows encountered. As discussed in the next section a properly completed CRBG well could have yields of 1 mgd or higher. Specifically, as discussed later in this section, yields for wells completed in the basalts ranged from less than 100 to over 1,000 gpm.

Marine Sediments

The marine sediments constitute the basement rocks in the area and are composed of sandstone, shales, and volcanoclastic sediments. The marine sediments in the study area occur at 1,500 to more than 2,000 feet below ground surface (bgs), depending on the thickness of the overlying CRBG and younger sediments. The marine sediments typically have low permeability and often produce saline groundwater. The marine sediments are not considered suitable for potable groundwater development or ASR.

Hydrogeology

This section describes the hydrogeology of the CRBG aquifer in the Hillsboro area. The CRBG contain some of the most productive aquifers in the Tualatin Valley. In the study area, however, few basalt wells extend deeper than several hundred feet into the upper portion of the CRBG section.

Groundwater in the CRBG aquifer primarily resides within interflow zones (Newcomb, 1969; Tolan et al., 2008). The permeability of interflow zones varies because not all interflow zones are vesicular and brecciated. The presence of a large pillow complex (basalt extruded into water, see Figure 8) can considerably increase the permeability of an interflow zone, whereas the presence of interbedded sediments can either enhance or inhibit groundwater flow. Other critical aspects of interflow zones that can enhance or inhibit the flow of water include: lateral variability, faults, folds, and secondary mineralization.

The dense interior of the CRBG flows (see Figure 8) are essentially impermeable, resulting in confined aquifer conditions for most CRBG aquifers (Tolan et al., 2008). Additionally, because groundwater levels in water wells completed in the CRBG rise above the top of the CRBG aquifer, the aquifer is considered semi-confined to confined. Based on a review of water well reports from OWRD, the depth to water in the CRBG aquifer in the study area is relatively shallow. In the central portion of the study area, where the valley is generally flat,

the static water level ranges from about 20 to 75 feet bgs. In the northeast portion of the study area, along the flanks of the Tualatin Mountains, the static water level is deeper, ranging from about 60 to 130 feet bgs. Several well logs for wells located throughout the valley and along the flanks of the Tualatin Mountains indicate static water levels ranging from about 200 feet bgs to nearly 400 feet bgs. However, many more well logs indicate that groundwater is relatively shallow; therefore, records that indicate static water levels that are between 200 to 400 feet bgs are considered anomalous or possibly inaccurate.

Well Yield Summary and Key Basalt Wells in the Hillsboro Area

A query of the OWRD well log database was conducted to identify basalt water wells in the study area. As listed in Table 2, the query produced 93 well logs for wells that are completed in basalt (i.e., drilled more than 10 feet into basalt). The records include 8 well logs for modification work or deepening of a preexisting well. The original well logs for these 8 wells may be included with the 93 well logs queried, in which case the well would be accounted for twice.

The distribution of wells in the study area is shown in Figure 1 and Figure 3. Most of the basalt wells lie in the north and northeast portions of the study area, and only four basalt wells were identified in the south and southwest portions of the study area.

Reported well yields were reviewed using the query described above. Table 3 summarizes the well yield statistics from the query. Based on well logs in the study area, the median and average basalt well yields are approximately 50 and 91 gallons per minute (gpm), respectively. It is important to note that the data are skewed low because most of the wells (86 percent) are for domestic use. Generally, a domestic water supply well would be completed after a yield of 10 gpm or less is achieved. Consequently, most basalt wells in the study area penetrate only the upper portion of the basalt section.

Table 4 presents the construction and yield information for basalt wells in the study area that penetrate relatively deep into basalt (i.e., 300 feet or more) or are relatively productive (i.e., yield 200 gpm or more). Only seven wells in the study area penetrate more than 300 feet of basalt, and only two wells penetrate more than 450 feet of basalt. The two wells that extend deeper than 450 feet into basalt are also the two wells that report the highest yields. Specifically, WASH 5213 extends 493 feet into basalt and reports a yield of 700 gpm, and the Dawson Creek Park well extends 549 feet into basalt and reports a yield of 1,060 gpm. As previously mentioned, the well yield and storage potential improve as more productive sections of the CRBG are encountered, and additional productive zones in the CRBG may be found deeper than what has been penetrated by existing wells .

As previously stated, Figure 2 presents hydrographs for OWRD observation wells completed in the CRBG aquifer in the study area. While several of the wells, such as WASH 330, WASH 10143, WASH 5344, have water levels that have remained relatively stable or even increased during the period of record, many of the wells show substantial water level declines. For example, the Dawson Creek Park well (WASH 5586) and WASH 5377 have water level declines that exceed 15 feet. Based on these findings, it is likely that a native groundwater production well completed in the CRBG in Hillsboro and subject to relatively

continuous, long-term pumping could result in similar water level declines and production may not be sustainable for the long term.

Based on aquifer tests conducted at wells completed in the CRBG in the study area, early-time aquifer transmissivity estimates range from 2,600 gallons per day per foot (gpd/ft) (Liberty High School ASR well [WASH 58925]) to 78,000 gpd/ft (Dawson Creek Park well). The transmissivity values estimated from aquifer tests are, in part, affected by the number and thickness of productive zones encountered during drilling. For example, the Liberty High School ASR well penetrated the upper 192 feet of the CRBG, and the well is open to only one interflow zone with a thickness of 8 feet. An as-built for the Liberty High School ASR well is presented in Figure 9. In contrast, the Dawson Creek Park well penetrated the upper 549 feet of CRBG, and encountered more than 150 feet of permeable interflow zones. It is likely that additional productive zones (interflow zones), which would improve well yield and storage potential, may be found deeper than the depth explored by either of these two wells. These two wells – Liberty and Dawson – are the only two wells in the area with sufficient hydraulic data to estimate aquifer parameters, and the Dawson Creek Park well is the most productive well in the study area.

In summary, results from this groundwater evaluation indicate the following:

- The CRBG is the target aquifer for groundwater development.
- Yields around 1,000 gpm and transmissivities up to 78,000 gpd/ft have been achieved in the study area.
- Static water levels are relatively shallow, ranging from about 20 feet bgs to 75 feet bgs in the valley and 60 feet bgs to 130 feet bgs along the flanks of the Tualatin Mountains.
- It is likely that additional productive zones (i.e., interflow zones in the CRBG) may be found deeper than the depth penetrated by existing wells in the study area (about 550 feet of the potentially 1,000-foot CRBG section has been explored to date). Additional productive zones would improve well yield however, given the confined nature of the aquifer, the longer-term sustainable yield of a CRBG well is questionable.
- Finally, based on hydrograph data from specific wells in the Hillsboro area, there is a potential that long-term pumping of native groundwater from the CRBG will result in water level declines; long-term sustainable yield, as previously discussed, is questionable, and design and operation of the well(s) would have to take that into consideration.

Water Rights Summary

This section presents a review of water rights in the study area that was conducted to identify existing groundwater users and to evaluate conditions that may impact a new application by the City.

Table 1 lists wells completed in the Columbia River Basalt Group (CRBG) aquifer in the study area and their associated groundwater rights. The locations of these wells are shown

in Figure 1 and the individual certificates or permits are included in Attachment A. When reviewing a new groundwater right application, OWRD considers the following criteria:

1. Is there a statutory prohibition to obtaining a new water right?
2. Is the proposed use allowed as outlined in the Willamette Basin Program?
3. Is water available for the proposed use?
4. Will the proposed use cause injury to other users – surface water and other groundwater right users?
5. Is there a potential impact to surface water bodies due to groundwater development?
6. Does the proposed use comply with other rules of the Oregon Water Resources Commission?

Based on the water rights review described above, a review of the Willamette Basin Program rules, conversations with OWRD staff, and water rights experience in the study area, those six criteria are discussed below in more detail. Additionally, when possible, an assessment of the likely results of OWRD's review for the criterion is provided.

1. *Statutory Prohibition*
   Oregon Revised Statute (ORS) 538 does not preclude municipal or industrial use of groundwater.

2. *Basin Program*
   The Willamette Basin Program authorizes the use of groundwater for municipal and industrial purposes. The exceptions to this are provided by the Copper Mountain-Bull Mountain Critical Groundwater Area order and the rules related to limited groundwater areas, which are not applicable for obtaining a new groundwater right in the study area.

3. *Water Availability*
   Based on discussions with OWRD staff, OWRD may consider that groundwater is available for municipal or industrial use, despite some wells showing declines in the study area. Any new permit issued would be conditioned to allow OWRD to regulate the use if certain water level decline conditions occur at the well. A survey of existing groundwater certificates and permits in the study area indicates that many contain water level decline conditions. These or similar decline conditions, which would be included in any groundwater right issued to the City, potentially could reduce the reliability of the source. The most recently issued permits all contain essentially the same decline conditions, which state:

   Decline Conditions:
   Use of water from the well…shall be controlled or shut off if the well displays:
   a) An average water level decline of three or more feet per year for five consecutive years; or
   b) A total water level decline of 15 or more feet; or
   c) *A hydraulic interference decline of 15 or more feet in any neighboring well providing water for senior exempt uses or wells covered by prior rights.*

It is worth noting that OWRD often does not regulate groundwater users when decline conditions are triggered. Nonetheless, an applicant cannot assume that their water use would not be regulated if decline conditions of their water right are triggered. Figure 2 shows hydrographs for OWRD observation wells completed in the CRBG aquifer in the study area. While several of the wells, such as WASH 330, WASH 10143, WASH 5344, have water levels that have remained relatively stable or even increased during the period of record, many of the wells show substantial water level declines. For example, the Dawson Creek Park well (WASH 5586) and WASH 5377 have water level declines that exceed 15 feet. As far as we know, both of these wells have not been regulated by the Department even though they have experienced declines in excess of 15 feet.

OWRD would apply the basic review criteria for any new groundwater application; however, an applicant that is considering an ASR program in concert with a new groundwater right may have greater support from OWRD, which could facilitate processing. If this approach were to be considered, it is recommended that the project details be presented to OWRD before submittal of a groundwater permit application to discuss difficulties that may arise when applying for the necessary licenses or permits.

4. *Injury to Other Users*
   As noted above, conditions regarding hydraulic interference with other wells are included in recently issued permits. The potential impact to other users in the CRBG would need to be evaluated during a more site-specific evaluation in the future.

5. *Potential for Substantial Interference (PSI) Division 9 Rules (OAR 690-009)*
   Impacts on surface water associated with groundwater development are not expected to be an issue for the City because groundwater is not anticipated to be hydraulically connected to any surface water bodies.

6. *Rules of the Commission*
   New water use permits authorizing the use of groundwater from the CRBG aquifer require specific conditions, as provided by the Willamette Basin Program rules in Oregon Administrative Rules (OAR) 690-502-0250. A copy of the rule is included in Attachment B. The conditions include a requirement to take static water level measurements and to have decline conditions.

   Division 33 rules, which aid the OWRD in determining whether the proposed use will impair or be detrimental to fish, would not be an issue because groundwater is not expected to be hydraulically connected to surface water.

In summary, results of the water rights review in the study area indicate the following:

- The use of municipal or industrial use of groundwater is not precluded by rule, and OWRD likely would issue a new groundwater permit for native groundwater development, which is in part based on discussions with OWRD staff; however, due

to observed declining water levels in some wells it less certain in our opinion a permit would be issued.
- A new groundwater permit would include decline conditions to protect other users and to prevent overdraft of the native groundwater.
- Based on conversations with OWRD staff, an applicant that is considering an ASR program in concert with a new groundwater right may have greater support from the Department.

ASR Potential

This section presents a preliminary evaluation of the feasibility of developing ASR in the study area. As discussed in the water rights section of this memorandum, a new groundwater permit (if issued) would include decline conditions as previously outlined in the Water Right section of this memorandum. Based on OWRD observation wells (Figure 2) in the study area, it is likely that a new production well completed in the CRBG and subject to relatively continuous, long-term pumping would result in water level declines that exceed 15 feet. In addition, as discussed in the water quality section of this report, native groundwater is of poor quality. For all of these reasons, ASR is being evaluated as a means to offset water level declines associated with a new water right obtained by the City, or improve produced water quality.

This preliminary ASR evaluation is based on aquifer tests and groundwater quality assessments conducted at existing basalt wells in the study area. However, site-specific data are needed to determine the ASR potential and long-term yields at any new site. The following general hydrogeologic criteria are considered in our assessment of ASR feasibility in the study area:

- Aquifer characteristics
- Target storage volume
- Long-term ASR operation
- Depth to groundwater, injecting under pressure, and activation of seeps
- Water quality compatibility

These hydrogeologic criteria are discussed in more detail in the following sections.

Aquifer Characteristics

The target aquifer, the CRBG, is host to nearly all of the ASR facilities in Oregon. Based on the well log query, the depth to the CRBG in the study area ranges from about 50 feet to more than 1,300 feet, but in most of the study area is between 400 feet to 1,000 feet (see Figures 4 and 5).

The most productive CRBG well in the study area is the Dawson Creek Park well. A step-drawdown pump test and a 76-hour constant-rate pump test were conducted at the Dawson Creek Park well after well construction was completed (H.G. Schlicker and Associates, Inc., 1987). The step-drawdown pump test results (change in drawdown with increased pumping

rate) are presented in Figure 10. Using the drawdown equation from step-test data, the estimated drawdown at a pumping rate of 1,750 gpm (i.e., about 2.5 million gallons per day [mgd]) is 55.4 feet (equivalent to a specific capacity of 31.6 gallons per minute per foot of drawdown [gpm/ft]). During the 76-hour constant-rate pump test, the well was pumped at an average rate of 1,060 gpm and the total drawdown recorded was 27 feet, yielding a specific capacity of 39.3 gpm/ft. For comparison, the successful City of Beaverton ASR 1 and ASR 2 wells have initial specific capacities of about 30 gpm/ft. The City of Beaverton's ASR 1 and ASR 2 wells yield 1 mgd and 2 mgd, respectively.

Based on aquifer test data from Dawson Creek Park well (H.G. Schlicker and Associates, Inc., 1987), the CRBG in the study area has the potential to be productive with yields of 1 mgd or more. Moreover, the Dawson Creek Park well did not penetrate the entire CRBG section, which means additional productive zone may be found deeper, thereby improving the potential yield of the well. As previously mentioned, the target CRBG aquifer in the study area is confined and is sealed from the surface by hundreds of feet of fine-grained low permeability sediments. Pressure in the aquifer will increase as a result of injection, but because of the confining fine-grained sediments that overlie the CRBG, groundwater in the aquifer will not reach the surface. However, the pressure response (i.e., hydraulic head) could cause water to flow above the ground surface in the ASR well, and in wells that are located near an ASR well (i.e., area of impact as defined in the following section) and that penetrated the CRBG aquifer. It is likely that an ASR well in the study area would need to be designed to inject under pressure because of the limited available head space above the static water level. The pressure response and the area of impact as a result of injection at selected ASR well sites in the study area are discussed further below.

Target Storage Volume

For the purposes of this memorandum, the area of influence used to estimate the storage zone as a result of ASR is defined as the area where the injection mound (i.e., drawup resulting from the pressure response) exceeds the depth to groundwater. Using hydrogeologic parameters obtained from CRBG-hosted ASR wells near Hillsboro, the potential area of influence was developed for three locations in the study area. The three locations chosen for the analysis, based on discussion with the City, are shown in Figure 1 and Figure 3: (1) the Evergreen Reservoir site located in the northern portion of the City, (2) the future Will Crandall Reservoir site located just beyond the northwest city limit boundary and (3) the Knife River well site located in the southern portion of the City. The Dawson Creek Park well area is another site that could be considered for ASR purposes since this is the location of the most productive well in the study area.

The depth to groundwater at all three locations was conservatively assumed to be 15 feet, based on water level data in the study area; however, the depth to groundwater may be greater in some portions of the study area, particularly in the northeast portion of the study area along the flanks of the Tualatin Mountains. Injection volumes of 10 million gallons (MG), 20 MG, 50 MG, and 100 MG were assumed, and the area of influence was estimated using the high and low ends of expected aquifer transmissivities (permeability): 56,000

gpd/ft and 5,600 gpd/ft, respectively [1]. For reference, late-time transmissivity at the Dawson Creek Park well is on the high end with a transmissivity of 78,000 gpd/ft and late-time transmissivity at the Liberty High School ASR well is on the low end with a transmissivity of less than 2,000 gpd/ft. Hence the transmissivities used in our analysis are well bracketed by available hydraulic data in the study area.

Figures 11, 13, and 15 (low end expected aquifer transmissivity equal to 5,600 gpd/ft) and Figures 12, 14, and 16 (high end aquifer transmissivity equal to 56,000 gpd/ft) show the potential area of impact at the three locations assuming different injection volumes. It is important to note that this is a simple analytical calculation and it does not take into account boundaries and/or non-homogenous subsurface conditions, such as lateral changes in permeability of the basalt aquifer. Site-specific test well drilling and aquifer testing would be needed to better estimate how much water could be stored without adversely affecting nearby basalt wells at any potential ASR site. More detailed discussions of the three sites chosen for ASR evaluation are presented below.

Evergreen Reservoir Site

Figures 11 and 12 show the area of influence based on the low and high ends of expected aquifer transmissivity at the Evergreen Reservoir site. At the high end of expected transmissivity completed wells in the area are not within the area of influence. Two frames show an influence to nearby basalt wells: 50 MG of storage volume at an aquifer transmissivity of 5,600 gpd/ft and 100 MG of storage volume at an aquifer transmissivity of 5,600 gpd/ft. The frame showing 100 MG of storage volume at an aquifer transmissivity of 5,600 gpd/ft suggests that 8 basalt wells are within the area of potential impact. The Ronler Acres Intel campus, which is approximately 2,000 feet to the southeast of the Evergreen Reservoir, is within the area of influence shown in these two frames (50 MG and 100 MG storage volumes, and a transmissivity of 5,600 gpd/ft). If the area of impact as a result of ASR at the Ronler Acres Intel campus were evaluated, the results would be similar to the results shown in Figures 11 and 12. With that said, we would anticipate this site to still be favorable for ASR, because we would anticipate a well in this area to be on the high-end of the transmissivity range, especially if a greater section of the basalt is completed than what has been penetrated to date.

Will Crandall Reservoir Site

Figures 13 and 14 show the area of impact based on the low and high ends of expected aquifer transmissivity at the Will Crandall Reservoir site. The only frame that shows an influence to nearby basalt wells is 100 MG of storage volume at an aquifer transmissivity of 5,600 gpd/ft. A separate memorandum, prepared for the City, recommending that the Crandall Reservoir Site include infrastructure to support a future ASR well, is included in Attachment C. Similar to the Evergreen Reservoir Site, we would anticipate this site to be favorable for ASR.

[1] It was assumed that a 500-foot section of basalt is penetrated, 150 feet of which is permeable, and that the storativity is equal to 10^{-3}. For the low end and high end of expected aquifer transmissivity it was assumed that the hydraulic conductivity of the permeable basalt is equal to 5 feet per day and 50 feet per day, respectively.

Knife River Well Site

Figures 15 and 16 show the area of influence based on the low and high ends of expected aquifer transmissivity at the Knife River well site. The only frame that shows an impact to nearby basalt wells is 100 MG of storage volume at an aquifer transmissivity of 5,600 gpd/ft. Much like the other two sites, the Knife River Well site is favorable for ASR purposes, especially if the new ASR well penetrates more of the basalt section than what has been explored to date.

Depth to Groundwater, Injecting Under Pressure, and Activation of Flowing Wells or Seeps

The depth to the static water level is relatively shallow (20 feet bgs to 75 feet bgs) in much of the study area. As such, it is likely that there would be little available head space in an ASR well for mounding during injection without the water level in an ASR well rising above the ground surface. If necessary, an ASR well could be designed to inject under pressure, which adds to the construction costs, but is not a fatal flaw. Depending on the depth to groundwater in the vicinity of an ASR well, the pressure response (i.e., hydraulic head) in the aquifer likely will reach ground surface at nearby lowland areas. The potential for groundwater to discharge at the surface as a result of increased heads in the deep aquifer will depend on the degree of vertical continuity between the deeper and shallower basalt units, as well as the geometry of the injection mound surrounding the ASR well (i.e., the area of impact). A hydraulic connection to the surface within the area of impact, such as a well that intercepts the CRBG aquifer, a fault, or existing seeps/springs, would be necessary for water injected during ASR operation to discharge at the surface. Work has not been completed to field-verify existing seeps or springs that would allow discharge of stored water from the target aquifer. However, because hundreds of feet of fine-grained sediment overlie the CRBG within the study area, it is not anticipated that activation of seeps or springs would occur as a result of ASR operation. It is more likely that deeper basalt wells would experience a water level rise during injection, possibly above ground surface.

Water Quality

This section discusses the CRBG aquifer groundwater quality near Hillsboro. Before this groundwater evaluation, existing available groundwater quality data for the deep CRBG aquifer in Hillsboro were limited, and included data from a sample collected in 1987 at the Dawson Creek Park well and data from a sample collected in 2010 at the Liberty High School ASR well. The City approved resampling of the Dawson Creek Park well and also approved sampling of the Knife River well as an expanded scope item for this project to help assess native groundwater quality. Additionally, CRBG groundwater quality data were available from a sample collected in 1953 from the St. Mary's well (WASH 8851), which is located southeast outside of the City along Tualatin Valley Highway. As part of this groundwater evaluation, two groundwater samples were collected from CRBG wells in Hillsboro: the Dawson Creek Park well, which was sampled on June 17, 2011, and the Knife River well (WASH 50197), which was sampled on August 4, 2011. Laboratory analytical results for these two samples are included in Attachment D and in Table 5. An as-built of

the Knife River well is provided in Figure 17 and the Dawson Creek Park well as built in presented in Figure 7. The locations of the wells with CRBG groundwater quality data including the wells sampled in this evaluation are shown in Figure 1.

Concentrations of select CRBG groundwater quality constituents are listed in Table 6. Compositional differences in CRBG groundwater quality are shown graphically in the stiff diagram presented in Figure 18. A stiff diagram is a representation of the chemical signature of water; major cations are shown to the left and major anions are shown to the right. A relatively large stiff diagram indicates that the water has high concentrations of cations and anions and a relatively small stiff diagram indicates that the water has low concentrations of cations and anions, which typically is aesthetically preferred for potable drinking water. For comparison, CRBG groundwater analytical results for the City of Beaverton's ASR 1 well are included in Table 6 and Figure 18. As shown in Figure 18, the results from these samples indicate that there is substantial spatial variability in CRBG groundwater quality. The chemical signatures of the samples collected from the City of Beaverton ASR 1 and Liberty High School wells depict relatively 'good' water quality; conversely, the chemical signatures of the samples collected from the St. Mary's, Dawson Creek Park, and Knife River wells depict relatively 'poor' water quality. Concentrations of chloride, total hardness, total manganese, total iron, sodium, and total dissolved solids exceed the regulatory standards (secondary maximum contaminant level [SMCL], or the Oregon Health Authority Unregulated Contaminants [URC] for sodium) in one or more of the samples (Tables 5 and 6, shown in bold red text). The high chloride and sodium content and high specific conductivity suggest that there may be localized hydraulic connections between the CRBG and the underlying, saline marine sediments. Additionally, the groundwater temperature measured at the Dawson Creek Park well (22.2 degrees Celsius [71.6 degrees Fahrenheit]) and the Knife River well (21.4 degrees Celsius [70.5 degrees Fahrenheit]) are anomalously high (typical CRBG groundwater temperature is about 12 to 13 degrees Celsius [about 56 degrees Fahrenheit]), suggesting that a geothermal heat source underlies the study area. In addition, the water quality data indicates that the target aquifer is relatively isolated from sources of natural recharge.

Source and Groundwater Quality Compatibility

Based on results from other ASR sites in the region (e.g., City of Beaverton, Liberty High School, and Tualatin Valley Water District's Grabhorn ASR well), GSI anticipates that source water and native groundwater in the CRBG aquifer in the study area will be compatible. In other words, the mixing of the two waters does not result in adverse water quality impacts such as precipitation of constituents that could clog the ASR well or mineral reactions that could mobilize minerals and degrade the aquifer. However, the water quality of the native groundwater in the CRBG in the Hillsboro area is different when compared to the water quality data at the Cooper Mountain ASR sites, where compatibility between the waters has not been an issue. Assuming the City would want to advance the ASR concept further, then it is highly recommended that geochemical compatibility modeling be completed with water quality information from the Dawson Creek Park and the Knife River wells to assess the mixing of native groundwater with source water. If a test well is completed at a particular location, a native groundwater sample and a nearby source water sample also

should be collected, and the geochemical compatibility of mixing these two waters also should be assessed.

Water Treatment

As discussed in the previous section, native groundwater quality is likely to be poor. It is important to point out though that the level of treatment discussed in this section is for developing a native groundwater source, whereas ASR would not require treatment so long a the native groundwater can be buffered as discussed in the next section. Specifically, this section summarizes the water treatment necessary to meet potable standards for native groundwater and is based on a report prepared by HDR for this study. A copy of HDR's technical memorandum is presented in Attachment E. As discussed in the water quality section, the native groundwater quality at the Dawson Creek Park and Knife River wells is poor, especially when compared to Joint Water Commission (JWC) treated surface water, which is the primary source for the City's customers. HDR reviewed water quality criteria relative to Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) and secondary MCLs (SMCLs) parameters. The need to implement treatment is based on whether the presence of MCL and SMCL constituents would adversely impact the water quality delivered to City customers. Compliance with MCLs is mandatory under the SDWA, while compliance with SMCLs is optional because the latter parameters are associated with aesthetic (i.e., color, taste, odor) problems and are not known to adversely impact public health.

The native groundwater quality of the Dawson Creek Park well was significantly better than the native groundwater quality of the Knife River well. In addition, none of the constituents measured in either well exceeded the primary MCLs. Several constituents, however, were elevated and/or exceeded their respective SMCLs, and some constituents were at levels more than 50 percent of the MCLs (see Attachment E). Table 7 provides a summary of select water quality parameters for the Dawson Creek Park and Knife River wells taken from HDR's water quality treatment technical memorandum (Attachment E).

To successfully reduce constituent concentrations identified by HDR (see Attachment E) and achieve acceptable levels typical of what City customers are accustomed to receiving, a treatment approach would need to make use of a multiple treatment process. The two treatment options in HDR's technical memorandum remove target contaminants and employ multiple stages of pumping, chemical addition, and will produce a substantial waste stream. Both target treatment options are complex, expensive to capitalize, and expensive to operate.

Option 1 includes conventional softening, pressure filtration, air stripping (for ammonia), reverse osmosis (RO), and chlorine addition. Option 2 relies on greensand filtration followed by RO and chlorine addition. As outlined in the following section, the costs are high for either treatment options, making it financially impractical for the City to develop a native groundwater source in the Hillsboro area, assuming the Dawson Creek Park and Knife River wells are representative of native groundwater quality throughout the service area and further assuming that, at a minimum, the City would like to match the quality of

its current source (i.e., JWC treatment plant source). Lastly, it is important to point out that the treatment options do not address the high native groundwater temperatures (e.g., 20 degrees Celsius [68 degrees Fahrenheit]). To meet consistent quality, the native groundwater source would have to be run through a heat exchanger to reduce the final temperature before delivery to customers. It is important to point out however, that this heat exchange in the winter could provide revenue to offset operational costs, but was not developed further in this assessment given the extremely high capital cost to treat native groundwater. Another option to mitigate the high native groundwater temperature could include mixing the warmer native groundwater with cooler surface water in the reservoirs, but thermal modeling would be needed to determine how much mixing would be required to reduce the temperature to acceptable levels, which is beyond the scope of this project.

Cost Considerations

This section presents planning-level costs for exploration and development of a groundwater resource in the study area. The planning-level costs also include treatment costs if the City elected to treat native groundwater to acceptable standards.

Table 8 presents the detailed planning-level capital costs for a treatment system for a native groundwater well, assuming the lower-end treatment option presented by HDR (see Attachment E). This simple economic analysis assumes a 2-mgd native groundwater well would be utilized and would bear the total cost of the treatment; obviously an economy of scale could be realized by combining multiple native groundwater wells to a single treatment system. However, as a fatal flaw analysis, the capital costs, even if annualized for a 20-year period at net 5 percent, are high, at more than $650,000. The non-annualized capital cost for the proposed treatment alternatives ranges from $9-$13M. This annualized capital cost is three times more than the average annualized costs for ASR wells proposed for the JWC ASR program on Cooper Mountain. The 20-year annualized cost period and net 5 percent also match the financial variables used by the JWC to evaluate the feasibility of developing the ASR system on Cooper Mountain. The annualized unit cost per hundred cubic feet (ccf), assuming 6 months of recovery (365 MG), which may not be sustainable given the decline conditions observed with native groundwater pumping at the Dawson Creek Park well, is roughly $1.41 per ccf. To reduce the annualized capital costs, multiple native groundwater wells would need to be developed and GSI is uncertain this would be sustainable given the nature of the target CRBG aquifer as discussed previously. In addition to capital costs, the treatment system would have annual operation and maintenance costs and residual treatment handling costs that **would add to the annualize costs** per ccf. For example, assuming a Category III industrial sewer rate, which is defined as more than 25,000 gallons per day of wastewater discharge, an additional $2.64 per ccf would be added to treatment system cost for waste handling. O&M costs vary from $1.40 to $3.20 per ccf depending on the treatment option used. As a result the total cost for a treatment system of native groundwater could range from $5.45 per ccf ($1.41 + $2.64+ $1.40) to as much as $7.25 per ccf ($1.41 + $2.64 + $3.20). The latter cost per ccf does not include system development charges (SDC), nor did it even take into account the cost of drilling a native groundwater well and building the associated pump station, which could easily add $2M to the capital cost. In our opinion, given the poor quality of the native groundwater, treatment of it to

acceptable standards is cost prohibitive and does not appear to be a viable option for the City at this time. In other words, GSI considers this to be a fatal flaw for native groundwater development.

With that said, the following cost estimate assumes any future well development in the study area will be used for ASR purposes alone, and any use of native groundwater is not considered at this time. For ASR to work, given the poor quality of the native groundwater, an initial buffer of source water would need to be developed to ensure a high recovery efficiency (good water quality). Recovery efficiency is defined as the percentage of the water volume stored that is subsequently recovered in the same cycle while meeting a target water quality criterion (Pyne, 2005). Recovery efficiency is of particular importance when evaluating the feasibility of an ASR well in the Hillsboro area because the difference in water quality between stored and native groundwater is significant enough that mixing must be controlled. Mixing is controlled by developing a buffer zone in the aquifer that separates the high-quality stored water from the surrounding poor-quality ambient groundwater. In general, if the same volume of water were stored and recovered, recovery efficiency likely would improve with successive ASR cycles. This is because residual stored water remains in the aquifer as a result of mixing and, over time, the residual stored water creates a buffer zone. A buffer zone also can be intentionally developed by injecting more water than is recovered. A high recovery efficiency can be achieved using this approach because an initial buffer zone is developed causing mixing to occur at a considerable distance from the well (Pyne, 2005). The volume of water in the buffer zone combined with the volume of stored water required for recovery is defined as the Target Storage Volume (TSV). A site-specific TSV would need to be developed for each ASR well system in the study area based on exploration drilling, water quality testing, and pilot testing. Lastly, the anomalously native groundwater temperature could impact stored ASR water temperature even with a healthy buffer. As such, thermal modeling would be needed to evaluate the impact of injecting cool water into the aquifer that host the warm native groundwater.

Table 9 presents exploration and capital costs to develop an ASR well that would be injected under pressure. The average storage volume is conservatively estimated at 150 MG with a peak 75-day recovery period at 2 mgd. The annualized capital cost for 20 years at net 5 percent is $226,000, which is in line with capitalized costs for the JWC's proposed ASR wells on Cooper Mountain. The non-annualized capital cost to develop a single ASR well without pilot testing is conservatively is $2.9M. The annualized unit cost per ccf, assuming at 150 MG of storage (about half of the native groundwater well), is roughly $1.12 per ccf. Base operation and maintenance costs of an ASR well are roughly $0.34 per ccf and raw water costs to the City of Hillsboro are roughly $0.32 per ccf from the JWC. As such, the total cost per ccf based on this analysis for an ASR well would be roughly $1.78 per ccf ($1.12 + $0.34 + $0.32). GSI believes this cost would be less than the native groundwater well given its high capital costs primarily because of treatment, and most likely high operational and maintenance costs, including residual disposal costs. Given these costing considerations, GSI strongly suggests the City focus on ASR development within its service area instead of developing a native groundwater source with treatment if they want to augment their summer supply capacity as an alternate to treatment plant expansions.

Conclusions and Recommendations

Based on the forgoing, the following conclusions and recommendations are provided:

Conclusions

- GSI's review of applicable OWRD regulations, finds a new native groundwater permit is not precluded by rule, and most likely could be secured from OWRD; however, because of observed declining water levels in some wells (e.g., Dawson Creek Park well), it is less certain, in our opinion, that a permit would be issued. If the permit were issued, it most certainly would be conditioned with decline criteria much like existing permits elsewhere in the Willamette Valley. A native groundwater right, coupled with ASR, may have a greater chance of receiving OWRD support.
- The target aquifer is the CRBG, which is roughly 1,000 feet bgs. The total thickness of the CRBG is up to an additional 1,000 feet, which means a test well in the study area may need to be drilled to from 1,500 to 2,000 feet bgs. Yields of around 1,000 gpm and transmissivities of up to 78,000 gpd/ft have been achieved in the study area. More than 500 feet of the CRBG section have not been explored beyond the deepest borehole to date (Dawson Creek Park well) in the study area.
- The static water level is shallow and varies from around 20 to 130 feet bgs. As such, an ASR well would have to be designed to inject under pressure.
- Because the target aquifer is confined, water quality data indicate that the target aquifer is relatively isolated from sources of natural recharge and hydrograph data have shown water level decline conditions in some basalt wells, the long-term sustainability of pumping native groundwater is questionable, and would have to be managed.
- ASR in the target CRBG aquifer, considering conservative hydraulic parameters, appears feasible in three target locations: Evergreen Reservoir, Will Crandall Reservoir, and Knife River. If transmissivities are low at these locations, monitoring of nearby basalt wells will be required because artesian flow could occur; however, we anticipate the transmissivity of the CRBG aquifer at these locations to be good, especially if the full basalt section were explored, making ASR more attractive.
- Based on data from two CRBG wells in the study area, the native groundwater quality is poor, several SMCLs are exceeded, and some MCLs were detected at 50 percent above their regulatory threshold. In addition, the native groundwater at these sites is anomalously warm at roughly 20 degrees Celsius (68 degrees Fahrenheit) whereas normal native groundwater is typically 13 degrees Celsius (58 degrees Fahrenheit). With ASR development and a healthy buffer, as outlined in this report, the anomalously native groundwater temperature could still impact stored ASR water temperature. As such, thermal modeling would be needed to

evaluate the impact of injecting cool water into the aquifer that hosts the warm native groundwater.

- Based on the water quality results, treatment is necessary to meet minimum potability standards consistent with the quality to which City consumers are accustomed to receiving. Two treatment options were presented; both include RO and are costly to capitalize and expensive to operate.
- The capital cost for the least expensive treatment option, annualized for 20 years at net 5 percent is roughly $650,000 (the low-end non-annualized treatment option capital cost is $9M) , whereas an ASR well with roughly the same yield has an annualized capital cost for 20 years at net 5 percent of roughly $225,000 (capital cost of $2.9M).
- Given the high treatment cost of developing a stand-alone native groundwater source, ASR without native groundwater development, is the recommended option for the City to pursue.
- If ASR were to be employed, a buffer zone of water will need to be developed at each ASR location to buffer the poor native groundwater quality from the recovered ASR water (i.e., high recovery efficiency).

Recommendations

One of the main goals of this evaluation was to assess the groundwater development potential in the Hillsboro area. A native groundwater right may not be attainable. It is also clear that the target aquifer is productive given the success of the Dawson Creek Park well; however, the sustainable yield of the aquifer is uncertain. Another critical issue is groundwater quality, which is poor and anomalously warm. Treatment costs to meet acceptable water quality standards are high, especially when compared to annualized capital costs for an ASR facility. It is GSI's opinion that native groundwater development is problematic, but that ASR could be employed within the study area to create in-town storage and help to meet peak demands. If ASR is to be advanced as a supply option, the following actions are recommended:

- Complete a siting assessment for a future ASR well that takes into account available land, infrastructure needs, distribution hydraulics, future demands, preliminary costing, and land use issues.
- Select a preferred site and drill a test well to the base of the basalt section (an exploration well up to 2,000 feet deep would be needed).
- Complete aquifer testing to determine the potential ASR capacity of the site including evaluation of the potential for flowing wells and seeps.
- Collect water quality samples and complete a water quality compatibility assessment between native groundwater and distribution source water.

- Complete preliminary design including an updated economic analysis and hydraulic assessment of the ASR facility and make a "go"/"no-go" determination for reaming the test well, and developing a full-scale ASR pump station.

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Table 1
Water Rights Summary in the Hillsboro Vicinity [1]
City of Hillsboro

OWRD ID	Well Owner	Exempt from Water Right	Priority Date	Identified WR associated with Well			Potential WR associated with Well			Entity Name on Water Right	Well	Type of Beneficial Use	Authorized Rate	Maximum rate of Withdrawal to Date		Authorized Date for Completion
				Application	Permit	Certificate/ Claim	Application	Permit	Certificate/ Claim					Instantaneous (cfs)	Annually	
WASH076	Claremont Joint Venture			G12094	G11129					Claremont Development Co.	Well 1, Well 2, Well 3, Well 4, Well 5	Irrigation	0.0125 cfs	0.0125 cfs	2.5 acre-feet/acre	
WASH327	Franklin C. Pierson	Exempt										Domestic				
WASH360	Cliff Grow											Domestic & Industrial				
WASH361	John Bauman	Exempt										Domestic				
WASH362	Frederick & Sherry Joyner	Exempt										Domestic				
WASH363	Edgar W Phillips	Exempt										Domestic				
WASH364	Don Munster	Exempt										Domestic				
WASH1383	Kathryn Owen	Exempt										Domestic				
WASH1662	William Long	Exempt										Domestic				
WASH1751	DeLoris & Gerry Grossen	Exempt										Domestic				
WASH2118	Russ & Marie Turney	Exempt										Domestic				
WASH3343	Oak West Homes	Exempt										Domestic				
WASH4012	Wes Epler	Exempt										Domestic				
WASH4534	Travis Gregory	Exempt										Domestic				
WASH4678	Walter Allenback	Exempt										Domestic				
WASH4680	Robert & Patricia Beville	Exempt										Domestic				
WASH4682	D. J. St Peter	Exempt										Domestic				
WASH4692	Floyd G Redding	Exempt										Domestic				
WASH4708	Nancy Wismer	Exempt										Domestic				
WASH4863	Vern Gilbert											Domestic & Irrigation	*Well was overdrilled by WASH4864, which only has domestic purposes according to OWRD well log.			
WASH4864	Vern Gilbert	Exempt										Domestic				
WASH4866	W King	Exempt										Domestic				
WASH4879	Tansabrook		3/8/1973	G6021	G5149					Tanasbrook	A Well	Irrigation	0.56 cfs			Permit Cancelled
WASH5190	Benedict Nussbaumer	Exempt										Domestic				
WASH5191	Bill Cook	Exempt										Domestic				
WASH5193	Hans Schoch	Exempt										Domestic				
WASH5213	Cascadian Nurseries		10/21/1997	G14646	G13531					Cascadian Nurseries Inc.	Well 2	Irrigation	0.15 cfs/acre	1.11	2.5 acre-feet/acre	
WASH66930			12/7/2001	G15664	G15334					Cascadian Nurseries Inc.	A Well	Irrigation	0.15 cfs/acre	0.78	2.5 acre-feet/acre	
			5/17/2002	G15765	G15372					Cascadian Nurseries Inc.	Well 2 & Well 3	Irrigation	0.15 cfs/acre	0.891	2.5 acre-feet/acre	
WASH5214	Merrill Kneeland	Exempt										Domestic				
WASH5218	Raymond M Munson		12/27/1973	G6393	G5252	48488				Raymond Munson	Raymond Munson Well	Irrigation	0.22 cfs	0.22 cfs	2.5 acre-feet/acre	
WASH5219	Matilda & Oliver Dick		7/9/1962				G2378	G2189	33294	Carl J Berg	A Well	Irrigation	0.05 cfs	0.05 cfs	2.5 acre-feet/acre	
WASH5221	Jeff Boden		3/30/1987	G11636	G10766	83033				Jeff Boden	A Well	Irrigation	0.33 cfs	0.33 cfs	2.5 acre-feet/acre	
			11/26/1991	G12717	G11436	84786						Irrigation	0.30 cfs	0.30 cfs	2.5 acre-feet/acre	
WASH5262	Earl Braddock	Exempt										Domestic				
WASH5277	Lewis & Gwyn Neace	Exempt										Domestic				
WASH5278	Gary Rae	Exempt										Domestic				
WASH5279	David Pratt	Exempt										Domestic				
WASH5282	Paul Gartner	Exempt										Domestic				
WASH5283	Virgil M Wroe	Exempt										Domestic				
WASH5284	Mike Caraualah	Exempt										Domestic				
WASH5285	John Tye	Exempt										Domestic				
WASH5286	Joe Martinez	Exempt										Domestic				
WASH5287	Jim Trobaugh	Exempt										Domestic				
WASH5288	Ken Stewart		8/25/1981	G10529	G9692	60593				Kenneth Ray Stewart	A Well	Irrigation	0.0125 cfs	0.0125 cfs	2.5 acre-feet/acre	
WASH5290	Arden D Danielson	Exempt										Domestic				
WASH5291	Archie Trobough	Exempt										Domestic				
WASH5292	Gideon Hess	Exempt										Domestic				
WASH5295	O. Lochden	Exempt										Domestic				
WASH5296	Joseph Hickey	Exempt										Domestic				
WASH5297	West Union Garage	Exempt										Domestic				
WASH5298	Lila Oviatt	Exempt										Domestic				
WASH5299	Charles Bell	Exempt										Domestic				
WASH5300	Jack Keller	Exempt										Domestic				
WASH5309	Charles Hardin	Exempt										Domestic				
WASH5319	Robert Bennett		8/8/1977	G8345	G7527	55147				Robert & Mary Bennett	A Well	Irrigation	0.02 cfs	0.02 cfs	2.5 acre-feet/acre	
WASH5321	Ralph Altmanns	Exempt										Domestic				
WASH5322	Roger Hughes	Exempt										Domestic				
WASH5337	Don Munster											*No purpose checked on OWRD well log; all other of Don Munster's wells are domestic wells.				
WASH5338	Ruddy Vanderzee	Exempt										Domestic				
WASH5339	Val Schaef	Exempt										Domestic				
WASH5340	Lawrence Kilgore	Exempt										Domestic				
WASH5343	C. I. Nelson	Exempt										Domestic				
WASH5350	Ed Moore	Exempt										Domestic				

GSI Water Solutions, Inc.

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				Application	Permit	Certificate/ Claim	Application	Permit	Certificate/ Claim					Instantaneous (cfs)	Annually	
WASH5351	West Union School											Public School				
WASH5432	Thomas E Rutte	Exempt										Domestic				
WASH5521	Sunset Farms & Stables	Exempt										Domestic				
WASH5524	Kenneth Berger											*Well is an overdrill of another well but uncertain which well. All other wells owned by Kenneth Berger are dometic wells.				
WASH5544	Riviera Motors, Inc.	Exempt										Domestic				
WASH5545	Jerry Kimzey	Exempt										Domestic				
WASH5586	PlanTek		5/8/1986				G11520	G10819	83076	Forum Properties	A Well	Irrigation	251.3 gpm (Supp. Irrigation) 85.3 gpm (Reservoir Maintenance)	251.3 gpm (Supp. Irrigation) 85.3 gpm (Reservoir Maintenance)	2.5 acre-feet/acre	
WASH5595	Roy Thwaite	Exempt										Domestic				
WASH5810	E. M. Johnson		12/31/1936						GR2693	H W Ray	Well 1	Irrigation			7.5 acre-feet	
WASH9800	Warren Collins	Exempt										Domestic				
WASH10535	David Edwards	Exempt										Domestic				
WASH50197	Best Mix Concrete		11/19/1971				G5670	G4983	56399	Oregon Roses Inc.	Well 2, Well 3, Well 4	Irrigation	0.02 cfs from Well #2, 0.02 cfs from Well #3, 0.05 cfs from Well #4	0.02 cfs from Well #2, 0.02 cfs from Well #3, 0.05 cfs from Well #4	2.5 acre-feet/acre	
WASH51064	Don Hamburg	Exempt										Domestic				
WASH51447	Pacific Land Management		1/28/1997				G14450	G13463		Jones Farm Owners Assoc	A Well	Irrigation	1.07 cfs	1.07 cfs	2.5 acre-feet/acre	
WASH51495	Reserve Vineyard Golf Club		1/10/1997	G14435	G13163					Reserve Vineyards and Golf Club LLC	A Well	Commerical Uses	0.334 cfs	0.334		
WASH51780	Steven Schmidt	Exempt										Domestic				
WASH52264	Danford Hoots	Exempt										Domestic				
WASH52316	Allen Schaaf	Exempt										Domestic				
WASH53544	Larry & Mary Sullivan	Exempt										Domestic				
WASH54735	Bill Hickox	Exempt										Domestic				
WASH54761	Steve Chinick	Exempt										Domestic				
WASH55985	Beverly McClenathan	Exempt										Domestic				
WASH56198	Kozak Interprises Inc.	Exempt										Domestic				
WASH56477	Tara Francis	Exempt										Domestic				
WASH57025	Randall & Linda Schade	Exempt										Domestic				
WASH58499	Matthew Yunker	Exempt										Domestic				
WASH58884	George Choban	Exempt										Domestic				
WASH58925	Hillsboro School Dist. 1J		10/15/2008	G17123	G16510					Hillsboro School Dist 1J	Well 1 (WASH 58925)	Irrigation	0.266 cfs	0.266	2.5 acre-feet/acre	
WASH59088	Lowell Berger	Exempt										Domestic				
WASH59240	Peggy Demarini	Exempt										Domestic				
WASH62822	Gary & Susan Rae	Exempt										Domestic				
WASH64646	Dan Carey	Exempt										Domestic				
WASH66523	Chuck Garner	Exempt										Domestic				
WASH66595	Ken Bryan	Exempt										Domestic				

Notes:
[1] Basalt wells are located in the City of Hillsboro boundary plus a 1-mile buffer zone
cfs = cubic feet per second
gpm = gallons per minute

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Table 2

Basalt Wells near the City of Hillsboro Boundary[1]

City of Hillsboro

OWRD ID	Well Owner	Well Information							Well Location						
		Yield (gpm)	Specific Capacity (gpm/ft)	Test Type	Total Depth (ft bgs)	Thickness of Basalt Penetrated [2]	SWL (ft bgs)	Use	Township	Range	Section	Quarter	Quarter	Tax Lot	Well Address
WASH076	Claremont Joint Venture	45	NA	Air	425	53	66	Irrigation	1N	2W	20	SE	SE		15955 NW West Union Rd
WASH327	Franklin C. Pierson	50	NA	Bailer	350	32	60	Domestic	1N	1W	14	A	C		West side of Bendimer Rd
WASH360	Cliff Grow	180	NA	Air	485	84	72	Domestic & Industrial	1N	2W	14	NW	SE		
WASH361	John Bauman	30	0.08	Air	495	56	60	Domestic	1N	2W	14				
WASH362	Frederick & Sherry Joyner	16	0.05	Air	425	38	65	Domestic	1N	2W	14A		NE		
WASH363	Edgar W Phillips	30	0.13	Air	430	95	110	Domestic	1N	2W	14				
WASH364	Don Munster	60	0.11	Air	652	235	25	Domestic	1N	2W	15				
WASH1383	Kathryn Owen	125	NA	Air	365	140	62	Domestic	1N	2W	11	NE	SE	1300	8960 NW Dick Rd, Hillsboro 97124
WASH1662	William Long	60	NA	Air	485	387	129	Domestic	1N	2W	12	SW	SW	2000	Rt 1, Box 929 (Phillips Rd), Hillsboro 97124
WASH1751	DeLoris & Gerry Grossen	24	0.41	Bailer	600	88	85	Domestic	1N	2W	16	SE	SE		24815 NW Groveland Dr, Hillsboro 97124
WASH2118	Russ & Marie Turney	50	NA	Air	486	137	74	Domestic	1N	2W	15	SE	NE	212	23510 NW Publos Rd, Hillsboro 97124
WASH3343	Oak West Homes	20	NA	Air	370	153	20	Domestic	1N	2W	14		NE	600	Old Pass Rd
WASH4012	Wes Epler	30	0.07	Air	500	90	98	Domestic	1N	2W	14	SW	NW	3000	21393 NW West Union Dr
WASH4534	Travis Gregory	15	NA	Bailer	360	44	61.5	Domestic	1N	2W	14	SW	NE	1300	7444 NW 212 Place, West Union
WASH4678/ WASH4679	Walter Allenback	20	NA	Air	465	NA	200	Domestic	1N	1W	19				
WASH4680	Robert & Patricia Beville	25	0.12	Bailer	335	75	30	Domestic	1N	1W	19				
WASH4682	D. J. St Peter	15	0.08	Bailer	365	120	150	Domestic	1N	1W	19				
WASH4692	Floyd G Redding	30	0.37	Bailer	417	47	NA	Domestic	1N	1W	19				See diagram on well log
WASH4708	Nancy Wismer	18	0.05	Air	475	85	136	Domestic	1N	1W	20	SE	NE		
WASH4863/ WASH4864	Vern Gilbert	85	0.16	Air	630	147	105	Domestic & Irrigation	1N	1W	30				
WASH4879	Tansabrook	500	0.89	Air	825	160	42	Irrigation	1N	1W	31				
WASH5190	Benedict Nussbaumer	30	0.12	Air	335	65	25	Domestic	1N	2W	10				
WASH5191	Bill Cook	50	0.25	Bailer	335	67	100	Domestic	1N	2W	10				
WASH5193	Hans Schoch	30	0.16	Bailer	560	155	56	Domestic	1N	2W	10				
WASH5213	Cascadian Nurseries	700	NA	Air	605	493	103	Irrigation	1N	2W	11	NW	SE		
WASH5214	Merrill Kneeland	150	NA	Air	348	173	80	Domestic	1N	2W	11	NE	SW		Route 5, Box 678, Hillsboro 97124
WASH5218	Raymond M Munson	150	0.62	Air	320	200	60	Irrigation	1N	2W	11				
WASH5219	Matilda & Oliver Dick	120	0.5	AIr	380	277	95	Domestic & Irrigation	1N	2W	11				
WASH5221	Jeff Boden	210	NA	AIr	495	336	35	Irrigation	1N	2W	12	SW	SW		
WASH5262	Earl Braddock	75	NA	Air	310	138	45	Domestic	1N	2W	13				Route 2, Box 464A, Portland
WASH5277	Lewis & Gwyn Neace	75	NA	Air	380	220	88	Domestic	1N	2W	14	NW	NE		Route 5, Box 525, Hillsboro
WASH5278	Gary Rae	120	NA	Air	370	75	80	Domestic	1N	2W	14	NW	NW		
WASH5279	David Pratt	40	NA	Air	390	25	40	Domestic	1N	2W	14				
WASH5282	Paul Gartner	60	NA	Air	470	239	68	Domestic	1N	2W	14	NW	NE		
WASH5283	Virgil M Wroe	30	NA	Air	415	77	80	Domestic	1N	2W	14	SE	NW		Route 5, Box 644, Hillsboro 97123
WASH5284	Mike Caraualah	50	NA	Air	385	51	70	Domestic	1N	2W	14	SE	NW		Route 5, Box 647, Hillsboro 97123
WASH5285	John Tye	50	NA	Air	635	95	70	Domestic	1N	2W	14				Route 5, Box 633, Hillsboro
WASH5286	Joe Martinez	8	0.16	Pump	315	65	10	Domestic	1N	2W	14	SE	NE		
WASH5287	Jim Trobaugh	30	0.08	Air	420	40	80	Domestic	1N	2W	14				
WASH5288	Ken Stewart	80	0.46	Air	454	111	25	Domestic	1N	2W	14				
WASH5290	Arden D Danielson	55	0.15	Air	435	110	60	Domestic	1N	2W	14				
WASH5291	Archie Trobough	25	0.08	Air	410	64	95	Domestic	1N	2W	14				
WASH5292	Gideon Hess	22	0.07	Air	405	68	95	Domestic	1N	2W	14				
WASH5295	O. Lochden	18	NA	Bailer	399	11	63	Domestic	1N	2W	14				
WASH5296	Joseph Hickey	50	0.5	Air	475	118	65	Domestic	1N	2W	14			3	West Union Acres
WASH5297	West Union Garage	20	0.1	Air	495	85	60	Domestic	1N	2W	14				
WASH5298	Lila Oviatt	10	0.05	Air	335	55	20	Domestic	1N	2W	14			700	
WASH5299	Charles Bell	100	1	Air	415	35	85	Domestic	1N	2W	14	SW	NW	14	West Union Acres
WASH5300	Jack Keller	12	0.07	Air	385	11	85	Domestic	1N	2W	14				
WASH5309	Charles Hardin	7	0.11	Bailer	425	65	70	Domestic	1N	2W	14				
WASH5319	Robert Bennett	75	1	Air	421	46	53	Domestic	1N	2W	14				
WASH5321	Ralph Altmanns	75	0.36	Air	393	93	42	Domestic	1N	2W	14	NW			
WASH5322	Roger Hughes	50	0.22	Air	440	96	105	Domestic	1N	2W	14	SE	NW		

GSI Water Solutions, Inc.

Table 2

Basalt Wells near the City of Hillsboro Boundary[1]

City of Hillsboro

OWRD ID	Well Owner	Well Information							Well Location						
		Yield (gpm)	Specific Capacity (gpm/ft)	Test Type	Total Depth (ft bgs)	Thickness of Basalt Penetrated [2]	SWL (ft bgs)	Use	Township	Range	Section	Quarter	Quarter	Tax Lot	Well Address
WASH5338	Ruddy Vanderzee	95	0.63	Air	590	176	75	Domestic	1N	2W	15		SW		
WASH5339	Val Schaef	60	0.13	Air	525	55	79	Domestic	1N	2W	15				
WASH5340	Lawrence Kilgore	80	0.8	Air	415	30	45	Domestic	1N	2W	15			200	
WASH5343	C. I. Nelson	30	0.5	Pump & Bailer	700	190	30	Domestic	1N	2W	15				
WASH5350	Ed Moore	80	0.21	Air	500	100	70	Domestic	1N	2W	15	SW			
WASH5351	West Union School	NA	NA	NA	560	230	35	Public School	1N	2W	15	C			
WASH5432	Thomas E Rutte	15	NA	Air	365	176	140	Domestic	1N	2W	20			13 + 14	16745 NW Brugger Rd, Portland 97229
WASH5521	Sunset Farms & Stables	10	0.02	Air	775	67	210	Domestic	1N	2W	22				
WASH5524	Kenneth Berger	30	1.5	NA	757	152	40	NA	1N	2W	22	NW	NW		
WASH5544	Riviera Motors, Inc.	25	NA	Air	525	120	40	Domestic	1N	2W	23	SW			
WASH5545	Jerry Kimzey	50	NA	Air	440	50	130	Domestic	1N	2W	23				
WASH5586	PlanTek	1060	39.26	Pump	1517	548	20	Irrigation	1N	2W	28	SE	NW		Dawson Creek Corp Park, Hillsboro
WASH5595	Roy Thwaite	3.5	0.06	Bailer	385	120	325	Domestic	1N	2W	28				
WASH5810	E. M. Johnson	NA	NA	NA	1385	50	NA	NA	1N	2W	34	H			
WASH9800	Warren Collins	10	0.11	Air	500	200	395	Domestic	1N	2W	13				
WASH10535	David Edwards	30	0.12	Air	365	320	220	Domestic	1S	3W	1	NW	NW		
WASH50197	Best Mix Concrete	300	NA	Air	1350	114	17	Industrial	1S	2W	8	NE	SE	00100	3144 SW TV Hwy, Hillsboro
WASH51064	Don Hamburg	45	NA	Air	430	56	100	Domestic	1N	2W	15	NE	SW	216	23670 NW Publos Rd, Hillsboro
WASH51447	Pacific Land Management	200	0.65	Pump	1410	429	51	Irrigation	1N	2W	30	NE	NE	1100	Jones Farm Devel., NE 15 Ave, Hillsboro
WASH51495	Reserve Vineyard Golf Club	150	NA	Air	705	145	72	Domestic	1S	2W	15	SW	NE	600	4805 SW 229th Ave, Aloha 97007
WASH51780	Steven Schmidt	90	NA	Air	370	153	60	Domestic	1N	2W	13	NW	NW	600	7225 NW Cornelius Pass, Hillsboro
WASH52264	Danford Hoots	15	NA	Bailer	420	40	77	Domestic	1N	2W	14	SW	NE	19	21282 NW Bendemeer Rd, Hillsboro
WASH52316	Allen Schaaf	60	NA	Air	607	217	89	Domestic	1N	2W	15	NW	SE	209	Pueblos Rd, Hillsboro
WASH53544	Larry & Mary Sullivan	60	NA	Air	915	104	45	Domestic	1N	2W	19	NE	NE	1700	6077 NW Jackson School Rd, Hillsboro 97124
WASH54735	Bill Hickox	18	NA	Air	425	162	94	Domestic	1N	2W	14	SW	NE	2701	21330 NW Bendemeer Rd
WASH54761	Steve Chinick	30	NA	Air	480	110	75	Domestic	1N	2W	14	SW	NE	700	21300 NW West Union Hills Rd, Hillsboro
WASH55985	Beverly McClenathan	75	NA	Air	421	132	82	Domestic	1N	2W	14	SE	NE	2300	20956 NW Bendemeer Rd
WASH56198	Kozak Interprises Inc.	125	NA	Air	798	61	53	Domestic	1S	2W	15	SE	NE	904	22830 SW Noble St, Beaverton
WASH56477	Tara Francis	70	NA	Air	460	68	122	Domestic	1N	2W	15	NE	SW	215	23797 SW Shaaf Rd
WASH57025	Randall & Linda Schade	60	NA	Air	355	123	Artesian: 2 lb/in^2	Domestic	1N	2W	14	SE	NE	500	20701 NW Old Pass Rd, Hillsboro
WASH58499	Matthew Yunker	40	NA	Air	325	141	62	Domestic	1N	2W	10	NW	SE	800	8700 NW Helvatia Rd
WASH58884	George Choban	120	NA	Air	643	240	107	Domestic	1N	2W	15	NW	NW	1000	7435 NW Helvatia Rd, Hillsboro 97124
WASH58925	Hillsboro School Dist. 1J	275	NA	Air	648	192	100	Irrigation	1N	2W	14	SW	SW	102	21945 Wagon Way, Hillsboro
WASH59088	Lowell Berger	27	NA	Air	306	120	121	Domestic	1N	2W	11	NE	SE	1191	8833 NW Dick Rd, Hillsboro
WASH59240	Peggy Demarini	60	NA	Air	485	82	115	Domestic	1N	2W	15	NW	SE	211	6860 NW Schaaf Rd, Hillsboro
WASH62822	Gary & Susan Rae	150	NA	Air	379	NA	153	Domestic	1N	2W	10	NE	SE		22651 NW West Union Rd
WASH64646	Dan Carey	90	NA	Air	400	228	115	Domestic	1N	2W	11	NE	SE	207	20950 NW Phillips Rd, Hillsboro
WASH66523	Chuck Garner	35	0.58	Air	328	134	185	Domestic	1N	2W	11	SW	NW	501	9349 Dick Rd
WASH66595	Ken Bryan	75	NA	Air	785	235	76	Domestic	1N	2W	16	SW	SW	800	26290 NW Meek Rd
WASH66930	Cascadian Nurseries	525	NA	Air	647	430	118	Irrigation	1N	2W	11	NW	SE	1400	8900 NW Dick Rd

Notes:

[1] Basalt wells are located in the City of Hillsboro boundary plus a 1-mile buffer zone

[2] Thickness of basalt penetrated includes weathered and/or decomposing basalt.

NA = not available

ft bgs = feet below ground surface

GSI Water Solutions, Inc.

Table 3. Summary of Well Yields

City of Hillsboro

Number of Basalt Well Logs [1]	Minimum Yield (gpm)	Median Yield (gpm)	Average Yield (gpm)	Maximum Yield (gpm)
93	3.5	50	91	1,060

Notes:

[1] Number of basalt well logs includes wells that were drilled into more than 10 feet of basalt.

Table 4. Key Basalt Wells

City of Hillsboro

Basalt Well Construction Information								
OWRD ID	**Well Owner**	**Yield** (gpm)	**SC** (gpm/ft)	**Depth** (ft)	**Basalt Penetrated** (ft)	**SWL** (ft bgs)	**Use**	**Location**
Wash 5586	Dawson Creek Park	1,000+	37	1,517	549	20	Irrigation	T1N, R2W, S28, SE NW
WASH 5213	Cascadian Nurseries	700	NA	605	493	103	Irrigation	T1N, R2W, S11, NW SE
WASH 66930	Cascadian Nurseries	525	NA	647	430	118	Irrigation	T1N, R2W, S11, NW SE
WASH 4879	Tansabrook	500	0.89	825	160	42	Irrigation	T1N, R1W, S31
WASH 50197	Knife River	300	NA	1,350	114	17	Industrial	T1S, R2W, S8, NE SE
WASH 58925	Hillsboro School District	275	1	648	192	100	Irrigation	T1N, R2W, S14, SW SW
WASH 5221	Jeff Boden	210	NA	495	336	35	Irrigation	T1N, R2W, S12, SW SW
WASH 51447	Pacific Land Management	200	0.65	1,410	429	51	Irrigation	T1N, R2W, S30, NE NE
WASH 1662	William Long	60	NA	485	387	129	Domestic	T1N, R2W, S12, SW SW
WASH 10535	David Edwards	30	0.12	365	320	220	Domestic	T1S, R3W, S1, NW NW

Table 5
Dawson Creek Park Well and Knife River Well Groundwater Quality Data
City of Hillsboro

Category	Analyte	Regulatory Standard	Regulatory Criteria	Units	Dawson Creek Park Well (WASH 5586) 6/14/2011	Knife River Well (WASH 50197) 8/4/2011
Field Parameters	Dissolved Oxygen	None	None	mg/L	0.135	
	ORP	None	None	mV	5.1	
	pH	6 - 8.5 standard units	SMCL	pH	7.89	
	Specific Conductance	None	None	us/cm	1117	
	Temperature	None	None	degC	21.02	
Geochemical	Ammonia Nitrogen	None	None	mg/L	0.067	
	Bicarbonate	None	None	mg/L	130	
	Calcium	None	None	mg/L	37	
	Carbonate	None	None	mg/L	2 U	
	Chloride	250	SMCL	mg/L	280	
	Hardness (as CaCO3)	None	None	mg/L	140	
	Hydroxide as OH	None	None	mg/L	2 U	
	Magnesium	None	None	mg/L	13	
	Nitrate as N	10	MCL, MML	mg/L	0.25 U	
	Nitrate+Nitrite	None	None	mg/L	0.05 U	
	Nitrite as N	1	MCL	mg/L	0.25 U	
	Orthophosphate	None	None	mg/L	0.015	
	Potassium	None	None	mg/L	22	
	Silica	None	None	mg/L	54	
	Sodium	20	MCLG	mg/L	160	
	Sulfate	250	SMCL	mg/L	3.4	
	Total Alkalinity	None	None	mg/L	110	
	Total Dissolved Solids	500	SMCL	mg/L	650	
	Dissolved Organic Carbon	None	None	mg/L	0.3 U	
	Total Organic Carbon	None	None	mg/L	0.3 U	
	Total Suspended Solids	None	None	mg/L	10 U	
Metals	Aluminum	0.05	SMCL	mg/L	0.020 U	
	Antimony	0.006	MCL	mg/L	0.001 U	
	Arsenic	0.01	MCL	mg/L	0.0049	
	Barium	1	MML	mg/L	0.077	
	Beryllium	0.004	MCL	mg/L	0.001 U	
	Cadmium	0.005	MCL	mg/L	0.0005 U	
	Chromium	0.05	MML	mg/L	0.001 U	
	Cobalt	None	None	mg/L	0.002 U	
	Copper	1	SMCL	mg/L	0.0023	
	Iron, Dissolved	None	None	mg/L	0.024	
	Iron, Total	0.3	SMCL	mg/L	0.032	
	Lead	0.05	MML	mg/L	0.0005 U	
	Manganese, Dissolved	None	None	mg/L	0.065	
	Manganese, Total	0.05	SMCL	mg/L	0.061	
	Mercury	0.002	MCL, MML	mg/L	0.0002 U	
	Molybdenum	None	None	mg/L	0.0045	
	Nickel	None	None	mg/L	0.005 U	
	Selenium	0.01	MML	mg/L	0.005 U	
	Silver	0.05	MML	mg/L	0.0005 U	
	Strontium	None	None	mg/L	0.13	
	Thallium	0.002	MCL	mg/L	0.001 U	
	Vanadium	None	None	mg/L	0.0095	
	Zinc	5	SMCL	mg/L	0.020 U	
Miscellaneous	Color	15 standard units	SMCL	cu	3 U	
	Lab Specific Conductance at 25 degrees C	None	None	us/cm	1100	
	Lab pH at 25 degrees C	6 - 8.5 standard units	SMCL	pH	7.8	
	Corrosivity at 25 degrees C	Noncorrosive	SMCL	None	0.27	
	Cyanide, Free	0.2	MCL	mg/L	0.005 U	
	Fluoride	2 [4]	SMCL [MCL,MML]	mg/L	0.63	
	Dissolved UV 254	None	None	cm^{-1}	0.009 U	
	Charge balance of analysis using major ions	None	None	%	5.9	
	Odor at 60 degrees C	3 threshold #s	SMCL	ton	1	
Radionuclides	Radon 222	None	None	pCi/L	390 ±18	
	Uranium	0.03	MCL	mg/L	0.001 U	

Notes:
NT - analyte not tested.
U = Analyte not detected at indicated detection lmit.

GSI Water Solutions, Inc.

Table 6
Comparison of CRBG Groundwater Quality Data
City of Hillsboro

Analyte	Unit	Regulatory Standard	Regulatory Criteria	St. Mary's Well (WASH 8851)	Knife River Well (WASH 501997)	Dawson Creek Park Well (WASH 5586)	Dawson Creek Park Well (WASH 5586)	Liberty High School ASR Well (WASH 58925)	City of Beaverton ASR 1 (WASH 8988)
Date Sampled				11/19/1953	8/4/2011	3/2/1987	6/17/2011	1/11/2010	7/14/1994
Alkalinity	mg/l	250	SMCL	NT		120	110	154	110
Calcium	mg/l	None	None	222		20	37	50	36
Chloride	mg/l	250	SMCL	**960**		**275**	**280**	90	47.5
Carbonate (CO3)	mg/l	None	URC	NT		NT	ND	ND	NT
Total Hardness, as CaCO3	mg/l	250	SMCL	**739**		91	140	172	140
Bicarbonate (HCO3)	mg/l	None	None	63		120	130	154	110
Potassium	mg/l	None	None	40		22	22	7.4	2.6
Magnesium	mg/l	None	None	45		10	13	16.1	19
Manganese	mg/l	0.05	SMCL	NT		0.04	**0.061**	ND	NT
Manganese Dissoloved	mg/l	None	None	NT		NT	0.065	ND	NT
Iron Total	mg/l	0.3	SMCL	**0.33**		0.1	0.032	ND	0.015
Iron Dissolved	mg/l	None	None	NT		NT	0.024	ND	NT
Fluoride	mg/l	2	SMCL	0.1		1.3	0.63	ND	0.12
Sodium	mg/l	20	URC (advisory)	**290**		**140**	**160**	**73**	12.1
Nitrite as N	mg/l	1	MCL	NT		NT	ND	ND	0
Nitrate as N	mg/l	10	MML	0.3		ND	ND	ND	0.56
Silica	mg/l	None	None	45		NT	54	32	NT
Sulfate	mg/l	250	URC, SMCL	2.7		5	3.4	ND	3.5
Total Dissolved Solids	mg/l	500	SMCL	**1640**		**630**	**650**	396	245
Total Organic Carbon	mg/l	None	None	NT		1.8	ND	2.55	0.7
Total Suspended Solids	mg/l	None	None	NT		ND	ND	2	0.5
Lab pH	Units	6 - 8.5	None	8.2**		8	7.8	NT	NT
Field pH	Units	6 - 8.5	None	8.2**		NT	7.89	8.09	6.88
Field Temperature	Celsius	None	None	NT	21.38	22.2	22.2	13.3	NT
Field Specific Conductance	umho/cm	None	None	3,140**	3,603	NT	1,117	423	377
Lab Specific Conductance	umho/cm	None	None	3,140**		900	1,100	NT	NT
Field Dissolved Oxygen	mg/l	None	None	NT	0.17	NT	0.135	0.22	4.2
Odor	TON	3	SMCL	NT		NT	1	1	NT
Radon 222	pCi/l	300 or 4000	Proposed MCL	NT		NT	390 ±18	NT	NT
Eh	mV	None	None	NT		NT	NT	NT	NT

Note:

Analytical data shown in bold exceeds the regulatory standard
Green shading = 1/2 the method reporting limit.
ND = not detected
NT = not tested
SMCL = Secondary Maximum Contaminant Levels -- Federal Regulations
MCL = Maximum Contaminant Levels -- Federal Regulations
MML = Maximum Measurable Level -- Oregon Department of Environmental Quality
URC = Oregon Health Division Unregulated Contaminants
mg/l = milligrams per kilograms (equivalent to part per million)
umhos/cm = micromhos per centimeters
Celsius (C = 5/9 (F - 32))
** Unknown if measurements are from lab or field.

GSI Water Solutions, Inc.

Table 7: Comparison of Selected Dawson Creek Park and Knife River Well Water Quality against EPA MCLs and SMCLs and Typical JWC Levels

City of Hillsboro

Analyte	Regulatory Criteria	Units	Regulatory Standard	JWC Typical Range[1]	Dawson Creek Park Well (WASH 5586) 6/14/2011	Knife River Well (WASH 50197) 8/4/2011	Rec'd Criteria for Treatment[2]
Parameters Exceeding SMCLs							
Iron, Dissolved	None	mg/L	None	0.01U-0.05	0.024	0.02 U	-
Iron, Total	SMCL	mg/L	0.3	0.01U-0.16	0.032	1.1	<0.1
Manganese, Dissolved	None	mg/L	None	0-0.02	0.065	0.22	-
Manganese, Total	SMCL	mg/L	0.05	0.002-0.02	0.061	0.21	<0.02
Total Dissolved Solids	SMCL	mg/L	500	57-100	650	2600	<200
Parameters substantially different than JWC water, exceeding 50% of MCL, or that have the potential to adversely impact water quality or customer acceptance							
Chloride	SMCL	mg/L	250	4-6	280	1200	Per TDS
Sodium	None	mg/L	None	9.6-12	**160**	**370**	Per TDS
Hardness (as $CaCO_3$)	None	mg/L	None	27-40.6	140	700	<50
Arsenic	MCL	mg/L	0.01	0.001-0.003	0.0049	0.0081	<0.005
Barium	MML	mg/L	1	0.0042-0.02	0.077	0.46	
Ammonia (as N)	None	mg/L	None	NT	0.067	1.6	<0.05
Fluoride	SMCL [MCL,MML]	mg/L	2 [4]	0.6-1	0.63	0.45	0.7
Temperature	None	degC	None	6.5-14	21.02	21.38	Mitigation

Notes:

NT = Analyte not tested.
MCL = Maximum contaminant level.
SMCL = Secondary MCL.
JWC = Joint Water Commission

U = Analyte not detected at indicated detection limit.

Values highlighted in gray exceed referenced MCLs or SMCLs.

[1]JWC water quality ranges from data collected by GSI from 2005-2008 during aquifer recovery cycles from City of Beaverton ASR wells.

[2]Treatment criteria recommendations are based on levels known to sufficiently reduce risk from aesthetic contaminants and that otherwise are not anticipated to result in customer complaints. Treatment criteria typically are refined with input from the owner during the development of a basis of design.

TABLE 8

Hillsboro GW Development

Treatment Costs

Payment Calculations	
Rate	5%
Term Years	20

								Annualized Capital Costs using low end Treatment Costs	
Well Yield gpm	Well Yield mgd	Annual yield gallons	Annual yield MG		Capital Cost Treatment (low)	Capital Cost Treatment (high)		Annualized Capital Cost, 20 year payment at 5% net	Annualized Captial Cost per ccf based on 6 months of recovery[1]
1,389	2	730,000,058	730		$9,000,000	$13,000,000		$687,794	$1.410

[1] Assumes 6 months yield at 2 mgd or 365 MG of recovery

gpm = gallons per minute

mgd = million gallons per day

MG = million gallons

ccf = 748 gallons (unit of billing/measurement typically used by municipalities)

Table 9

Hillsboro ASR Planning Level Costs [1]

Exploration and Testing Phase		
1	Land use and potential purchase	$200,000
2	Test well (small diameter 12-inch to 2,000 feet)	$700,000
3	Construction management/hydro support	$50,000
4	Water quality evaluation (buffer zone scale testing and compatibility testing)	$30,000
5	Preliminary engineering design and evaluation "go vs. no-go" decision	$100,000
	Subtotal	$1,080,000
ASR Pump Station Design and Permitting		
6	ASR Limited License	$50,000
7	Reaming exploratoin borehole and oversight	$250,000
8	ASR pump station design 15% of construction services	$206,250
	Subtotal	$506,250
ASR Pump Station Construction		
9	ASR pump station with on-site chlorination	$1,000,000
10	ASR pump station costs for injecting under pressure	$250,000
11	Misc. costs 10% of costs	$125,000
	Total ASR pump station costs	$1,375,000
Year 1 - 3 ASR Pilot testing and reporting		
12	Hydro support ASR pilot testing 3 years	$250,000
13	Shut-in of flowing wells (assume 2)	$150,000
	Subtotal pilot testing	$400,000
	Grand total with Year 1-3 pilot testing	**$3,361,250**
	Grand total without pilot testing	**$2,961,250**

Payment calculations	
Rate	5%
Term	20 years

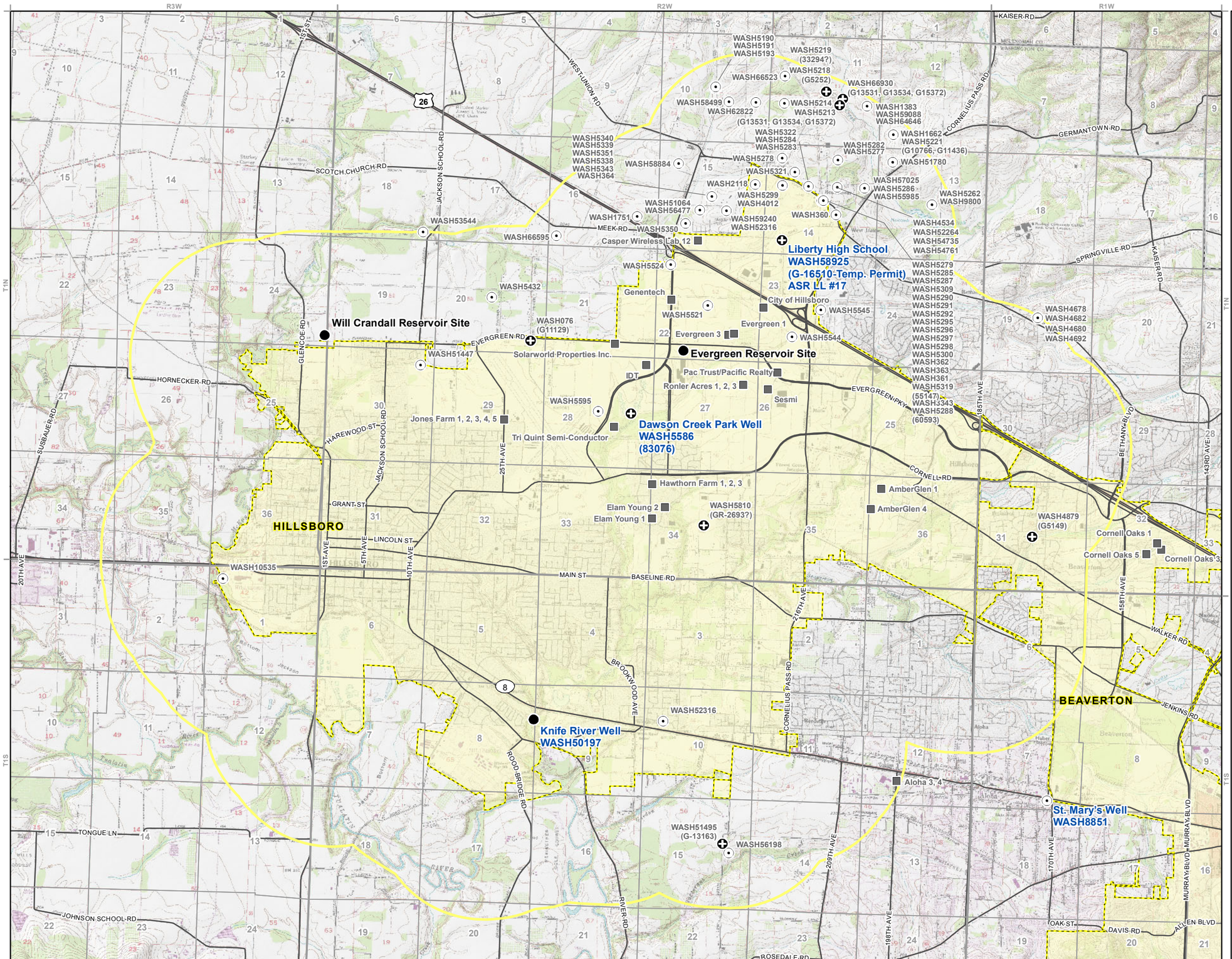
	Capital cost annualized 20 years at net 5% (without pilot testing)	$226,303
	Assumed yield	2 mgd yield for 75 days of peakin
	Assumed storage	150 MG storage
	Annualized capital cost per ccf based on 150 MG storage	$1.128

[1] Based on the current 2011 JWC drilling costs and an assumed cost increase with depth. Assumes that the drilling depth will be twice that of the JWC basalt test wells.

FIGURE 1

Basalt Wells and Associated Water Rights Near Hillsboro

City of Hillsboro



LEGEND

- Potential ASR Sites
- Basalt Wells
- Basalt Wells with Water Right Permits or Certificates
- WASH XX OWRD Well ID
- Major High-Tech Water Users
- 1 Mile Buffer (City of Hillsboro)
- Cities
- Counties
- Major Roads

NOTE:

- BLUE text indicates water quality sample location
- Intel locations based on Intel website office locations (http://www.intel.com/content/www/us/en/location/usa.html#Oregon Aug, 2011)
- Wells located according to information on OWRD well ID: address, quarter/quarter section, quarter section or section.

N

0 0.5 1 1.5

Miles

MAP NOTES:

Date: February 23, 2012
Data Sources: Oregon Geospatial Data Clearinghouse, METRO RLIS,USGS, ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\254 - Joint Water Commission\009-Hillsboro Specific 11-12\Project_GIS\Project_mxds\Figure1_Hillsboro_OWRD_Basalt_Wells_WRs.mxd, Date: February 23, 2012 3:26:52 PM

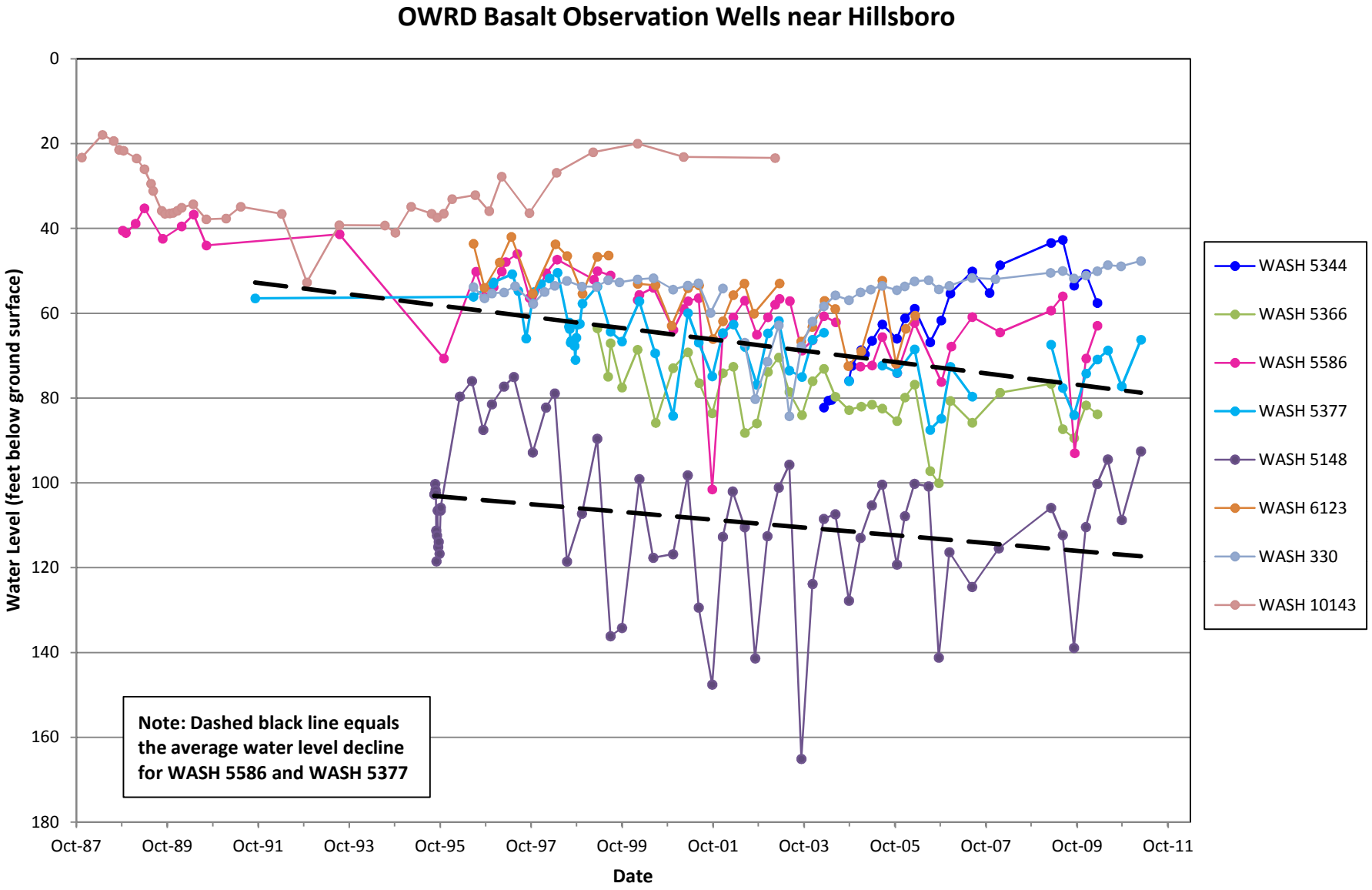


Figure 2

OWRD Basalt Observation Well Water Level Data

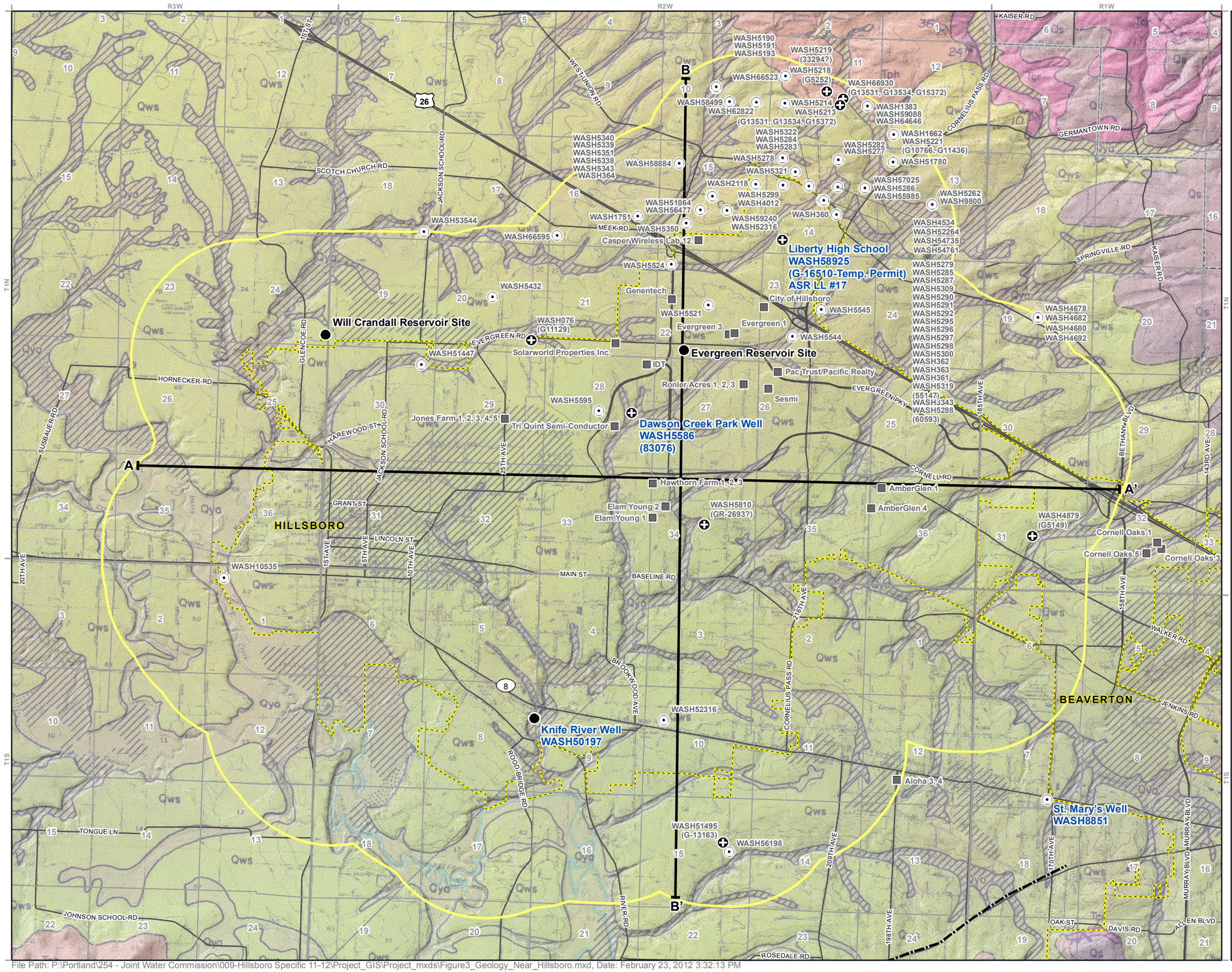
City of Hillboro

GSI Water Solutions, Inc.

FIGURE 3

Geology and Basalt Wells Near Hillsboro

City of Hillsboro



LEGEND

- Potential ASR Sites
- Basalt Wells
- Basalt Wells with Water Right Permits or Certificates
- WASH XX OWRD Well ID
- Major High-Tech Water Users

Surficial Geology

- Recent Young Alluvium
- Willamette Silt (Missoula flood sediment)
- Upland Silt
- Helvetia Formation (fluvial)
- Columbia River Basalt

All Other Features

- Cross Section Lines
- Major Faults
- 1 Mile Buffer (City of Hillsboro)
- Cities
- Counties
- Major Roads

NOTE:

- BLUE text indicates water quality sample location
- Intel locations based on Intel website office locations (http://www.intel.com/content/www/us/en/location/usa.html#Oregon Aug, 2011)
- Wells located according to information on OWRD well ID: address, quarter/quarter section, quarter section or section.
- Original Geology map from Schlicker and Deacon 1967, "Geology and Surficial Deposits of the Tualatin Valley Region, Oregon".

N

0 0.5 1 1.5

Miles

MAP NOTES:

Date: February 23, 2012
Data Sources: Oregon Geospatial Data Clearinghouse, METRO RLIS,USGS, ESRI

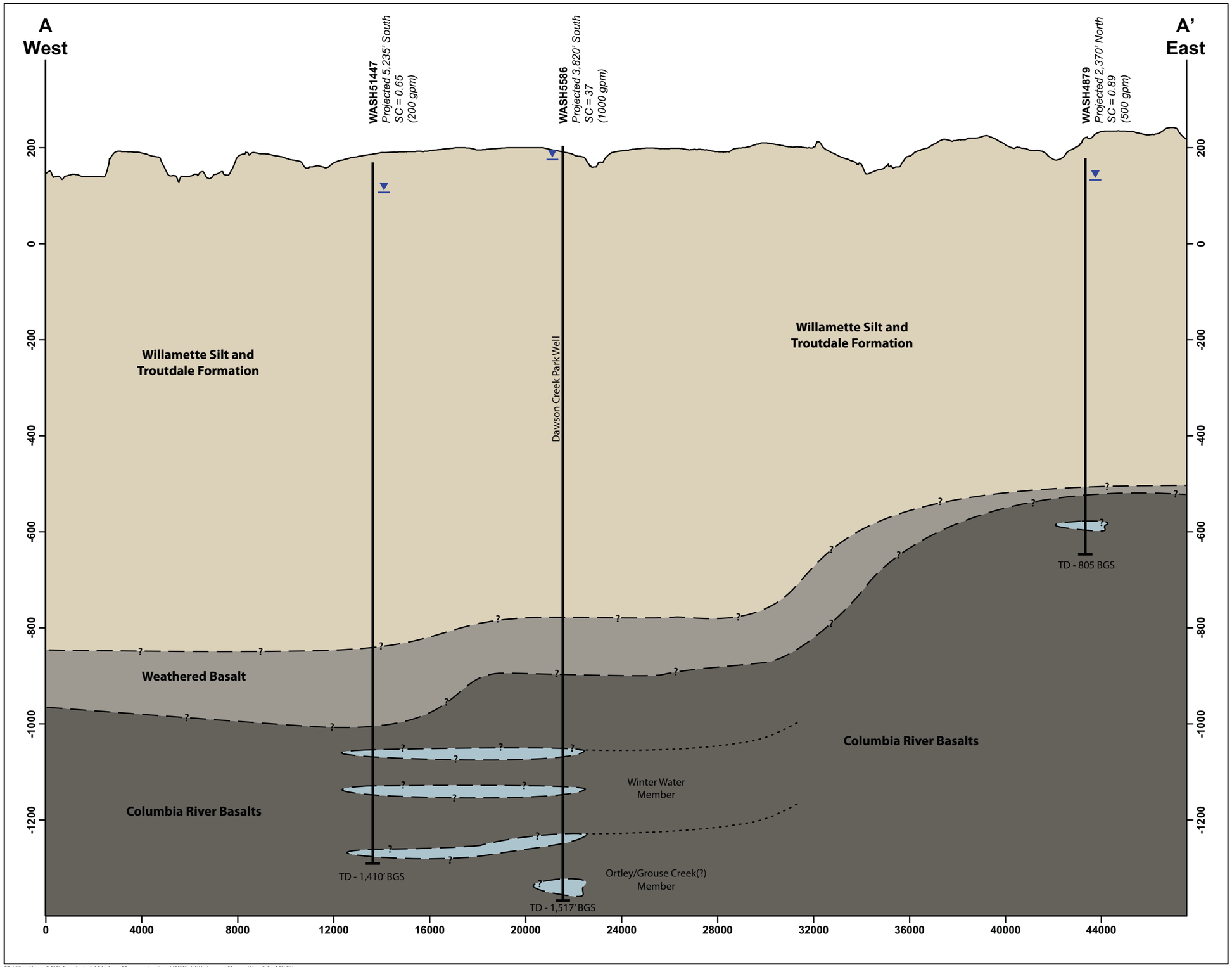
GSI Water Solutions, Inc.

File Path: P:\Portland\254 - Joint Water Commission\009-Hillsboro Specific 11-12\Project_GIS\Project_mxds\Figure3_Geology_Near_Hillsboro.mxd, Date: February 23, 2012 3:32:13 PM

FIGURE 4

Cross Section A-A'

City of Hillsboro



LEGEND

- Willamette Silt and Troutdale Formation Sediments-Clay, Sandy Clays, and Sands
- Weathered Basalt
- Columbia River Basalt Grande Ronde Formation
- Interflow Zones
- Static Water Level

NOTES

SC - Specific Capacity
gallon per minute
per foot of drawdown
gpm/ft
GPM - Gallons per Minute
BGS - Below Ground Surface
TD - Total Depth

GSI Water Solutions, Inc.

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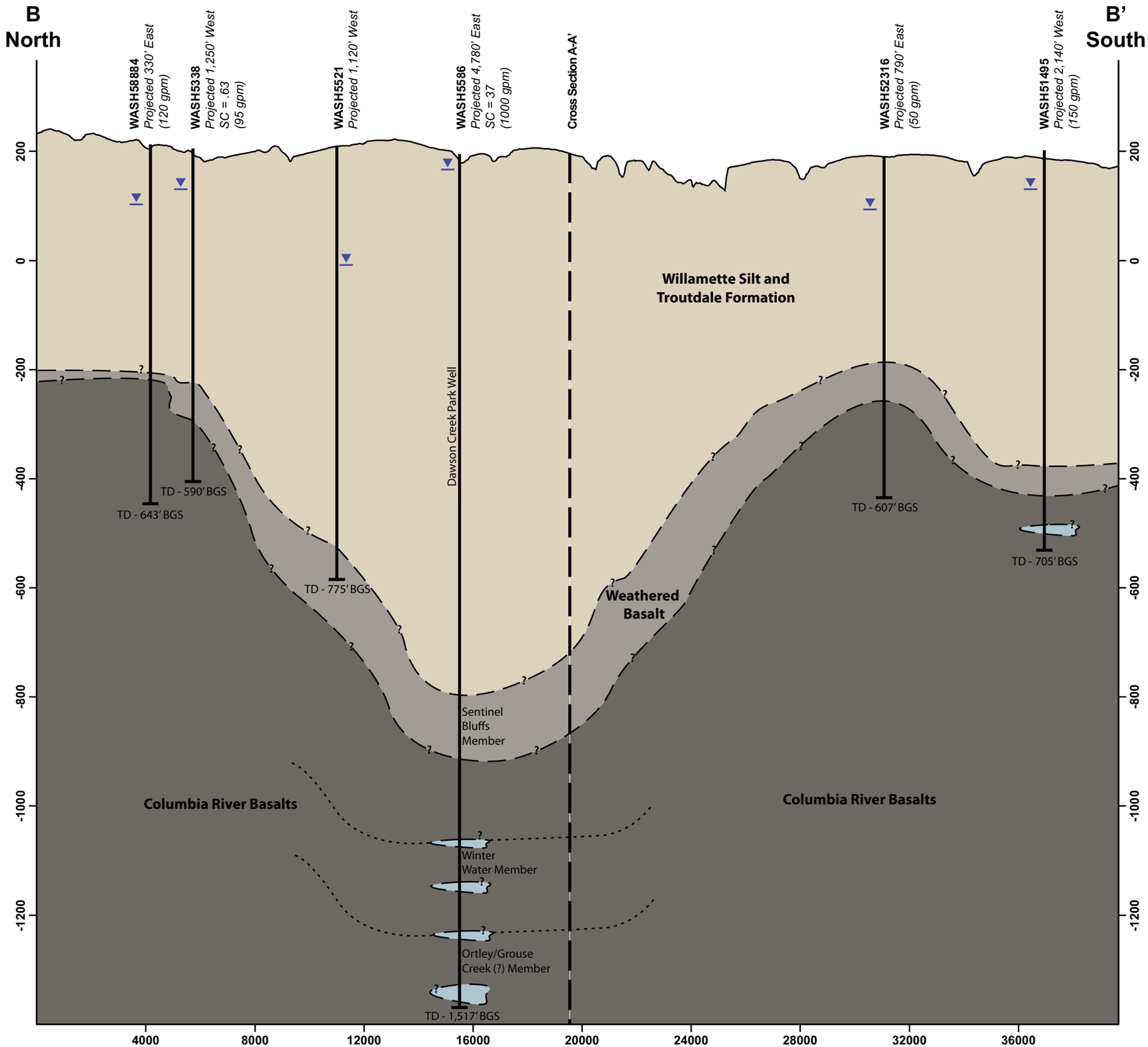
FIGURE 5

Cross Section B-B'

City of Hillsboro



LEGEND

- Willamette Silt and Troutdale Formation Sediments-Clay, Sandy Clays, and Sands
- Weathered Basalt
- Columbia River Basalt Grande Ronde Formation
- Interflow Zones
- Static Water Level

NOTES

SC - Specific Capacity
gallon per minute
per foot of drawdown
gpm/ft
GPM - Gallons per Minute
BGS - Below Ground Surface
TD - Total Depth

GSI Water Solutions, Inc.

Geologic Log For Site WASH 5586

NWIS Site ID: 453230122555701
OWRD Log ID: WASH 5586
Well location: 01N/02W-28DAB
Depth drilled, in feet below land surface: 1517
Land surface altitude, in feet above Nation Geodetic Vertical Datum of 1929: 183

Logged by: T. L. Tolan and M. H. Beeson
Date drilled: 10/01/1986

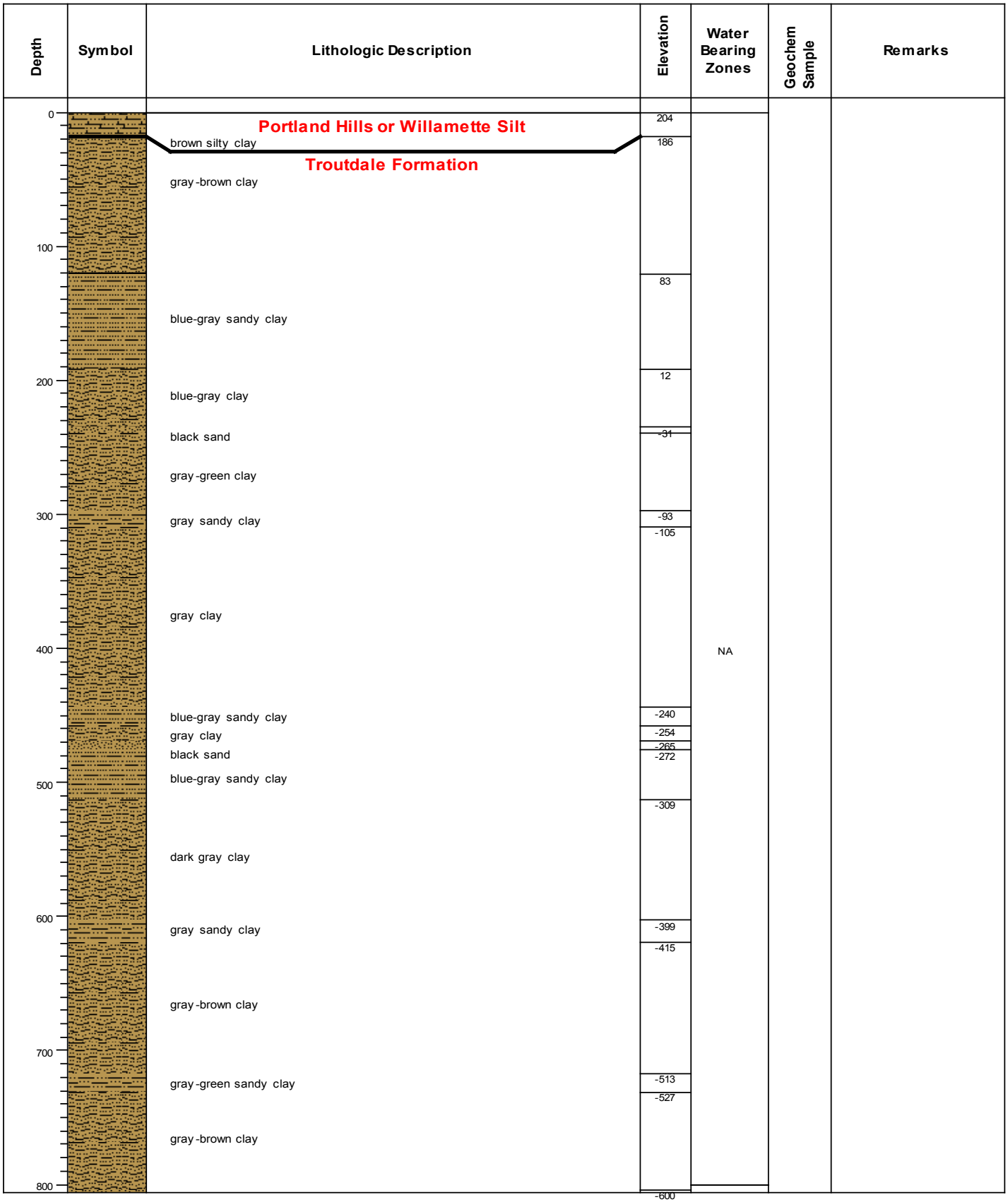


FIGURE 6a

Dawson Creek Park Well (WASH 5586)

City of Hillsboro

Geologic Log For Site WASH 5586

NWIS Site ID: 453230122555701
OWRD Log ID: WASH 5586
Well location: 01N/02W-28DAB
Depth drilled, in feet below land surface: 1517
Land surface altitude, in feet above Nation Geodetic Vertical Datum of 1929: 183

Logged by: T. L. Tolan and M. H. Beeson
Date drilled: 10/01/1986

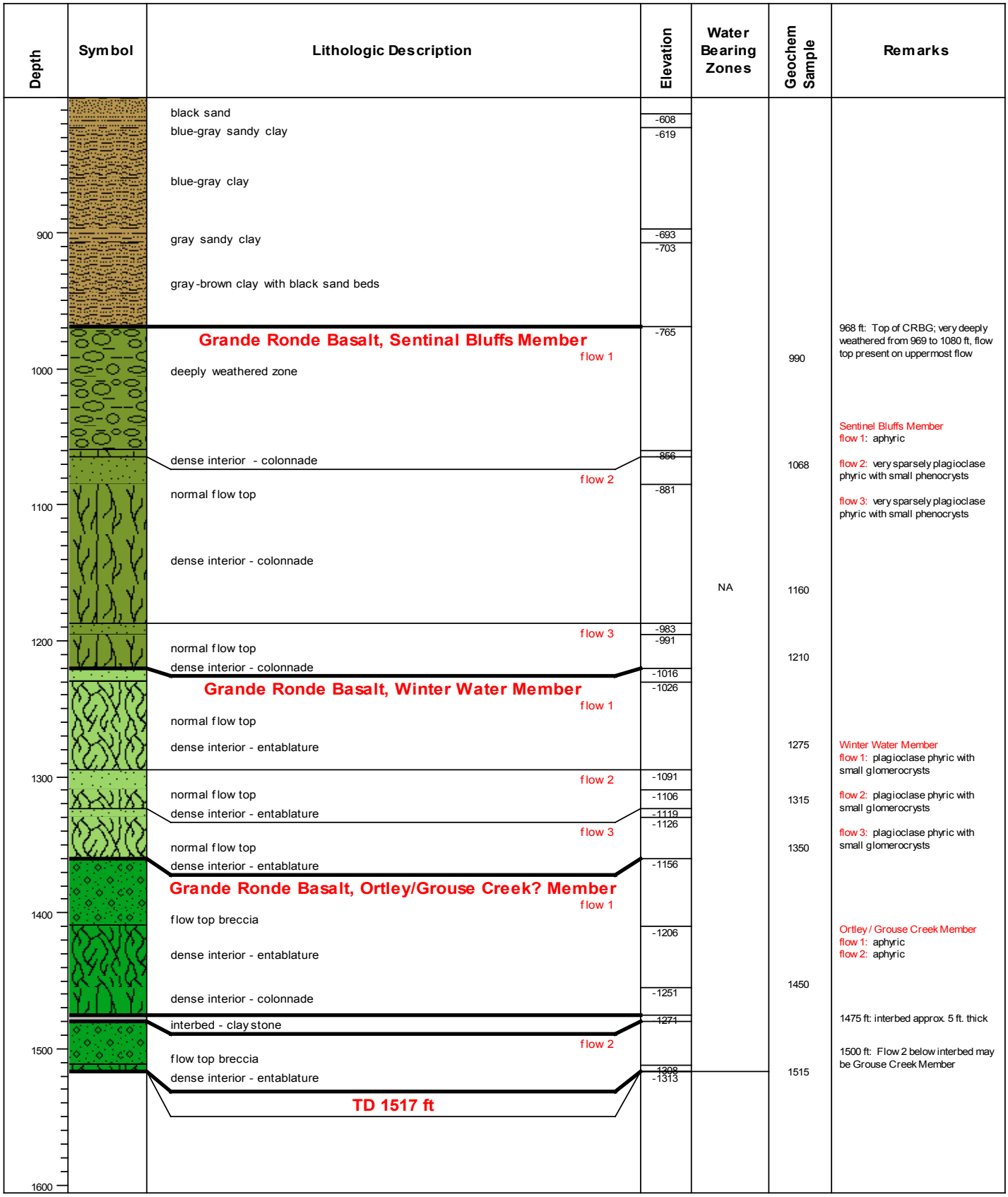
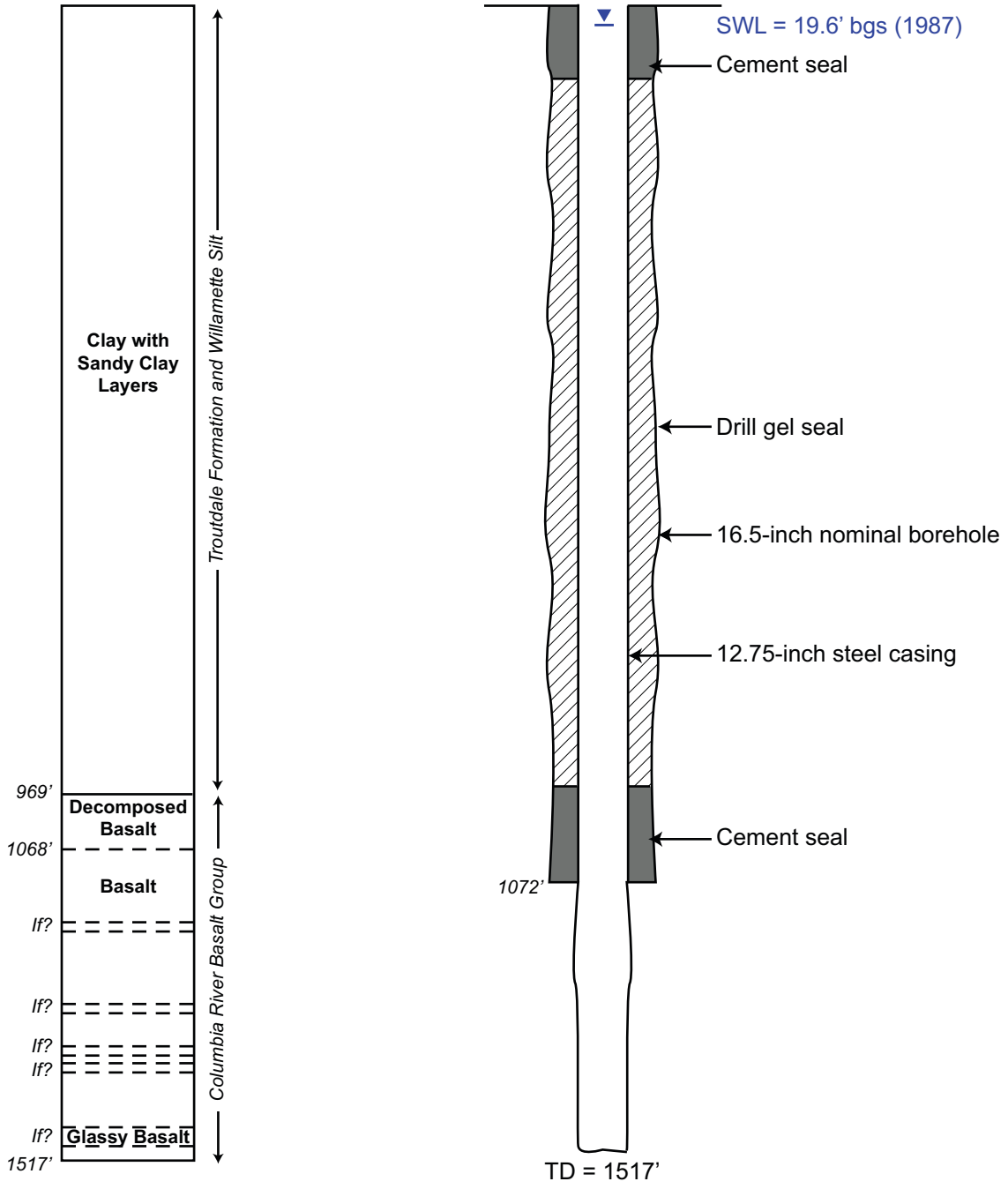


FIGURE 6b

Dawson Creek Park Well (WASH 5586)

City of Hillsboro

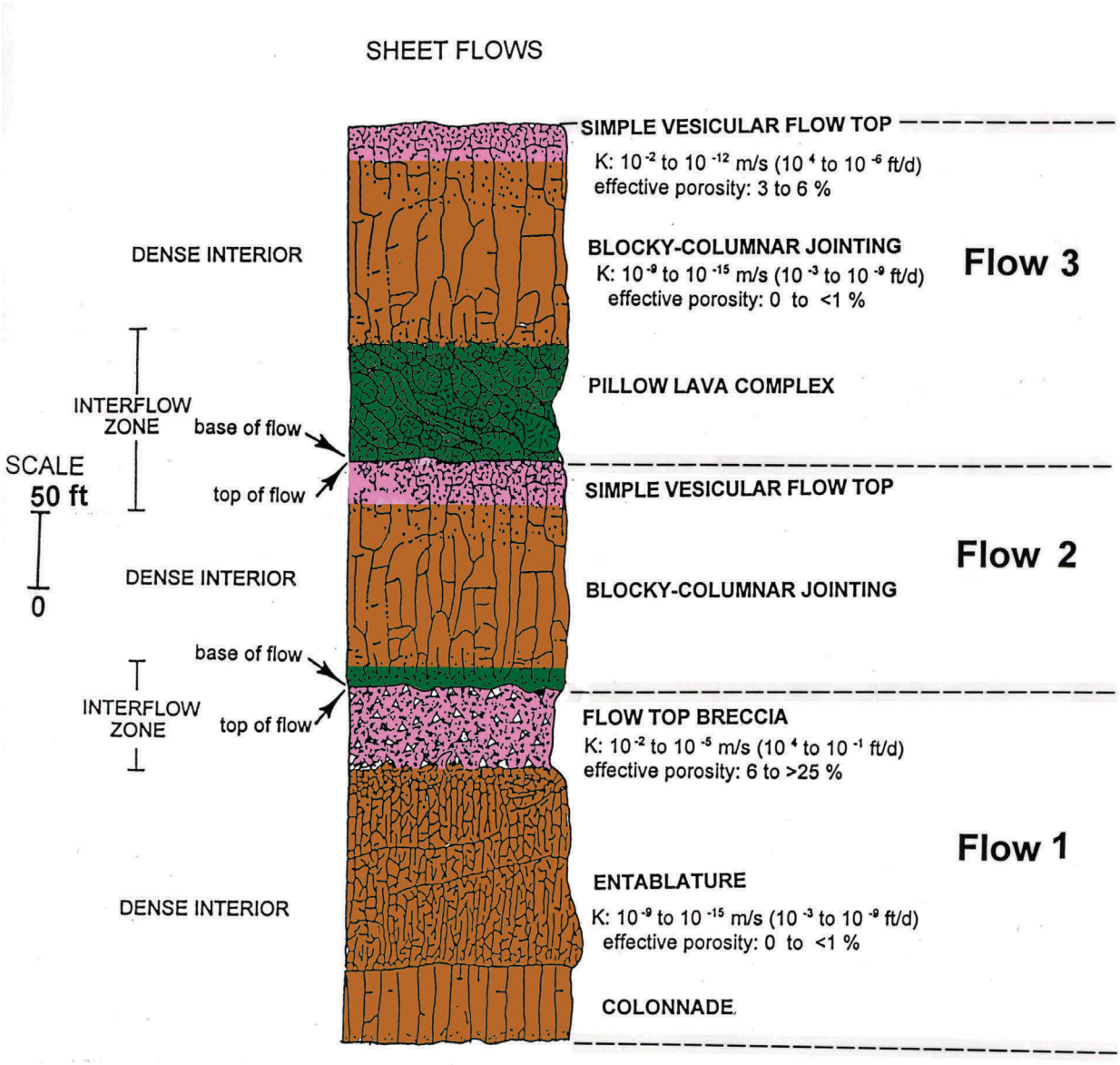


NOTES

- IF = Basalt Interflow
- 76-hour pump test during construction yielded 1,060 gallons per minute and a specific capacity of 39.3 gallons per minute per foot of drawdown.

FIGURE 7
Dawson Creek Park Well (WASH 5586)
As-Built and Lithology
City of Hillsboro

GSI Water Solutions, Inc.

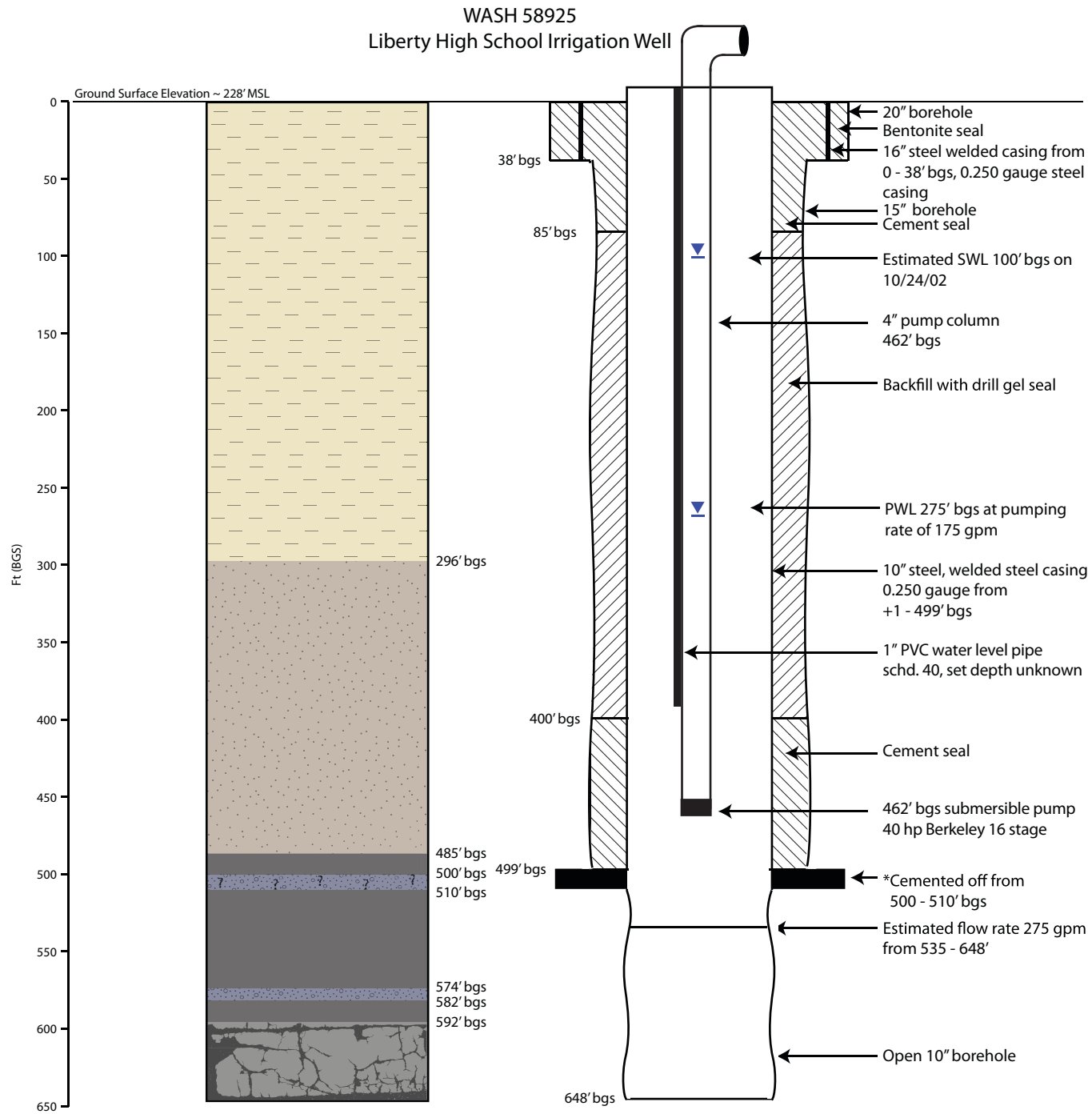


Diagrammatic representation of common Columbia River Basalt Group (CRBG) intraflow structure and terminology. Flow tops are highlighted in pink, dense interiors in orange, and flow bottoms in green. From Tolan et al. (2000)

K= represents a bulk hydraulic conductivity value

FIGURE 8
CRBG Geomorphology and Hydraulic Properties
City of Hillsboro

GSI Water Solutions, Inc.



LEGEND

- Clay or Silt
- Decomposing or Soft Brown Basalt
- Firm or Hard Gray-Black Basalt
- Interflow Zone
- Fractured Basalt

NOTES

SWL - Static Water Level
BGS - Below Ground Surface
GPM - Gallons per Minute
MSL - Mean Sea Level
PWL - Pumping Water Level
* Air pressure was used to force cement into formation after hole had been backfilled with gravel.

FIGURE 9
As-Built and Lithology
City of Hillsboro

GSI Water Solutions, Inc.

P:\Portland\254 - Joint Water Commission\007- Hillsboro Specific\006-GW Evaluation\Figures

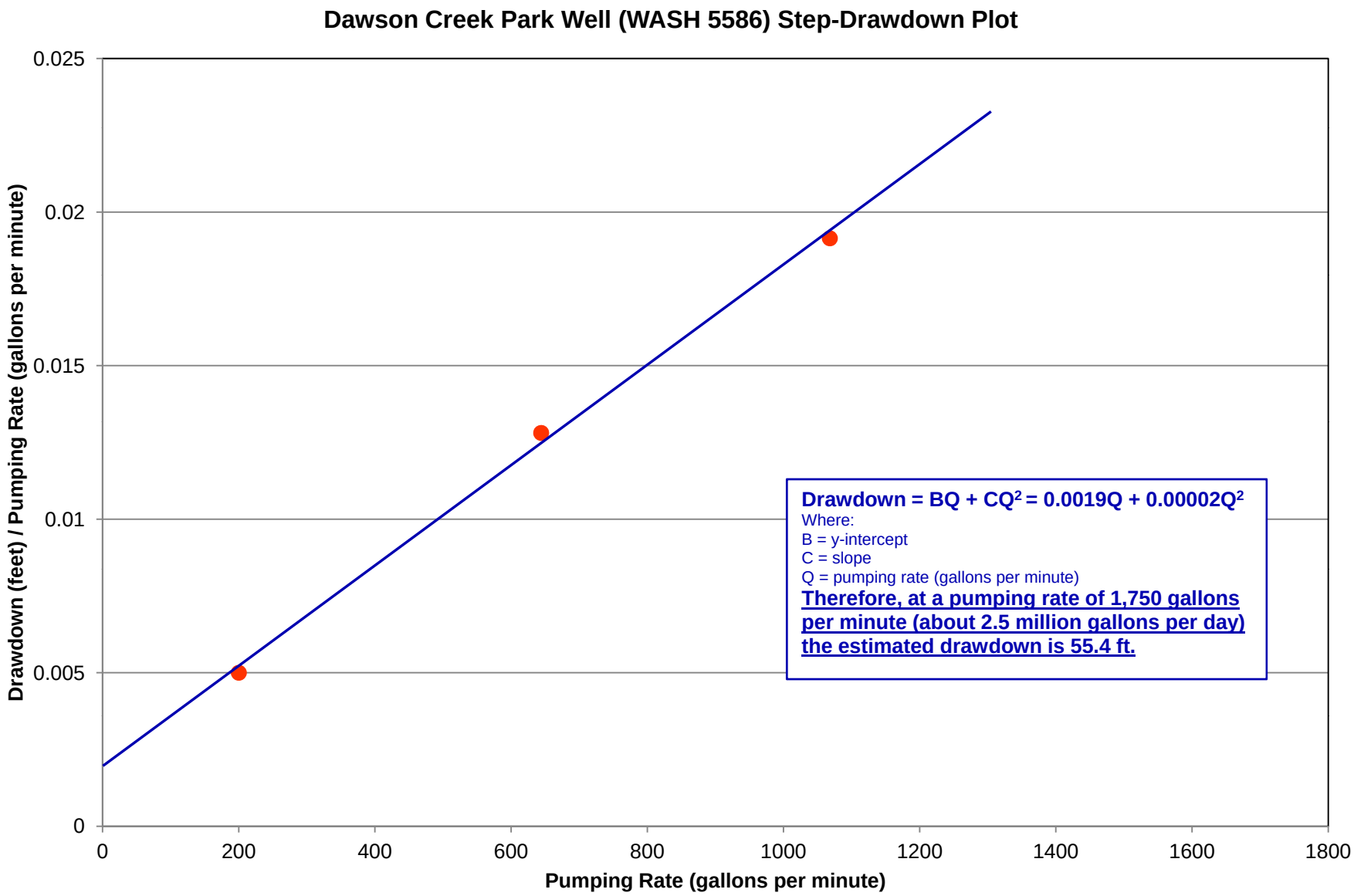


Figure 10
Dawson Creek Park Well Step-Drawdown Plot
City of Hillsboro

GSI Water Solutions, Inc.

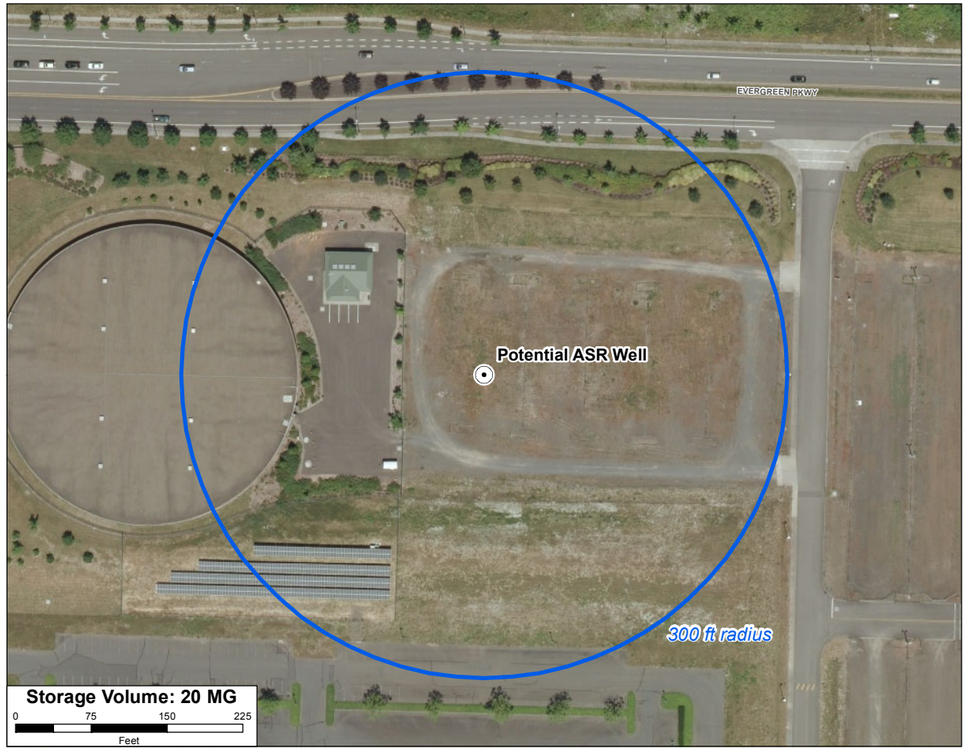


FIGURE 11

Evergreen Reservoir Site

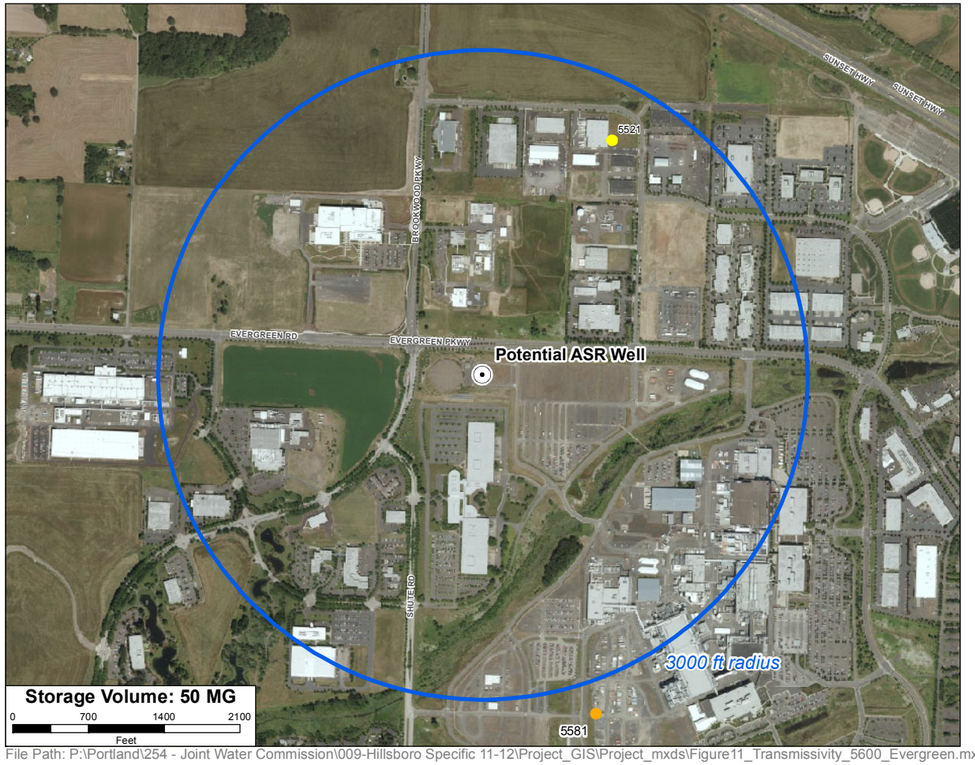
Area of Potential Impact
Due to ASR Injection Given Low End
Expected Aquifer Transmissivity
(5,600 gallons per day per foot)
City of Hillsboro

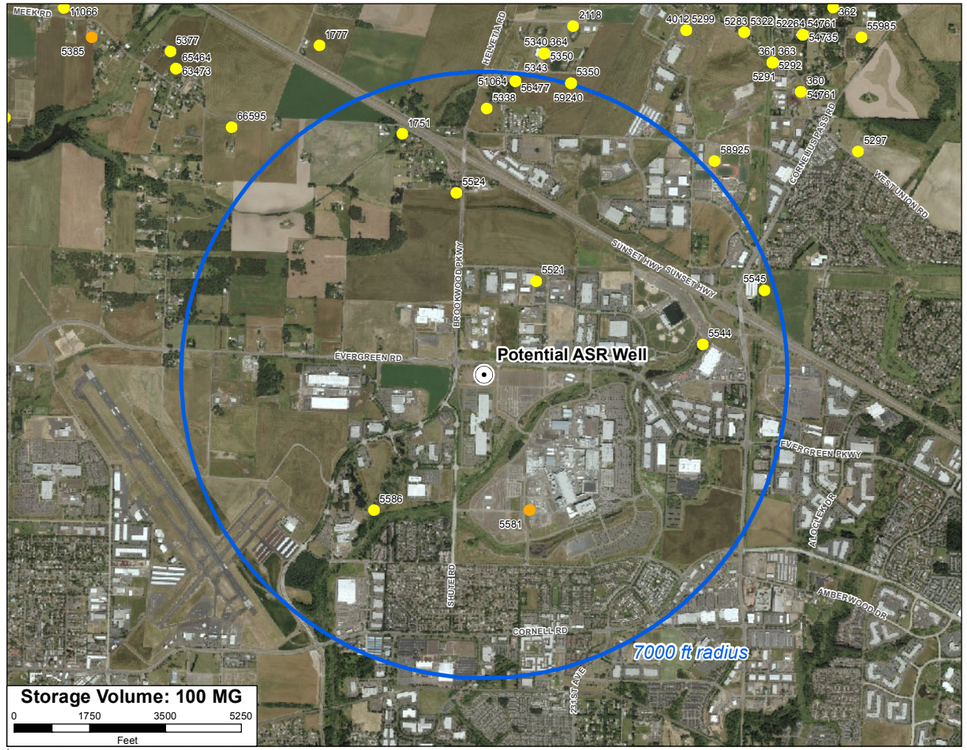
LEGEND

- ASR Well
- Wells Completed in Basalt
- Wells Completed in Silt and Clay
- Radius of 15 feet or Greater Drawup

NOTES:

- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 5 feet per day), and a storativity equal to 10^{-3}.





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MAP NOTES:
Date: November 2, 2011
Data Sources: METRO RLIS, ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\254 - Joint Water Commission\009-Hillsboro Specific 11-12\Project_GIS\Project_mxds\Figure11_Transmissivity_5600_Evergreen.mxd

FIGURE 12

Evergreen Reservoir Site

Area of Potential Impact
Due to ASR Injection Given High End
Expected Aquifer Transmissivity
(56,000 gallons per day per foot)

LEGEND

- ASR Well
- Radius of 15 feet or Greater Drawup

NOTES:

- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 5 feet per day), and a storativity equal to 10^{-3}.

N

MAP NOTES:
Date: February 20, 2012
Data Sources: METRO RLIS, ESRI

GSI Water Solutions, Inc.

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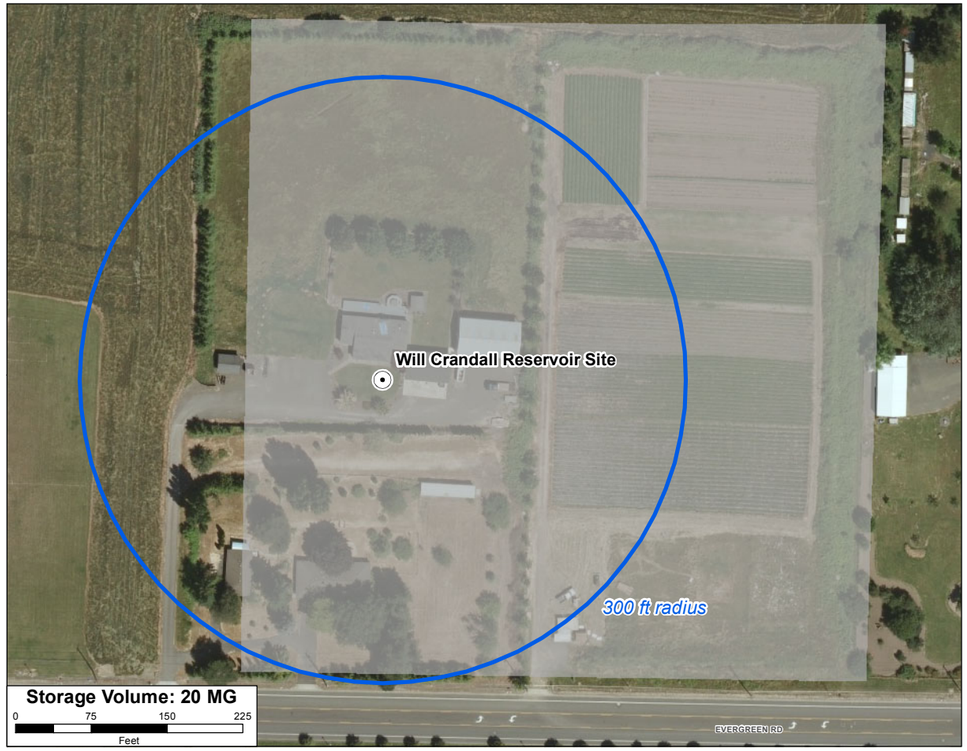

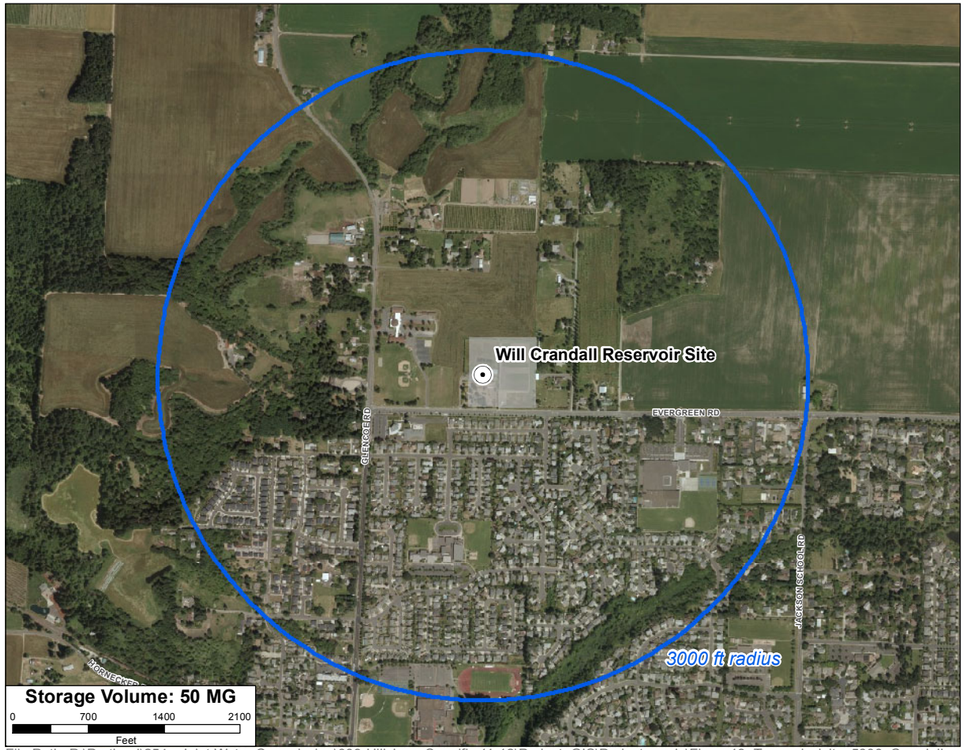

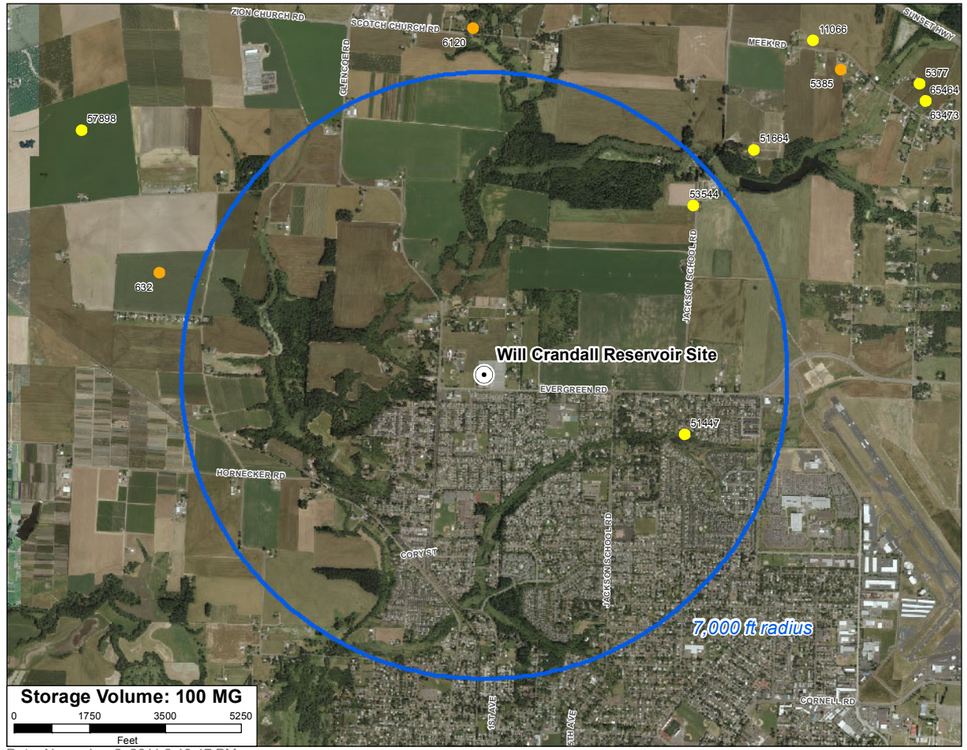

FIGURE 13

Will Crandall Reservoir

Area of Potential Impact
Due to ASR Injection Given Low End
Expected Aquifer Transmissivity
(5,600 gallons per day per foot)

LEGEND

- ASR Well
- Wells Completed in Basalt
- Wells Completed in Silt and Clay
- Radius of 15 feet or Greater Drawup
- Site

NOTES:

- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 5 feet per day), and a storativity equal to 10^{-3}.

N

MAP NOTES:
Date: November 2, 2011
Data Sources: METRO RLIS, ESRI

GSI Water Solutions, Inc.

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FIGURE 14

Will Crandall Reservoir

Area of Potential Impact
Due to ASR Injection Given High End
Expected Aquifer Transmissivity
(56,000 gallons per day per foot)

LEGEND

- ASR Well
- Radius of 15 feet or Greater Drawup
- Site

NOTES:

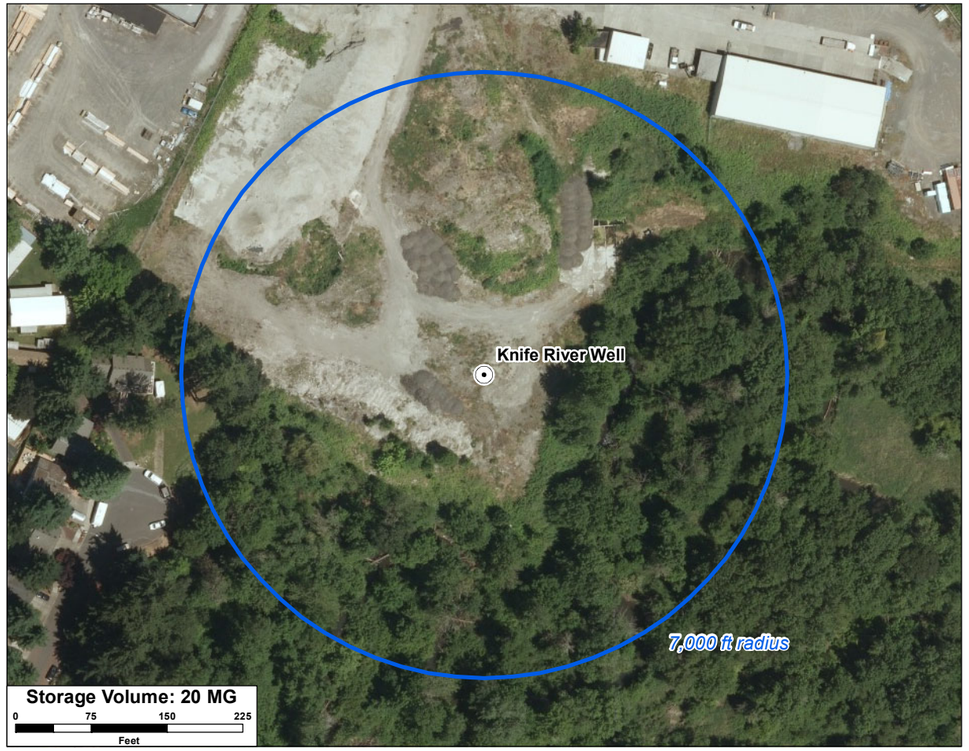
- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 50 feet per day), and a storativity equal to 10^{-3}.

N

MAP NOTES:
Date: November 2, 2011
Data Sources: METRO RLIS, ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\254 - Joint Water Commission\009-Hillsboro Specific 11-12\Project_GIS\Project_mxds\Figure14_Transmissivity_56000_Crandall.mxd



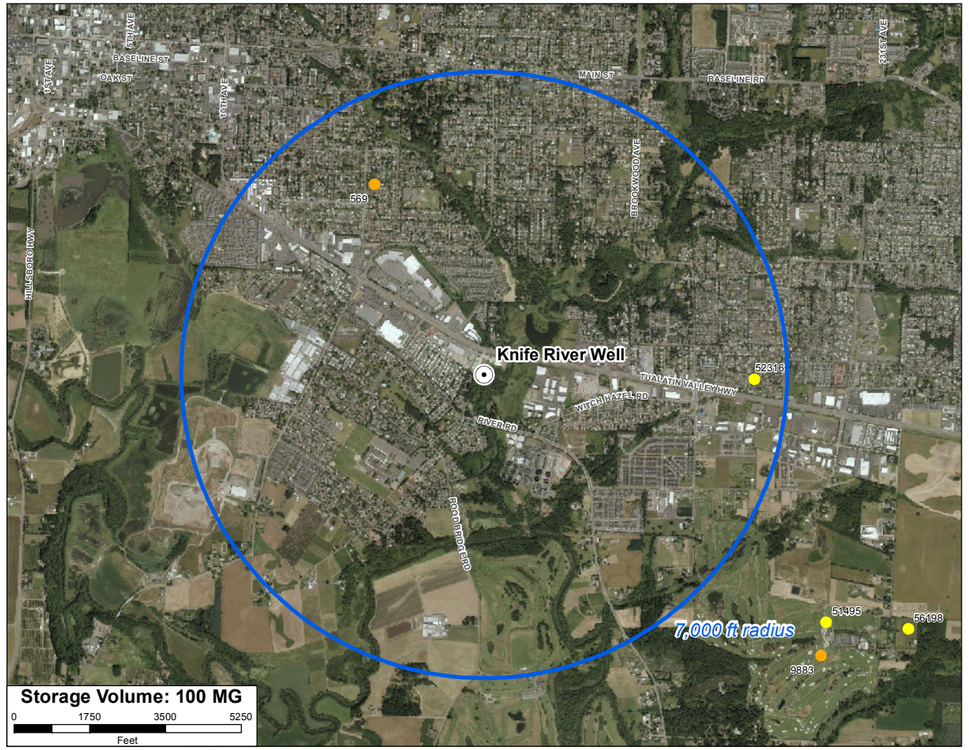


FIGURE 15

Knife River Well

Area of Potential Impact
Due to ASR Injection Given Low End
Expected Aquifer Transmissivity
(5,600 gallons per day per foot)

LEGEND

- ASR Well
- Wells Completed in Basalt
- Wells Completed in Silt and Clay
- Radius of 15 feet or Greater Drawup

NOTES:

- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 5 feet per day), and a storativity equal to 10^{-3}.

N

MAP NOTES:
Date: November 2, 2011
Data Sources: METRO RLIS, ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\254 - Joint Water Commission\009-Hillsboro Specific 11-12\Project_GIS\Project_mxds\Figure15_Transmissivity_5600_Knife.mxd

FIGURE 16

Knife River Well

Area of Potential Impact
Due to ASR Injection Given High End
Expected Aquifer Transmissivity
(56,000 gallons per day per foot)

LEGEND

- ASR Well
- Radius of 15 feet or Greater Drawup

NOTES:

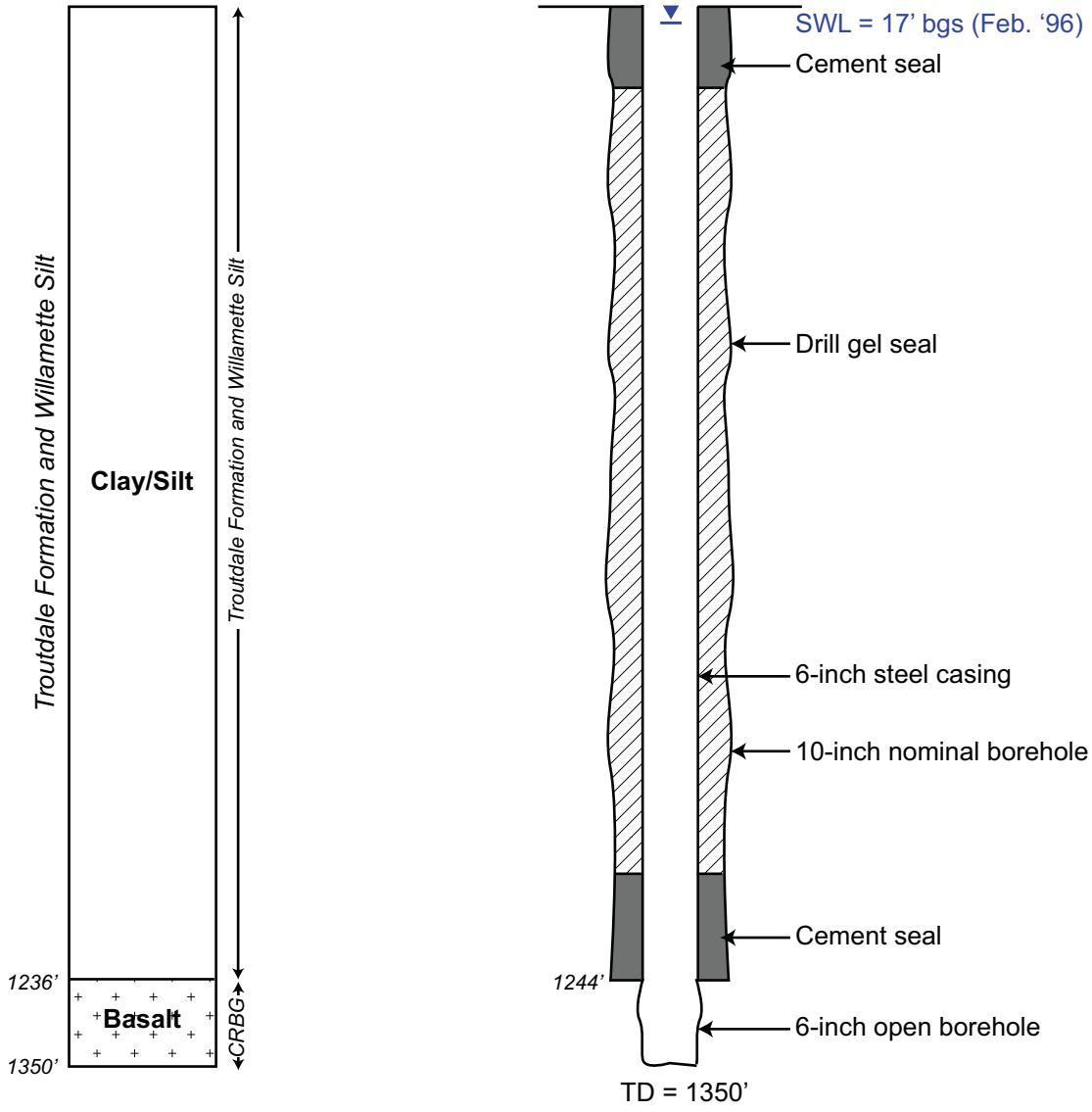
- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 5 feet per day), and a storativity equal to 10^{-3}.

N

MAP NOTES:
Date: February 20, 2012
Data Sources: METRO RLIS, ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\254 - Joint Water Commission\009-Hillsboro Specific 11-12\Project_GIS\Project_mxds\Figure16_Transmissivity_56000_Knife.mxd, Date: February 20, 2012 4:21:22 PM



NOTES

- IF = Basalt Interflow
- Air lift during consturction produced 300 gallons per minute with the drill stem set at 500' bgs
- No specific capacity data

FIGURE 17
Knife River Well (WASH 50197)
As-Built and Lithology
City of Hillsboro

GSI Water Solutions, Inc.

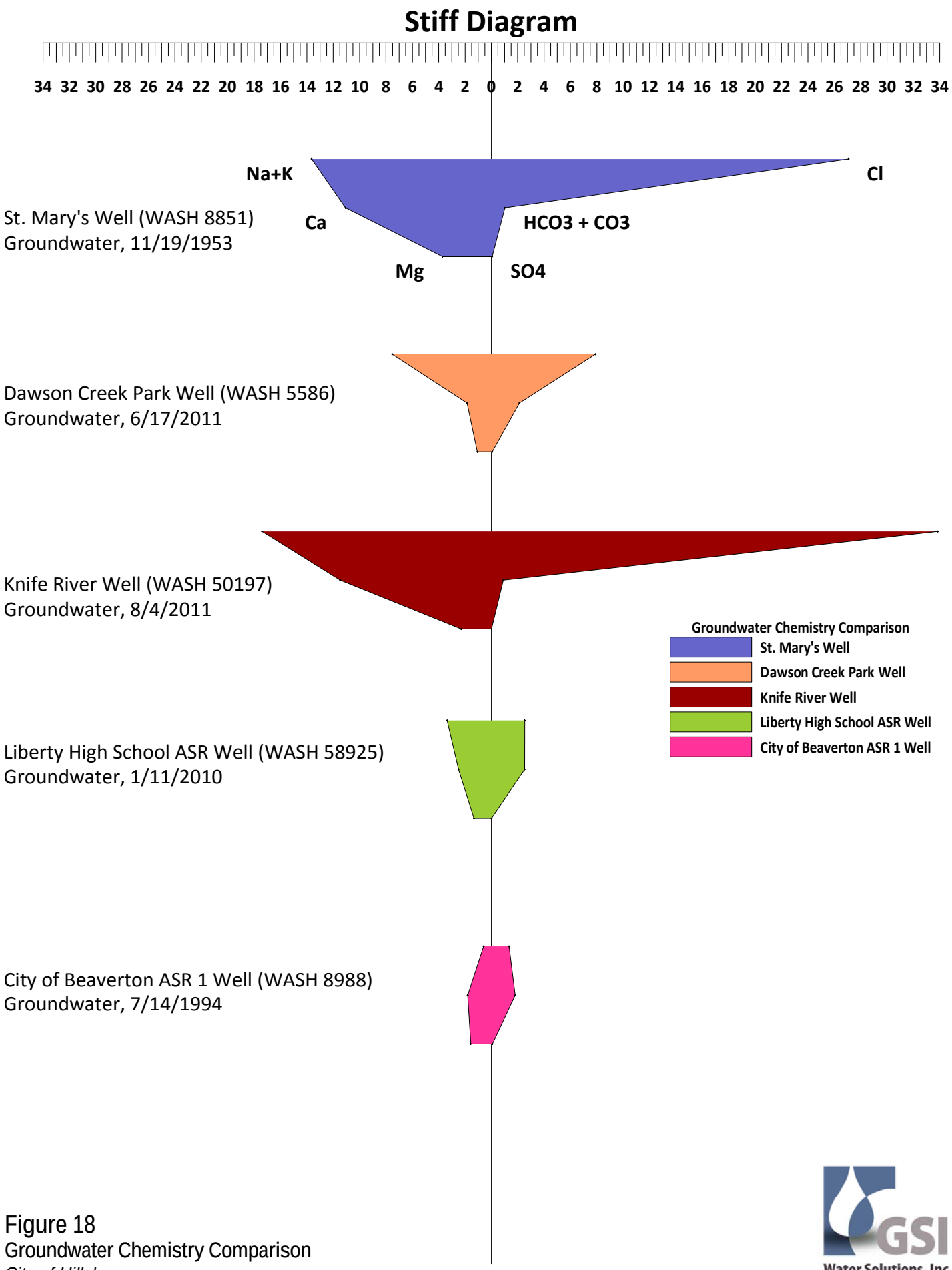


Figure 18
Groundwater Chemistry Comparison
City of Hillsboro

GSI Water Solutions, Inc.

Attachment A

Water Rights Permits

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

CLAREMONT DEVELOPMENT COMPANY
PO BOX 280
WILSONVILLE, OREGON 97070

503-694-5533

to use the waters of FIVE WELLS in the ROCK CREEK BASIN for IRRIGATION OF 69.96 ACRES.

This permit is issued approving Application G-12094. The date of priority is MAY 1, 1990 FOR 0.27 CUBIC FOOT PER SECOND (CFS) AND OCTOBER 2, 1990 FOR 0.11 CFS. The use is limited to not more than 0.38 CFS, BEING 0.06 CFS EACH FROM WELLS 1 AND 2, 0.04 CFS FROM WELL 3 AND 0.11 CFS EACH FROM WELLS 4 AND 5, or its equivalent in case of rotation, measured at the wells.

The wells are located as follows:

NE 1/4 NE 1/4, NE 1/4 NW 1/4, SECTION 29; SW 1/4 SW 1/4, SECTION 20, T 1 N, R 1 W, W.M.; WELL 1 - 705.84 FEET SOUTH AND 1146.04 FEET WEST; WELL 2 - 1241.09 FEET SOUTH AND 741.03 FEET WEST; WELL 3 - 1245.42 FEET SOUTH AND 744.36 FEET WEST, ALL FROM N 1/4 CORNER, SECTION 29; WELL 4 - 377.86 FEET NORTH AND 540.16 FEET EAST FROM SW CORNER, SECTION 20; WELL 5 - 16.17 FEET SOUTH AND 1574.74 FEET EAST FROM N 1/4 CORNER, SECTION 29.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to ONE-EIGHTIETH of one cubic foot per second per acre, or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the proposed place of use under the permit is as follows:

NE 1/4 SW 1/4 7.04 ACRES
NW 1/4 SW 1/4 7.50 ACRES
SW 1/4 SW 1/4 18.11 ACRES
SE 1/4 SW 1/4 15.58 ACRES
SECTION 20

NE 1/4 NW 1/4 19.07 ACRES
NW 1/4 NW 1/4 2.66 ACRES
SECTION 29
TOWNSHIP 1 NORTH, RANGE 1 WEST, W.M.

The well shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure guage adequate to determine water level elevations in the well at all times. When required by the department, the permittee shall install and maintain a weir, meter, or other suitable measuring device, and shall keep a complete record of the amount of ground water withdrawn.

The water user shall report a March static water level in the wells to the Groundwater/Hydrology Section of the Water Resources Department by April 15 of each year. The measurement shall be made and calculations detailed by a certified water rights examiner, registered professional geologist, certified engineering geologist, or professional engineer.

Use of water from the well shall not be allowed under this permit if the well displays an (A) average water level decline of 3 or more feet per year for 5 consecutive years, or (B) a water level decline of 15 or more feet in fewer than 5 consecutive years, or (C) a water level decline of 25 or more feet, or (D) a hydraulic interference of 25 or more feet in any neighboring well with senior priority which provides water for an authorized use.

The Water Resources Department has determined that the initial water level in the wells are those of the initial March report. That is the level from which the cited declines in (A), (B) and (C) above will be referenced.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Actual construction work shall begin on or before October 29, 1991, and shall be completed on or before October 1, 1992. Complete application of the water shall be made on or before October 1, 1993.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for beneficial use of water without waste. The water user is advised that new regulations may require use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use granted herein may be made only at times when sufficient water is available to satisfy all prior rights.

Issued this date, OCTOBER 29, 1990.

/s/ WILLIAM H. YOUNG
Water Resources Department
William H. Young
Director

Permit No. G- 5149

Cancelled - sp. or Rec. Vol. 31 P. 379

APPLICATION FOR A PERMIT

To Appropriate the Ground Waters of the State of Oregon

I, TANASBROOK, a Joint Venture
(Name of applicant)

of P. O. Box 1009, Beaverton 97005, county of Washington,
(Postoffice Address)

state of Oregon, *do hereby make application for a permit to appropriate the following described ground waters of the state of Oregon, SUBJECT TO EXISTING RIGHTS:*

If the applicant is a corporation, give date and place of incorporation

.....

1. *Give name of nearest stream to which the well, tunnel or other source of water development is*

situated Bronson Creek
(Name of stream)

..... *tributary of* Tualatin River

2. *The amount of water which the applicant intends to apply to beneficial use is* 0.56 cubic *feet per second or* 250 *gallons per minute.* Irrigation will require 127 gal. per minute, and maintaining pond level will require 123 gal. per minute.

3. *The use to which the water is to be applied is* 1) Irrigation purposes and 2) offset seepage and evaporation losses of reservoir ~~(See attached letter)~~ constructed under Per R5847 *

4. *The well or other source is located* 274 *ft.* S *(N. or S.) and* 1560 *ft.* E *(E. or W.) from the* N W *corner of* Section 31 T 1 N, R 1 W, W.M.
(Section or subdivision)

.....
(If preferable, give distance and bearing to section corner)

.....
(If there is more than one well, each must be described. Use separate sheet if necessary)

being within the NE 1/4, NW 1/4 *of Sec.* 31, *Twp.* 1 N, *R.* 1 W, *W. M., in the county of* Washington.

5. *The* Pipe line *(Canal or pipe line) to be* 50 feet ± *miles in length, terminating in the* ..... *(Smallest legal subdivision) of Sec.* 31, *Twp.* 1 N, *R.* 1 W, *W. M., the proposed location being shown throughout on the accompanying map.*

6. *The name of the well or other works is* .....

DESCRIPTION OF WORKS

7. *If the flow to be utilized is artesian, the works to be used for the control and conservation of the supply when not in use must be described.*

(To be pumped)

.....

.....

8. *The development will consist of* 1 well *(Give number of wells, tunnels, etc.) having a diameter of* 12 *inches and an estimated depth of* 500 *feet. It is estimated that* 500 *feet of the well will require* steel *(Kind) casing. Depth to water table is estimated* 15 *(Feet)*

.....

MUNICIPAL SUPPLY— **G 5149**

13. *To supply the city of* .....

in ..... *county, having a present population of* .....

and an estimated population of ..... *in 19*.....

ANSWER QUESTIONS 14, 15, 16, 17 AND 18 IN ALL CASES

14. *Estimated cost of proposed works, $* 18,000.00

15. *Construction work will begin on or before* APRIL 1, 1973 OR UPON ISSUANCE OF PERMIT

16. *Construction work will be completed on or before* JUNE 1, 1973.

17. *The water will be completely applied to the proposed use on or before* OCTOBER 1, 1976

18. *If the ground water supply is supplemental to an existing water supply, identify any application for permit, permit, certificate or adjudicated right to appropriate water, made or held by the applicant.* .....

.....

Phillip B. Michel
(Signature of applicant)
Phillip B. Michel, Project Manager

Remarks: .....

* THE AMOUNT OF WATER REQUIRED TO MAINTAIN LAKE LEVEL AT ELEV. 176 (PER ATTACHED MAP) IS 165,000 GAL. PER DAY BASED ON EVAPORATION RATE OF 10" PER MONTH AND SEEPAGE AT 5" PER MONTH. THE TOTAL DEVELOPMENT AREA IS APPROX. 98 ACRES, WITH APPROX. 45 ACRES TO BE IRRIGATED. BALANCE OF THE ACREAGE WILL CONSIST OF BUILDINGS, ROADS, SIDEWALKS AND PARKING AREAS. IRRIGATION WILL BE UNDER THE CONTROL AND MAINTENANCE OF COMMON MANAGEMENT FOR THE TOTAL DEVELOPMENT.

.....

.....

.....

.....

STATE OF OREGON,
County of Marion, } *ss.*

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for .....

.....

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ....., *19*.....

WITNESS my hand this ..... *day of* ....., *19*.....

.....
STATE ENGINEER

By .....
ASSISTANT

CANAL SYSTEM OR PIPE LINE— **G 5149**

9. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) ..... feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(b) At ..... miles from headgate: width on top (at water line) ..... feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(c) Length of pipe, ... ft.; size at intake ..... in.; in size at ..... ft. from intake ..... in.; size at place of use ..... in.; difference in elevation between intake and place of use, ... ft. Is grade uniform? ..... Estimated capacity, ... sec. ft.

10. If pumps are to be used, give size and type .....

Give horsepower and type of motor or engine to be used 30 horsepower electric motor

11. If the location of the well, tunnel, or other development work is less than one-fourth mile from a natural stream or stream channel, give the distance to the nearest point on each of such channels and the difference in elevation between the stream bed and the ground surface at the source of development

85 feet to the existing center line of Bronson Creek. Difference in elevation is 4' +. After completion of dam the lake will be approximately 25 feet from well. The difference in elevation between the well and the lake when completed will be 5 feet.

12. Location of area to be irrigated, or place of use .....

Township N. or S.	Range E. or W. of Willamette Meridian	Section	Forty-acre Tract	Number Acres To Be Irrigated
Total T 1 N	R 1 W	30 31		44 acres
T 1N	R 1W	31	NW 1/4 NW 1/4	15.2
T 1N	R 1W	31	NE 1/4 NW 1/4	20.7
T 1N	R 1W	30	SE 1/4 SW 1/4	4.6
T 1N	R 1W	30	SW 1/4 SW 1/4	3.5

(If more space required, attach separate sheet)

Character of soil Silty clay

Kind of crops raised .....

STATE OF OREGON,)
County of Marion, } *ss.*

PERMIT

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 0.56 *cubic feet per second measured at the point of diversion from the well or source of appropriation, or its equivalent in case of rotation with other water users, from* a well being 0.27 cfs for recreation and 0.29 cfs for irrigation

The use to which this water is to be applied is irrigation and recreation with reservoir constructed under permit No. R-5847

If for irrigation, this appropriation shall be limited to 1/80 *of one cubic foot per second or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed* 2½ *acre feet per acre for each acre irrigated during the irrigation season of each year;*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The well shall be cased as necessary in accordance with good practice and if the flow is artesian the works shall include proper capping and control valve to prevent the waste of ground water.

The works constructed shall include an air line and pressure gauge or an access port for measuring line, adequate to determine water level elevation in the well at all times.

The permittee shall install and maintain a weir, meter, or other suitable measuring device, and shall keep a complete record of the amount of ground water withdrawn.

The priority date of this permit is March 8, 1973

Actual construction work shall begin on or before April 24, 1974 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*74

*Complete application of the water to the proposed use shall be made on or before October 1, 19*75

WITNESS my hand this 24th *day of* April, 1973

STATE ENGINEER

Application No. G- 6021

Permit No. G- **5149**

PERMIT

TO APPROPRIATE THE GROUND WATERS OF THE STATE OF OREGON

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 8 *day of* March, 19 73, *at* 1:45 *o'clock* P. *M.*

Returned to applicant:

Approved:

April 24, 1973

Recorded in book No. ..... *of Ground Water Permits on page* **G 5149**

CHRIS L. WHEELER
STATE ENGINEER

Drainage Basin No. 2 *page* 122

32.0

5-5-74

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

ALFRED MEISNER
13495 NW THOMPSON ROAD PHONE: (503) 645-3351
PORTLAND, OREGON 97229

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-14626

SOURCE OF WATER: WELL 2 IN THE WILLAMETTE RIVER BASIN

PURPOSE OR USE: NURSERY OPERATIONS ON 45.2 ACRES

MAXIMUM RATE: 1.11 CUBIC FEET PER SECOND

PERIOD OF USE: YEAR ROUND

DATE OF PRIORITY: OCTOBER 21, 1997

POINT OF DIVERSION LOCATION: NW 1/4 SE 1/4, SECTION 11, T1N, R2W, W.M.; 1870 FEET NORTH & 2275 FEET WEST FROM SE CORNER, SECTION 11

The amount of water used for NURSERY OPERATIONS is limited to a diversion of 0.15 cubic foot per second per acre. For the irrigation of **containerized nursery plants**, the amount of water diverted is limited to ONE-FORTIETH of one cubic foot per second (or its equivalent) and 5.0 acre feet per acre per year. For the irrigation of **in ground nursery plants** the amount of water diverted is limited to ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2.5 acre feet per acre per year. The use of water for NURSERY OPERATIONS may be made at anytime of the year that the use is beneficial. For the irrigation of **any other crop**, the amount of water diverted is limited to ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2.5 acre feet per acre during the irrigation season of each year.

THE PLACE OF USE IS LOCATED AS FOLLOWS:

NE 1/4 SE 1/4 25.9 ACRES
NW 1/4 SE 1/4 3.2 ACRES
SE 1/4 SE 1/4 16.1 ACRES
SECTION 11
TOWNSHIP 1 NORTH, RANGE 2 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The permittee shall maintain the meter or measuring device in good working order, shall keep a complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

(1) Use of water from the well, as allowed herein, shall be controlled or shut off if the well displays:

(a) An average water level decline of three or more feet per year for five consecutive years; or

(b) A total water level decline of fifteen or more feet; or

(c) A hydraulic interference decline of fifteen or more feet in any neighboring well providing water for senior exempt uses or wells covered by prior rights.

(2) The water user shall install a meter or other measuring device suitable to the Director, and shall submit an annual report of water used to the Department by December 1 of each year.

(3) The permittee/appropriator shall be responsible for complying with each of the following requirements for measuring water levels in the well.

(a) Use of water from a new well shall not begin until an initial static water level in the well has been measured and submitted to the Department.

(b) In addition to the measurement required in subsection (a) of this section, a water level measurement shall be made each year during the period March 1 through March 31.

(c) All water level measurements shall be made by a qualified individual. Qualified individuals are certified water rights examiners, registered geologists, registered professional engineers, licensed land surveyors, licensed water well constructor, licensed pump installer, or the permittee/appropriator.

(d) Any qualified individual measuring a well shall use standard methods of procedure and equipment designed for the purpose of well measurement. The equipment used shall be well suited to the conditions of construction at the well. A list of standard methods of procedure and suitable equipment shall be available from the Department.

(e) The permittee/appropriator shall submit a record of the measurement to the Department on a form available from the Department. The record of measurement shall include both measurements and calculations, shall include a certification as to their accuracy signed by the individual making the measurements, and shall be submitted to the Department within 90 days from the date of measurement. The Department shall determine when any of the declines cited in section (1) are evidenced by the well measurement required in section (3).

STANDARD CONDITIONS

The wells shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

Actual construction of the well shall begin by September 24, 1999. Complete application of water to the use shall be made on or before October 1, 2002. Within one year after complete application of water to the proposed use, the permittee shall submit a claim of beneficial use, which includes a map and report, prepared by a Certified Water Rights Examiner (CWRE).

Issued November 13, 1998

Dwight Stricklin for

Martha O. Pagel, Director
Water Resources Department

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

CASCADIAN NURSERIES INC.; ALFRED MEISNER
13495 NW THOMPSON RD (503) 645-3350
PORTLAND, OREGON 97229

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-15664

SOURCE OF WATER: A WELL IN HOLCOMB CREEK BASIN

PURPOSE OR USE: NURSERY USE ON 19.25 ACRES

MAXIMUM RATE: 0.78 CUBIC FOOT PER SECOND

PERIOD OF USE: YEAR ROUND

DATE OF PRIORITY: DECEMBER 7, 2001

WELL LOCATION: NW ¼ SE ¼, SECTION 11, T1N, R2W, W.M.; 1870 FEET NORTH & 365 FEET EAST FROM S1/4 CORNER, SECTION 11

The amount of water used for NURSERY OPERATIONS is limited to a diversion of 0.15 cubic foot per second per acre. For the irrigation of **containerized nursery plants**, the amount of water diverted is limited to ONE-FORTIETH of one cubic foot per second (or its equivalent) and 5.0 acre feet per acre per year. For the irrigation of **in ground nursery plants** the amount of water diverted is limited to ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2.5 acre feet per acre per year. The use of water for NURSERY OPERATIONS may be made at anytime, during the period of allowed use specified above, that the use is beneficial. For the irrigation of **any other crop**, the amount of water diverted is limited to ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2.5 acre feet per acre during the irrigation season of each year.

THE PLACE OF USE IS LOCATED AS FOLLOWS:

NE ¼ SW ¼ 5.2 ACRES
SE ¼ SW ¼ 12.5 ACRES
NW ¼ SE ¼ 0.6 ACRE
SW ¼ SE ¼ 0.95 ACRE
SECTION 11
TOWNSHIP 1 NORTH, RANGE 2 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The permittee shall maintain the meter or measuring device in good working order, shall keep a complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

(1) Use of water from the well, as allowed herein, shall be controlled or shut off if the well displays:

(a) An average water level decline of three or more feet per year for five consecutive years; or

(b) A total water level decline of fifteen or more feet; or

(c) A hydraulic interference decline of fifteen or more feet in any neighboring well providing water for senior exempt uses or wells covered by prior rights.

(2) For the purpose of determining declines, a reference level of 92 feet below land surface, as set in ground water permits G-11038 and G-13531, shall be used.

(3) The water user shall install a meter or other measuring device suitable to the Director, and shall submit an annual report of water used to the Department by December 1 of each year.

(4) The permittee/appropriator shall be responsible for complying with each of the following requirements for measuring water levels in the well.

(a) A water level measurement shall be made each year during the period March 1 through March 31.

(b) All water level measurements shall be made by a qualified individual. Qualified individuals are certified water rights examiners, registered geologists, registered professional engineers, licensed land surveyors, licensed water well constructor, licensed pump installer, or the permittee/appropriator.

(e) Any qualified individual measuring a well shall use standard methods of procedure and equipment designed for the purpose of well measurement. The equipment used shall be well suited to the conditions of construction at the well. A list of standard methods of procedure and suitable equipment shall be available from the Department.

(f) The permittee/appropriator shall submit a record of the measurement to the Department on a form available from the Department. The record of measurement shall include both measurements and calculations, shall include a certification as to their accuracy signed by the individual making the measurements, and shall be submitted to the Department within 90 days from the date of measurement. The Department shall determine when any of the declines cited in section (1) are evidenced by the well measurement required in section (3).

STANDARD CONDITIONS

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

The wells shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

Complete application of the water to the use shall be made on or before October 1, 2007. If the water is not completely applied before this date, and the permittee wishes to continue development under the permit, the permittee must submit an application for extension of time, which may be approved based upon the merit of the application.

Within one year after complete application of water to the proposed use, the permittee shall submit a claim of beneficial use, which includes a map and report, prepared by a Certified Water Rights Examiner (CWRE).

Issued February 13, 2003

Paul A. Cleary, Director
Water Resources Department

REAL ESTATE TRANSACTIONS: Pursuant to ORS 537.330, in any transaction for the conveyance of real estate that includes any portion of the lands described in this permit, the seller of the real estate shall, upon accepting an offer to purchase that real estate, also inform the purchaser in writing whether any permit, transfer approval order, or certificate evidencing the water right is available and that the seller will deliver any permit, transfer approval order or certificate to the purchaser at closing, if the permit, transfer approval order or certificate is available.

CULTURAL RESOURCES PROTECTION LAWS: Permittees involved in ground-disturbing activities should be aware of federal and state cultural resources protection laws. ORS 358.920 prohibits the excavation, injury, destruction or alteration of an archeological site or object, or removal of archeological objects from public and private lands without an archeological permit issued by the State Historic Preservation Office. 16 USC 470, Section 106, National Historic Preservation Act of 1966 requires a federal agency, prior to any undertaking to take into account the effect of the undertaking that is included on or eligible for inclusion in the National Register. For further information, contact the State Historic Preservation Office at 503-378-4168, extension 232.

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

ALFRED MEISNER, FOR CASCADIAN NURSERIES INC.
13495 NW THOMPSON RD (503) 545-3350
PORTLAND, OREGON 97229

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-15765

SOURCE OF WATER: TWO WELLS IN HOLCOMB CREEK BASIN

PURPOSE OR USE: NURSERY USE ON 36.7 ACRES

MAXIMUM RATE: 0.891 CUBIC FOOT PER SECOND

PERIOD OF USE: YEAR ROUND

DATE OF PRIORITY: MAY 17, 2002

WELL LOCATIONS:

WELL 2: NW ¼ SE ¼, SECTION 11, T1N, R2W, W.M.; 1870 FEET NORTH & 365 FEET EAST FROM S1/4 CORNER, SECTION 11

WELL 3: NE ¼ SE ¼, SECTION 11, T1N, R2W, W.M.; 2440 FEET NORTH & 370 FEET WEST FROM SE CORNER, SECTION 11

The amount of water used for NURSERY OPERATIONS is limited to a diversion of 0.15 cubic foot per second per acre. For the irrigation of **containerized nursery plants**, the amount of water diverted is limited to ONE-FORTIETH of one cubic foot per second (or its equivalent) and 5.0 acre feet per acre per year. For the irrigation of **in ground nursery plants** the amount of water diverted is limited to ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2.5 acre feet per acre per year. The use of water for NURSERY OPERATIONS may be made at anytime, during the period of allowed use specified above, that the use is beneficial. For the irrigation of **any other crop**, the amount of water diverted is limited to ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2.5 acre feet per acre during the irrigation season of each year.

THE PLACE OF USE IS LOCATED AS FOLLOWS:

SE ¼ SW ¼ 3.7 ACRES
SW ¼ SE ¼ 16.2 ACRES
SE ¼ SE ¼ 11.5 ACRES
SECTION 11

NE ¼ NE ¼ 2.1 ACRES
NW ¼ NE ¼ 2.8 ACRES
NE ¼ NW ¼ 0.4 ACRES
SECTION 14
TOWNSHIP 1 NORTH, RANGE 2 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The permittee shall maintain the meter or measuring device in good working order, shall keep a complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

The reference water level for well 2 (WASH 5213) shall be 92 feet below ground surface as specified in Certificate 68714 (Permit #G-11038) and Permit #G-13531. The reference level for well 3 (WASH 1383) shall be the water level measured in March, 2003.

(1) Use of water from the well, as allowed herein, shall be controlled or shut off if the well displays:

(a) An average water level decline of three or more feet per year for five consecutive years; or

(b) A total water level decline of fifteen or more feet; or

(c) A hydraulic interference decline of fifteen or more feet in

any neighboring well providing water for senior exempt uses or wells covered by prior rights.

(2) The water user shall install a meter or other measuring device suitable to the Director, and shall submit an annual report of water used to the Department by December 1 of each year.

(3) The permittee/appropriator shall be responsible for complying with each of the following requirements for measuring water levels in the well.

(a) A water level measurement shall be made each year during the period March 1 through March 31.

(b) All water level measurements shall be made by a qualified individual. Qualified individuals are certified water rights examiners, registered geologists, registered professional engineers, licensed land surveyors, licensed water well constructor, licensed pump installer, or the permittee/appropriator.

(c) Any qualified individual measuring a well shall use standard methods of procedure and equipment designed for the purpose of well measurement. The equipment used shall be well suited to the conditions of construction at the well. A list of standard methods of procedure and suitable equipment shall be available from the Department.

(d) The permittee/appropriator shall submit a record of the measurement to the Department on a form available from the Department. The record of measurement shall include both measurements and calculations, shall include a certification as to their accuracy signed by the individual making the measurements, and shall be submitted to the Department within 90 days from the date of measurement. The Department shall determine when any of the declines cited in section (1) are evidenced by the well measurement required in section (3).

STANDARD CONDITIONS

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate

the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

The wells shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

Complete application of the water to the use shall be made on or before October 1, 2007. If the water is not completely applied before this date, and the permittee wishes to continue development under the permit, the permittee must submit an application for extension of time, which may be approved based upon the merit of the application.

Within one year after complete application of water to the proposed use, the permittee shall submit a claim of beneficial use, which includes a map and report, prepared by a Certified Water Rights Examiner (CWRE).

Issued April 3 , 2003

Paul R. Cleary, Director
Water Resources Department

REAL ESTATE TRANSACTIONS: Pursuant to ORS 537.330, in any transaction for the conveyance of real estate that includes any portion of the lands described in this permit, the seller of the real estate shall, upon accepting an offer to purchase that real estate, also inform the purchaser in writing whether any permit, transfer approval order, or certificate evidencing the water right is available and that the seller will deliver any permit, transfer approval order or certificate to the purchaser at closing, if the permit, transfer approval order or certificate is available.

CULTURAL RESOURCES PROTECTION LAWS: Permittees involved in ground-disturbing activities should be aware of federal and state cultural resources protection laws. ORS 358.920 prohibits the excavation, injury, destruction or alteration of an archeological site or object, or removal of archeological objects from public and private lands without an archeological permit issued by the State Historic Preservation Office. 16 USC 470, Section 106, National Historic Preservation Act of 1966 requires a federal agency, prior to any undertaking to take into account the effect of the undertaking that is included on or eligible for inclusion in the National Register. For further information, contact the State Historic Preservation Office at 503-378-4168, extension 232.

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* RAYMOND M. MUNSON

of Route 1, Box 380-A, Hillsboro , *State of* Oregon, 97123 , *has made proof to the satisfaction of the Water Resources Director, of a right to the use of the waters of* the Raymond Munson Well

a tributary of Rock Creek *for the purpose of* irrigation of 34.7 acres

under Permit No. G-5225 *and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* December 27, 1973

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.22 cubic foot per second

or its equivalent in case of rotation, measured at the point of diversion from the well. The well is located in the SE¼ NW¼, Section 11, T. 1 N., R. 2 W., W. M., 1820 feet South and 270 feet West from N¼ Corner, Section 11

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth*of one cubic foot per second per acre,* or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed 2½ acre feet per acre for each acre irrigated during the irrigation season of each year,

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

13.4 acres NE¼ NW¼
21.3 acres SE¼ NW¼
Section 11
T. 1 N., R. 2 W., W. M.

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the Water Resources Director, affixed this date. August 23, 1979

Water Resources Director

Recorded in State Record of Water Right Certificates, Volume 42 *, page* 48488

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* CARL J. BERG

of Route 1, Box 382, Hillsboro *, State of* Oregon *, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* a well

a tributary of an unnamed tributary of Rock Creek *for the purpose of* irrigation of 4.8 acres and supplemental irrigation of 4.0 acres

under Permit No. G-2189 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* July 9, 1962

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.05 cubic foot per second

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the NW¼ NE¼, Section 11, T. 1 N., R. 2 W., W. M. Well located 200 feet South and 460 feet East from the N¼ Corner, Section 11.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth *of one cubic foot per second per acre,* or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed 2½ acre feet per acre for each acre irrigated during the irrigation season of each year;

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

Supplemental	Primary		
4.0	4.8	acres	NW¼ NE¼

Section 11
T. 1 N., R. 2 W., W. M.

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed this date. August 31, 1966

CHRIS L. WHEELER
State Engineer

Recorded in State Record of Water Right Certificates, Volume 25 *, page* 33294

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

NORTHWEST FARM CREDIT SERVICE ACA
P.O. BOX 5209
OREGON CITY OR 97045

JEFF BODEN
7775 NW CORNELIUS PASS
HILLSBORO OR 97124

confirms the right to use the waters of A WELL in the Rock Creek Basin for IRRIGATION of 34.1 ACRES.

This right was perfected under Permit G-10766. The date of priority is MARCH 30, 1987. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.33 CUBIC FOOT PER SECOND or its equivalent in case of rotation, measured at the well.

The well is located as follows:

Twp	Rng	Mer	Sec	Q-Q	GLot	DLC	Survey Coordinates
1 N	2 W	WM	12	SW SW		66	610 FEET NORTH AND 1300 FEET EAST FROM SW CORNER, SECTION 12

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, is limited to a diversion of ONE-EIGHTIETH of one cubic foot per second, or its equivalent for each acre irrigated, and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year. The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

A description of the place of use to which this right is appurtenant is as follows:

IRRIGATION							
Twp	Rng	Mer	Sec	Q-Q	GLot	DLC	Acres
1 N	2 W	WM	12	SW SW		66	34.1

The well shall be maintained in accordance with the General Standards for the Construction and Maintenance of Water Wells

NOTICE OF RIGHT TO PETITION FOR RECONSIDERATION OR JUDICIAL REVIEW

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080, you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied. In addition, under ORS 537.260 any person with an application, permit or water right certificate subsequent in priority may jointly or severally contest the issuance of the certificate at any time before it has issued, and after the time has expired for the completion of the appropriation under the permit, or within three months after issuance of the certificate.

in Oregon.

The works constructed shall include an air line and pressure gauge or an access port for measuring line, adequate to determine water level elevation in the well at all times.

The water user shall install and maintain a weir, meter, or other suitable measuring device and keep a complete record of the amount of ground water withdrawn.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

WITNESS the signature of the Water Resources Director, affixed FEB 0 2 2007.

Phillip C. Ward, Director
Water Resources Department

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

JEFF BODEN
7775 NW CORNELIUS PASS
HILLSBORO OR 97124

confirms the right to use the waters of A WELL in the ROCK CREEK BASIN for IRRIGATION of 24.0 ACRES.

This right was perfected under Permit G-11436. The date of priority is NOVEMBER 26, 1991. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.30 CUBIC FOOT PER SECOND or its equivalent in case of rotation, measured at the well.

The well is located as follows:

Twp	Rng	Mer	Sec	Q-Q	GLot	DLC	Survey Coordinates
1 N	2 W	WM	12	SW SW		66	630 FEET NORTH & 1270 FEET EAST FROM SW CORNER, SECTION 12

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, is limited to a diversion of ONE-EIGHTIETH of one cubic foot per second, or its equivalent for each acre irrigated, and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year. The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

A description of the place of use to which this right is appurtenant is as follows:

IRRIGATION							
Twp	Rng	Mer	Sec	Q-Q	GLot	DLC	Acres
1 N	2 W	WM	13	NW NW		66	23.5
1 N	2 W	WM	13	SW NW		66	0.5

The well shall be maintained in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

NOTICE OF RIGHT TO PETITION FOR RECONSIDERATION OR JUDICIAL REVIEW

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080, you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied. In addition, under ORS 537.260 any person with an application, permit or water right certificate subsequent in priority may jointly or severally contest the issuance of the certificate at any time before it has issued, and after the time has expired for the completion of the appropriation under the permit, or within three months after issuance of the certificate.

The water user shall maintain the meter or other suitable measuring device in good working order and submit an annual report of water used to the Department.

The water user shall measure the water levels in the well each year between March 1 and March 31 (spring high-water level) and submit the data to the Department within 90 days of measurement. Water level measurements shall be made by a certified water rights examiner, licensed water well drilled, licensed pump installer, registered geologist, licensed land surveyor, registered professional engineer or the water user.

The Director may require water level or pump test results every ten years.

Failure to comply with any of the provisions of this right may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the right.

This right is for beneficial use of water without waste. The water user is advised that new regulations may require use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

Issued SEP 2 2 2008

Phillip C. Ward, Director
Water Resources Department

 Recorded in State Record of Water Right Certificates numbered 84786.

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

KENNETH RAY AND BEVERLY MAY STEWART
ROUTE 5, BOX 662
HILLSBORO, OREGON 97123

confirms the right to use the waters of A WELL in the MCKAY CREEK BASIN for the purpose of IRRIGATING 4.1 ACRES.

The right has been perfected under Permit G-9692. The date of priority is AUGUST 25, 1981. The right is limited to not more than 0.05 CUBIC FOOT PER SECOND or its equivalent in case of rotation, measured at the well.

The well is located as follows:

SE 1/4 NW 1/4, AS PROJECTED WITHIN DLC 65, SECTION 14, T 1 N, R 2 W, W.M.; 600 FEET SOUTH AND 690 FEET EAST FROM NORTHWEST CORNER DLC 65.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to ONE-EIGHTIETH of one cubic foot per second per acre, or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year.

The right shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right, and to which such right is appurtenant, is as follows:

NE 1/4 NW 1/4 2.1 ACRES
SE 1/4 NW 1/4 2.0 ACRES
BOTH AS PROJECTED WITHIN DLC 65
SECTION 14
TOWNSHIP 1 NORTH, RANGE 2 WEST, W.M.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

WITNESS the signature of the Water Resources Director, affixed this date MARCH 29, 1989.

/s/ WILLIAM H. YOUNG
Water Resources Director

Recorded in State Record of Water Right Certificates numbered 60593

G-10529.TMW

690-10-GBC

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

This is to certify, *That* ROBERT A. AND MARY G. BENNETT

of Route 5, Box 663, Hillsboro *, State of* OR 97124 *, has made proof to the satisfaction of the Water Resources Director, of a right to the use of the waters of*
a well

a tributary of McKay Creek *for the purpose of*
irrigation of 1.9 acres

under Permit No. G-7527 *and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from*
August 8, 1977
that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed
0.02 cubic foot per second

or its equivalent in case of rotation, measured at the point of diversion from the well. The well is located in the NW 1/4 NW 1/4, as projected within Mauzey DLC 65, Section 14, T1N, R2W, WM; 300 feet South and 540 feet East from NW corner Mauzey DLC 65.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth *of one cubic foot per second per acre,* or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year,

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

1.2 acres NW 1/4 NW 1/4 as projected within Mauzey DLC 65
0.7 acre SW 1/4 NW 1/4 as projected within Mauzey DLC 65
Section 14
Township 1 North, Range 2 West, WM

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the Water Resources Director, affixed this date. October 27, 1986

/s/ William H. Young
Water Resources Director

Recorded in State Record of Water Right Certificates, Volume 50 *, page* 55147

6324D/SB
G-8345

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

DAWSON CREEK PARK SOUTH OWNERS ASSOCIATION
8705 SW NIMBUS AVE SUITE 230
BEAVERTON OR 97008

confirms the right to use the waters of A WELL in the ROCK CREEK BASIN for SUPPLEMENTAL IRRIGATION of 45.0 ACRES and MAINTENANCE OF SEVEN RESERVOIRS CONSTRUCTED UNDER PERMIT R-10624.

This right was perfected under Permit G-10819. The date of priority is MAY 8, 1986. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not 336.6 GALLONS PER MINUTE (GPM), BEING 251.3 GPM FOR SUPPLEMENTAL IRRIGATION AND 85.3 GPM FOR MAINTENANCE OF SEVEN RESERVOIRS or its equivalent in case of rotation, measured at the well.

The well is located as follows:

Twp	Rng	Mer	Sec	Q-Q	DLC	Survey Coordinates
1 N	2 W	WM	28	NE SE	39	1150 FEET NORTH AND 2100 FEET EAST FROM MOST WESTERLY SW CORNER, DLC 39

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, is limited to a diversion of ONE-EIGHTIETH of one cubic foot per second, or its equivalent for each acre irrigated, and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year. The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

A description of the place of use to which this right is appurtenant is as follows:

SUPPLEMENTAL IRRIGATION						
Twp	Rng	Mer	Sec	Q-Q	DLC	Acres
1 N	2 W	WM	22	SW SW	39	1.5
1 N	2 W	WM	27	NW NW	39	4.2
1 N	2 W	WM	27	SW NW	39	2.6
1 N	2 W	WM	28	NE NE	39	7.5
1 N	2 W	WM	28	NW NE	39	0.7
1 N	2 W	WM	28	SW NE	39	8.2

NOTICE OF RIGHT TO PETITION FOR RECONSIDERATION OR JUDICIAL REVIEW

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080, you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied. In addition, under ORS 537.260 any person with an application, permit or water right certificate subsequent in priority may jointly or severally contest the issuance of the certificate at any time before it has issued, and after the time has expired for the completion of the appropriation under the permit, or within three months after issuance of the certificate.

SUPPLEMENTAL IRRIGATION						
Twp	Rng	Mer	Sec	Q-Q	DLC	Acres
1 N	2 W	WM	28	SE NE	39	13.7
1 N	2 W	WM	28	NE SE	39	1.8
1 N	2 W	WM	28	NW SE	39	4.8

POND MAINTENANCE					
Twp	Rng	Mer	Sec	Q-Q	DLC
1 N	2 W	WM	28	NE NE	39
1 N	2 W	WM	28	SW NE	39
1 N	2 W	WM	28	SE NE	39
1 N	2 W	WM	28	NE SE	39

The well shall be maintained in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon.

The works constructed shall include an air line and pressure gauge or an access port measuring line, adequate to determine the water level elevation in the well at all times.

The water user shall install and maintain a weir, meter, or other suitable measuring device and keep a complete record of the amount of ground water withdrawn.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

WITNESS the signature of the Water Resources Director, affixed JAN 2 6 2007.

Phillip C. Ward, Director
Water Resources Department

 Recorded in State Record of Water Right Certificates numbered 83076.

Registration No. GR 2693

Certificate No. GR 2551

Registration Statement

OF CLAIMANT OF RIGHT TO APPROPRIATE GROUND WATER

TO THE STATE ENGINEER OF OREGON:

I, H.W. Ray

of Rt 1 Box 372 Hillsboro (Mailing address) County of Washington

State of Oregon, do hereby make application for a certificate of registration as evidence of a right to appropriate ground water.

1. **Source** from which water is withdrawn is Pump well #1 (Flowing well, pump well, infiltration trench, or tunnel)

2. **Location** is: 3 miles East on Cornell Rd. (Approximate distance and direction from nearest city or town);

and is more particularly described as follows:

(a) S 13°W 1500 feet from N¼ corner Section 34 (Give distance and bearing to corner of section or other legal subdivision)

being within SE¼ of NW¼ (Smallest legal subdivision) of Sec. 34, Twp. 1N (N. or S.), Rge. 2W (E. or W.)

or (b) within limits of recorded platted property, town or city:

in Lot ....., Block ..... of ..... (Name of plat or addition)

..... (If within city or town, give name) County of .....

3. **Construction Work** was begun on 1936 (Date); was completed on 1936 (Date)

and the ground water claimed was first used for the purposes set out below on 1936 (Date),

since which time the water has been used Continuously through irrigation season (Continuously or intermittently)

from 1936 (Date) to 1958 (Date).

4. **Quantity** of water claimed and used is 30 gallons per minute; 72 acre feet per year.

5. **Purpose or Purposes** for which water is used Irrigation (Domestic, irrigation, municipal, manufacturing, industrial, etc.)

6. **Description of Well:** Depth 28 feet. Type Dug (Dug or drilled)

diameter 144 inches. Elevation of ground at well site ..... feet, mean sea level. (As near as known)

Depth to water table 10 feet.

7. **Capacity of Well:** 30 g.p.m. with 15 feet drawdown.

..... g.p.m. with ..... feet drawdown.

Date of test 1957

If Flowing Well: Measured discharge ..... g.p.m. on ..... (Date)

Shut-in pressure at ground surface ..... lbs. per sq. in. on ..... (Date)

Water is controlled by ..... (Cap, valve, etc.)

8. **Casing:** (Give diameter, commercial specifications and depth below ground surface of each casing size.)

144 inch diameter Brick Line from 0 to 28 feet

..... inch diameter ..... from ..... to ..... feet

..... inch diameter ..... from ..... to ..... feet

..... inch diameter ..... from ..... to ..... feet

Describe and show depth of shoe, plug, adapter, liner or other details: .....

9. **Perforated Casings or Screens:**

..... from ..... to .....
(Number per foot and size of perforations, or describe screen)

NO

..... from ..... to .....

..... from ..... to .....

..... from ..... to .....

10. **Log of Well:** (Describe each stratum or formation clearly, indicate if water bearing, and give thickness and depth as indicated.)

MATERIAL	Thickness (Feet)	Depth to Bottom (Feet)
Not available		

GR 2551

If log of well is not available, give name and address of driller. Not Known

11. **Infiltration Trench:** Covered or open .....

Dimensions: Length ..... ft. Minimum depth ..... ft. Maximum depth ..... ft.

Bottom width ..... ft. Discharge ..... g.p.m. Date of test .....

12. **Tunnel:** Type of lining .....

Dimensions: ..... (Length, course, and cross sectional size)

Position of water bearing stratum with reference to portal of tunnel .....

Log of tunnel: (Preceding table for log of well may be used, if desired. Give footage from portal and character of materials, as pertinent.)

13. **Pumping Equipment:**

(a) Pump U.S. Turbine (Make, type and size) Capacity 30 g.p.m.

(b) Motor 3HP U.S. Electric (Type and horsepower)

14. Location of area irrigated or to be irrigated, or place of use if for purposes other than irrigation.

Township North or South	Range E. or W. of Willamette Meridian	Section	Forty-acre Tract	Number Acres To Be Irrigated	Date of Reclamation
T 1 N	2 W	34	NE¼ NW¼	½	1936
T 1 N	2 W	34	SE¼ NW¼	1½	1936
				2 Ac	

15. If the ground water supply is supplemental to an existing water supply, identification of any application for a permit, permit, certificate or adjudicated right to appropriate water made or held by the registrant.

.....

.....

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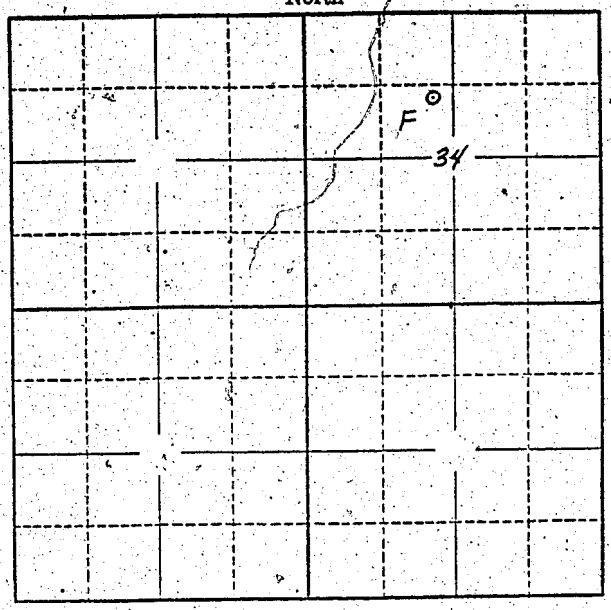
Township 1N Range 2W W.M.

North



Locate well and acreage of irrigated land on plat.

Scale: 2" — 1 Mile

STATE OF OREGON
County of Marion } ss.

I, ..., being first duly sworn, do hereby certify that I have read the foregoing Registration Statement and that all of the items therein contained are true to the best of my knowledge and belief.

H. W. Ray
(Signature of Registrant)
By Susan Bronner

Subscribed and sworn to before me this 26th day of March, 1958

My commission expires 12th June 1961

Wm. S. Bartholomew
(Notary Public)

(SEAL)

CERTIFICATE OF REGISTRATION

STATE OF OREGON
County of Marion } ss.

This is to certify that the foregoing Registration Statement was received in the office of the State Engineer on the 25 day of July, 1958, at 8:00 o'clock A. M. and has been duly recorded in said office in Book No. 11 of Registration Statements on page GR-2551

Witness my hand this 6th day of April, 1959

Kenneth H. Hanley
(State Engineer)

$15.00

By .....
(Deputy)

GR-2551

90-10-CBC

STATE OF OREGON

COUNTY OF WASHINGTON

CERTIFICATE OF WATER RIGHT

This is to certify, *That* OREGON ROSES, INC.

of 1170 E. Tualatin Valley Hwy., Hillsboro *, State of* OR 97123 *, has made proof to the satisfaction of the Water Resources Director, of a right to the use of the waters of*
3 wells

a tributary of unnamed drainage channel (Tualatin River) *for the purpose of*
supplemental irrigation of 7.3 acres

under Permit No. G-4983 *and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from*
November 19, 1971
that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed
0.09 cubic foot per second; being 0.02 cfs from Well #2, 0.02 cfs from Well #3, and 0.05 cfs from Well #4

or its equivalent in case of rotation, measured at the point of diversion from the well. The well is located in the NE 1/4 SE 1/4, SE 1/4 SE 1/4, as projected within M. Moore DLC 41, Section 6, T1S, R2W, WM; #2 - 1150 feet North and 2940 feet East; #3 - 1070 feet North and 2850 feet East; #4 - 770 feet North and 3050 feet East; all from SW corner M. Moore DLC 41.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth *of one cubic foot per second per acre,* or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed 2.5 acre-feet per acre for each acre irrigated during the irrigation season of each year, provided further that the right allowed herein shall be limited to any deficiency in the available supply of any prior right existing for the same land and shall not exceed the limitation allowed herein, and shall be subject to such reasonable rotation system as may be ordered by the proper state officer, *and shall conform to such reasonable rotation system as may be ordered by the proper state officer.*

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

6.4 acres NE 1/4 SE 1/4 as projected within M. Moore DLC 41
0.6 acre NW 1/4 SE 1/4 as projected within M. Moore DLC 41
0.1 acre SW 1/4 SE 1/4 as projected within M. Moore DLC 41
0.2 acre SE 1/4 SE 1/4 as projected within M. Moore DLC 41
Section 6
Township 1 South, Range 2 West, WM

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the Water Resources Director, affixed this date. July 2, 1987

/s/ William H. Young
Water Resources Director

Recorded in State Record of Water Right Certificates, Volume 52 *, page* 56399

9658D/SB
G-5670

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

BENCHMARK LAND CO. - JONES FARM SINGLE FAMILY LLC
16325 SW BOONES FERRY RD., SUITE 203 PHONE: (503)635-2996
LAKE OSWEGO, OREGON 97035

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-14450

SOURCE OF WATER: A WELL, IN MCKAY CREEK BASIN, WITHIN THE WILLAMETTE BASIN

PURPOSE OR USE: IRRIGATION OF 85.7 ACRES

MAXIMUM RATE: 1.07 CUBIC FEET PER SECOND

PERIOD OF USE: MARCH 1 THROUGH OCTOBER 31

DATE OF PRIORITY: JANUARY 28, 1997

POINT OF DIVERSION LOCATION: SE 1/4 NE 1/4, SECTION 30, T1N, R2W, W.M.; 1476 FEET SOUTH & 220 FEET WEST FROM NE CORNER, SECTION 30

The amount of water used for irrigation under this right, together with the amount secured under any other right existing for the same lands, is limited to a diversion of ONE-EIGHTIETH of one cubic foot per second (or its equivalent) and 2 ½ acre-feet for each acre irrigated during the irrigation season of each year.

THE PLACE OF USE IS LOCATED AS FOLLOWS:

NW 1/4 NW 1/4 8.0 ACRES
SW 1/4 NW 1/4 25.0 ACRES
NW 1/4 SW 1/4 10.8 ACRES
SECTION 29
NE 1/4 NE 1/4 8.6 ACRES
SE 1/4 NE 1/4 25.3 ACRES
NE 1/4 SE 1/4 8.0 ACRES
SECTION 30
TOWNSHIP 1 NORTH, RANGE 2 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The permittee shall maintain the meter or measuring device in good working order, shall keep a

complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

(1) Use of water from the well, as allowed herein, shall be controlled or shut off if the well displays:

(a) An average water level decline of three or more feet per year for five consecutive years; or

(b) A total water level decline of fifteen or more feet; or

(c) A hydraulic interference decline of fifteen or more feet in any neighboring well providing water for senior exempt uses or wells covered by prior rights.

(2) The water user shall install a meter or other measuring device suitable to the Director, and shall submit an annual report of water used to the Department by March 31 of each year.

(3) The permittee/appropriator shall be responsible for complying with each of the following requirements for measuring water levels in the well.

(a) Use of water from a new well shall not begin until an initial static water level in the well has been measured and submitted to the Department.

(b) In addition to the measurement required in subsection (a) of this section, a water level measurement shall be made each year during the period March 1 through March 31.

(c) All water level measurements shall be made by a qualified individual. Qualified individuals are certified water rights examiners, registered geologists, registered professional

engineers, licensed land surveyors, licensed water well constructor, licensed pump installer, or the permittee/appropriator.

(d) Any qualified individual measuring a well shall use standard methods of procedure and equipment designed for the purpose of well measurement. The equipment used shall be well suited to the conditions of construction at the well. A list of standard methods of procedure and suitable equipment shall be available from the Department.

(e) The permittee/appropriator shall submit a record of the measurement to the Department on a form available from the Department. The record of measurement shall include both measurements and calculations, shall include a certification as to their accuracy signed by the individual making the measurements, and shall be submitted to the Department within 90 days from the date of measurement. The Department shall determine when any of the declines cited in section (1) are evidenced by the well measurement required in section (3).

STANDARD CONDITIONS

The wells shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

Actual construction of the well shall begin by June 8, 1999. Complete application of water to the use shall be made on or before October 1, 2002. Within one year after complete application of water to the proposed use, the permittee shall submit a claim of beneficial use, which includes a map and report, prepared by a Certified Water Rights Examiner (CWRE).

Issued August 21, 1998

Dwight Fruend for

Martha O. Pagel, Director
Water Resources Department

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

D.S. PARKLANE DEVELOPMENT INC.
10700 SW BEAVERTON-HILLSDALE HWY, SUITE 501 PHONE: (503) 241-2300
BEAVERTON, OREGON 97005

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-14435

SOURCE OF WATER: A WELL IN BUTTERNUT CREEK BASIN

PURPOSE OR USE: COMMERCIAL USE

MAXIMUM RATE: 0.334 CUBIC FOOT PER SECOND

PERIOD OF USE: YEAR ROUND

DATE OF PRIORITY: JANUARY 10, 1997

POINT OF DIVERSION LOCATION: SW 1/4 NE 1/4, SECTION 15, T1S, R2W, W.M.; 312 FEET SOUTH & 1527 FEET WEST FROM SW CORNER, ROBERTSON DLC

THE PLACE OF USE IS LOCATED AS FOLLOWS:

SW 1/4 NE 1/4
SECTION 15
TOWNSHIP 1 SOUTH, RANGE 2 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The permittee shall maintain the meter or measuring device in good working order, shall keep a complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

(1) Use of water from the well, as allowed herein, shall be controlled or shut off if the well displays:

(a) An average water level decline of three or more feet per year for five consecutive years; or

(b) A total water level decline of fifteen or more feet; or

(c) A hydraulic interference decline of fifteen or more feet in any neighboring well providing water for senior exempt uses or wells covered by prior rights.

(2) The water user shall install a meter or other measuring device suitable to the Director, and shall submit an annual report of water used to the Department by December 1 of each year.

(3) The permittee/appropriator shall be responsible for complying with each of the following requirements for measuring water levels in the well.

(a) Use of water from a new well shall not begin until an initial static water level in the well has been measured and submitted to the Department.

(b) In addition to the measurement required in subsection (a) of this section, a water level measurement shall be made each year during the period March 1 through March 31.

(c) All water level measurements shall be made by a qualified individual. Qualified individuals are certified water rights examiners, registered geologists, registered professional engineers, licensed land surveyors, licensed water well constructor, licensed pump installer, or the permittee/appropriator.

(d) Any qualified individual measuring a well shall use standard methods of procedure and equipment designed for the purpose of well measurement. The equipment used shall be well suited to the conditions of construction at the well. A list of standard methods of procedure and suitable equipment shall be available from the Department.

(e) The permittee/appropriator shall submit a record of the measurement to the Department on a form available from the Department. The record of measurement shall include both

measurements and calculations, shall include a certification as to their accuracy signed by the individual making the measurements, and shall be submitted to the Department within 90 days from the date of measurement. The Department shall determine when any of the declines cited in section (1) are evidenced by the well measurement required in section (3).

STANDARD CONDITIONS

The wells shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

Actual construction of the well shall begin within one year from permit issuance. Complete application of water to the use shall be made on or before October 1, 2001.

Issued July 3, 1997

for Martha O. Pagel, Director
Water Resources Department

STATE OF OREGON

COUNTY OF WASHINGTON

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

HILLSBORO SCHOOL DISTRICT 1J
4901 SE WITCH HAZEL RD
HILLSBORO, OR 97123

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-17123

SOURCE OF WATER: WELL 1 (WASH 58925) IN WAIBLE GULCH BASIN

PURPOSE OR USE: IRRIGATION OF 21.26 ACRES

MAXIMUM RATE: 0.266 CUBIC FOOT PER SECOND

PERIOD OF USE: MARCH 1 THROUGH OCTOBER 31

DATE OF PRIORITY: OCTOBER 15, 2008

WELL LOCATION: SE ¼ SW ¼, SECTION 14, T1N, R2W, W.M.; 330 FEET NORTH AND 1450 FEET EAST FROM SW CORNER, SECTION 14

The amount of water used for irrigation under this right, together with the amount secured under any other right existing for the same lands, is limited to a diversion of ONE-EIGHTIETH of one cubic foot per second and 2.5 acre-feet for each acre irrigated during the irrigation season of each year.

THE PLACE OF USE IS LOCATED AS FOLLOWS:

SW ¼ SW ¼ 1.0 ACRE
SE ¼ SW ¼ 4.2 ACRES
SECTION 14

NE ¼ NW ¼ 12.98 ACRES
NW ¼ NW ¼ 1.47 ACRES
SE ¼ NW ¼ 1.61 ACRES
SECTION 23
TOWNSHIP 1 NORTH, RANGE 2 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a totalizing flow meter or other suitable measuring device as approved by the Director at each point of

appropriation. The permittee shall maintain the meter or measuring device in good working order.

B. The permittee shall keep a complete record of the amount of water used each month, and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water-use information, including the place and nature of use of water under the permit.

C. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where any meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

D. The Director may provide an opportunity for the permittee to submit alternative measuring and reporting procedures for review and approval.

Prior to using water from any well listed on this permit, the permittee shall ensure that the well has been assigned an OWRD Well Identification Number (Well ID tag), which shall be permanently attached to the well. The Well ID shall be used as a reference in any correspondence regarding the well, including any reports of water use, water level, or pump test data.

This permit expires on October 31, 2010.

The permittee shall seek a replacement source of water and provide annual progress reports (signed by the Chief Financial Officer or the Superintendent) to the Water Resources Department no later than July 1, 2009 and July 1, 2010.

To monitor the effect of water use from the well authorized under this permit, the Department requires the water user to make and report annual static water level measurements. The static water level shall be measured in the month of March prior to initiation of irrigation for the season. Reports shall be submitted to the Department within 15 days after use has begun. The static water level shall be measured in the months of July, November, and January. Reports shall be submitted to the Department within 15 days of measurement.

All measurements shall be made by a certified water rights examiner, registered professional geologist, registered professional engineer, licensed well constructor or pump installer licensed by the Construction Contractors Board and be submitted to the Department on forms provided by the Department. The Department requires the individual performing the measurement to:

A. Identify each well with its associated measurement; and
B. Measure and report water levels to the nearest tenth of a foot as depth-to-water below ground surface; and
C. Specify the method used to obtain each well measurement; and
D. Certify the accuracy of all measurements and calculations submitted to the Department.

The reference water level is 79.2 feet below land surface, which was the initial static water level measured in Well 1 (WASH 58925) in March 2004. This reference level will be used to identify any water-level declines.

If a well listed on this permit displays a total static water-level decline of 25 or more feet over any period, as compared to the reference level, then the water user shall discontinue use of, or reduce the rate or volume of withdrawal from, the well. Such action shall be taken until the water level recovers to above the 25-foot decline level or until the Department determines, based on the water user's and/or the Department's data and analysis, that no action is necessary because the aquifer in question can sustain the observed declines without adversely impacting the resource or senior water rights. The water user shall in no instance allow excessive decline, as defined in Commission rules, to occur within the aquifer as a result of use under this permit.

Use of water under this permit shall, as determined by the Department, be reduced or discontinued if a senior ground water user, affected directly by the use of the District's well (Well 1, WASH 58925), has its use reduced or discontinued by the Department due to the triggering of water-level decline permit conditions or due to excessive decline within the subject aquifer.

Failure to provide water level measurements on a quarterly basis will likely result in suspension of water use from the well authorized under this permit, until compliance with the measurement requirements are met.

STANDARD CONDITIONS

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

If the number, location, source, or construction of any well deviates from that proposed in the permit application or required by permit conditions, this permit may be subject to cancellation, unless the Department authorizes the change in writing.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department

approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

The well(s) shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

If the riparian area is disturbed in the process of developing a point of appropriation, the permittee shall be responsible for restoration and enhancement of such riparian area in accordance with ODFW's Fish and Wildlife Habitat Mitigation Policy OAR 635-415. For purposes of mitigation, the ODFW Fish and Wildlife Habitat Mitigation Goals and Standards, OAR 635-415, shall be followed.

The use may be restricted if the quality of downstream waters decreases to the point that those waters no longer meet existing state or federal water quality standards due to reduced flows.

Where two or more water users agree among themselves as to the manner of rotation in the use of water and such agreement is placed in writing and filed by such water users with the watermaster, and such rotation system does not infringe upon such prior rights of any water user not a party to such rotation plan, the watermaster shall distribute the water according to such agreement.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

Issued May 26, 2009

E. Timothy Wall

for Phillip C. Ward, Director
Water Resources Department

Attachment B

Oregon Administrative Rules

OAR 690-502-0250

690-502-0250

Special Columbia River Basalt Group Aquifer Permit Conditions**.**

New permits issued to appropriate groundwater from Columbia River Basalt Group aquifers shall be specially conditioned. The conditions shall specify:

(1) A static water level measurement be made and submitted before any use of water may commence at the well;

(2) The permittee/appropriator install a meter or other suitable measuring device approved by the Director and submit an annual report of water used to the Department;

(3) Limits on acceptable amounts of depletion and interference with other users;

(4) Use of water from the well be controlled or shut off if limits specified in the permit to protect the resource from depletion, and prior appropriators from interference, are exceeded;

(5) The Department shall determine, from measurements submitted by the permittee/appropriator, or other data on file in the department, the initial and subsequent water levels from which the previously cited declines are referenced;

(6) Following the issuance of a permit, the permittee/appropriator shall measure the water levels in the permitted well each year between March 1 and March 31 (spring high-water level) and submit the data to the Department within 90 days of measurement. Water level measurements shall be made by a certified water rights examiner, licensed water well driller, licensed pump installer, registered geologist, licensed land surveyor, registered professional engineer or the permittee/appropriator;

(7) Any other conditions derived from OAR Chapter 690, Division 008 as deemed necessary to protect the groundwater resource.

Stat. Auth.: ORS 536 & ORS 537
Hist.: WRD 11-2003, f. & cert. ef. 12-04-03

Attachment C

Crandall Reservoir Site Memorandum

GSI Water Solutions, Inc.
55 SW Yamhill Street, Suite 400 Portland, OR 97204
P: 503.239.8799 F: 503.239.8940
info@gsiwatersolutions.com www.gsiwatersolutions.com

Aquifer Storage and Recovery Considerations at the Will Crandall Reservoir Site, Hillsboro Oregon

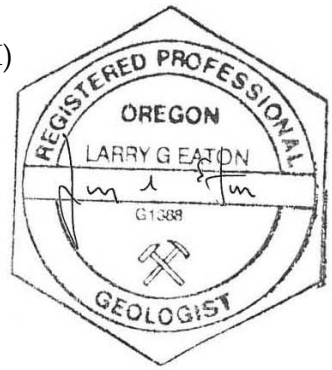
PREPARED FOR: Brad Phelps, PE – CH2M Hill

PREPARED BY: Larry Eaton, RG, LHG – GSI Water Solutions, Inc. (GSI)
Rachael Peavler – GSI

Jason Melady, RG, CWRE – GSI

CC Jeff Barry, RG, CWRE – GSI

DATE: July 11, 2011



The purpose of this memorandum is to present a professional opinion on whether the City of Hillsboro (City) should consider installing the necessary infrastructure at the future Will Crandall Reservoir (Crandall Reservoir) and pump site in Hillsboro, Oregon, to support a future aquifer storage and recovery (ASR) well.

This memorandum also briefly describes the Curl irrigation well, which the City obtained with the purchase of a portion of the reservoir site.

Background

We understand that CH2M Hill is designing a 10 million gallon (MG) reservoir for the City located near the intersection of NW Evergreen Road and 3rd Avenue (see attached CH2M Hill plan map – Figure 1). The site also is being designed to host a booster pump and re-chlorination, as well as a stormwater and overflow detention pond.

The City is required by its Joint Water Commission (JWC) Intergovernmental Agreement (IGA) to have finished water storage equivalent to 3 days of its average day demand. Currently, the City's average day demand is roughly 14 million gallons per day (mgd), which means the City needs about 42 MG of finished water storage. After the Crandall Reservoir is complete, the City will have roughly 41 MG of finished water storage. ASR is being considered as a potential cost effective way to help increase the City's finished water storage to meet future demands. The Crandall Reservoir site is a likely candidate to host an

ASR facility because it will have available land and it will already be equipped with infrastructure needed to support an ASR facility.

In addition, the Curl irrigation well (WASH 63633) located on-site is an existing irrigation well drilled in 2005 by the former owner of a portion of the Crandall Reservoir site. The well was permitted to irrigate up to 5 acres of land.

Aquifer Storage and Recovery

ASR Preliminary Evaluation Approach

Key factors to consider when completing a preliminary ASR assessment in general include:

1. Is land/space available to host an ASR well?
2. What infrastructure is present on-site to support an ASR well (e.g., source water piping, pump to waste)?
3. What is the target aquifer and what is its potential yield (hydrogeologic parameters)?
4. What is the depth to the static water table?
5. Will water have to be injected under pressure?
6. Are source water and groundwater compatible?
7. What is the storage potential given known hydrogeologic parameters. For a confined aquifer, will the increased pressure affect nearby wells and cause them to flow?
8. What is the anticipated recovery yield?
9. Are more cost effective storage options available other than ASR?

Preliminary ASR Assessment

A review of the factors outlined above that could affect the development of a potential ASR facility at the Crandall Reservoir site is briefly discussed below.

1. Available Land

The 10-acre site is owned by the City and there is sufficient land available to site an ASR well (see Figure 1).

2. Available and Future Infrastructure

The site will host a 10-MG reservoir and booster pump station and will have a finished source water line available to recharge the ASR well from the JWC system, the reservoir, or the discharge of the booster pump station. A detention pond planned for the site could be used to provide discharge flushing water from a future ASR well. Lastly, we understand that on-site chlorination system will be available that could feed recovered ASR water. All of the planned infrastructures to support the 10-MG reservoir also would support an ASR facility, thus reducing the investment to develop an ASR well.

3. Target Aquifer

The target aquifer is the Columbia River Basalt Group (CRBG), which is host to all of the ASR facilities in the Willamette region. The depth to the target aquifer beneath the site is approximately 800 feet below ground surface (bgs) (see Figures 2 and 3). The overlying sediments of the Troutdale Formation are not suitable for hosting an ASR well because of their low permeability (low yield potential and typically not sustainable). The nearest highly productive CRBG well is the Dawson Creek Park well (see Figure 2). This well has a very high specific capacity (SC) of around 30 gallons per minute per foot of decline (gpm/ft) and during drilling and testing pumped at up to 2 mgd. For comparison, the very successful ASR 1 and ASR 2 wells for Beaverton have initial SCs close to 30 gpm/ft and during late time injection their SCs are around 5 gpm/ft. ASR 1 yields 1 mgd and ASR 2 yields 2 mgd. Overall, we believe the CRBG beneath the Crandall Reservoir site has the potential to be productive with yields of 1 mgd or more. Moreover, the Dawson Creek Park well did not penetrate the entire CRBG section, which means additional productive zone may be found deeper than the depth explored to date (i.e., 1,500 feet bgs). More productive sections of the CRBG would only improve the potential yield of the well. The target aquifer at this site is confined – sealed from the surface by more than 800 feet of fine-grained sediments.

4. Depth to Static Water Level

The depth to the static water level is relatively shallow in this area because of the confined nature of the CRBG aquifer and most likely less than 50 feet bgs. As such, there is very little head room in the injection well for mounding during injection, and the water level in the injection well would rise above the ground surface. This is not a fatal flaw because the well can be designed to inject under pressure. Because the aquifer is confined, groundwater will not reach the surface during injection; however, there will be an increase in pressure in the CRBG as a result injection. Therefore, a well located near the ASR well (within the area of mounding) that intercepts the CRBG aquifer could become artesian (i.e., the pressure response causes water within the well to flow above the ground surface).

5. Injecting Under Pressure

As previously stated, the ASR well at the Crandall Reservoir site will need to be designed to inject under pressure. This adds to construction costs, but is not a fatal flaw. We understand that the JWC NTL pipeline could provide source water lines and has pressure of roughly 130 pounds per square inch (psi), which would facilitate injecting under pressure at this site. Another source also could be the Hillsboro distribution system at 70 psi . The third alternative for source water would be from the reservoir itself, which would provide only minimal pressure, but would take advantage of running water through the hydroturbine generator.

6. Source and Groundwater Compatibility

Although site-specific groundwater quality data are not available, we anticipate that JWC source water and native groundwater in the CRBG aquifer at this site would be compatible as proven at other ASR sites in the region (e.g., Beaverton, Liberty High School, and Tualatin Valley Water District's (TVWD) Grabhorn ASR well). However, we would recommend, at a minimum, that native groundwater for the Dawson Creek Park well be modeled to see if it is compatible with JWC source water. After a test well is completed at the Crandall Reservoir site and an on-site source water sample is collected, the geochemical compatibility of the two waters should be modeled.

7. Storage Potential

As previously mentioned, an ASR well at the Crandall Reservoir site could cause nearby basalt wells to flow if they are located within the area of influence (injection mound). Using hydrogeologic parameters for other CRBG-hosted ASR wells, the potential areas of influence around the proposed Crandall Reservoir ASR well were developed. Injection volumes of 10, 20, 50, and 100 MG were assumed and the area of influence was estimated using the high and low ends of expected aquifer transmissivities (permeability): 56,000 gallons per day per foot (gpd/ft) and 5, 600 gpd/ft, respectively. For reference, the late time transmissivity at Beaverton's ASR well is on the high end with a transmissivity of 80,000 gpd/ft and the Liberty High School ASR well is on the low end with a transmissivity of less than 2,000 gpd/ft. Figures 4 (low end expected aquifer transmissivity equal to 5,600 gpd/ft) and Figure 5 (high end aquifer transmissivity equal to 56,000 gpd/ft) show the potential area of influence using different injection volumes. The assumed static water level was 15 feet bgs. The only frame that shows an impact to nearby basalt wells is 100 MG of storage volume at transmissivity of 5,600 gpd/ft. It is important to note that this is a very simple analytical calculation and it does not take into account boundaries and/or non-homogenous subsurface conditions, such as lateral changes in permeability of the basalt aquifer. Test well drilling and aquifer testing at the site would be needed to better estimate how much water could be stored without adversely affecting nearby basalt wells.

8. Anticipated Yield

Based on our work on other CRBG ASR wells, we anticipate yields of 1 mgd or more for a properly constructed ASR well completed in a portion of the basalt section that is as transmissive as what has been encountered elsewhere. However, site-specific data are needed to determine long-term yields at any given site.

9. Cost Effective

Based on work done to date on other ASR wells, the cost per MG to store water using an ASR well, even after taking into consideration operation and maintenance costs, has proven to be more cost effective when compared to conventional supply and storage options. Because the Crandall Reservoir site will have existing infrastructure to support and an ASR facility, the cost to develop an ASR well at this site would be on the low end, even if the wellhead were designed to inject under pressure. For planning purposes we would assume a cost of $1.5 million to test and develop an ASR well at the Crandall Reservoir site and that it could store roughly 50 MG.

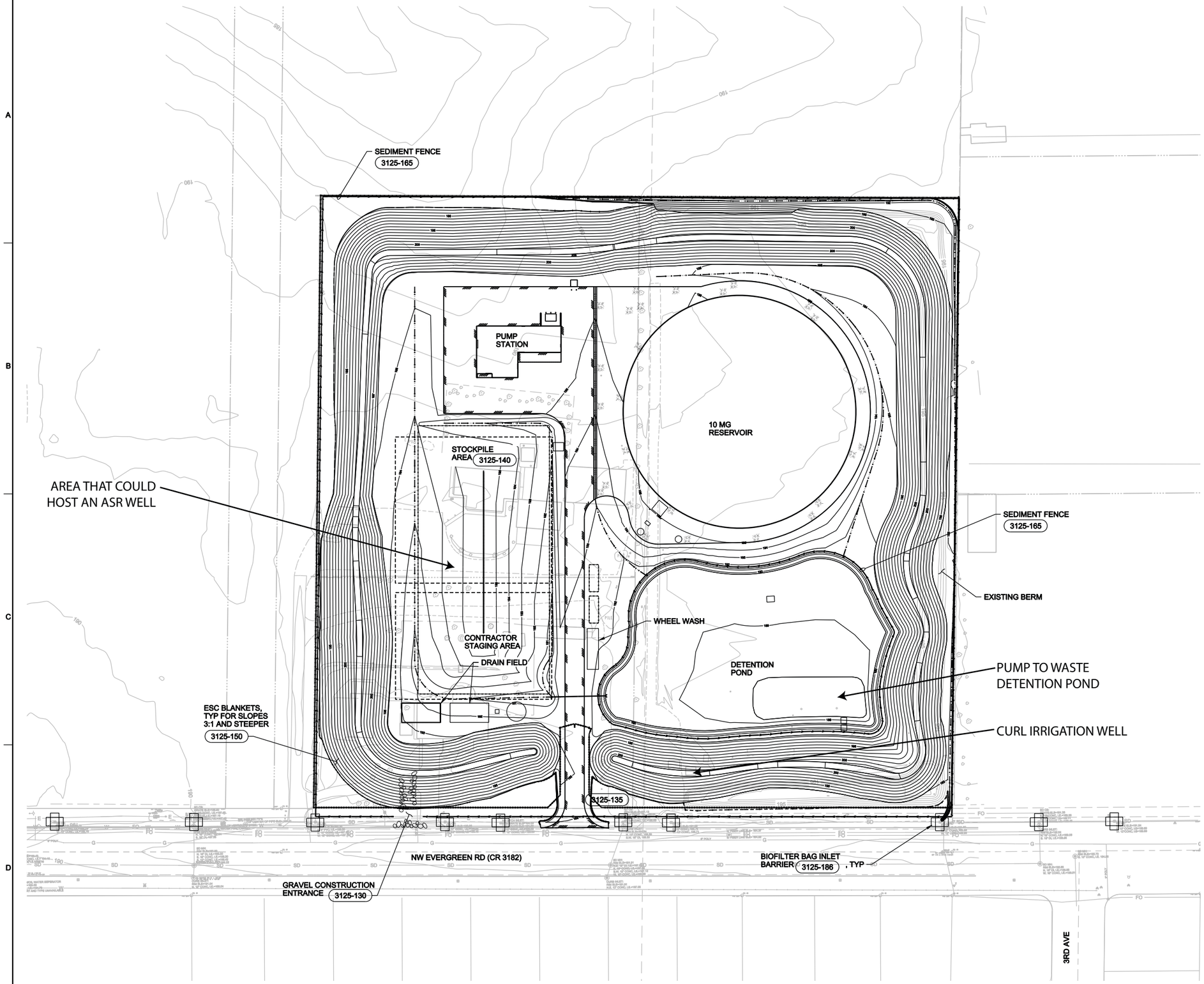
Conclusion and Recommendation

Based on the forgoing, we recommend that the City prepare the Crandall Reservoir site for a future ASR well. A test well is recommended to better define the storage and yield potential and to determine the site-specific compatibility between native groundwater and source water. The risk of storing less than 50 MG at the site is relatively low. This is based on simple analytical calculations and our experience with developing ASR at the Liberty High School well. This year, 10 MG were stored at the Liberty High School ASR well, which was completed only in the very upper part of the CRBG aquifer and has a very low transmissivity. We expect a properly constructed deep basalt well at the Crandall Reservoir site would have much better hydraulic characteristics when compared to the Liberty High

School ASR well. Finally, a modest ASR well at the Crandall Reservoir site would have the added benefit of providing the City with additional in-town, finished water storage, which would help it to meet its IGA requirements for JWC storage.

Curl Irrigation Well

We understand that the City obtained three wells with the purchase of the three parcels of land that comprise the Crandall Reservoir site. Two of the domestic wells are being properly abandoned in the summer of 2011. The remaining well was installed in 2005 for the purpose of providing irrigation water to a row crop and strawberry field. The well was drilled in 2005 to a depth of roughly 210 feet bgs and is reported to yield around 40 gpm shortly after drilling. The well is poorly constructed, has a very low SC (SC = 0.3 gpm/ft) and, of particular importance, was not completed with a well screen. As such, the long-term yield of the well would be questionable and the well could end up becoming silted because of its poor construction. The well has an irrigation water right at 8.9 gpm from March 1 to October 31, to irrigate up to 5 acres. The well would not be affected by ASR operation at the site because it is completed in the shallow overlying sediments and there is most likely 600 feet of fine-grained sediments between the bottom of this well and the underlying CRBG target aquifer. The well could be used by the City to irrigate the site, but it may require maintenance if used frequently. The landscape design for the Crandall project is projected to need 38 to 45 gpm for each of the zones. Reducing the landscape design to 8.9 gpm will significantly increase the costs of the landscape system, as more zones, and valves, and controllers would be needed. In addition, groundwater sampling at the well should be completed if the well is to be used as an emergency potable supply.



PRELIMINARY
NOT FOR CONSTRUCTION
60% DESIGN

NOTES:

1. EROSION CONTROL MEASURES SHOWN ARE MINIMUM REQUIREMENTS. CONTRACTOR SHALL PROVIDE AND INSTALL SILT FENCES, STRAW BALES, MATTING AND OTHER MEASURES AS REQUIRED TO ENSURE NO TURBID RUNOFF LEAVES THE PROJECT SITE, SEE SPECIFICATION SECTION 01 57 13.
2. CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES WEEKLY AT A MINIMUM, AND IMMEDIATELY AFTER EACH STORM EVENT, AND MAKE REPAIRS AS NEEDED TO ENSURE PROPER FUNCTION.
3. PROVIDE CLEAN WATER AS NEEDED AT CONSTRUCTION ACCESS / WHEEL WASH AREAS TO ALLOW WASHING OF WHEELS TO PREVENT SEDIMENT FROM BEING TRACKED ONTO ADJACENT PROPERTY / RIGHT-OF-WAY.
4. EROSION CONTROL MEASURES ARE TO REMAIN IN PLACE UNTIL PERMANENT SEEDING HAS BEEN ESTABLISHED.
5. PROVIDE DEWATERING AS NECESSARY TO ENSURE NO CONTAMINATION OF DRAIN ROCK IN TANK EXCAVATION OCCURS.

NO.	DATE	DSGN	DR	CHK	APVD
		JP KOCH	AR HOWE	DJ PETERSON	BJ PHELPS

REVISION BY APVD

CH2MHILL.

WILL CRANDALL RESERVOIR AND PUMP STATION
CITY OF HILLSBORO, OREGON

FIGURE 1
EROSION CONTROL PLAN

GSI Water Solutions, Inc.

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

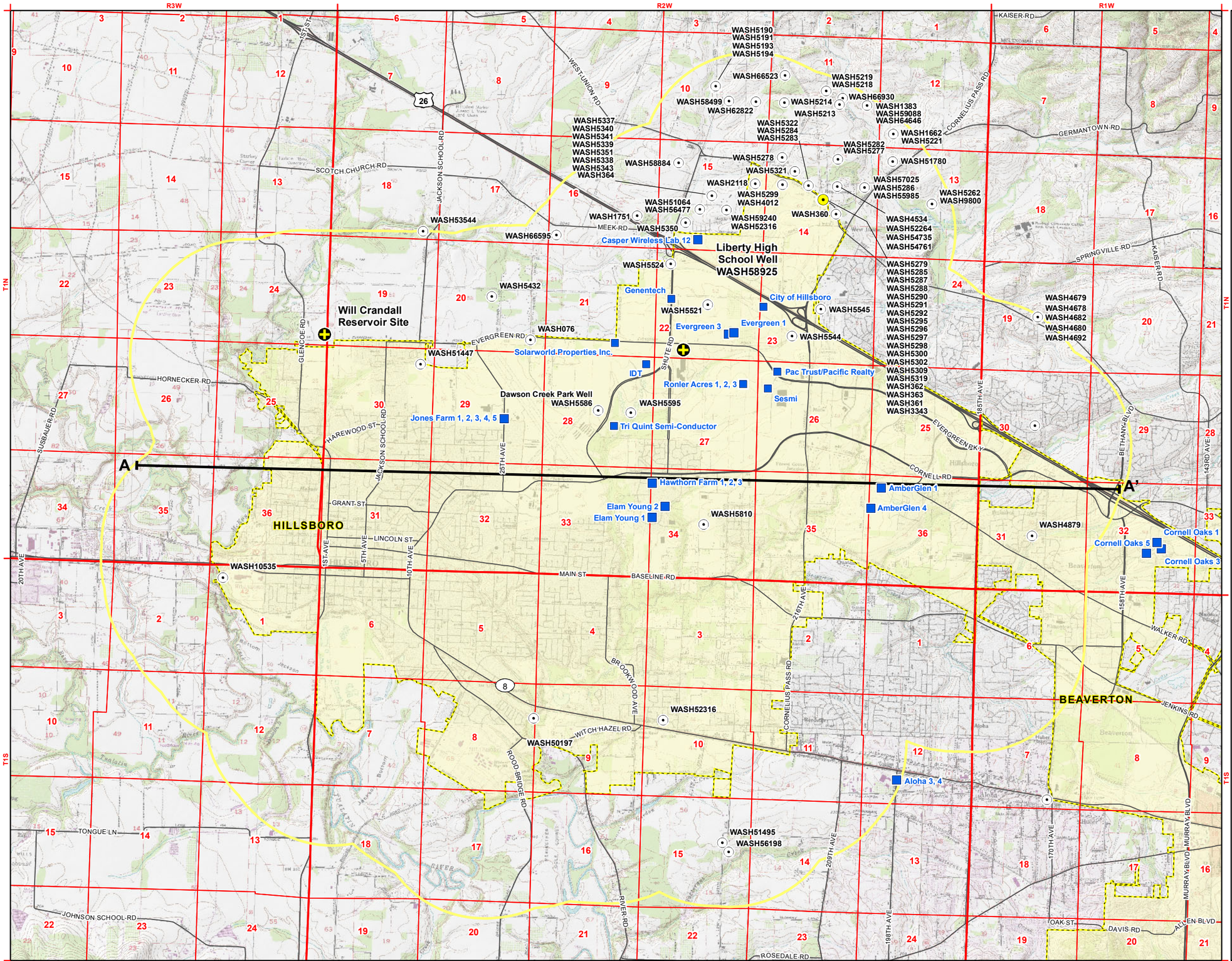
DATE	AUGUST 2011
PROJ	411129
DWG	05-CE-2001
SHEET	

FILENAME: 05-CE-2001_411129.dgn PLOT DATE: 6/27/2011 PLOT TIME: 2:33:05 PM

FIGURE 2

OWRD Basalt Wells

Will Crandall Reservoir
City of Hillsboro



LEGEND

- Will Crandall Reservoir Site
- Liberty High School Well
- OWRD Basalt Wells
- Major High-Tech Water Users
- Cross Section Lines
- 1 Mile Buffer (City of Hillsboro)
- Cities
- Counties
- Freeways and Highways
- Major Roads

N

Scale
1:55,000

0 0.25 0.5 0.75 1
Miles

MAP NOTES:
Date: February 23, 2012
Data Sources: Oregon Geospatial Data Clearinghouse, METRO RLIS,USGS, ESRI

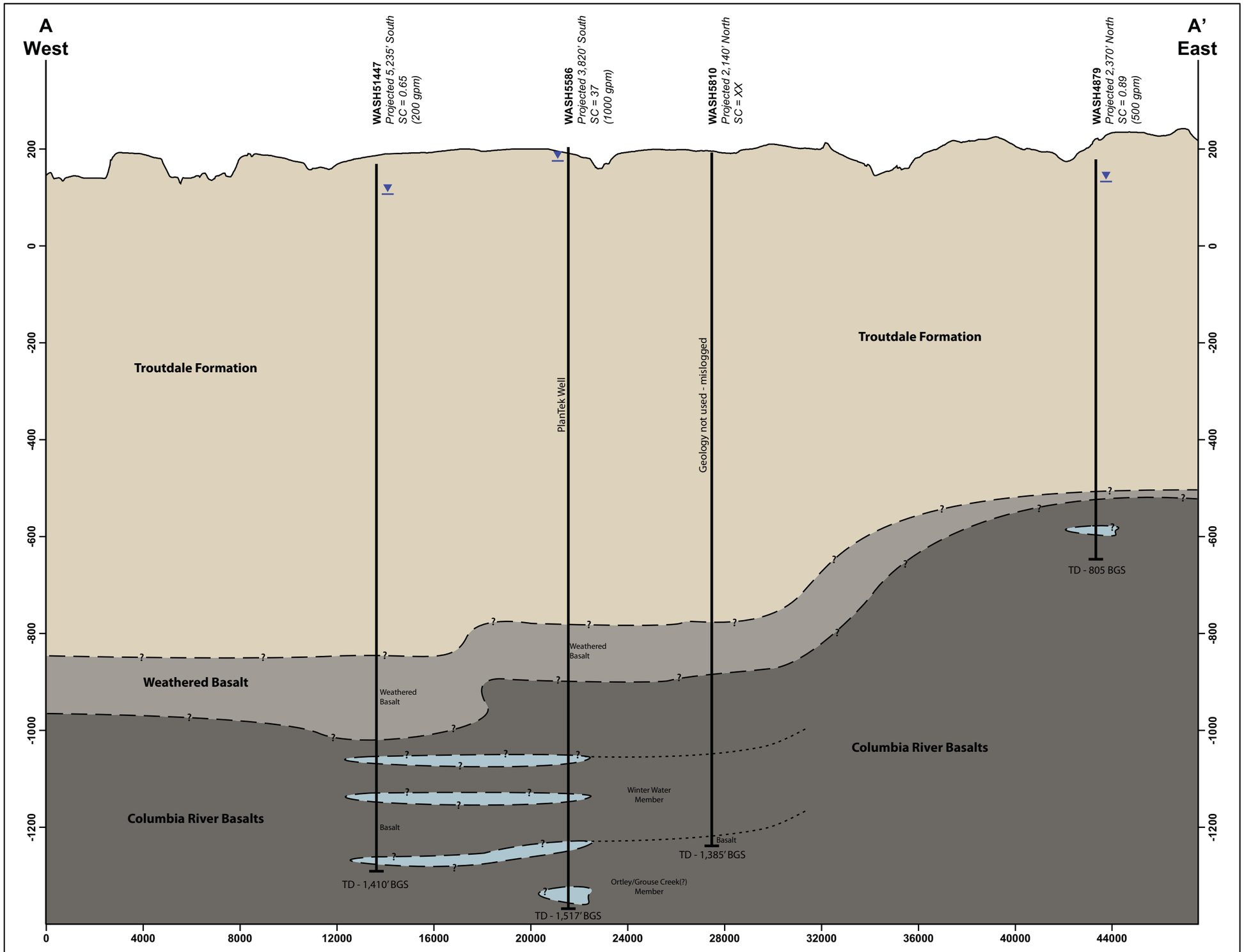
GSI Water Solutions, Inc.

File Path: P:\Portland\268 - CH2M_Hill\003 - Crandall Reservoir Preliminary ASR Evaluation\Project_GIS\Project_mxds\Figure2_Hillsboro_OWRD_Basalt_Wells_Cross_Lines.mxd, Date: February 23, 2012 3:37:01 PM

FIGURE 3

Cross Section A-A'

Will Crandall Reservior
City of Hillsboro



LEGEND

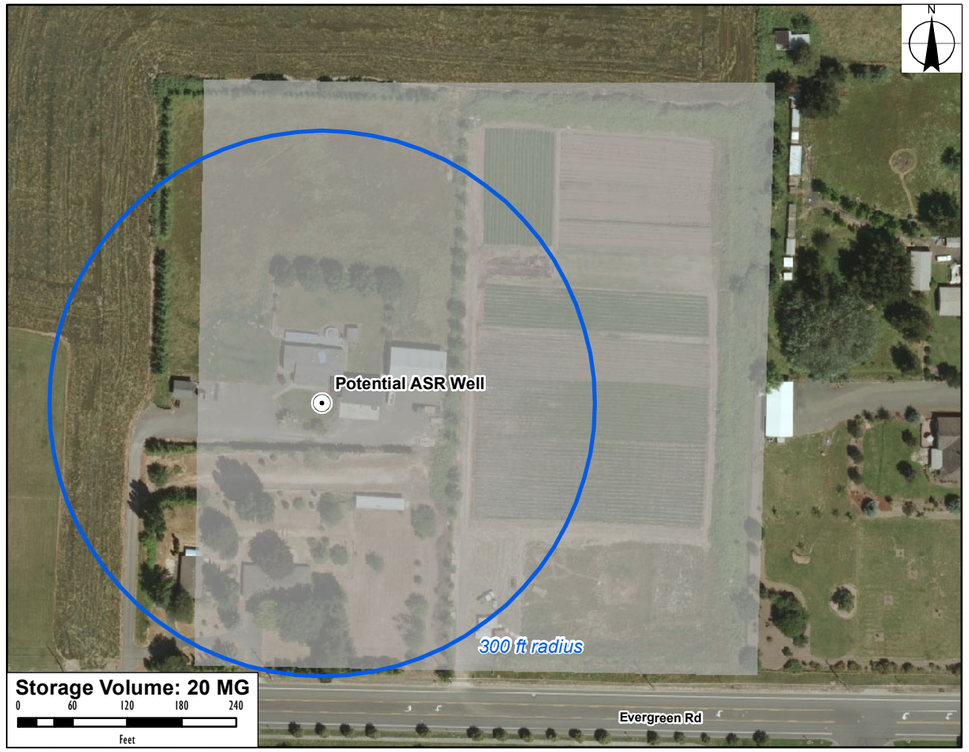
- Troutdale Formation
  Sediments-Clay, Sandy Clays, and Sands
- Weathered Basalt
- Columbia River Basalt
  Grande Ronde Formation
- Interflow Zones
- Static Water Level

NOTES

SC - Specific Capacity
gallon per minute
per foot of drawdown
gpm/ft
GPM - Gallons per Minute
BGS - Below Ground Surface
TD - Total Depth

GSI Water Solutions, Inc.

P:\Portland\268 - CH2M_Hill\003 - Crandall Reservoir Preliminary ASR Evaluation\Figures



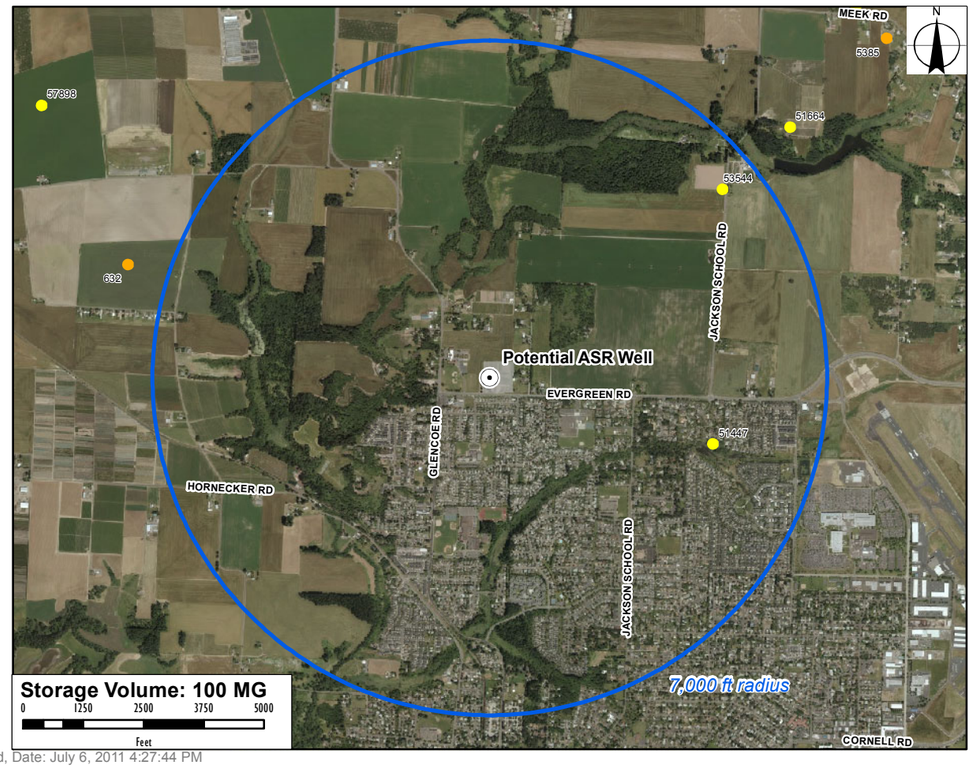


FIGURE 4

Area of Potential Impact Due to ASR Injection Given Low End Expected Aquifer Transmissivity (5,600 gallons per day per foot)

Will Crandall Reservoir
City of Hillsboro

LEGEND

- ASR Well
- Wells Completed in Basalt
- Wells Completed in Silt and Clay
- Radius of 15 feet or Greater Drawup
- Site

NOTEs:

- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 5 feet per day), and a storativity equal to 10^{-3}.

MAP NOTES:
Date: July 6, 2011
Data Sources: ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\268 - CH2M_Hill\003 - Crandall Reservoir Preliminary ASR Evaluation\Project_GIS\Project_mxds\Figure4_Transmissivity_5600.mxd, Date: July 6, 2011 4:27:44 PM

FIGURE 5

Area of Potential Impact Due to ASR Injection Given High End Expected Aquifer Transmissivity (56,000 gallons per day per foot)

Will Crandall Reservoir
City of Hillsboro

LEGEND

- ASR Well
- Radius of 15 feet or Greater Drawup
- Site

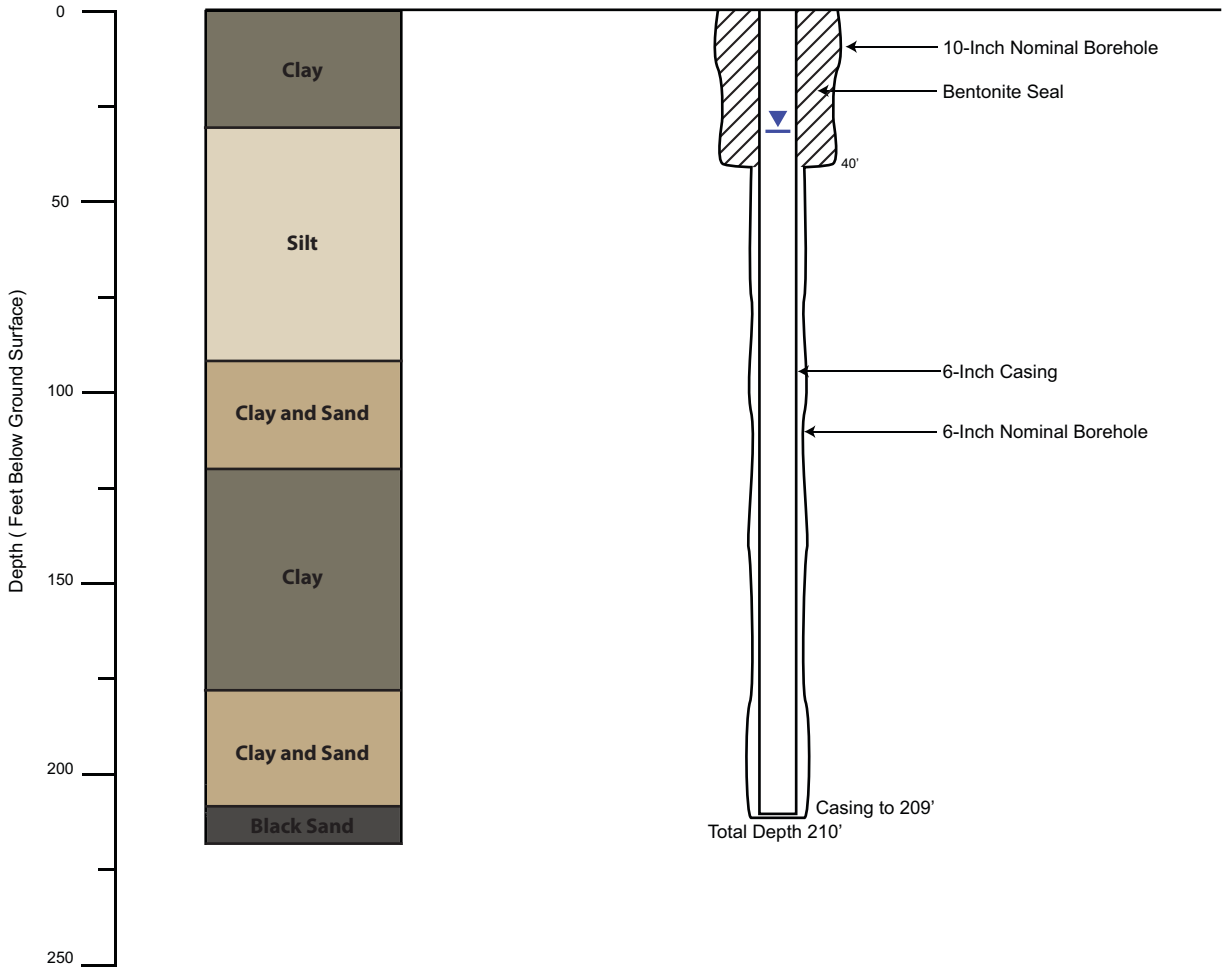
NOTEs:

- Area inside circle represents drawup greater than 15 feet based on injection volume shown in each frame.
- The static water level is conservatively estimated at 15 feet below ground surface. However, static water levels in the vicinity likely are between 35-50 feet below ground surface.
- Analysis assumes a 500-foot section of basalt, 150 feet of which is permeable (hydraulic conductivity = 50 feet per day), and a storativity equal to 10^{-3}.

MAP NOTES:
Date: July 6, 2011
Data Sources: ESRI

GSI Water Solutions, Inc.

File Path: P:\Portland\268 - CH2M_Hill\003 - Crandall Reservoir Preliminary ASR Evaluation\Project_GIS\Project_mxds\Figure5_Transmissivity_56000.mxd, Date: July 6, 2011 4:28:23 PM



NOTES:

- Water Right Limitation: 8.9 gpm to irrigate 5.0 acres between March 1st and October 31st, 2003 priority date.
- Yield 40 gallons per minute with 135 feet of drawdown
- Specific Capacity (SC) = 0.29 gpm/ft
- Well does not have a screen or slots
- WASH 63633, Drilled 2006, Water Right Permit G-15550

FIGURE 6

Curl Irrigation Well

Will Crandall Reservoir
City of Hillsboro

GSI Water Solutions, Inc.

Attachment D

Laboratory Results

Dawson Creek Park and Knife River Wells

MWH
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A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Report

for

City of Hillsboro
390 W Main Street
Hillsboro, OR 97123
Attention: Jessica Dorsey
Fax:

Date of Issue
07/07/2011
MWH LABORATORIES

ACCREDITED IN ACCORDANCE WITH nelac 01114CA

Report#: 367626
Project: GROUNDWATER
Group: Groundwater 2011

RSR: Rita Reeves

Project Manager

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Hits Reports, Comments, QC Summary, QC Report and Regulatory Forms. This report shall not be reproduced except in full, without the written approval of the laboratory.

MWH LABORATORIES

STATE CERTIFICATION LIST

State	Certification Number	State	Certification Number
Alabama	41060	**Mississippi**	Certified
Alaska	CA00006	**Montana**	Cert 0035
Arizona	AZ0455	**Nevada**	CA00006-2010-1
Arkansas	Certified	**New Hampshire**	2959-10
California – NELAP	01114CA	**New Jersey**	CA 008
California – ELAP	1422	**New Mexico**	Certified
Colorado	Certified	**New York**	11320
Connecticut	PH-0107	**North Carolina**	6701
Delaware	CA 006	**North Dakota**	R-009
Florida	E871024	**Oregon**	CA 200003-007
Georgia	947	**Pennsylvania**	68-565
Guam	09-006r	**Rhode Island**	01114CA
Hawaii	Certified	**South Carolina**	87016001
Idaho	Certified	**South Dakota**	Certified
Illinois	200033	**Tennessee**	TN02839
Indiana	C-CA-01	**Texas**	T104704230-10-1
Kansas	E-10268	**Utah**	Mont-1
Kentucky	90107	**Vermont**	VT0114
Louisiana	LA070018	**Virginia**	210
Maine	CA0006	**Washington**	C383-10a
Maryland	224	**West Virginia**	9943 C
Commonwealth of Northern Marianas Is.	0007;0008	**Wisconsin**	998316660
Massachusetts	M-CA006	**Wyoming**	8TMS-Q
Michigan	9906	**EPA Region 5**	Certified

750 Royal Oaks Dr., Ste 100, Monrovia, CA 91016 Tel (626) 386-1100 Fax (626) 386-1101 http://MWHLabs.com

MWH LABORATORIES

Acknowledgement of Samples Received

City of Hillsboro
390 W Main Street
Hillsboro, OR 97123
Attn: Jessica Dorsey
Phone: 503-615-6579

Customer Code: HILLSBORO-OR
Folder #: 367626
Project: GROUNDWATER
Sample Group: Groundwater 2011
Project Manager: Rita Reeves
Phone: 916-418-8358

The following samples were received from you on **June 15, 2011**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using MWH Laboratories.

Sample #	Sample ID	Sample Date
201106150002	WASH 5586 Plan Tek/Dawson Creek	Jun 14, 2011 12:00

@ANIONS28	@ANIONS48	@ICP
@ICPMS	Agressiveness Index-Calculated	Alkalinity in CaCO3 units
Anion Sum - Calculated	Bicarb.Alkalinity as HCO3,calc	Carbon Dioxide,Free(25C)-Calc.
Carbonate as CO3, Calculated	Cation Sum - Calculated	Cation/Anion Difference
Fluoride	Hydroxide as OH, Calculated	Langelier Index - 25 degree
Langlier Index at 60 degrees C	Mercury	PH (H3=past HT not compliant)
pH of CaCO3 saturation(25C)	pH of CaCO3 saturation(60C)	Specific Conductance
Total Dissolved Solid (TDS)	Total Hardness as CaCO3 by ICP	Apparent Color
Odor at 60 C (TON)	@RN	Ammonia Nitrogen
Cyanide by manual distillation	Dissolved Organic Carbon	Hydrogen Sulfide
Iron Dissolved ICAP	Manganese Dissolved ICAP	Orthophosphate as P (OPO4)
Silica	Strontium ICAP	Total Organic Carbon
Total Suspended Solids (TSS)	UV absorbance at 254 nm	

Test Description

@ANIONS28 -- Chloride, Sulfate by EPA 300.0
@ANIONS48 -- Nitrate, Nitrite by EPA 300.0
@ICP -- ICP Metals
@ICPMS -- ICPMS Metals
@RN -- Radon 222

750 Royal Oaks Dr., Ste 100, Monrovia, CA 91016 Tel (626) 386-1100 Fax (626) 386-1101 http://MWHLabs.com

MWH Laboratories

A Division of MWH Americas, Inc.

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

CHAIN OF CUSTODY RECORD

367624

MWH LABS USE ONLY:

LOGIN COMMENTS: _____

SAMPLES CHECKED AGAINST COC BY: JS

SAMPLES LOGGED IN BY: JS

SAMPLE TEMP WHEN REC'D AT LAB: 5° (Compliance: 4 +/- 2°C)

SAMPLES REC'D DAY OF COLLECTION? ☐ (check for yes)

CONDITION OF BLUE ICE: FROZEN ___ PARTIALLY FROZEN ✓ THAWED ___

TO BE COMPLETED BY SAMPLER:

COMPANY/AGENCY NAME: City of Hillsboro - OR

PROJECT CODE: Groundwater

COMPLIANCE SAMPLES (check for yes) ☐
- Requires state forms

NON-COMPLIANCE SAMPLES (check for yes) ☒
REGULATION INVOLVED: _____ (eg. SDWA, Phase V, NPDES, FDA,...)

Type of samples (circle one): ROUTINE (SPECIAL) CONFIRMATION

MWH LABS CLIENT CODE: Hillsboro-OR

COC ID:

SAMPLE GROUP: Groundwater 2011

SEE ATTACHED BOTTLE ORDER FOR ANALYSES ☒ (check for yes), OR
list ANALYSES REQUIRED (enter number of bottles sent for each test for each sample)

SAMPLER PRINTED NAME AND SIGNATURE: Jessica Dorsey Jessica Dorsey

TAT requested: rush by adv notice only
STD___ 1 wk___ 3 day__ 2 day___ 1 day__ 1 day

SAMPLE DATE	SAMPLE TIME	SAMPLE ID	CLIENT LAB ID	MATRIX *	Field Data pH	Field Data Cond.	See sheet	SAMPLER COMMENTS
6/14/11	1200	Dawson Creek Well		RGW	7.02	1117 µS		DO=1.59 ORP=5.1 pH=7.89
								only one Sample set submitted

4/25

* **MATRIX TYPES:** RSW = Raw Surface Water; RGW = Raw Ground Water; CFW = Chlor(am)inated Finished Water; FW = Other Finished Water; SEAW = Sea Water; WW = Waste Water; BW = Bottled Water; SW = Storm Water; SO = Soil; SL = Sludge; O = Other - Please Identify

	SIGNATURE	PRINT NAME	COMPANY/TITLE	DATE	TIME
RELINQUISHED BY:	Jessica Dorsey	Jessica Dorsey	City of Hillsboro	6-14-11	
RECEIVED BY:		Joe Sanchez	MWH	6-15-11	0740
RELINQUISHED BY:					
RECEIVED BY:					

C-O-C# _____

PAGE ____ OF ____

MWH Laboratories, a Division of MWH Americas, Inc.
750 Royal Oaks Drive Suite 100
Monrovia, CA 91016 (626) 386-1100 FAX (626) 386-1124

Bottle Order for City of Hillsboro

Group#
Date Sampled
Date Received

Rita Reeves Your MWHL Project Manager

BO #: 35141
Created By: RSR
Order Date: 06/08/2011
Bottle Orders

Sampler: please return this paper with your samples

Client Code HILLSBORO-OR
Project Code GROUNDWATER Bottle Orders
Group Name Groundwater 2011
PO# / Job#

Ship By:
05/29/2011

Ship Sample Kits to
City of Hillsboro
Water Operations
390 W Main St.
Hillsboro, OR 97123
Attn: Jessica Dorsey - shipping
Phone:
Fax:

Send Report to
City of Hillsboro
~~4475 Southwest Fernhill Road~~
~~Forrest Grove, OR 97116-8504~~
390 W Main St.
Hillsboro, OR 97123
Attn: Jessica Dorsey
Phone: 503-615-6579
Fax:

Billing Address
City of Hillsboro
~~4475 Southwest Fernhill Road~~
~~Forrest Grove, OR 97116-8504~~
150 E Main St. 3rd Floor
Hillsboro, OR 97123
Attn: Jessica Dorsey
Phone: 503-615-6579
Fax:

# of Samples	Tests	Qteline#	Bottles - Qty for each sample, type & preservative if any	UN DOT #
2	@ANIONS28, @ANIONS48, Alkalinity in CaCO3 units, Fluoride, PH (H3=past HT not compliant), Specific Conductance, Iron Dissolved ICAP, Manganese Dissolved ICAP, Orthophosphate as P	1	125ml poly no preservative	
2	@ICP, @ICPMS, Mercury, Silica, Strontium ICAP	1	250ml acid rinsed 1ml HNO3 (18%)	
2	@RN	2	40ml amber glass vial RN_no preservative	
2	Ammonia Nitrogen	1	250ml poly 0.5ml H2SO4 (50%)	
2	Apparent Color, Odor at 60 C (TON)	1	1L amber glass ODOR_no preservative	
2	Cyanide	1	250 ml poly 2 ml NaOH (30%)+6 scoops AA	
2	Dissolved Organic Carbon, UV absorbance at 254 nm	1	125ml amber glass no preservative	
2	Total Dissolved Solid (TDS), Total Suspended Solids (TSS)	1	500ml poly TDS - no preservative	
2	Total Organic Carbon	1	125ml amber glass 0.5ml H2SO4 (50%)	

Comments

Please ship to client for receipt by Thursday morning via 10am FedEx shipping

* Only one sample set submitted at this time. The other set will be sampled at a later date -6-14-11 JD

Code	Status	Date Shipped	Via	Tracking #	# of Coolers	Prepared By

MWH
LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Comments
Report: #367626

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Flags Legend:

MD - Matrix spike recovery was low; the associated blank spike recovery was acceptable. MS/MSD RPD met acceptance criteria.

The Comments Report may be blank if there are no comments for this report.

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750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
Hits Report: 367626

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
06/15/2011

Analyzed		Analyte	Sample ID	Result	Federal MCL	Units	MRL
		201106150002	**WASH 5586 Plan Tek/Dawson Creek**				
06/21/2011	09:58	Agressiveness Index-Calculated		12		None	0.1
06/15/2011	22:09	Alkalinity in CaCO3 units		110		mg/L	2
06/20/2011	17:56	Ammonia Nitrogen		0.067		mg/L	0.05
06/23/2011	15:44	Anion Sum - Calculated		10		meq/L	0.001
06/17/2011	22:48	Arsenic Total ICAP/MS		4.9	10	ug/L	1
06/17/2011	22:48	Barium Total ICAP/MS		77	2000	ug/L	2
06/16/2011	12:10	Bicarb.Alkalinity as HCO3calc		130		mg/L	2
06/20/2011	18:57	Calcium Total ICAP		37		mg/L	1
06/21/2011	09:58	Cation Sum - Calculated		10		meq/L	0.001
06/21/2011	14:54	Chloride		280	250	mg/L	10
06/17/2011	22:48	Copper Total ICAP/MS		2.3	1300	ug/L	2
06/23/2011	14:48	Fluoride		0.63	4	mg/L	0.05
06/29/2011	19:22	Iron Dissolved ICAP		0.024		mg/L	0.02
06/20/2011	18:57	Iron Total ICAP		0.032	0.3	mg/L	0.02
06/21/2011	09:58	Langelier Index - 25 degree		0.27		None	
06/22/2011	01:01	Langelier Index at 60 degrees C		-0.15		None	
06/20/2011	18:57	Magnesium Total ICAP		13		mg/L	0.1
06/29/2011	19:22	Manganese Dissolved ICAP		0.065		mg/L	0.002
06/17/2011	22:48	Manganese Total ICAP/MS		61	50	ug/L	2
06/15/2011	10:53	Odor at 60 C (TON)		1.0	3	TON	1
06/15/2011	20:55	Orthophosphate as P		0.015		mg/L	0.01
06/15/2011	22:09	PH (H3=past HT not compliant)		8.0		Units	0.1
06/21/2011	09:58	pH of CaCO3 saturation(25C)		7.8		Units	0.1
06/21/2011	09:58	pH of CaCO3 saturation(60C)		7.3		Units	0.1
06/20/2011	18:57	Potassium Total ICAP		22		mg/L	1
06/15/2011	12:55	Radon 222		390		pCi/L	50
06/20/2011	18:57	Silica		54		mg/L	0.5
06/20/2011	18:57	Sodium Total ICAP		160		mg/L	1
06/15/2011	22:09	Specific Conductance, 25 C		1100		umho/cm	2
06/20/2011	18:57	Strontium ICAP		0.13		mg/L	0.01
06/15/2011	16:11	Sulfate		3.4	250	mg/L	2.5
06/20/2011	16:34	Total Dissolved Solids (TDS)		650	500	mg/L	10
06/21/2011	09:58	Total Hardness as CaCO3 by ICP (calc)		140		mg/L	3

SUMMARY OF POSITIVE DATA ONLY

MWH
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750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 367626

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
06/15/2011

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
WASH 5586 Plan Tek/Dawson Creek (201106150002)						**Sampled on 06/14/2011 1200**		
			SM 2330B - pH of CaCO3 saturation(60C)					
06/21/2011	09:58		(SM 2330B)	pH of CaCO3 saturation(60C)	7.3	Units	0.1	1
			SM 2330B - Langelier Index - 25 degree					
06/21/2011	09:58		(SM 2330B)	Langelier Index - 25 degree	0.27	None		1
			SM 1030E - Anion Sum - Calculated					
06/23/2011	15:44		(SM 1030E)	Anion Sum - Calculated	10	meq/L	0.001	1
			SM 1030E - Cation Sum - Calculated					
06/21/2011	09:58		(SM 1030E)	Cation Sum - Calculated	10	meq/L	0.001	1
			SM 2330B - pH of CaCO3 saturation(25C)					
06/21/2011	09:58		(SM 2330B)	pH of CaCO3 saturation(25C)	7.8	Units	0.1	1
			EPA 350.1 - Ammonia Nitrogen					
06/20/2011	17:56	606229	(EPA 350.1)	Ammonia Nitrogen	0.067	mg/L	0.05	1
			SM 2330 - Agressiveness Index-Calculated					
06/21/2011	09:58		(SM 2330)	Agressiveness Index-Calculated	12	None	0.1	1
			SM 2330B - Langlier Index at 60 degrees C					
06/22/2011	01:01		(SM 2330B)	Langelier Index at 60 degrees C	-0.15	None		1
			SM 1030E - Cation/Anion Difference					
06/22/2011	01:01		(SM 1030E)	Cation/Anion Difference	5.9	%		1
			EPA 200.8 - ICPMS Metals					
06/17/2011	22:48	605951	(EPA 200.8)	Aluminum Total ICAP/MS	ND	ug/L	20	1
06/17/2011	22:48	605951	(EPA 200.8)	Antimony Total ICAP/MS	ND	ug/L	1	1
06/17/2011	22:48	605951	(EPA 200.8)	Arsenic Total ICAP/MS	4.9	ug/L	1	1
06/17/2011	22:48	605951	(EPA 200.8)	Barium Total ICAP/MS	77	ug/L	2	1
06/17/2011	22:48	605951	(EPA 200.8)	Beryllium Total ICAP/MS	ND	ug/L	1	1
06/17/2011	22:48	605951	(EPA 200.8)	Cadmium Total ICAP/MS	ND	ug/L	0.5	1
06/17/2011	22:48	605951	(EPA 200.8)	Chromium Total ICAP/MS	ND	ug/L	1	1
06/17/2011	22:48	605951	(EPA 200.8)	Copper Total ICAP/MS	2.3	ug/L	2	1
06/17/2011	22:48	605951	(EPA 200.8)	Lead Total ICAP/MS	ND	ug/L	0.5	1
06/17/2011	22:48	605951	(EPA 200.8)	Manganese Total ICAP/MS	61	ug/L	2	1
06/17/2011	22:48	605951	(EPA 200.8)	Nickel Total ICAP/MS	ND	ug/L	5	1
06/17/2011	22:48	605951	(EPA 200.8)	Selenium Total ICAP/MS	ND	ug/L	5	1
06/25/2011	20:07	607180	(EPA 200.8)	Silver Total ICAP/MS	ND	ug/L	0.5	1
06/17/2011	22:48	605951	(EPA 200.8)	Thallium Total ICAP/MS	ND	ug/L	1	1

Rounding on totals after summation.
(c) - indicates calculated results

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Laboratory Data
Report: 367626

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
06/15/2011

Prepared	Analyzed		QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	06/17/2011	22:48	605951	(EPA 200.8)	Zinc Total ICAP/MS	ND	ug/L	20	1
			EPA 200.7 - ICP Metals						
	06/20/2011	18:57	606208	(EPA 200.7)	Calcium Total ICAP	37	mg/L	1	1
	06/29/2011	19:22	607677	(EPA 200.7)	Iron Dissolved ICAP	0.024	mg/L	0.02	1
	06/20/2011	18:57	606208	(EPA 200.7)	Iron Total ICAP	0.032	mg/L	0.02	1
	06/20/2011	18:57	606208	(EPA 200.7)	Magnesium Total ICAP	13	mg/L	0.1	1
	06/29/2011	19:22	607677	(EPA 200.7)	Manganese Dissolved ICAP	0.065	mg/L	0.002	1
	06/20/2011	18:57	606208	(EPA 200.7)	Potassium Total ICAP	22	mg/L	1	1
	06/20/2011	18:57	606208	(EPA 200.7)	Silica	54	mg/L	0.5	1
	06/20/2011	18:57	606208	(EPA 200.7)	Sodium Total ICAP	160	mg/L	1	1
	06/20/2011	18:57	606208	(EPA 200.7)	Strontium ICAP	0.13	mg/L	0.01	1
			EPA 245.1 - Mercury						
6/21/2011	06/23/2011	17:16	606372	(EPA 245.1)	Mercury	ND	ug/L	0.2	1
			SM 5310C - Dissolved Organic Carbon						
6/15/2011	06/21/2011	12:26	606259	(SM 5310C)	Dissolved Organic Carbon	ND	mg/L	0.3	1
			SM 5910 - Dissolved UV Abs. at 254 nm						
	06/15/2011	15:10	605432	(SM 5910)	Dissolved UV Abs. at 254 nm	ND	cm -1	0.009	1
			SM 4500-S2- H - Hydrogen Sulfide						
	07/07/2011	01:00		(SM 4500-S2- H)	Hydrogen Sulfide	NA	mg/L		1
			EPA 300.0 - Nitrate, Nitrite by EPA 300.0						
	06/15/2011	16:11	605447	(EPA 300.0)	Nitrate as Nitrogen by IC	ND	mg/L	0.25	5
	06/15/2011	16:11	605447	(EPA 300.0)	Nitrate as NO3 (calc)	ND	mg/L	1.1	5
	06/15/2011	16:11	605447	(EPA 300.0)	Nitrite Nitrogen by IC	ND (MD)	mg/L	0.25	5
	06/15/2011	16:11	605447	(EPA 300.0)	Total Nitrate, Nitrite-N, CALC	ND	mg/L	0.05	1
			EPA 300.0 - Chloride, Sulfate by EPA 300.0						
	06/21/2011	14:54	606371	(EPA 300.0)	Chloride	280	mg/L	10	10
	06/15/2011	16:11	605540	(EPA 300.0)	Sulfate	3.4	mg/L	2.5	5
			SM 7500RN - Radon 222						
	06/15/2011	12:55	605963	(SM 7500RN)	Radon 222	390	pCi/L	50	1
	06/15/2011	12:55	605963	(SM 7500RN)	Radon 222, Two Sigma Error	18	pCi/L		1
			SM2330B - Hydroxide as OH, Calculated						
	06/16/2011	12:10		(SM2330B)	Hydroxide as OH Calculated	ND	mg/L	2	1
			SM 2150B - Odor at 60 C (TON)						
	06/15/2011	10:53	605926	(SM 2150B)	Odor at 60 C (TON)	1.0	TON	1	1
			SM4500-CO2-D - Carbon Dioxide,Free(25C)-Calc.						

Rounding on totals after summation.
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Laboratory Data
Report: 367626

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
06/15/2011

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	06/16/2011 12:10		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	ND	mg/L	2	1
	SM5310C/E415.3 - Total Organic Carbon							
	06/21/2011 14:32	606367	(SM5310C/E415.3)	Total Organic Carbon	ND	mg/L	0.3	1
	SM 4500F-C - Fluoride							
	06/23/2011 14:48	606787	(SM 4500F-C)	Fluoride	0.63	mg/L	0.05	1
	SM2330B - Carbonate as CO3, Calculated							
	06/16/2011 12:10		(SM2330B)	Carbonate as CO3, Calculated	ND	mg/L	2	1
	SM 2340B - Total Hardness as CaCO3 by ICP							
	06/21/2011 09:58		(SM 2340B)	Total Hardness as CaCO3 by ICP (calc)	140	mg/L	3	1
	SM 2320B - Alkalinity in CaCO3 units							
	06/15/2011 22:09	605397	(SM 2320B)	Alkalinity in CaCO3 units	110	mg/L	2	1
	E160.1/SM2540C - Total Dissolved Solids (TDS)							
6/20/2011	06/20/2011 16:34	606197	(E160.1/SM2540C)	Total Dissolved Solids (TDS)	650	mg/L	10	1
	EPA 335.4 - Cyanide by manual distillation							
6/22/2011	06/22/2011 16:42	606920	(EPA 335.4)	Cyanide by manual distillation	ND	mg/L	0.005	1
	SM4500-HB - PH (H3=past HT not compliant)							
	06/15/2011 22:09	605395	(SM4500-HB)	PH (H3=past HT not compliant)	8.0	Units	0.1	1
	SM 2540D - Total Suspended Solids (TSS)							
	06/20/2011 12:36	605791	(SM 2540D)	Total Suspended Solids (TSS)	ND	mg/L	10	1
	SM2330B - Bicarb.Alkalinity as HCO3,calc							
	06/16/2011 12:10		(SM2330B)	Bicarb.Alkalinity as HCO3calc	130	mg/L	2	1
	SM2510B - Specific Conductance							
	06/15/2011 22:09	605396	(SM2510B)	Specific Conductance, 25 C	1100	umho/cm	2	1
	SM 2120B - Apparent Color							
	06/15/2011 16:08	605606	(SM 2120B)	Apparent Color	ND	ACU	3	1
	4500P-E/365.1 - Orthophosphate as P (OPO4)							
	06/15/2011 20:55	605588	(4500P-E/365.1)	Orthophosphate as P	0.015	mg/L	0.01	1

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QC Ref # 605395 - PH (H3=past HT not compliant) **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KXS

QC Ref # 605396 - Specific Conductance **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KXS

QC Ref # 605397 - Alkalinity in CaCO3 units **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KXS

QC Ref # 605432 - Dissolved UV Abs. at 254 nm **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KXS

QC Ref # 605447 - Nitrate, Nitrite by EPA 300.0 **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: SXK

QC Ref # 605540 - Chloride, Sulfate by EPA 300.0 **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KCR

QC Ref # 605588 - Orthophosphate as P (OPO4) **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: CYP

QC Ref # 605606 - Apparent Color **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: NEM

QC Ref # 605791 - Total Suspended Solids (TSS) **Analysis Date: 06/20/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: JRF

QC Ref # 605926 - Odor at 60 C (TON) **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: NEM

QC Ref # 605951 - ICPMS Metals **Analysis Date: 06/17/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: DYH

QC Ref # 605963 - Radon 222 **Analysis Date: 06/15/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: MAL

QC Ref # 606197 - Total Dissolved Solids (TDS) **Analysis Date: 06/20/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: JRF

QC Ref # 606208 - ICP Metals **Analysis Date: 06/20/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: NINA

QC Ref # 606229 - Ammonia Nitrogen **Analysis Date: 06/20/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: NJR

QC Ref # 606259 - Dissolved Organic Carbon **Analysis Date: 06/21/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KXS

QC Ref # 606367 - Total Organic Carbon **Analysis Date: 06/21/2011**
201106150002 WASH 5586 Plan Tek/Dawson Creek Analyzed by: KXS

QC Ref # 606371 - Chloride, Sulfate by EPA 300.0 **Analysis Date: 06/21/2011**

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(continued)

201106150002	WASH 5586 Plan Tek/Dawson Creek	Analyzed by: KCR

QC Ref # 606372 - Mercury **Analysis Date: 06/23/2011**

201106150002	WASH 5586 Plan Tek/Dawson Creek	Analyzed by: VXT

QC Ref # 606787 - Fluoride **Analysis Date: 06/23/2011**

201106150002	WASH 5586 Plan Tek/Dawson Creek	Analyzed by: MXT

QC Ref # 606920 - Cyanide by manual distillation **Analysis Date: 06/22/2011**

201106150002	WASH 5586 Plan Tek/Dawson Creek	Analyzed by: MCE

QC Ref # 607180 - ICPMS Metals **Analysis Date: 06/25/2011**

201106150002	WASH 5586 Plan Tek/Dawson Creek	Analyzed by: VXT

QC Ref # 607677 - ICP Metals **Analysis Date: 06/29/2011**

201106150002	WASH 5586 Plan Tek/Dawson Creek	Analyzed by: NINA

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 605395 - PH (H3=past HT not compliant) by SM4500-HB							**Analysis Date: 06/15/2011**		
DUP_201106140631	PH (H3=past HT not compliant)	7.8		7.85	Units		(0-20)	20	0.076
DUP2_201106140633	PH (H3=past HT not compliant)	7.9		7.85	Units		(0-20)	20	0.37
LCS1	PH (H3=past HT not compliant)		6.0	6.02	Units	100	(98-102)		
LCS2	PH (H3=past HT not compliant)		6.0	6.02	Units	100	(98-102)	20	0.0
QC Ref# 605396 - Specific Conductance by SM2510B							**Analysis Date: 06/15/2011**		
DUP1_201106140631	Specific Conductance	830		830	umho/cm		(0-20)	20	0.29
DUP2_201106140633	Specific Conductance	830		829	umho/cm		(0-20)	20	0.036
LCS1	Specific Conductance		1000	988	umho/cm	99	(95-105)		
LCS2	Specific Conductance		1000	985	umho/cm	99	(95-105)	20	0.30
MBLK	Specific Conductance			<2	umho/cm				
MRL_CHK	Specific Conductance		2.0	2.2	umho/cm	110	(50-150)		
QC Ref# 605397 - Alkalinity in CaCO3 units by SM 2320B							**Analysis Date: 06/15/2011**		
LCS1	Alkalinity in CaCO3 units		100	96.6	mg/L	97	(90-110)		
LCS2	Alkalinity in CaCO3 units		100	96.1	mg/L	96	(90-110)	20	0.52
MBLK	Alkalinity in CaCO3 units			<2	mg/L				
MRL_CHK	Alkalinity in CaCO3 units		2.0	2.19	mg/L	110	(50-150)		
MS_201106140631	Alkalinity in CaCO3 units		100	236	mg/L	**24**	(80-120)		
MS2_201106140633	Alkalinity in CaCO3 units		100	237	mg/L	**24**	(80-120)		
MSD_201106140631	Alkalinity in CaCO3 units		100	236	mg/L	**23**	(80-120)	20	3.0
MSD2_201106140633	Alkalinity in CaCO3 units		100	236	mg/L	**23**	(80-120)	20	3.9
QC Ref# 605432 - Dissolved UV Abs. at 254 nm by SM 5910							**Analysis Date: 06/15/2011**		
DUP1_201106150008	UV absorbance at 254 nm	0.0545		0.0550	cm -1		(0-15)	15	0.91
LCS1	UV absorbance at 254 nm		0.22	0.203	cm -1	91	(82-134)		
MBLK	UV absorbance at 254 nm			<0.004	cm -1				
MRL_CHK	UV absorbance at 254 nm		0.009	0.00800	cm -1	89	(85-115)		
QC Ref# 605447 - Nitrate, Nitrite by EPA 300.0 by EPA 300.0							**Analysis Date: 06/15/2011**		
LCS1	Nitrate as Nitrogen by IC		2.5	2.5	mg/L	100	(90-110)		
LCS2	Nitrate as Nitrogen by IC		2.5	2.5	mg/L	100	(90-110)	20	0.0
MBLK	Nitrate as Nitrogen by IC			<0.10	mg/L				
MRL_CHK	Nitrate as Nitrogen by IC		0.05	0.0505	mg/L	101	(50-150)		
MRLLW	Nitrate as Nitrogen by IC		0.013	0.0135	mg/L	108	(50-150)		
MS_201106150002	Nitrate as Nitrogen by IC	ND	1.3	6.57	mg/L	105	(80-120)		
MS_201106150449	Nitrate as Nitrogen by IC	ND	1.3	6.63	mg/L	106	(80-120)		
MSD_201106150002	Nitrate as Nitrogen by IC	ND	1.3	6.6	mg/L	106	(80-120)	20	0.95

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD_201106150449	Nitrate as Nitrogen by IC	ND	1.3	6.68	mg/L	107	(80-120)	20	0.94
LCS1	Nitrite Nitrogen by IC		1.0	0.916	mg/L	92	(90-110)		
LCS2	Nitrite Nitrogen by IC		1.0	0.917	mg/L	92	(90-110)	20	0.11
MBLK	Nitrite Nitrogen by IC			<0.10	mg/L				
MRL_CHK	Nitrite Nitrogen by IC		0.05	0.0457	mg/L	91	(50-150)		
MRLLW	Nitrite Nitrogen by IC		0.013	0.0129	mg/L	103	(50-150)		
MS_201106150002	Nitrite Nitrogen by IC	ND	0.5	1.9	mg/L	**76**	(80-120)		
MS_201106150449	Nitrite Nitrogen by IC	ND	0.5	2.09	mg/L	84	(80-120)		
MSD_201106150002	Nitrite Nitrogen by IC	ND	0.5	1.89	mg/L	**76**	(80-120)	20	0.92
MSD_201106150449	Nitrite Nitrogen by IC	ND	0.5	2.09	mg/L	84	(80-120)	20	0.0
QC Ref# 605540 - Chloride, Sulfate by EPA 300.0 by EPA 300.0							**Analysis Date: 06/15/2011**		
LCS1	Chloride		25	25.8	mg/L	103	(90-110)		
LCS2	Chloride		25	25.8	mg/L	103	(90-110)	20	0.0
MBLK	Chloride			<0.5	mg/L				
MRL_CHK	Chloride		0.5	0.443	mg/L	89	(50-150)		
MS_201106150449	Chloride	160	13	228	mg/L	106	(80-120)		
MSD_201106150449	Chloride	160	13	229	mg/L	107	(80-120)	20	0.94
LCS1	Sulfate		50	51.4	mg/L	103	(90-110)		
LCS2	Sulfate		50	51.4	mg/L	103	(90-110)	20	0.0
MBLK	Sulfate			<0.25	mg/L				
MRL_CHK	Sulfate		1.0	0.944	mg/L	94	(50-150)		
MRLLW	Sulfate		0.25	0.266	mg/L	106	(50-150)		
MS_201106150002	Sulfate	3.4	25	138	mg/L	108	(80-120)		
MS_201106150449	Sulfate	180	25	314	mg/L	111	(80-120)		
MSD_201106150002	Sulfate	3.4	25	139	mg/L	109	(80-120)	20	0.92
MSD_201106150449	Sulfate	180	25	316	mg/L	112	(80-120)	20	0.90
QC Ref# 605588 - Orthophosphate as P (OPO4) by 4500P-E/365.1							**Analysis Date: 06/15/2011**		
LCS1	Orthophosphate as P		0.25	0.256	mg/L	102	(90-110)		
LCS2	Orthophosphate as P		0.25	0.259	mg/L	104	(90-110)	20	1.2
MBLK	Orthophosphate as P			<0.01	mg/L				
MRL_CHK	Orthophosphate as P		0.01	0.0100	mg/L	100	(50-150)		
MS_201106150067	Orthophosphate as P	0.012	0.5	0.517	mg/L	101	(90-110)		
MS2_201106150060	Orthophosphate as P	0.39	0.5	0.898	mg/L	102	(90-110)		
MSD_201106150067	Orthophosphate as P	0.012	0.5	0.519	mg/L	101	(90-110)	20	0.0
QC Ref# 605606 - Apparent Color by SM 2120B							**Analysis Date: 06/15/2011**		

Spike recovery is already corrected for native results.
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(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
DUP_201106140394	Apparent Color	ND		ND	ACU		(0-20)		
DUP1_201106140537	Apparent Color	ND		ND	ACU		(0-20)		
MBLK	Apparent Color			<3	ACU				
QC Ref# 605791 - Total Suspended Solids (TSS) by SM 2540D							**Analysis Date: 06/20/2011**		
DUP_201106160127	Total Suspended Solids (TSS)	47		50.0	mg/L		(0-10)	10	6.2
LCS1	Total Suspended Solids (TSS)		175	154	mg/L	88	(71-107)		
LCS2	Total Suspended Solids (TSS)		175	162	mg/L	93	(71-107)	20	5.1
MBLK	Total Suspended Solids (TSS)			<10	mg/L				
MRL_CHK	Total Suspended Solids (TSS)		10	10.0	mg/L	100	(50-150)		
QC Ref# 605926 - Odor at 60 C (TON) by SM 2150B							**Analysis Date: 06/15/2011**		
DUP1_201106140457	Odor at 60 C (TON)	ND		ND	TON		(0-20)		
DUP2_201106140458	Odor at 60 C (TON)	ND		ND	TON		(0-20)		
MBLK	Odor at 60 C (TON)			<1	TON				
QC Ref# 605951 - ICPMS Metals by EPA 200.8							**Analysis Date: 06/17/2011**		
LCS1	Aluminum Total ICAP/MS		200	208	ug/L	104	(85-115)		
LCS2	Aluminum Total ICAP/MS		200	208	ug/L	104	(85-115)	20	0.0
MBLK	Aluminum Total ICAP/MS			<20	ug/L				
MRL_CHK	Aluminum Total ICAP/MS		20	20.8	ug/L	104	(50-150)		
MS_201106140179	Aluminum Total ICAP/MS	ND	200	190	ug/L	94	(70-130)		
MS2_201106150002	Aluminum Total ICAP/MS	ND	200	195	ug/L	97	(70-130)		
MSD_201106140179	Aluminum Total ICAP/MS	ND	200	194	ug/L	96	(70-130)	20	2.0
MSD2_201106150002	Aluminum Total ICAP/MS	ND	200	192	ug/L	95	(70-130)	20	1.3
LCS1	Antimony Total ICAP/MS		50	49.5	ug/L	99	(85-115)		
LCS2	Antimony Total ICAP/MS		50	49.9	ug/L	100	(85-115)	20	0.60
MBLK	Antimony Total ICAP/MS			<1	ug/L				
MRL_CHK	Antimony Total ICAP/MS		1.0	1.01	ug/L	101	(50-150)		
MS_201106140179	Antimony Total ICAP/MS	ND	50	45.6	ug/L	91	(70-130)		
MS2_201106150002	Antimony Total ICAP/MS	ND	50	46.5	ug/L	93	(70-130)		
MSD_201106140179	Antimony Total ICAP/MS	ND	50	46.6	ug/L	93	(70-130)	20	2.3
MSD2_201106150002	Antimony Total ICAP/MS	ND	50	45.8	ug/L	92	(70-130)	20	1.5
LCS1	Arsenic Total ICAP/MS		20	20.5	ug/L	103	(85-115)		
LCS2	Arsenic Total ICAP/MS		20	20.6	ug/L	103	(85-115)	20	0.49
MBLK	Arsenic Total ICAP/MS			<1	ug/L				
MRL_CHK	Arsenic Total ICAP/MS		1.0	1.09	ug/L	109	(50-150)		
MS_201106140179	Arsenic Total ICAP/MS	ND	20	20.4	ug/L	98	(70-130)		

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Laboratory
QC Report: 367626

City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MS2_201106150002	Arsenic Total ICAP/MS	4.9	20	25.6	ug/L	104	(70-130)		
MSD_201106140179	Arsenic Total ICAP/MS	ND	20	20.8	ug/L	99	(70-130)	20	1.7
MSD2_201106150002	Arsenic Total ICAP/MS	4.9	20	25.0	ug/L	101	(70-130)	20	2.9
LCS1	Barium Total ICAP/MS		100	99.6	ug/L	100	(85-115)		
LCS2	Barium Total ICAP/MS		100	99.8	ug/L	100	(85-115)	20	0.20
MBLK	Barium Total ICAP/MS			<2	ug/L				
MRL_CHK	Barium Total ICAP/MS		2.0	2.03	ug/L	102	(50-150)		
MS_201106140179	Barium Total ICAP/MS	51	100	140	ug/L	89	(70-130)		
MS2_201106150002	Barium Total ICAP/MS	77	100	171	ug/L	94	(70-130)		
MSD_201106140179	Barium Total ICAP/MS	51	100	143	ug/L	92	(70-130)	20	3.3
MSD2_201106150002	Barium Total ICAP/MS	77	100	168	ug/L	91	(70-130)	20	3.4
LCS1	Beryllium Total ICAP/MS		5.0	5.00	ug/L	100	(85-115)		
LCS2	Beryllium Total ICAP/MS		5.0	5.00	ug/L	100	(85-115)	20	0.0
MBLK	Beryllium Total ICAP/MS			<1	ug/L				
MRL_CHK	Beryllium Total ICAP/MS		1.0	1.02	ug/L	102	(50-150)		
MS_201106140179	Beryllium Total ICAP/MS	ND	5.0	4.88	ug/L	98	(70-130)		
MS2_201106150002	Beryllium Total ICAP/MS	ND	5.0	6.11	ug/L	122	(70-130)		
MSD_201106140179	Beryllium Total ICAP/MS	ND	5.0	4.96	ug/L	99	(70-130)	20	1.7
MSD2_201106150002	Beryllium Total ICAP/MS	ND	5.0	5.98	ug/L	120	(70-130)	20	1.6
LCS1	Cadmium Total ICAP/MS		20	20.8	ug/L	104	(85-115)		
LCS2	Cadmium Total ICAP/MS		20	20.6	ug/L	103	(85-115)	20	0.97
MBLK	Cadmium Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Cadmium Total ICAP/MS		0.5	0.518	ug/L	104	(50-150)		
MS_201106140179	Cadmium Total ICAP/MS	ND	20	18.6	ug/L	93	(70-130)		
MS2_201106150002	Cadmium Total ICAP/MS	ND	20	19.0	ug/L	95	(70-130)		
MSD_201106140179	Cadmium Total ICAP/MS	ND	20	19.0	ug/L	95	(70-130)	20	2.2
MSD2_201106150002	Cadmium Total ICAP/MS	ND	20	18.4	ug/L	92	(70-130)	20	3.3
LCS1	Chromium Total ICAP/MS		100	106	ug/L	106	(85-115)		
LCS2	Chromium Total ICAP/MS		100	106	ug/L	106	(85-115)	20	0.0
MBLK	Chromium Total ICAP/MS			<1	ug/L				
MRL_CHK	Chromium Total ICAP/MS		1.0	1.06	ug/L	106	(50-150)		
MS_201106140179	Chromium Total ICAP/MS	ND	100	96.9	ug/L	96	(70-130)		
MS2_201106150002	Chromium Total ICAP/MS	ND	100	98.1	ug/L	98	(70-130)		
MSD_201106140179	Chromium Total ICAP/MS	ND	100	98.2	ug/L	98	(70-130)	20	1.3
MSD2_201106150002	Chromium Total ICAP/MS	ND	100	96.5	ug/L	96	(70-130)	20	1.6
LCS1	Cobalt Total ICAP/MS		100	104	ug/L	104	(85-115)		
LCS2	Cobalt Total ICAP/MS		100	104	ug/L	104	(85-115)	20	0.0

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Cobalt Total ICAP/MS			<2	ug/L				
MRL_CHK	Cobalt Total ICAP/MS		2.0	2.04	ug/L	102	(50-150)		
MS_201106140179	Cobalt Total ICAP/MS	ND	100	91.1	ug/L	91	(70-130)		
MS2_201106150002	Cobalt Total ICAP/MS	ND	100	94.0	ug/L	94	(70-130)		
MSD_201106140179	Cobalt Total ICAP/MS	ND	100	93.3	ug/L	93	(70-130)	20	2.3
MSD2_201106150002	Cobalt Total ICAP/MS	ND	100	92.9	ug/L	93	(70-130)	20	1.2
LCS1	Copper Total ICAP/MS		100	99.3	ug/L	99	(85-115)		
LCS2	Copper Total ICAP/MS		100	99.5	ug/L	100	(85-115)	20	0.20
MBLK	Copper Total ICAP/MS			<2	ug/L				
MRL_CHK	Copper Total ICAP/MS		2.0	2.03	ug/L	102	(50-150)		
MS_201106140179	Copper Total ICAP/MS	12	100	97.1	ug/L	85	(70-130)		
MS2_201106150002	Copper Total ICAP/MS	2.3	100	89.9	ug/L	88	(70-130)		
MSD_201106140179	Copper Total ICAP/MS	12	100	98.5	ug/L	87	(70-130)	20	1.6
MSD2_201106150002	Copper Total ICAP/MS	2.3	100	89.4	ug/L	87	(70-130)	20	0.57
LCS1	Lead Total ICAP/MS		20	20.2	ug/L	101	(85-115)		
LCS2	Lead Total ICAP/MS		20	20.4	ug/L	102	(85-115)	20	0.99
MBLK	Lead Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Lead Total ICAP/MS		0.5	0.510	ug/L	102	(50-150)		
MS_201106140179	Lead Total ICAP/MS	2.6	20	20.5	ug/L	89	(70-130)		
MS2_201106150002	Lead Total ICAP/MS	ND	20	18.4	ug/L	89	(70-130)		
MSD_201106140179	Lead Total ICAP/MS	2.6	20	20.7	ug/L	91	(70-130)	20	1.3
MSD2_201106150002	Lead Total ICAP/MS	ND	20	18.1	ug/L	88	(70-130)	20	1.8
LCS1	Manganese Total ICAP/MS		50	53.5	ug/L	107	(85-115)		
LCS2	Manganese Total ICAP/MS		50	54.0	ug/L	108	(85-115)	20	0.93
MBLK	Manganese Total ICAP/MS			<2	ug/L				
MRL_CHK	Manganese Total ICAP/MS		2.0	2.15	ug/L	107	(50-150)		
MS_201106140179	Manganese Total ICAP/MS	7.3	50	56.2	ug/L	98	(70-130)		
MS2_201106150002	Manganese Total ICAP/MS	61	50	109	ug/L	95	(70-130)		
MSD_201106140179	Manganese Total ICAP/MS	7.3	50	56.9	ug/L	99	(70-130)	20	1.4
MSD2_201106150002	Manganese Total ICAP/MS	61	50	108	ug/L	93	(70-130)	20	2.1
LCS1	Molybdenum Total ICAP/MS		100	98.0	ug/L	98	(85-115)		
LCS2	Molybdenum Total ICAP/MS		100	98.6	ug/L	99	(85-115)	20	0.61
MBLK	Molybdenum Total ICAP/MS			<2	ug/L				
MRL_CHK	Molybdenum Total ICAP/MS		2.0	2.06	ug/L	103	(50-150)		
MS_201106140179	Molybdenum Total ICAP/MS	ND	100	89.0	ug/L	87	(70-130)		
MS2_201106150002	Molybdenum Total ICAP/MS	4.5	100	95.0	ug/L	91	(70-130)		
MSD_201106140179	Molybdenum Total ICAP/MS	ND	100	91.5	ug/L	90	(70-130)	20	2.9

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD2_201106150002	Molybdenum Total ICAP/MS	4.5	100	94.7	ug/L	90	(70-130)	20	0.33
LCS1	Nickel Total ICAP/MS		50	49.6	ug/L	99	(85-115)		
LCS2	Nickel Total ICAP/MS		50	49.7	ug/L	99	(85-115)	20	0.20
MBLK	Nickel Total ICAP/MS			<5	ug/L				
MRL_CHK	Nickel Total ICAP/MS		5.0	5.04	ug/L	101	(50-150)		
MS_201106140179	Nickel Total ICAP/MS	ND	50	44.0	ug/L	85	(70-130)		
MS2_201106150002	Nickel Total ICAP/MS	ND	50	44.3	ug/L	87	(70-130)		
MSD_201106140179	Nickel Total ICAP/MS	ND	50	44.8	ug/L	87	(70-130)	20	1.9
MSD2_201106150002	Nickel Total ICAP/MS	ND	50	43.7	ug/L	86	(70-130)	20	1.5
LCS1	Selenium Low Level ICAP/MS		20	20.8	ug/L	104	(85-115)		
LCS2	Selenium Low Level ICAP/MS		20	20.6	ug/L	103	(85-115)	20	0.97
MBLK	Selenium Low Level ICAP/MS			<2	ug/L				
MRL_CHK	Selenium Low Level ICAP/MS		2.0	2.22	ug/L	111	(50-150)		
MS_201106140179	Selenium Low Level ICAP/MS	ND	20	21.1	ug/L	101	(70-130)		
MS2_201106150002	Selenium Low Level ICAP/MS	ND	20	22.0	ug/L	103	(70-130)		
MSD_201106140179	Selenium Low Level ICAP/MS	ND	20	21.6	ug/L	103	(70-130)	20	2.0
MSD2_201106150002	Selenium Low Level ICAP/MS	ND	20	21.8	ug/L	101	(70-130)	20	2.0
LCS1	Selenium Total ICAP/MS		20	20.8	ug/L	104	(85-115)		
LCS2	Selenium Total ICAP/MS		20	20.6	ug/L	103	(85-115)	20	0.97
MBLK	Selenium Total ICAP/MS			<5	ug/L				
MRL_CHK	Selenium Total ICAP/MS		5.0	5.19	ug/L	104	(50-150)		
MS_201106140179	Selenium Total ICAP/MS	ND	20	21.1	ug/L	101	(70-130)		
MS2_201106150002	Selenium Total ICAP/MS	ND	20	22.0	ug/L	103	(70-130)		
MSD_201106140179	Selenium Total ICAP/MS	ND	20	21.6	ug/L	103	(70-130)	20	2.0
MSD2_201106150002	Selenium Total ICAP/MS	ND	20	21.8	ug/L	101	(70-130)	20	2.0
MBLK	Silver Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Silver Total ICAP/MS		0.5	0.498	ug/L	100	(50-150)		
MS_201106140179	Silver Total ICAP/MS		50	42.2	ug/L	84	(70-130)		
MS2_201106150002	Silver Total ICAP/MS		50	36.4	ug/L	73	(70-130)		
MSD_201106140179	Silver Total ICAP/MS		50	42.2	ug/L	85	(70-130)	20	0.12
MSD2_201106150002	Silver Total ICAP/MS		50	35.8	ug/L	72	(70-130)	20	1.8
LCS1	Thallium Total ICAP/MS		20	20.5	ug/L	103	(85-115)		
LCS2	Thallium Total ICAP/MS		20	20.7	ug/L	104	(85-115)	20	0.97
MBLK	Thallium Total ICAP/MS			<1	ug/L				
MRL_CHK	Thallium Total ICAP/MS		1.0	1.08	ug/L	108	(50-150)		
MS_201106140179	Thallium Total ICAP/MS	ND	20	18.5	ug/L	92	(70-130)		
MS2_201106150002	Thallium Total ICAP/MS	ND	20	18.3	ug/L	91	(70-130)		

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD_201106140179	Thallium Total ICAP/MS	ND	20	18.7	ug/L	93	(70-130)	20	0.97
MSD2_201106150002	Thallium Total ICAP/MS	ND	20	18.0	ug/L	90	(70-130)	20	1.6
LCS1	Uranium ICAP/MS		20	21.4	ug/L	107	(85-115)		
LCS2	Uranium ICAP/MS		20	21.6	ug/L	108	(85-115)	20	0.93
MBLK	Uranium ICAP/MS			<1	ug/L				
MRL_CHK	Uranium ICAP/MS		1.0	0.949	ug/L	95	(50-150)		
MS_201106140179	Uranium ICAP/MS	1.5	20	21.8	ug/L	101	(70-130)		
MS2_201106150002	Uranium ICAP/MS	ND	20	20.8	ug/L	103	(70-130)		
MSD_201106140179	Uranium ICAP/MS	1.5	20	22.0	ug/L	103	(70-130)	20	2.0
MSD2_201106150002	Uranium ICAP/MS	ND	20	19.3	ug/L	96	(70-130)	20	7.2
LCS1	Vanadium Total ICAP/MS		100	105	ug/L	105	(85-115)		
LCS2	Vanadium Total ICAP/MS		100	105	ug/L	105	(85-115)	20	0.0
MBLK	Vanadium Total ICAP/MS			<3	ug/L				
MRL_CHK	Vanadium Total ICAP/MS		3.0	3.15	ug/L	105	(50-150)		
MS_201106140179	Vanadium Total ICAP/MS	ND	100	97.9	ug/L	97	(70-130)		
MS2_201106150002	Vanadium Total ICAP/MS	9.5	100	111	ug/L	101	(70-130)		
MSD_201106140179	Vanadium Total ICAP/MS	ND	100	99.8	ug/L	99	(70-130)	20	1.9
MSD2_201106150002	Vanadium Total ICAP/MS	9.5	100	109	ug/L	100	(70-130)	20	1.3
LCS1	Zinc Total ICAP/MS		100	104	ug/L	104	(85-115)		
LCS2	Zinc Total ICAP/MS		100	105	ug/L	105	(85-115)	20	0.96
MBLK	Zinc Total ICAP/MS			<20	ug/L				
MRL_CHK	Zinc Total ICAP/MS		20	20.7	ug/L	103	(50-150)		
MS_201106140179	Zinc Total ICAP/MS	44	100	139	ug/L	95	(70-130)		
MS2_201106150002	Zinc Total ICAP/MS	ND	100	102	ug/L	95	(70-130)		
MSD_201106140179	Zinc Total ICAP/MS	44	100	141	ug/L	97	(70-130)	20	2.1
MSD2_201106150002	Zinc Total ICAP/MS	ND	100	102	ug/L	95	(70-130)	20	0.53
QC Ref# 605963 - Radon 222 by SM 7500RN							**Analysis Date: 06/15/2011**		
DUP_201106150089	Radon 222	2900		2880	pCi/L		(0-20)	20	1.1
LCS1	Radon 222		200	218	pCi/L	109	(80-120)		
LCS2	Radon 222		200	220	pCi/L	110	(80-120)	20	0.91
MBLK	Radon 222			<50	pCi/L				
QC Ref# 606197 - Total Dissolved Solids (TDS) by E160.1/SM2540C							**Analysis Date: 06/20/2011**		
DUP_201106140629	Total Dissolved Solid (TDS)	500		512	mg/L		(0-20)	20	2.0
DUP_201106150002	Total Dissolved Solid (TDS)	650		652	mg/L		(0-20)	20	0.92
LCS1	Total Dissolved Solid (TDS)		175	176	mg/L	101	(80-114)		

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(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS2	Total Dissolved Solid (TDS)		700	714	mg/L	102	(80-114)		
MBLK	Total Dissolved Solid (TDS)			<10	mg/L				
MRL_CHK	Total Dissolved Solid (TDS)		10	9.00	mg/L	90	(50-150)		
QC Ref# 606208 - ICP Metals by EPA 200.7						**Analysis Date: 06/20/2011**			
LCS1	Calcium Total ICAP		50	51.4	mg/L	103	(85-115)		
LCS2	Calcium Total ICAP		50	51.3	mg/L	103	(85-115)	20	0.20
MBLK	Calcium Total ICAP			<1	mg/L				
MRL_CHK	Calcium Total ICAP		1.0	1.05	mg/L	105	(50-150)		
MS_201106160471	Calcium Total ICAP	29	50	78.7	mg/L	100	(70-130)		
MS2_201106150263	Calcium Total ICAP	49	50	95.2	mg/L	92	(70-130)		
MSD_201106160471	Calcium Total ICAP	29	50	75.1	mg/L	92	(70-130)	20	7.5
MSD2_201106150263	Calcium Total ICAP	49	50	93.8	mg/L	89	(70-130)	20	3.1
LCS1	Iron Total ICAP		5.0	5.23	mg/L	105	(85-115)		
LCS2	Iron Total ICAP		5.0	5.22	mg/L	104	(85-115)	20	0.19
MBLK	Iron Total ICAP			<0.02	mg/L				
MRL_CHK	Iron Total ICAP		0.02	0.0231	mg/L	116	(50-150)		
MS_201106160471	Iron Total ICAP	ND	5.0	5.15	mg/L	103	(70-130)		
MS2_201106150263	Iron Total ICAP	ND	5.0	5.09	mg/L	102	(70-130)		
MSD_201106160471	Iron Total ICAP	ND	5.0	4.87	mg/L	97	(70-130)	20	5.6
MSD2_201106150263	Iron Total ICAP	ND	5.0	5.06	mg/L	101	(70-130)	20	0.99
LCS1	Magnesium Total ICAP		20	21.2	mg/L	106	(85-115)		
LCS2	Magnesium Total ICAP		20	21.1	mg/L	105	(85-115)	20	0.47
MBLK	Magnesium Total ICAP			<0.1	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.119	mg/L	119	(50-150)		
MS_201106160471	Magnesium Total ICAP	9.3	20	29.9	mg/L	103	(70-130)		
MS2_201106150263	Magnesium Total ICAP	20	20	39.4	mg/L	96	(70-130)		
MSD_201106160471	Magnesium Total ICAP	9.3	20	28.3	mg/L	95	(70-130)	20	8.0
MSD2_201106150263	Magnesium Total ICAP	20	20	38.9	mg/L	94	(70-130)	20	2.5
LCS1	Potassium Total ICAP		20	20.0	mg/L	100	(85-115)		
LCS2	Potassium Total ICAP		20	19.9	mg/L	100	(85-115)	20	0.50
MBLK	Potassium Total ICAP			<1	mg/L				
MRL_CHK	Potassium Total ICAP		1.0	1.1	mg/L	110	(50-150)		
MS_201106160471	Potassium Total ICAP	1.6	20	21.5	mg/L	99	(70-130)		
MS2_201106150263	Potassium Total ICAP	4.0	20	23.4	mg/L	97	(70-130)		
MSD_201106160471	Potassium Total ICAP	1.6	20	20.5	mg/L	94	(70-130)	20	5.2
MSD2_201106150263	Potassium Total ICAP	4.0	20	23.3	mg/L	97	(70-130)	20	0.72

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RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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Laboratory
QC Report: 367626

City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Silica		21	23.3	mg/L	109	(85-115)		
LCS2	Silica		21	23.3	mg/L	109	(85-115)	20	0.0
MBLK	Silica			<0.5	mg/L				
MRL_CHK	Silica		0.42	0.476	mg/L	113	(50-150)		
MS_201106160471	Silica	18	21	40.3	mg/L	105	(70-130)		
MS2_201106150263	Silica	9.8	21	32.3	mg/L	105	(70-130)		
MSD_201106160471	Silica	18	21	40.1	mg/L	104	(70-130)	20	0.96
MSD2_201106150263	Silica	9.8	21	32.0	mg/L	104	(70-130)	20	0.96
LCS1	Sodium Total ICAP		50	50.2	mg/L	100	(85-115)		
LCS2	Sodium Total ICAP		50	50.0	mg/L	100	(85-115)	20	0.40
MBLK	Sodium Total ICAP			<1	mg/L				
MRL_CHK	Sodium Total ICAP		1.0	1.09	mg/L	109	(50-150)		
MS_201106160471	Sodium Total ICAP	48	50	95.1	mg/L	95	(70-130)		
MS2_201106150263	Sodium Total ICAP	76	50	119	mg/L	86	(70-130)		
MSD_201106160471	Sodium Total ICAP	48	50	90.8	mg/L	86	(70-130)	20	9.4
MSD2_201106150263	Sodium Total ICAP	76	50	118	mg/L	83	(70-130)	20	3.1
LCS1	Strontium ICAP		1.0	1.02	mg/L	102	(85-115)		
LCS2	Strontium ICAP		1.0	1.02	mg/L	102	(85-115)	20	0.0
MBLK	Strontium ICAP			<0.01	mg/L				
MRL_CHK	Strontium ICAP		0.01	0.00970	mg/L	97	(50-150)		
MS_201106160471	Strontium ICAP	0.30	1.0	1.31	mg/L	101	(70-130)		
MS2_201106150263	Strontium ICAP	0.66	1.0	1.61	mg/L	96	(70-130)		
MSD_201106160471	Strontium ICAP	0.30	1.0	1.24	mg/L	94	(70-130)	20	7.1
MSD2_201106150263	Strontium ICAP	0.66	1.0	1.58	mg/L	93	(70-130)	20	3.2
QC Ref# 606229 - Ammonia Nitrogen by EPA 350.1							**Analysis Date: 06/13/2011**		
LCS1	Ammonia Nitrogen		1.0	1.04	mg/L	104	(90-110)		
LCS2	Ammonia Nitrogen		1.0	1.05	mg/L	105	(90-110)	20	0.96
MBLK	Ammonia Nitrogen			<0.05	mg/L				
MRL_CHK	Ammonia Nitrogen		0.05	0.0431	mg/L	86	(50-150)		
MS_201106150095	Ammonia Nitrogen	0.13	1.0	1.14	mg/L	101	(90-110)		
MS2_201106130368	Ammonia Nitrogen	ND	1.0	0.941	mg/L	94	(90-110)		
MSD_201106150095	Ammonia Nitrogen	0.13	1.0	1.12	mg/L	99	(90-110)	20	2.4
QC Ref# 606259 - Dissolved Organic Carbon by SM 5310C							**Analysis Date: 06/21/2011**		
LCS1	Dissolved Organic Carbon		5.0	4.74	mg/L	95	(90-110)		
LCS2	Dissolved Organic Carbon		5.0	4.86	mg/L	97	(90-110)	20	2.5

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Dissolved Organic Carbon			<0.3	mg/L				
MRL_CHK	Dissolved Organic Carbon		0.2	0.223	mg/L	111	(50-150)		
MS_201106220065	Dissolved Organic Carbon	2.4	4.0	6.18	mg/L	96	(80-120)		
MSD_201106220065	Dissolved Organic Carbon	2.4	4.0	6.29	mg/L	98	(80-120)	20	2.8
QC Ref# 606367 - Total Organic Carbon by SM5310C/E415.3							**Analysis Date: 06/21/2011**		
LCS1	Total Organic Carbon		5.0	4.74	mg/L	95	(80-120)		
LCS2	Total Organic Carbon		5.0	4.86	mg/L	97	(80-120)	20	2.5
MBLK	Total Organic Carbon			<0.3	mg/L				
MRL_CHK	Total Organic Carbon		0.2	0.223	mg/L	111	(50-150)		
MS_201106150296	Total Organic Carbon	2.4	4.0	6.18	mg/L	96	(80-120)		
MS2_201106180026	Total Organic Carbon	3.3	2.0	5.33	mg/L	102	(80-120)		
MSD_201106150296	Total Organic Carbon	2.4	4.0	6.29	mg/L	98	(80-120)	20	2.8
QC Ref# 606371 - Chloride, Sulfate by EPA 300.0 by EPA 300.0							**Analysis Date: 06/21/2011**		
LCS1	Chloride		25	25.1	mg/L	100	(90-110)		
LCS2	Chloride		25	25.0	mg/L	100	(90-110)	20	0.40
MBLK	Chloride			<0.5	mg/L				
MRL_CHK	Chloride		0.5	0.427	mg/L	85	(50-150)		
MS_201106210001	Chloride	3.7	13	17.3	mg/L	109	(80-120)		
MS_201106210175	Chloride	20	13	34.2	mg/L	112	(80-120)		
MSD_201106210001	Chloride	3.7	13	16.9	mg/L	106	(80-120)	20	2.8
MSD_201106210175	Chloride	20	13	34.4	mg/L	113	(80-120)	20	0.89
LCS1	Sulfate		50	49.7	mg/L	99	(90-110)		
LCS2	Sulfate		50	49.5	mg/L	99	(90-110)	20	0.40
MBLK	Sulfate			<0.25	mg/L				
MRL_CHK	Sulfate		1.0	0.941	mg/L	94	(50-150)		
MRLLW	Sulfate		0.25	0.264	mg/L	105	(50-150)		
MS_201106210001	Sulfate	12	25	37.8	mg/L	105	(80-120)		
MS_201106210175	Sulfate	77	25	104	mg/L	108	(80-120)		
MSD_201106210001	Sulfate	12	25	37.1	mg/L	102	(80-120)	20	2.9
MSD_201106210175	Sulfate	77	25	104	mg/L	110	(80-120)	20	1.8
QC Ref# 606372 - Mercury by EPA 245.1							**Analysis Date: 06/21/2011**		
LCS1	Mercury		1.5	1.31	ug/L	87	(85-115)		
LCS2	Mercury		1.5	1.45	ug/L	97	(85-115)	20	10
MBLK	Mercury			<0.2	ug/L				
MRL_CHK	Mercury		0.2	0.161	ug/L	81	(50-150)		

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MS_201106180129	Mercury	ND	1.5	1.53	ug/L	101	(70-130)		
MS2_201106180039	Mercury	ND	1.5	1.64	ug/L	109	(70-130)		
MSD_201106180129	Mercury	ND	1.5	1.47	ug/L	97	(70-130)	20	3.9
MSD2_201106180039	Mercury	ND	1.5	1.62	ug/L	108	(70-130)	20	0.92
QC Ref# 606787 - Fluoride by SM 4500F-C							**Analysis Date: 06/23/2011**		
LCS1	Fluoride		1.0	0.992	mg/L	99	(81-116)		
LCS2	Fluoride		1.0	0.973	mg/L	97	(81-116)	20	1.9
MBLK	Fluoride			<0.05	mg/L				
MRL_CHK	Fluoride		0.05	0.0510	mg/L	102	(50-150)		
MS_201106080235	Fluoride	ND	1.0	1.01	mg/L	100	(73-124)		
MS_201106100354	Fluoride	ND	1.0	1.07	mg/L	104	(73-124)		
MSD_201106100354	Fluoride	ND	1.0	1.06	mg/L	104	(73-124)	20	0.0
QC Ref# 606920 - Cyanide by manual distillation by EPA 335.4							**Analysis Date: 06/22/2011**		
LCS1	Cyanide by manual distillation		0.1	0.109	mg/L	109	(90-110)		
LCS2	Cyanide by manual distillation		0.1	0.103	mg/L	103	(90-110)	20	5.7
MBLK	Cyanide by manual distillation			-0.0000	mg/L				
MRL_CHK	Cyanide by manual distillation		0.005	0.00640	mg/L	128	(50-150)		
MS_201106150002	Cyanide by manual distillation	ND	0.1	0.0972	mg/L	96	(90-110)		
MS_201106210376	Cyanide by manual distillation	ND	0.1	0.0810	mg/L	**79**	(90-110)		
MSD_201106150002	Cyanide by manual distillation	ND	0.1	0.0963	mg/L	95	(90-110)	20	0.94
RLHIGH	Cyanide by manual distillation		0.1	0.0984	mg/L	98	(90-110)		
RLLOW	Cyanide by manual distillation		0.02	0.0212	mg/L	106	(90-110)		
QC Ref# 607180 - ICPMS Metals by EPA 200.8							**Analysis Date: 06/25/2011**		
LCS1	Silver Total ICAP/MS		25	23.3	ug/L	93	(85-115)		
LCS2	Silver Total ICAP/MS		25	23.5	ug/L	94	(85-115)	20	0.86
MBLK	Silver Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Silver Total ICAP/MS		0.5	0.551	ug/L	110	(50-150)		
MS_201106210001	Silver Total ICAP/MS	ND	50	48.4	ug/L	97	(70-130)		
MS2_201106210002	Silver Total ICAP/MS	ND	50	46.3	ug/L	93	(70-130)		
MSD_201106210001	Silver Total ICAP/MS	ND	50	48.7	ug/L	97	(70-130)	20	0.52
MSD2_201106210002	Silver Total ICAP/MS	ND	50	47.6	ug/L	95	(70-130)	20	2.8
QC Ref# 607677 - ICP Metals by EPA 200.7							**Analysis Date: 06/29/2011**		
LCS1	Calcium Total ICAP		50	47.5	mg/L	95	(85-115)		
LCS2	Calcium Total ICAP		50	48.7	mg/L	97	(85-115)	20	2.5

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Calcium Total ICAP			<1	mg/L				
MRL_CHK	Calcium Total ICAP		1.0	0.976	mg/L	98	(50-150)		
MS_201106220055	Calcium Total ICAP	4.3	50	56.8	mg/L	105	(70-130)		
MS2_201106220488	Calcium Total ICAP	5.7	50	56.5	mg/L	102	(70-130)		
MSD_201106220055	Calcium Total ICAP	4.3	50	54.2	mg/L	100	(70-130)	20	5.2
MSD2_201106220488	Calcium Total ICAP	5.7	50	51.7	mg/L	92	(70-130)	20	10
LCS1	Iron Dissolved ICAP		5.0	4.61	mg/L	92	(85-115)		
LCS2	Iron Dissolved ICAP		5.0	4.84	mg/L	97	(85-115)	20	4.9
MBLK	Iron Dissolved ICAP			<0.02	mg/L				
MRL_CHK	Iron Dissolved ICAP		0.02	0.0197	mg/L	99	(50-150)		
MS_201106220055	Iron Dissolved ICAP	ND	5.0	5.19	mg/L	104	(70-130)		
MS2_201106220488	Iron Dissolved ICAP	ND	5.0	5.11	mg/L	102	(70-130)		
MSD_201106220055	Iron Dissolved ICAP	ND	5.0	5.01	mg/L	100	(70-130)	20	3.9
MSD2_201106220488	Iron Dissolved ICAP	ND	5.0	4.62	mg/L	92	(70-130)	20	10
LCS1	Iron Total ICAP		5.0	4.61	mg/L	92	(85-115)		
LCS2	Iron Total ICAP		5.0	4.84	mg/L	97	(85-115)	20	4.9
MBLK	Iron Total ICAP			<0.02	mg/L				
MRL_CHK	Iron Total ICAP		0.02	0.0197	mg/L	99	(50-150)		
MS_201106220055	Iron Total ICAP	ND	5.0	5.19	mg/L	104	(70-130)		
MS2_201106220488	Iron Total ICAP	ND	5.0	5.11	mg/L	102	(70-130)		
MSD_201106220055	Iron Total ICAP	ND	5.0	5.01	mg/L	100	(70-130)	20	3.9
MSD2_201106220488	Iron Total ICAP	ND	5.0	4.62	mg/L	92	(70-130)	20	10
LCS1	Magnesium Total ICAP		20	18.6	mg/L	93	(85-115)		
LCS2	Magnesium Total ICAP		20	19.6	mg/L	98	(85-115)	20	5.2
MBLK	Magnesium Total ICAP			<0.1	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.101	mg/L	101	(50-150)		
MS_201106220055	Magnesium Total ICAP	1.5	20	22.6	mg/L	106	(70-130)		
MS2_201106220488	Magnesium Total ICAP	1.9	20	22.6	mg/L	103	(70-130)		
MSD_201106220055	Magnesium Total ICAP	1.5	20	21.7	mg/L	101	(70-130)	20	4.8
MSD2_201106220488	Magnesium Total ICAP	1.9	20	20.4	mg/L	92	(70-130)	20	11
LCS1	Manganese Dissolved ICAP		0.5	0.486	mg/L	97	(85-115)		
LCS2	Manganese Dissolved ICAP		0.5	0.502	mg/L	100	(85-115)	20	3.2
MBLK	Manganese Dissolved ICAP			<0.002	mg/L				
MRL_CHK	Manganese Dissolved ICAP		0.002	0.00216	mg/L	108	(50-150)		
MS_201106220055	Manganese Dissolved ICAP	ND	0.5	0.536	mg/L	107	(70-130)		
MS2_201106220488	Manganese Dissolved ICAP	ND	0.5	0.525	mg/L	105	(70-130)		
MSD_201106220055	Manganese Dissolved ICAP	ND	0.5	0.510	mg/L	102	(70-130)	20	4.8

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD2_201106220488	Manganese Dissolved ICAP	ND	0.5	0.480	mg/L	96	(70-130)	20	9.1
LCS1	Potassium Total ICAP		20	18.0	mg/L	90	(85-115)		
LCS2	Potassium Total ICAP		20	19.0	mg/L	95	(85-115)	20	5.4
MBLK	Potassium Total ICAP			<1	mg/L				
MRL_CHK	Potassium Total ICAP		1.0	0.969	mg/L	97	(50-150)		
MS_201106220055	Potassium Total ICAP	ND	20	20.9	mg/L	100	(70-130)		
MS2_201106220488	Potassium Total ICAP	1.8	20	21.4	mg/L	98	(70-130)		
MSD_201106220055	Potassium Total ICAP	ND	20	20.3	mg/L	98	(70-130)	20	2.4
MSD2_201106220488	Potassium Total ICAP	1.8	20	19.7	mg/L	90	(70-130)	20	9.3
LCS1	Silica		21	20.4	mg/L	95	(85-115)		
LCS2	Silica		21	21.1	mg/L	99	(85-115)	20	3.4
MBLK	Silica			<0.5	mg/L				
MRL_CHK	Silica		0.42	0.392	mg/L	93	(50-150)		
MS_201106220055	Silica	19	21	43.2	mg/L	113	(70-130)		
MS2_201106220488	Silica	8.9	21	31.1	mg/L	104	(70-130)		
MSD_201106220055	Silica	19	21	40.7	mg/L	101	(70-130)	20	11
MSD2_201106220488	Silica	8.9	21	28.3	mg/L	91	(70-130)	20	13
LCS1	Sodium Total ICAP		50	44.0	mg/L	88	(85-115)		
LCS2	Sodium Total ICAP		50	46.3	mg/L	93	(85-115)	20	5.1
MBLK	Sodium Total ICAP			<1	mg/L				
MRL_CHK	Sodium Total ICAP		1.0	0.991	mg/L	99	(50-150)		
MS_201106220055	Sodium Total ICAP	3.6	50	53.1	mg/L	99	(70-130)		
MS2_201106220488	Sodium Total ICAP		50	61.1	mg/L	96	(70-130)		
MSD_201106220055	Sodium Total ICAP	3.6	50	50.9	mg/L	95	(70-130)	20	4.7
MSD2_201106220488	Sodium Total ICAP		50	56.1	mg/L	86	(70-130)	20	11
LCS1	Strontium ICAP		1.0	0.911	mg/L	91	(85-115)		
LCS2	Strontium ICAP		1.0	0.945	mg/L	95	(85-115)	20	3.7
MBLK	Strontium ICAP			<0.01	mg/L				
MRL_CHK	Strontium ICAP		0.01	0.00884	mg/L	88	(50-150)		
MS_201106220055	Strontium ICAP	0.046	1.0	1.05	mg/L	100	(70-130)		
MSD_201106220055	Strontium ICAP	0.046	1.0	1.01	mg/L	96	(70-130)	20	3.7

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Laboratory Report

for

City of Hillsboro
390 W Main Street
Hillsboro, OR 97123
Attention: Jessica Dorsey
Fax:

Date of Issue
08/26/2011
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ACCREDITED IN ACCORDANCE WITH nelac 01114CA

Report#: 372522
Project: GROUNDWATER
Group: Groundwater 2011

RSR: Rita Reeves

Project Manager

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Hits Reports, Comments, QC Summary, QC Report and Regulatory Forms. This report shall not be reproduced except in full, without the written approval of the laboratory.

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Alaska	CA00006	**Montana**	Cert 0035
Arizona	AZ0455	**Nevada**	CA00006-2010-1
Arkansas	Certified	**New Hampshire**	2959-11
California – NELAP	01114CA	**New Jersey**	CA 008
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Georgia	947	**Pennsylvania**	68-565
Guam	11-004r	**Rhode Island**	01114CA
Hawaii	Certified	**South Carolina**	87016001
Idaho	Certified	**South Dakota**	Certified
Illinois	200033	**Tennessee**	TN02839
Indiana	C-CA-01	**Texas**	T104704230-11-2
Kansas	E-10268	**Utah**	Mont-1
Kentucky	90107	**Vermont**	VT0114
Louisiana	LA110022	**Virginia**	00210
Maine	CA0006	**Washington**	C383
Maryland	224	**West Virginia**	9943 C
Commonwealth of Northern Marianas Is.	MP0004	**Wisconsin**	998316660
Massachusetts	M-CA006	**Wyoming**	8TMS-L
Michigan	9906	**EPA Region 5**	Certified

750 Royal Oaks Dr., Ste 100, Monrovia, CA 91016 Tel (626) 386-1100 Fax (626) 386-1101 http://MWHLabs.com

MWH LABORATORIES

Acknowledgement of Samples Received

City of Hillsboro
390 W Main Street
Hillsboro, OR 97123
Attn: Jessica Dorsey
Phone: 503-615-6579

Customer Code: HILLSBORO-OR
Folder #: 372522
Project: GROUNDWATER
Sample Group: Groundwater 2011
Project Manager: Rita Reeves
Phone: 916-418-8358

The following samples were received from you on **August 05, 2011**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using MWH Laboratories.

Sample #	Sample ID	Sample Date
201108050372	Best Mix Concrete	Aug 04, 2011 10:45

@ANIONS28	@ANIONS48	@ICP
@ICPMS	Agressiveness Index-Calculated	Alkalinity in CaCO3 units
Anion Sum - Calculated	Bicarb.Alkalinity as HCO3,calc	Carbon Dioxide,Free(25C)-Calc.
Carbonate as CO3, Calculated	Cation Sum - Calculated	Cation/Anion Difference
Fluoride	Hydroxide as OH, Calculated	Langelier Index - 25 degree
Langlier Index at 60 degrees C	Mercury	PH (H3=past HT not compliant)
pH of CaCO3 saturation(25C)	pH of CaCO3 saturation(60C)	Specific Conductance
Total Dissolved Solid (TDS)	Total Hardness as CaCO3 by ICP	Apparent Color
Odor at 60 C (TON)	@RN	Ammonia Nitrogen
Cyanide by manual distillation	Dissolved Organic Carbon	Hydrogen Sulfide
Iron Dissolved ICAP	Manganese Dissolved ICAP	Orthophosphate as P (OPO4)
Silica	Strontium ICAP	Sulfide,Total
Total Organic Carbon	Total Suspended Solids (TSS)	UV absorbance at 254 nm

Test Description

@ANIONS28 -- Chloride, Sulfate by EPA 300.0
@ANIONS48 -- Nitrate, Nitrite by EPA 300.0
@ICP -- ICP Metals
@ICPMS -- ICPMS Metals
@RN -- Radon 222

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CHAIN OF CUSTODY RECORD

372522

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

MWH LABS USE ONLY:

LOGIN COMMENTS: _____

SAMPLES CHECKED AGAINST COC BY: JS

SAMPLES LOGGED IN BY: JM

SAMPLES REC'D DAY OF COLLECTION? ☐ (check for yes)

SAMPLE TEMP RECEIVED AT:

☐ Colton / Sacramento / Scottsdale _____ °c (Compliance: 4 ± 2 °C)

☑ Monrovia 5 °c (Compliance: 4 ± 2 °C)

CONDITION OF BLUE ICE: FROZEN ✓ PARTIALLY FROZEN ___ THAWED ___ WET ICE _____ NO ICE _____

METHOD OF SHIPMENT: Pick-Up / Walk-In / FedEx / UPS / DHL / Area Fast / Top Line / Other: _____

TO BE COMPLETED BY SAMPLER:

COMPANY/AGENCY NAME: City of Hillsboro

PROJECT CODE:

MWH LABS CLIENT CODE: Hillsboro-OR

COC ID:

SAMPLE GROUP: Ground Water

SAMPLER PRINTED NAME AND SIGNATURE: Jessica Dorsey JR

TAT requested: rush by adv notice only

STD X 1 wk ___ 3 day __ 2 day___ 1 day __

(check for yes) *(check for yes)*

COMPLIANCE SAMPLES - Requires state forms ☐

NON-COMPLIANCE SAMPLES ☑ REGULATION INVOLVED: _____ (eg. SDWA, Phase V, NPDES, FDA,...)

Type of samples (circle one): ROUTINE SPECIAL CONFIRMATION

SEE ATTACHED BOTTLE ORDER FOR ANALYSES ☐ (check for yes), *OR*

list ANALYSES REQUIRED (enter number of bottles sent for each test for each sample)

SAMPLE DATE	SAMPLE TIME	SAMPLE ID	CLIENT LAB ID	MATRIX *	Field Data	Field Data	DO, VX254	pH	Ammonia 28 and ORSAM	Alkalinity	Fluoride	Nitrate, E2	Fe-DIS	MN-DIS	Cyanide	Ammonia Nitrogen	ICP @ICPMS	Mercury @ICPMS	Silica Strontium ICAP	Sulfide Total			SAMPLER COMMENTS
8/4/11	4/30	Best Mix Concrete		RGW	21.38	3.68	1	1	←	1	→				1	1	←	1	→	→	1			See analysis list w/RPDs Reeves
																							DO = 0.17 mg/L
																							pH (Plas) = 8.3 ORP (Plas) = 158

* **MATRIX TYPES:** RSW = Raw Surface Water; RGW = Raw Ground Water; CFW = Chlor(am)inated Finished Water; FW = Other Finished Water; SEAW = Sea Water; WW = Waste Water; BW = Bottled Water; SW = Storm Water; SO = Soil; SL = Sludge; O = Other - Please Identify

	SIGNATURE	PRINT NAME	COMPANY/TITLE	DATE	TIME
RELINQUISHED BY:					
RECEIVED BY:		Joe Sanchez	MWH	8/5/11	0942
RELINQUISHED BY:					
RECEIVED BY:					

PAGE ____ OF ____

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Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

CHAIN OF CUSTODY RECORD

372522

MWH LABS USE ONLY:

LOGIN COMMENTS: _____

SAMPLES CHECKED AGAINST COC BY: JS

SAMPLES LOGGED IN BY: JM

SAMPLE TEMP WHEN REC'D AT LAB: 5 (Compliance: 4 +/- 2*C)

SAMPLES REC'D DAY OF COLLECTION? ☐ (check for yes)

CONDITION OF BLUE ICE: FROZEN ✓ PARTIALLY FROZEN ___ THAWED ___

TO BE COMPLETED BY SAMPLER:

COMPANY/AGENCY NAME: City of Hillsboro

PROJECT CODE:

COMPLIANCE SAMPLES (check for yes) ☐
- Requires state forms ☐

NON-COMPLIANCE SAMPLES (check for yes) ☒
REGULATION INVOLVED: _____ (eg. SDWA, Phase V, NPDES, FDA,...)

Type of samples (circle one): ROUTINE SPECIAL CONFIRMATION

MWH LABS CLIENT CODE: Hillsboro-OR

COC ID:

SAMPLE GROUP: Ground water

SEE ATTACHED BOTTLE ORDER FOR ANALYSES ☐ (check for yes), OR

list ANALYSES REQUIRED (enter number of bottles sent for each test for each sample)

SAMPLER PRINTED NAME AND SIGNATURE: Jessica Dorsey

TAT requested: rush by adv notice only

STD X 1 wk ___ 3 day ___ 2 day ___ 1 day ___

SAMPLE DATE	SAMPLE TIME	SAMPLE ID	CLIENT LAB ID	MATRIX *	Field Data T°	Field Data Cond	TDS, TSS	Apparent Color, Odor, pH	TOC	@RN										SAMPLER COMMENTS
8-4-11	10:45	Best Mix Concrete		RGW	21.38	3603	1	1	1	2										See analysis request w/ Rita Reeves
		5/30																		

* MATRIX TYPES: RSW = Raw Surface Water; RGW = Raw Ground Water; CFW = Chlor(am)inated Finished Water; FW = Other Finished Water; SEAW = Sea Water; WW = Waste Water; BW = Bottled Water; SW = Storm Water; SO = Soil; SL = Sludge; O = Other - Please Identify

	SIGNATURE	PRINT NAME	COMPANY/TITLE	DATE	TIME
RELINQUISHED BY:	Jessica Dorsey		City of Hillsboro	8-4-11	
RECEIVED BY:		Joe Sanchez	MWH	8-5-11	0939
RELINQUISHED BY:					
RECEIVED BY:					

C-O-C# _____

PAGE ____ OF ____

FedEx Express **NEW Package US Airbill**

FedEx Tracking Number **8757 1032 0537**

0200 Form ID No.

12 x 12 x 12
2 x 5 x 12

FedEx Retrieval Copy

1 From

Date 4 11 — Sender's FedEx Account Number

Sender's Name [illegible] — Phone [illegible]

Company [illegible]

Address [illegible] Main St — Dept./Floor/Suite/Room

City [illegible] — State [illegible] — ZIP [illegible]

2 Your Internal Billing Reference [illegible]

3 To

Recipient's Name [illegible] — Phone [illegible]

Company [illegible]

Address [illegible] — Dept./Floor/Suite/Room
We cannot deliver to P.O. boxes or P.O. ZIP codes.

Address
Use this line for the HOLD location address or for continuation of your shipping address.

City [illegible] — State [illegible] — ZIP [illegible]

01 ☐ HOLD Weekday — FedEx location address REQUIRED. NOT available for FedEx First Overnight.

31 ☐ HOLD Saturday — FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

4 Express Package Service *To most locations.
NOTE: Service order has changed. Please select carefully.

Packages up to 150 lbs. For packages over 150 lbs., use the new FedEx Express Freight US Airbill.

Next Business Day

06 ☐ FedEx First Overnight — Earliest next business morning delivery to select locations. Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

01 ☒ FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

05 ☐ FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.

2 or 3 Business Days

49 ☐ NEW FedEx 2Day A.M. — Second business morning.* Saturday Delivery NOT available.

03 ☐ FedEx 2Day — Second business afternoon.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

20 ☐ FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

5 Packaging *Declared value limit $500.

06 ☐ FedEx Envelope* 02 ☐ FedEx Pak* 03 ☐ FedEx Box 04 ☐ FedEx Tube 01 ☒ Other

6 Special Handling and Delivery Signature Options

03 ☐ **SATURDAY DELIVERY**

☒ No Signature Required — Package may be left without obtaining a signature for delivery.

10 ☐ Direct Signature — Someone at recipient's address may sign for delivery. *Fee applies.*

34 ☐ Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. *Fee applies.*

Does this shipment contain dangerous goods?
One box must be checked.

☒ No — 04 ☐ Yes As per attached Shipper's Declaration — ☐ Yes Shipper's Declaration not required — 06 ☐ Dry Ice Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

☐ Cargo Aircraft Only

7 Payment *Bill to:*

Enter FedEx Acct. No. or Credit Card No. below. — Obtain recip. Acct. No. ☐

1 ☐ Sender Acct. No. in Section 1 will be billed. — 2 ☒ Recipient — 3 ☐ Third Party — 4 ☐ Credit Card — 5 ☐ Cash/Check

[redacted]

Total Packages 1 — Total Weight 12 lbs. — [redacted] — Credit Card Auth.

†Our liability is limited to $100 unless you declare a higher value. See the current FedEx Service Guide for details.

612

fedex.com 1.800.GoFedEx 1.800.463.3339

MWH
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750 Royal Oaks Drive Suite 100
Monrovia, CA 91016 (626) 386-1100 FAX (626) 386-1124

Kit Order for City of Hillsboro

Rita Reeves is Your MWH Labs Project Manager

Sampler: please return this paper with your samples

Kit #: 36645
Created By: SRY
Order Date: 07/13/2011
STG: Bottle Orders

Client Code: HILLSBORO-OR
Project Code: GROUNDWATER Bottle Orders
Group Name: Hydrogen Sulfide
PO#/JOB#:

Ship By:
07/03/2011

Ship Sample Kits to
City of Hillsboro
Water Operations
390 W Main St.
Hillsboro, OR 97123

Attn: Jessica Dorsey - shipping
Phone:
Fax:

Send Report to
City of Hillsboro
390 W Main Street
Hillsboro, OR 97123

Attn: Jessica Dorsey
Phone: 503-615-6579
Fax:

Billing Address
City of Hillsboro
150 E Main Street
3rd Floor
Hillsboro, OR 97123

Attn: Jessica Dorsey - Billing
Phone: 503-615-6579
Fax: 503-735-5357

# of Samples	Tests	Bottles - Qty for each sample, type & preservative if any	UN DOT #
2	PH (H3=past HT not compliant)	1 125ml poly no preservative	
2	Sulfide Total	1 250 ml poly 10drop NAOH(30%)+5drops ZnAce	

Comments

7/30

Code	Status	Date Shipped	Via	Tracking #	# of Coolers	Prepared By

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Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Comments
Report: #372522

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Flags Legend:

D1 - Sample required dilution due to matrix.

H3 - Sample was received and analyzed past holding time. Data not acceptable for regulatory compliance.

The Comments Report may be blank if there are no comments for this report.

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Laboratory
Hits Report: 372522

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
08/05/2011

Analyzed		Analyte	Sample ID	Result	Federal MCL	Units	MRL
		201108050372	**Best Mix Concrete**				
08/10/2011	11:55	Agressiveness Index-Calculated		12		None	0.1
08/09/2011	16:52	Alkalinity in CaCO3 units		45		mg/L	2
08/08/2011	19:10	Ammonia Nitrogen		1.6		mg/L	0.1
08/10/2011	13:32	Anion Sum - Calculated		34		meq/L	0.001
08/05/2011	16:31	Apparent Color		10	15	ACU	3
08/17/2011	00:08	Arsenic Total ICAP/MS		8.1	10	ug/L	1
08/17/2011	00:08	Barium Total ICAP/MS		460	2000	ug/L	2
08/10/2011	11:55	Bicarb.Alkalinity as HCO3calc		55		mg/L	2
08/08/2011	22:55	Calcium Total ICAP		230		mg/L	1
08/10/2011	11:55	Carbon Dioxide,Free(25C)-Calc.		2.2		mg/L	2
08/09/2011	09:45	Cation Sum - Calculated		32		meq/L	0.001
08/05/2011	13:17	Chloride		1200	250	mg/L	25
08/17/2011	00:08	Copper Total ICAP/MS		17	1300	ug/L	2
08/11/2011	20:10	Dissolved Organic Carbon		0.34		mg/L	0.3
08/09/2011	14:46	Fluoride		0.45	4	mg/L	0.05
08/08/2011	22:55	Iron Total ICAP		1.1	0.3	mg/L	0.02
08/10/2011	11:55	Langelier Index - 25 degree		0.29		None	
08/10/2011	11:55	Langelier Index at 60 degrees C		0.73		None	
08/17/2011	00:08	Lead Total ICAP/MS		2.7	15	ug/L	0.5
08/08/2011	22:55	Magnesium Total ICAP		28		mg/L	0.1
08/12/2011	21:29	Manganese Dissolved ICAP		0.22		mg/L	0.002
08/17/2011	00:08	Manganese Total ICAP/MS		210	50	ug/L	2
08/09/2011	16:52	PH (H3=past HT not compliant)		7.6		Units	0.1
08/09/2011	09:45	pH of CaCO3 saturation(25C)		7.3		Units	0.1
08/10/2011	11:55	pH of CaCO3 saturation(60C)		6.9		Units	0.1
08/08/2011	22:55	Potassium Total ICAP		51		mg/L	1
08/05/2011	13:54	Radon 222		430		pCi/L	50
08/08/2011	22:55	Silica		54		mg/L	0.5
08/17/2011	16:55	Sodium Total ICAP		370		mg/L	5
08/09/2011	16:52	Specific Conductance, 25 C		3600		umho/cm	2
08/08/2011	22:55	Strontium ICAP		0.78		mg/L	0.01
08/10/2011	21:29	Total Dissolved Solids (TDS)		2600	500	mg/L	10
08/09/2011	09:45	Total Hardness as CaCO3 by ICP (calc)		700		mg/L	3
08/11/2011	20:35	Total Organic Carbon		0.30		mg/L	0.3

SUMMARY OF POSITIVE DATA ONLY

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Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
Hits Report: 372522

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
08/05/2011

Analyzed	Analyte	Sample ID	Result	Federal MCL	Units	MRL
08/17/2011 00:08	Zinc Total ICAP/MS		180	5000	ug/L	20

SUMMARY OF POSITIVE DATA ONLY

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1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 372522

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
08/05/2011

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
Best Mix Concrete (201108050372)						**Sampled on 08/04/2011 1045**		
	SM 2330B - pH of CaCO3 saturation(60C)							
08/10/2011	11:55		(SM 2330B)	pH of CaCO3 saturation(60C)	6.9	Units	0.1	1
	SM 2330B - Langelier Index - 25 degree							
08/10/2011	11:55		(SM 2330B)	Langelier Index - 25 degree	0.29	None		1
	SM 1030E - Anion Sum - Calculated							
08/10/2011	13:32		(SM 1030E)	Anion Sum - Calculated	34	meq/L	0.001	1
	SM 1030E - Cation Sum - Calculated							
08/09/2011	09:45		(SM 1030E)	Cation Sum - Calculated	32	meq/L	0.001	1
	SM 2330B - pH of CaCO3 saturation(25C)							
08/09/2011	09:45		(SM 2330B)	pH of CaCO3 saturation(25C)	7.3	Units	0.1	1
	EPA 350.1 - Ammonia Nitrogen							
08/08/2011	19:10	613093	(EPA 350.1)	Ammonia Nitrogen	1.6	mg/L	0.1	2
	SM 2330 - Agressiveness Index-Calculated							
08/10/2011	11:55		(SM 2330)	Agressiveness Index-Calculated	12	None	0.1	1
	SM 2330B - Langlier Index at 60 degrees C							
08/10/2011	11:55		(SM 2330B)	Langelier Index at 60 degrees C	0.73	None		1
	SM 1030E - Cation/Anion Difference							
08/10/2011	01:04		(SM 1030E)	Cation/Anion Difference	5.9	%		1
	EPA 200.8 - ICPMS Metals							
08/17/2011	00:08	614229	(EPA 200.8)	Aluminum Total ICAP/MS	ND	ug/L	20	1
08/17/2011	00:08	614229	(EPA 200.8)	Antimony Total ICAP/MS	ND	ug/L	1	1
08/17/2011	00:08	614229	(EPA 200.8)	Arsenic Total ICAP/MS	8.1	ug/L	1	1
08/17/2011	00:08	614229	(EPA 200.8)	Barium Total ICAP/MS	460	ug/L	2	1
08/17/2011	21:56	614643	(EPA 200.8)	Beryllium Total ICAP/MS	ND	ug/L	1	1
08/17/2011	00:08	614229	(EPA 200.8)	Cadmium Total ICAP/MS	ND	ug/L	0.5	1
08/24/2011	22:11	615784	(EPA 200.8)	Chromium Total ICAP/MS	ND (D1)	ug/L	5	5
08/17/2011	00:08	614229	(EPA 200.8)	Copper Total ICAP/MS	17	ug/L	2	1
08/17/2011	00:08	614229	(EPA 200.8)	Lead Total ICAP/MS	2.7	ug/L	0.5	1
08/17/2011	00:08	614229	(EPA 200.8)	Manganese Total ICAP/MS	210	ug/L	2	1
08/17/2011	00:08	614229	(EPA 200.8)	Nickel Total ICAP/MS	ND	ug/L	5	1
08/17/2011	00:08	614229	(EPA 200.8)	Selenium Total ICAP/MS	ND	ug/L	5	1
08/19/2011	14:11	614868	(EPA 200.8)	Silver Total ICAP/MS	ND	ug/L	0.5	1
08/17/2011	00:08	614229	(EPA 200.8)	Thallium Total ICAP/MS	ND	ug/L	1	1

Rounding on totals after summation.
(c) - indicates calculated results

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1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 372522

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
08/05/2011

Prepared	Analyzed		QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	08/17/2011	00:08	614229	(EPA 200.8)	Zinc Total ICAP/MS	180	ug/L	20	1
			EPA 200.7 - ICP Metals						
	08/08/2011	22:55	613055	(EPA 200.7)	Calcium Total ICAP	230	mg/L	1	1
	08/12/2011	21:29	613971	(EPA 200.7)	Iron Dissolved ICAP	ND	mg/L	0.02	1
	08/08/2011	22:55	613055	(EPA 200.7)	Iron Total ICAP	1.1	mg/L	0.02	1
	08/08/2011	22:55	613055	(EPA 200.7)	Magnesium Total ICAP	28	mg/L	0.1	1
	08/12/2011	21:29	613971	(EPA 200.7)	Manganese Dissolved ICAP	0.22	mg/L	0.002	1
	08/08/2011	22:55	613055	(EPA 200.7)	Potassium Total ICAP	51	mg/L	1	1
	08/08/2011	22:55	613055	(EPA 200.7)	Silica	54	mg/L	0.5	1
	08/17/2011	16:55	614591	(EPA 200.7)	Sodium Total ICAP	370	mg/L	5	5
	08/08/2011	22:55	613055	(EPA 200.7)	Strontium ICAP	0.78	mg/L	0.01	1
			EPA 245.1 - Mercury						
8/8/2011	08/09/2011	17:53	613256	(EPA 245.1)	Mercury	ND	ug/L	0.2	1
			SM 5310C - Dissolved Organic Carbon						
8/5/2011	08/11/2011	20:10	613533	(SM 5310C)	Dissolved Organic Carbon	0.34	mg/L	0.3	1
			SM 5910 - Dissolved UV Abs. at 254 nm						
	08/05/2011	15:50	612749	(SM 5910)	Dissolved UV Abs. at 254 nm	ND	cm -1	0.009	1
			SM 4500-S2- H - Hydrogen Sulfide						
	08/12/2011	11:59		(SM 4500-S2- H)	Hydrogen Sulfide	ND	mg/L		1
			EPA 300.0 - Nitrate, Nitrite by EPA 300.0						
	08/05/2011	13:17	613300	(EPA 300.0)	Nitrate as Nitrogen by IC	ND	mg/L	0.33	25
	08/05/2011	13:17	613300	(EPA 300.0)	Nitrate as NO3 (calc)	ND	mg/L	1.4	25
	08/05/2011	13:17	613300	(EPA 300.0)	Nitrite Nitrogen by IC	ND	mg/L	0.33	25
	08/05/2011	13:17	613300	(EPA 300.0)	Total Nitrate, Nitrite-N, CALC	ND	mg/L	0.1	1
			EPA 300.0 - Chloride, Sulfate by EPA 300.0						
	08/05/2011	13:17	613366	(EPA 300.0)	Chloride	1200	mg/L	25	25
	08/12/2011	14:25	614143	(EPA 300.0)	Sulfate	ND	mg/L	0.5	2
			SM 7500RN - Radon 222						
	08/05/2011	13:54	612952	(SM 7500RN)	Radon 222	430	pCi/L	50	1
	08/05/2011	13:54	612952	(SM 7500RN)	Radon 222, Two Sigma Error	17	pCi/L		1
			SM2330B - Hydroxide as OH, Calculated						
	08/10/2011	11:55		(SM2330B)	Hydroxide as OH Calculated	ND	mg/L	2	1
			SM 2150B - Odor at 60 C (TON)						
	08/05/2011	10:34	612899	(SM 2150B)	Odor at 60 C (TON)	ND	TON	1	1
			SM4500-CO2-D - Carbon Dioxide,Free(25C)-Calc.						

Rounding on totals after summation.
(c) - indicates calculated results

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Laboratory Data
Report: 372522

City of Hillsboro
Jessica Dorsey
390 W Main Street
Hillsboro, OR 97123

Samples Received on:
08/05/2011

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	08/10/2011 11:55		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	2.2	mg/L	2	1
	SM5310C/E415.3 - Total Organic Carbon							
	08/11/2011 20:35	613517	(SM5310C/E415.3)	Total Organic Carbon	0.30	mg/L	0.3	1
	SM4500SD/376.2 - Sulfide,Total							
	08/11/2011 15:49	613818	(SM4500SD/376.2)	Sulfide,Total	ND	mg/L	0.05	1
	SM 4500F-C - Fluoride							
	08/09/2011 14:46	613123	(SM 4500F-C)	Fluoride	0.45	mg/L	0.05	1
	SM2330B - Carbonate as CO3, Calculated							
	08/10/2011 11:55		(SM2330B)	Carbonate as CO3, Calculated	ND	mg/L	2	1
	SM 2340B - Total Hardness as CaCO3 by ICP							
	08/09/2011 09:45		(SM 2340B)	Total Hardness as CaCO3 by ICP (calc)	700	mg/L	3	1
	SM 2320B - Alkalinity in CaCO3 units							
	08/09/2011 16:52	613287	(SM 2320B)	Alkalinity in CaCO3 units	45	mg/L	2	1
	E160.1/SM2540C - Total Dissolved Solids (TDS)							
8/10/2011	08/10/2011 21:29	613507	(E160.1/SM2540C)	Total Dissolved Solids (TDS)	2600	mg/L	10	1
	EPA 335.4 - Cyanide by manual distillation							
8/17/2011	08/17/2011 04:57	614436	(EPA 335.4)	Cyanide by manual distillation	ND	mg/L	0.005	1
	SM4500-HB - PH (H3=past HT not compliant)							
	08/09/2011 16:52	613291	(SM4500-HB)	PH (H3=past HT not compliant)	7.6	Units	0.1	1
	SM 2540D - Total Suspended Solids (TSS)							
	08/10/2011 12:59	613383	(SM 2540D)	Total Suspended Solids (TSS)	ND	mg/L	10	1
	SM2330B - Bicarb.Alkalinity as HCO3,calc							
	08/10/2011 11:55		(SM2330B)	Bicarb.Alkalinity as HCO3calc	55	mg/L	2	1
	SM2510B - Specific Conductance							
	08/09/2011 16:52	613359	(SM2510B)	Specific Conductance, 25 C	3600	umho/cm	2	1
	SM 2120B - Apparent Color							
	08/05/2011 16:31	612896	(SM 2120B)	Apparent Color	10	ACU	3	1
	4500P-E/365.1 - Orthophosphate as P (OPO4)							
	08/09/2011 19:18	613423	(4500P-E/365.1)	Orthophosphate as P	ND (H3)	mg/L	0.01	1

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QC Ref # 612749 - Dissolved UV Abs. at 254 nm **Analysis Date: 08/05/2011**
201108050372 Best Mix Concrete Analyzed by: MYH

QC Ref # 612896 - Apparent Color **Analysis Date: 08/05/2011**
201108050372 Best Mix Concrete Analyzed by: ADV

QC Ref # 612899 - Odor at 60 C (TON) **Analysis Date: 08/05/2011**
201108050372 Best Mix Concrete Analyzed by: ADV

QC Ref # 612952 - Radon 222 **Analysis Date: 08/05/2011**
201108050372 Best Mix Concrete Analyzed by: MAL

QC Ref # 613055 - ICP Metals **Analysis Date: 08/08/2011**
201108050372 Best Mix Concrete Analyzed by: NINA

QC Ref # 613093 - Ammonia Nitrogen **Analysis Date: 08/08/2011**
201108050372 Best Mix Concrete Analyzed by: NJR

QC Ref # 613123 - Fluoride **Analysis Date: 08/09/2011**
201108050372 Best Mix Concrete Analyzed by: YXP

QC Ref # 613256 - Mercury **Analysis Date: 08/09/2011**
201108050372 Best Mix Concrete Analyzed by: MXT

QC Ref # 613287 - Alkalinity in CaCO3 units **Analysis Date: 08/09/2011**
201108050372 Best Mix Concrete Analyzed by: CYP

QC Ref # 613291 - PH (H3=past HT not compliant) **Analysis Date: 08/09/2011**
201108050372 Best Mix Concrete Analyzed by: CYP

QC Ref # 613300 - Nitrate, Nitrite by EPA 300.0 **Analysis Date: 08/05/2011**
201108050372 Best Mix Concrete Analyzed by: SXK

QC Ref # 613359 - Specific Conductance **Analysis Date: 08/09/2011**
201108050372 Best Mix Concrete Analyzed by: CYP

QC Ref # 613366 - Chloride, Sulfate by EPA 300.0 **Analysis Date: 08/05/2011**
201108050372 Best Mix Concrete Analyzed by: SXK

QC Ref # 613383 - Total Suspended Solids (TSS) **Analysis Date: 08/10/2011**
201108050372 Best Mix Concrete Analyzed by: JRF

QC Ref # 613423 - Orthophosphate as P (OPO4) **Analysis Date: 08/09/2011**
201108050372 Best Mix Concrete Analyzed by: QMK

QC Ref # 613507 - Total Dissolved Solids (TDS) **Analysis Date: 08/10/2011**
201108050372 Best Mix Concrete Analyzed by: JRF

QC Ref # 613517 - Total Organic Carbon **Analysis Date: 08/11/2011**
201108050372 Best Mix Concrete Analyzed by: KXS

QC Ref # 613533 - Dissolved Organic Carbon **Analysis Date: 08/11/2011**

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201108050372	Best Mix Concrete	Analyzed by: KXS
QC Ref # 613818 - Sulfide,Total		**Analysis Date: 08/11/2011**
201108050372	Best Mix Concrete	Analyzed by: QMK
QC Ref # 613971 - ICP Metals		**Analysis Date: 08/12/2011**
201108050372	Best Mix Concrete	Analyzed by: VXT
QC Ref # 614143 - Chloride, Sulfate by EPA 300.0		**Analysis Date: 08/12/2011**
201108050372	Best Mix Concrete	Analyzed by: SXK
QC Ref # 614229 - ICPMS Metals		**Analysis Date: 08/17/2011**
201108050372	Best Mix Concrete	Analyzed by: DYH
QC Ref # 614436 - Cyanide by manual distillation		**Analysis Date: 08/17/2011**
201108050372	Best Mix Concrete	Analyzed by: MCE
QC Ref # 614591 - ICP Metals		**Analysis Date: 08/17/2011**
201108050372	Best Mix Concrete	Analyzed by: NINA
QC Ref # 614643 - ICPMS Metals		**Analysis Date: 08/17/2011**
201108050372	Best Mix Concrete	Analyzed by: DYH
QC Ref # 614868 - ICPMS Metals		**Analysis Date: 08/19/2011**
201108050372	Best Mix Concrete	Analyzed by: VXT
QC Ref # 615784 - ICPMS Metals		**Analysis Date: 08/24/2011**
201108050372	Best Mix Concrete	Analyzed by: DYH

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 612749 - Dissolved UV Abs. at 254 nm by SM 5910							**Analysis Date: 08/05/2011**		
DUP1_201108050372	UV absorbance at 254 nm	ND		0.00850	cm -1		(0-15)	15	6.1
LCS1	UV absorbance at 254 nm		0.22	0.203	cm -1	91	(82-134)		
MBLK	UV absorbance at 254 nm			<0.004	cm -1				
MRL_CHK	UV absorbance at 254 nm		0.009	0.00900	cm -1	100	(85-115)		
QC Ref# 612896 - Apparent Color by SM 2120B							**Analysis Date: 08/05/2011**		
DUP1_201108050174	Apparent Color	ND		ND	ACU		(0-20)		
MBLK	Apparent Color			<3	ACU				
QC Ref# 612899 - Odor at 60 C (TON) by SM 2150B							**Analysis Date: 08/05/2011**		
DUP1_201108050174	Odor at 60 C (TON)	1.0		1.00	TON		(0-20)	20	0.0
MBLK	Odor at 60 C (TON)			<1	TON				
QC Ref# 612952 - Radon 222 by SM 7500RN							**Analysis Date: 08/05/2011**		
DUP_201108050245	Radon 222	ND		ND	pCi/L		(0-20)		
LCS1	Radon 222		200	211	pCi/L	105	(80-120)		
LCS2	Radon 222		200	198	pCi/L	99	(80-120)	20	6.4
MBLK	Radon 222			<50	pCi/L				
QC Ref# 613055 - ICP Metals by EPA 200.7							**Analysis Date: 08/08/2011**		
LCS1	Calcium Total ICAP		50	49.8	mg/L	100	(85-115)		
LCS2	Calcium Total ICAP		50	50.1	mg/L	100	(85-115)	20	0.60
MBLK	Calcium Total ICAP			<1	mg/L				
MRL_CHK	Calcium Total ICAP		1.0	1.02	mg/L	102	(50-150)		
MS_201108050220	Calcium Total ICAP	9.0	50	59.2	mg/L	101	(70-130)		
MS2_201108050274	Calcium Total ICAP	31	50	79.2	mg/L	97	(70-130)		
MSD_201108050220	Calcium Total ICAP	9.0	50	56.0	mg/L	94	(70-130)	20	7.2
MSD2_201108050274	Calcium Total ICAP	31	50	77.8	mg/L	94	(70-130)	20	3.0
LCS1	Iron Total ICAP		5.0	4.96	mg/L	99	(85-115)		
LCS2	Iron Total ICAP		5.0	5.02	mg/L	100	(85-115)	20	1.2
MBLK	Iron Total ICAP			<0.02	mg/L				
MRL_CHK	Iron Total ICAP		0.02	0.0214	mg/L	107	(50-150)		
MS_201108050220	Iron Total ICAP	ND	5.0	5.05	mg/L	101	(70-130)		
MS2_201108050274	Iron Total ICAP	ND	5.0	5.00	mg/L	100	(70-130)		
MSD_201108050220	Iron Total ICAP	ND	5.0	4.81	mg/L	96	(70-130)	20	5.0
MSD2_201108050274	Iron Total ICAP	ND	5.0	4.88	mg/L	98	(70-130)	20	2.3
LCS1	Magnesium Total ICAP		20	20.3	mg/L	102	(85-115)		
LCS2	Magnesium Total ICAP		20	20.4	mg/L	102	(85-115)	20	0.49

Spike recovery is already corrected for native results.
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(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Magnesium Total ICAP			<0.1	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.107	mg/L	107	(50-150)		
MS_201108050220	Magnesium Total ICAP	1.3	20	21.9	mg/L	103	(70-130)		
MS2_201108050274	Magnesium Total ICAP	14	20	33.6	mg/L	98	(70-130)		
MSD_201108050220	Magnesium Total ICAP	1.3	20	20.9	mg/L	98	(70-130)	20	5.2
MSD2_201108050274	Magnesium Total ICAP	14	20	33.1	mg/L	96	(70-130)	20	2.7
LCS1	Potassium Total ICAP		20	19.5	mg/L	98	(85-115)		
LCS2	Potassium Total ICAP		20	19.6	mg/L	98	(85-115)	20	0.51
MBLK	Potassium Total ICAP			<1	mg/L				
MRL_CHK	Potassium Total ICAP		1.0	1.06	mg/L	106	(50-150)		
MS_201108050220	Potassium Total ICAP	5.2	20	25.0	mg/L	99	(70-130)		
MS2_201108050274	Potassium Total ICAP	2.8	20	22.3	mg/L	97	(70-130)		
MSD_201108050220	Potassium Total ICAP	5.2	20	23.9	mg/L	93	(70-130)	20	5.9
MSD2_201108050274	Potassium Total ICAP	2.8	20	22.0	mg/L	96	(70-130)	20	1.5
LCS1	Silica		21	22.8	mg/L	107	(85-115)		
LCS2	Silica		21	23.0	mg/L	108	(85-115)	20	0.87
MBLK	Silica			<0.5	mg/L				
MRL_CHK	Silica		0.42	0.500	mg/L	118	(50-150)		
MS_201108050220	Silica	14	21	38.2	mg/L	112	(70-130)		
MS2_201108050274	Silica	13	21	35.5	mg/L	105	(70-130)		
MSD_201108050220	Silica	14	21	36.5	mg/L	105	(70-130)	20	6.5
MSD2_201108050274	Silica	13	21	35.0	mg/L	103	(70-130)	20	1.9
LCS1	Sodium Total ICAP		50	48.8	mg/L	98	(85-115)		
LCS2	Sodium Total ICAP		50	49.0	mg/L	98	(85-115)	20	0.41
MBLK	Sodium Total ICAP			<1	mg/L				
MRL_CHK	Sodium Total ICAP		1.0	1.09	mg/L	109	(50-150)		
MS_201108050220	Sodium Total ICAP	44	50	92.9	mg/L	98	(70-130)		
MS2_201108050274	Sodium Total ICAP	56	50	103	mg/L	94	(70-130)		
MSD_201108050220	Sodium Total ICAP	44	50	89.0	mg/L	90	(70-130)	20	8.3
MSD2_201108050274	Sodium Total ICAP	56	50	102	mg/L	92	(70-130)	20	2.9
LCS1	Strontium ICAP		1.0	0.967	mg/L	97	(85-115)		
LCS2	Strontium ICAP		1.0	0.954	mg/L	95	(85-115)	20	1.4
MBLK	Strontium ICAP			<0.01	mg/L				
MRL_CHK	Strontium ICAP		0.01	0.00977	mg/L	98	(50-150)		
MS_201108050220	Strontium ICAP	0.077	1.0	1.04	mg/L	96	(70-130)		
MS2_201108050274	Strontium ICAP	0.36	1.0	1.3	mg/L	95	(70-130)		
MSD_201108050220	Strontium ICAP	0.077	1.0	0.992	mg/L	92	(70-130)	20	5.1

Spike recovery is already corrected for native results.
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(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD2_201108050274	Strontium ICAP	0.36	1.0	1.28	mg/L	93	(70-130)	20	2.1
QC Ref# 613093 - Ammonia Nitrogen by EPA 350.1							**Analysis Date: 08/08/2011**		
LCS1	Ammonia Nitrogen		1.0	1.09	mg/L	109	(90-110)		
LCS2	Ammonia Nitrogen		1.0	1.09	mg/L	109	(90-110)	20	0.0
MBLK	Ammonia Nitrogen			<0.05	mg/L				
MRL_CHK	Ammonia Nitrogen		0.05	0.0420	mg/L	84	(50-150)		
MS_201108050372	Ammonia Nitrogen	1.6	1.0	3.68	mg/L	107	(90-110)		
MSD_201108050372	Ammonia Nitrogen	1.6	1.0	3.7	mg/L	108	(90-110)	20	0.93
QC Ref# 613123 - Fluoride by SM 4500F-C							**Analysis Date: 08/09/2011**		
LCS1	Fluoride		1.0	0.900	mg/L	90	(81-116)		
LCS2	Fluoride		1.0	0.893	mg/L	89	(81-116)	20	0.78
MBLK	Fluoride			<0.05	mg/L				
MRL_CHK	Fluoride		0.05	0.0480	mg/L	96	(50-150)		
MS_201108050174	Fluoride	ND	1.0	0.914	mg/L	87	(73-124)		
MS_201108050221	Fluoride	ND	1.0	0.894	mg/L	87	(73-124)		
MSD_201108050221	Fluoride	ND	1.0	0.901	mg/L	88	(73-124)	20	0.80
QC Ref# 613256 - Mercury by EPA 245.1							**Analysis Date: 08/09/2011**		
LCS1	Mercury		1.5	1.5	ug/L	100	(85-115)		
LCS2	Mercury		1.5	1.44	ug/L	96	(85-115)	20	4.1
MBLK	Mercury			<0.2	ug/L				
MRL_CHK	Mercury		0.2	0.209	ug/L	105	(50-150)		
MS_201108050035	Mercury	ND	1.5	1.5	ug/L	100	(70-130)		
MS_201108050040	Mercury	ND	1.5	1.57	ug/L	105	(70-130)		
MSD_201108050035	Mercury	ND	1.5	1.57	ug/L	105	(70-130)	20	5.2
MSD_201108050040	Mercury	ND	1.5	1.54	ug/L	102	(70-130)	20	2.9
QC Ref# 613287 - Alkalinity in CaCO3 units by SM 2320B							**Analysis Date: 08/09/2011**		
LCS1	Alkalinity in CaCO3 units		100	97.7	mg/L	98	(90-110)		
LCS2	Alkalinity in CaCO3 units		100	98.6	mg/L	99	(90-110)	20	0.92
MBLK	Alkalinity in CaCO3 units			<2	mg/L				
MRL_CHK	Alkalinity in CaCO3 units		2.0	1.95	mg/L	98	(50-150)		
MS_201108040440	Alkalinity in CaCO3 units	150	100	244	mg/L	96	(80-120)		
MS_201108050245	Alkalinity in CaCO3 units	86	100	179	mg/L	93	(80-120)		
MSD_201108040440	Alkalinity in CaCO3 units	150	100	245	mg/L	96	(80-120)	20	0.31
MSD_201108050245	Alkalinity in CaCO3 units	86	100	180	mg/L	94	(80-120)	20	1.3

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(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 613291 - PH (H3=past HT not compliant) by SM4500-HB							**Analysis Date: 08/09/2011**		
DUP_201108040440	PH (H3=past HT not compliant)	7.8		7.82	Units		(0-20)	20	0.31
DUP_201108050245	PH (H3=past HT not compliant)	7.9		7.89	Units		(0-20)	20	0.23
LCS1	PH (H3=past HT not compliant)		6.0	6.01	Units	100	(98-102)		
LCS2	PH (H3=past HT not compliant)		6.0	6.01	Units	100	(98-102)	20	0.0
QC Ref# 613300 - Nitrate, Nitrite by EPA 300.0 by EPA 300.0							**Analysis Date: 08/05/2011**		
LCS1	Nitrate as Nitrogen by IC		2.5	2.49	mg/L	99	(90-110)		
LCS2	Nitrate as Nitrogen by IC		2.5	2.45	mg/L	98	(90-110)	20	1.6
MBLK	Nitrate as Nitrogen by IC			<0.10	mg/L				
MRL_CHK	Nitrate as Nitrogen by IC		0.05	0.0502	mg/L	100	(50-150)		
MRLLW	Nitrate as Nitrogen by IC		0.013	0.0187	mg/L	150	(50-150)		
MS_201108050245	Nitrate as Nitrogen by IC	0.18	1.3	1.57	mg/L	110	(80-120)		
MS_201108100150	Nitrate as Nitrogen by IC	ND	1.3	1.36	mg/L	109	(80-120)		
MSD_201108050245	Nitrate as Nitrogen by IC	0.18	1.3	1.53	mg/L	107	(80-120)	20	2.8
MSD_201108100150	Nitrate as Nitrogen by IC	ND	1.3	1.35	mg/L	108	(80-120)	20	0.92
LCS1	Nitrite Nitrogen by IC		1.0	0.964	mg/L	96	(90-110)		
LCS2	Nitrite Nitrogen by IC		1.0	0.952	mg/L	95	(90-110)	20	1.3
MBLK	Nitrite Nitrogen by IC			<0.10	mg/L				
MRL_CHK	Nitrite Nitrogen by IC		0.05	0.0535	mg/L	107	(50-150)		
MRLLW	Nitrite Nitrogen by IC		0.013	0.0155	mg/L	124	(50-150)		
MS_201108050245	Nitrite Nitrogen by IC	ND	0.5	0.440	mg/L	88	(80-120)		
MS_201108100150	Nitrite Nitrogen by IC	ND	0.5	0.513	mg/L	103	(80-120)		
MSD_201108050245	Nitrite Nitrogen by IC	ND	0.5	0.433	mg/L	87	(80-120)	20	1.5
MSD_201108100150	Nitrite Nitrogen by IC	ND	0.5	0.510	mg/L	102	(80-120)	20	0.98
QC Ref# 613359 - Specific Conductance by SM2510B							**Analysis Date: 08/09/2011**		
DUP1_201108040440	Specific Conductance	430		431	umho/cm		(0-20)	20	0.070
DUP1_201108050245	Specific Conductance	470		471	umho/cm		(0-20)	20	0.28
LCS1	Specific Conductance		1000	1010	umho/cm	101	(95-105)		
LCS2	Specific Conductance		1000	1000	umho/cm	100	(95-105)	20	1
MBLK	Specific Conductance			<2	umho/cm				
MRL_CHK	Specific Conductance		2.0	1.8	umho/cm	90	(50-150)		
QC Ref# 613366 - Chloride, Sulfate by EPA 300.0 by EPA 300.0							**Analysis Date: 08/05/2011**		
LCS1	Chloride		25	26.0	mg/L	104	(90-110)		
LCS2	Chloride		25	25.6	mg/L	102	(90-110)	20	1.6

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RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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Laboratory
QC Report: 372522

City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Chloride			<0.5	mg/L				
MRL_CHK	Chloride		0.5	0.441	mg/L	88	(50-150)		
MS_201108050245	Chloride		13	64.7	mg/L	106	(80-120)		
MS_201108100150	Chloride	4.2	13	18.8	mg/L	117	(80-120)		
MSD_201108050245	Chloride		13	63.8	mg/L	99	(80-120)	20	6.5
MSD_201108100150	Chloride	4.2	13	18.8	mg/L	117	(80-120)	20	0.0
LCS1	Sulfate		50	51.5	mg/L	103	(90-110)		
LCS2	Sulfate		50	50.8	mg/L	102	(90-110)	20	1.4
MBLK	Sulfate			<0.25	mg/L				
MRL_CHK	Sulfate		1.0	0.971	mg/L	97	(50-150)		
MRLLW	Sulfate		0.25	0.303	mg/L	121	(50-150)		
MS_201108050245	Sulfate	65	25	93.5	mg/L	116	(80-120)		
MS_201108100150	Sulfate	6.4	25	34.7	mg/L	113	(80-120)		
MSD_201108050245	Sulfate	65	25	91.9	mg/L	109	(80-120)	20	6.2
MSD_201108100150	Sulfate	6.4	25	34.6	mg/L	113	(80-120)	20	0.0
QC Ref# 613383 - Total Suspended Solids (TSS) by SM 2540D							**Analysis Date: 08/10/2011**		
DUP_201108090397	Total Suspended Solids (TSS)	ND		8.00	mg/L		(0-10)	10	**13**
DUP_201108110295	Total Suspended Solids (TSS)	ND		9.00	mg/L		(0-10)	10	0.0
LCS1	Total Suspended Solids (TSS)		175	158	mg/L	90	(71-107)		
LCS2	Total Suspended Solids (TSS)		175	166	mg/L	95	(71-107)	20	4.9
MBLK	Total Suspended Solids (TSS)			<10	mg/L				
MRL_CHK	Total Suspended Solids (TSS)		10	12.0	mg/L	120	(50-150)		
QC Ref# 613423 - Orthophosphate as P (OPO4) by 4500P-E/365.1							**Analysis Date: 08/09/2011**		
LCS1	Orthophosphate as P		0.25	0.251	mg/L	100	(90-110)		
LCS2	Orthophosphate as P		0.25	0.255	mg/L	102	(90-110)	20	1.6
MBLK	Orthophosphate as P			<0.01	mg/L				
MRL_CHK	Orthophosphate as P		0.01	0.0100	mg/L	100	(50-150)		
MS_201108100337	Orthophosphate as P	ND	0.5	0.498	mg/L	98	(90-110)		
MSD_201108100337	Orthophosphate as P	ND	0.5	0.499	mg/L	98	(90-110)	20	0.20
QC Ref# 613507 - Total Dissolved Solids (TDS) by E160.1/SM2540C							**Analysis Date: 08/10/2011**		
DUP_201108040440	Total Dissolved Solid (TDS)	270		280	mg/L		(0-20)	20	2.9
DUP_201108050273	Total Dissolved Solid (TDS)	320		320	mg/L		(0-20)	20	1.2
LCS1	Total Dissolved Solid (TDS)		175	166	mg/L	95	(80-114)		
LCS2	Total Dissolved Solid (TDS)		700	710	mg/L	101	(80-114)		
MBLK	Total Dissolved Solid (TDS)			<10	mg/L				

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MRL_CHK	Total Dissolved Solid (TDS)		10	12.0	mg/L	120	(50-150)		
QC Ref# 613517 - Total Organic Carbon by SM5310C/E415.3							**Analysis Date: 08/11/2011**		
LCS1	Total Organic Carbon		5.0	5.12	mg/L	102	(80-120)		
LCS2	Total Organic Carbon		5.0	5.25	mg/L	105	(80-120)	20	2.5
MBLK	Total Organic Carbon			<0.3	mg/L				
MRL_CHK	Total Organic Carbon		0.2	0.236	mg/L	118	(50-150)		
MS_201108100269	Total Organic Carbon	4.8	4.0	8.9	mg/L	103	(80-120)		
MS2_201108050372	Total Organic Carbon	0.30	2.0	2.13	mg/L	92	(80-120)		
MSD_201108100269	Total Organic Carbon	4.8	4.0	8.88	mg/L	102	(80-120)	20	0.98
QC Ref# 613533 - Dissolved Organic Carbon by SM 5310C							**Analysis Date: 08/11/2011**		
LCS1	Dissolved Organic Carbon		5.0	5.12	mg/L	102	(90-110)		
LCS2	Dissolved Organic Carbon		5.0	5.25	mg/L	105	(90-110)	20	2.5
MBLK	Dissolved Organic Carbon			<0.3	mg/L				
MRL_CHK	Dissolved Organic Carbon		0.2	0.236	mg/L	118	(50-150)		
MS_201108120116	Dissolved Organic Carbon	4.8	4.0	8.9	mg/L	103	(80-120)		
MSD_201108120116	Dissolved Organic Carbon	4.8	4.0	8.88	mg/L	102	(80-120)	20	0.98
QC Ref# 613818 - Sulfide,Total by SM4500SD/376.2							**Analysis Date: 08/11/2011**		
LCS1	SulfideTotal		0.5	0.511	mg/L	102	(90-110)		
LCS2	SulfideTotal		0.5	0.469	mg/L	94	(90-110)	20	8.6
MBLK	SulfideTotal			<0.05	mg/L				
MRL_CHK	SulfideTotal		0.05	0.0500	mg/L	100	(50-150)		
MS_201108090373	SulfideTotal	ND	0.5	0.477	mg/L	95	(80-120)		
MSD_201108090373	SulfideTotal	ND	0.5	0.502	mg/L	100	(80-120)	20	5.1
QC Ref# 613971 - ICP Metals by EPA 200.7							**Analysis Date: 08/12/2011**		
LCS1	Calcium Total ICAP		50	48.1	mg/L	96	(85-115)		
LCS2	Calcium Total ICAP		50	48.9	mg/L	98	(85-115)	20	1.6
MBLK	Calcium Total ICAP			<1	mg/L				
MRL_CHK	Calcium Total ICAP		1.0	0.988	mg/L	99	(50-150)		
MS_201108100526	Calcium Total ICAP	33	50	79.7	mg/L	93	(70-130)		
MS2_201108100610	Calcium Total ICAP	68	50	111	mg/L	87	(70-130)		
MSD_201108100526	Calcium Total ICAP	33	50	82.2	mg/L	98	(70-130)	20	5.0
MSD2_201108100610	Calcium Total ICAP	68	50	114	mg/L	93	(70-130)	20	6.6
LCS1	Iron Dissolved ICAP		5.0	4.81	mg/L	96	(85-115)		
LCS2	Iron Dissolved ICAP		5.0	4.88	mg/L	98	(85-115)	20	1.4

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Iron Dissolved ICAP			<0.02	mg/L				
MRL_CHK	Iron Dissolved ICAP		0.02	0.0224	mg/L	112	(50-150)		
MS_201108100526	Iron Dissolved ICAP	ND	5.0	4.86	mg/L	97	(70-130)		
MS2_201108100610	Iron Dissolved ICAP	0.090	5.0	4.84	mg/L	95	(70-130)		
MSD_201108100526	Iron Dissolved ICAP	ND	5.0	4.99	mg/L	100	(70-130)	20	2.4
MSD2_201108100610	Iron Dissolved ICAP	0.090	5.0	4.82	mg/L	95	(70-130)	20	0.32
LCS1	Iron Total ICAP		5.0	4.81	mg/L	96	(85-115)		
LCS2	Iron Total ICAP		5.0	4.88	mg/L	98	(85-115)	20	1.4
MBLK	Iron Total ICAP			<0.02	mg/L				
MRL_CHK	Iron Total ICAP		0.02	0.0224	mg/L	112	(50-150)		
MS_201108100526	Iron Total ICAP	ND	5.0	4.86	mg/L	97	(70-130)		
MS2_201108100610	Iron Total ICAP	0.090	5.0	4.84	mg/L	95	(70-130)		
MSD_201108100526	Iron Total ICAP	ND	5.0	4.99	mg/L	100	(70-130)	20	2.4
MSD2_201108100610	Iron Total ICAP	0.090	5.0	4.82	mg/L	95	(70-130)	20	0.32
LCS1	Magnesium Total ICAP		20	19.5	mg/L	97	(85-115)		
LCS2	Magnesium Total ICAP		20	19.7	mg/L	98	(85-115)	20	1.0
MBLK	Magnesium Total ICAP			<0.1	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.106	mg/L	106	(50-150)		
MS_201108100526	Magnesium Total ICAP	8.8	20	28.1	mg/L	96	(70-130)		
MS2_201108100610	Magnesium Total ICAP	10	20	28.9	mg/L	94	(70-130)		
MSD_201108100526	Magnesium Total ICAP	8.8	20	28.9	mg/L	100	(70-130)	20	3.9
MSD2_201108100610	Magnesium Total ICAP	10	20	28.8	mg/L	94	(70-130)	20	0.43
LCS1	Manganese Dissolved ICAP		0.5	0.494	mg/L	99	(85-115)		
LCS2	Manganese Dissolved ICAP		0.5	0.503	mg/L	101	(85-115)	20	1.8
MBLK	Manganese Dissolved ICAP			<0.002	mg/L				
MRL_CHK	Manganese Dissolved ICAP		0.002	0.00173	mg/L	87	(50-150)		
MS_201108100526	Manganese Dissolved ICAP	0.0060	0.5	0.500	mg/L	99	(70-130)		
MS2_201108100610	Manganese Dissolved ICAP	ND	0.5	0.488	mg/L	98	(70-130)		
MSD_201108100526	Manganese Dissolved ICAP	0.0060	0.5	0.510	mg/L	101	(70-130)	20	2.2
MSD2_201108100610	Manganese Dissolved ICAP	ND	0.5	0.486	mg/L	97	(70-130)	20	0.41
LCS1	Potassium Total ICAP		20	18.7	mg/L	94	(85-115)		
LCS2	Potassium Total ICAP		20	18.9	mg/L	94	(85-115)	20	1.1
MBLK	Potassium Total ICAP			<1	mg/L				
MRL_CHK	Potassium Total ICAP		1.0	0.956	mg/L	96	(50-150)		
MS_201108100526	Potassium Total ICAP	1.5	20	20.3	mg/L	94	(70-130)		
MS2_201108100610	Potassium Total ICAP	2.0	20	20.6	mg/L	93	(70-130)		
MSD_201108100526	Potassium Total ICAP	1.5	20	20.9	mg/L	97	(70-130)	20	3.6

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD2_201108100610	Potassium Total ICAP	2.0	20	20.5	mg/L	93	(70-130)	20	0.54
LCS1	Silica		21	21.6	mg/L	101	(85-115)		
LCS2	Silica		21	22.0	mg/L	103	(85-115)	20	1.8
MBLK	Silica			<0.5	mg/L				
MRL_CHK	Silica		0.42	0.498	mg/L	118	(50-150)		
MS_201108100526	Silica	0.83	21	22.7	mg/L	102	(70-130)		
MS2_201108100610	Silica	30	21	50.7	mg/L	98	(70-130)		
MSD_201108100526	Silica	0.83	21	23.2	mg/L	104	(70-130)	20	1.9
MSD2_201108100610	Silica	30	21	50.3	mg/L	96	(70-130)	20	2.0
LCS1	Sodium Total ICAP		50	46.1	mg/L	92	(85-115)		
LCS2	Sodium Total ICAP		50	46.1	mg/L	92	(85-115)	20	0.0
MBLK	Sodium Total ICAP			<1	mg/L				
MRL_CHK	Sodium Total ICAP		1.0	0.990	mg/L	99	(50-150)		
MS_201108100526	Sodium Total ICAP	12	50	57.7	mg/L	90	(70-130)		
MS2_201108100610	Sodium Total ICAP	23	50	66.5	mg/L	87	(70-130)		
MSD_201108100526	Sodium Total ICAP	12	50	59.8	mg/L	95	(70-130)	20	4.7
MSD2_201108100610	Sodium Total ICAP	23	50	68.3	mg/L	91	(70-130)	20	4.1
LCS1	Strontium ICAP		1.0	0.909	mg/L	91	(85-115)		
LCS2	Strontium ICAP		1.0	0.917	mg/L	92	(85-115)	20	0.88
MBLK	Strontium ICAP			<0.01	mg/L				
MRL_CHK	Strontium ICAP		0.01	0.00933	mg/L	93	(50-150)		
MS_201108100526	Strontium ICAP	0.16	1.0	1.06	mg/L	90	(70-130)		
MS2_201108100610	Strontium ICAP	0.41	1.0	1.27	mg/L	86	(70-130)		
MSD_201108100526	Strontium ICAP	0.16	1.0	1.09	mg/L	93	(70-130)	20	3.3
MSD2_201108100610	Strontium ICAP	0.41	1.0	1.3	mg/L	89	(70-130)	20	3.4
QC Ref# 614143 - Chloride, Sulfate by EPA 300.0 by EPA 300.0							**Analysis Date: 08/12/2011**		
LCS1	Chloride		25	25.8	mg/L	103	(90-110)		
LCS2	Chloride		25	25.7	mg/L	103	(90-110)	20	0.39
MBLK	Chloride			<0.5	mg/L				
MRL_CHK	Chloride		0.5	0.445	mg/L	89	(50-150)		
MS_201108110384	Chloride	210	13	344	mg/L	111	(80-120)		
MS_201108110761	Chloride	83	13	154	mg/L	114	(80-120)		
MSD_201108110384	Chloride	210	13	349	mg/L	114	(80-120)	20	2.7
MSD_201108110761	Chloride	83	13	156	mg/L	118	(80-120)	20	3.5
LCS1	Sulfate		50	51.2	mg/L	102	(90-110)		
LCS2	Sulfate		50	50.9	mg/L	102	(90-110)	20	0.59

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Sulfate			<0.25	mg/L				
MRL_CHK	Sulfate		1.0	0.993	mg/L	99	(50-150)		
MRLLW	Sulfate		0.25	0.335	mg/L	134	(50-150)		
MS_201108110384	Sulfate	106.554	25	379	mg/L	109	(80-120)		
MS_201108110761	Sulfate	83.6346	25	223	mg/L	111	(80-120)		
MSD_201108110384	Sulfate	106.554	25	383	mg/L	111	(80-120)	20	1.8
MSD_201108110761	Sulfate	83.6346	25	224	mg/L	113	(80-120)	20	1.8
QC Ref# 614229 - ICPMS Metals by EPA 200.8						**Analysis Date: 08/16/2011**			
LCS1	Aluminum Total ICAP/MS		200	200	ug/L	100	(85-115)		
LCS2	Aluminum Total ICAP/MS		200	200	ug/L	100	(85-115)	20	0.0
MBLK	Aluminum Total ICAP/MS			<20	ug/L				
MRL_CHK	Aluminum Total ICAP/MS		20	23.1	ug/L	115	(50-150)		
MS_201108160193	Aluminum Total ICAP/MS	ND	200	192	ug/L	94	(70-130)		
MS2_201108150064	Aluminum Total ICAP/MS	ND	200	200	ug/L	100	(70-130)		
MSD_201108160193	Aluminum Total ICAP/MS	ND	200	191	ug/L	93	(70-130)	20	0.96
MSD2_201108150064	Aluminum Total ICAP/MS	ND	200	190	ug/L	95	(70-130)	20	5.0
LCS1	Antimony Total ICAP/MS		50	48.7	ug/L	97	(85-115)		
LCS2	Antimony Total ICAP/MS		50	48.8	ug/L	98	(85-115)	20	0.21
MBLK	Antimony Total ICAP/MS			<1	ug/L				
MRL_CHK	Antimony Total ICAP/MS		1.0	1.1	ug/L	110	(50-150)		
MS_201108160193	Antimony Total ICAP/MS	ND	50	46.5	ug/L	93	(70-130)		
MS2_201108150064	Antimony Total ICAP/MS	ND	50	47.7	ug/L	95	(70-130)		
MSD_201108160193	Antimony Total ICAP/MS	ND	50	46.0	ug/L	92	(70-130)	20	1.3
MSD2_201108150064	Antimony Total ICAP/MS	ND	50	47.9	ug/L	95	(70-130)	20	0.32
LCS1	Arsenic Total ICAP/MS		20	20.2	ug/L	101	(85-115)		
LCS2	Arsenic Total ICAP/MS		20	20.1	ug/L	100	(85-115)	20	0.50
MBLK	Arsenic Total ICAP/MS			<1	ug/L				
MRL_CHK	Arsenic Total ICAP/MS		1.0	1.13	ug/L	113	(50-150)		
MS_201108160193	Arsenic Total ICAP/MS	ND	20	20.5	ug/L	99	(70-130)		
MS2_201108150064	Arsenic Total ICAP/MS	2.9	20	22.9	ug/L	100	(70-130)		
MSD_201108160193	Arsenic Total ICAP/MS	ND	20	20.3	ug/L	98	(70-130)	20	1.1
MSD2_201108150064	Arsenic Total ICAP/MS	2.9	20	22.4	ug/L	98	(70-130)	20	2.4
LCS1	Barium Total ICAP/MS		100	101	ug/L	101	(85-115)		
LCS2	Barium Total ICAP/MS		100	102	ug/L	102	(85-115)	20	0.99
MBLK	Barium Total ICAP/MS			<2	ug/L				
MRL_CHK	Barium Total ICAP/MS		2.0	2.5	ug/L	125	(50-150)		

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(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MS_201108160193	Barium Total ICAP/MS	31	100	128	ug/L	96	(70-130)		
MS2_201108150064	Barium Total ICAP/MS	8.2	100	106	ug/L	98	(70-130)		
MSD_201108160193	Barium Total ICAP/MS	31	100	127	ug/L	96	(70-130)	20	0.63
MSD2_201108150064	Barium Total ICAP/MS	8.2	100	106	ug/L	98	(70-130)	20	0.0
LCS1	Beryllium Total ICAP/MS		5.0	4.81	ug/L	96	(85-115)		
LCS2	Beryllium Total ICAP/MS		5.0	4.83	ug/L	97	(85-115)	20	0.42
MBLK	Beryllium Total ICAP/MS			<1	ug/L				
MRL_CHK	Beryllium Total ICAP/MS		1.0	1.09	ug/L	109	(50-150)		
MS_201108160193	Beryllium Total ICAP/MS	ND	5.0	4.95	ug/L	99	(70-130)		
MS2_201108150064	Beryllium Total ICAP/MS	ND	5.0	5.32	ug/L	106	(70-130)		
MSD_201108160193	Beryllium Total ICAP/MS	ND	5.0	4.88	ug/L	98	(70-130)	20	1.2
MSD2_201108150064	Beryllium Total ICAP/MS	ND	5.0	5.29	ug/L	106	(70-130)	20	0.0
LCS1	Cadmium Total ICAP/MS		20	20.3	ug/L	102	(85-115)		
LCS2	Cadmium Total ICAP/MS		20	20.4	ug/L	102	(85-115)	20	0.49
MBLK	Cadmium Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Cadmium Total ICAP/MS		0.5	0.571	ug/L	114	(50-150)		
MS_201108160193	Cadmium Total ICAP/MS	ND	20	19.4	ug/L	97	(70-130)		
MS2_201108150064	Cadmium Total ICAP/MS	ND	20	19.9	ug/L	100	(70-130)		
MSD_201108160193	Cadmium Total ICAP/MS	ND	20	19.3	ug/L	96	(70-130)	20	0.93
MSD2_201108150064	Cadmium Total ICAP/MS	ND	20	19.9	ug/L	99	(70-130)	20	0.10
LCS1	Chromium Total ICAP/MS		100	102	ug/L	102	(85-115)		
LCS2	Chromium Total ICAP/MS		100	101	ug/L	101	(85-115)	20	0.99
MBLK	Chromium Total ICAP/MS			<1	ug/L				
MRL_CHK	Chromium Total ICAP/MS		1.0	1.22	ug/L	122	(50-150)		
MS_201108160193	Chromium Total ICAP/MS	1.2	100	95.5	ug/L	94	(70-130)		
MS2_201108150064	Chromium Total ICAP/MS	ND	100	96.8	ug/L	96	(70-130)		
MSD_201108160193	Chromium Total ICAP/MS	1.2	100	93.8	ug/L	93	(70-130)	20	1.8
MSD2_201108150064	Chromium Total ICAP/MS	ND	100	94.3	ug/L	93	(70-130)	20	2.6
LCS1	Copper Total ICAP/MS		100	101	ug/L	101	(85-115)		
LCS2	Copper Total ICAP/MS		100	99.8	ug/L	100	(85-115)	20	1.2
MBLK	Copper Total ICAP/MS			<2	ug/L				
MRL_CHK	Copper Total ICAP/MS		2.0	2.38	ug/L	119	(50-150)		
MS_201108160193	Copper Total ICAP/MS	ND	100	94.3	ug/L	94	(70-130)		
MS2_201108150064	Copper Total ICAP/MS	ND	100	96.3	ug/L	96	(70-130)		
MSD_201108160193	Copper Total ICAP/MS	ND	100	93.3	ug/L	93	(70-130)	20	1.1
MSD2_201108150064	Copper Total ICAP/MS	ND	100	94.6	ug/L	95	(70-130)	20	1.8
LCS1	Lead Total ICAP/MS		20	19.7	ug/L	99	(85-115)		

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Laboratory
QC Report: 372522

City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS2	Lead Total ICAP/MS		20	19.8	ug/L	99	(85-115)	20	0.51
MBLK	Lead Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Lead Total ICAP/MS		0.5	0.568	ug/L	114	(50-150)		
MS_201108160193	Lead Total ICAP/MS	ND	20	18.3	ug/L	91	(70-130)		
MS2_201108150064	Lead Total ICAP/MS	ND	20	18.7	ug/L	93	(70-130)		
MSD_201108160193	Lead Total ICAP/MS	ND	20	17.9	ug/L	89	(70-130)	20	2.2
MSD2_201108150064	Lead Total ICAP/MS	ND	20	18.5	ug/L	92	(70-130)	20	1.1
LCS1	Manganese Total ICAP/MS		50	52.6	ug/L	105	(85-115)		
LCS2	Manganese Total ICAP/MS		50	52.4	ug/L	105	(85-115)	20	0.38
MBLK	Manganese Total ICAP/MS			<2	ug/L				
MRL_CHK	Manganese Total ICAP/MS		2.0	2.32	ug/L	116	(50-150)		
MS_201108160193	Manganese Total ICAP/MS	ND	50	49.6	ug/L	98	(70-130)		
MS2_201108150064	Manganese Total ICAP/MS	ND	50	49.5	ug/L	99	(70-130)		
MSD_201108160193	Manganese Total ICAP/MS	ND	50	48.7	ug/L	96	(70-130)	20	2.0
MSD2_201108150064	Manganese Total ICAP/MS	ND	50	47.7	ug/L	95	(70-130)	20	3.8
LCS1	Nickel Total ICAP/MS		50	50.1	ug/L	100	(85-115)		
LCS2	Nickel Total ICAP/MS		50	49.6	ug/L	99	(85-115)	20	1.0
MBLK	Nickel Total ICAP/MS			<5	ug/L				
MRL_CHK	Nickel Total ICAP/MS		5.0	5.72	ug/L	114	(50-150)		
MS_201108160193	Nickel Total ICAP/MS	ND	50	47.7	ug/L	92	(70-130)		
MS2_201108150064	Nickel Total ICAP/MS	ND	50	47.9	ug/L	95	(70-130)		
MSD_201108160193	Nickel Total ICAP/MS	ND	50	47.1	ug/L	91	(70-130)	20	1.2
MSD2_201108150064	Nickel Total ICAP/MS	ND	50	46.7	ug/L	93	(70-130)	20	2.4
LCS1	Selenium Total ICAP/MS		20	20.1	ug/L	100	(85-115)		
LCS2	Selenium Total ICAP/MS		20	20.2	ug/L	101	(85-115)	20	0.50
MBLK	Selenium Total ICAP/MS			<5	ug/L				
MRL_CHK	Selenium Total ICAP/MS		5.0	5.55	ug/L	111	(50-150)		
MS_201108160193	Selenium Total ICAP/MS	ND	20	23.4	ug/L	104	(70-130)		
MS2_201108150064	Selenium Total ICAP/MS	ND	20	21.6	ug/L	107	(70-130)		
MSD_201108160193	Selenium Total ICAP/MS	ND	20	23.3	ug/L	103	(70-130)	20	0.97
MSD2_201108150064	Selenium Total ICAP/MS	ND	20	20.6	ug/L	102	(70-130)	20	4.8
MBLK	Silver Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Silver Total ICAP/MS		0.5	0.624	ug/L	125	(50-150)		
MS_201108160193	Silver Total ICAP/MS		50	43.6	ug/L	87	(70-130)		
MS2_201108150064	Silver Total ICAP/MS		50	50.4	ug/L	101	(70-130)		
MSD_201108160193	Silver Total ICAP/MS		50	43.7	ug/L	87	(70-130)	20	0.12
MSD2_201108150064	Silver Total ICAP/MS		50	50.3	ug/L	101	(70-130)	20	0.0

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QC Report: 372522

City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Thallium Total ICAP/MS		20	20.0	ug/L	100	(85-115)		
LCS2	Thallium Total ICAP/MS		20	20.1	ug/L	101	(85-115)	20	0.50
MBLK	Thallium Total ICAP/MS			<1	ug/L				
MRL_CHK	Thallium Total ICAP/MS		1.0	1.12	ug/L	112	(50-150)		
MS_201108160193	Thallium Total ICAP/MS	ND	20	18.5	ug/L	92	(70-130)		
MS2_201108150064	Thallium Total ICAP/MS	ND	20	19.0	ug/L	95	(70-130)		
MSD_201108160193	Thallium Total ICAP/MS	ND	20	18.0	ug/L	90	(70-130)	20	2.4
MSD2_201108150064	Thallium Total ICAP/MS	ND	20	18.8	ug/L	94	(70-130)	20	1.5
LCS1	Zinc Total ICAP/MS		100	100	ug/L	100	(85-115)		
LCS2	Zinc Total ICAP/MS		100	99.2	ug/L	99	(85-115)	20	0.80
MBLK	Zinc Total ICAP/MS			<20	ug/L				
MRL_CHK	Zinc Total ICAP/MS		20	22.9	ug/L	115	(50-150)		
MS_201108160193	Zinc Total ICAP/MS	ND	100	99.0	ug/L	98	(70-130)		
MS2_201108150064	Zinc Total ICAP/MS	ND	100	99.6	ug/L	100	(70-130)		
MSD_201108160193	Zinc Total ICAP/MS	ND	100	97.4	ug/L	97	(70-130)	20	1.6
MSD2_201108150064	Zinc Total ICAP/MS	ND	100	96.5	ug/L	97	(70-130)	20	3.2
QC Ref# 614436 - Cyanide by manual distillation by EPA 335.4							**Analysis Date: 08/17/2011**		
LCS1	Cyanide by manual distillation		0.1	0.0939	mg/L	94	(90-110)		
LCS2	Cyanide by manual distillation		0.1	0.0924	mg/L	92	(90-110)	20	1.6
MBLK	Cyanide by manual distillation			<0.005	mg/L				
MRL_CHK	Cyanide by manual distillation		0.005	0.00650	mg/L	130	(50-150)		
MS_201108120322	Cyanide by manual distillation	ND	0.1	0.0856	mg/L	**83**	(90-110)		
MS_201108130057	Cyanide by manual distillation	ND	0.1	0.0878	mg/L	**87**	(90-110)		
MSD_201108120322	Cyanide by manual distillation	ND	0.1	0.0836	mg/L	**81**	(90-110)	20	2.4
RLHIGH	Cyanide by manual distillation		0.1	0.0947	mg/L	95	(90-110)		
RLLOW	Cyanide by manual distillation		0.02	0.0208	mg/L	104	(90-110)		
QC Ref# 614591 - ICP Metals by EPA 200.7							**Analysis Date: 08/17/2011**		
LCS1	Calcium Total ICAP		50	49.7	mg/L	99	(85-115)		
LCS2	Calcium Total ICAP		50	49.2	mg/L	98	(85-115)	20	1.0
MBLK	Calcium Total ICAP			<1	mg/L				
MRL_CHK	Calcium Total ICAP		1.0	1.13	mg/L	113	(50-150)		
MS_201108120307	Calcium Total ICAP	14	50	63.0	mg/L	97	(70-130)		
MS2_201108160346	Calcium Total ICAP	95	50	142	mg/L	93	(70-130)		
MSD_201108120307	Calcium Total ICAP	14	50	64.0	mg/L	99	(70-130)	20	2.0
MSD2_201108160346	Calcium Total ICAP	95	50	139	mg/L	89	(70-130)	20	5.0

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RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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QC Report: 372522

City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Iron Total ICAP		5.0	4.94	mg/L	99	(85-115)		
LCS2	Iron Total ICAP		5.0	4.89	mg/L	98	(85-115)	20	1.0
MBLK	Iron Total ICAP			<0.02	mg/L				
MRL_CHK	Iron Total ICAP		0.02	0.0251	mg/L	126	(50-150)		
MS_201108120307	Iron Total ICAP	ND	5.0	4.92	mg/L	98	(70-130)		
MS2_201108160346	Iron Total ICAP	ND	5.0	5.03	mg/L	101	(70-130)		
MSD_201108120307	Iron Total ICAP	ND	5.0	5.02	mg/L	100	(70-130)	20	1.7
MSD2_201108160346	Iron Total ICAP	ND	5.0	4.98	mg/L	100	(70-130)	20	1.4
LCS1	Magnesium Total ICAP		20	20.1	mg/L	101	(85-115)		
LCS2	Magnesium Total ICAP		20	19.9	mg/L	100	(85-115)	20	1.0
MBLK	Magnesium Total ICAP			<0.1	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.116	mg/L	116	(50-150)		
MS_201108120307	Magnesium Total ICAP	6.1	20	26.0	mg/L	99	(70-130)		
MS2_201108160346	Magnesium Total ICAP	26	20	45.8	mg/L	96	(70-130)		
MSD_201108120307	Magnesium Total ICAP	6.1	20	26.6	mg/L	102	(70-130)	20	2.8
MSD2_201108160346	Magnesium Total ICAP	26	20	45.0	mg/L	92	(70-130)	20	4.0
LCS1	Potassium Total ICAP		20	19.4	mg/L	97	(85-115)		
LCS2	Potassium Total ICAP		20	19.3	mg/L	97	(85-115)	20	0.52
MBLK	Potassium Total ICAP			<1	mg/L				
MRL_CHK	Potassium Total ICAP		1.0	1.06	mg/L	106	(50-150)		
MS_201108120307	Potassium Total ICAP	3.2	20	22.7	mg/L	97	(70-130)		
MS2_201108160346	Potassium Total ICAP	4.4	20	24.3	mg/L	100	(70-130)		
MSD_201108120307	Potassium Total ICAP	3.2	20	23.2	mg/L	100	(70-130)	20	2.6
MSD2_201108160346	Potassium Total ICAP	4.4	20	24.1	mg/L	99	(70-130)	20	1.1
LCS1	Silica		21	21.5	mg/L	101	(85-115)		
LCS2	Silica		21	21.9	mg/L	102	(85-115)	20	1.8
MBLK	Silica			<0.5	mg/L				
MRL_CHK	Silica		0.42	0.474	mg/L	112	(50-150)		
MS_201108120307	Silica	8.6	21	30.0	mg/L	100	(70-130)		
MS2_201108160346	Silica	30	21	50.5	mg/L	97	(70-130)		
MSD_201108120307	Silica	8.6	21	30.8	mg/L	104	(70-130)	20	3.9
MSD2_201108160346	Silica	30	21	49.9	mg/L	95	(70-130)	20	2.7
LCS1	Sodium Total ICAP		50	48.5	mg/L	97	(85-115)		
LCS2	Sodium Total ICAP		50	48.9	mg/L	98	(85-115)	20	0.82
MBLK	Sodium Total ICAP			<1	mg/L				
MRL_CHK	Sodium Total ICAP		1.0	1.1	mg/L	110	(50-150)		
MS_201108120307	Sodium Total ICAP	44	50	89.7	mg/L	92	(70-130)		

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RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MS2_201108160346	Sodium Total ICAP	54	50	102	mg/L	95	(70-130)		
MSD_201108120307	Sodium Total ICAP	44	50	92.0	mg/L	97	(70-130)	20	4.9
MSD2_201108160346	Sodium Total ICAP	54	50	101	mg/L	93	(70-130)	20	2.2
LCS1	Strontium ICAP		1.0	0.949	mg/L	95	(85-115)		
LCS2	Strontium ICAP		1.0	0.958	mg/L	96	(85-115)	20	0.94
MBLK	Strontium ICAP			<0.01	mg/L				
MRL_CHK	Strontium ICAP		0.01	0.0108	mg/L	108	(50-150)		
MS_201108120307	Strontium ICAP	0.18	1.0	1.11	mg/L	94	(70-130)		
MS2_201108160346	Strontium ICAP	0.69	1.0	1.62	mg/L	93	(70-130)		
MSD_201108120307	Strontium ICAP	0.18	1.0	1.13	mg/L	96	(70-130)	20	2.1
MSD2_201108160346	Strontium ICAP	0.69	1.0	1.6	mg/L	91	(70-130)	20	2.2
QC Ref# 614643 - ICPMS Metals by EPA 200.8							**Analysis Date: 08/17/2011**		
LCS1	Aluminum Total ICAP/MS		200	197	ug/L	99	(85-115)		
LCS2	Aluminum Total ICAP/MS		200	199	ug/L	100	(85-115)	20	1.0
MBLK	Aluminum Total ICAP/MS			<20	ug/L				
MRL_CHK	Aluminum Total ICAP/MS		20	21.8	ug/L	109	(50-150)		
MS_201108040065	Aluminum Total ICAP/MS	ND	200	188	ug/L	91	(70-130)		
MSD_201108040065	Aluminum Total ICAP/MS	ND	200	188	ug/L	92	(70-130)	20	0.44
LCS1	Beryllium Total ICAP/MS		5.0	5.2	ug/L	104	(85-115)		
LCS2	Beryllium Total ICAP/MS		5.0	5.11	ug/L	102	(85-115)	20	1.8
MBLK	Beryllium Total ICAP/MS			<1	ug/L				
MRL_CHK	Beryllium Total ICAP/MS		1.0	1.1	ug/L	110	(50-150)		
MS_201108040065	Beryllium Total ICAP/MS	ND	5.0	5.51	ug/L	110	(70-130)		
MSD_201108040065	Beryllium Total ICAP/MS	ND	5.0	5.37	ug/L	107	(70-130)	20	2.8
QC Ref# 614868 - ICPMS Metals by EPA 200.8							**Analysis Date: 08/19/2011**		
LCS1	Silver Total ICAP/MS		50	48.5	ug/L	97	(85-115)		
LCS2	Silver Total ICAP/MS		50	49.3	ug/L	99	(85-115)	20	1.6
MBLK	Silver Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Silver Total ICAP/MS		0.5	0.484	ug/L	97	(50-150)		
MS_201108010061	Silver Total ICAP/MS	ND	50	45.0	ug/L	90	(70-130)		
MS2_201108050281	Silver Total ICAP/MS	ND	50	45.7	ug/L	91	(70-130)		
MSD_201108010061	Silver Total ICAP/MS	ND	50	44.3	ug/L	89	(70-130)	20	1.3
MSD2_201108050281	Silver Total ICAP/MS	ND	50	45.2	ug/L	90	(70-130)	20	0.99
QC Ref# 615784 - ICPMS Metals by EPA 200.8							**Analysis Date: 08/24/2011**		
LCS1	Arsenic Total ICAP/MS		20	20.2	ug/L	101	(85-115)		

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RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

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City of Hillsboro
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS2	Arsenic Total ICAP/MS		20	20.2	ug/L	101	(85-115)	20	0.0
MBLK	Arsenic Total ICAP/MS			<1	ug/L				
MRL_CHK	Arsenic Total ICAP/MS		1.0	1.08	ug/L	108	(50-150)		
MS_201108200079	Arsenic Total ICAP/MS		20	33.2	ug/L	119	(70-130)		
MS2_201108200092	Arsenic Total ICAP/MS	2.3	20	26.2	ug/L	119	(70-130)		
MSD_201108200079	Arsenic Total ICAP/MS		20	32.6	ug/L	116	(70-130)	20	2.5
MSD2_201108200092	Arsenic Total ICAP/MS	2.3	20	26.0	ug/L	118	(70-130)	20	0.84
LCS1	Chromium Total ICAP/MS		100	100	ug/L	100	(85-115)		
LCS2	Chromium Total ICAP/MS		100	99.9	ug/L	100	(85-115)	20	0.10
MBLK	Chromium Total ICAP/MS			<1	ug/L				
MRL_CHK	Chromium Total ICAP/MS		1.0	1.08	ug/L	108	(50-150)		
MS_201108200079	Chromium Total ICAP/MS	1.4	100	96.9	ug/L	96	(70-130)		
MS2_201108200092	Chromium Total ICAP/MS	ND	100	96.5	ug/L	96	(70-130)		
MSD_201108200079	Chromium Total ICAP/MS	1.4	100	96.1	ug/L	95	(70-130)	20	0.84
MSD2_201108200092	Chromium Total ICAP/MS	ND	100	95.7	ug/L	95	(70-130)	20	0.84

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

Attachment E

HDR Technical Memorandum

Hillsboro Groundwater Quality Review and Treatment Recommendations

HDR | ONE COMPANY *Many Solutions*℠

TECHNICAL MEMORANDUM

PREPARED FOR: Larry Eaton, GSI Water Solutions, Inc.

PREPARED BY: Anna Zaklikowski, PE, HDR Engineering, Inc.

REVIEWED BY: Pierre Kwan, PE, HDR Engineering, Inc.

DATE: February 17, 2012

RE: Hillsboro Groundwater Water Quality Review and Treatment Recommendations

Introduction

The City of Hillsboro (City) is investigating the development of new groundwater sources, which could potentially be used to supplement existing water supplies or as sites for aquifer storage and recovery. Samples from two groundwater test wells were collected to evaluate overall water quality, and included analyses for geochemical parameters, inorganic contaminants, radionuclides, and several other parameters of interest. The objectives of this technical memorandum are as follows:

1. Review water quality data to identify any parameters in excess of Safe Drinking Water Act (SDWA) primary or secondary maximum contaminant levels (MCLs) or that could adversely affect water quality or customer acceptability of distributed drinking water.
2. Develop an approach and provide planning-level costs for treatment needed to meet SDWA requirements.

Water Quality Review

During the summer of 2011, water quality analyses were performed on water sampled from two groundwater test wells located within the City's service area. The complete water quality analysis results are provided as **Appendix A** for these wells, which have been identified as the Dawson Creek Park (DCP) Well and the Knife River (KR) Well. The water quality testing evaluated field and geochemical parameters, metals, radionuclides, and several other parameters of interest; however, it should be noted that analyses were not completed for all contaminants regulated by the SDWA, including organic contaminants and microbiological contaminants. The evaluation provided is restricted to water quality issues associated with the available data and does not address the potential for contaminants that were not measured.

The results were reviewed for compliance with the Safe Drinking Water Act (SDWA) MCLs and secondary MCLs (SMCLs) and to evaluate the need to implement treatment that would mitigate the presence of any parameters that would adversely impact the water quality in the distribution system. Compliance with MCLs, which are intended to be protective of public

health, is mandatory under the SDWA while compliance with SMCLs is optional as these parameters are associated with aesthetic (i.e., color, taste, odor) problems and are not known to adversely impact public health.

In general, the water quality for the DCP Well was significantly better compared with the KR Well. None of the constituents measured in either well water were found in excess of any of the primary MCLs. However, several water quality parameters were identified at levels in excess of SMCLs, in levels greater than 50% of the MCLs, or with levels that otherwise have the potential to adversely affect customer perception. These parameters are discussed below and compared against SDWA MCLs and typical Joint Water Commission (JWC) ranges in Table 1.

Table 1: Comparison of Selected Dawson Creek Park and Knife River Well Water Quality against EPA MCLs and SMCLs and Typical JWC Levels

Analyte	Regulatory Criteria	Units	Regulatory Standard	JWC Typical Range[1]	Dawson Creek Park Well (WASH 5586) 6/14/2011	Knife River Well (WASH 50197) 8/4/2011	Rec'd Criteria for Treatment[2]
Parameters Exceeding SMCLs							
Iron, Dissolved	None	mg/L	None	0.01U-0.05	0.024	0.02 U	-
Iron, Total	SMCL	mg/L	0.3	0.01U-0.16	0.032	**1.1**	<0.1
Manganese, Dissolved	None	mg/L	None	0-0.02	0.065	0.22	-
Manganese, Total	SMCL	mg/L	0.05	0.002-0.02	**0.061**	**0.21**	<0.02
Total Dissolved Solids	SMCL	mg/L	500	57-100	**650**	**2600**	<200
Chloride	SMCL	mg/L	250	4-6	**280**	**1200**	Per TDS
Parameters substantially different than JWC water, exceeding 50% of MCL, or that have the potential to adversely impact water quality or customer acceptance							
Sodium	None	mg/L	None	9.6-12	**160**	**370**	Per TDS
Hardness (as CaCO3)	None	mg/L	None	27-40.6	140	700	<50
Arsenic	MCL	mg/L	0.01	0.001-0.003	0.0049	0.0081	<0.005
Barium	MML	mg/L	1	0.0042-0.02	0.077	0.46	
Ammonia (as N)	None	mg/L	None	NT	0.067	1.6	<0.05
Fluoride	SMCL [MCL,MML]	mg/L	2 [4]	0.6-1	0.63	0.45	0.7
Temperature	None	degC	None	6.5-14	21.02	21.38	Mitigation

Notes:

NT = Analyte not tested.

U = Analyte not detected at indicated detection limit.

Values highlighted in gray exceed referenced MCLs or SMCLs.

[1]JWC water quality ranges from data collected by GSI from 2005-2008 during aquifer recovery cycles from Beaverton ASR wells.

[2]Treatment criteria recommendations are based on levels known to sufficiently reduce risk from aesthetic contaminants and that otherwise are not anticipated to result in customer complaints. Treatment criteria are typically refined with input from the owner during the development of a basis of design.

Iron and Manganese

Iron and manganese in water can discolor water and result in the discoloration of porcelain water fixtures (i.e. sinks, toilets, and tubs) and laundry and so are provided with SMCLs to prevent the aesthetic issues related to their presence in water. Manganese was measured at levels that exceed the SMCL of 0.05 mg/L in both wells. In the KR well, iron was measured at a

level over 300% of the SMCL, which is set at 0.3 mg/L. Despite what is recommended as an SMCL, iron and manganese have been known to precipitate out and accumulate in water system piping and result in water discoloration at levels lower than the SMCLs when high water velocities (i.e. fire flows) scour out the pipes and re-suspend the accumulated metals. For this reason, some utilities practice iron and manganese removal to well below the SMCL concentrations. To prevent aesthetic problems in the distribution system associated with the presence of iron and manganese, it is recommended that they be removed or mitigated to levels below 0.1 mg/L and 0.02 mg/L, respectively.

Total Dissolved Solid, Chloride, and Sodium

Total dissolved solids (TDS) is a measure of the total dissolved ions in water and can serve as an indicator of the potential for water to form scale deposits and to create a salty taste to taste-sensitive customers. The SDWA has established an SMCL for TDS of 500 mg/L. TDS exceeded the SMCL in both wells, which was measured at 650 mg/L and 2,600 mg/L in the DCP and KR Wells, respectively. Both wells also exceeded the chloride SMCL, which is set at 250 mg/L to address the salty taste associated with the presence of high levels of chloride. Sodium, which contributes to TDS, was measured at relatively high levels in both wells. Although not regulated as a contaminant, sodium can be a concern for those individuals on restricted sodium diets.

Hardness

Hardness was measured at 140 mg/L and 700 mg/L in the DCP and KR Wells, respectively, which is considered “hard.” This level would likely be noticeable and undesirable to customers as it could increase scaling in distribution piping and household plumbing, and is especially an issue in hot water heaters, medical dialysis systems, and any manufacturing facilities dependent on soft water. In addition, hardness will change the “feel” of the water, especially when compared to the JWC water, which is typically below 40 mg/L hardness and considered to be “soft.” There is no federal or state regulatory standard or MCL for hardness in drinking water; however, it is recommended that hardness in Hillsboro’s system be restricted to less than 50 mg/L, or perhaps lower, to maintain acceptability of the water for residential and industrial customers and maintain consistency with JWC water.

Arsenic and Barium

Arsenic and barium are inorganic contaminants regulated with MCLs as a result of their impact to public health: arsenic is a carcinogen and barium induces diarrhea at concentrations exceeding the MCL. Arsenic and barium were measured at levels below their respective MCLs in both wells; however, their presence at significant levels in the collected samples suggests there is potential for these inorganic contaminants to exceed the regulated levels. Therefore, it is recommended that any treatment approach provided consider benefits related to the removal of arsenic and barium.

Ammonia

Ammonia is not regulated as a primary or secondary contaminant; however, its presence is generally not desirable as it can contribute to nitrification in the distribution system and can combine with free chlorine during the treatment process to destroy free chlorine or form

chloramines. While controlled chloramine formation is used by some utilities as the distribution system disinfectant residual (as monochloramine), uncontrolled chloramination can generate di- and trichloroamines, which are the compounds associated the negative smell of bleach. Ammonia was present in the KR well at a concentration of 1.6 mg/L, a level that would result in all chlorine added reacting to form monochloramine. To avoid reactions that will exert a chlorine demand and interfere with disinfection, removal of ammonia is recommended if it is present in concentrations exceeding 0.05 mg/L.

Fluoride

The SDWA includes primary and secondary MCLs for fluoride to address its public health and aesthetic effects. When added by utilities to water for the prevention of tooth decay, EPA recommends a target dose of 0.7 mg/L. Fluoride was measured at 0.63 mg/L and 0.45 mg/L in the DCP and KR wells, respectively. Hillsboro does not add fluoride to its water supply, which contains little to no background fluoride. Although the levels detected in the test wells are significantly lower than the secondary MCL, the change may be of concern to the City's customers.

Temperature

The water temperature in both wells was measured around 21°C (70°F), which suggests the aquifer is geothermal. Hillsboro customers would definitely notice the higher temperature as JWC water typically ranges from 6°C to 15°C. Along with issues of customer acceptance, the elevated temperature could contribute to accelerated biological growth in the system, which could increase the potential for violations meeting the requirements of the Total Coliform Rule. Despite these concerns, the elevated temperature could be a benefit during treatment as it generally leads to faster chemical reactions and filtration efficiencies.

Treatment Approach and Recommendations

This section describes treatment recommendations for the development of a new well characterized by similar water quality to the DCP and KR wells and based on an assumed well capacity of 2 mgd. Treatment recommendations are based on treatment requirements for compliance with the SDWA and for the removal of undesirable water quality parameters and contaminants identified in the previous section.

Per the requirements of the SDWA and its amendments, treatment and disinfection of groundwater distributed to a public water system is not required unless contaminants are present in excess of the primary regulations and/or the Oregon Department of Human Services (DHS) identifies vulnerabilities in the well that trigger the need for disinfection. The City maintains a free chlorine residual throughout its distribution system, and as such, adding chlorine to newly introduced groundwater to maintain a residual consistent with the rest of the system is required. Per the requirements of the 2006 Groundwater Rule, there is a potential that 4-log disinfection of viruses could be required prior to distribution to the first customer, which adds contact time and monitoring/reporting requirements in excess of what is needed to establish a residual. It is recommended that provisions for 4-log virus inactivation prior to reaching the well's 1st customer be considered in developing the design.

To successfully address and remove the parameters identified in the previous section to acceptable levels defined by the City, a treatment approach would need to make use of multiple treatment processes. **Table 2** provides examples of suggested treatment processes that have the potential to remove target contaminants to acceptable levels as defined in the previous section.

Table 2: Examples of suggested treatment process(es) for contaminants/water quality parameters of concern

Parameter	Lime Softening (Settling & Filtration)	Reverse Osmosis (RO)	Mixed Bed Ion Exchange (IX)	Greensand Filtration (GF)	Air Stripping (AS)
Hardness	+	+	+	-	O
TDS	O	+	O	O	O
Iron/ Manganese	+	-	-	+	O
Arsenic	+	+	+	?	O
Barium	+	+	+	?	O
Ammonia	O	?	+	O	+
Temperature	?	?	O	O	O

Key:

+ Recommended for removal
- Negative effect on treatment process
O Neutral; no benefit or drawback expected
? Potential for some removal, if treatment parameters can be optimized to target parameter

Two treatment approaches are described in the tables below that offer the ability to remove the target contaminants previously identified. Both scenarios include multiple stages of pumping, multiple points of chemical addition, and produce substantial waste streams, resulting in expensive and highly complex processes to maintain and operate. Ammonia removal is addressed in both approaches; however, it is considered optional as it was only found in one of the two wells tested.

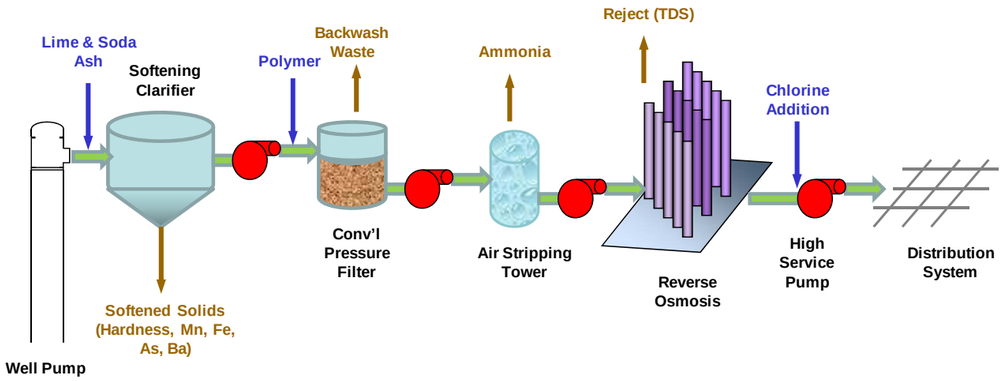
Both approaches rely on reverse osmosis for the removal of TDS and differ in the way hardness, ammonia, and metals are addressed. The approaches are expected to have similar ranges of capital costs, but each will have unique O&M requirements. Due to the high reject rate of the reverse osmosis process, the total production capacity of each of the proposed treatment approaches is estimated to be 1.5 mgd.

Approach #1 includes conventional softening using a combination of lime and soda ash, which will remove hardness down to approximately 50 mg/L, while also binding up the inorganics present, including iron, manganese, arsenic, and barium. Softening solids not settled out in the clarifier will proceed to and be trapped by a conventional filter, to avoid fouling the RO process. Taking advantage of the high pH used during softening, the filtrate will be pumped to an air stripping tower for ammonia removal. Following stripping, the effluent will be pumped to RO units for removal of TDS, and remaining hardness and metals. A large waste stream (~25%) comprised of the softened solids and RO reject wastewater will be generated during treatment, which is expected to require some level of on-site treatment and subsequent disposal. Assumed O&M costs for Alternative #1 include 3 FTE staff at the facility, chemicals, pump and process energy usage, sewer disposal, and replacement of RO membrane elements every four years.

The 2011 O&M estimated cost could range between $2.00/ccf and $3.20/ccf, a range highly dependent on soda ash usage associated with the softening process. The comparatively high chemical usage and associated residuals management costs for this alternative make it less desirable than Alternative #2.

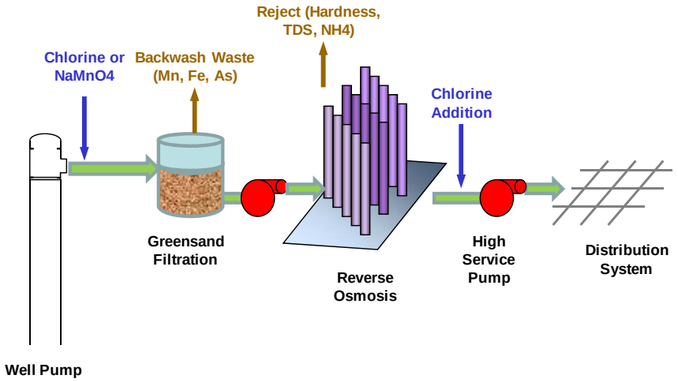
Approach #2 relies on greensand filtration for the removal of iron and manganese, and possibly arsenic, leaving the remaining contaminants (TDS, hardness, ammonia) to be removed via RO. Approach #2 is more ambitious of a treatment strategy compared with #1, as the presence of ammonia could interfere with greensand filtration and there is a greater potential for RO fouling with high levels of hardness. Assumed O&M costs ($1.40/ccf to $1.60/ccf) for Alternative #2 include 3 FTE staff at the facility, chemicals, pump and process energy usage, sewer disposal, and replacement of RO membrane elements every three years.

Table 3/Figure 1: Treatment Approach #1



Treatment Process	Target Contaminants/WQ Parameters	Notes	Capital Cost Range[1]
Raw Water Pumping	n/a	• 1st stage of pumping based on water elevation of softening process	$300-500k
Softening, followed by conventional filtration	Hardness, also arsenic, barium, iron, and manganese	• High capital cost • Large footprint (clarifier diameter estimated between 65 and 150 ft, depending on process) • Clarification can be via conventional settling or high-rate contact clarifier • Substantial residuals production • Complex; high O&M needs • Significant chemical handling and feed requirements (lime, soda ash) • Low alkalinity in water restricts reaction, requiring feed of both lime and soda ash or caustic soda • Hardness removal performance may be unsatisfactory; limit is estimated at 50 mg/L • Effective in removal inorganic contaminants as well as hardness (iron, manganese, barium, arsenic) • Softening requires pH in the 9-11 range; recarbonation or acid addition is required to reduce pH to target level for distribution system (~7.8)	$2.5-4M
Air Stripping	Ammonia	• High capital and O&M cost • Potential for biological fouling • No waste stream • Efficient at high pH, following lime/soda ash softening • Requires pumping stage	$500k-1.5M
Reverse Osmosis	TDS, remaining hardness, metals, and ammonia	• Very high capital and O&M cost • Significant waste stream (~25% reject waste stream) • Requires pumping to 200-250 psi	$5-7M
Chlorine Add'n & High Service Pumps	n/a	• Chlorine residual maintenance • Assumes liquid hypochlorite, supplied via on-site generation or delivered 12.5% bleach	$300-500k
Residuals Handling	Waste from softening, filtration, and RO	• Assumes all waste is discharged directly to sewer (Industrial Category III) • No residual pre-treatment facilities are assumed prior to discharge. Pre-treatment facilities may be recommended or required prior to disposal.	-
Total Capital Cost for 1.5 MGD Production Treatment Facility			**$9-$13M**
2014 O&M Cost per CCF			**$2.00-$3.20**

Table 4/Figure 2: Treatment Approach #2



Treatment Process	Target Contaminants/WQ Parameters	Notes	Capital Cost Range[1]
Raw Water Pumping	n/a	• 1st stage of pumping based on water elevation of softening process	$300-500k
Greensand Filtration	Iron, manganese, possibly arsenic	• Catalytically adsorbs Fe, Mn with the addition of oxidant (chlorine or permanganate) • Ammonia may interfere with removal as it combines with the oxidant	$2-3M
Reverse Osmosis (inc. Dechlorination and Calcite Stabilization)	TDS, hardness, ammonia, and remaining metals	• Very high capital and O&M cost • Significant waste stream (~25% reject waste stream) • Requires pumping to 200-250 psi • Greater fouling potential/cleaning requirements due to presence of Fe, Mn, and hardness • Larger system required than described in Approach #1 because of removal of hardness • Dechlorination needed prior to RO as chlorine attacks RO materials and reduces performance	$6-9M
Chlorine Addition & High Service Pumping	n/a	• Chlorine residual maintenance • Assumes liquid hypochlorite, supplied via on-site generation or delivered 12.5% bleach	$300-500k
Residuals Handling	Waste from filtration and RO	• Assumes all waste is discharged directly to sewer (Industrial Category III) • No residual pre-treatment facilities are assumed prior to discharge	-
Total Capital Cost for 1.5 MGD Production Treatment Facility			**$9-$13M**
2014 O&M Cost per CCF			**$1.40-1.60**

Notes:

[1]Cost estimate ranges are planning level and are estimated based on vendor budgetary quotes for equipment and EPA cost curves. Cost estimates heavily dependant on treatment design criteria, redundancy requirements, technology used, and site/building requirements.

Conclusions

The water quality of the tested wells demands a treatment strategy consisting of multiple treatment processes, each with considerable capital and O&M costs and high levels of operational complexity. In order for the development of a new groundwater source to be feasible, the water quality would likely need to be as good as or better than water collected from the DCP Well. Even then, treatment could still be needed to avoid negatively impacting customers. Alternatively, a new well or wells could be used to supplement surface water supplies with water quality mitigation through blending, or could be used for aquifer storage and recovery.

If the City wishes to pursue groundwater development further after reviewing the presented information, further evaluation and refinement is recommended before proceeding with design of new groundwater production facilities:

- Investigate additional well sites to determine if water quality is better in other areas of the aquifer, either vertically or spatially.
- Collect additional water quality data to refine raw water criteria
- Develop an understanding of the criteria for treatment in order to establish basis of design
- Complete more detailed alternatives analysis to investigate feasibility and refine costs
- Perform bench and/or pilot testing on the selected alternative to refine design criteria and demonstrate performance

Appendix A: Groundwater Test Well Water Quality Data

Dawson Creek Park Well and Knife River Well Groundwater Quality Data

City of Hillsboro

Category	Analyte	Regulatory Criteria	Units	Regulatory Standard	Dawson Creek Park Well (WASH 5586) 6/14/2011	Knife River Well (WASH 50197) 8/4/2011
Field Parameters	Dissolved Oxygen	None	mg/L	None	0.135	0.17
	ORP	None	mV	None	5.1	-154.8
	pH	SMCL	pH	6 - 8.5 standard units	7.89	
	Specific Conductance	None	us/cm	None	1117	3603
	Temperature	None	degC	None	21.02	21.38
Geochemical	Ammonia Nitrogen	None	mg/L	None	0.067	1.6
	Bicarbonate	None	mg/L	None	130	55
	Calcium	None	mg/L	None	37	230
	Carbonate	None	mg/L	None	2 U	2 U
	Chloride	SMCL	mg/L	250	280	1200
	Hardness (as CaCO3)	None	mg/L	None	140	700
	Hydroxide as OH	None	mg/L	None	2 U	2 U
	Magnesium	None	mg/L	None	13	28
	Nitrate as N	MCL, MML	mg/L	10	0.25 U	0.33 U
	Nitrate+Nitrite	None	mg/L	None	0.05 U	0.1 U
	Nitrite as N	MCL	mg/L	1	0.25 U	0.33 U
	Orthophosphate	None	mg/L	None	0.015	0.01 U
	Potassium	None	mg/L	None	22	51
	Silica	None	mg/L	None	54	54
	Sodium	None	mg/L	None	**160**	**370**
	Sulfate	SMCL	mg/L	250	3.4	0.5 U
	Total Alkalinity	None	mg/L	None	110	45
	Total Dissolved Solids	SMCL	mg/L	500	650	2600
	Dissolved Organic Carbon	None	mg/L	None	0.3 U	0.34
	Total Organic Carbon	None	mg/L	None	0.3 U	0.3
	Total Suspended Solids	None	mg/L	None	10 U	10 U
Metals	Aluminum	SMCL	mg/L	0.05	0.020 U	0.020 U
	Antimony	MCL	mg/L	0.006	0.001 U	0.001 U
	Arsenic	MCL	mg/L	0.01	0.0049	0.0081
	Barium	MML	mg/L	1	0.077	0.46
	Beryllium	MCL	mg/L	0.004	0.001 U	0.001 U
	Cadmium	MCL	mg/L	0.005	0.0005 U	0.0005 U
	Chromium	MML	mg/L	0.05	0.001 U	0.005 U
	Cobalt	None	mg/L	None	0.002 U	
	Copper	SMCL	mg/L	1	0.0023	0.017
	Iron, Dissolved	None	mg/L	None	0.024	0.02 U
	Iron, Total	SMCL	mg/L	0.3	0.032	1.1
	Lead	MML	mg/L	0.05	0.0005 U	0.0027
	Manganese, Dissolved	None	mg/L	None	0.065	0.22
	Manganese, Total	SMCL	mg/L	0.05	0.061	0.21
	Mercury	MCL, MML	mg/L	0.002	0.0002 U	0.0002 U
	Molybdenum	None	mg/L	None	0.0045	
	Nickel	None	mg/L	None	0.005 U	0.005 U
	Selenium	MML	mg/L	0.01	0.005 U	0.005 U
	Silver	MML	mg/L	0.05	0.0005 U	0.0005 U
	Strontium	None	mg/L	None	0.13	0.78
	Thallium	MCL	mg/L	0.002	0.001 U	0.001 U
	Vanadium	None	mg/L	None	0.0095	
	Zinc	SMCL	mg/L	5	0.020 U	0.180
Miscellaneous	Color	SMCL	cu	15 standard units	3 U	10
	Lab Specific Conductance at 25 degrees C	None	us/cm	None	1100	3600
	Lab pH at 25 degrees C	SMCL	pH	6 - 8.5 standard units	7.8	7.3
	Corrosivity at 25 degrees C	SMCL	None	Noncorrosive	0.27	0.29
	Cyanide, Free	MCL	mg/L	0.2	0.005 U	0.005 U
	Fluoride	SMCL [MCL,MML]	mg/L	2 [4]	0.63	0.45
	Dissolved UV 254	None	cm^{-1}	None	0.009 U	0.009 U
	Charge balance of analysis using major ions	None	%	None	5.9	5.9
	Odor at 60 degrees C	SMCL	ton	3 threshold #s	1	1 U
Radionuclides	Radon 222	None	pCi/L	None	390 ±18	430
	Uranium	MCL	mg/L	0.03	0.001 U	

Notes:

NT - analyte not tested.

U = Analyte not detected at indicated detection lmit.

Cells highlighted in gray contain values that exceed the referenced MCL or SMCL

Cells highlighted in yellow contain values that have the potential to result in water quality problems or could be unsatisfactory to customers

GSI Water Solutions, Inc.