Walla Walla Basin Watershed Council

Water Year 2017

Oregon Walla Walla Basin Aquifer Recharge Report

FINAL REPORT

February 2018

Oregon Walla Walla Basin Aquifer Recharge Report

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EXECUTIVE SUMMARY

This report summarizes Water Year (WY) 2017 aquifer recharge operations at the Anspach, Barrett, Chuckhole, Fruitvale, Johnson, Mud Creek, NW Umapine, Triangle Road, and Trumbull sites and supporting groundwater level and surface water and groundwater quality monitoring data. The nine aquifer recharge sites were operated under Limited License 1621(LL-1621) issued by the Oregon Water Resources Department. This report was prepared per Condition 11 of LL-1621 requiring annual reporting of aquifer recharge site operations and data collected in fulfillment of the water level and water quality monitoring plan.

Source water for the nine aquifer recharge sites was diverted from the Walla Walla River at the Little Walla Walla Diversion in Milton-Freewater, OR. The water was delivered through the existing irrigation system to each site's turnout. The WY 2017 recharge season started December 16, 2016 and ended May 15, 2017, with 110 days of active recharge operations. The recharge season began late due to low river flows and was interrupted during January by periods of freezing temperatures. Annual cleaning of the fish screens at the Little Walla Walla Diversion prevented recharge operations during the month of February and early March. The total amount of water diverted under LL-1621 for the WY 2017 recharge season was 5,148 acre-feet (ac-ft).

Water level and water quality data were collected in accordance with the approved monitoring plan for LL-1621. Groundwater monitoring wells in the vicinity of the recharge sites responded to recharge activities, with groundwater elevations increasing and decreasing as recharge operations began and ended. After recharge operations ended on May 15, 2017, water levels at some monitoring wells remained static or increased in response to increased seepage through the fully charged ditches/canals and percolation from irrigation.

Groundwater and surface water quality data collected during aquifer recharge activities do not indicate that aquifer recharge activities are degrading groundwater quality. Source water quality being delivered to the aquifer recharge sites was generally of good quality.

Groundwater elevations increased (became shallower) between years of operation by 0.1 to 11.8 feet at the wells associated with recharge sites which have been operating for at least three years.

Continued operation of the nine current sites and the addition of four new aquifer recharges sites under LL-1621 is expected in WY 2018.

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INTRODUCTION

This report describes groundwater level monitoring data, surface and groundwater quality sampling data and aquifer recharge operations during water year (WY) 2017 (October 1, 2016 – September 30, 2017) performed by the Walla Walla Basin Watershed Council (WWBWC) in cooperation with the Hudson Bay District Improvement Company (HBDIC). The Walla Walla basin aquifer recharge program began recharge operations in the spring of 2004 at a pilot project, the Johnson site, located in Oregon. The program expanded in 2006, adding the Hall-Wentland site just south of the Oregon-Washington state line. The first aquifer recharge site in the Washington portion of the Walla Walla watershed, Locher Road, began operations in 2007. For a more in-depth background on the aquifer recharge program and the Walla Walla basin's hydrology and geology, please see the *Walla Walla Basin Aquifer Recharge Strategic Plan* (available at www.wwbwc.org/projects/recharge.html).

In contrast to many other aquifer recharge projects, the Walla Walla basin aquifer recharge program is not currently being implemented to store water that can later be recovered for beneficial use. Although some use of the stored water is likely occurring at existing water supply wells located hydraulically downgradient of the aquifer recharge sites, the primary purpose of aquifer recharge in the Walla Walla basin is to restore the watershed by enhancing groundwater contributions to instream flow for public and regional benefits. Increases in groundwater levels will not only enhance stream and river baseflow during periods of seasonally low flow but will also result in multiple benefits including those for aquatic life and additional water for multiple uses.

During WY 2017 the aquifer recharge program consisted of nine sites: Anspach, Barrett, Chuckhole, Fruitvale, Johnson, Mud Creek, NW Umapine, Triangle Road, and Trumbull. These recharge sites were operated under Limited License LL-1621 (Appendix A) issued by the Oregon Water Resources Department (OWRD) on October 18, 2016. Source water for aquifer recharge was diverted from the Walla Walla River at the Little Walla Walla Diversion in Milton-Freewater, Oregon at a maximum rate of up to 70 cubic feet per second (cfs) between November 16, 2016 and May 15, 2017. The WY 2017 recharge season had 110 days of active recharge operations. The total amount of water diverted under LL-1621 from November 16, 2016 through May 15, 2017 was 5,148 ac-ft.

Per Condition 11 of LL-1621, the WWBWC is required to submit an annual report that provides a detailed description of aquifer recharge operations and source and groundwater observations during the aquifer recharge period. The annual report's main goals are to: 1) provide data to evaluate how aquifer recharge operations are influencing groundwater quality and groundwater levels; and 2) provide recommendations for modifications to the monitoring program and aquifer recharge operations based on site operations and interpretation of the data. To this end, diverted surface water volumes, aquifer recharge volumes and application rates, groundwater elevations, and source water quality and groundwater quality data were collected in accordance with the approved monitoring plan for LL-1621 (Appendix B).

Appendices are provided at the end of the report. Water level data in the OWRD requested format were provided in a separate transmittal to the OWRD.

HYDROLOGIC SETTING

The Walla Walla River system is a bi-state watershed located in northeast Oregon and southeast Washington (Figure 1). The headwaters are located in the Blue Mountains, the crest of which defines the eastern extent of the watershed. The mainstem Walla Walla River and its primary tributaries, Mill Creek and the Touchet River, are the three primary surface water channels of the system. They coalesce within the Walla Walla Valley from which the Walla Walla River then flows to the Columbia River (Figure 2). This report focuses on the Oregon portion of the watershed, including the Walla Walla River mainstem and the distributary network, especially where they flow onto and across the Walla Walla Valley.

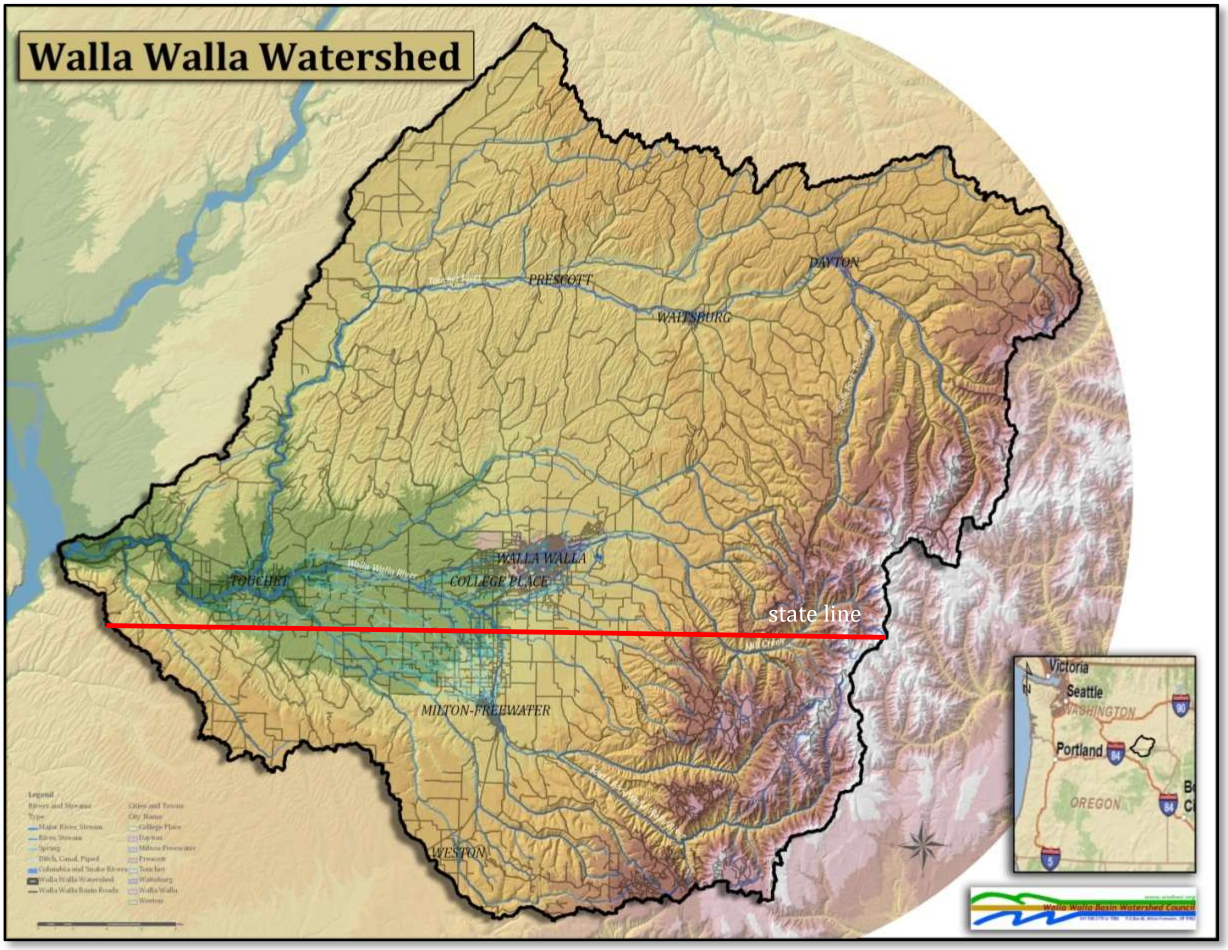

Figure 1 - Walla Walla Watershed in northeast Oregon and southeast Washington.

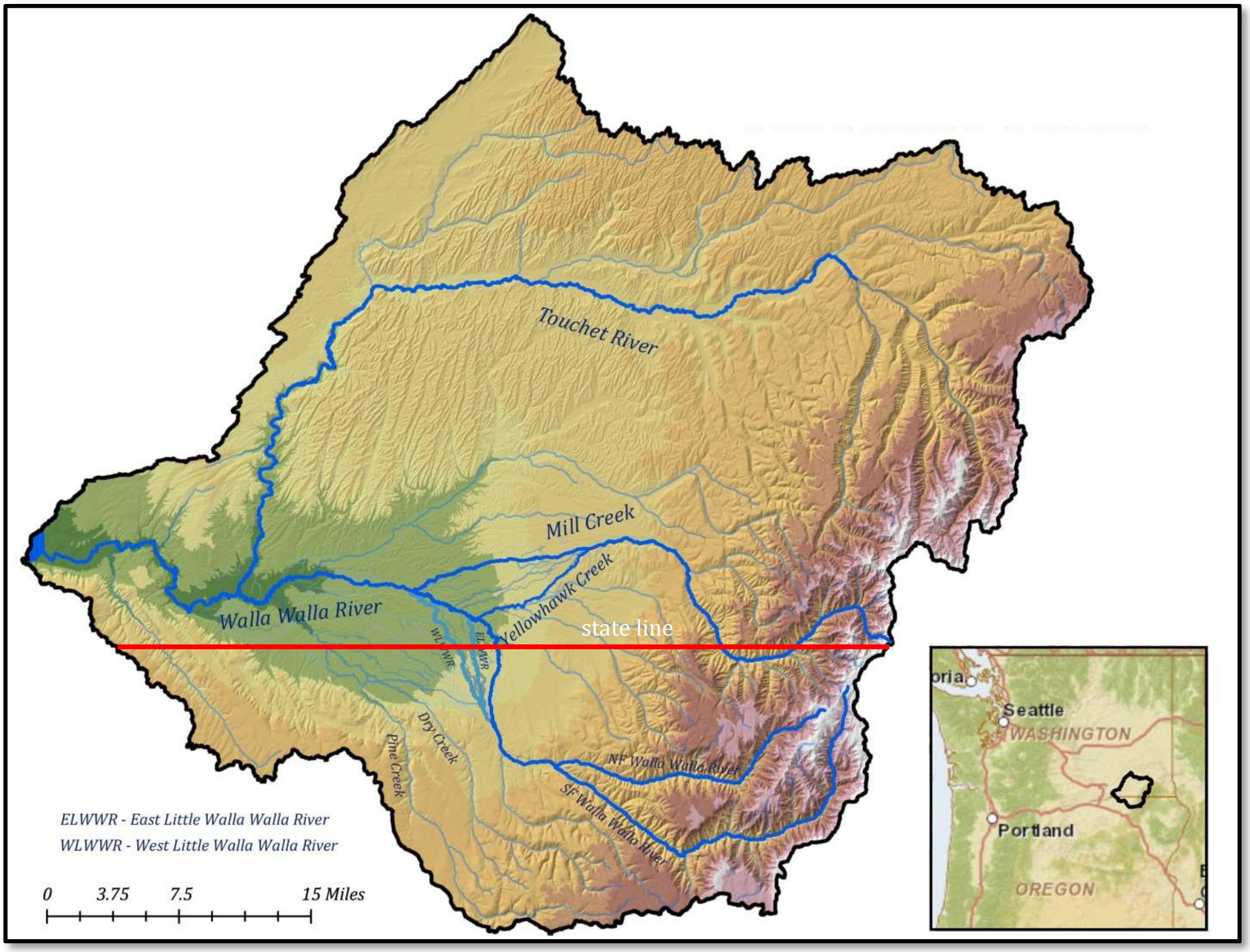

Figure 2 - Walla Walla River and its major tributaries and distributaries.

Walla Walla basin hydrology is largely defined by a distributary river system and an underlying alluvial aquifer system hosted by the sediments overlying basalt. Surface waters entering the Walla Walla Valley changes regimes from steep sided canyons in the headwaters portion of the watershed to a system of distributary and coalescing streams on the central valley floor. With this, shallow groundwater systems see a regime change from localized, saturated valley deposits and confined basalt aquifers controlled by the geologic structure of the Columbia River basalt typical of the highland areas to the more widespread, thick alluvial aquifer system immediately underlying the valley floor. Depth to basalt beneath the base of the canyon floors in the highland areas upstream of the cities of Walla Walla and Milton-Freewater is typically less than 60 feet, with 30 feet more commonly observed. Beneath the central valley floor the top of basalt often is hundreds of feet deep below overlying alluvial sediments.

Groundwater in the Walla Walla basin occurs in two principal aquifer systems: (1) the unconfined to confined suprabasalt sediment (alluvial) aquifer system; and (2) the underlying confined basalt aquifer system (Newcomb, 1965). The basalt aquifer system is regional in character, having limited hydraulic connection to the Walla Walla River, primarily in the canyons of the Blue Mountains. The alluvial aquifer system is the focus of the aquifer recharge program because of its high degree of hydraulic connection with streams on the valley floor.

The alluvial aquifer system, or alluvial aquifer, is found within a sequence of continental clastic sediments overlying the top of basalt (the Mio-Pliocene strata [upper coarse, fine and lower coarse units] and the Quaternary coarse unit). Beneath the Walla Walla Valley floor these sediments, and the alluvial aquifer system, is up to 800 feet thick. The majority of the productive portions of the alluvial aquifer system are hosted by the Mio-Pliocene coarse unit although, at least locally, it is hosted in the overlying Quaternary coarse unit. The alluvial aquifer is generally characterized as unconfined, but it does, at least locally, display evidence of confined conditions. Preferential groundwater flow within the alluvial aquifer is inferred to largely reflect the distribution of coarse sedimentary strata. General groundwater flow direction is from east to west based on contoured groundwater elevations in the alluvial aquifer (Figure 3).

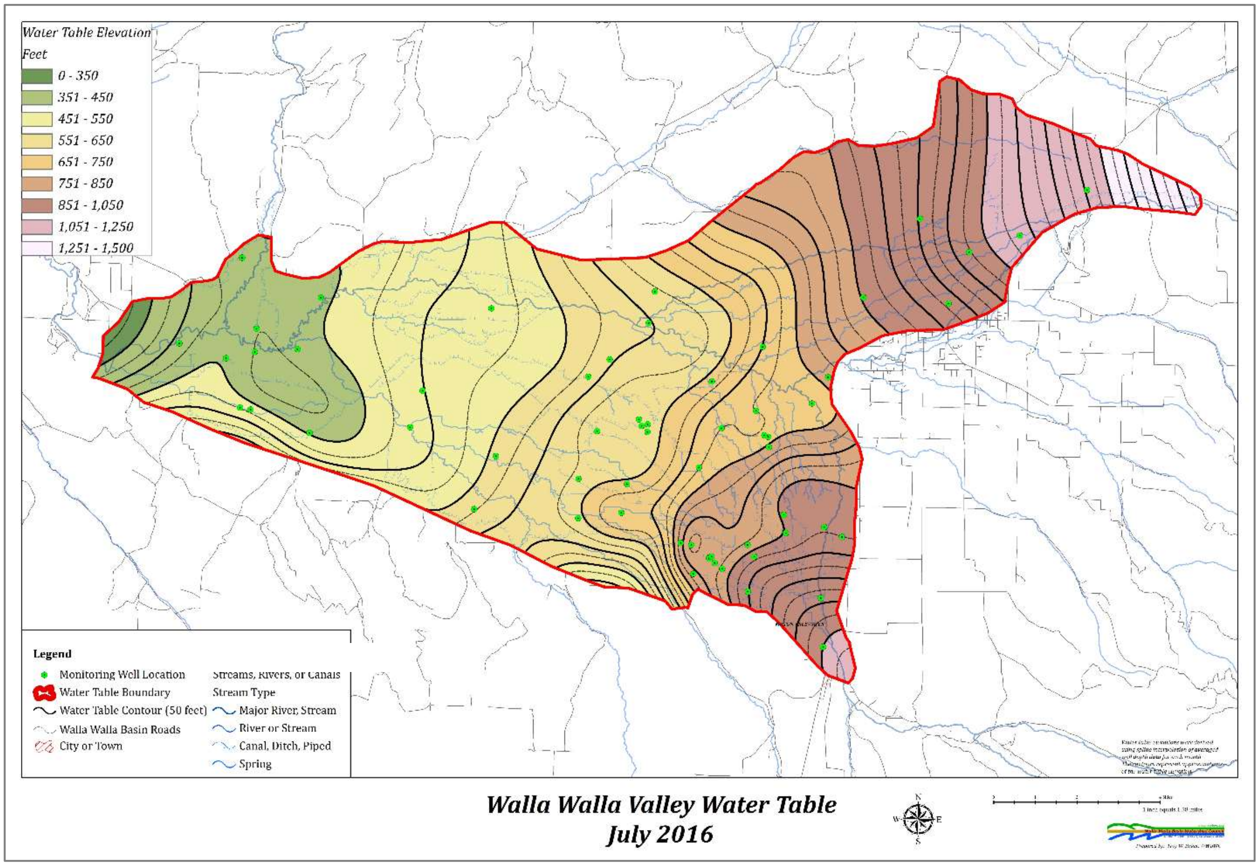

Figure 3 - Water table elevation contours for the alluvial aquifer system in July 2016.

The surficial hydrology of the Walla Walla basin generally is defined by streams confined to steep-walled canyons in the foothills surrounding the valley, a distributary stream system as these streams exit the highlands and flow out onto the valley floor, and then, as the streams flow west, they coalesce into the main Walla Walla River channel. The distributary system formed as streams leaving the highlands entered the valley, went from higher to lower gradient and, as a consequence, deposited coarse sediment loads and formed a series of low angle, coalescing alluvial fans. Upon the alluvial fans in and around the cities of Walla Walla and Milton-Freewater these natural distributary channels still exist in part or in whole to this day. These channels are known today as the East Little Walla Walla River, West Little Walla Walla River, Mud Creek, Yellowhawk Creek, and Garrison Creek. Prior to the development of water resources in the valley, these distributary channels, with other unnamed channels, served as high water channels that conveyed large amounts of energy and water across the alluvial fan and away from the mainstem Walla Walla River and Mill Creek. These stream networks also provided off-channel habitat for aquatic species and provided recharge to the alluvial aquifer system. The channels run for several miles, accumulating spring flow, before returning back to the river further down the valley (Figure 4).

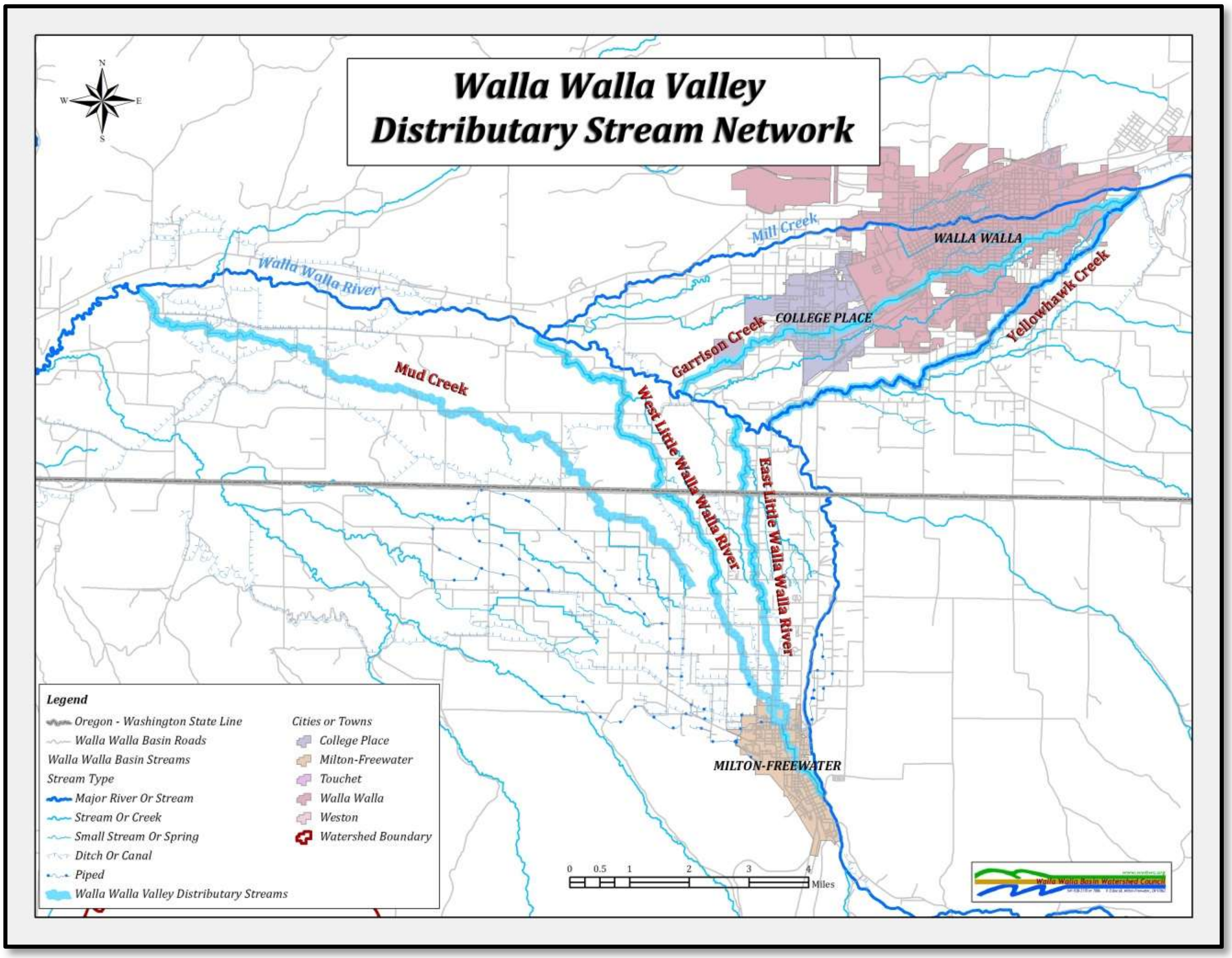

Figure 4 - Map of the distributary stream networks of the Walla Walla River and Mill Creek.

Generally, the ‘spreading out’ of water across the alluvial fans via distributary channels and adjacent floodplains, coupled with the high hydraulic conductivity of the underlying coarse sediment, functions as a primary groundwater recharge mechanism for the entire alluvial aquifer. This seasonally recharged aquifer system in turn feeds the valley’s springs, spring creeks and larger streams. This cycling of surface water to groundwater recharge, followed by later discharge in springs and as stream baseflow creates a delay in discharge of these waters from the valley.

Depending on local conditions, this delay can range from days to months, and even years (Jiménez, 2012).

The management and development of surface water resources in the basin led to the installation of flow control devices (i.e. irrigation head gates) at the heads of the distributary channels. Over time, management of the flow within the distributary network has resulted in a less natural distribution of floodwaters during periods of high flow. Peak stream flows that would generally occur during the winter and spring no longer have free access to the distributary network and adjacent floodplains that would provide recharge to the underlying alluvial aquifer. The current management of peak flows, channelization of the valley's rivers and creeks, and development of the alluvial aquifer as a groundwater resource has contributed substantially to declining groundwater levels in the alluvial aquifer.

The steep gradients between alluvial aquifer water levels and water in the river, coupled with the high hydraulic connectivity between surface water and alluvial groundwater, results in losing reaches along the streams and/or rivers where high seepage loss occurs (Figure 5). Instream flow is decreased as significant volumes of surface water drain to the underlying alluvial aquifer. Within the 23-mile segment of the Walla Walla River presented in Figure 5, some reaches experience greater than 30 percent flow loss to seepage. Gains (positive values) indicate groundwater discharging to the river and losses (negative values) indicate surface water seeping into the ground (see WWBWC, 2017a for details).

In recent years, the listing of steelhead and bull trout as threatened under the Endangered Species Act and the reintroduction of spring chinook salmon within the Walla Walla Watershed have led to out-of-court agreements between irrigators and federal fishery agencies to enhance instream flows. As a result of these agreements, local irrigators leave a portion of their legal water rights instream year-round. For example, the HBDIC and Walla Walla River Irrigation District irrigators leave 25-27 cfs instream throughout the year. However, depending on the water-year and a number of other factors, it is not unusual to have a significant portion (40-50%) of the bypass water seep into the underlying alluvial aquifer before it reaches the border between Washington State and Oregon State (WWBWC, 2014)

Creeks across the valley are sourced by springs discharging from the alluvial aquifer and have also seen declines in flow since the earliest hydrogeologic studies were conducted by Piper (acting on behalf of the US Supreme Court) in the 1930s, Newcomb in the 1960s, and Barker and MacNish in the 1970s (Piper, 1933; Newcomb, 1965; Barker and MacMish, 1976). Groundwater level declines in the alluvial aquifer since the 1930s and 1940s (Figures 6 and 7) are consistent with the general decline in discharge from springs sourced in the shallow aquifer (Figure 8). These trends indicate that over the past several decades there has been a general decrease in groundwater contributions to baseflow of the Walla Walla River and other surface water bodies during critical low-flow periods. Data in recent years suggest groundwater levels in GW_16 and GW_19 (Figures 6 and 7) are nearing a new equilibrium. The loss of cooler groundwater baseflow to streams affects not only the amount of flow in the river but also leads to increased surface water temperature during the low-flow periods, affecting aquatic species and the stream ecosystem.

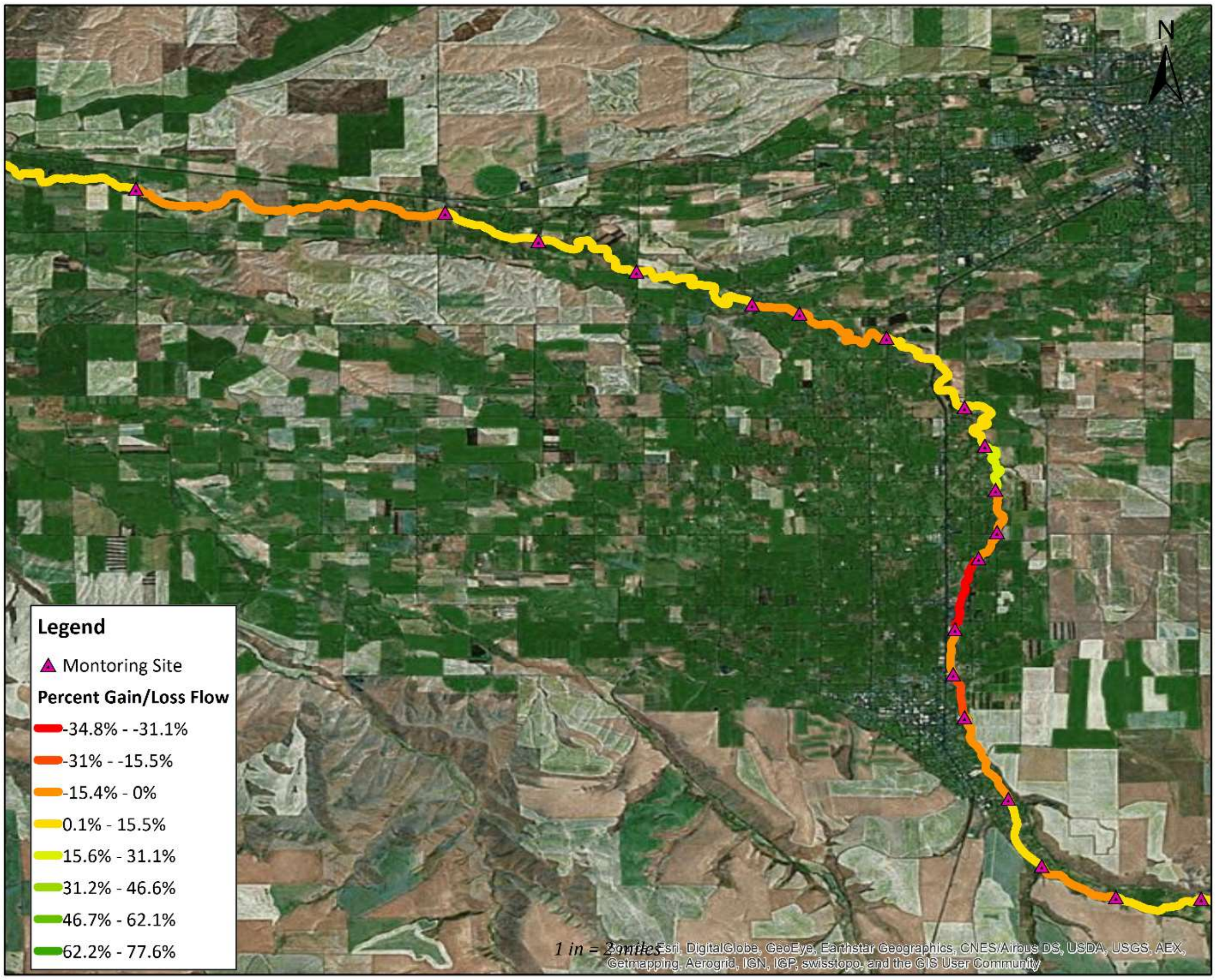

Figure 5 - Average percent gains or losses in flow of a segment of the Walla Walla River as measured during seepage runs conducted 2004-2016.

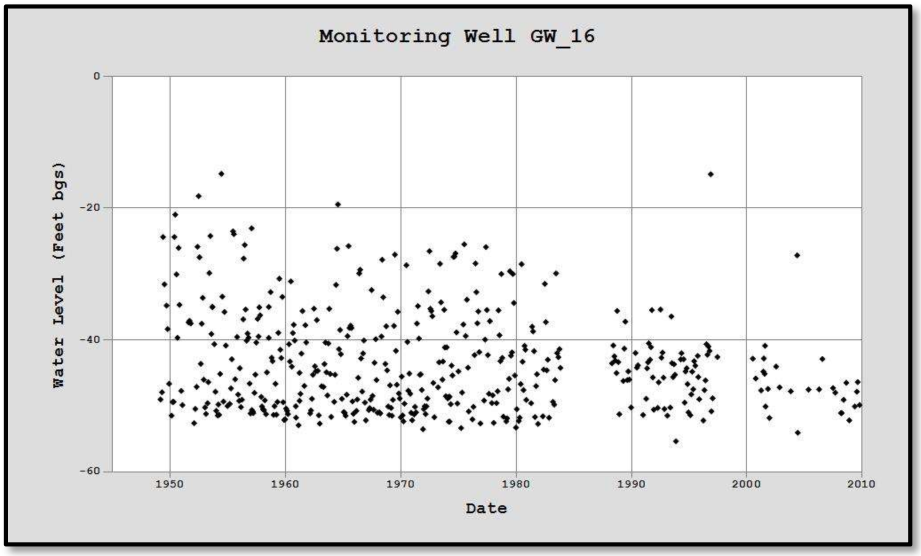

Figure 6 - Hydrograph for monitoring well GW_16 showing a long-term decline in the alluvial aquifer.

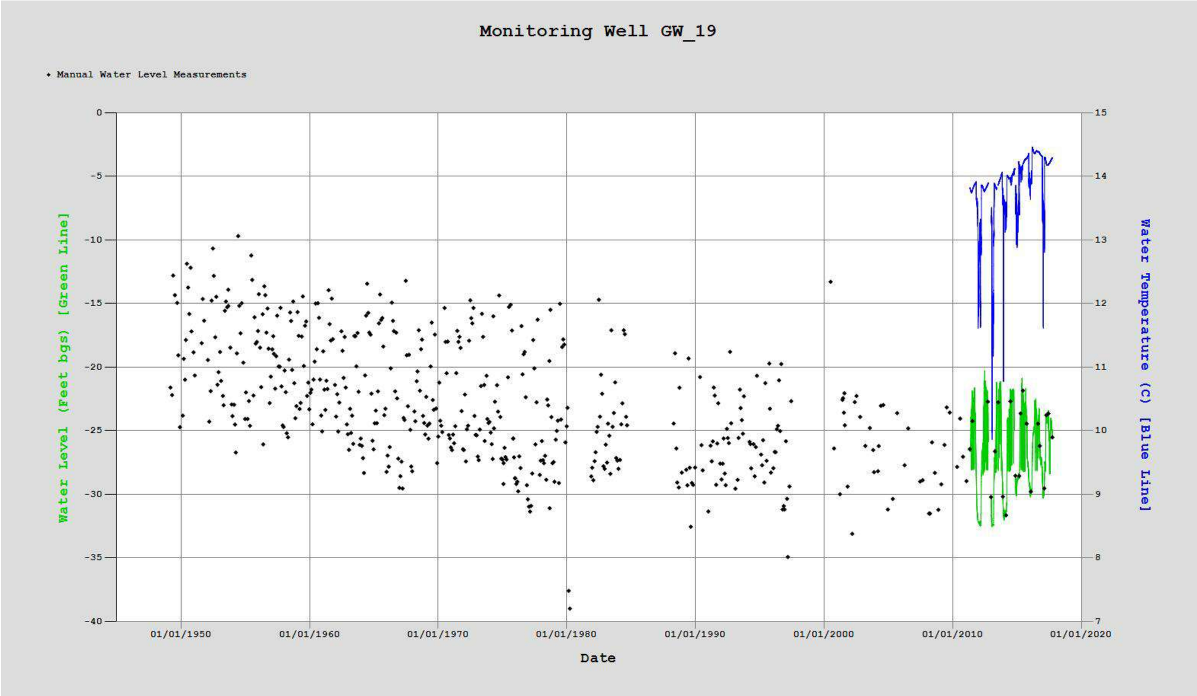

Figure 7 - Hydrograph for monitoring well GW_19 showing the groundwater level decline since 1950 in the alluvial aquifer in the Walla Walla basin.

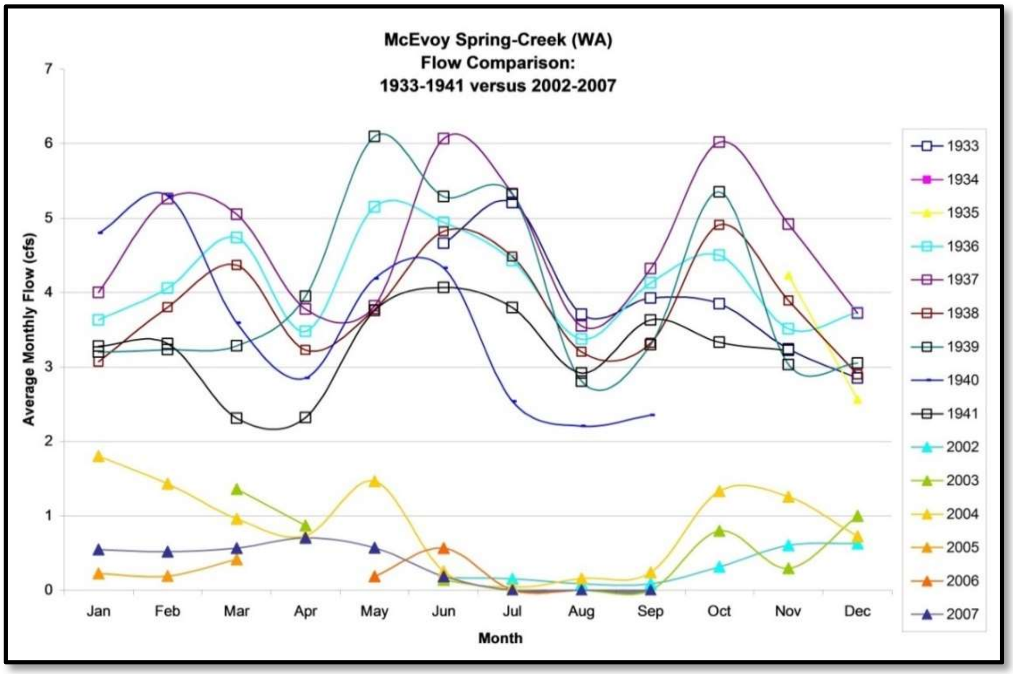

Figure 8 - Hydrograph for McEvoy Spring Creek showing the decline in flows between 1933-1941 and 2002-2007.

AQUIFER RECHARGE SITE INFRASTRUCTURE DESIGN AND OPERATION

The Anspach, Barrett, Chuckhole, Fruitvale, Johnson, Mud Creek, NW Umapine, Triangle Road, and Trumbull aquifer recharge sites were in operation during WY2017 as part of the Walla Walla basin aquifer recharge program (Figure 9). Each site's design, construction and operational capacity is provided in the following sections. Design drawings for each site are included as Appendix C.

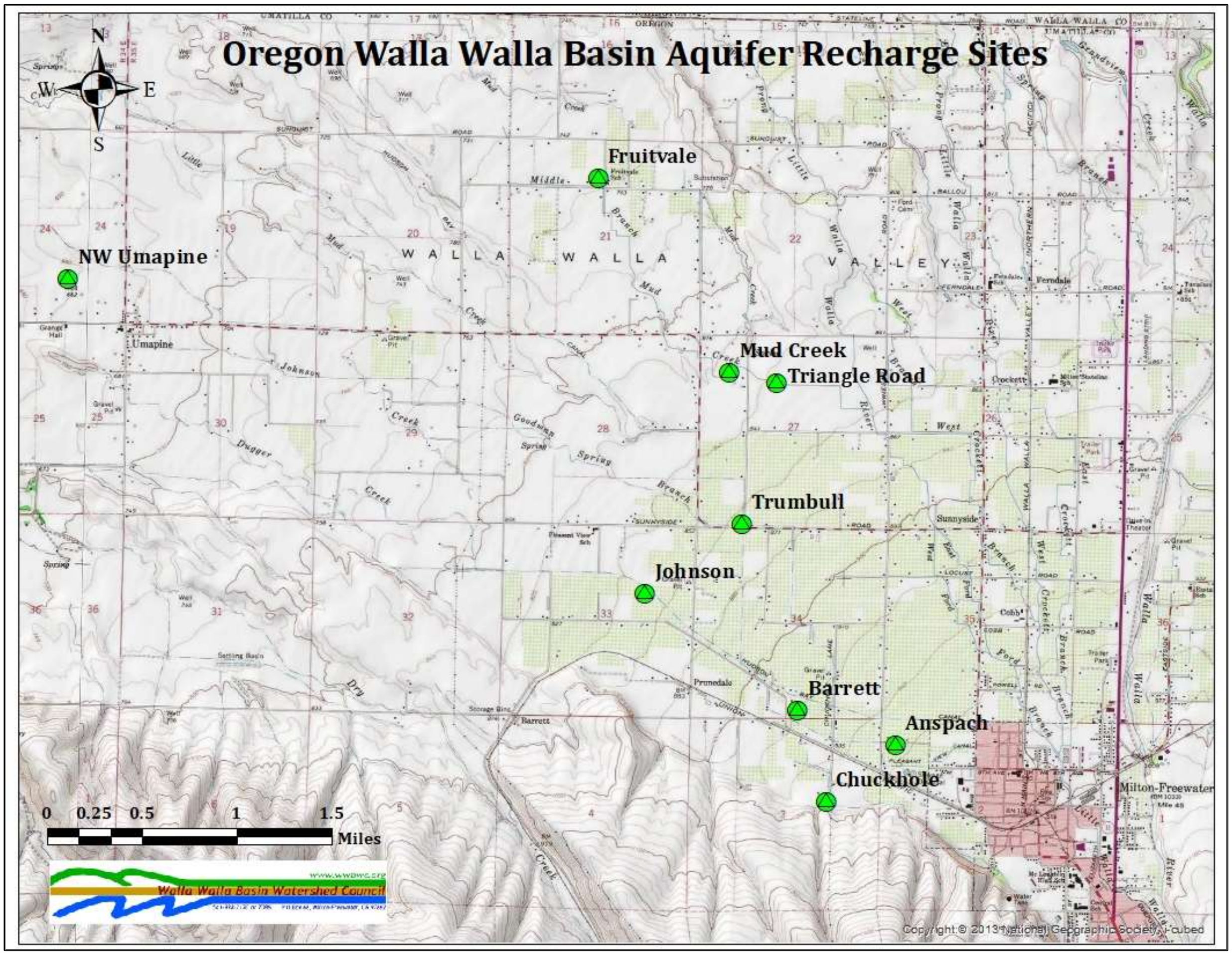

Figure 9 - Active aquifer recharge sites in the Oregon portion of the Walla Walla basin during WY2017.

ANSPACH SITE

The Anspach site was constructed in October 2012 using a combination of Bonneville Power Administration and Oregon Watershed Enhancement Board (OWEB) funding and expanded in the fall/winter of 2015. The site consists of a single turnout structure installed in the HBDIC canal that delivers water to a new pipeline that serves both infiltration galleries. Each infiltration gallery is independently controlled via valves and turnout pipes. The pipe manifolds into ten 4-inch diameter perforated drain field pipes buried 6 to7 feet below ground surface (bgs) and extends approximately 200 feet from the source water manifold (Figure 10). The perforated pipes sit on top of approximately 1 to 2 feet of clean gravel and are overlaid with approximately 0.5 to 1 foot of clean gravel (See Appendix C for designs).

Water for this site is delivered down the HBDIC's White Ditch and diverted into a private pipeline/ditch. The original site was designed to operate at a recharge rate of approximately 1 cfs. In the fall/winter of 2015, the Anspach site was expanded to include a second infiltration gallery and a new turnout and supply pipeline (Figure 11). The second infiltration gallery is similar in design to the original gallery. The expanded site is designed to operate at approximately 1,500 gallons per minute (gpm) which is 5 to 10 times what the site previously operated at. During the WY2017 recharge season, the site operated around 1,300 gpm (~3.0 cfs).

Figure 10 - The Anspach site during construction in 2012 (left) and new intake structure in 2015 (right).

BARRETT SITE

The Barrett site was constructed in the winter of 2014 using OWEB funding. The site consists of seven 4-inch diameter perforated drain field pipes buried 4 to 5 feet bgs and extending approximately 600 feet from the source water manifold (Figure 11). The perforated pipes sit on top of approximately 1 to 2 foot of clean gravel and are overlaid with approximately 0.5 to 1 foot of clean gravel (See Appendix C for designs). Water for this site is delivered down the HBDIC's White Ditch and diverted into the Barrett pipeline. The Barrett site's turnout and valve are situated along the pipeline. The site was designed to operate at a recharge rate of approximately 2-3 cfs (approximately 900 to 1300 gpm). During the WY2017 recharge season, the site operated at an average of 1.8 cfs. The site's intake structure is susceptible to clogging, which periodically results in lower intake rates than the designed rates.

Figure 11 - Barrett site under construction.

CHUCKHOLE SITE

The Chuckhole site was constructed in the fall of 2015 (Figure 12) but could not begin operating until after LL-1621 was issued on October 18, 2016. The site has an infiltration basin (roughly 0.05 acres in size) and sediment settling pond, located near the end of the Milton pipeline. The site was expected to recharge approximately 300-400 gpm or just under 1 cfs. During WY2017, its first recharge season, the site operated at an average of 0.1 cfs. The low calculated recharge rate may be a result of the flow meter's accuracy at low flow rates and may underestimate actual recharge. The meter's performance will be further evaluated.

Figure 12 - Chuckhole site under construction.

FRUITVALE SITE

The Fruitvale site was constructed in the fall of 2015 (Figure 13) but could not begin operating until after LL-1621 was issued on October 18, 2016. The site is an infiltration gallery with 12 x 4" perforated pipes 150' in length. The Fruitvale site is located within the Fruitvale Water Users Association system. The site was expected to recharge approximately 400 gpm or just under 1 cfs. During WY2017, its first recharge season, the site operated at an average of 0.2 cfs. The lower than expected recharge rate may have been a result of the low head (pressure from the gravity-fed system).

Figure 13 - Fruitvale site under construction.

JOHNSON SITE

The Johnson site, formerly known as the Hudson Bay site and/or the Hulette Johnson site, has been operating since 2004. The Johnson site has been developed in three phases since pilot testing operations began in 2004 (Figure 14). The initial two phases are described extensively in the final report for the sites first limited license (WWBWC, 2010). The site currently has the capacity for approximately 16 to 17 cfs (approximately 7,200 to 7,600 gpm) of infiltration into approximately 3 acres of infiltration basins (spreading basins) and three infiltration galleries (Figure 15). During the WY2017 season the site operated at an average recharge rate of 13.6 cfs (6,104 gpm). Johnson site construction is summarized below. For additional details on the Johnson site please see WWBWC (2010; 2013; 2014b).

SPREADING BASINS

The Johnson site was originally constructed with three spreading basins (Figure 13). The three original basins were constructed in the winter/spring of 2004. These basins were increased in size during 2005 to almost triple their original area. Phase II included the addition of a hydraulically upgradient spreading basin in 2006 and four infiltration galleries in the winter of 2009. Water for the new upgradient basin was fed through the original diversion with water being “pushed” into it from the first basin. Phase III included the addition of four additional basins on the lower end of the property, a new out-flow measurement weir, a new pipeline that feeds water to each individual basin, a telemetry system to remotely monitor site operation and an alternate method to deliver water to the upgradient basin. During the Phase III construction of the downgradient spreading basins, the largest basin described in the preliminary design was modified because subsurface material beneath the southern half of the planned basin consisted of finer-grained sand/silt while the northern half consisted of coarser gravel/cobbles. On the basis of the encountered heterogeneous conditions, it was decided to divide the downgradient basin into two basins based upon the sediment types.

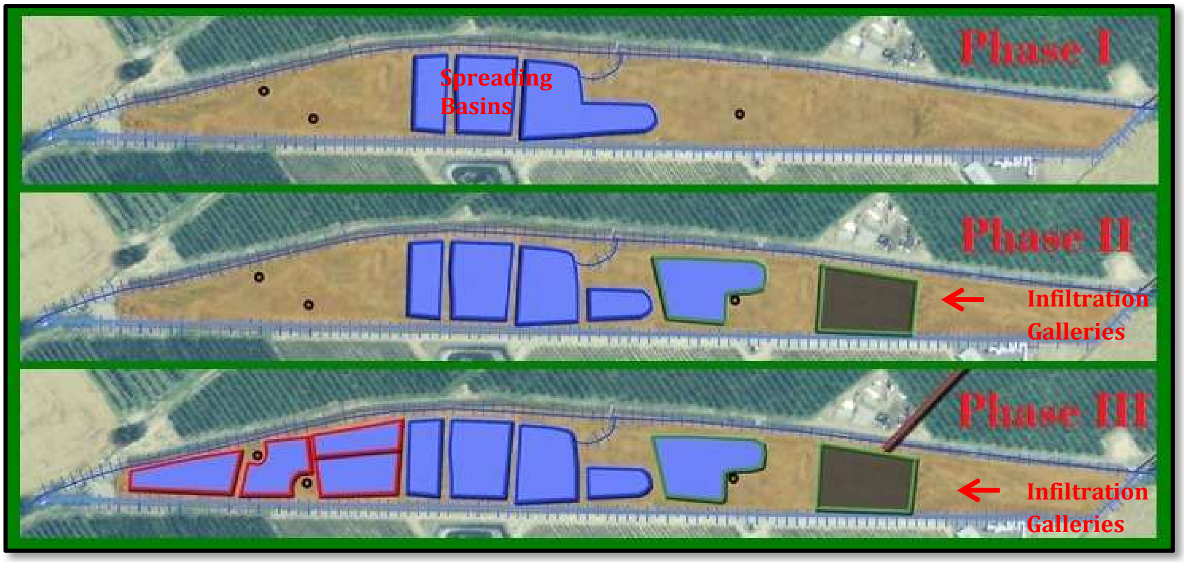

Figure 14 - Three phases of constructing infiltration basins at the Johnson site: phase I in 2004-2005, phase II in 2006-2009 and phase III in 2010-2011.

Figure 15 - Aerial photo of the Johnson site in 2013 showing 10 basins and location of infiltration galleries.

INFILTRATION GALLERIES

During Phase II, four different infiltration gallery (IG) designs were installed at the Johnson site to evaluate each design's performance, longevity, and cost-benefit. IG #1 was constructed of four corrugated 4-inch perforated pipe, IG #2 was constructed of twenty 4-inch drain field pipe, IG #3 was four 4-inch drain field pipe inside Stormtech stormwater chambers, and IG #4 was a single 4-inch drain field pipe inside Atlantis stormwater devices (Figure 16). During the first season of testing IG #1 clogged up and has not been utilized since. IG #2, IG #3 and IG #4 have all continued to function and have been operated during each recharge season.

Figure 16 - Photographs of infiltration galleries #2 (left), #3 (center), and #4 (right) being installed at the Johnson site.

MUD CREEK SITE

The Mud Creek site was constructed in the fall of 2015 (Figure 17) but could not begin operating until after LL-1621 was issued on October 18, 2016. The site is an infiltration basin approximately 0.6 acres in size within a grass pasture/wildlife area. Water for the project is delivered from the Fruitvale Ditch and then can overflow, if needed, back into the Fruitvale Ditch. The site is upgradient of the Mud Creek headwater springs and is expected to improve instream flows in Mud Creek and recover local groundwater levels. The site was expected to operate around 400-500 gpm or approximately 1 cfs. During WY2017, its first recharge season, the site operated at an estimated average of 0.1 cfs. The low recharge rate may be a function of the limitations of the method used to estimate recharge through the bottom of the basin. The outlet from the basin into the Fruitvale Ditch was reconfigured this year which should help improve estimating recharge rates.

Figure 17 - Photograph of Mud Creek site during construction.

NW UMAPINE SITE

The NW Umapine site was constructed in the fall of 2013 (Figure 18). The site consists of a single infiltration basin approximately 0.46 acres in size (Figure 18). The site is supplied by an approximately 1,000-ft long lateral pipeline installed off of HBDIC's Richartz's pipeline. The site was designed to operate at a recharge rate of 2-3 cfs (approximately 900 to 1300 gpm). During the WY2017 recharge season the site averaged 1.6 cfs (718 gpm).

Figure 18 - NW Umapine site during WY2014 recharge season.

TRIANGLE ROAD SITE

The Triangle Road site was constructed in the fall of 2016 (Figure 19). The site is an approximately 0.2-acre infiltration basin. Water is delivered from the Fruitvale Ditch and then can overflow, if needed, back into the Fruitvale Ditch. The site is upgradient of the Mud Creek headwater springs and is expected to improve instream flows in Mud Creek and recover local groundwater levels. The site was expected to operate around 400-500 gpm or approximately 1 cfs. In WY 2017, the site operated at an average of 0.4 cfs. The lower than expected recharge rate may have been related to an operational issue.

Figure 19 - Triangle Road site under construction in fall 2016.

TRUMBULL SITE

The Trumbull site was constructed in October 2012 using a combination of Bonneville Power Administration and OWEB funding. The site consists of three 8-inch perforated pipes buried 6 feet bgs and extending approximately 300 feet in length from the source water discharge and inline flow meter (Figure 20). The perforated pipes sit on top of approximately 1-2 foot of clean gravel and are overlaid with approximately 0.5-1 feet of clean gravel (See Appendix C for designs). The Trumbull site's water source is at the structure that splits the HBDIC canal into the Hyline pipeline and the Richartz ditch. The site has its own turnout and valve so it can operate independent of the ditch or pipeline. The site was designed to operate at a recharge rate of 2 to 3 cfs (approximately 900 to 1300 gpm). During WY2017, the site operated at an average of 0.8 cfs. As in WY2016, the reduced recharge rate may be due to downgradient control by springs and groundwater mounding as well as limited head pressure in the diversion structure at times during the recharge season.

Figure 20 - Trumbull site under construction in October 2012.

WY 2017 AQUIFER RECHARGE PROGRAM MONITORING

This section describes diversion system monitoring results, individual site aquifer recharge operations, groundwater level monitoring, and source and groundwater quality monitoring results. Laboratory water quality testing results are provided in Appendix D. Well logs for groundwater monitoring wells are included in Appendix E.

Diversion System

LL-1621 allows for up to 70 cfs to be diverted from the Walla Walla River for the purpose of testing artificial recharge. Per the conditions of LL-1621, a minimum instream flow amount is required to remain in the Tum a Lum reach of the Walla Walla River depending on the time of year (Table 1). WWBWC coordinated with HBDIC and the OWRD District 5 watermaster to ensure that this condition of LL-1621 was met during recharge operations in WY 2017.

Table 1. Minimum instream flow values that must be met before water can be diverted for aquifer recharge sites under LL-1621.

Minimum Instream Flow Values for Limited License 1621		
Nov 1 thru Nov 30	***Dec 1 thru Jan 31***	***Feb 1 thru May 15***
64 cfs	***95 cfs***	***150 cfs***

Managed recharge under the limited license did not begin until December 12, 2016 due to minimum flow requirements not being met prior to this date. Later in the season, recharge was interrupted from January 25 to March 6 due to the annual maintenance of fish screens at the Little Walla Walla River diversion, which effectively ceases delivery of water to all canals and ditches from which the recharge sites receive their water. Ditches supplying the recharge sites serviced by the Walla Walla River Irrigation District and Fruitvale Water Users Association (Chuckhole, Fruitvale, Mud Creek, and Triangle Road) did not resume water delivery until late April due to ditch maintenance activities. Ditches and canals operated by the HBDIC resumed water delivery in early March to Anspach, Barrett, Johnson, NW Umapine, and Trumbull. Ice also caused intermittent short-term shut-offs at some sites. Diversions for aquifer recharge were terminated for the season on May 15, 2017 due to the end of the recharge season as defined in the Limited License.

Not all of the water diverted from the Walla Walla River reaches the aquifer recharge sites due to seepage through unlined portions of the canal system and/or evaporative losses. Because recharge operations occur during winter and spring months, evaporative losses are assumed to be negligible. To estimate ditch seepage losses during diversion, total water volumes at the Little Walla Walla Diversion stream gage (during periods when only recharge water was being diverted from the Walla Walla River) were compared to measured water volumes delivered to the recharge sites. Ditch seepage was estimated by subtracting the water delivered to the recharge sites from the water diverted from the Walla Walla River, with the difference assumed to be the amount of ditch seepage. Because the transducer for S-204, which measures the amount of water diverted at the Little Walla Walla Diversion, had operational issues during WY2017, the seepage loss rate from WY2016[1] was used for WY2017. Applying the 8.8 ac-ft per day seepage loss estimate from WY2016 to the 110 days of operation in WY2017 results in 968 ac-ft of seepage loss in WY2017.

Groundwater Monitoring System

The groundwater monitoring network consisted of 27 wells in WY2017 (Figure 21). For each recharge site, the following section presents the amount of water recharged during WY2017, a map of groundwater monitoring wells associated with the site, and the results from monitoring groundwater levels. A chart of groundwater levels over the entire period of record is included for each well. In these charts, the scales on the x-axis and y-axis are consistent between different charts as much as possible to make comparisons between wells easier.

For monitoring wells at aquifer recharge sites with at least three years of continuous data, a second set of charts displays the shallowest and deepest groundwater level values during each water year, with no attempt to keep the scales comparable, to better show the differences between years. For wells associated with recharge sites with at least three years of operation, Table 2, below, lists the difference in groundwater elevation between the first and last year in the time series for the yearly shallowest and yearly deepest groundwater levels – either the first year and most recent year of operations, or the first year and most recent year of monitoring if the well was not installed until

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[1] The seepage loss rate for WY2016 was based on the following: The total amount of water diverted at the Little Walla Walla Diversion stream gage from November 16, 2016 to May 15, 2017 was 6,229.54 ac-ft. A total of 5,208.74 ac-ft were applied at the five recharge sites over the same period. The resulting calculated ditch seepage from November 16, 2015 to May 15, 2016 was 1,020.8 ac-ft, or approximately 8.8 ac-ft per day based on a 116-day recharge period (WWBWC, 2017b).

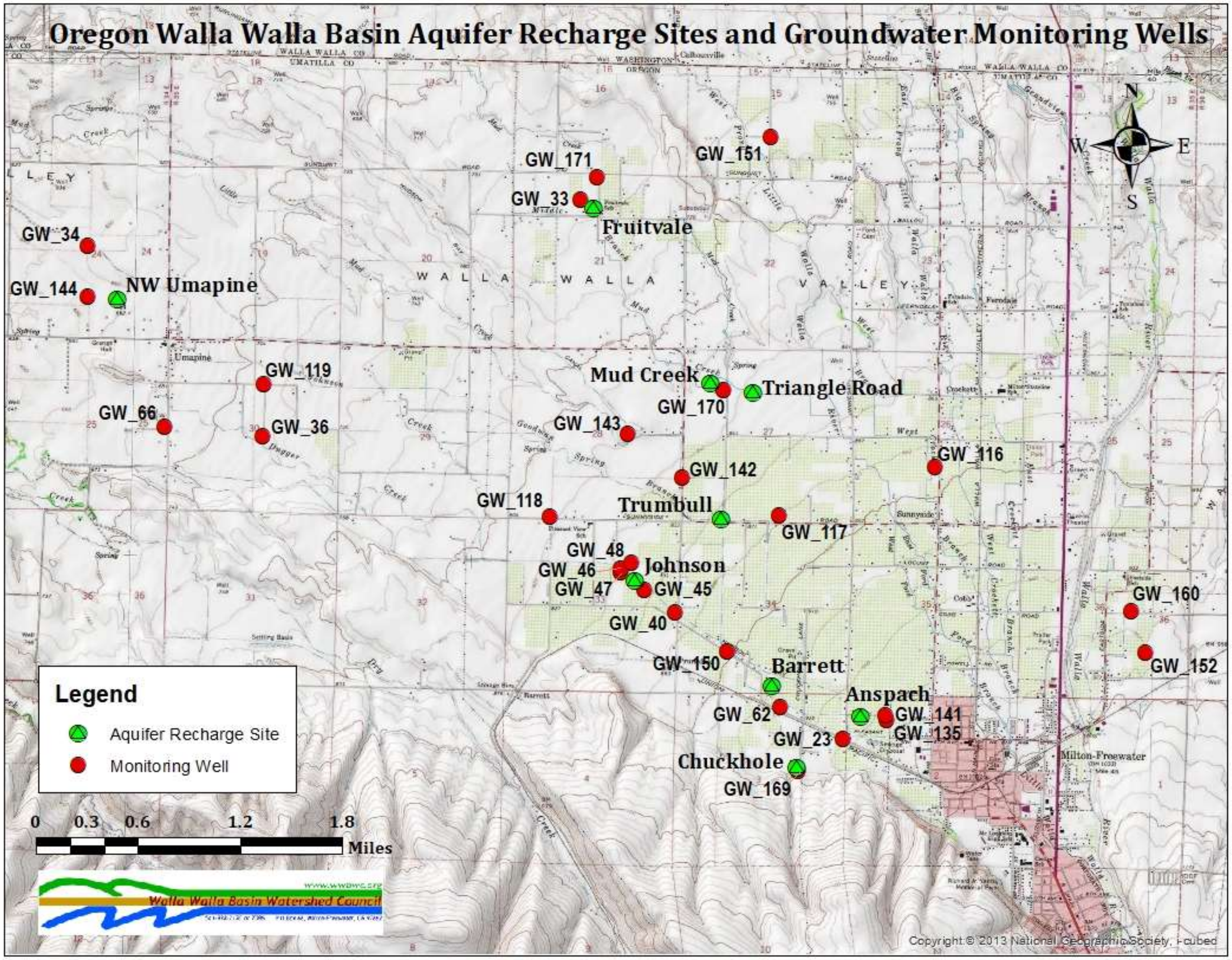


Figure 21 – Groundwater monitoring wells and aquifer recharge sites.

after the first year of recharge. The annual shallowest and deepest groundwater levels (the peaks and troughs in the hydrographs) were assessed because different factors influence recharge and discharge, although the resulting seasonal variability is of course a function of the interaction between the two sets of factors. Groundwater elevations become shallower when recharge is greater than discharge; in contrast, groundwater elevations become deeper when discharge is greater than recharge. Factors influencing recharge rates include managed aquifer recharge, passive seepage from surface waters (e.g., rivers, streams, ponds, unlined ditches and canals), precipitation, and irrigation. Factors influencing discharge rates (groundwater leaving the location being monitored) include pumping, movement to another aquifer, and groundwater returning to the surface as springs or as contributions to instream flows in rivers and streams. Of all these interacting factors, this report only evaluates recharge from managed aquifer recharge sites. If funding allows, in the future more detailed analyses of changes over time could include quantitative trend analyses of groundwater elevations, differences between years in precipitation rates, differences in years between measured seepage losses, and qualitative or semi-quantitative assessments of changes in passive infiltration (e.g., what length of canal was piped, in what year, and where) and other factors influencing recharge and discharge rates.

Please note, in some of the hydrographs, the duration of the recharge season is provisional because some of the tentative on and off dates for a few of the older sites could not be confirmed. The dates may be adjusted once confirmation is received.

Table 2. Differences between the first and last year of the yearly shallowest and deepest groundwater levels.

Monitoring Well	Water Years Evaluated*	Difference (ft) between first and last year of shallowest groundwater level	Difference (ft) between first and last year of deepest groundwater level	Associated Aquifer Recharge Site	Water Years Site Has Operated
GW_135	manual measurements			Anspach	part of 2013 thru 2017
GW_141	2014 to 2017	11.8	9.1	Anspach	
GW_62	2015 to 2017	3.7	-0.2	Barrett	part of 2014 thru 2017
GW_118	2010 to 2017	7.5	3.8	Johnson	part of 2004 thru 2017
GW_40	Jan. 2007 to 2017*	9.2	-0.1	Johnson	
GW_45	2005 to 2017	-0.1	4.0	Johnson	
GW_46	2005 to 2017	8.5	2.6	Johnson	
GW_47	2005 to 2017	-0.6	6.1	Johnson	
GW_48	2005 to 2017	2.9	7.5	Johnson	
GW_119	2014 to 2017	0.4	0.1	NW Umapine	2014 thru 2017
GW_144	2014 to 2017	1.1	6.8	NW Umapine	
GW_34	2014 to 2017	1.1	0.1	NW Umapine	
GW_36	manual measurements			NW Umapine	
GW_66	2014 to 2017	-0.2	1.5	NW Umapine	
GW_117	2014 to 2017	1.7	6.3	Trumbull	part of 2013 thru 2017
GW_142	2014 to 2017	1.4	0.0	Trumbull	
GW_143	2014 to 2017	0.7	-0.9	Trumbull	

*Not a complete water year.

Note: Green shaded cells indicate increased water levels between first and last year, beige shaded cells indicate decreased water levels between first and last year.

ANSPACH SITE

The Anspach site was operated for 110 days during the WY2017 recharge season, receiving a total of 659.9 ac-ft for an average of 6 ac-ft per day of water (Figure 22). The site has two upgradient wells, GW_135 and GW_141, and cross-gradient well GW_23 (Figure 22). Groundwater levels at GW_141 and GW_135 are increasing (becoming shallower) in recent years (Figure 24). At GW_141, between 2014 (the first full year of operations) and 2017, the shallowest groundwater levels (the peaks of the hydrograph curves) increased by 11.8 ft and the deepest groundwater levels (the troughs of the hydrograph curves) increased by 9.1 ft (Table 2 and Figure 23). Even though GW_141 and GW_135 are upgradient of the recharge site, the timing of the seasonal patterns (Figure 24) suggests both wells are influenced by managed recharge operations, perhaps as a result of groundwater mounding under the Anspach site. GW_135 is monitored quarterly while GW_141 is monitored continuously. While the quarterly data from GW_135 appear generally consistent with the seasonal pattern of the continuously monitored GW_141, the two sets of data illustrate the greater power of continuous data in helping understand temporal changes.

In GW_141, water levels began increasing in mid-September likely in response to passive recharge from the conveyance system, then continuing to rise as the managed recharge season began later in early winter. Water levels decreased in late May 2017 shortly after recharge operations were suspended for the season (Figure 24).

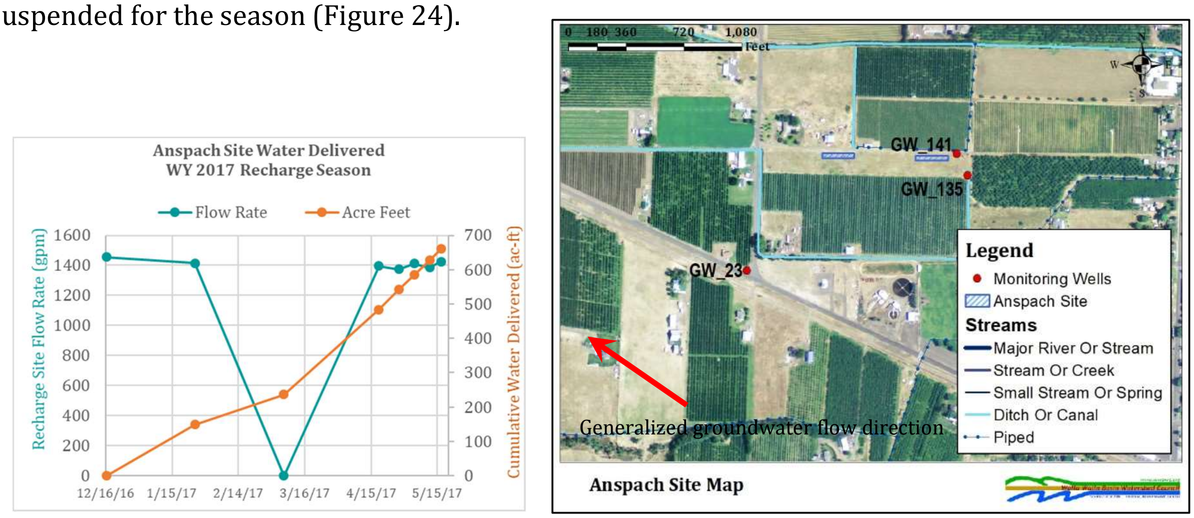


Figure 22 - Anspach inflow rates and cumulative water delivered during WY 2017 (left) and monitoring well locations (right).

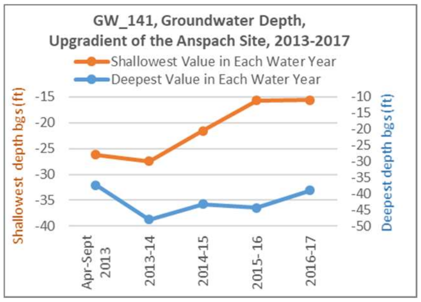
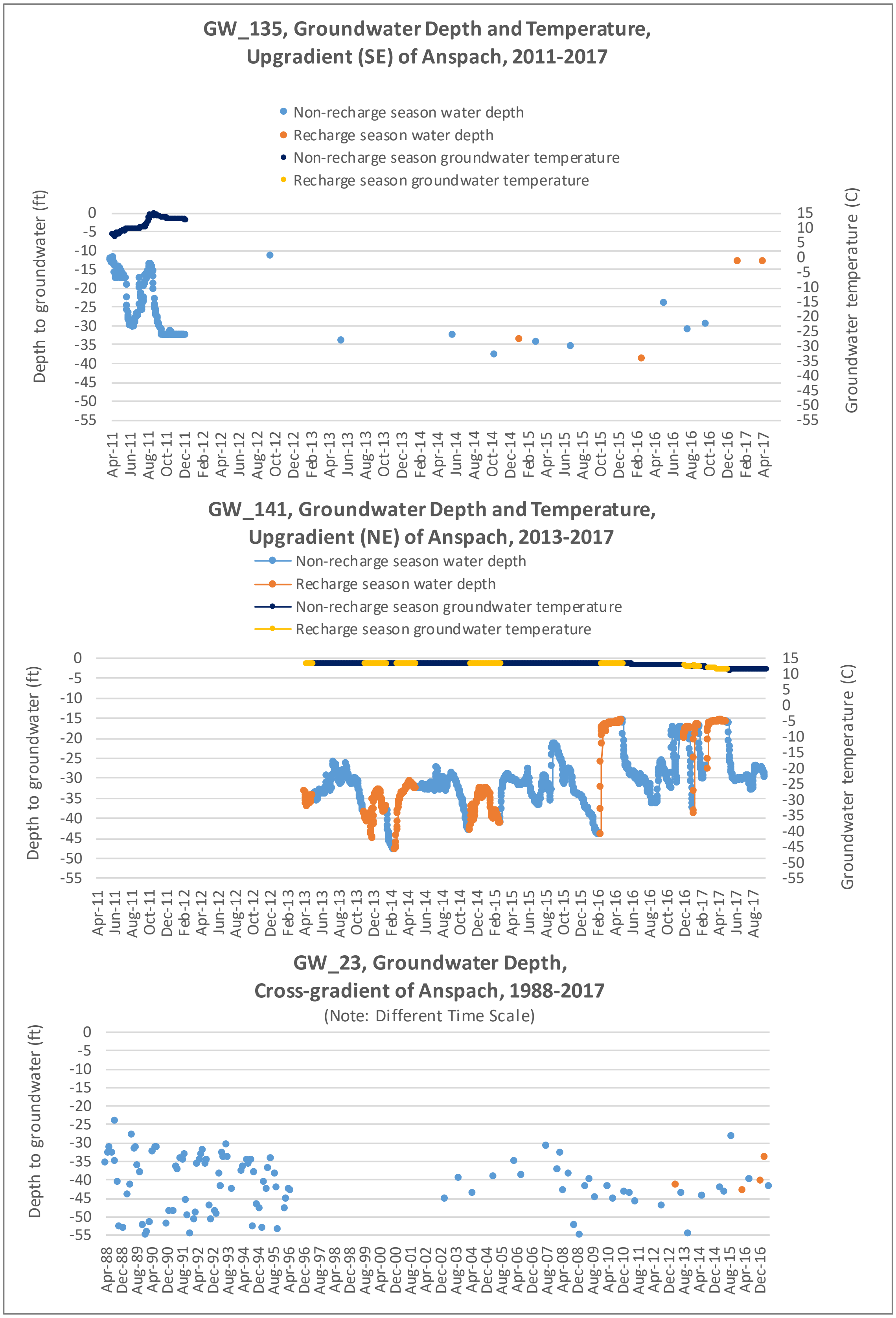


Figure 23 - Shallowest and deepest groundwater levels, by year, GW_141.



GW_135, Groundwater Depth and Temperature, Upgradient (SE) of Anspach, 2011-2017

GW_141, Groundwater Depth and Temperature, Upgradient (NE) of Anspach, 2013-2017

GW_23, Groundwater Depth, Cross-gradient of Anspach, 1988-2017

(Note: Different Time Scale)

Figure 24 - Hydrographs for Anspach monitoring wells.

BARRETT SITE

During the WY2017 recharge season the Barrett site operated for 110 days from mid-December 2016 until May 15, 2017, receiving a total of 383.5 ac-ft of water for an average of 6 ac-ft per day (Figure 25). Responses to recharge operations at the Barrett site were observed at the upgradient groundwater monitoring well, GW_62 (Figure 26). Groundwater levels typically increased during recharge operations and decreased when recharge operations stopped. Between 2014, the first year of operations, and 2017 the shallowest groundwater levles at GW_62 increased (became shallower) by 3.7 ft and the deepest groundwater levels decreased (became deeper) by 0.2 ft (Table 2 and Figure 27). Peak groundwater levels were roughly 5 feet shallower in the four years during operation of the Barrett site than the four years prior to operation of the Barrett site (Figure 26).

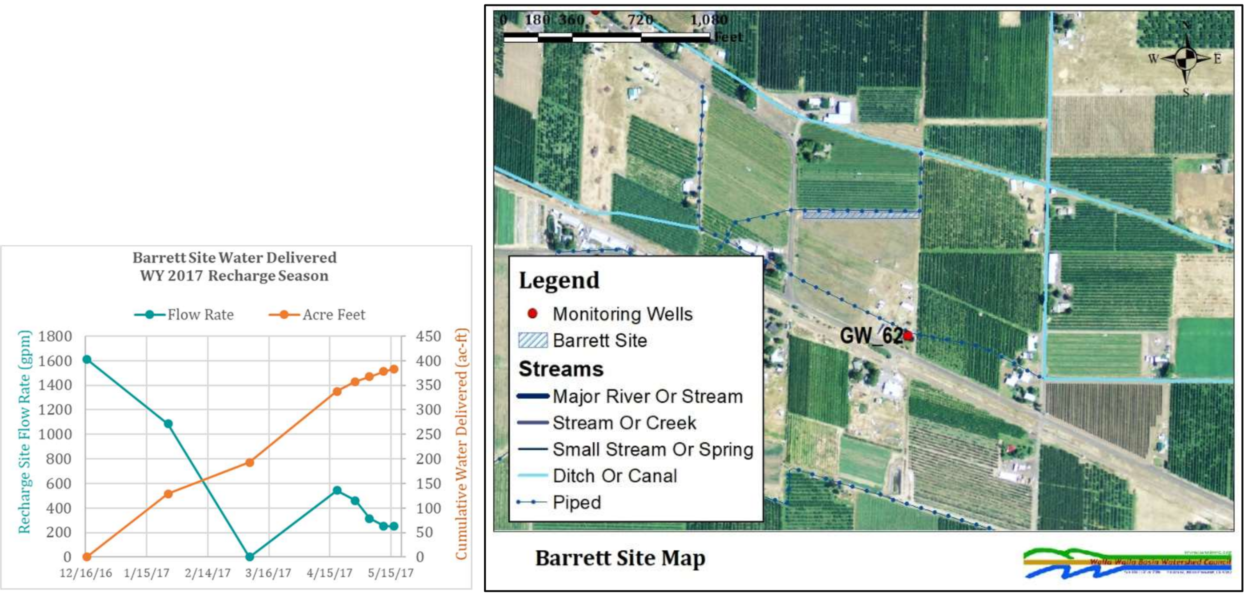


Figure 25 - Barrett inflow rates and cumulative water delivered during WY 2017 (left) and monitoring well location (right).

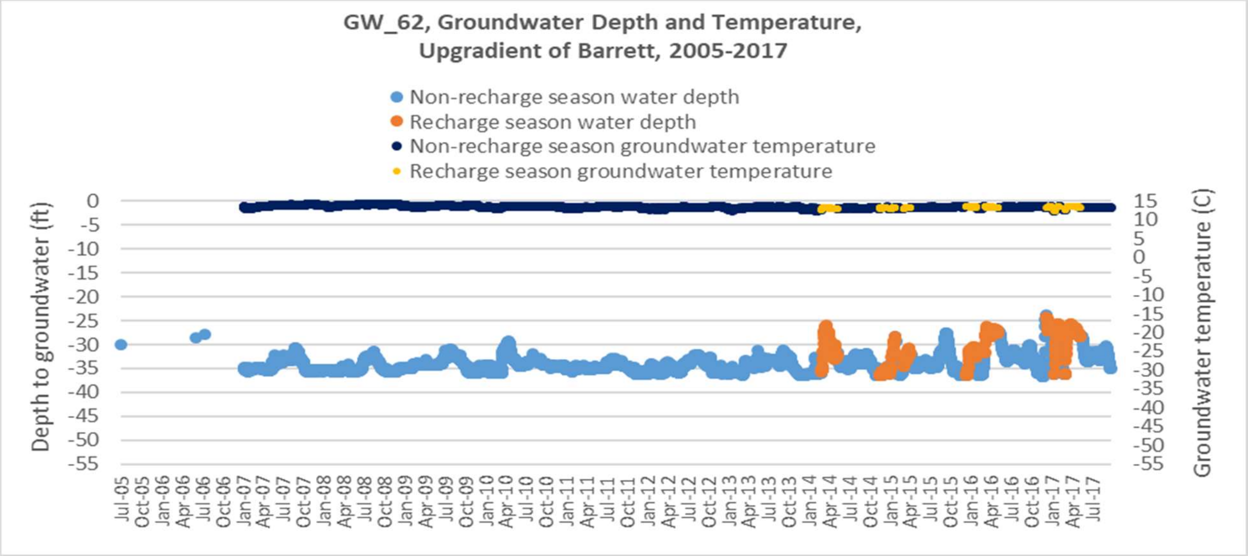


Figure 26 - Hydrograph for monitoring well GW_62.

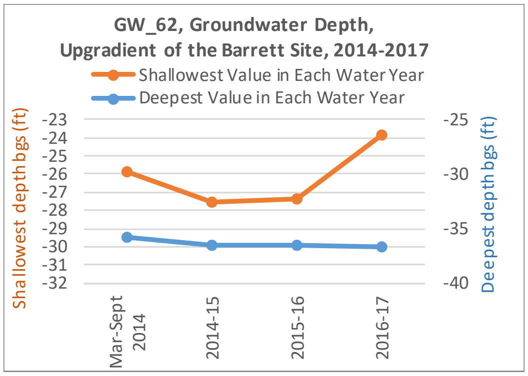


Figure 27 – Shallowest and deepest groundwater levels, by year, GW_62.

CHUCKHOLE SITE

During WY2017, the first recharge season for the Chuckhole site, the site operated for 48 days, primarily in April and May, receiving a total of 13 ac-ft of water (Figure 28). The site has three monitoring wells: GW_169 upgradient, GW_62 downgradient, and GW_23 cross-gradient (Figure 28). At GW_62, the timing of recharge at the Chuckhole site does not correspond to an increase in groundwater levels (Figure 29); however, GW_62 is influenced by the Barrett site. At GW_169, the timing of the improvement in groundwater levels at GW_169 cannot be determined due to a gap in the continuous data set. At GW_23, which may be influenced by the Anspach site, the long-term groundwater levels appear to have a downward trend until 2013, when groundwater levels increase, which coincides with the beginning of recharge operations at Anspach.

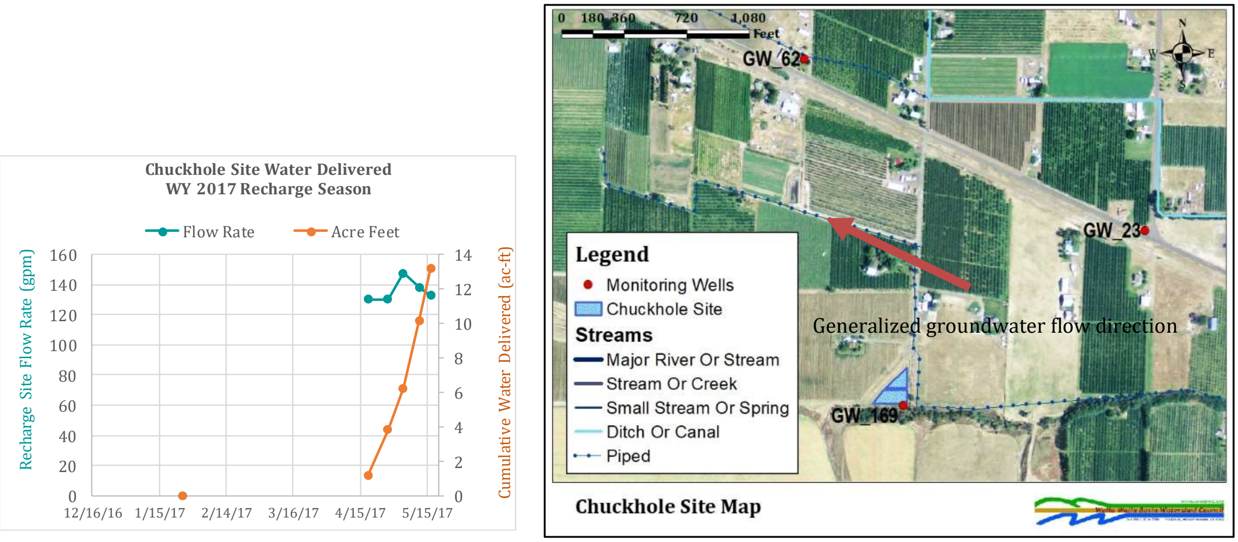


Figure 28 - Chuckhole inflow rates and cumulative water delivered during WY 2017 (left) and monitoring well locations (right).

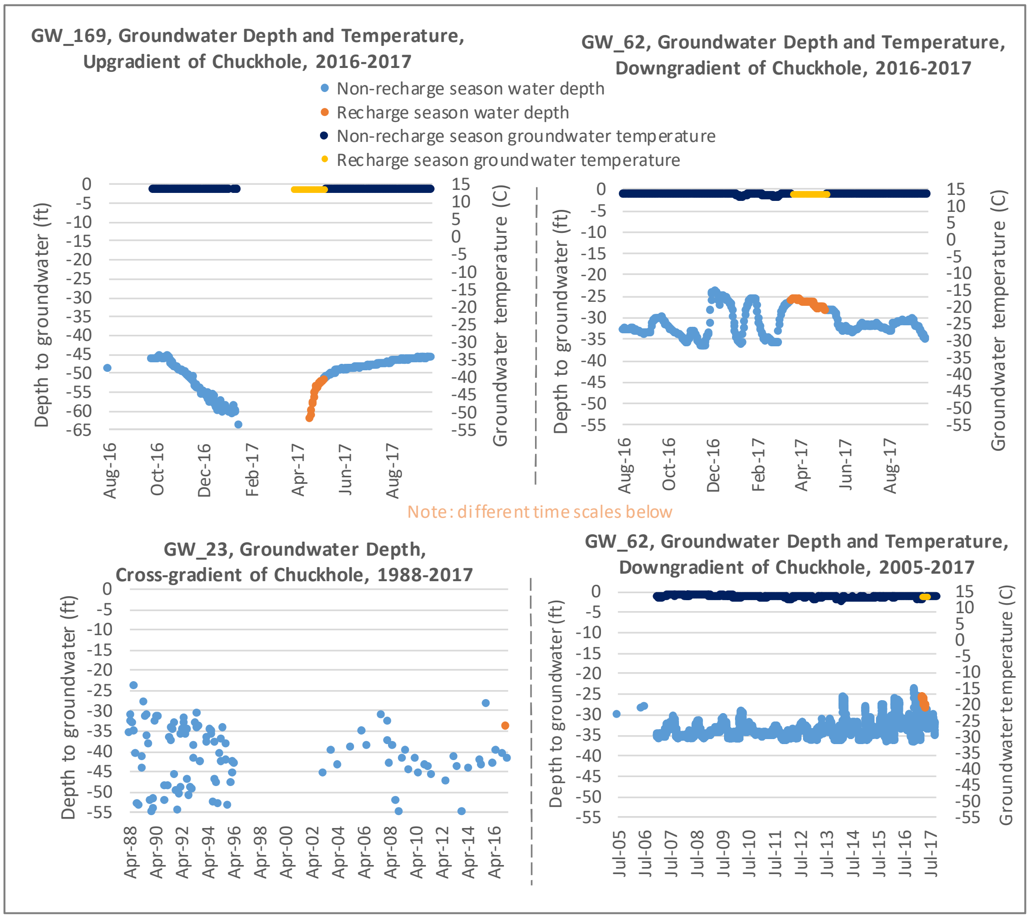
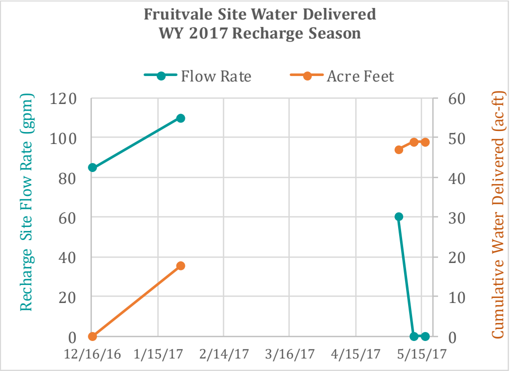


Figure 29 - Hydrographs for monitoring wells GW_169, GW_62, and GW_23.

FRUITVALE SITE

During WY2017, the first recharge season for the Fruitvale site, the site operated for 56 days in early winter and in May, receiving a total of 49 ac-ft of water (Figure 30). However, a portion of the total water received by the site consists of natural springs which are not included in the Limited License and are not managed under the WWBWC's program. Flow values that were recorded when water from the Little Walla Walla River was not being delivered to the recharge site were assumed to represent spring flow and were subtracted from the cumulative volume. Subtracting the estimated spring flow from the total results in an estimated total recharge of 17 ac-ft, for an average of 0.4 ac-ft per day.

Groundwater monitoring well GW_33 is downgradient and GW_171 is cross-gradient of the site. Groundwater levels began increasing (becoming shallower) before recharge began in December 2016, presumably due to irrigation conveyance losses, and continued to increase during the managed recharge season at downgradient GW_33. Groundwater levels decreased in both monitoring wells after mid-May 2017 (Figure 31).



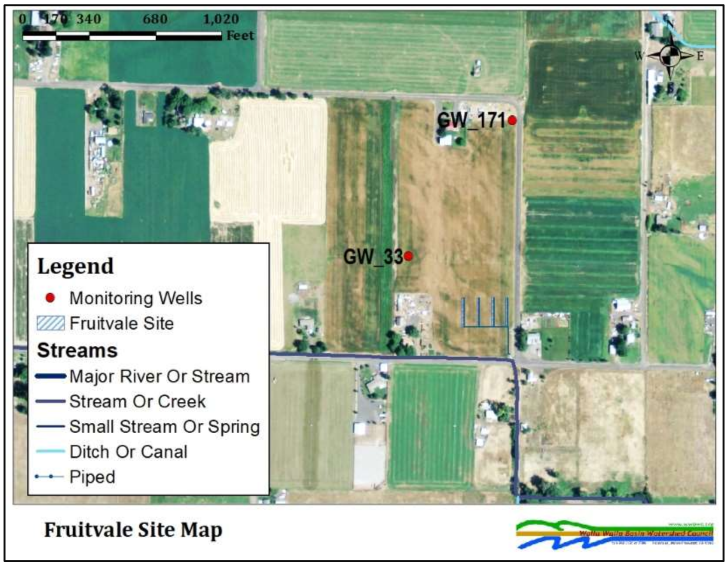


Figure 30 - Fruitvale inflow rates and cumulative water delivered during WY 2017 (above) and monitoring well locations (right).

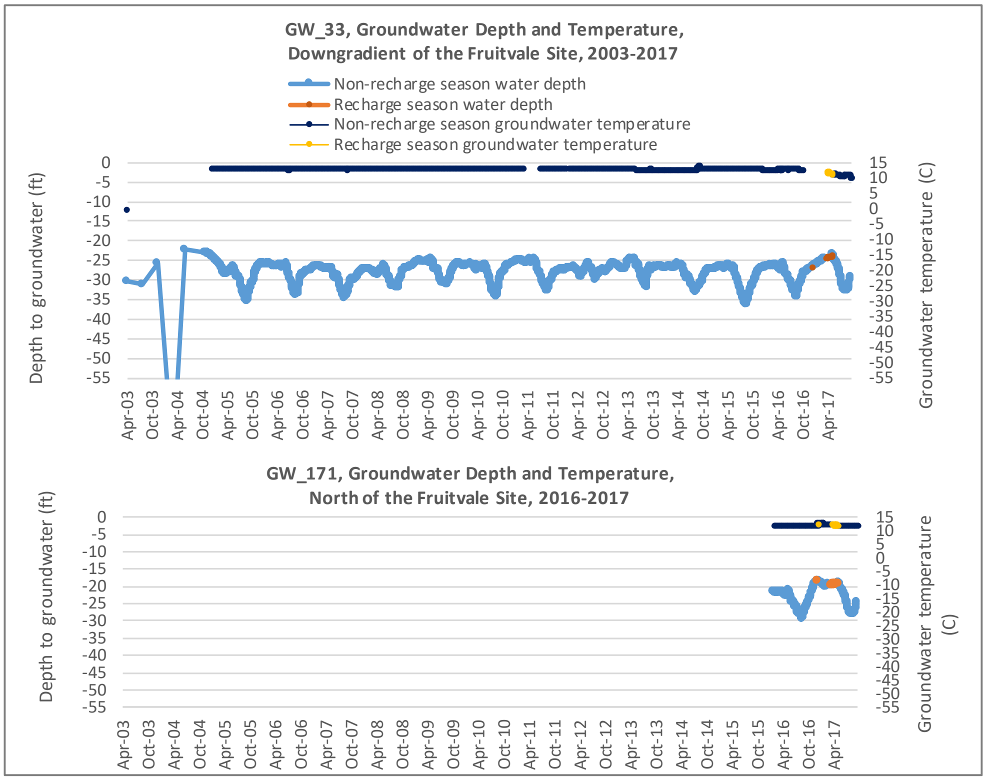


Figure 31 - Hydrographs for monitoring wells GW_33 and GW_171.

JOHNSON SITE

The Johnson site operated for 101 days during the WY 2017 recharge season. The site began recharging in mid-December, continued through early February, and from mid-March until May 15, 2017, receiving a total of 2,732 ac-ft of water for recharge at an average rate of 27 ac-ft per day (Figure 32). The ten spreading basins received 2,271 ac-ft and three active infiltration galleries received 461 ac-ft.

Six monitoring wells are on or near the site (Figure 33). Groundwater levels under the Johnson site (GW_45, GW_46, and GW_47) are roughly 15-20 ft closer to the ground surface than at the upgradient well (GW_40). The shallowest groundwater levels in downgradient GW_118 are similar to levels under the Johnson site during recharge season (Figures 34 and 35). Groundwater levels have become shallower over time in all six monitoring wells to varying degrees. Between the first year of monitoring and WY2017, the shallowest groundwater levels improved by 8.5, 2.9, 9.2 and 7.5 ft at GW_46, GW_48, GW_40, and GW_188, respectively, and the deepest groundwater levels improved by 2.6, 4.0, 6.1, 7.5, and 3.8 ft at GW_46, GW_45, GW_47, GW_48, GW_118, respectively (Table 2 and Figure 36). Groundwater levels slightly decreased between the first year of monitoring and 2017 for the shallowest levels at GW_45 and GW_47 and the deepest levels at GW_40 (Table 2 and Figure 36).

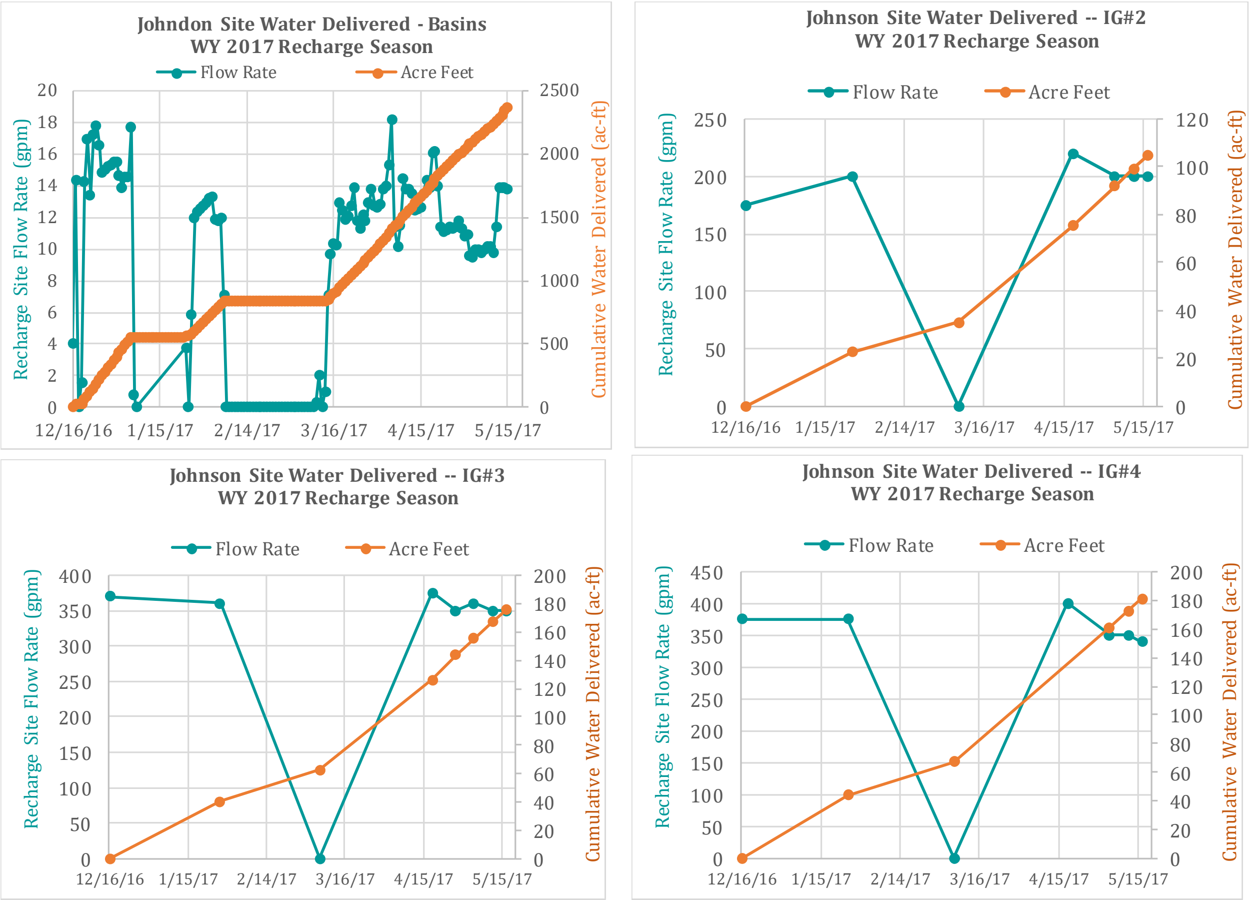


Figure 32 - Inflow rates and cumulative water delivered to the Johnson site during WY 2017.

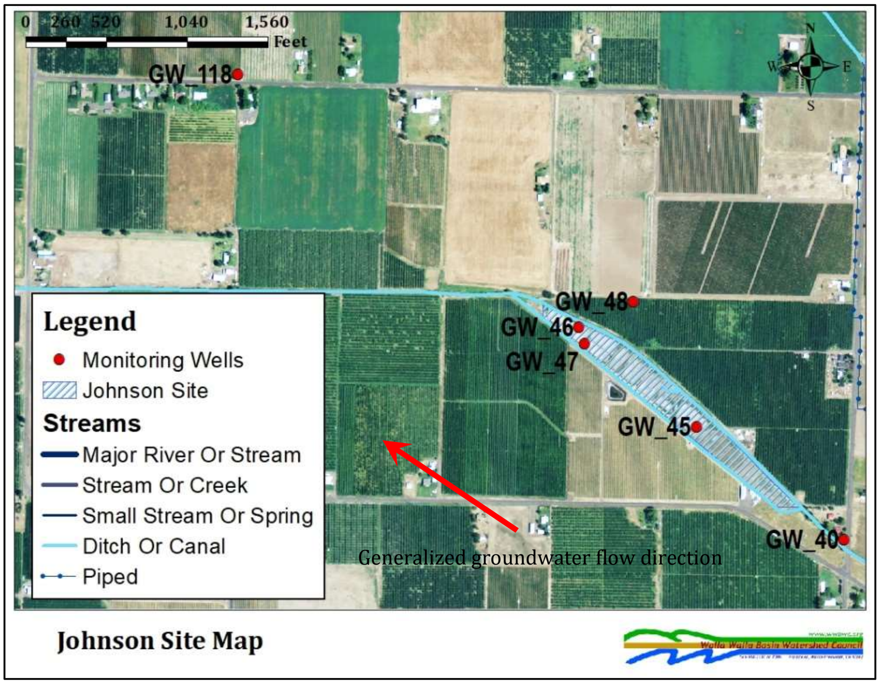


Figure 33 - Monitoring well locations for the Johnson site.

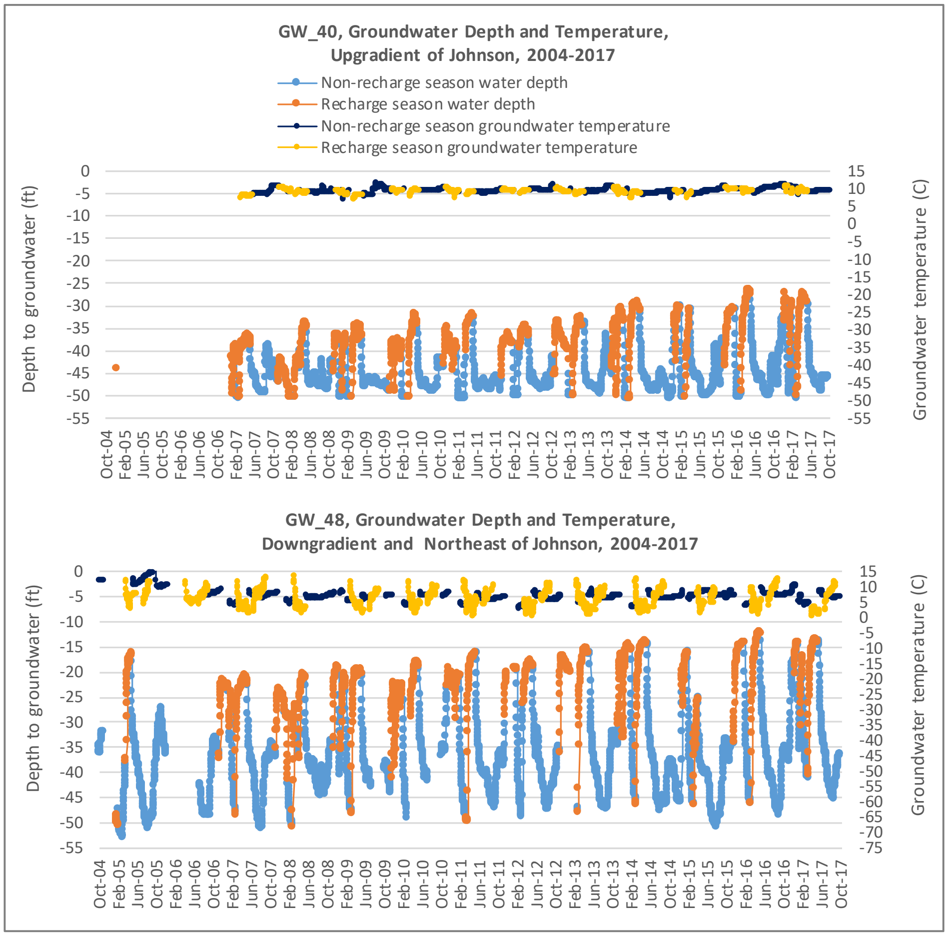
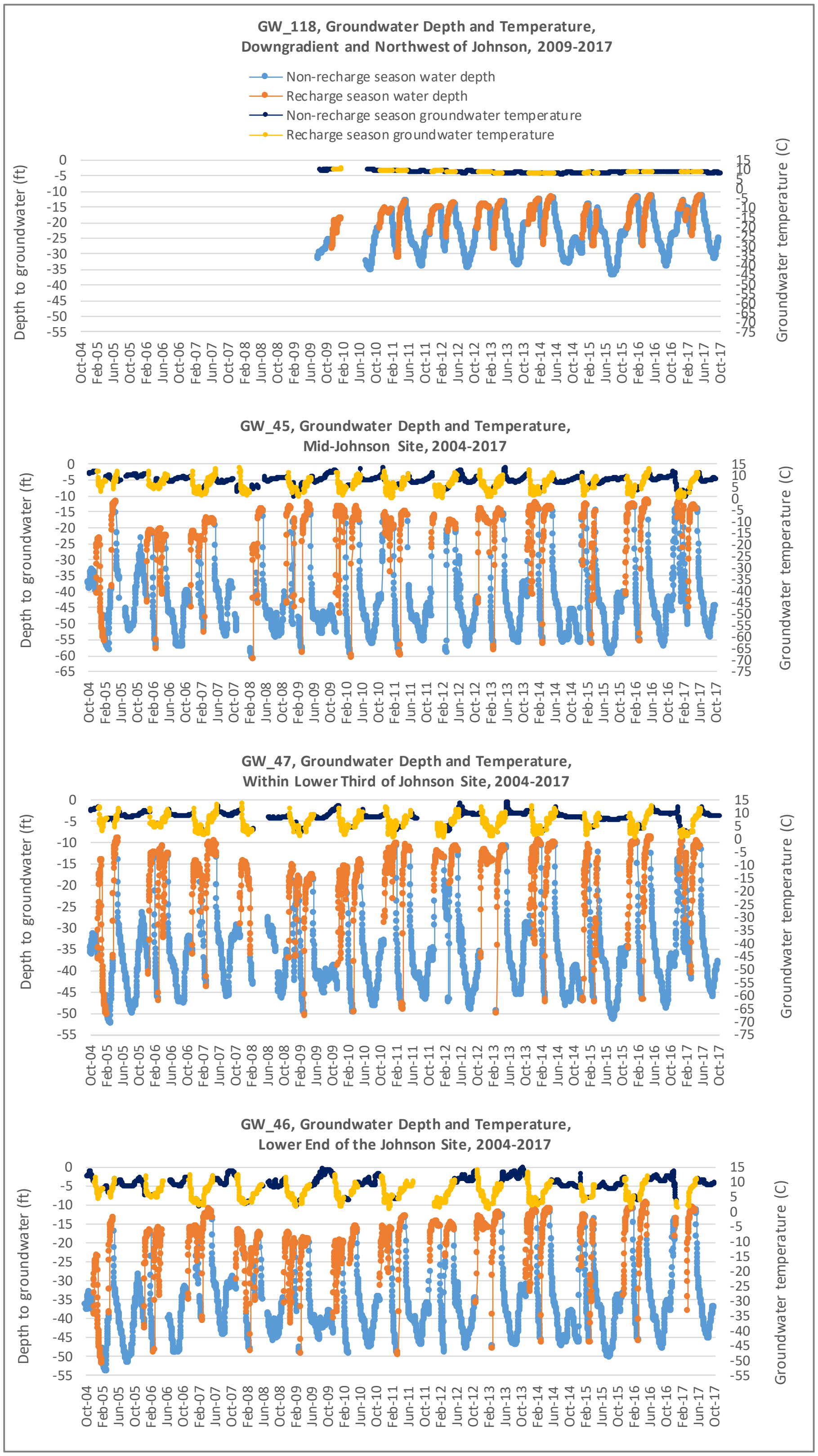


Figure 34 - Hydrographs for GW_40 and GW_48.



GW_118, Groundwater Depth and Temperature, Downgradient and Northwest of Johnson, 2009-2017

GW_45, Groundwater Depth and Temperature, Mid-Johnson Site, 2004-2017

GW_47, Groundwater Depth and Temperature, Within Lower Third of Johnson Site, 2004-2017

GW_46, Groundwater Depth and Temperature, Lower End of the Johnson Site, 2004-2017

Figure 35 - Hydrographs for monitoring wells GW_118, GW_ 45, GW_47, and GW_46.

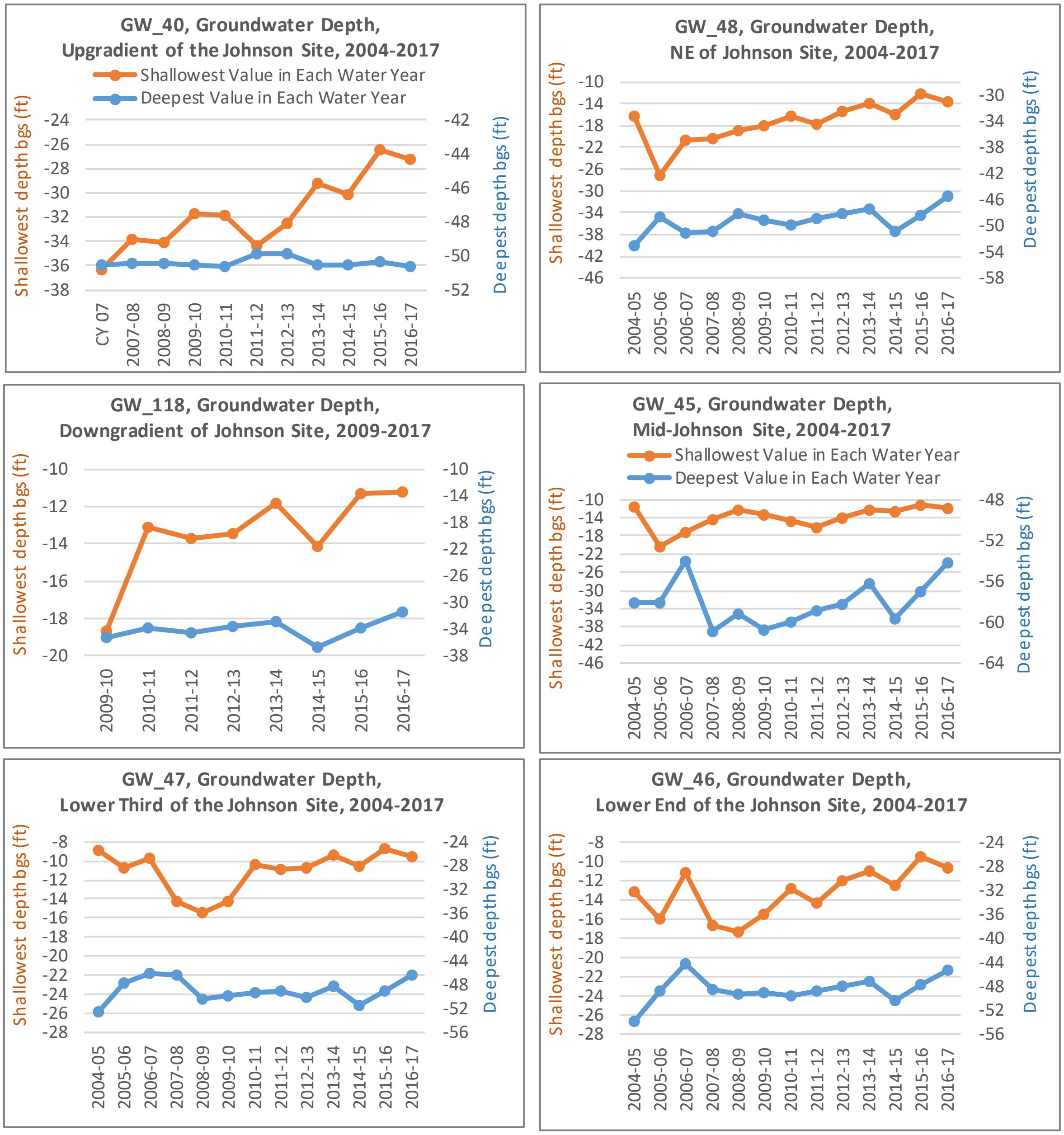


Figure 36 - Shallowest and deepest groundwater levels, by year, GW_40, GW_48, GW_118, GW_45, GW_47, and GW_46.

MUD CREEK SITE

During WY2017, the first year of the Mud Creek site's operation, the site operated for 56 days, primarily in April and May, receiving a total of 8 ac-ft of water (Figure 37). The site has two monitoring wells[2], both upgradient (Figure 37). While seasonal changes were observed in groundwater elevations (Figure 38), additional monitoring during more and longer recharge seasons are needed to assess the influence of this site on groundwater elevations.

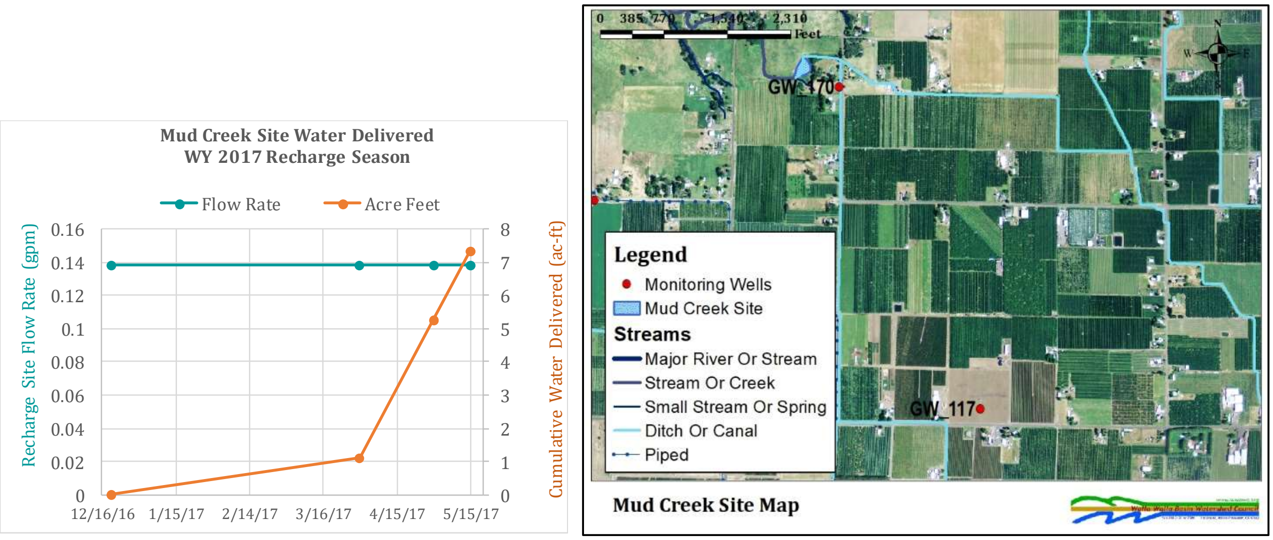


Figure 37 - Mud Creek Site's inflow rates and cumulative water delivered during WY 2017 (above) and monitoring well locations (right).

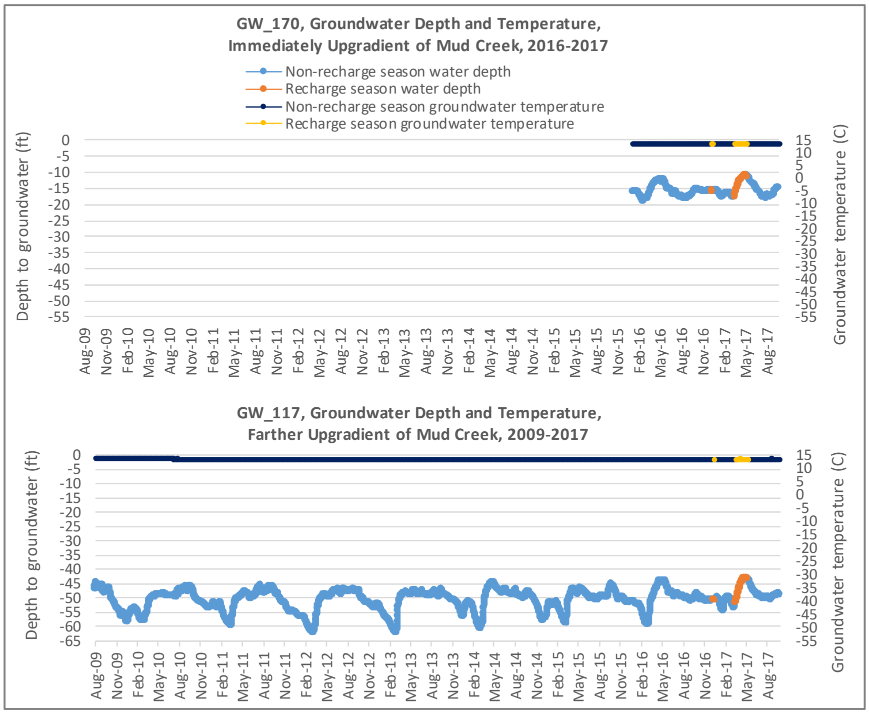


Figure 38 - Hydrographs for monitoring wells GW_170 and GW_117.

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[2] The Mud Creek Site Map shows a north-south ditch adjacent to GW_170 but it is actually a pipeline which flows into an east-west ditch located 70 feet south of GW_170.

NW UMAPINE SITE

The NW Umapine site ran for 64 days during the WY 2017 recharge season, receiving a total of 182 ac-ft of recharge water at an average rate of 3.2 ac-ft per day (Figure 39). The site operated for a few days in late December 2016 and from April through May 15, 2017. Five monitoring wells are associated with the site (Figure 39). The ranges of depths to groundwater appear similar in the years before recharge began and the years after recharge began. Seasonal patterns in groundwater depths appear more variable at GW_66 (Figure 39) than at GW_119, GW_36, and GW_34 (Figures 40 and 41). At upgradient wells GW_66 and GW_119, between WY2014 (the first year of managed recharge) and 2017, the depth to the seasonally deepest groundwater levels became shallower by 1.5 and 0.1 ft, respectively, while the depth to the seasonally shallowest groundwater levels became shallower in GW_119 by 0.4 ft and deepened in GW_66 by 0.2 ft (Table 2 and Figure 42). Seasonal patterns are more difficult to see in the manual measurements at GW_36 (Figure 40).

Within the two downgradient wells GW_34 and GW_144, between WY2014 and 2017, the depth to the seasonally shallowest groundwater levels became shallower by 1.1 ft at both wells and the depth to seasonally deepest groundwater levels became shallower by 0.1 ft at GW_34 and 6.8 ft at GW_144 (Table 2 and Figure 42). Early fall groundwater level increases observed at monitoring wells GW_34 and GW_144 may be due to recharge from the start of fall irrigation and/or reduction of groundwater pumping in the fall. Likewise, observed summer groundwater level decreases are likely due to increased groundwater pumping in the area.

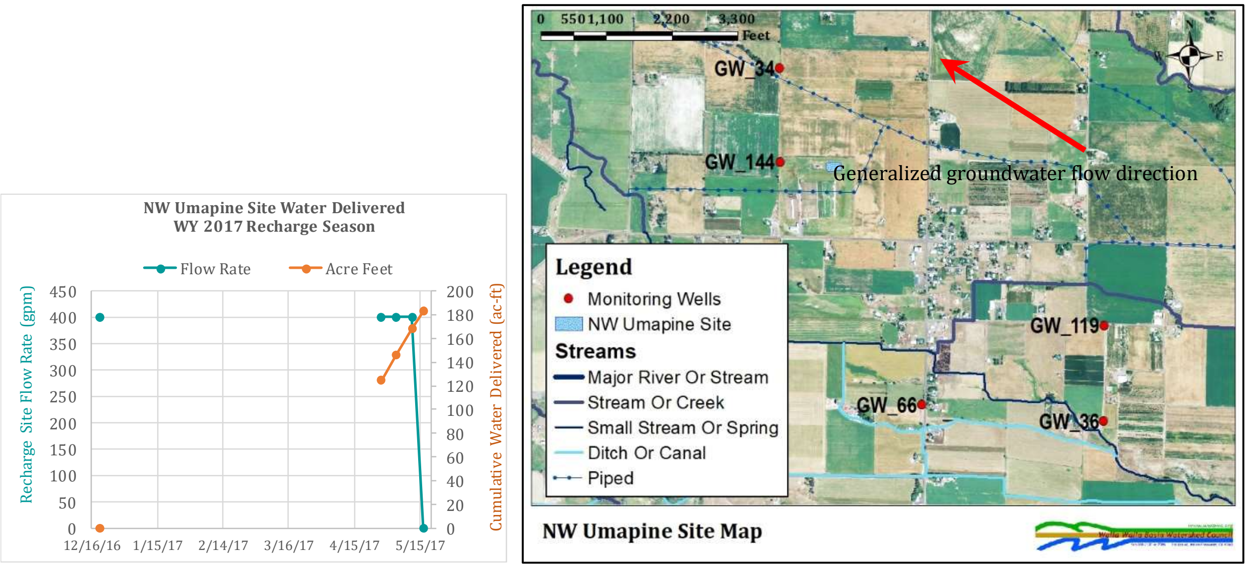
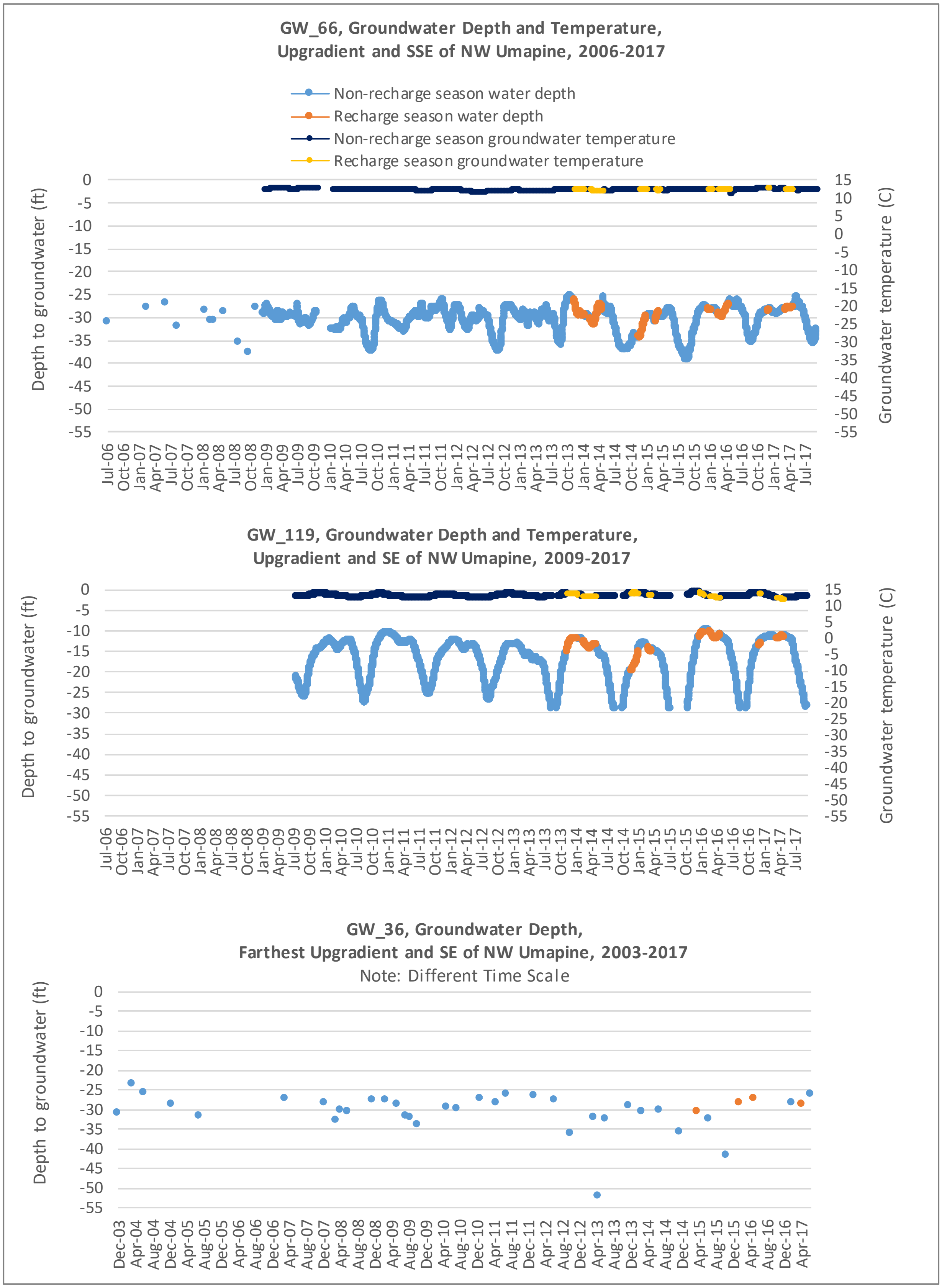


Figure 39 - NW Umapine inflow rates and cumulative water delivered during WY 2017 (left) and monitoring well locations (right).



GW_66, Groundwater Depth and Temperature, Upgradient and SSE of NW Umapine, 2006-2017

GW_119, Groundwater Depth and Temperature, Upgradient and SE of NW Umapine, 2009-2017

GW_36, Groundwater Depth, Farthest Upgradient and SE of NW Umapine, 2003-2017

Note: Different Time Scale

Figure 40 - Hydrographs for monitoring wells GW_66, GW_119, and GW_36.

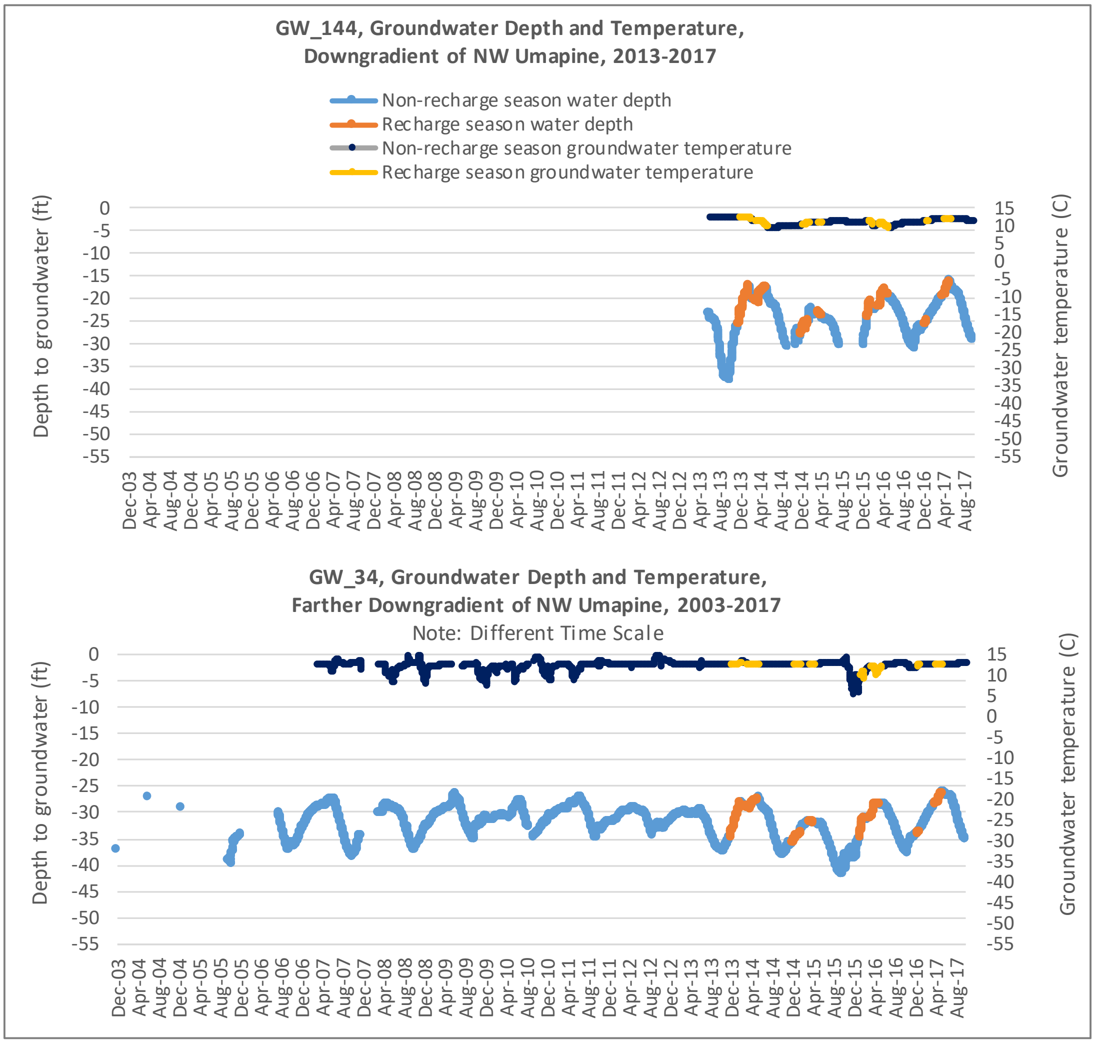


Figure 41 - Hydrographs for monitoring wells GW_144 and GW_34.

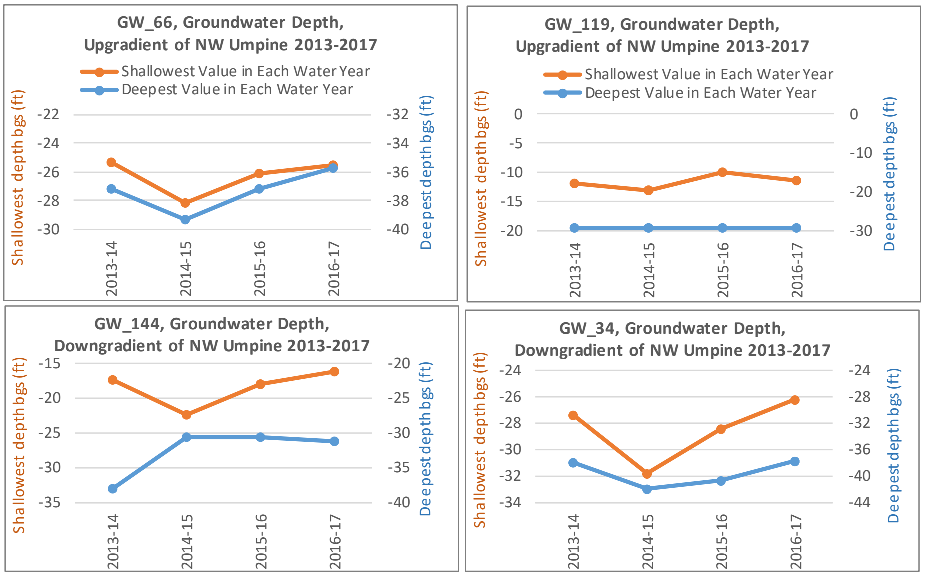


Figure 42 - Shallowest and deepest groundwater levels, by year, GW_66, GW_119, GW144, and GW_34.

TRIANGLE ROAD SITE

During WY2017, the first year of operations for the Triangle Road site, the site operated for only 19 days, primarily in the last part of the recharge season, receiving a total of 13.26 ac-ft of water at an average rate of 0.7 ac-ft per day (Figure 43). The limited duration of recharge was due to operational issues which have since been resolved.

Four monitoring wells are associated with the Triangle Road site (Figure 44[3]). While seasonal changes were observed in groundwater elevations at GW_117, GW_170, GW_171, and GW_143 (Figure 45), additional monitoring during more and longer recharge seasons are needed to assess the influence of this site on groundwater elevations.

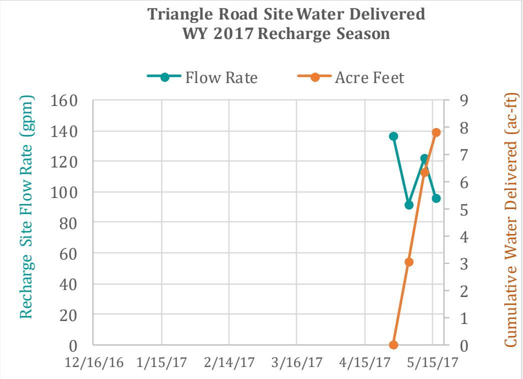


Figure 43 - Inflow rates and cumulative water delivered to the Triangle Road site during WY 2017.

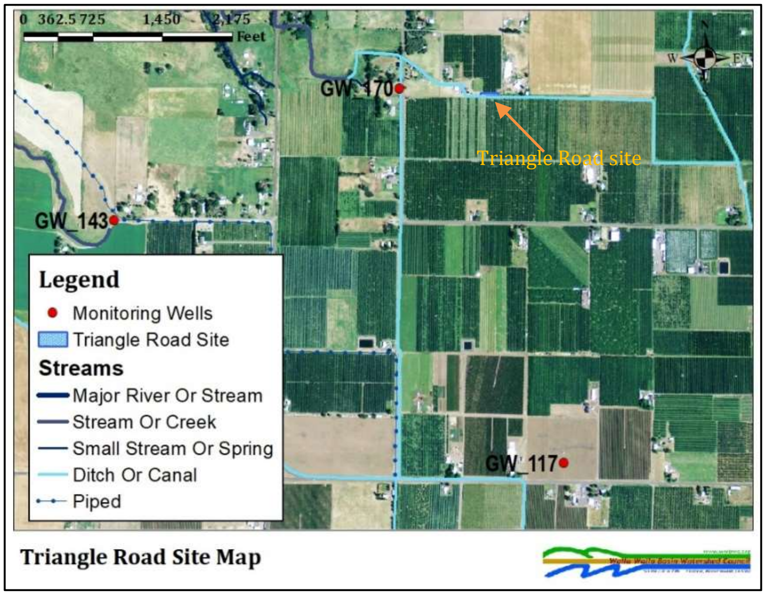


Figure 44 - Monitoring well locations for the Triangle Road site during WY 2017.

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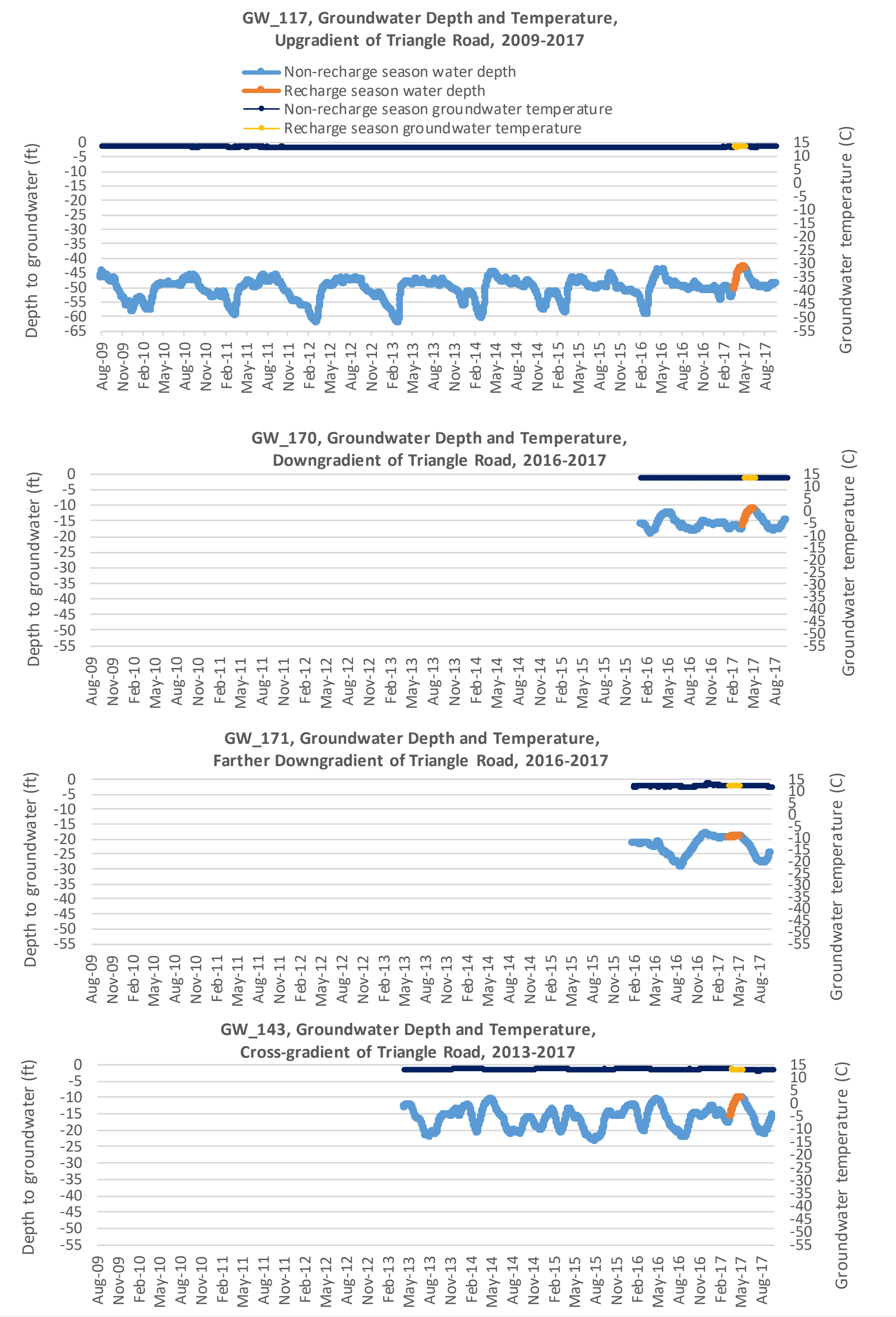
[3] GW_171, one of the four monitoring wells associated with the Triangle Road site, is not shown in Figure 44 because it is 1.6 miles northwest of the site; the location of GW_171 can be seen in Figure 21.



GW_117, Groundwater Depth and Temperature, Upgradient of Triangle Road, 2009-2017

GW_170, Groundwater Depth and Temperature, Downgradient of Triangle Road, 2016-2017

GW_171, Groundwater Depth and Temperature, Farther Downgradient of Triangle Road, 2016-2017

GW_143, Groundwater Depth and Temperature, Cross-gradient of Triangle Road, 2013-2017

Figure 45 - Hydrographs for monitoring wells GW_117, GW_170, GW_171, and GW_143.

TRUMBULL SITE

The Trumbull site operated for 108 days beginning in mid-December 2016, continuing intermittently through early February 2017, and from March through May 15, 2017. A total of 170 ac-ft of water, for an average of 1.6 ac-ft per day, was delivered to the site in WY 2017 (Figure 46). At upgradient monitoring well GW_117, from WY2014 (the first complete year of operations) to 2017, the yearly shallowest and deepest groundwater levels became shallower by 4.1 and 7.7 ft, respectively (Table 2 and Figure 47). At GW_142 during the same water years, the shallowest groundwater levels increased by 1.4 ft while the deepest levels were unchanged.

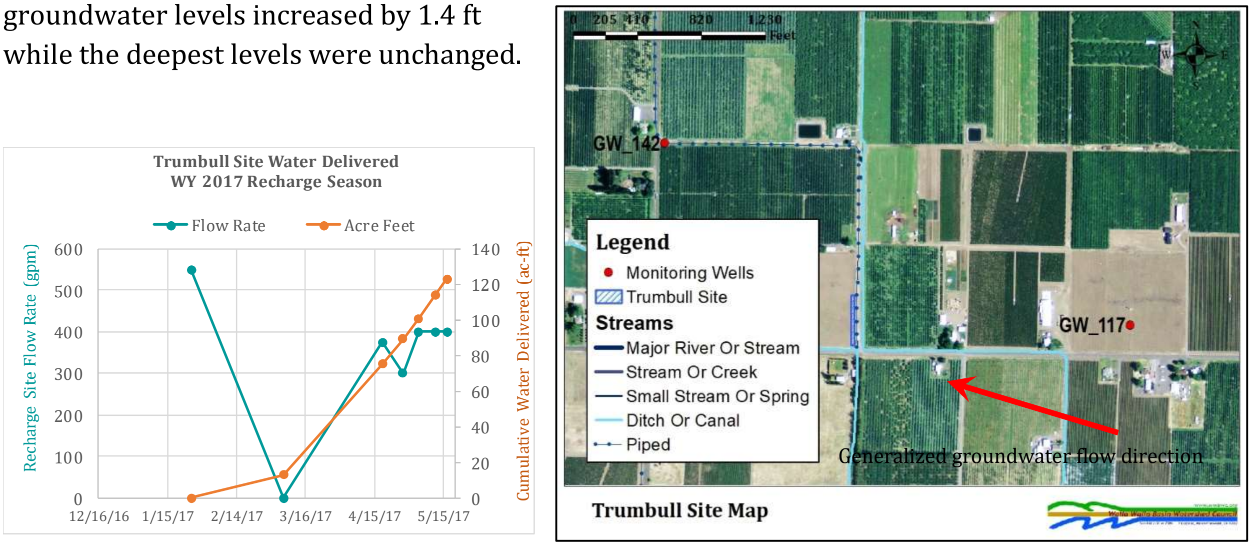


Figure 46 - Trumbull inflow rates and cumulative water delivered during WY 2017 (left) and monitoring well locations (right).

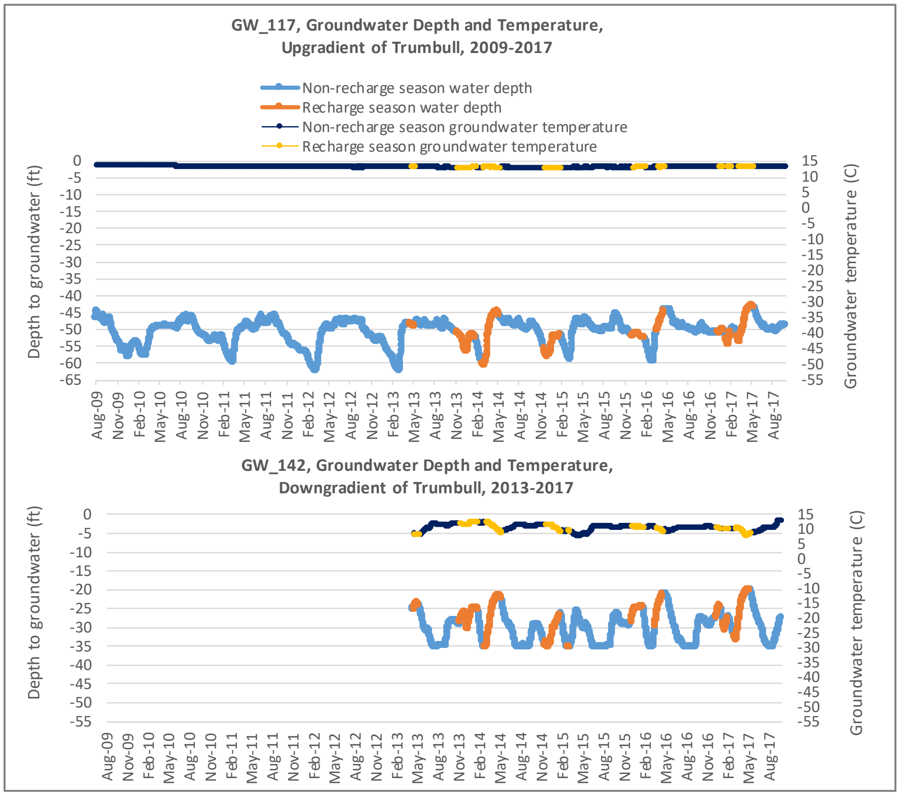
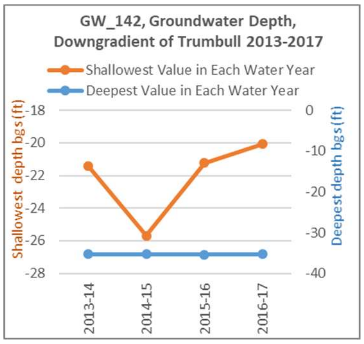


Figure 47 - Hydrographs for monitoring wells GW_117 and GW_142 (left) and shallowest and deepest groundwater levels, by year, GW_142 (below).



OTHER GROUNDWATER MONITORING WELLS

Four monitoring wells are not directly associated with recharge sites which operated during WY2017: two wells, GW_151 and GW_116 (Figure 48), which are far downgradient of existing recharge sites, and two wells, GW_160 and GW_152 (Figure 49), which are east of the Walla Walla River, where no recharge site has yet operated. Groundwater levels and temperatures are more stable in the two wells east of the river than in other wells in the aquifer recharge program network.

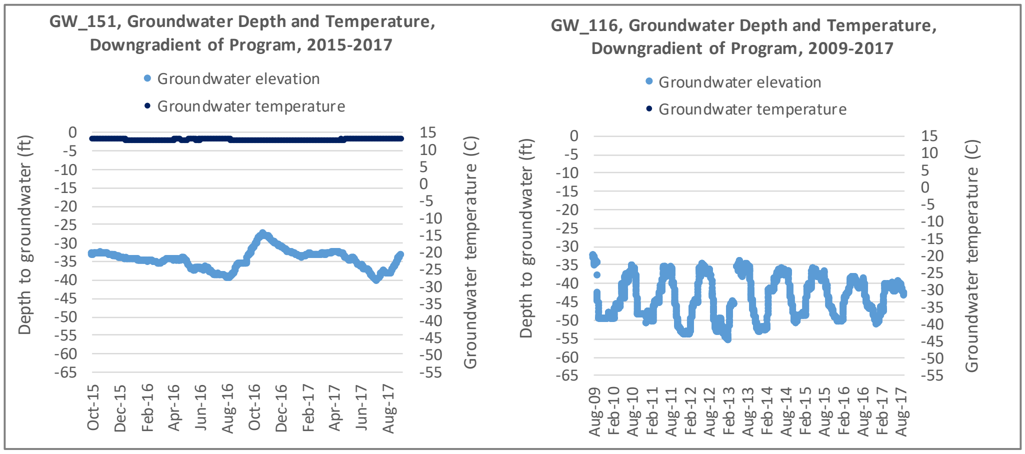


Figure 48 - Hydrographs for GW_151 and GW_116, downgradient of the aquifer recharge program.

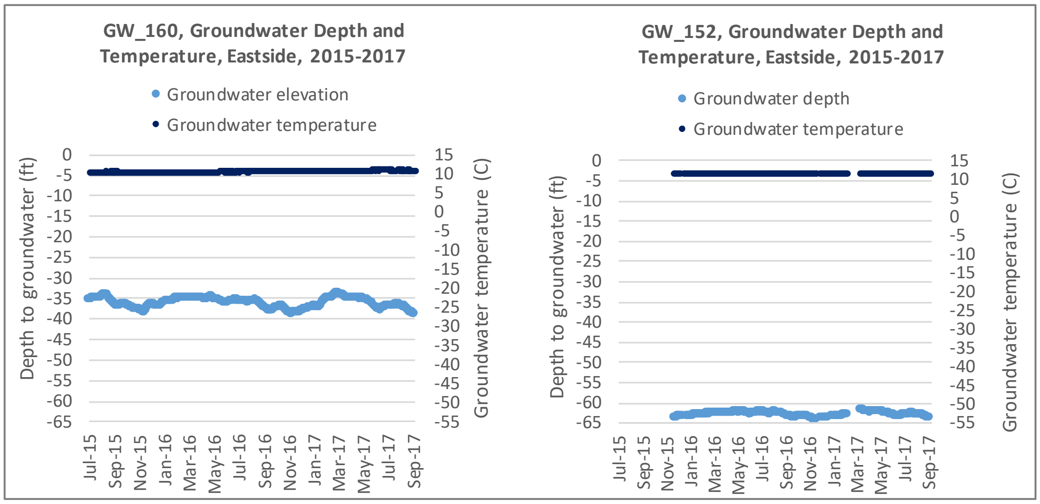


Figure 49 - Hydrographs for monitoring well GW_160 and GW_152 on the east side of the Walla Walla River.

WATER QUALITY MONITORING

Water samples were collected under the approved monitoring plan for LL-1621[4] (Appendix B). The list of analytes in LL-1621 differed from the list in the previous limited license, LL-1433, adding zinc and copper, analyzing ammonia instead of total Kjeldahl nitrogen, sulfur instead of sulfate, and orthophosphate instead of total phosphorus, and not analyzing total organic carbon, chloride, aluminum, or alkalinity. The field parameters and nitrate, calcium, sodium, potassium, magnesium, manganese, and iron remained the same.

Water quality was sampled once before and once after the recharge season. Tables 4 through 12 and Figures 49 through 62 summarize the results. Analytical laboratory reports are included in Appendix D. Table 3 lists detection limits for the analytical methods. Source water quality and groundwater quality at each site are discussed below.

Table 3. Analyte list, analytical methods, and method reporting limits for WY 2017

Analyte	Analytical Method	Method Detection Limit (mg/L)
Ammonia-N (mg/L)	Eco-Tracker (Unibest)	1.2
Calcium (mg/L)	Eco-Tracker (Unibest)	0.31
Copper (mg/L)	Eco-Tracker (Unibest)	0.01
Iron (mg/L)	Eco-Tracker (Unibest)	0.05
Magnesium (mg/L)	Eco-Tracker (Unibest)	0.27
Manganese (mg/L)	Eco-Tracker (Unibest)	0.01
Nitrate-N(mg/L)	Eco-Tracker (Unibest)	0.09
Phosphorus (mg/L)	Eco-Tracker (Unibest)	0.02
Potassium (mg/L)	Eco-Tracker (Unibest)	0.18
Sodium (mg/L)	Eco-Tracker (Unibest)	0.17
Sulfur (mg/L)	Eco-Tracker (Unibest)	0.02
Zinc (mg/L)	Eco-Tracker (Unibest)	0.01
Synthetic Organic Constituents	**Analytical Method**	**Quantitation Limit (ug/L)**
Azinphos-methyl	8141B	0.5
Chlorpyrifos	8141B	0.1
Diuron	8321B	0.06
Malathion	8141B	0.1

SOURCE WATER QUALITY DURING WY 2017

Source water samples were collected at three locations on 12/12/2016 and four locations on 05/30/2017 (see Figure 50 for map):

- Source Water #1 – Zerba Weir
- Source Water #2 – Duff Weir (S-418)
- Source Water #4 – Fruitvale (S-318)
- Source Water #5 -- Eastside

Although the Eastside was sampled during the post-operations sampling, no aquifer recharge site on the Eastside operated in WY2017, so these data were reported for informational purposes only. Source water #3 was not sampled because there was no flow.

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[4] The approved monitoring plan inadvertently lists lead and mercury as analytes. These were never intended to be part of the sampling program and a revised monitoring plan will be submitted to correct the error.

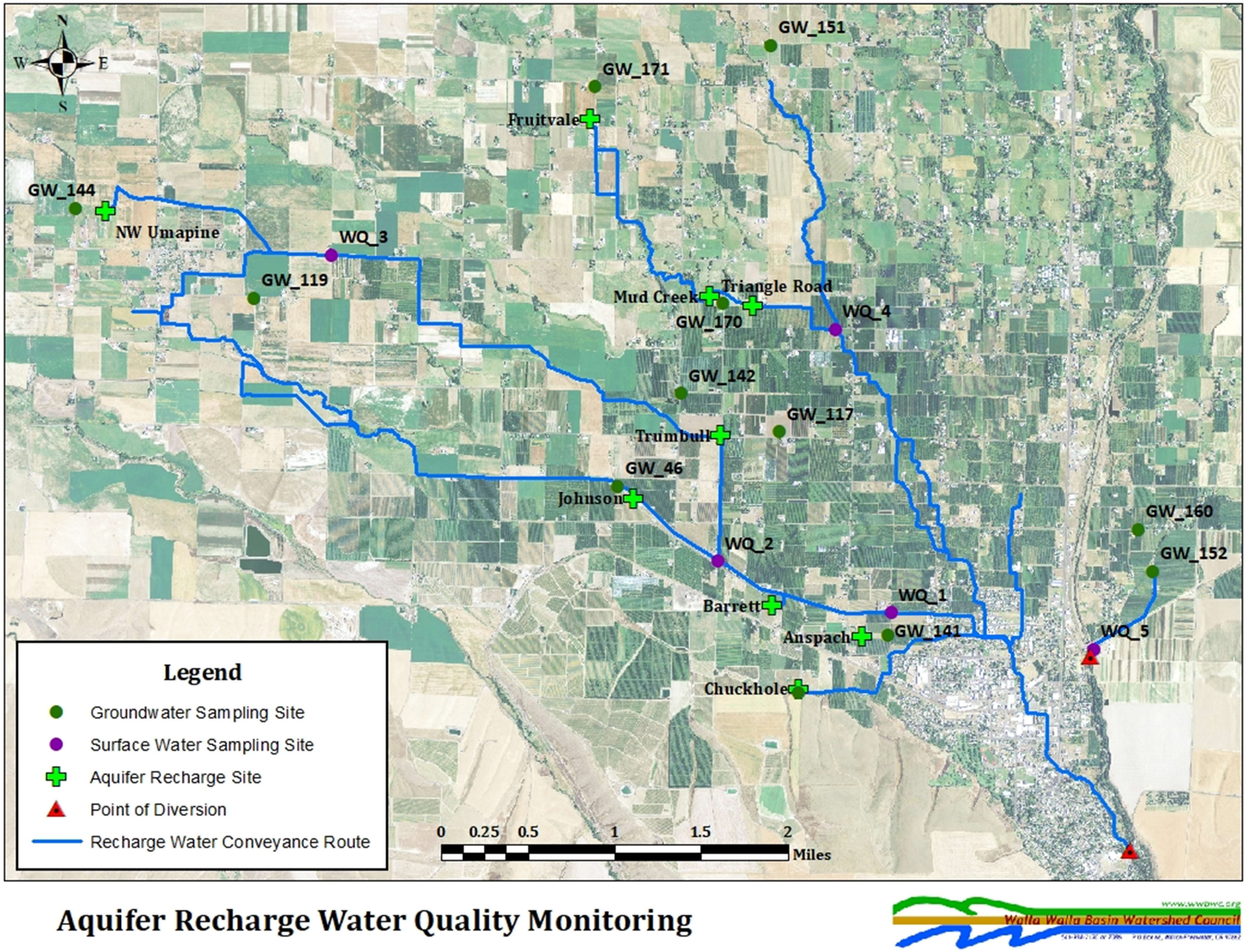

Figure 50 - Water quality sampling locations for the managed aquifer recharge program in WY2017.

In general, water quality appears to be good at the sampled locations. The source water has low concentrations of major cations (sodium, potassium, calcium and magnesium) and nitrate, orthophosphate, iron, manganese, sulfur, and zinc (Tables 2-4). Zinc concentrations were less than the state criteria of 0.043 mg/L for chronic exposure and 0.042 mg/L for acute exposure, assuming a hardness of 30 mg/L. Ammonia and copper concentrations appear high compared to state criteria and other surface water data; the elevated values may be the result of a new sampling/analytical technology, the Unibest Ecotracker, which was used for the first time in WY2017.

The ammonia values for surface water samples as reported by the laboratory ranged from 1.27 to 3.64 mg/L. A search of the Oregon Department of Environmental Quality's (ODEQ) Ambient Water Quality Monitoring System database found only one sample location with ammonia data in surface water within the watershed, at Pine Creek (location ID 36786)[5]. Ammonia concentrations ranged from less than the detection limit of 0.01 to 0.125 mg/L from 2012 through 2017 (ODEQ, 2018). The maximum value reported by the Washington State Department of Ecology (WDOE) in surface waters sampled in the *Assessment of Surface Water and Groundwater Interchange in the Walla Walla River Watershed* was 0.147 mg/L (Marti, 2005). The ODEQ water quality criterion for total ammonia is dependent on temperature and pH. For surface waters with a pH greater than 8.3, within a temperature range of 0 to 14°C, the acute criterion is 3.1 mg/L.

The reported copper values of 0.01 and 0.02 mg/L were also high compared to other data and calculated toxicity values. The ODEQ water quality criteria for copper are calculated on a site-specific basis using the Biotic Ligand Model. The model outputs based on WWBWC data were 0.00427 mg/L for the acute criterion and 0.00265 mg/L for the chronic criterion[6]. No copper data were found within the Oregon portion of the watershed when searching ODEQ's database. When the Washington State Department of Ecology's Environmental Information Management database was searched for copper data in surface water within the Washington portion of the Walla Walla basin, only one site had data -- the Walla Walla River at Touchet (location ID 32A070). Dissolved copper concentrations at that site ranged from 0.00041 to 0.00163 mg/L (WDOE, 2018).

After reviewing the data from Unibest, the laboratory was contacted about the elevated values. The laboratory representatives explained that the Unibest method, in which an absorbent packet of resin is placed in the water to be sampled for a period of time and the contaminants absorbed into

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[5] A search for ammonia and copper data in surface waters in the AWQMS database returned results for ammonia at only one site within the Walla Walla basin, at Pine Creek. No copper data were found. The search used the filtered locations option and the following selections as noted within the parentheses: organization (ODEQ), monitoring location types (canal drainage, canal irrigation, canal transport, channelized stream, constructed water transport structure, other-surface water, river/stream [ephemeral, intermittent and perennial], riverine impoundment, and spring), eco-region level 3 (Columbia Plateau), date range (1-1-1980 to 12-31-2017), activity types (default values), result status (default values), projects (checked all), media (water), media subdivision (none selected), sampling component (none selected), individual parameter (ammonia, dissolved copper, and total recoverable copper). A separate search for ammonia and copper in the Blue Mountains eco-region level 3 yielded no data within the Walla Walla basin.

[6] The model requires inputs which were not analyzed in WY2017, so the following data from 4/23/2013 at S-417 were used to calculate the toxicity criteria: temperature 5.462 C, pH 7.23, dissolved organic carbon 1.7 mg C/L (based on total organic carbon of 2.05 and standard conversion factor of 0.83), calcium 5.1 mg/L, magnesium 2.1 mg/L, sodium 2.9 mg/L, potassium 1.7 mg/L, sulfate 0.9 mg/L, chloride 0.82 mg/L (assumed value based on ODEQ guidance), alkalinity 30 mg/L $CaCO_3$, and sulfur 0.00001 mg/L.

the packet are then analyzed, was not intended to represent instantaneous concentrations but is intended to represent cumulative concentrations. Therefore, the values reported in WY2017 are not comparable to previous years which obtained grab samples, nor are the values comparable to grab samples obtained by other organizations. The lab representatives further explained the Unibest technology is not intended to be used for regulatory purposes but rather as a screening tool to identify sites appropriate for characterization. The WWBWC intends to update the monitoring plan in the near future to address this issue, if funding allows. In the immediate future, the four constituents with water quality criteria -- ammonia, copper, nitrate, and zinc -- will be analyzed in the next sampling round using traditional laboratory methods.

Table 4. Source Water #1 and #2

Sample Parameter	**Source Water #1 Zerba Weir**		**Source Water #2 Johnson Intake/Duff Weir**	
	12/12/2016	**05/30/2017**	**12/12/2016**	**05/30/2017**
Ammonia-N (mg/L)	2.28	3.64	1.27	3.34
Calcium (mg/L)	4.64	3.57	4.27	4.40
Copper (mg/L)	0.02	0.01	0.02	0.01
Iron (mg/L)	0.07	ND	0.07	ND
Magnesium (mg/L)	1.74	1.37	1.64	1.65
Manganese (mg/L)	ND	0.01	ND	0.01
Nitrate-N(mg/L)	ND	ND	ND	ND
Phosphorus (mg/L)	0.04	0.03	0.05	0.04
Potassium (mg/L)	2.35	1.49	1.58	2.14
Sodium (mg/L)	2.27	1.73	2.05	2.08
Sulfur (mg/L)	3.81	8.44	3.26	8.58
Zinc (mg/L)	0.01	0.01	0.01	0.01

ND = no detection

Table 5. Source Water #4 and #5

Sample Parameter	**Source Water #4 S318**		**Source Water #5 Eastside**	
	12/12/2016	**05/30/2017**	**12/12/2016**	**05/30/2017**
Ammonia-N (mg/L)	1.59	2.53	Not sampled	2.92
Calcium (mg/L)	3.83	3.40		4.24
Copper (mg/L)	0.02	0.01		0.01
Iron (mg/L)	0.08	ND		ND
Magnesium (mg/L)	1.48	1.31		1.64
Manganese (mg/L)	ND	ND		0.01
Nitrate-N(mg/L)	ND	ND		ND
Phosphorus (mg/L)	0.05	0.03		0.04
Potassium (mg/L)	1.51	1.83		2.24
Sodium (mg/L)	1.75	1.63		1.92
Sulfur (mg/L)	3.50	7.09		8.04
Zinc (mg/L)	0.01	0.01		0.01

GROUNDWATER QUALITY MONITORING

Groundwater quality samples and field parameter data were collected at 12 locations (GW_46, GW_117, GW_119, GW_141, GW_142, GW_144, GW_151, GW_152, GW_160, GW_169, GW_170, and GW_171) near the nine aquifer recharge sites. The general rationale for each sampling location are listed below.

- GW_152 provides upgradient monitoring of the aquifer recharge program.
- GW_160 will provide downgradient monitoring of the Lefore Road site when it becomes operational; in WY2017 it functioned as an upgradient site of the aquifer recharge program.
- GW_169 provides upgradient monitoring of the Chuckhole site.
- GW_141: provides upgradient monitoring for the entire project and specifically for the Anspach, Barrett, Chuckhole, and Johnson sites.
- GW46 provides mid-gradient monitoring for the Johnson site and central region of the aquifer recharge program and downgradient monitoring for the Barrett, Anspach, and Chuckhole sites.
- GW117 provides water quality information for the central region of the aquifer recharge program, and upgradient monitoring for the Trumbull, Mud Creek, and Triangle Road sites.
- GW_142 provides mid-gradient of the aquifer recharge program and downgradient coverage for the Trumbull site.
- GW_170 provides upgradient monitoring of the Mud Creek and Fruitvale sites, downgradient monitoring of the Triangle Road site, and mid-gradient monitoring of the aquifer recharge program.
- GW119 provides upgradient monitoring for the NW Umapine site and downgradient monitoring of the Johnson site.
- GW_144 provides downgradient monitoring for the NW Umapine site.
- GW_171 provides downgradient monitoring of the aquifer recharge program and specifically for the Fruitvale site.
- GW_151 provides downgradient monitoring of the aquifer recharge program.

The 12 wells were sampled on December 12, 2016 and May 30, 2017 and analyzed for the analytes listed in Table 3 (see Tables 6 through 12 and Figures 51 through 64 for results). Nitrate exceeded the groundwater quality criteria of 10 mg/L at four sites (GW_119, GW_144, GW_171, and GW_151) with concentrations from 13.5 to 40.3 mg/L. The source of these nitrates is unknown; however, given the low nitrate concentrations in the source water (less than the detection limit of 0.09 mg/L), the source water is highly unlikely contributing to the elevated nitrate concentrations in the groundwater. Based on the description of the Unibest representative that the Ecotracker sampling/analytical method is not intended to represent instantaneous concentrations, nor to be used to evaluate compliance with water quality criteria, in the future nitrate analyses will be conducted using traditional laboratory methods.

The groundwater samples collected at wells GW_144 and GW_171 on May 30, 2017 were also analyzed using traditional laboratory methods for the approved targeted list of herbicides and pesticides: azinphos-methyl, chlorpyrifos, diuron, and malathion (see Appendix B). There were no detections of the four targeted constituents in either sample. Analytical laboratory reports are included in Appendix D.

Table 6. GW_152 and GW_160 water quality data

Sample Parameter	GW_152		GW_160	
	12/12/2016	05/30/2017	12/12/2016	5/30/2017
Ammonia-N (mg/L)	2.41	3.51	1.63	3.9
Calcium (mg/L)	16.89	15.92	8.02	10.98
Copper (mg/L)	0.02	0.01	0.02	0.01
Iron (mg/L)	0.31	ND	0.36	ND
Magnesium (mg/L)	6.46	6.15	2.91	4.1
Manganese (mg/L)	0.01	ND	0.01	0.01
Nitrate-N(mg/L)	0.56	1.95	1.15	4.99
Phosphorus (mg/L)	0.24	0.04	0.18	0.05
Potassium (mg/L)	3.40	6.15	2.86	3.88
Sodium (mg/L)	6.92	5.76	2.53	3.17
Sulfur (mg/L)	5.16	10.33	4.15	9.36
Zinc (mg/L)	0.01	0.01	0.01	0.01

ND = no detection

Table 7. GW_169 and GW_141 water quality data

Sample Parameter	GW_169		GW_141	
	12/12/2016	05/30/2017	12/12/2016	05/30/2017
Ammonia-N (mg/L)	1.54	2.81	3.63	3.35
Calcium (mg/L)	11.71	14.37	10.05	ND
Copper (mg/L)	0.02	0.02	0.02	0.01
Iron (mg/L)	0.22	ND	0.14	ND
Magnesium (mg/L)	4.41	ND	3.08	4.07
Manganese (mg/L)	0.02	5.28	0.02	ND
Nitrate-N(mg/L)	0.90	3.40	ND	3.59
Phosphorus (mg/L)	0.13	0.05	0.12	0.07
Potassium (mg/L)	3.42	3.90	6.90	4.52
Sodium (mg/L)	4.74	5.28	4.13	4.95
Sulfur (mg/L)	4.21	7.82	6.24	10.46
Zinc (mg/L)	0.01	0.02	0.02	0.02

ND = no detection

Table 8. GW_46 and GW_117 water quality data

Sample Parameter	GW_46		GW_117	
	12/12/2016	05/30/2017	12/12/2016	05/30/2017
Ammonia-N (mg/L)	1.42	3.09	1.72	2.93
Calcium (mg/L)	4.98	4.86	13.06	16.40
Copper (mg/L)	0.01	ND	0.01	0.01
Iron (mg/L)	0.07	ND	0.20	ND
Magnesium (mg/L)	2.03	1.97	5.12	6.36
Manganese (mg/L)	ND	ND	0.02	ND
Nitrate-N(mg/L)	ND	ND	1.81	7.36
Phosphorus (mg/L)	0.06	0.06	0.14	0.06
Potassium (mg/L)	2.25	3.26	4.28	5.45
Sodium (mg/L)	2.50	2.38	4.79	4.89
Sulfur (mg/L)	3.83	7.42	6.70	11.76
Zinc (mg/L)	0.01	0.01	0.01	0.01

ND = no detection

Table 9. GW_142 and GW_170 water quality data

Sample Parameter	GW_142		GW_170	
	12/12/2016	05/30/2017	12/12/2016	05/30/2017
Ammonia-N (mg/L)	1.71	3.71	1.22	3.41
Calcium (mg/L)	8.76	7.60	14.11	19.99
Copper (mg/L)	0.01	0.01	0.01	0.01
Iron (mg/L)	0.19	0.09	0.18	ND
Magnesium (mg/L)	3.07	2.26	5.13	7.66
Manganese (mg/L)	0.01	0.07	0.01	0.01
Nitrate-N(mg/L)	0.35	0.41	1.27	ND
Phosphorus (mg/L)	0.40	0.15	0.21	0.06
Potassium (mg/L)	3.67	3.10	3.93	5.07
Sodium (mg/L)	2.96	2.31	5.55	8.53
Sulfur (mg/L)	4.45	0.05	5.43	15.49
Zinc (mg/L)	0.01	0.02	0.01	0.01

ND = no detection

Table 10. GW_119 and GW_144 water quality data

Sample Parameter	GW_119		GW_144	
	12/12/2016	05/30/2017	12/12/2016	05/30/2017
Ammonia-N (mg/L)	1.75	3.51	1.28	3.66
Calcium (mg/L)	34.21	48.13	30.01	46.74
Copper (mg/L)	0.01	0.01	0.02	0.02
Iron (mg/L)	0.38	ND	0.28	ND
Magnesium (mg/L)	13.86	20.05	11.13	18.37
Manganese (mg/L)	0.03	0.01	0.02	0.01
Nitrate-N(mg/L)	1.75	24.31	12.93	40.29
Phosphorus (mg/L)	0.19	0.13	0.30	0.09
Potassium (mg/L)	9.82	12.06	8.59	10.69
Sodium (mg/L)	18.65	23.89	15.67	21.39
Sulfur (mg/L)	12.44	19.23	5.36	19.67
Zinc (mg/L)	0.01	0.01	0.01	0.01

ND = no detection

Table 11. GW_171 and GW_151 water quality data

Sample Parameter	GW_171		GW_151	
	12/12/2016	05/30/2017	12/12/2016	05/30/2017
Ammonia-N (mg/L)	1.26	2.94	2.22	2.60
Calcium (mg/L)	35.94	37.11	28.51	29.62
Copper (mg/L)	0.01	0.01	0.02	0.01
Iron (mg/L)	0.33	ND	0.46	ND
Magnesium (mg/L)	13.52	15.12	10.13	11.12
Manganese (mg/L)	0.03	0.01	0.02	0.01
Nitrate-N(mg/L)	8.38	13.52	17.14	21.15
Phosphorus (mg/L)	0.29	0.08	0.24	0.06
Potassium (mg/L)	8.50	7.96	5.81	7.13
Sodium (mg/L)	10.32	9.15	6.17	7.33
Sulfur (mg/L)	8.88	12.51	11.68	13.56
Zinc (mg/L)	0.01	0.01	0.01	0.01

ND = no detection

Table 12. Synthetic organic compounds sampled 5/17/2016 at GW_144 and GW_171

Sample Parameter	GW_144	GW_171
Azinphos-methyl	ND	ND
Chlorpyrifos	ND	ND
Diuron	ND	ND
Malathion	ND	ND

ND = no detection

The primary objective of sampling source water and groundwater is to assess if adverse impacts are occurring in groundwater due to the introduced recharge water. When comparing source (surface) water and groundwater concentrations by constituent, the following patterns were observed:

(1) For the following constituents, concentrations in the source water were less than concentrations in groundwater in most of the wells: calcium, iron, magnesium, manganese (pre-operations), nitrate, ortho-phosphate, potassium, sodium, and sulfur (post-operations) (Figures 52 and 54 through 61). Decreased concentrations in the source water would be expected to dilute the constituents present in groundwater when introduced as recharge, improving water quality.

(2) For the following constituents, concentrations in the source water were comparable to concentrations in groundwater at most of the wells: ammonia, copper, manganese (post-operations, except for GW_142), sulfur (pre-operations, except downgradient wells), and zinc (Figures 51, 53,56, 61, and 62).

(3) None of the constituents had concentrations in source water consistently greater than concentrations in groundwater.

When comparing groundwater conditions pre- and post-recharge (Figures 63 and 64), the following differences were observed:

(1) The following monitoring wells had generally very similar concentrations pre- and post-recharge: GW_169 (upgradient of Chuckhole), GW_171 (far downgradient of Fruitvale), GW_151 (far downgradient of any active site), and GW_152 (on the Eastside, not near an active site).

(2) In the following monitoring wells, concentrations of at least four of the 12 constituents were noticeably greater post-recharge than pre-recharge: GW_117 (upgradient of Trumbull), GW_119 (upgradient of NW Umapine), GW_144 (downgradient of NW Umapine), GW_170 (upgradient of Mud Creek and downgradient of Triangle Road), and GW_160 (on the Eastside, not near any recharge site). The constituents with the largest post-recharge increases were typically calcium, magnesium, nitrate, and sulfur. However, concentrations of these constituents are lower in the source water than in groundwater, strongly suggesting the source water is not the reason for the increased concentrations post-recharge in groundwater.

(3) At the remaining wells, concentrations varied, with some constituents having higher pre-recharge concentrations and others having similar pre-and post-recharge concentrations or higher post-recharge concentrations: GW_141 (upgradient of Anspach), GW_46 (downgradient of Johnson), and GW_142 (downgradient of Trumbull).

When comparing upgradient and downgradient conditions, the following were observed:

(1) Comparing upgradient and downgradient wells over the entire well network, some substantial differences in groundwater quality were apparent. The more upgradient wells had lower calcium, magnesium, nitrate, potassium, sodium, and sulfur concentrations than downgradient wells during WY 2017 (Figures 52, 55, 57, 59, 60, and 61). This spatial pattern may reflect the influence of agricultural and livestock activities resulting in percolation of nutrients below the root zone. The pattern is highly unlikely due to the presence of the recharged water because, as described above, concentrations of these constituents in the source water are lower than in groundwater, even at the upgradient wells.

(2) Comparing upgradient and downgradient monitoring locations at the Trumbull (GW_117 and GW_142) and Johnson (GW_141 and GW_46) sites shows decreases in nitrate and major anion and cation concentrations at the downgradient locations relative to the upgradient locations and that recharge activities are improving, or at least not degrading, groundwater quality (Figures 63 and 64).

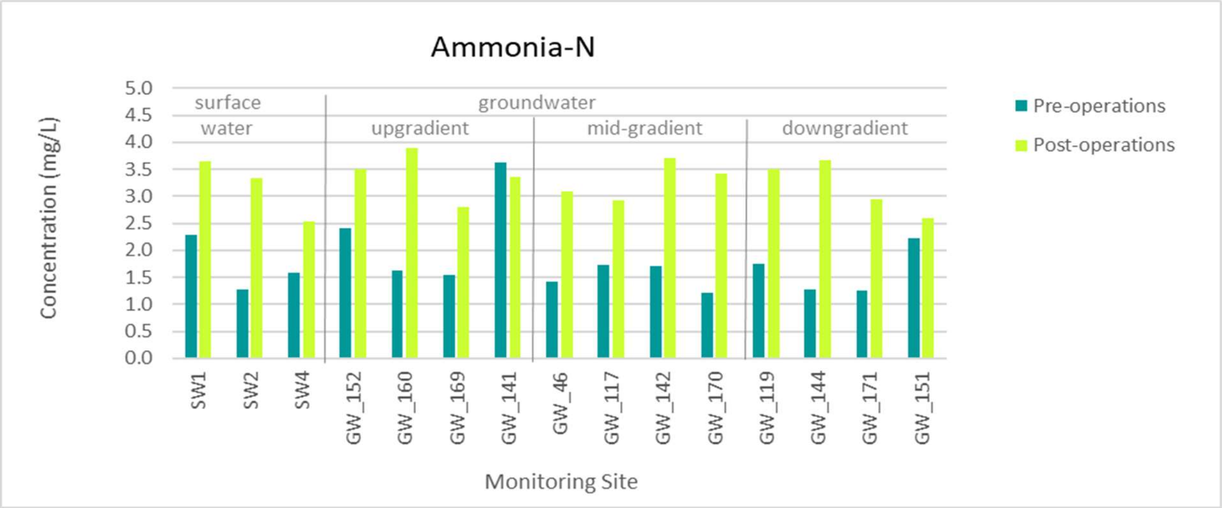

Figure 51 - Ammonia concentrations in surface water and groundwater before and after managed recharge.

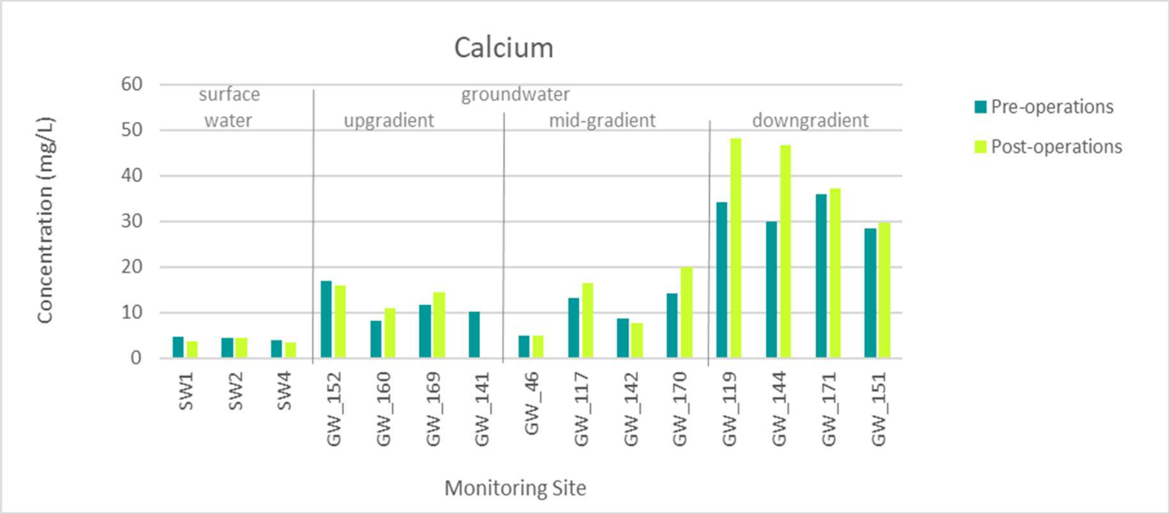

Figure 52 - Calcium concentrations in surface water and groundwater before and after managed recharge.

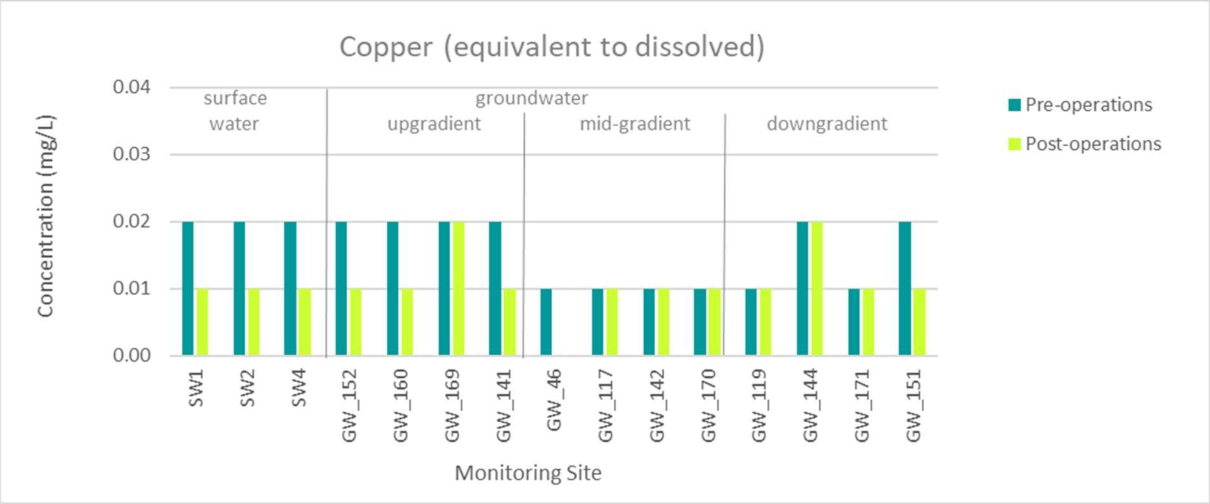

Figure 53 - Copper concentrations in surface water and groundwater before and after managed recharge.

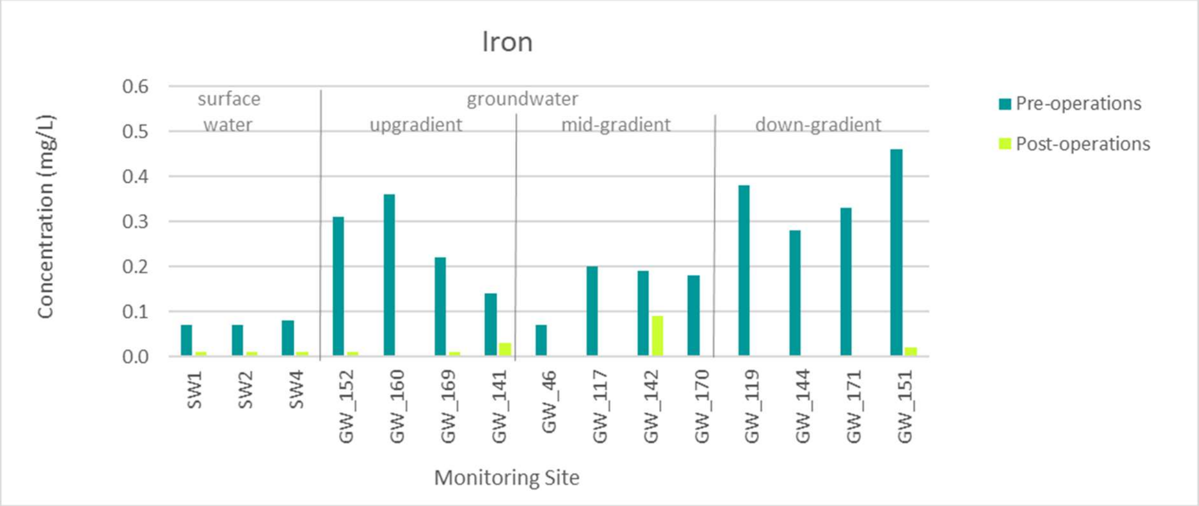

Figure 54 - Iron concentrations in surface water and groundwater before and after managed recharge.

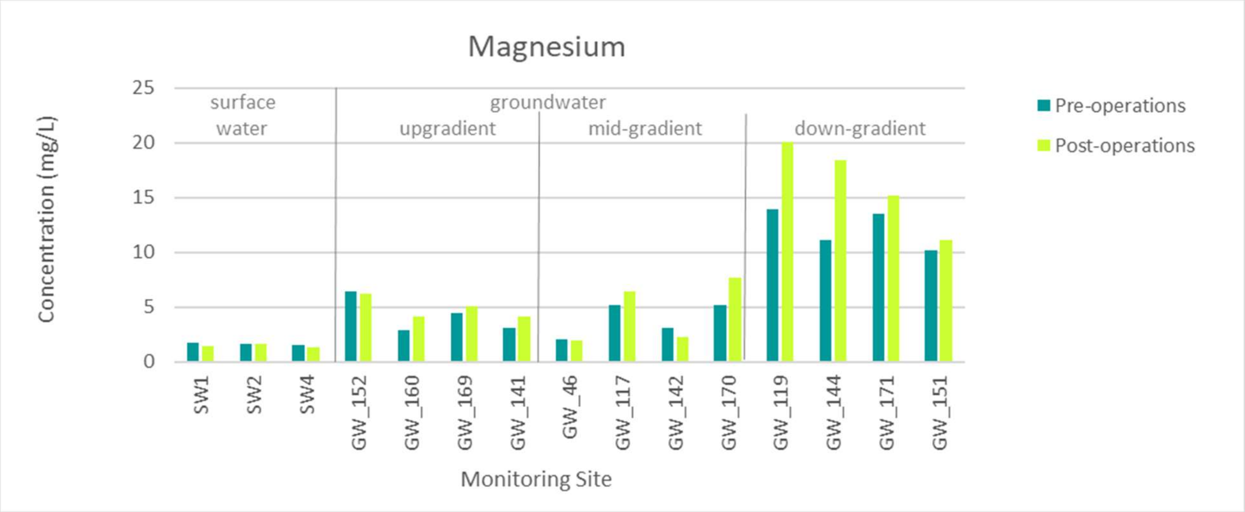

Figure 55 - Magnesium concentrations in surface water and groundwater before and after managed recharge.

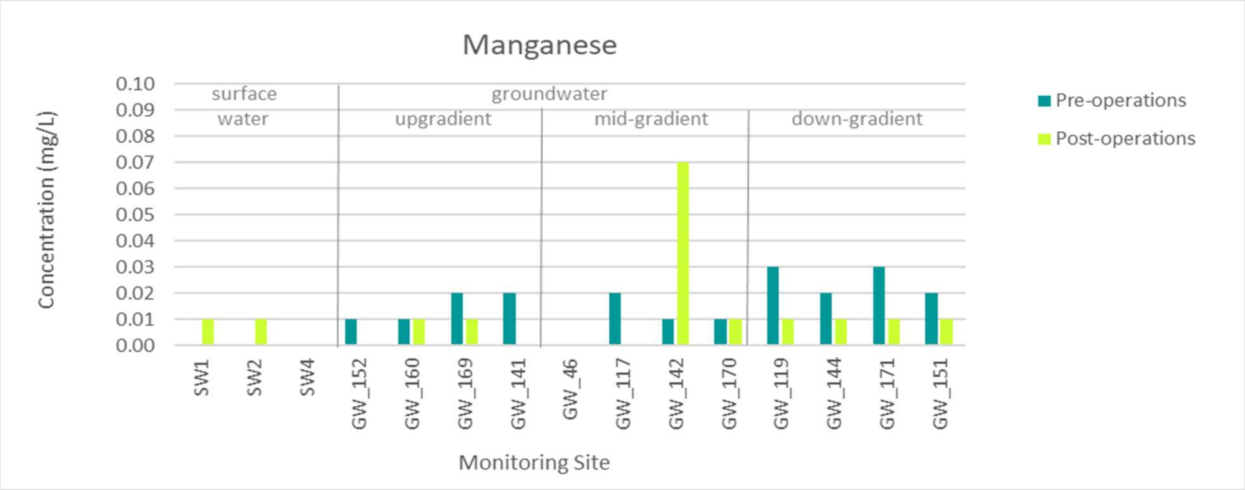

Figure 56 - Manganese concentrations in surface water and groundwater before and after managed recharge.

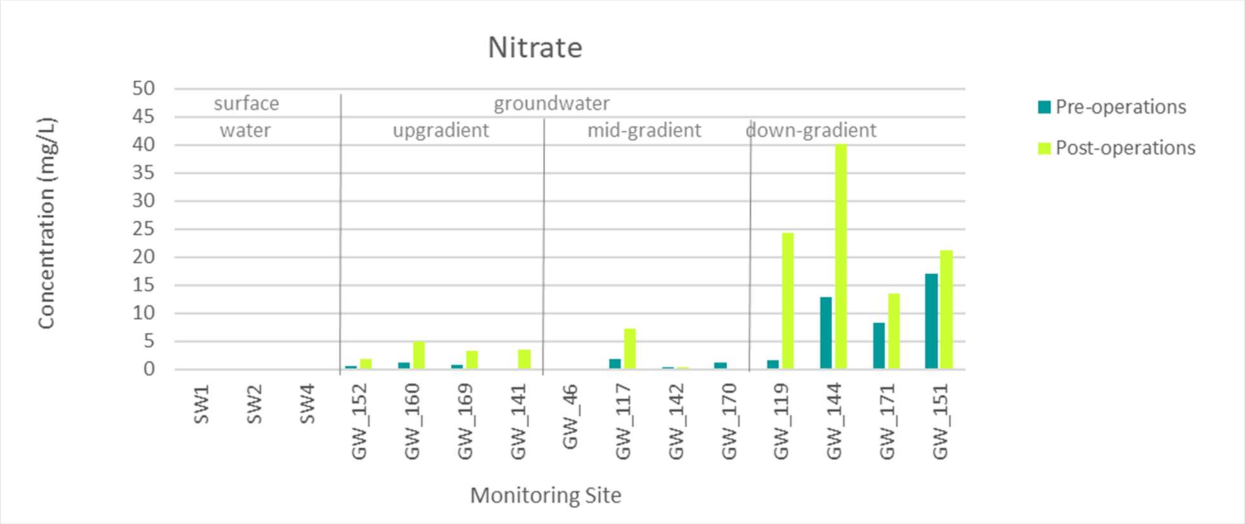

Figure 57 - Nitrate concentrations in surface water and groundwater before and after managed recharge.

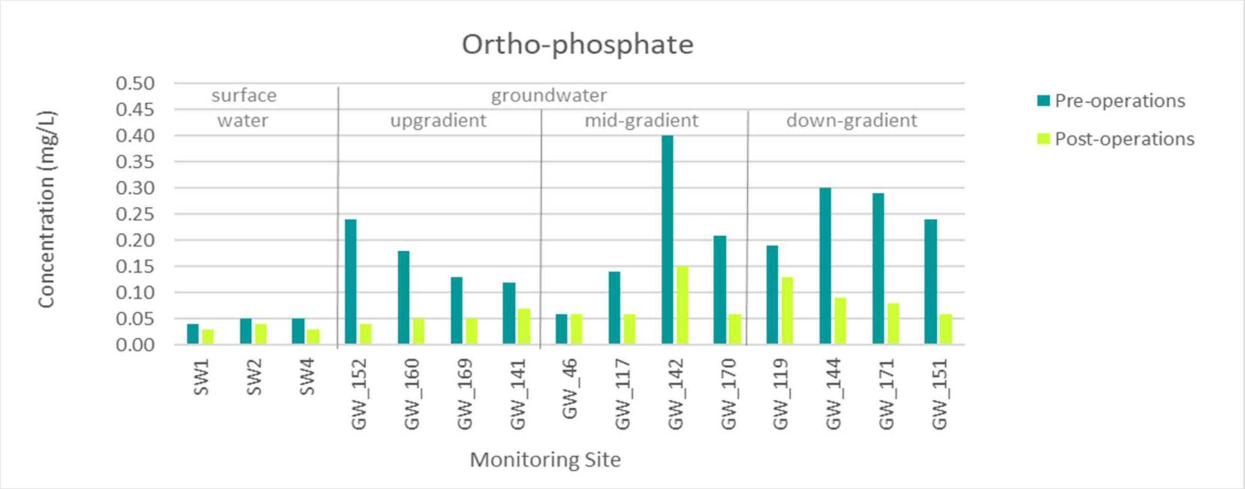

Figure 58 - Ortho-phosphate concentrations in surface water and groundwater before and after managed recharge.

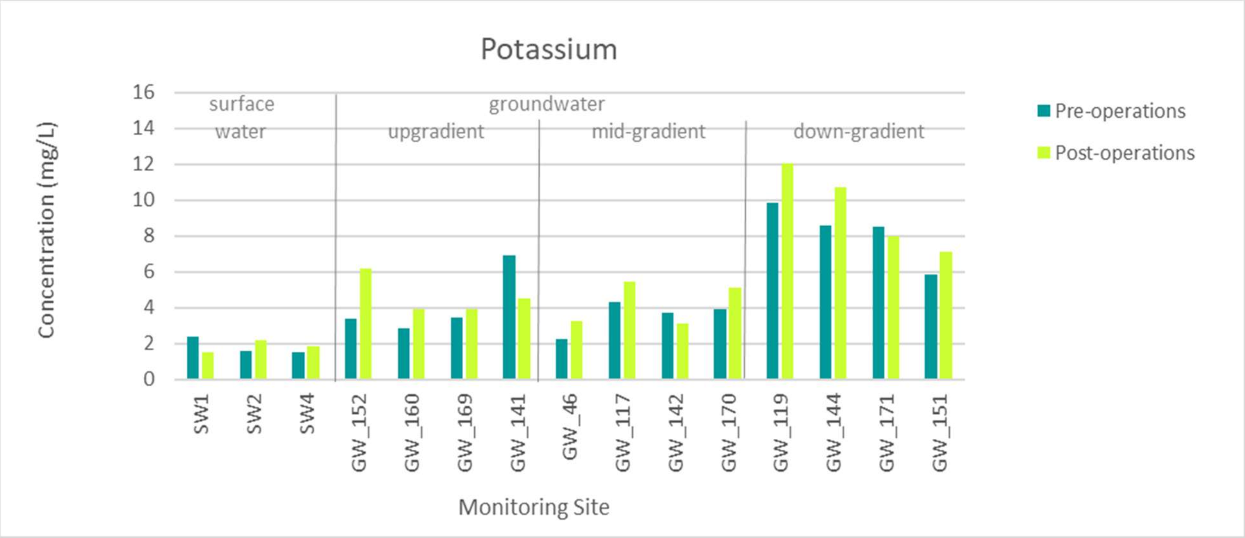

Figure 59 - Potassium concentrations in surface water and groundwater before and after managed recharge.

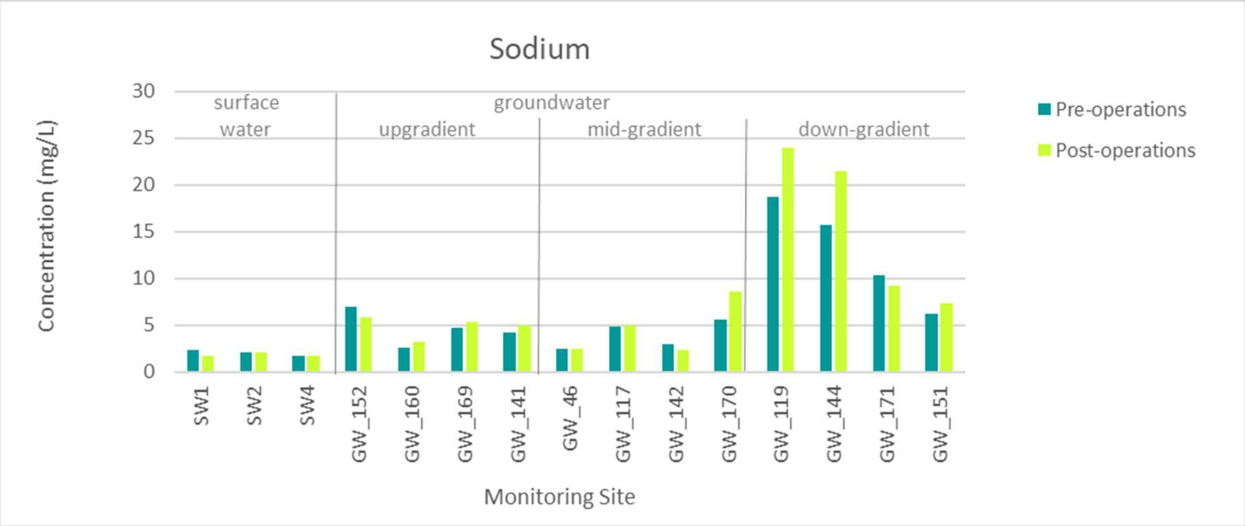

Figure 60 - Sodium concentrations in surface water and groundwater before and after managed recharge.

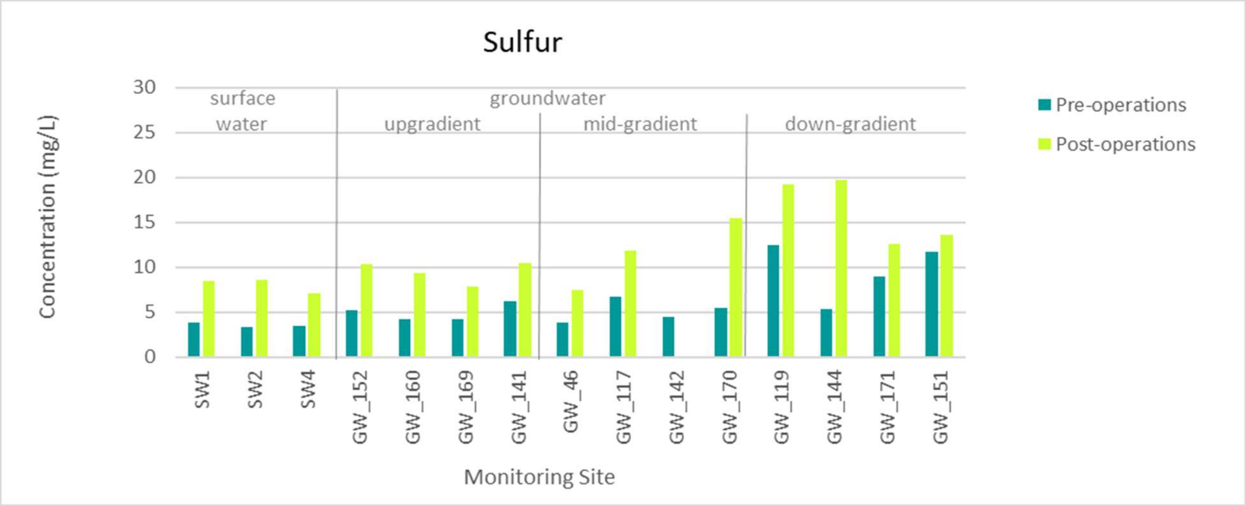

Figure 61 - Sulfur concentrations in surface water and groundwater before and after managed recharge.

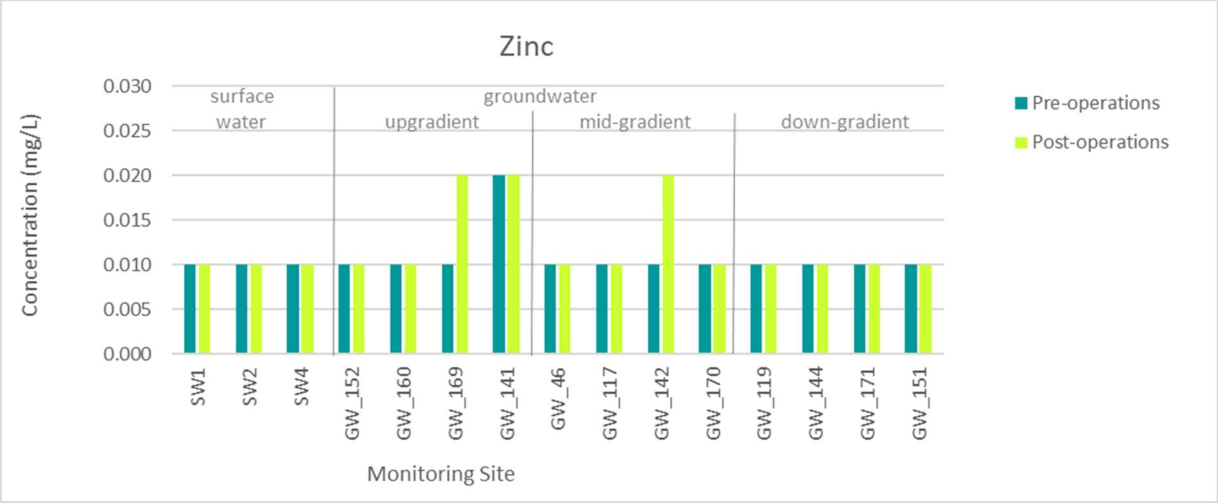

Figure 62 - Zinc concentrations in surface water and groundwater before and after managed recharge.

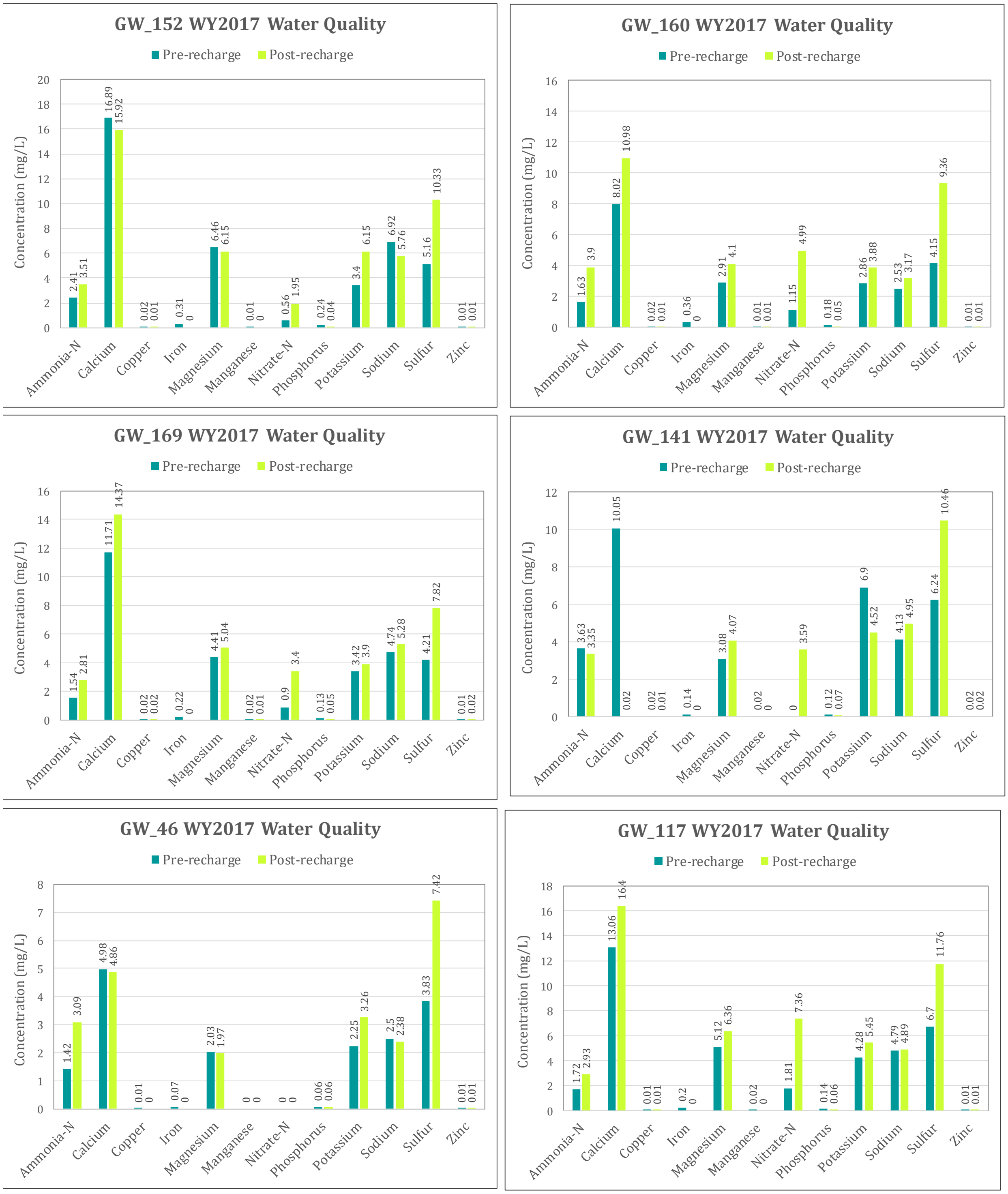

Figure 63 - Constituent concentrations pre- and post-recharge at GW_152, GW_160, GW169, GW_141, GW_46, and GW_117 in WY2017.

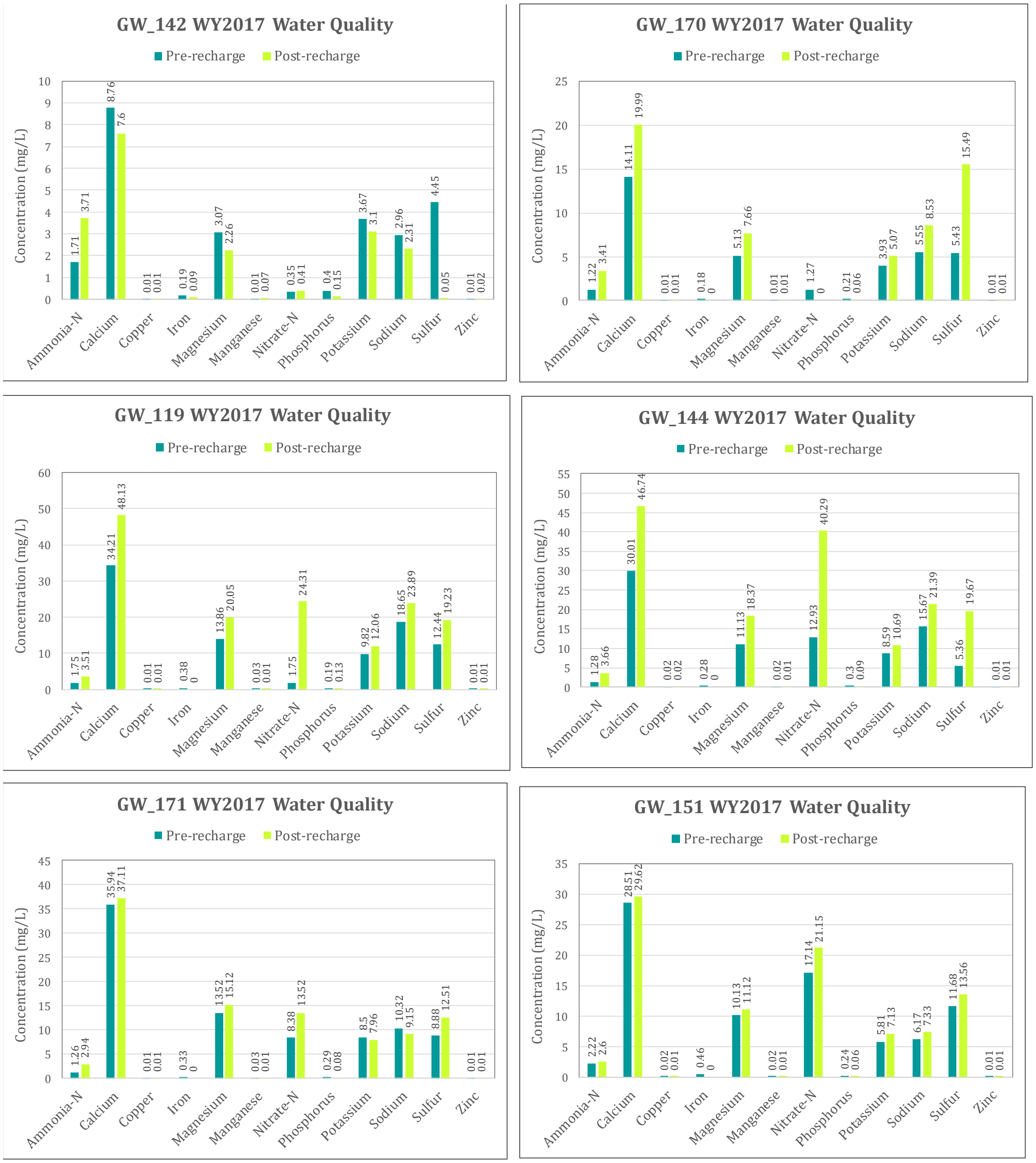

Figure 64 - Constituent concentrations pre- and post-recharge at GW_142, GW_170, GW_119, GW_144, GW_171, and GW_151 in WY2017.

DISCUSSION OF RESULTS

During the WY 2017 recharge season 5,148 ac-ft (1,677,375,965 gallons) of water was diverted from the Walla Walla River and delivered to recharge basins and infiltration galleries recharging the alluvial aquifer northwest of Milton-Freewater, OR. Wells near the Johnson site show a year to year positive (i.e. increasing) trend in alluvial aquifer water levels (except for the drought year of 2014-15) suggesting that water is being stored within the alluvial aquifer, potentially due to aquifer recharge activities. Differences between years at monitoring wells near the other sites with at least three years of data -- Anspach, Barrett (GW_62), Trumbull (GW_143, GW_117), and NW Umapine (GW_144) -- also indicate increasing groundwater levels, although additional years of operation and monitoring are required to evaluate trends. Results from WY 2017 are largely consistent with changes over time seen previously, and the positive trends are expected to continue, assuming continued aquifer recharge operations and normal water years.

The Walla Walla basin's aquifer recharge program continues to simulate the distributary and floodplain functions and processes that have been lost due to irrigation development and channelization of the river and stream channels for flood control and other uses. With continued aquifer recharge activities and increases in the total annual volume of water recharged, increases in alluvial aquifer water levels are anticipated, which should lead to further spring flow and/or base flow to the Walla Walla River system similar to those observed in previous pilot testing operations at the Johnson site (WWBWC, 2010, WWBWC, 2014b).

As in previous recharge seasons, groundwater and surface water quality data collected during aquifer recharge activities do not indicate that aquifer recharge activities are degrading groundwater quality per Condition 5 of LL-1621. In many cases, groundwater quality parameters improved over the recharge season, in other cases water quality remained unchanged, and for a few isolated sites and constituents declined. Source water quality being delivered to the aquifer recharge sites continues to be of generally acceptable quality and would not be anticipated to degrade groundwater quality. Elevated ammonia and copper concentrations may be due to the sampling/analytical method and will be analyzed in the next sampling round using a standard analytical method.

PROPOSED AQUIFER RECHARGE PROGRAM IN WY 2018

Continued operation of the nine current sites and the addition of new aquifer recharges sites under LL-1621 is expected in WY 2018. Operating existing sites which have only one or two years of recharge for longer periods will help to identify their influence on the alluvial aquifer via program monitoring wells. An additional four sites are in the planning phase and will likely be constructed in the next year.

In addition to new sites, WY2018 will continue the operation of near real-time water quality stations to monitor conditions of the recharge source water. The goal of these stations is to eventually operate the aquifer recharge sites using near real-time data for the inflowing source water and to manage the sites via telemetry. The new water quality stations will operate during the WY 2018 recharge season and data will be evaluated against grab sample water quality test results to determine the efficacy of the real-time stations and if they can be used in place of grab sample testing.

In WY 2018 monitoring will continue to be performed per the monitoring plan approved under LL-1621. A report summarizing groundwater level monitoring, water quality monitoring and aquifer recharge operations performed during the WY 2018 recharge season will be submitted to OWRD by February 15, 2019. If funding allows, additional quantification of longer-term changes in groundwater conditions over time will be included in next year's annual report.

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APPENDIX A – LIMITED LICENSE LL-1621

Oregon Water Resources Department

Final Order
Limited License Application LL-1621
Walla Walla Basin Watershed Council and
Hudson Bay District Improvement
Company

Appeal Rights

This is a final 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.

Requested Water Use

On June 13, 2016, the Water Resources Department received completed limited license request **1621** from Walla Walla Basin Watershed Council and Hudson Bay District Improvement Company for the use of up to 70 cubic feet per second from the Walla Walla River. The points of diversion are located in the NE ¼ NW ¼ , Section 1, Township 5 North, Range 35 East W.M. and in the SW ¼, NE ¼, Section 12, Township 5 North, Range 35 East, W.M., for the purpose of artificial groundwater recharge testing, for the period of March 1, 2015 through December 31, 2020.

Authorities

The Department may approve a limited license pursuant to its authority under ORS 537.143, 537.144 and OAR 690-340-0030.

ORS 537.143(2) authorizes the Director to revoke the right to use water under a limited license if it causes injury to any other water right or a minimum perennial streamflow.

A limited license will not be issued for more than five consecutive years for the same use, as directed by ORS 537.143(8).

Findings of Fact

1. The forms, fees and map have been submitted, as required by OAR 690-340-0030(1).
2. The Department provided public notice of the application, on December 22, 2015 as required by OAR 690-340-0030(2).
3. This limited license request is limited to an area within a single drainage basin as required by OAR 690-340-0030(3).

4. The Department has determined that there is water available for the requested use.

5. The Department has determined that the proposed source has not been withdrawn from further appropriation.

6. Because this use is from surface water and has the potential to impact fish, the Department finds that fish screening is required to protect the public interest.

7. Because the use requested is longer than 120 days and because the use is in an area that has sensitive, threatened or endangered fish species, the use is subject to the Department's rules under OAR 690-33. These rules aid the Department in determining whether a proposed use will impair or be detrimental to the public interest with regard to sensitive, threatened, or endangered fish species.

8. The Department has determined that the use is not subject to its rules under OAR 690-350. However, artificial groundwater recharge testing must be done in a manner that provides a test with results and supplemental information for the user's artificial groundwater recharge permit application. Consistent with this intent, the Department has added conditions pertaining to testing, monitoring, reporting and coordination with Oregon Department of Environmental Quality (ODEQ), Oregon Department of Fish and Wildlife (ODFW) and this Department.

9. The Department has received comments related to the possible issuance of the limited license from ODEQ requesting changes to the proposed monitoring plan. The water quality monitoring plan was revised and approved by ODEQ on February 25, 2016. The Department has received comments from ODFW in support of this issuance and recommending conditions related to instream water rights and bypass flows. The Department's Groundwater Section determined the testing and water quantity monitoring plan submitted as an addendum to the application on June 13, 2016 is sufficient for artificial groundwater recharge testing. The authorization of Limited License **1621** is conditioned to satisfactorily address issues raised in those comments.

10. Pursuant to OAR 690-340-0030(4)(5), conditions have been added with regard to notice and water-use measurement.

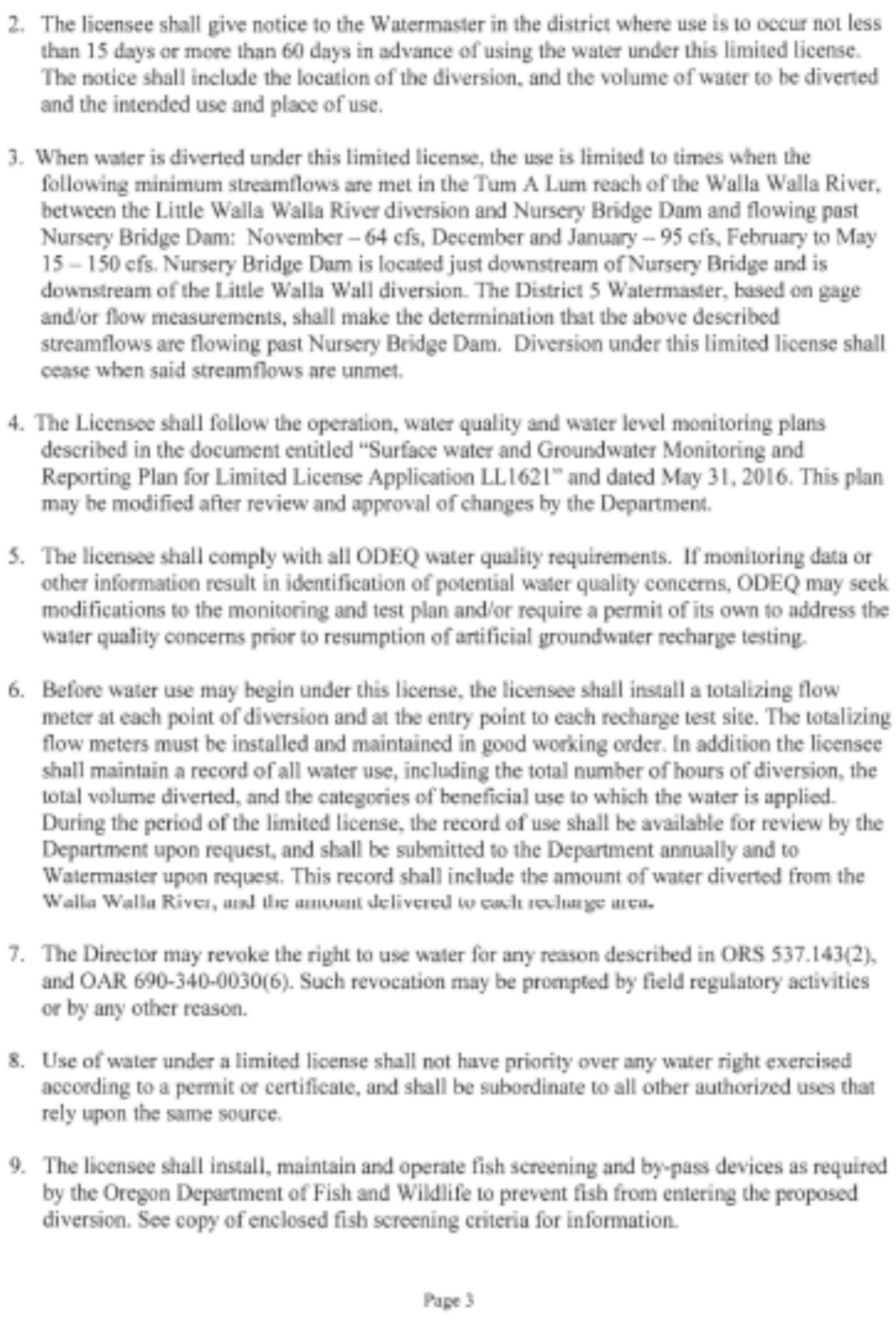
Conclusions of Law

The proposed water use will not impair or be detrimental to the public interest pursuant to OAR 690-340-0030(2), as limited in the order below.

Order

Therefore, pursuant to ORS 537.143, ORS 537.144, and OAR 690-340-0030, application for Limited License **1621** is approved as conditioned below.

1. The period and rate of use for Limited License **1621** shall be from October 17, 2016 through December 31, 2020 for the use of 70 cubic feet per second from the Walla Walla River, for the purpose of artificial groundwater recharge testing. The season of use is limited to November 1 through May 15.



2. The licensee shall give notice to the Watermaster in the district where use is to occur not less than 15 days or more than 60 days in advance of using the water under this limited license. The notice shall include the location of the diversion, and the volume of water to be diverted and the intended use and place of use.

3. When water is diverted under this limited license, the use is limited to times when the following minimum streamflows are met in the Tum A Lum reach of the Walla Walla River, between the Little Walla Walla River diversion and Nursery Bridge Dam and flowing past Nursery Bridge Dam: November – 64 cfs, December and January – 95 cfs, February to May 15 – 150 cfs. Nursery Bridge Dam is located just downstream of Nursery Bridge and is downstream of the Little Walla Wall diversion. The District 5 Watermaster, based on gage and/or flow measurements, shall make the determination that the above described streamflows are flowing past Nursery Bridge Dam. Diversion under this limited license shall cease when said streamflows are unmet.

4. The Licensee shall follow the operation, water quality and water level monitoring plans described in the document entitled "Surface water and Groundwater Monitoring and Reporting Plan for Limited License Application LL1621" and dated May 31, 2016. This plan may be modified after review and approval of changes by the Department.

5. The licensee shall comply with all ODEQ water quality requirements. If monitoring data or other information result in identification of potential water quality concerns, ODEQ may seek modifications to the monitoring and test plan and/or require a permit of its own to address the water quality concerns prior to resumption of artificial groundwater recharge testing.

6. Before water use may begin under this license, the licensee shall install a totalizing flow meter at each point of diversion and at the entry point to each recharge test site. The totalizing flow meters must be installed and maintained in good working order. In addition the licensee shall maintain a record of all water use, including the total number of hours of diversion, the total volume diverted, and the categories of beneficial use to which the water is applied. During the period of the limited license, the record of use shall be available for review by the Department upon request, and shall be submitted to the Department annually and to Watermaster upon request. This record shall include the amount of water diverted from the Walla Walla River, and the amount delivered to each recharge area.

7. The Director may revoke the right to use water for any reason described in ORS 537.143(2), and OAR 690-340-0030(6). Such revocation may be prompted by field regulatory activities or by any other reason.

8. Use of water under a limited license shall not have priority over any water right exercised according to a permit or certificate, and shall be subordinate to all other authorized uses that rely upon the same source.

9. The licensee shall install, maintain and operate fish screening and by-pass devices as required by the Oregon Department of Fish and Wildlife to prevent fish from entering the proposed diversion. See copy of enclosed fish screening criteria for information.

10. In supporting this license, ODFW retains the prerogative to pursue a future instream water right for the Walla Walla River. A permanent water right for the requested location may fall under the requirements of Division 33 rules, which limit water usage during the period from April 15-September 30.

11. The licensee is required to provide a written annual report by February 15th of each year. This report will detail recharge testing and any subsequent recovery under a secondary limited license from the preceding water year. Reporting shall include, but is not limited to, the results of testing efforts that relate to water quality, water quantity, and operations. Water level data shall be submitted in a Department-specified digital format. The licensee shall consult with ODEQ and OWRD to identify additional specific reporting elements. The first report is due in February 2014. The annual report shall be sealed and signed by a professional(s) registered or allowed, under Oregon law, to practice geology.

12. Failure to meet the conditions of the license to the satisfaction of the Department will lead to a cancellation of the limited license, in which case it would no longer be in force.

13. The licensee shall conduct recharge testing as proposed in the application and later amended by the licensee, and as otherwise conditioned herein.

NOTE: This water-use authorization is temporary. Applicants are advised that issuance of this final order does not guarantee that any permit for the authorized use will be issued in the future; any investments should be made with that in mind.

Issued October 18 , 2016

E. Timothy Wallin

E. Timothy Wallin, Water Rights Program Manager, *for*
Thomas M. Byler, Director
Water Resources Department

Enclosures - limited license

cc: Greg Silbernagel, District 5 Watermaster
Bill Duke, ODFW
Phil Richerson, ODEQ
File

If you need further assistance, please contact the Water Rights Section at the address, phone number, or fax number below. When contacting the Department, be sure to reference your limited license number for better service.

Remember, the use of water under the terms of this limited license is not a secure source of water. Water use can be revoked at any time. Such revocation may be prompted by field regulatory activities or many other reasons.

Water Rights Section
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem OR 97301-1271
Phone: (503) 986-0817 Fax: (503) 986-0901

FISH SCREENING CRITERIA FOR WATER DIVERSIONS

This summary describes ODFW fish screening criteria for all fish species.

Screen material openings for ditch (gravity) and pump screens must provide a minimum of 27% open area:

> **Perforated plate**: Openings shall not exceed 3/32 or 0.0938 inches (2.38 mm).
> **Mesh/Woven wire screen**: Square openings shall not exceed 3/32 or 0.0938 inches (2.38 mm) in the narrow direction, e.g., 3/32 inch x 3/32 inch open mesh.
> **Profile bar screen/Wedge wire**: Openings shall not exceed 0.0689 inches (1.75 mm) in the narrow direction.

Screen area must be large enough to prevent fish impact. Wetted screen area depends on the water flow rate and the approach velocity.

> **Approach velocity**: The water velocity perpendicular to and approximately three inches in front of the screen face.
> **Sweeping velocity**: The water velocity parallel to the screen face.
> **Bypass system**: Any pipe, flume, open channel or other means of conveyance that transports fish back to the body of water from which the fish were diverted.
> **Active pump screen**: Self cleaning screen that has a proven cleaning system.
> **Passive pump screen**: Screen that has no cleaning system other than periodic manual cleaning.

Screen approach velocity for ditch and active pump screens shall not exceed 0.4 fps (feet per second) or 0.12 mps (meters per second). The wetted screen area in square feet is calculated by dividing the maximum water flow rate in cubic feet per second (1 cfs = 449 gpm) by 0.4 fps.

Screen sweeping velocity for ditch screens shall exceed the approach velocity. Screens greater than 4 feet in length must be angled at 45 degrees or less relative to flow. An adequate bypass system must be provided for ditch screens to safely and rapidly collect and transport fish back to the stream.

Screen approach velocity for passive pump screens shall not exceed 0.2 fps or 0.06 mps. The wetted screen area in square feet is calculated by dividing the maximum water flow rate by 0.2 fps. Pump rate should be less than 1 cfs.

For further information please contact:

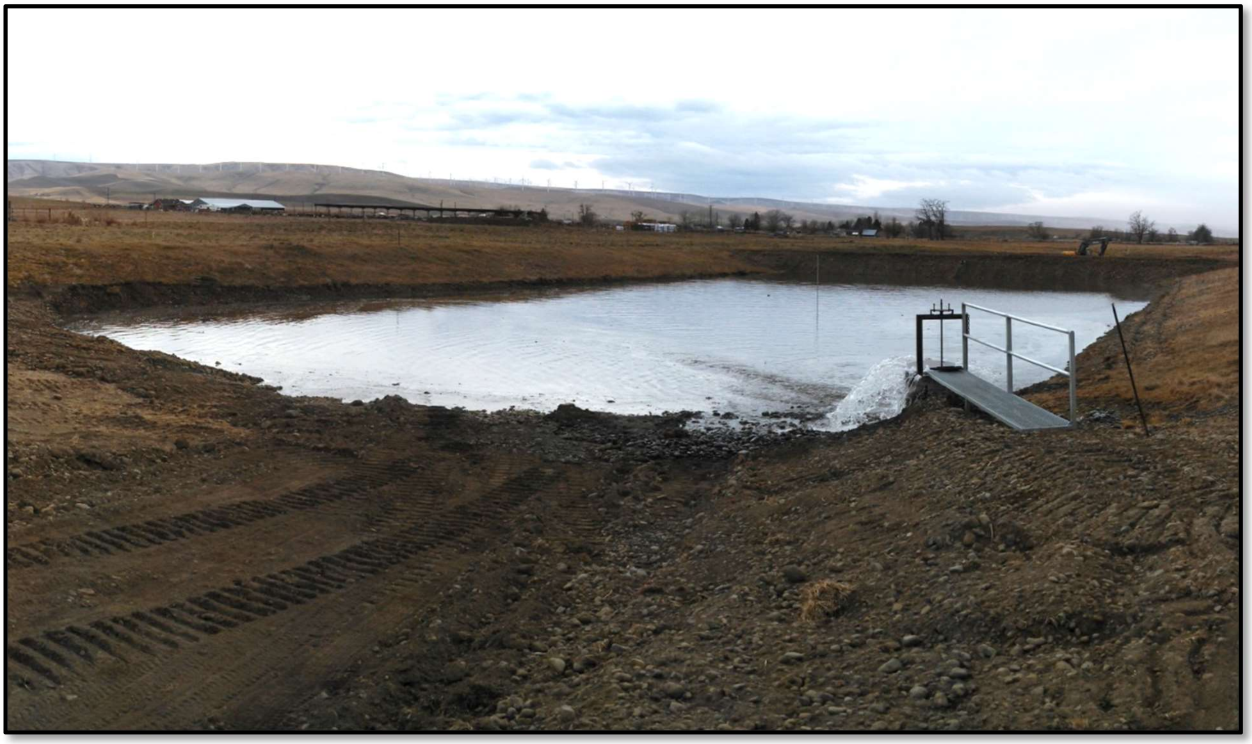
Bernie Kepshire
Oregon Department of Fish and Wildlife
7118 NE Vandenberg Avenue
Corvallis, OR 97330-9446
(541)757-4186 x255
bernard.m.kepshire@state.or.us

APPENDIX B – LL-1621 SOURCE AND GROUNDWATER MONITORING PLAN

The following is a replica of the monitoring plan without figures or appendices. Click here to download complete Monitoring Plan with figures and appendices.

Surface water and Groundwater Monitoring and Reporting Plan

For Limited License Application LL1621



MAY 2016

Walla Walla Basin Watershed Council
810 S. Main St., Milton-Freewater, OR 97862

&

GeoSystems Analysis, Inc.
1412 13th St, Suite 200, Hood River, OR 97031

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INTRODUCTION

This document was prepared to fulfill certain requirements in Oregon Administrative Rules (OAR) 690-350-0110 through 0130 in support of the application for artificial recharge (AR) Limited License LL1621. The aquifer recharge projects included in this plan will be managed by the Walla Walla Basin Watershed Council (WWBWC) and Hudson Bay District Improvement Company (HBDIC). The application for Limited License LL1621 was submitted to the Oregon Water Resources Department (OWRD) in December 2015. The program includes seventeen aquifer recharge projects located at different sites. Because of the unique nature of this program with distributed recharge sites, as well as the availability of a body of information from other related or nearby recharge projects, OWRD staff requested that the applicant provide a summary compilation of the hydrogeologic information relevant to the overall program area and specific recharge sites (See Appendix C), as well as a monitoring plan for the AR project.

The objectives of the document are three-fold: (1) present a proposed source water and groundwater monitoring plan, (2) present a proposed water level monitoring plan (groundwater and surface water) and (3) present a proposed reporting regime for the program. All of these document elements were prepared in support of the Limited License application.

The recharge sites included in this project are referred to as Anspach, Barrett, Chuckhole, County Road, East Trolley Lane, Fruitvale, Gallagher, Johnson, LeFore Road, Locust Road, Mud Creek, NW Umapine, Sunquist, Triangle Road, Triangle Station, Trumbull and West Ringer Road (Figure 1). At this time five of these sites (Johnson, Anspach, Trumbull, NW Umapine and Barrett) are active under Limited License LL1433, which will be superseded by Limited License LL1621. Upon receipt of Limited License LL1621 operations at the other sites will be initiated as the WWBWC is able to complete infrastructure improvements necessary to operate the sites. Current information regarding each of the seventeen sites, including recharge sites and proposed monitoring, are summarized in this document (hydrogeology information is included in Appendix C).

Water quality data collected at seven active sites (Johnson, Anspach, Trumbull, Barrett, NW Umapine, Stiller Pond and Locher Road) and one inactive site (Hall-Wentland) in the greater Walla Walla Basin have shown that AR activities conducted in the Walla Walla Basin have not lead to degradation of the alluvial groundwater system (GSI, 2009a, 2009b, WWBWC 2010). Moreover, water quality monitoring in support of Limited License LL1433 indicates groundwater quality improvements in response to AR activities (WWBWC, 2014a). Given these observations, the dispersed nature of the individual AR sites, and the common source water for the proposed AR program, the monitoring approach described herein focuses on evaluating the effects of each recharge season on water quality using a dispersed, but integrated, monitoring network.

The balance of this document includes the following:

1. Program goals and a summary of AR sites to be covered under LL1621.
2. The scope of the proposed monitoring effort, including:
    a. Proposed number, locations, and physical characteristics of monitoring points.
    b. Constituents to be monitored for.
    c. Sample collection frequency.
    d. Quality assurance and quality control (QA/QC) elements.
3. Reporting methods.

PROGRAM GOALS

The overarching goal of the proposed aquifer recharge program is to restore and maintain the shallow alluvial aquifer for the benefit of people, the environment and wildlife. Specific goals of the projects include: (1) stopping and reversing the water level declines observed in the shallow alluvial aquifer system throughout the Walla Walla Valley, (2) reducing the hydraulic gradient away from streams and creeks in the valley to reduce surface water seepage, especially during dry summer months, and (3) restoring flows to spring creeks.

AQUIFER RECHARGE SITES

Recharge to be conducted under Limited License LL1621 will occur at the seventeen sites shown in Table 1 and Figure 1. The Anspach, Barrett, Johnson, NW Umapine and Trumbull sites are currently operated and monitored under Limited License LL1433. Recharge volumes estimates and estimated conveyance losses between the point of diversion and the recharge site are provided in Table 2. This section summarizes the basic physical layout and operation of each of the seventeen sites (Figure 1).

Table 1. Aquifer recharge sites included in Limited License LL1621.

Site Name	GPS Coordinates	Section, Township & Range	Site Type
Anspach	45.945540, -118.411043	NW ¼, NW ¼, Sec. 30, T6N, R35E	Gallery
Barrett	45.948009, -118.421811	SW ¼, SE ¼, Sec. 34, T6N, R35E	Gallery
Chuckhole	45.941074, -118.419149	SW ¼, NE ¼, Sec. 3, T5N, R35E	Basin
County Road	45.951563, -118.428188	NE ¼, SW ¼, Sec. 34, T6N, R35E	*Gallery*
East Trolley Lane	45.993006, -118.423812	SW ¼, SE ¼, Sec. 15, T6N, R35E	Gallery
Fruitvale	45.987780, -118.444852	NE ¼, NW ¼, Sec. 21, T6N, R35E	Gallery
Gallagher	45.967480, -118.485502	SE ¼ & SW ¼ of Sec. 30, T6N, R35E	*Gallery & Basin*
Johnson	45.956690, -118.439271	SE ¼, SW ¼, Sec. 33, T6N, R35E	Gallery & Basin
LeFore Road	45.951187, -118.377397	NE ¼, SW ¼, Sec. 36, T6N, R35E	Gallery
Locust Road	45.957360, -118.392845	SE ¼, NE ¼, Sec. 35, T6N, R35E	*Gallery*
Mud Creek	45.973630, -118.430493	NW ¼, NW ¼, Sec. 27, T6N, R35E	Basin
NW Umapine	45.979884, -118.503350	SW ¼, SE ¼, Sec. 24, T6N, R34E	Basin
Sunquist	45.982522, -118.445141	NE ¼, SW ¼, Sec. 21, T6N, R35E	*Gallery*
Triangle Road	45.973104, -118.425618	NE ¼, NW ¼, Sec. 27 T6N, R35E	*Gallery*
Triangle Station	45.975587, -118.436832	NE ¼, NE ¼, Sec. 28, T6N, R35E	*Basin*
Trumbull	45.962171, -118.428849	NW ¼, SW ¼, Sec. 27, T6N, R34E	Gallery
West Ringer Road	45.971661, -118.499919	SW ¼, NE ¼, Sec. 25, T6N, R34E	Gallery

Table 2. Aquifer Recharge sites with recharge rates, recharge volumes (low/high) and conveyance loss estimates (low/high) for LL1621

Site Name	Recharge Rate	Recharge Volume (Low/High)	Conveyance Loss (Low/High)
Anspach	3-5 cfs	445/1130 AF/year	145/295 AF/year
Barrett	4 cfs	555/1130 AF/year	145/295 AF/year
Chuckhole	*1-3 cfs*	*90/530 AF/year*	*90/180 AF/year*
County Road	*2-4 cfs*	*310/1260 AF/year*	*145/295 AF/year*
East Trolley Lane	*1-2 cfs*	*100/375 AF/year*	*100/375 AF/year*
Fruitvale	*2-4 cfs*	*200/750 AF/year*	*145/185 AF/year*
Gallagher	*2-6 cfs*	*315/1,900 AF/year*	*220/600 AF/year*
Johnson	18 cfs	1,350/4,650 AF/year	700/1425 AF/year
LeFore Road	*1 cfs*	*60/190 AF/year*	*0/0 AF/year*
Locust Road	*1.5 cfs*	*140/300 AF/year*	*90/185 AF/year*
Mud Creek	*1-2 cfs*	*100/375 AF/year*	*75/200 AF/year*
NW Umapine	3 cfs	450/950 AF/year	150/375 AF/year
Sunquist	*1-3 cfs*	*95/565 AF/year*	*100/185 AF/year*
Triangle Road	*1-2 cfs*	*100/375 AF/year*	*70/140 AF/year*
Triangle Station	*1 cfs*	*100/190 AF/year*	*70/140 AF/year*
Trumbull	2 cfs	300/630 AF/year	100/225 AF/year
West Ringer Road	*1-2 cfs*	*100/630 AF/year*	*150/450 AF/year*
Estimated Totals (Low/High)		**4,720/15,930 AF/year**	**2,495/5,550 AF/year**

NOTE: Italicized recharge rates are estimates because the site has not operated yet.

ANSPACH

The Anspach site is an operational infiltration gallery constructed in 2012 and expanded in 2015. The infiltration gallery is located immediately northwest of Milton-Freewater, OR and east of Winsap Road in NW ¼, NW ¼, Sec. 30, T6N, R35E (Figures 1, 2, and 3). Recharge capacity at the Anspach site has ranged from 0.5 to 1 cubic feet per second (cfs). After the expansion, the site is expected to increase to approximately 4 cfs. This site was built in a field that has been fallow for at least 14 years. Prior to this, the land was utilized as an apple orchard.

There are two onsite wells (GW135 and GW141). GW135 is an abandoned irrigation well located at the up-gradient, southeastern corner of the site and GW141 is a purpose built monitoring well at the up-gradient, northeastern corner of the site. Another well (GW23) is located generally down gradient of, and west southwest of, the site. GW135 and GW23 are water wells that have been adapted for use in the WWBWC water level monitoring network.

Recharge source water is diverted from the Hudson Bay District Improvement Company (HBDIC) White Ditch canal west of its intersection with the Old Milton Highway/Lamb Street. At a weir structure, water is diverted south through a pipeline to the project. HBDIC and the WWBWC manage the diversion of recharge water from the canal to the recharge site. The Anspach site will continue to be operated under the existing Limited License LL1433 until issuance of Limited License LL1621.

BARRETT

The Barrett site is an operational infiltration gallery constructed in January 2014. The site is located approximately 1.5 miles northwest of Milton-Freewater, OR between County Road and Chuckhole Lane in SW ¼, SE ¼, Sec. 34, T6N, R35E (Figures 1, 4, and 5). Recharge capacity at the Barrett site is 3-4 cfs. This site was built in a field that has been fallow since the early 1990s.

One well is in the immediate vicinity of this site, well GW_62, which is located up gradient of the facility. Another existing well, GW_150, is located down-gradient of the site. These wells are water wells adapted for use in the WWBWC water level monitoring network.

Recharge source water is delivered from the Barrett pipeline to the infiltration gallery. HBDIC manages the diversion of water to the site.

The Barrett site will continue to be operated under the existing Limited License LL1433 until issuance of Limited License LL11621.

CHUCKHOLE

The Chuckhole site is located approximately one mile northwest of Milton-Freewater, OR near the south end of Chuckhole Lane in SW ¼, NE ¼, Sec. 3, T5N, R35E (Figures 1, 6 and 7). The site consists of two basins: a sediment trap basin and an infiltration basin. The site is expected to have a total recharge capacity of 1 to 3 cfs. The Chuckhole site was constructed in the fall of 2015 and will be brought into use pending issuance of a new limited license. This site was constructed in a vacant corner of a vineyard. The land has not been utilized for at least 20 years. The adjacent field has been cultivated as a vineyard for approximately 10 years and before that it was apple orchard (at least to the early 1990s).

Existing wells in the area include GW_23 and GW_62. A planned well, GW_169, will be a purpose built monitoring well to be installed up-gradient of the site.

Recharge source water will be delivered from the Milton Pipeline into the project. WWBWC will be responsible for operating the diversion into the site.

COUNTY ROAD

The County Road site is proposed to be located approximately 2.25 miles northwest of Milton-Freewater, OR, just north of County Road and east of Prunedale Road in NE ¼, SW ¼, Sec. 34, T6N, R35E (Figures 1 and 8). The site is planned to be an infiltration gallery with a recharge capacity of 2-4 cfs. The County Road project is scheduled to be constructed in 2016 or 2017. The site will be built on land that has been used as an apple orchard since the mid-1990s.

There is a single existing well in the immediate area, GW_150. This well is utilized for water level monitoring. There are purpose built monitoring wells up and down-gradient from the site (GW_141 and GW_45-48) as well as additional water level monitoring wells (GW_40, GW_62 and GW_135).

Recharge source water will be delivered down the HBDIC system and diverted into the proposed infiltration gallery. HBDIC will be responsible for operating the diversion into the site.

EAST TROLLEY LANE

The East Trolley Lane site is an infiltration gallery constructed in late 2013 and will be brought into use pending issuance of a new limited license. The site is located east of Trolley Lane and approximately 0.5 miles south of the Oregon/Washington border in SW ¼, SE ¼, Sec. 15, T6N, R35E (Figures 1, 9 and 10). Recharge capacity at the site is expected to range from approximately 1-2 cfs. The infiltration gallery was built between an apple orchard and the county road. This field has been used as an apple orchard since at least the early 1990s.

A purpose built monitoring well, GW_151, is located immediately north (down-gradient) of the infiltration gallery, approximately down-gradient of the site. Additional down gradient wells exist on the Washington side of the border.

Recharge water will be delivered down the Ford branch to the West Little Walla Walla River and then diverted down the Trolley Lane pipeline to the project. WWBWC staff will manage the Trolley Lane diversion.

FRUITVALE

The proposed Fruitvale recharge site will be located approximately 3.5 miles northwest of Milton-Freewater, OR near the intersection of Sunquist Road and Fruitvale Road in NE ¼, NW ¼, Sec. 21, T6N, R35E (Figures 1 and 11). The site is planned to be an infiltration gallery, with the potential for a sediment settling pond, with a recharge capacity of 2 to 4 cfs. The Fruitvale site will be constructed in the fall of 2015 and will begin operations pending issuance of a new limited license. The site will be constructed in an existing wheat/alfalfa field. The land has historically (since the early 1990s) been in a wheat/alfalfa rotation, however there have been times when a portion of the land was planted in corn. In 2015, the land was planted with peas for the winter with buckwheat to follow in the late spring/summer.

There is one existing well in the area, GW_33, a water well adapted for use in the WWBWC water level monitoring network. An additional planned purpose built monitoring well will be installed near the site, GW_171.

Recharge source water will be delivered from the Fruitvale ditch into the proposed infiltration gallery. WWBWC will be responsible for operating the diversion into the site.

GALLAGHER

The proposed Gallagher recharge site will be located approximately 0.75 miles southeast of Umapine, OR in SE ¼ and SW ¼ of Sec. 30, T6N, R35E (Figures 1 and 12). The site is planned to be a combination of infiltration galleries and infiltration basins with an expected recharge capacity of 3-6 cfs. The Gallagher site will likely be constructed in phases starting with a single infiltration basin currently scheduled for construction in 2016, and then incorporating additional basins and the infiltration galleries in future years. The site consists of land that has been fallow and used as a horse pasture and farm equipment storage since the 1990s.

There are two existing wells in the area, GW_36 and GW_119. GW_36 is an irrigation well used to monitor water levels and GW_119 is a purpose built monitoring well used for water quality and water level monitoring. Down-gradient of the site is an additional well, GW_66. This well is used for water level monitoring in the WWBWC water level monitoring network.

This site will be connected to the White pipeline (currently the White ditch) and fed from the HBDIC system. Prior to the installation of the White pipeline, water will be delivered down HBDIC's system, routed into Dugger Creek and diverted into the Gallagher ditch. WWBWC and HBDIC will co-manage the diversion for this site.

JOHNSON

The Johnson site is an operational recharge site consisting of a combination of infiltration basins and infiltration galleries. The site is located approximately 2.5 miles northwest of Milton-Freewater, OR between County Road and Prunedale Road in SE ¼, SW ¼, Sec. 33, T6N, R35E (Figures 1, 13 and 14). Originally constructed in 2004, the site has undergone two expansion phases to provide a recharge capacity ranging between 15 to 18 cfs. The site was constructed on fallow ground (since at least the mid-1990s) but historically was used to grow cherry tree starts.

There are 6 wells on or very near the site, including: 1 up-gradient well (GW_40), one mid-site well (GW_45), and 4 down-gradient wells (GW_46, GW_47, GW_48, and GW_118). Wells GW_45, GW_46, GW_47, and GW_48 are purpose-built monitoring wells drilled and constructed as part of the original operation of the site and have been used at various times for water quality monitoring. GW_118 is also a purpose built monitoring well. All wells are included in the basin-wide WWBWC water level monitoring network.

Recharge source water is delivered to the site from the White Ditch. Water delivery and infiltration basin operation is managed by the HBDIC. The infiltration galleries are managed by the WWBWC.

The Johnson site will continue to be operated under the existing Limited License LL1433 until issuance of Limited License LL1621.

LEFORE ROAD

The LeFore Road recharge site is located immediately northeast of Milton-Freewater, OR and north of LeFore Road in NE ¼, SW ¼, Sec. 36, T6N, R35E (Figures 1, 15 and 16). The site is an infiltration gallery with an expected recharge capacity of 1-2 cfs. The LeFore Road site was constructed in October 2014 and will brought into use in 2015 pending issuance of a new limited license. The site was built between an apple and cherry orchard. The land has been utilized as apple/cherry orchards since at least the early 1990s.

There are two purpose built monitoring wells in the immediate area. GW_152 is immediately up-gradient of the site and GW_160 is down-gradient of the site. Additional monitoring wells in the general area were installed in the mid-2015.

Recharge source water will be delivered from a private pipeline into the infiltration gallery. WWBWC will be responsible for operating the diversion into the site.

LOCUST ROAD

The proposed Locust Road recharge site will be located approximately 1.0 mile north of Milton-Freewater, OR in SE ¼, NE ¼, of Sec. 35, T6N, R35E (Figures 1 and 17). The site is planned to be an infiltration gallery with an expected recharge capacity of 1-2 cfs. The Locust Road site will likely be constructed in early 2016. The site consists of land that has been used as a cherry orchard since at least the early 1990s.

There are two existing wells in the area, GW_14 and GW_116. GW_14 is an existing water well used to monitor water levels and GW_116 is a purpose built monitoring well built in 2009. These wells are used for water level monitoring in the WWBWC water level monitoring network.

Recharge source water will be delivered from the East Branch Crockett ditch into the proposed infiltration gallery. WWBWC will be responsible for operating the diversion into the site.

MUD CREEK

The Mud Creek site is located approximately 2.5 miles northwest of Milton-Freewater, OR between State Route 332 and Triangle Road in NW ¼, NW ¼, Sec. 27, T6N, R35E (Figures 1, 18 and 19). The site consists of one infiltration basin with a total expected recharge capacity of 1 to 2 cfs. The Mud Creek site was constructed in the fall of 2015 and will be brought into use pending issuance of a new limited license. The site was constructed in a pasture. The land has been in pasture grass since at least the early 1990s.

Existing wells in the area include an up-gradient well, GW_117. An additional planned purpose built monitoring well will be installed near the site (GW_170).

Recharge source water will be delivered from the Fruitvale ditch into the infiltration basins. WWBWC will be responsible for operating the diversion into the site.

NW UMAPINE

The NW Umapine site is an operational infiltration basin constructed in 2013. The site is located approximately 0.5 miles northwest of Umapine, OR and the intersection of Umapine-Stateline Road with State Road 332 in SW ¼, SE ¼, Sec. 24, T6N, R34E just (Figures 1, 20 and 21). Recharge capacity at the NW Umapine site ranges from 2 to 3 cfs. This site was constructed in a pasture field. The land has been used as pasture for at least the last 5 years. Prior to that it was farmed with a wheat/alfalfa rotation.

There is a single purpose built monitoring well (GW_144) on the site. Wells in the general area of the site include GW_34, GW_36, GW_66 and GW_119, all of which are part of the WWBWC water level monitoring network. GW_119 is a purpose built monitoring well and the other wells are water wells that have been adapted for use in the water level monitoring network.

Recharge source water is diverted from the Richartz pipeline to the basin. HBDIC manages the diversion of water to the site by a turn out from the Richartz pipeline.

The NW Umapine site will continue to be operated under the existing Limited License LL1433 until issuance of Limited License LL1621.

SUNQUIST

The Sunquist site will be located approximately 4.5 miles northwest of Milton-Freewater, OR in NE ¼, SW ¼, Sec. 21, T6N, R35E (Figures 1 and 22). The site is planned to be an infiltration gallery with a recharge capacity of 1-2 cfs. The Sunquist site is scheduled to be constructed in 2016. The site will be built on land that has been fallow since the early 1990s. A portion of the land, down-gradient of the proposed recharge site, was planted as a vineyard in 2012.

A planned purpose built monitoring well (GW_170) will be constructed up-gradient of this site. Two wells exist down gradient, GW_33 (water level well) and GW_171 (purpose built water quality and water level well).

Recharge source water will be delivered from the Fruitvale ditch into the proposed infiltration gallery. WWBWC will be responsible for operating the diversion into the site.

TRIANGLE ROAD

The Triangle Road site will be located approximately 3.5 miles northwest of Milton-Freewater, OR in NE ¼, NW ¼, Sec. 27 T6N, R35E (Figures 1 and 23). The site is planned to be an infiltration gallery with a recharge capacity of 1-2 cfs. The site is scheduled for construction in 2016 or 2017. The site will be built on land that has been an orchard lane/fruit box storage area. Historically the land has been utilized as an orchard since the early 1990s with a few years of fallow ground.

Two purpose built monitoring wells (GW_170 and GW_171) will be installed down-gradient of this site. A purpose built monitoring well is up-gradient of the site (GW_117 and another purpose built well is cross-gradient to the site (GW_143).

Recharge source water will be delivered from the Fruitvale ditch into the proposed infiltration gallery. WWBWC will be responsible for operating the diversion into the site.

TRIANGLE STATION

The Triangle Station site will be located approximately 3.75 miles northwest of Milton-Freewater, OR in NE ¼, NE ¼, Sec. 28, T6N, R35E (Figures 1 and 24). The site is planned to be an infiltration basin with a recharge capacity of 0.5 to 1 cfs. The Triangle Station site is planned to be constructed in 2016 or 2017. The site will be built on land that has been used as pasture and grass hay since the early 1990s.

Two purpose built monitoring wells (GW_142 and GW_143) exist near the site and a planned purpose built monitoring well (GW_170) will be installed up-gradient of the site and another built down-gradient of the site (GW_171).

Recharge source water will be delivered from the Fruitvale ditch into the proposed infiltration basin. WWBWC will be responsible for operating the diversion into the site.

TRUMBULL

The Trumbull site is an infiltration gallery constructed in late 2012 and operational since 2013. The site is located approximately 2.5 miles northwest of Milton-Freewater, OR between the Umapine Highway and Trumbull Road in NW ¼, SW ¼, Sec. 27, T6N, R34E (Figures 1, 25 and 26).

Recharge capacity at the Trumbull site ranges from 1.5 to 2.5 cfs. The site was built in a fallow field that has since been converted to a vineyard. Historically this land was utilized as cherry/apple orchards. The current vineyard is approximately 50 yards away from the infiltration gallery.

There are no monitoring wells located at the site, however, an existing purpose-built monitoring well (GW117) that is included in the WWBWC water level monitoring network is located approximately 0.3 miles east and up-gradient of the site. Two purpose built wells, GW142 and GW143, are located approximately 0.3 to 0.75 miles to the west and northwest of the Trumbull site, respectively. These locations are generally down gradient of the site.

Recharge source water is delivered to the site from the HBDIC Canal. HBDIC manages the diversion of water to the site.

The Trumbull site will continue to be operated under the existing Limited License LL1433 until issuance of Limited License LL1621.

WEST RINGER ROAD

The West Ringer Road site is a modified infiltration gallery that utilizes storm water chambers instead of perforated pipes. The site is located west of Ringer Road, just south of the community of Umapine in SW ¼, NE ¼, Sec. 25, T6N, R34E (Figures 1, 27 and 28). The infiltration gallery was constructed in late 2013 and will be brought into use pending issuance of a new limited license. The site is expected to have a capacity of 1 to 2 cfs. This project was built along the edge of and under a portion of a field that has had a wheat/alfalfa rotation since the 1990s.

Wells in the general area of the site include GW_36, GW_66, GW_119 and GW_144. GW_119 and GW_144 are purpose built monitoring wells that are part of the WWBWC water level monitoring network. The remaining wells are water wells adapted for use in the water level monitoring network.

Water will be delivered to this project in one of two routes. The primary route will be down the HBDIC's Richartz canal and then into Dugger ditch via the pipeline overflow. The secondary route will be down the White ditch, into Dugger Creek and then into Dugger ditch. WWBWC will be responsible for operating the diversion at this site.

MONITORING PLAN

This section describes water quality and water level monitoring to be performed in support of the AR program. All monitoring will follow the WWBWC Watershed Monitoring Program Standard Operation Procedures provided in Appendix B.

WATER QUALITY MONITORING

Water quality monitoring for this multi-site AR program will integrate source water quality data from several locations in the canal delivery system with groundwater quality data collected from multiple locations to assess the impacts on the entire AR program area. Under this programmatic approach individual AR facilities will be monitored to a greater or lesser extent in support of the entire program. This proposed programmatic approach was developed from evaluation of data from recharge projects in the region using similar source waters (GSI, 2012). Water quality sampling will be done for field parameters, basic water quality parameters (cations, anions, metals, etc.) and synthetic organic compounds (SOC).

Recharge source water and groundwater will be sampled twice during each recharge season for analysis of a select list of indicator constituents considered to be most representative of the potential for AR degradation of alluvial aquifer groundwater quality, based on recharge water sources, adjacent land uses and a review of AR data collected to date at several sites in the Walla Walla Basin. The list of proposed analytes was assembled using data from previous and on-going AR operations in the region that use similar source water (see below for complete list of analytes).

WATER QUALITY SAMPLING SCHEDULE

Samples will be collected at monitoring points listed in the following sections twice each recharge season. The first sampling event will occur within one (1) week of the start of recharge operations (Typically in early November). The second sampling event will occur within one (1) week after termination of each recharge season (typically in mid-May).

A single SOC sample will be taken at two down-gradient monitoring wells (GW_144 and GW_171) at the end of season sampling event (typically in mid-May).

WATER QUALITY SAMPLING LOCATIONS

GROUNDWATER LOCATIONS

Groundwater quality monitoring will be conducted at monitoring points located to evaluate overall AR program impacts on up-gradient and down-gradient water quality for the multi-site AR program and also provide site-specific water quality data for specific AR locations to be operated under the proposed limited license.

Data from these wells, when combined with the source water data collected at the five locations named in the following section, will be used to interpret water quality impacts of the entire AR program. As the AR program continues to develop it is anticipated that these monitoring locations will be periodically re-evaluated and potentially modified. The number of monitoring locations could increase or decrease as the number of AR sites changes, such as when new sites are added or old sites are decommissioned.

Refer to Table 2 and Figure 30 for groundwater quality site locations and their proximity to AR sites.

Table 2. Groundwater quality sampling locations in Limited License LL1621.

Monitoring ID	Well ID Tag #	Well Log #	GPS Coordinates	Proximity to sites
GW_141	97758	UMAT 57169	45.945663, -118.408360	**Up-gradient**: Program, Anspach, Barrett, Johnson, Chuckhole **Mid-gradient**: None **Down-gradient**: None
GW_46	63869	UMAT 55114	45.957821, -118.441180	**Up-gradient**: Gallagher **Mid-gradient**: Program, Johnson **Down-gradient**: Barrett, Anspach, Chuckhole, County Road
GW_117	91062	UMAT 56444	45.962511, -118.421880	**Up-gradient**: Trumbull, Mud Creek, Triangle Road, Triangle Road **Mid-gradient**: Program **Down-gradient**: None
GW_142	97760	UMAT 47171	45.965550, -118.433400	**Up-gradient**: Triangle Station and Sunquist **Mid-gradient**: Program **Down-gradient**: Trumbull
GW_170	*N/A*	*N/A*	*45.973074, -118.428844*	**Up-gradient**: Mud Creek, Fruitvale, Triangle Station, Sunquist **Mid-gradient**: Program **Down-gradient**: Triangle Road, Locust Road
GW_119	91065	UMAT 56447	45.972883, -118.485125	**Up-gradient**: NW Umapine, West Ringer **Mid-gradient**: Gallagher **Down-gradient**: Johnson
GW_144	97761	UMAT 57172	45.980159, -118.506767	**Up-gradient**: None **Mid-gradient**: None **Down-gradient**: NW Umapine, West Ringer Rd, Gallagher
GW_171	*N/A*	*N/A*	*45.991032, -118.444754*	**Up-gradient**: None **Mid-gradient**: None **Down-gradient**: Program, Fruitvale, Sunquist, Triangle Station
GW_151	111667	UMAT 57435	45.994728, -118.423728	**Up-gradient**: None **Mid-gradient**: None **Down-gradient**: Program, East Trolley
GW_152	111668	UMAT 57434	45.951427, -118.376960	**Up-gradient**: Program, LeFore Rd **Mid-gradient**: None **Down-gradient**: None
GW_160	*111671*	N/A	45.954846, -118.378992	**Up-gradient**: Locust Road **Mid-gradient**: None **Down-gradient**: Program, LeFore Rd
GW_169	*N/A*	*N/A*	*45.940828, -118.418978*	**Up-gradient**: Program, Barrett, Chuckhole **Mid-gradient**: None **Down-gradient**: None

NOTE: Italicized entries indicate proposed new groundwater monitoring locations.

SURFACE WATER LOCATIONS

Source water quality sampling will be conducted at several locations within the canal and pipeline recharge water conveyance system. Source water monitoring sites will be in the distribution system at select locations up-stream of AR facilities.

- Source water monitoring location WQ-1 is in the White Ditch canal up-stream of the diversion to the Anspach site. Samples from this location represent source water diverted to the Anspach, Barrett, Chuckhole, County Road and Locust Road sites. This location is also representative of the source water delivered to the Chuckhole site from the Milton pipeline. Additionally, this location is up-stream of all recharge sites and is considered representative of incoming source water conditions.
- Source water monitoring location WQ-2 is at the Duff Weir (White Ditch & Hudson Bay Canal split) upstream of the diversion for the Johnson, Gallagher and Trumbull sites.
- Source water monitoring point WQ-3 is at the Huffman-Richartz Weir (start of Huffman & Richartz pipelines) upstream of the NW Umapine and West Ringer Road sites.
- Source water monitoring point WQ-4 is at the Fruitvale Weir upstream of the Mud Creek, Fruitvale, Triangle Road, Triangle Station, Sunquist and East Trolley Lane sites.
- Source water monitoring point WQ-5 is at the Eastside diversion upstream of the LeFore Rd site.

Refer to Table 3 and Figure 30 for source water quality site locations and their proximity to AR sites.

Table 3. Source water quality sampling locations in Limited License LL1621.

Monitoring ID	GPS Coordinates	Source Water Monitoring Sites
WQ-1 Zerba	45.947580, -118.408015	Anspach, Barrett, County Road, Chuckhole, Locust Road
WQ-2 Duff	45.951665, -118.428920	Johnson, Trumbull, Gallagher
WQ-3 Huffman-Richartz	45.976577, -118.475888	NW Umapine, West Ringer Rd
WQ-4 Fruitvale	*45.971173, -118.414991*	Mud Creek, Fruitvale, Triangle Road, Triangle Station, Sunquist, East Trolley Lane
WQ-5 Eastside	*45.945233, -118.383753*	LeFore Rd

NOTE: Italicized entries indicate proposed new surface water monitoring locations.

WATER QUALITY PARAMETERS

FIELD COLLECTED PARAMETERS

Table 4. Field collected water quality parameters in Limited License LL1621.

Analyte	Sample Matrix	Analytical Method	Sampling Occurrence
Water Temperature	Surface Water & Groundwater	YSI 30 / Orion 5-Star	Pre & Post Operations
Specific Conductance	Surface Water & Groundwater	YSI 30 / Orion 5-Star	Pre & Post Operations
pH	Surface Water & Groundwater	Orion 5-Star	Pre & Post Operations
Dissolved Oxygen	Surface Water & Groundwater	Orion 5-Star	Pre & Post Operations

LAB PARAMETERS

Table 5. Grab sample/lab analyzed water quality parameters in Limited License LL1621.

Analyte	Sample Matrix	Analytical Method	Sampling Occurrence
Potassium	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Sulfur	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Phosphorus	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
NO3-N	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
NH4-N	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Calcium	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Magnesium	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Sodium	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Manganese	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Iron	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Zinc	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Copper	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Lead	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Mercury	Surface Water & Groundwater	Ag Manager (Unibest)	Pre & Post Operations
Chlorphyrifos	Groundwater	EPA Method 8141	Post Operations @ GW_144 & GW_F3
Diuron	Groundwater	EPA Method 532	Post Operations @ GW_144 & GW_F3
Malathion	Groundwater	EPA Method 8141	Post Operations @ GW_144 & GW_F3
Azinphosmethly	Groundwater	EPA Method 8141	Post Operations @ GW_144 & GW_F3

SAMPLING PROCEDURES & EQUIPMENT (EXTRACTED FROM WWBWC'S SOP)

WATER QUALITY SAMPLING (GROUNDWATER)

Groundwater sampling is conducted utilizing the following procedures. The general overview of groundwater sampling includes gathering equipment, measuring the initial water level, installing a submersible pump in the well, purging the well at a low flow rate, collecting and labeling all required samples and delivering them to the lab or shipping company. Details on parameters sampled for each site can be found in its monitoring and reporting plan.

Note: this procedure is modified from:

Marti, 2011. Standard Operating Procedure for Purging and Sampling Monitoring Wells. Washington State Department of Ecology – Environmental Assessment Program. EAP078.

Equipment

- Sampling field data sheets (see below) or field notebook
- Chain of Custody form
- Water level measuring equipment (e-tape)
- Water quality meters and probes (Temperature, Specific Conductance, pH & Dissolved Oxygen)
- Submersible pump
- Pump controller
- Tubing and connectors
- Sample bottles/containers
- Cooler
- Ice
- Deionized water
- Diluted Bleach solution
- Non-phosphate soap
- Nitrile or latex gloves
- First aid kit
- Well keys
- Camera
- Paper towels or clean rags
- Plastic sheet for keeping equipment clean
- Buckets (5-gallon or similar for purge volumes)
- 1 liter container (for purge volumes)
- Socket set
- Screwdriver(s)

Purging and Sampling

1. Check well for any changes or potential hazards.
2. Make sure equipment has been cleaned and decontaminated (see below for details). Spread plastic or other material if needed to keep equipment clean.

3. Wear clean disposable gloves (latex or Nitrile) while performing purging and sampling. If gloves become contaminated or dirty replace with new gloves.
4. Make sure field water quality meters are calibrated according to the manufacturer's instructions.
5. If well is equipped with a pressure transducer, note how it is installed and its position to replace it after sampling. Remove the pressure transducer from the well. Note the time the pressure transducer was removed from the well on the data sheet or in the field notebook.
6. Measure the static water level in the well (see Groundwater Level and Temperature protocol below for details).
7. Measure the depth of the well or refer to the well log to determine the depth of the well.
8. Calculate the length of the water column. Calculate the volume of water in the well using the following values: 2" well = 0.1631 gallons per linear foot, 4" = 0.6524 gallons per linear foot (Equation used for water volume calculation – Volume (gal/ft) = πr^2 (7.48 gal/ft^3) where r is the radius of the well and 7.48 is the conversion factor).
9. Install the submersible pump into the well. Be sure to slowly lower the pump into the well and through the water to avoid stirring up particulates. Place the pump in the middle of the screen section of the well (refer to well log to determine the open interval for pump placement).
10. Once the pump is installed correctly re-measure the static water level to monitor during purging.
11. Start purging. Set the pump controller to the desired pumping rate (~1 liter/minute). See notes from previous sampling for pumping rate.
12. Ideally, wells should be purged and sampled at flow rates at or less than the natural flow conditions of the aquifer in the screen interval to avoid drawing down the water level in the well. Use water level measurements to help adjust pumping rates to prevent well drawdown. Purging should not cause significant drawdown (considered to be 5% of the total height of the water column). If drawdown is significant, reduce pumping rate until water levels stabilize at an appropriate level.
13. Record pumping rate on the data sheet or field notebook.
14. Discharge evacuated water as far as possible from the wellhead and work area.
15. During purging and sampling water flow should be smooth and consistent without bubbles in the tubing.
16. Once pumping rate has been determined and flow has stabilized, start collecting field parameters (water temperature, specific conductance, pH and dissolved oxygen) at regular intervals. The measurement interval will depend upon the pumping rate (typically 2-5 minutes between measurements).
17. Record field parameters, water level measurement, and estimated amount of water purged. Note any changes in purged water's appearance (clear, turbid, odor, etc.).
18. Continue purging well until field parameters stabilize. Parameters should be considered to be stabilized when 3 consecutive measurements fall within the following ranges (see Table 6):

Table 6. Field collected water quality parameters in Limited License LL1621.

Field Parameter	Stabilized Range
Temperature	± 0.1 ° Celsius
Specific Conductance <1000 µs/cm	± 10 µs/cm
Specific Conductance >1000 µs/cm	± 20 µs/cm
Dissolved Oxygen < 1 mg/L	± 0.05 mg/L
Dissolved Oxygen > 1 mg/L	± 0.2 mg/L
pH	± 0.1 pH units

19. Collect samples once field parameters have stabilized. Do not stop or change pumping rate during the final phase of purging and sampling.
20. Collect most sensitive analytes first (i.e. organics) followed by less sensitive analytes (i.e. nutrients). This order can be modified if using sulfuric or nitric acid preservatives to prevent contamination of sulfate and/or nitrogen samples.
    Collect any duplicate or quality control samples (see below for details).
21. Place samples in an ice-cooled cooler for delivery to the lab or shipping company. Make sure samples do not freeze during transport.
22. Complete chain of custody form. Record sample date and time, final water level and estimated total purge volume on the data sheet or in the field notebook. Also record any comments or observations regarding the purging and sampling process.
23. Replace pressure transducer if the well was equipped with one. Note re-install time on the data sheet or in the field notebook.
24. Clean and disinfect sampling equipment for next sampling event.

Decontamination

All non-disposable field equipment that may potentially come in contact with any soil or water sample shall be decontaminated in order to minimize the potential for cross-contamination between sampling locations. Thorough decontamination of all sampling equipment shall be conducted prior to each sampling event. In addition, the sampling technician shall decontaminate all equipment in the field as required to prevent cross-contamination of samples collected in the field. The procedures described in this section are specifically for field decontamination of sampling equipment.

At a minimum, field-sampling equipment should be decontaminated following these procedures:

- Wash the equipment in a solution of non-phosphate detergent (Liquinox® or equivalent) and distilled or deionized water. All surfaces that may come in direct contact with the samples shall be washed. Use a clean Nalgene and/or plastic tub to contain the wash solution and a scrub brush to mechanically remove loose particles. Wear clean latex, plastic, or equivalent gloves during all washing and rinsing operations.
- Rinse twice with distilled or deionized water.
- Dry the equipment before use, to the extent practicable.

WATER QUALITY SAMPLING (SURFACE WATER)

Surface water sampling is conducted utilizing the following procedures.

Note: this procedure is a modified from:

Anderson, 2011. Standard Operating Procedure for Sampling of Pesticides in Surface Waters. Washington State Department of Ecology – Environmental Assessment Program. EAP003.

Equipment

- Sampling field data sheets (see below) or field notebook
- Chain of Custody form
- Water quality meters and probes (Temperature, Specific Conductance, pH & Dissolved Oxygen)
- Sample bottles/containers
- Cooler
- Ice
- Deionized water
- Diluted Bleach solution
- Non-phosphate soap (Liquinox or similar)
- Nitrile gloves
- First aid kit
- Camera
- Paper towels or clean rags
- Plastic sheet for keeping equipment clean
- Screwdriver(s)

Sampling

1. Check for any changes or potential hazards.
2. Make sure equipment has been cleaned and decontaminated (see below for details). Spread plastic or other material if needed to keep equipment clean.
3. Wear clean disposable gloves (Nitrile) while performing purging and sampling. If gloves become contaminated or dirty replace with new gloves.
4. Make sure field water quality meters are calibrated according to the manufacturer's instructions.
5. Collect required field water quality parameters and record on data sheet. Also note weather conditions
6. Fill out labels on each sample bottle with all necessary information.
7. Samples will be collected using the "Grab Sample" method described in EAP 003.
8. Take sample bottles and sampling equipment to the sample site and put on nitrile gloves.
9. Carefully collect samples by filling each container with water from the site. Note marked fill lines or preservatives to prevent over or under filling of the sample bottle.
10. Collect any duplicate or quality control samples (see below for details).
11. Place samples in an ice-cooled cooler for delivery to the lab or shipping company. Make sure samples do not freeze during transport.

12. Complete chain of custody form. Record sample date and time on the data sheet or in the field notebook. Also record any comments or observations regarding the sampling process.
13. Clean and disinfect sampling equipment for next sampling event.

Decontamination

All non-disposable field equipment that may potentially come in contact with any soil or water sample shall be decontaminated in order to minimize the potential for cross-contamination between sampling locations. Thorough decontamination of all sampling equipment shall be conducted prior to each sampling event. In addition, the sampling technician shall decontaminate all equipment in the field as required to prevent cross-contamination of samples collected in the field. The procedures described in this section are specifically for field decontamination of sampling equipment.

At a minimum, field-sampling equipment should be decontaminated following these procedures:

- Wash the equipment in a solution of non-phosphate detergent (Liquinox® or equivalent) and distilled or deionized water. All surfaces that may come in direct contact with the samples shall be washed. Use a clean Nalgene and/or plastic tub to contain the wash solution and a scrub brush to mechanically remove loose particles. Wear clean latex, plastic, or equivalent gloves during all washing and rinsing operations.
- Rinse twice with distilled or deionized water.
- Dry the equipment before use, to the extent practicable.

WATER QUALITY SAMPLING DATASHEET

WATER LEVEL MONITORING

GROUNDWATER LOCATIONS

The WWBWC currently maintains a water level monitoring program in the area of this aquifer recharge program. Groundwater level monitoring locations provide useful information on aquifer recharge influences to the shallow aquifer. Wells were located to capture up-gradient to down-gradient influences from individual recharge projects (Figure 31). However, based upon limited funding and the spatial nature of the aquifer, it is not possible to have wells at every desired location. Wells in the water level network provide year round data for analysis of groundwater changes during recharge activities and also for longer term analysis of groundwater recovery (i.e. changes to groundwater storage). Many of the wells used for monitoring have secondary hydraulic influences other than aquifer recharge. For example, wells located near the White Ditch show responses to ditch activity. A few wells may show draw down caused by pumping from other wells. See Appendix A for details on well locations (GPS coordinates) Well ID Tag #'s and UMAT numbers (when available). Groundwater level data will be included in digital format with the written annual report. Additional groundwater level data can be found on the WWBWC's website.

SURFACE WATER LOCATIONS

Flow monitoring will be done in the canals or pipelines feeding each individual AR site. The objective of flow monitoring is to document the volumes of water delivered to each AR site during its operations. Each aquifer recharge site will have either a rated intake structure (such as the Johnson site) or have a flow meter installed at the diversion from the irrigation canal (such as the Anspach site). Water volume delivered to each site will be collected and stored by the WWBWC and reported to OWRD in a written annual report which will include applicable digital data. WWBWC will also conduct flow monitoring in the canals to estimate seepage losses during aquifer recharge operations. A total diversion from the Walla Walla River (in acre-feet) will be included in the annual report.

QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

FIELD RECORDS

All field notes, analytical results and other pertinent data associated with the program should be maintained in a secure location and be archived for at least a five year period. Maintaining records will also facilitate tracking of environmental trends for the program.

DATA VALIDATION

Data validation for both field and lab QA/QC can be performed using a checklist. All pertinent information with respect to QA/QC will be checked. The following items will be included in the checklist:

- Completeness of field data sheets and observation
- Completeness of chain-of-custody
- Holding times for all constituents
- Completeness of laboratory quality controls

SPECIFIC QA/QC GUIDANCE

A field duplicate will be conducted once per season. Field duplicates are two samples collected at the same time and location and analyzed in the same batch.

A field blank will be conducted once per season. Field blanks will be transfer blanks created using deionized water with sample bottles filled at the monitoring site.

REPORTING

Primary reporting for this monitoring plan will focus on annual reports completed following the end of each recharge season, per OWRD requirements for the limited license. The basic goals of the annual reports will be to: (1) report water quantity diverted and quantity delivered to each recharge site, (2) analyze the data to evaluate how trends related to AR operations are influencing groundwater quality and quantity and (3) based on the results of that analysis provide recommendations (if any) for adjustments to the monitoring program and AR operations. In addition to written annual report, monitoring data collected under this monitoring plan will be provided to OWRD and ODEQ with the annual report.

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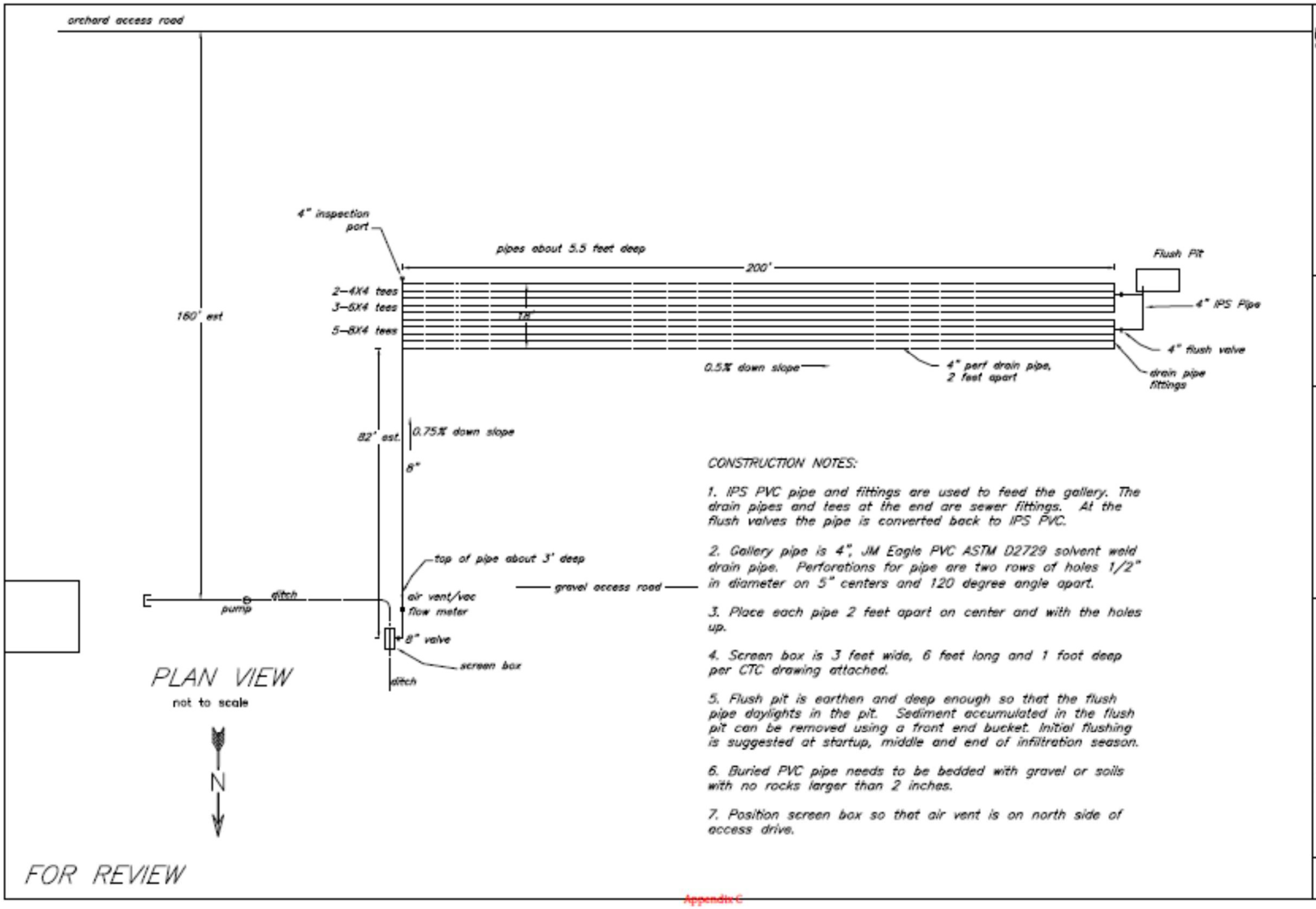
APPENDIX C – RECHARGE SITE DESIGNS



PLAN VIEW

not to scale

CONSTRUCTION NOTES:

1. IPS PVC pipe and fittings are used to feed the gallery. The drain pipes and tees at the end are sewer fittings. At the flush valves the pipe is converted back to IPS PVC.

2. Gallery pipe is 4", JM Eagle PVC ASTM D2729 solvent weld drain pipe. Perforations for pipe are two rows of holes 1/2" in diameter on 5" centers and 120 degree angle apart.

3. Place each pipe 2 feet apart on center and with the holes up.

4. Screen box is 3 feet wide, 6 feet long and 1 foot deep per CTC drawing attached.

5. Flush pit is earthen and deep enough so that the flush pipe daylights in the pit. Sediment accumulated in the flush pit can be removed using a front end bucket. Initial flushing is suggested at startup, middle and end of infiltration season.

6. Buried PVC pipe needs to be bedded with gravel or soils with no rocks larger than 2 inches.

7. Position screen box so that air vent is on north side of access drive.

FOR REVIEW

		DATE
DESIGN	jaf	8/12
DRAWN	jaf	9/12
CHECKED		
APPROVED		
TITLE		

File: InfGalleries.dwg

FAZIO ENGINEERING
P.O. BOX 246
MILTON–FREEWATER, OR 98762
(541) 938–6084

SITE LAYOUT
Anspach Recharge
MILTON–FREEWATER, OR

SHEET
1 OF 2

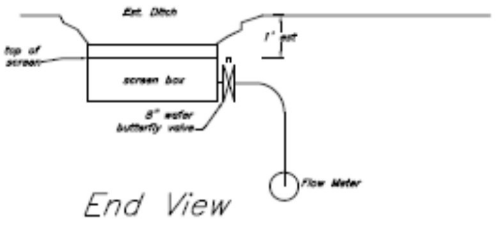
CONSTRUCTION NOTES:

1. The gallery requires 2,000 feet of drian pipe as noted. Cover drain pipe about 2" with gravel, with drain holes up.

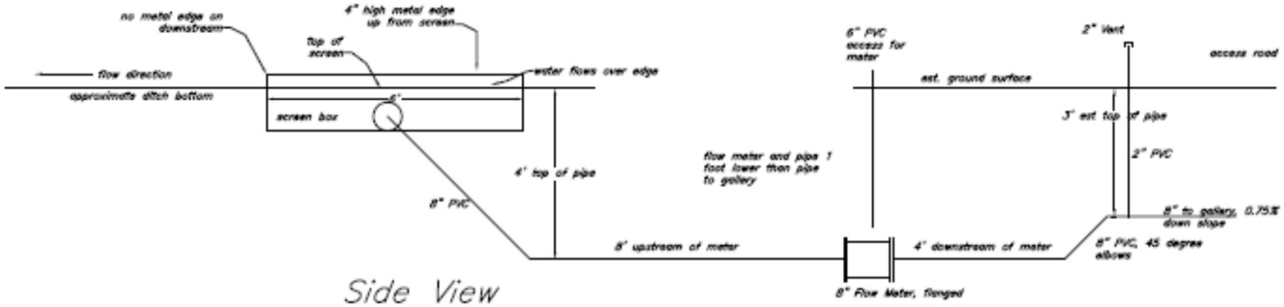
2. Proposed gravel material is 1–1/2" to 3/4" "Switch Yard", Koncrete Industries, or similar angular crushed rock with minimal fines. About 272 yards needed assuming 24' X 204' X 1.5' volume.

3. Filter fabric is a nonwoven geotextile, Mirafi MSCAPE or equivalent. About 544 square yards required, assume 24' X 204'.

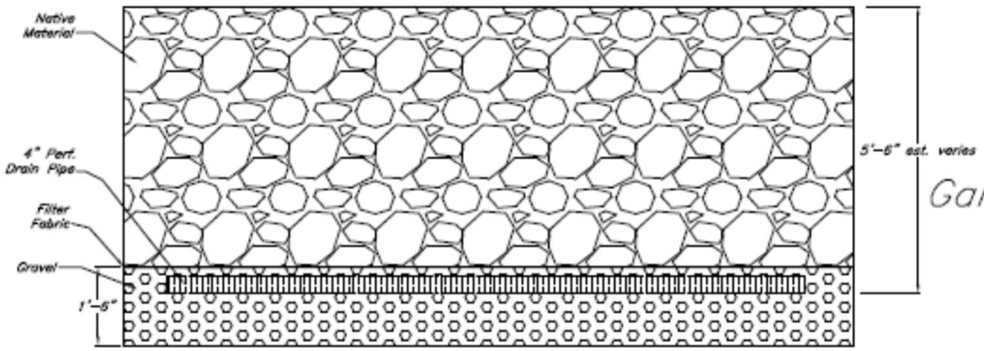
Screen Box Area Details



End View



Side View



Gallery Profile

FOR REVIEW

DATE
DESIGN jaf 8/12
DRAWN jaf 9/12
CHECKED
APPROVED
TITLE

File: h:\Galleries.dwg

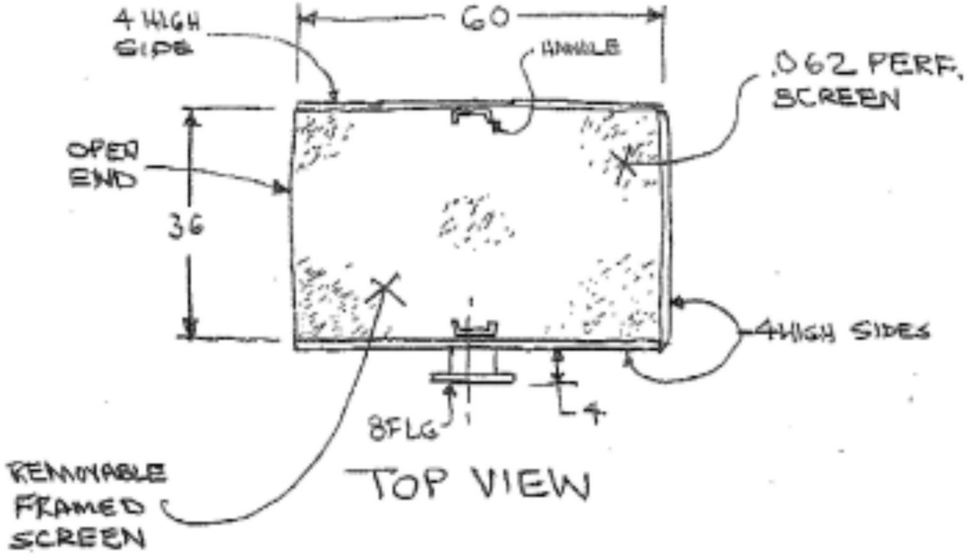
FAZIO ENGINEERING
P.O. BOX 246
MILTON–FREEWATER, OR 98762
(541) 938–6084

DETAILS
Anspach Recharge
MILTON–FREEWATER, OR

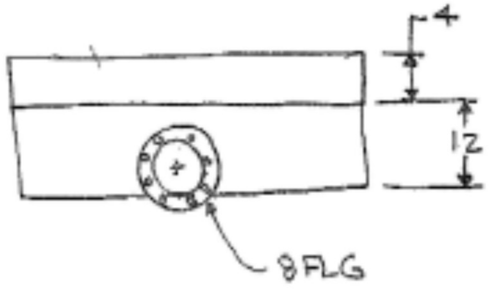
SHEET
2 OF 2

FROM : DUNNING IRRIGATION PHONE NO. : 509 529 6044 Sep. 07 2012 03:26PM P1

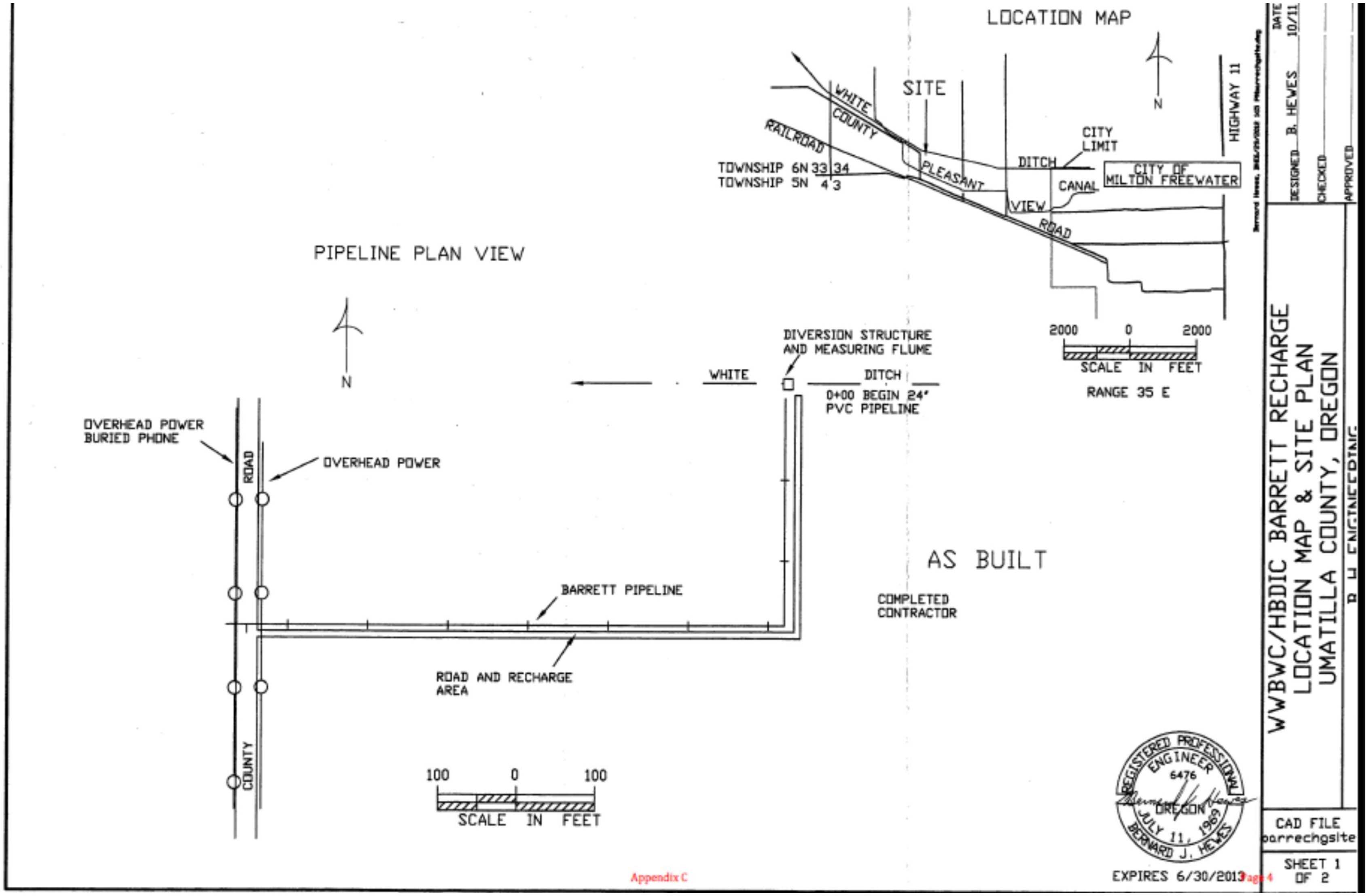
PROJECT JOHN FAZIO SHT 1 OF 1
SCREEN BOX DATE 4SEPT 12
BY B.L.B. JOB NO. ~

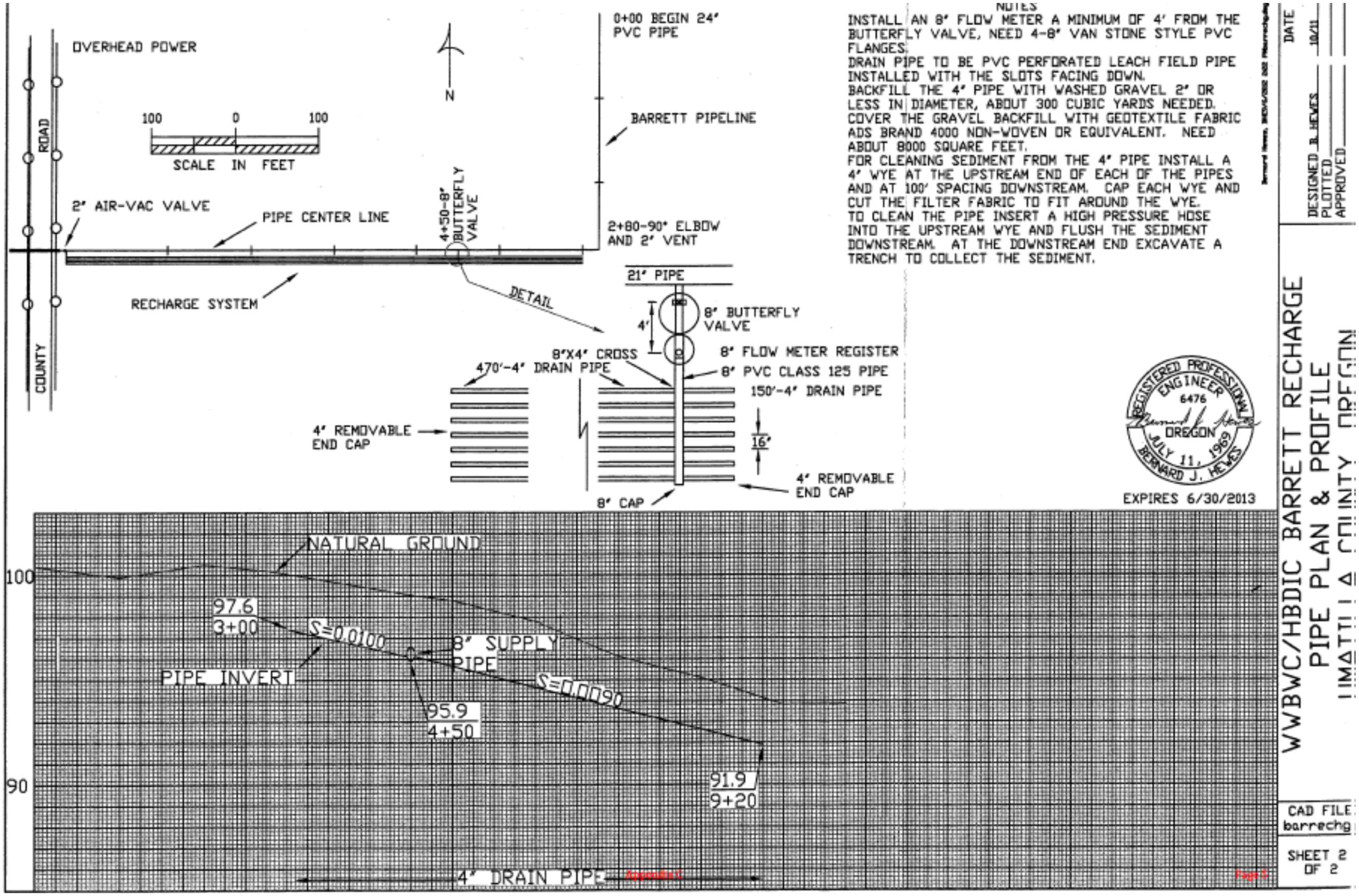


TOP VIEW



SIDE VIEW


LOCATION MAP
SITE
WHITE COUNTY
RAILROAD
PLEASANT VIEW ROAD
TOWNSHIP 6N 33 34
TOWNSHIP 5N 4 3
DITCH
CITY LIMIT
CITY OF MILTON FREEWATER
CANAL
HIGHWAY 11
N
2000 0 2000
SCALE IN FEET
RANGE 35 E
PIPELINE PLAN VIEW
N
DIVERSION STRUCTURE AND MEASURING FLUME
WHITE DITCH
0+00 BEGIN 24" PVC PIPELINE
OVERHEAD POWER BURIED PHONE
OVERHEAD POWER
ROAD
COUNTY
BARRETT PIPELINE
ROAD AND RECHARGE AREA
AS BUILT
COMPLETED CONTRACTOR
100 0 100
SCALE IN FEET
EXPIRES 6/30/2013
WWBWC/HBDIC BARRETT RECHARGE
LOCATION MAP & SITE PLAN
UMATILLA COUNTY, OREGON
DATE 10/11
DESIGNED B. HEWES
CHECKED
APPROVED
CAD FILE barrechgsite
SHEET 1 OF 2



NOTES

INSTALL AN 8" FLOW METER A MINIMUM OF 4' FROM THE BUTTERFLY VALVE, NEED 4-8" VAN STONE STYLE PVC FLANGES.

DRAIN PIPE TO BE PVC PERFORATED LEACH FIELD PIPE INSTALLED WITH THE SLOTS FACING DOWN.

BACKFILL THE 4" PIPE WITH WASHED GRAVEL 2" OR LESS IN DIAMETER, ABOUT 300 CUBIC YARDS NEEDED. COVER THE GRAVEL BACKFILL WITH GEOTEXTILE FABRIC ADS BRAND 4000 NON-WOVEN OR EQUIVALENT. NEED ABOUT 8000 SQUARE FEET.

FOR CLEANING SEDIMENT FROM THE 4" PIPE INSTALL A 4" WYE AT THE UPSTREAM END OF EACH OF THE PIPES AND AT 100' SPACING DOWNSTREAM. CAP EACH WYE AND CUT THE FILTER FABRIC TO FIT AROUND THE WYE.

TO CLEAN THE PIPE INSERT A HIGH PRESSURE HOSE INTO THE UPSTREAM WYE AND FLUSH THE SEDIMENT DOWNSTREAM. AT THE DOWNSTREAM END EXCAVATE A TRENCH TO COLLECT THE SEDIMENT.

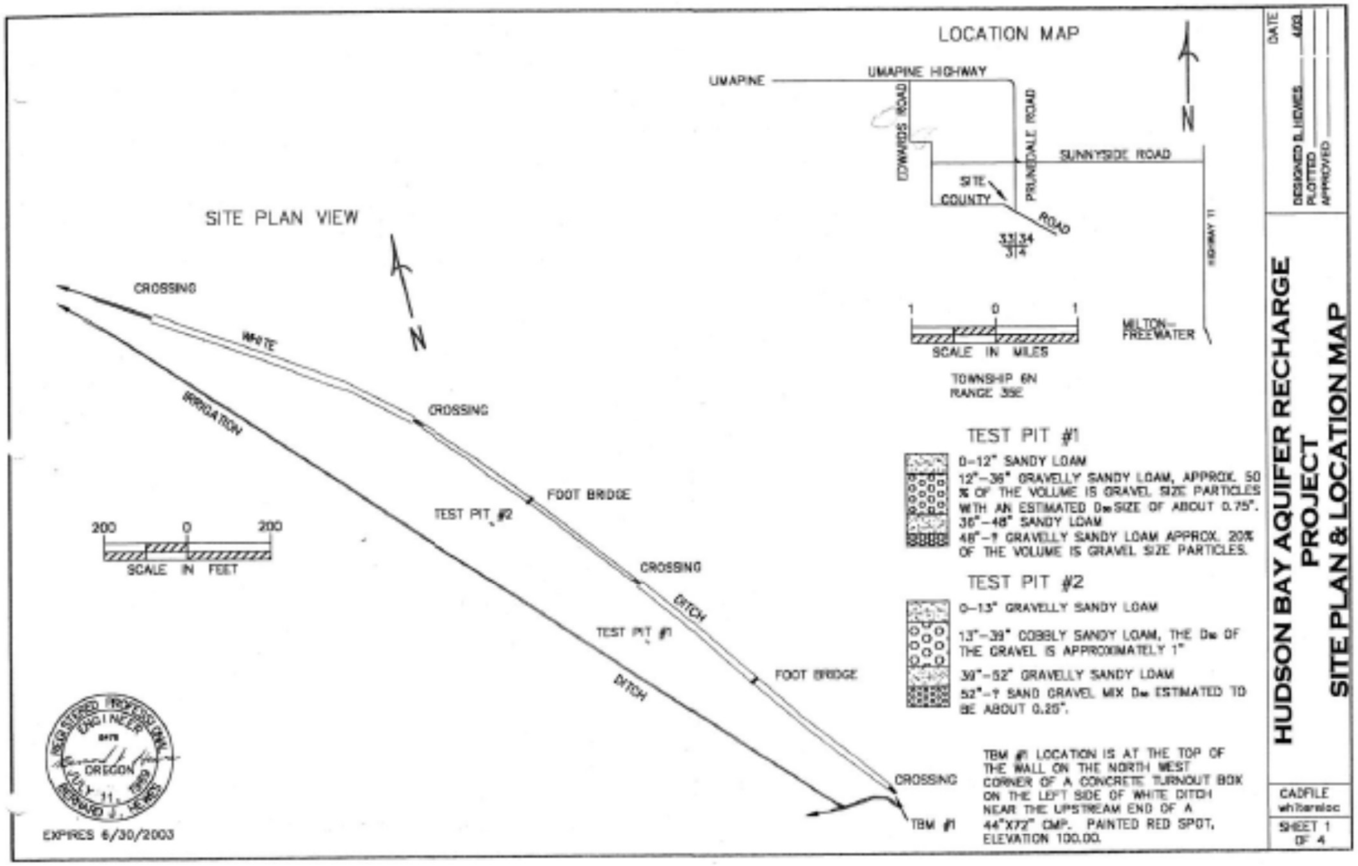
DESIGNED B. HEWES DATE 10/11
PLOTTED
APPROVED

REGISTERED PROFESSIONAL ENGINEER 6476 OREGON JULY 11, 1969 BERNARD J. HEWES

WWBWC/HBDIC BARRETT RECHARGE
PIPE PLAN & PROFILE
UMATILLA COUNTY OREGON

CAD FILE
barrechg

SHEET 2 OF 2



TEST PIT #1

0–12" SANDY LOAM

12"–36" GRAVELLY SANDY LOAM, APPROX. 50 % OF THE VOLUME IS GRAVEL SIZE PARTICLES WITH AN ESTIMATED D₅₀ SIZE OF ABOUT 0.75".

36"–48" SANDY LOAM

48"–? GRAVELLY SANDY LOAM APPROX. 20% OF THE VOLUME IS GRAVEL SIZE PARTICLES.

TEST PIT #2

0–13" GRAVELLY SANDY LOAM

13"–39" COBBLY SANDY LOAM, THE D₅₀ OF THE GRAVEL IS APPROXIMATELY 1"

39"–52" GRAVELLY SANDY LOAM

52"–? SAND GRAVEL MIX D₅₀ ESTIMATED TO BE ABOUT 0.25".

TBM #1 LOCATION IS AT THE TOP OF THE WALL ON THE NORTH WEST CORNER OF A CONCRETE TURNOUT BOX ON THE LEFT SIDE OF WHITE DITCH NEAR THE UPSTREAM END OF A 44"X72" CMP. PAINTED RED SPOT, ELEVATION 100.00.

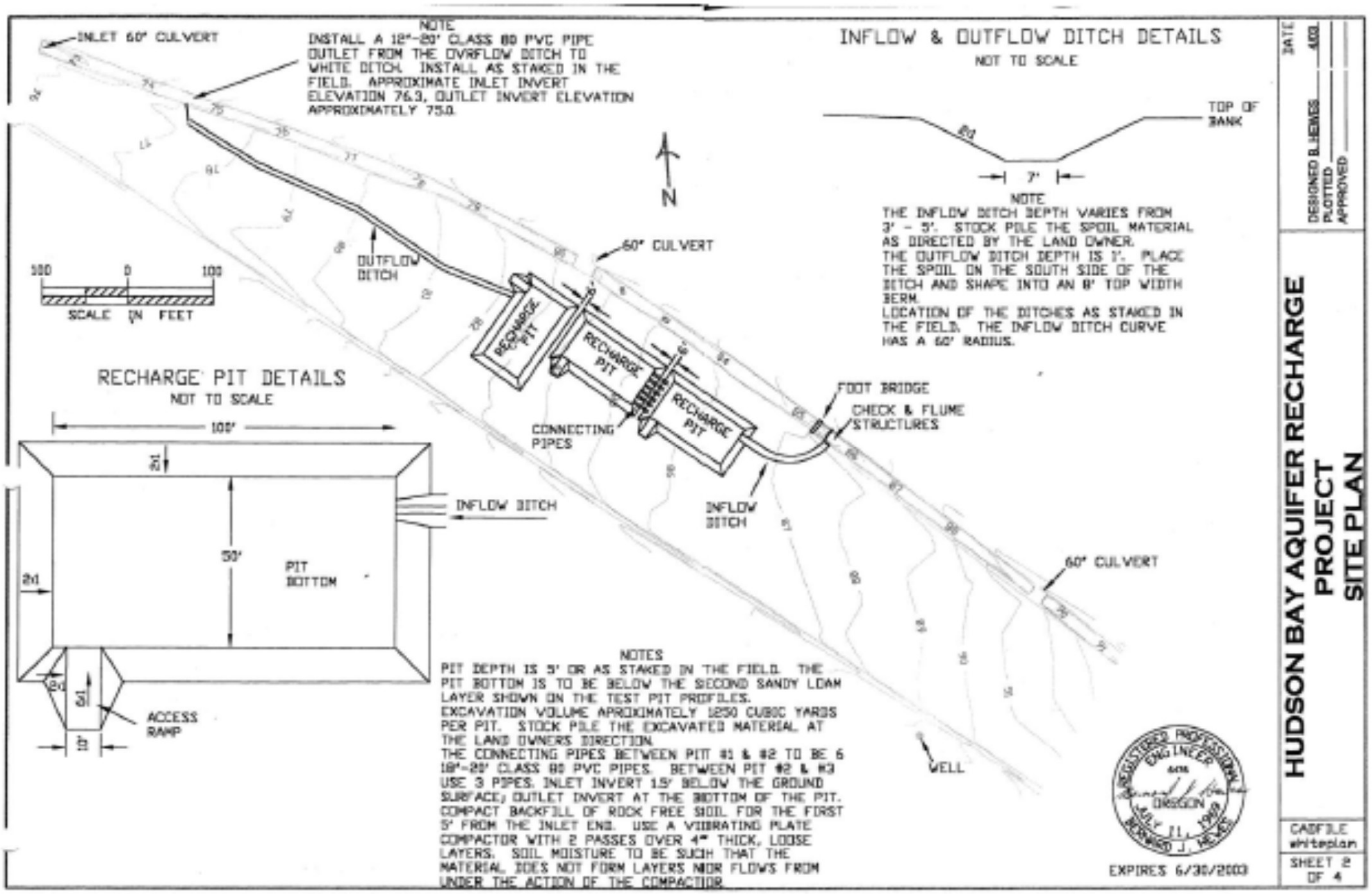
DATE
DESIGNED B.HEWES 4/03
PLOTTED
APPROVED

HUDSON BAY AQUIFER RECHARGE PROJECT

SITE PLAN & LOCATION MAP

CADFILE
whiteraloc

SHEET 1 OF 4



NOTE

INSTALL A 12"-20' CLASS 80 PVC PIPE OUTLET FROM THE OVRFLOW DITCH TO WHITE DITCH. INSTALL AS STAKED IN THE FIELD. APPROXIMATE INLET INVERT ELEVATION 76.3, OUTLET INVERT ELEVATION APPROXIMATELY 75.0.

INFLOW & OUTFLOW DITCH DETAILS

NOT TO SCALE

NOTE

THE INFLOW DITCH DEPTH VARIES FROM 3' - 5'. STOCK PILE THE SPOIL MATERIAL AS DIRECTED BY THE LAND OWNER.

THE OUTFLOW DITCH DEPTH IS 1'. PLACE THE SPOIL ON THE SOUTH SIDE OF THE DITCH AND SHAPE INTO AN 8' TOP WIDTH BERM.

LOCATION OF THE DITCHES AS STAKED IN THE FIELD. THE INFLOW DITCH CURVE HAS A 60' RADIUS.

RECHARGE PIT DETAILS

NOT TO SCALE

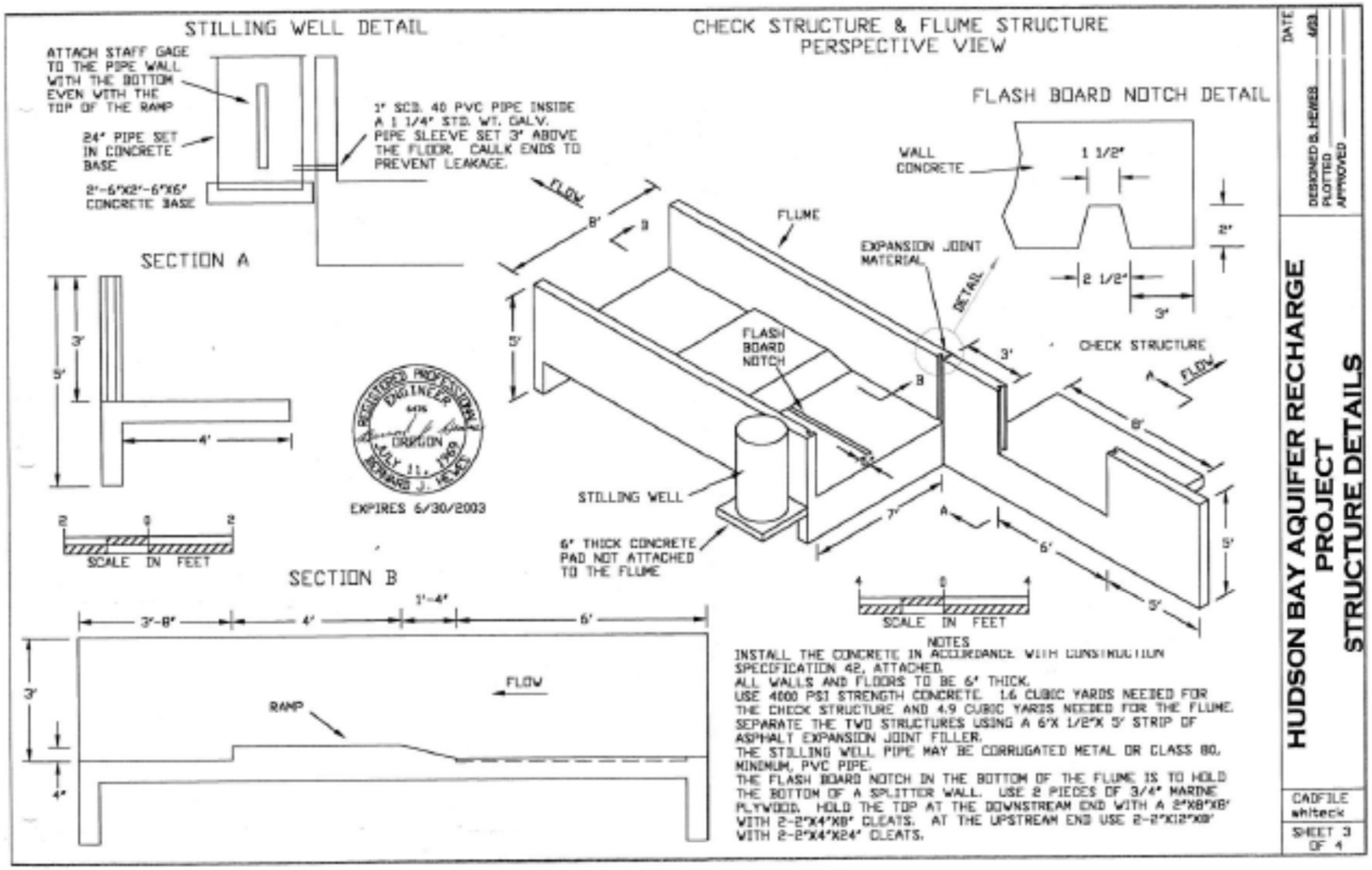
NOTES

PIT DEPTH IS 5' OR AS STAKED IN THE FIELD. THE PIT BOTTOM IS TO BE BELOW THE SECOND SANDY LOAM LAYER SHOWN ON THE TEST PIT PROFILES.

EXCAVATION VOLUME APROXIMATELY 1250 CUBIC YARDS PER PIT. STOCK PILE THE EXCAVATED MATERIAL AT THE LAND OWNERS DIRECTION.

THE CONNECTING PIPES BETWEEN PIT #1 & #2 TO BE 6 18"-20' CLASS 80 PVC PIPES. BETWEEN PIT #2 & #3 USE 3 PIPES. INLET INVERT 1.5' BELOW THE GROUND SURFACE; OUTLET INVERT AT THE BOTTOM OF THE PIT. COMPACT BACKFILL OF ROCK FREE SOIL FOR THE FIRST 5' FROM THE INLET END. USE A VIBRATING PLATE COMPACTOR WITH 2 PASSES OVER 4" THICK, LOOSE LAYERS. SOIL MOISTURE TO BE SUCH THAT THE MATERIAL DOES NOT FORM LAYERS NOR FLOWS FROM UNDER THE ACTION OF THE COMPACTOR.

HUDSON BAY AQUIFER RECHARGE PROJECT
SITE PLAN



6476
JULY 11, 1989
BERNARD J. HEWES

EXPIRES 6/30/2003

NOTES

INSTALL THE CONCRETE IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION 42, ATTACHED.
ALL WALLS AND FLOORS TO BE 6" THICK.
USE 4000 PSI STRENGTH CONCRETE. 1.6 CUBIC YARDS NEEDED FOR THE CHECK STRUCTURE AND 4.9 CUBIC YARDS NEEDED FOR THE FLUME.
SEPARATE THE TWO STRUCTURES USING A 6"X 1/2"X 5' STRIP OF ASPHALT EXPANSION JOINT FILLER.
THE STILLING WELL PIPE MAY BE CORRUGATED METAL OR CLASS 80, MINIMUM, PVC PIPE.
THE FLASH BOARD NOTCH IN THE BOTTOM OF THE FLUME IS TO HOLD THE BOTTOM OF A SPLITTER WALL. USE 2 PIECES OF 3/4" MARINE PLYWOOD. HOLD THE TOP AT THE DOWNSTREAM END WITH A 2"X8"X8' WITH 2-2"X4"X8" CLEATS. AT THE UPSTREAM END USE 2-2"X12"X8' WITH 2-2"X4"X24" CLEATS.

DATE
DESIGNED B. HEWES 4/03
PLOTTED
APPROVED

HUDSON BAY AQUIFER RECHARGE PROJECT
STRUCTURE DETAILS

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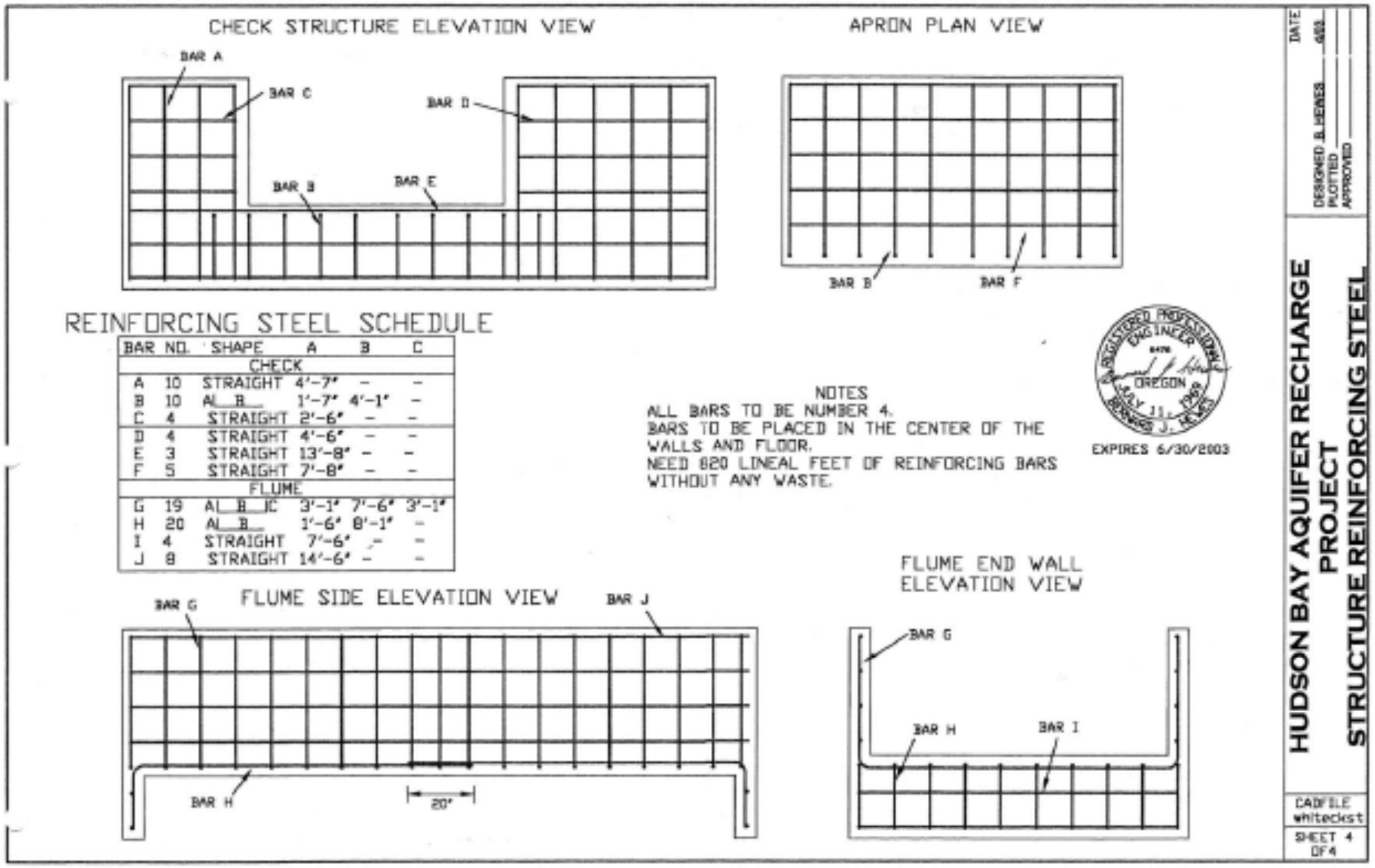
SHEET 3 OF 4



REINFORCING STEEL SCHEDULE

BAR	NO.	SHAPE	A	B	C
		CHECK			
A	10	STRAIGHT	4'-7"	–	–
B	10	A|_B_	1'-7"	4'-1"	–
C	4	STRAIGHT	2'-6"	–	–
D	4	STRAIGHT	4'-6"	–	–
E	3	STRAIGHT	13'-8"	–	–
F	5	STRAIGHT	7'-8"	–	–
		FLUME			
G	19	A|_B_|C	3'-1"	7'-6"	3'-1"
H	20	A|_B_	1'-6"	8'-1"	–
I	4	STRAIGHT	7'-6"	–	–
J	8	STRAIGHT	14'-6"	–	–

NOTES

ALL BARS TO BE NUMBER 4.

BARS TO BE PLACED IN THE CENTER OF THE WALLS AND FLOOR.

NEED 820 LINEAL FEET OF REINFORCING BARS WITHOUT ANY WASTE.

BERNARD J. HEWES
JULY 11, 1989
EXPIRES 6/30/2003

DATE
DESIGNED B.HEWES 6/99
PLOTTED
APPROVED

HUDSON BAY AQUIFER RECHARGE
PROJECT
STRUCTURE REINFORCING STEEL

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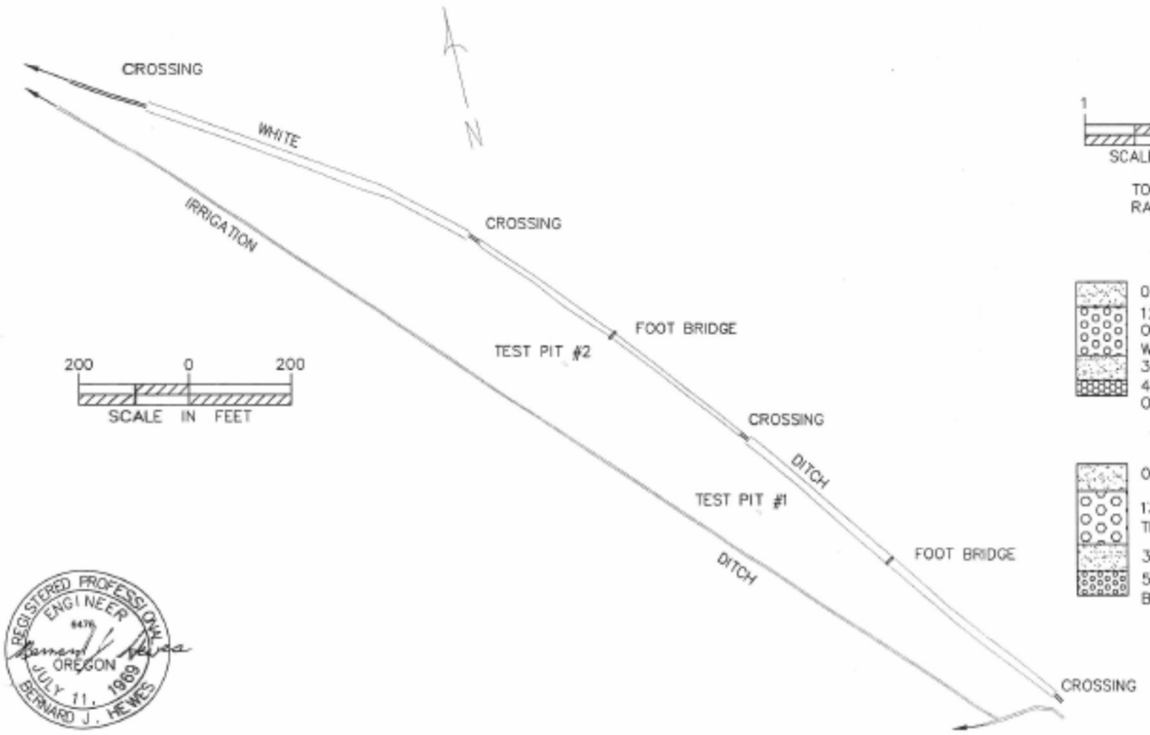
SHEET 4
OF4

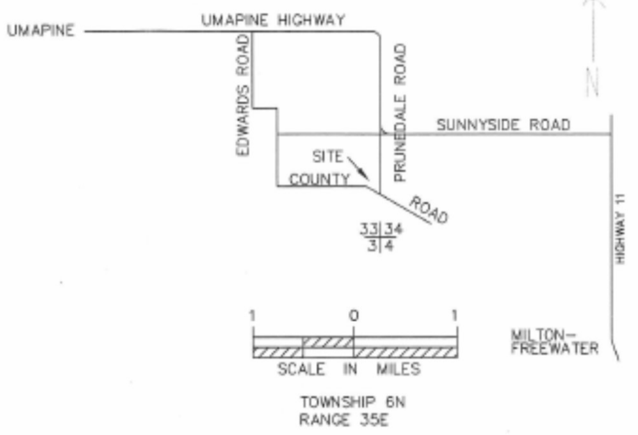
SITE PLAN VIEW



6476
OREGON
JULY 11, 1969
BERNARD J. HEWES

EXPIRES 6/30/2009

LOCATION MAP



TEST PIT #1

0–12" SANDY LOAM

12"–36" GRAVELY SANDY LOAM, APPROX. 50% OF THE VOLUME IS GRAVEL SIZE PARTICLES WITH AN ESTIMATED D_{50} SIZE OF ABOUT 0.75".

36"–48" SANDY LOAM

48"–? GRAVELY SANDY LOAM APPROX. 20% OF THE VOLUME IS GRAVEL SIZE PARTICLES.

TEST PIT #2

0–13" GRAVELY SANDY LOAM

13"–39" COBBLY SANDY LOAM, THE D_{50} OF THE GRAVEL IS APPROXIMATELY 1"

39"–52" GRAVELY SANDY LOAM

52"–? SAND GRAVEL MIX D_{50} ESTIMATED TO BE ABOUT 0.25".

	DATE
DESIGNED B. HEWES	4/03
PLOTTED	
APPROVED	

WWBWC/HBDIC UPPER RECHARGE PROJECT
SITE PLAN & LOCATION MAP
UMATILLA COUNTY, OREGON

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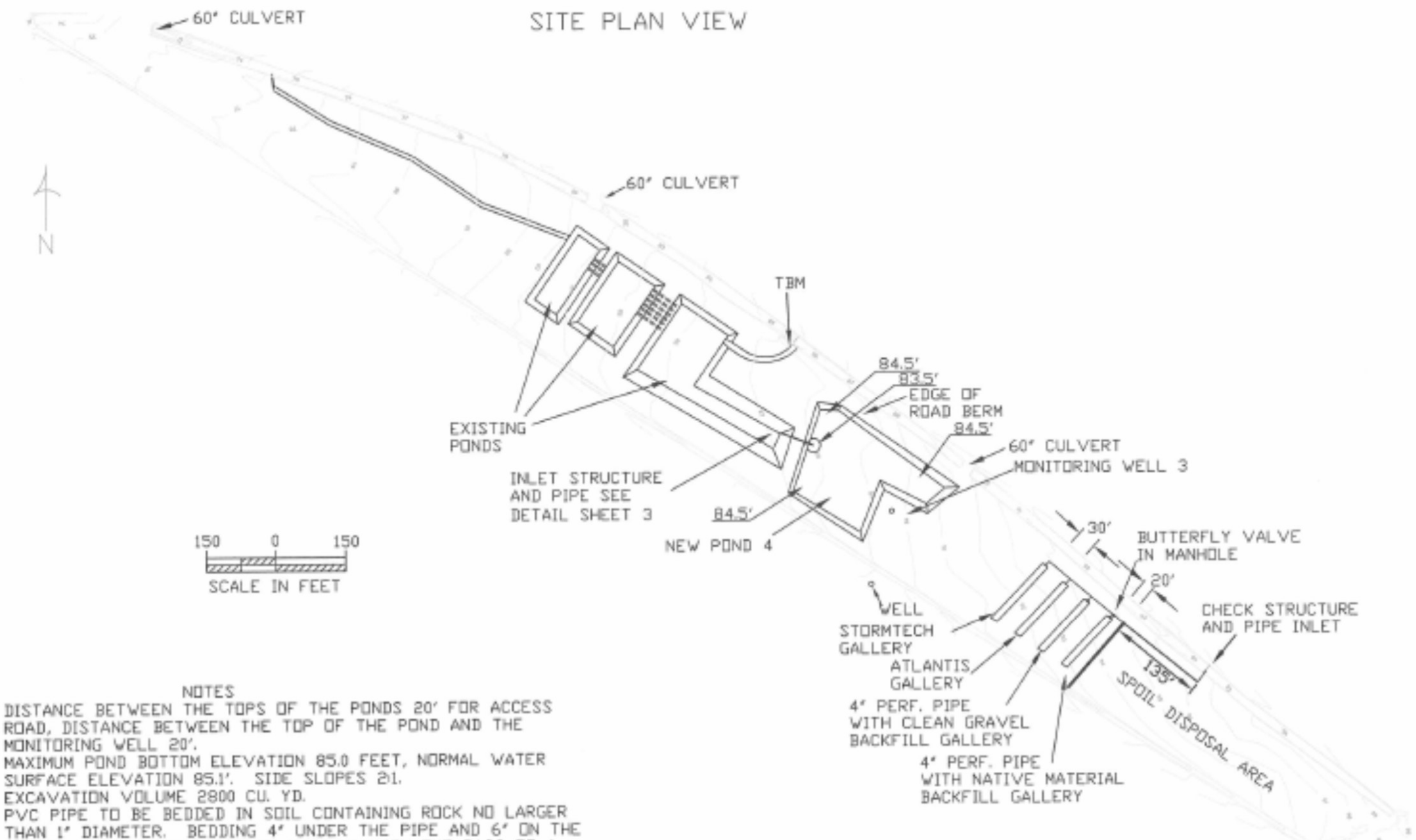
SHEET 1
OF 7

SITE PLAN VIEW



NOTES

DISTANCE BETWEEN THE TOPS OF THE PONDS 20' FOR ACCESS ROAD, DISTANCE BETWEEN THE TOP OF THE POND AND THE MONITORING WELL 20'.

MAXIMUM POND BOTTOM ELEVATION 85.0 FEET, NORMAL WATER SURFACE ELEVATION 85.1'. SIDE SLOPES 2:1.

EXCAVATION VOLUME 2800 CU. YD.

PVC PIPE TO BE BEDDED IN SOIL CONTAINING ROCK NO LARGER THAN 1" DIAMETER. BEDDING 4" UNDER THE PIPE AND 6" ON THE SIDES AND TOP. COMPACT THE BEDDING WITH ONE PASS OF A VIBRATING PLATE COMPACTOR OVER 6" LOOSE LIFTS.

CONSIDER FLOW METERS: AQUA MASTER MODEL 900R FROM JENNINGS INC.

McCROMETER MODEL E0300 PROPELLER STYLE METER.

CHECK FOR COMPATIBILITY WITH YOUR EXISTING RECORDING AND CONTROL EQUIPMENT.

SPACE THE DIFFERENT KIND OF GALLERIES 30'.

TBM IS AT THE TOP OF THE RIGHT SIDE WALL, DOWNSTREAM END OF THE FLUME. ELEVATION 88.7 FEET.

6476
OREGON
JULY 11, 1969
BERNARD J. HEWES
EXPIRES 6/30/2009

DESIGNED B. HEWES DATE 11/07
PLOTTED
APPROVED

WWBWC/HBDIC UPPER RECHARGE PROJECT
SITE PLAN
UMATILLA COUNTY, OREGON

CADFILE
whitextpln2

SHEET 2
OF 7

SUPPLY PIPE TO POND 4 PLAN VIEW

NOTES

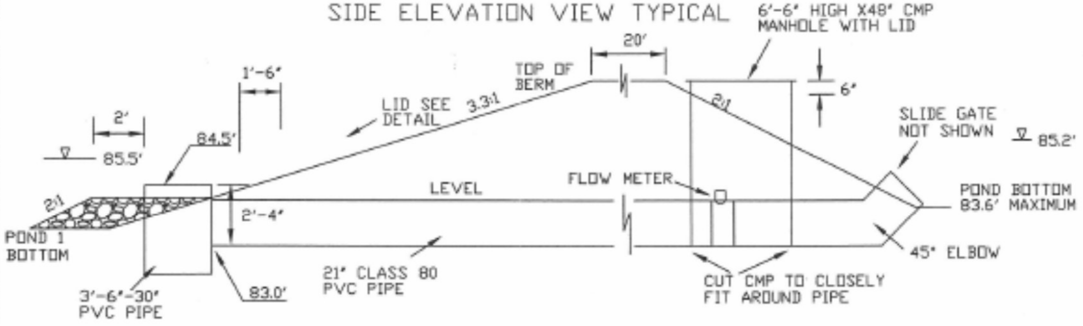
CUT THE HOLE IN THE INLET STRUCTURE TO CLOSELY FIT AROUND THE SUPPLY PIPE. FILL THE SPACE BETWEEN THE STRUCTURE AND PIPES WITH CAULKING ON BOTH SIDES.

THE BOTTOM LIP OF THE 45° ELBOW CAN BE NO LESS THAN 0.2' BELOW THE TOP OF THE 21" PIPE.

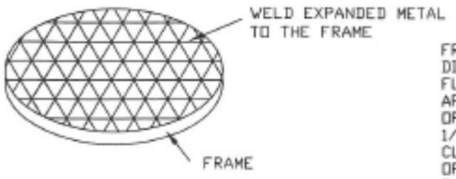
LID FOR THE CMP MANHOLE TO BE GALVANIZED 1/8" THICK STEEL.

SLIDE GATE TO BE A WATERMAN C-8-4 OR EQUIVALENT. INSTALL A CATWALK FOR ACCESS TO THE SLIDE GATE.

SIDE ELEVATION VIEW TYPICAL

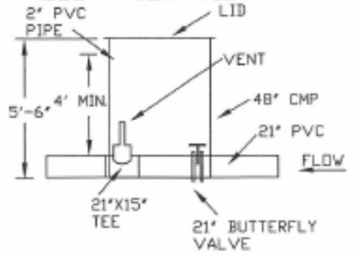


INLET STRUCTURE TRASH RACK DETAIL PERSPECTIVE VIEW

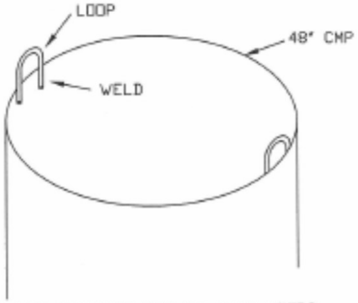


FRAME IS 1/4" X 3" STEEL, INSIDE DIAMETER 32". COVER TO BE FLATTENED EXPANDED METAL APPROXIMATELY 0.120" THICK; OPENINGS APPROXIMATELY 1/2" X 1 5/8 ". CLEAN AND PAINT WITH 2 COATS OF HIGH ZINC COLD GALVANIZING PAINT.

GALLERY SUPPLY PIPE VALVE DETAILS ELEVATION VIEW



MANHOLE LID HOLD DOWN PERSPECTIVE VIEW



USE 1/2" DIAMETER ROD TO MAKE LOOPS. DIAMETER OF THE LOOP 2"

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MISCELLANEOUS DETAILS
UMATILLA COUNTY, OREGON
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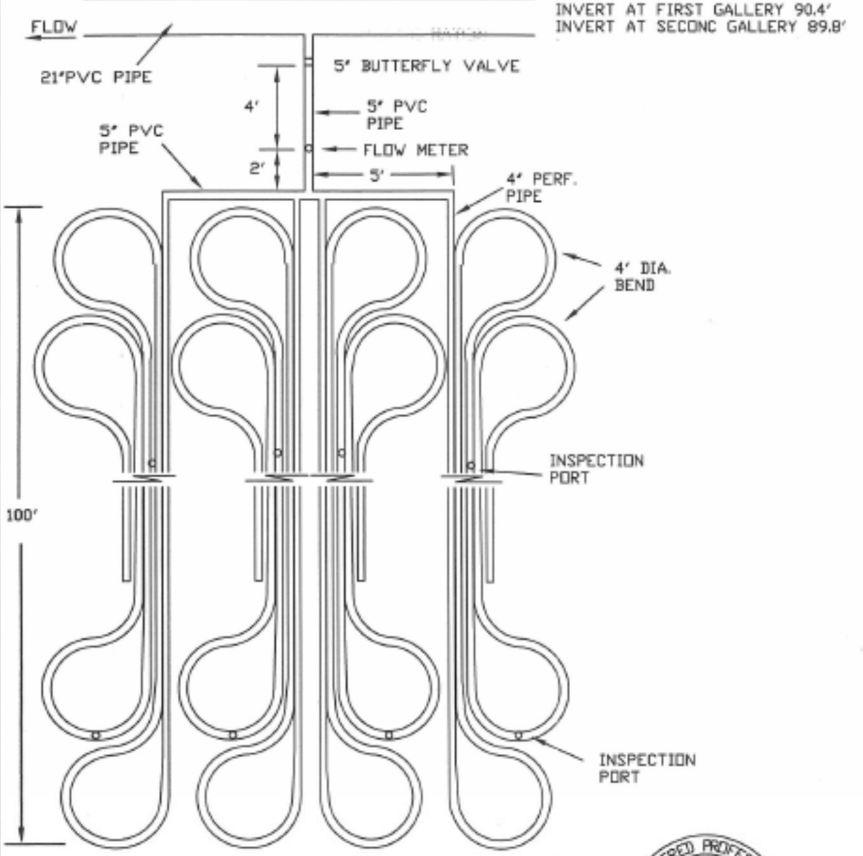
SHEET 3 OF 7

TYPICAL 4" PERFORATED PIPE GALLERY PLAN VIEW



NOTE: ON THIS SIDE THE PERF. PIPE CHANGED TO SMOOTH DRAIN FIELD PIPE WITH A TEE FOR EACH PIPE ROW, 20 ROWS.

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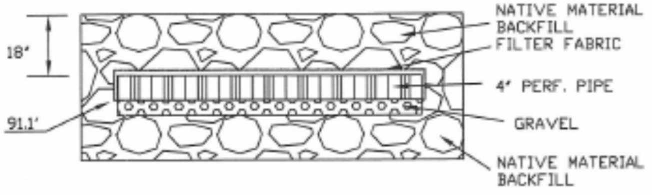
4" PERFORATED PIPE WITH NATIVE MATERIAL BACKFILL ELEVATION VIEW



NOTES

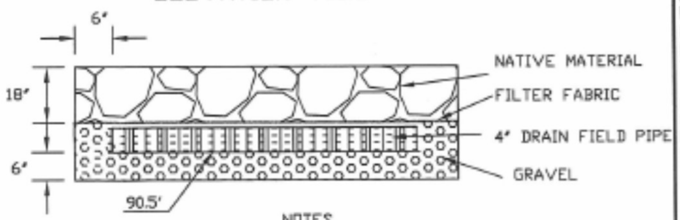
NEED 2000' OF ADS 4" SINGLE WALL, PERFORATED, CORRUGATED POLYETHYLENE PIPE OR EQUIVALENT. CONNECT THE 4" TO THE 5" PIPE USING A MAR-MAC POLYSEAL PIPE COUPLER OR EQUIVALENT.

USE ONLY ENOUGH GRAVEL BEDDING TO PROVIDE A SMOOTH SURFACE TO LAY THE PIPE ON OR REMOVE ALL ROCK GREATER THAN 2" IN DIAMETER FROM CONTACTING THE PIPE.

THE INSPECTION PORT TO BE INSTALLED WHERE THE TWO PIPE ROLLS CONNECT AND NEAR THE END AS SHOWN. CONNECT THE ROLLS WITH A 4" TEE, USE 2' OF VERTICAL 4" PERF. PIPE WRAPPED WITH FILTER FABRIC FOR AN INSPECTION PORT. INSTALL A 4" CAP ON THE END OF THE PIPE AND INSPECTION PORT.

THE FILTER FABRIC TO BE ADS 4000 NONWOVEN OR EQUIVALENT. ABOUT 75 SQ. YD. NEEDED.

4" DRAIN FIELD PIPE WITH GRAVEL BEDDING ELEVATION VIEW



NOTES

NEED 2000' OF 4" PVC DRAIN FIELD PIPE. CONNECT THE 4" TO THE 5" PIPE USING A MAR-MAC POLYSEAL PIPE COUPLER OR EQUIVALENT.

THE INSPECTION PORTS TO BE INSTALLED NEAR THE MIDDLE OF ONE OF THE ROWS AND NEAR THE END. USE 2' OF VERTICAL 4" PIPE WRAPPED WITH FILTER FABRIC FOR AN INSPECTION PORT. INSTALL A 4" CAP ON THE END OF THE PIPE AND INSPECTION PORT.

THE FILTER FABRIC TO BE ADS 4000 NONWOVEN OR EQUIVALENT. ABOUT 75 SQ. YD. NEEDED.

GRAVEL TO BE ANGULAR CRUSHED ROCK WITH THE MAJORITY BEING $\frac{3}{4}$"-2", ABOUT 60 CU. YD. NEEDED.

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4" PERF. & DRAIN FIELD PIPE DETAILS
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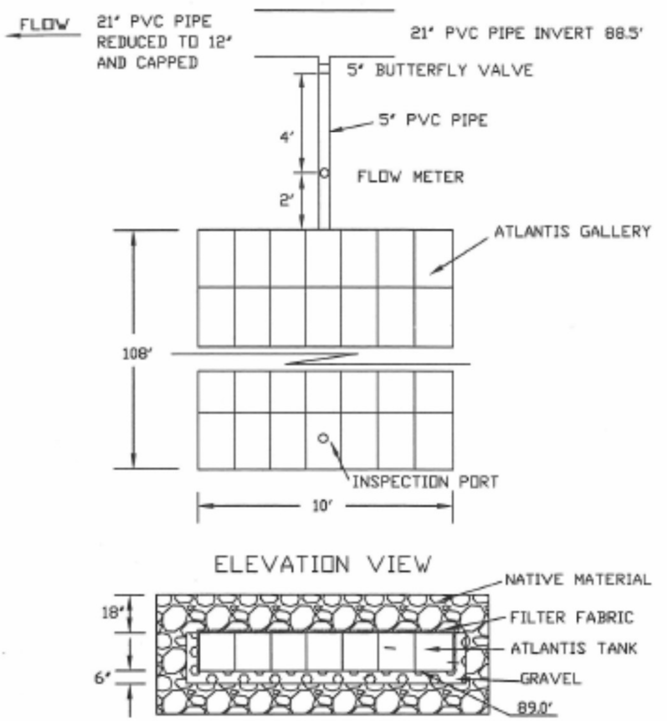
SHEET 4 OF 7

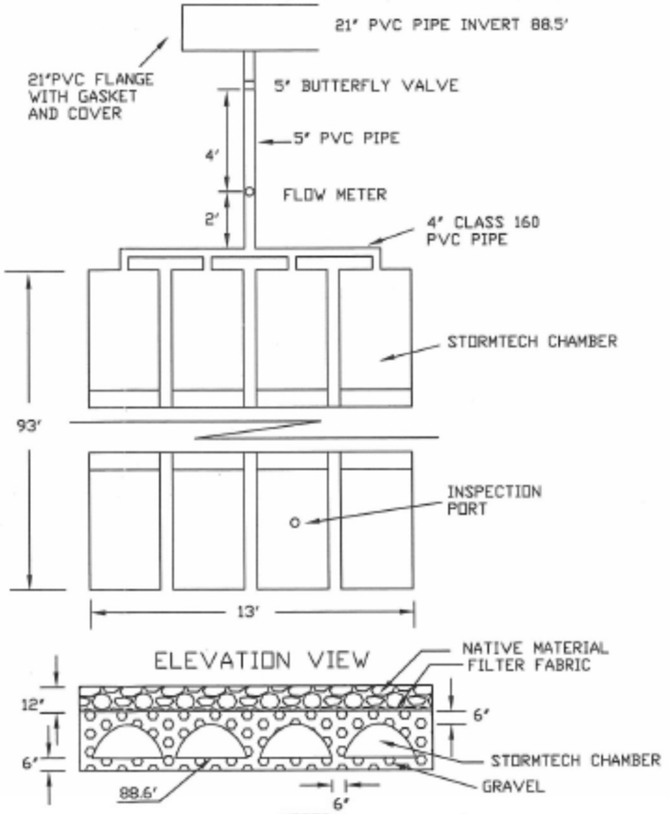
ATLANTIS RAIN TANK DETAIL
PLAN VIEW



NOTES

ASSEMBLE AND INSTALL RAIN TANKS AND INSPECTION PORT AS DESCRIBED IN THE MANUFACTURERS LITERATURE. TANKS ARE 16" WIDE, 27" LONG AND 17¾" HIGH, NEED 336 TANKS FOR H-10 LOADING. USE 4" PVC PIPE FOR THE PORT, EXTEND 1' ABOVE GROUND AND PROTECT WITH A FENCE POST AND END CAP.
FILTER FABRIC TO BE ADS 4000 OR EQUIVALENT, NEED 160 SQ. YD.
FOLD AND TAPE THE CORNERS AS SHOWN IN THE LITERATURE.
GRAVEL TO BE ANGULAR CRUSHED ROCK WITH THE MAJORITY OF PARTICLES BETWEEN ¾"-2", NEED ABOUT 25 CU. YD.

STORMTECH CHAMBER
PLAN VIEW



NOTES

ASSEMBLE AND INSTALL CHAMBERS AND INSPECTION PORT AS SHOWN IN THE MANUFACTURERS LITERATURE. TANKS ARE 34" WIDE, 7'-2" LONG AND 16" HIGH, NEED 50 CHAMBERS. IN LIEU OF THE SUBSURFACE PORT SHOWN IN THE LITERATURE EXTEND THE PORT 1' ABOVE GROUND AND PROTECT WITH A FENCE POST AND END CAP.
FILTER FABRIC TO BE ADS 4000 OR EQUIVALENT, NEED 190 SQ. YD.
GRAVEL TO BE ANGULAR CRUSHED ROCK WITH THE MAJORITY OF PARTICLES BETWEEN ¾"-2", NEED ABOUT 115 CU. YD.

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Appendix C

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WWBWC/HBDIC UPPER RECHARGE PROJECT
ATLANTIS & STORMTECH CHAMBERS DETAILS
UMATILLA COUNTY, OREGON

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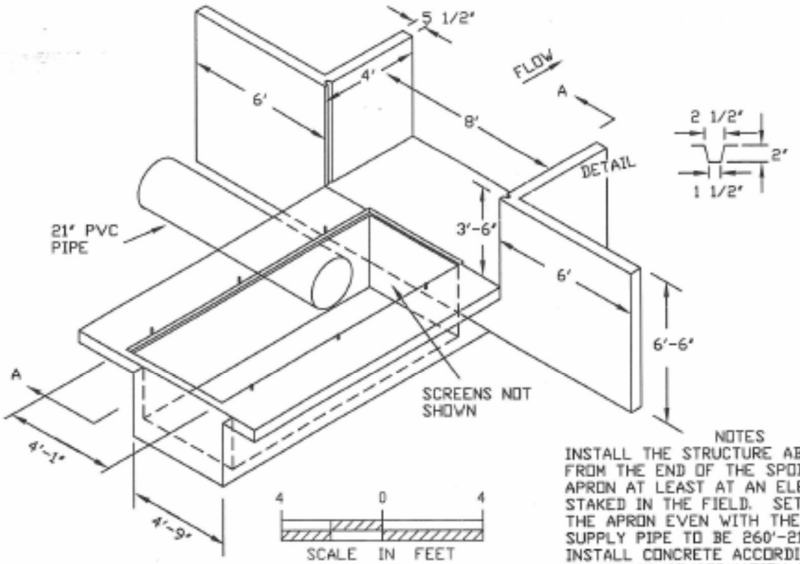
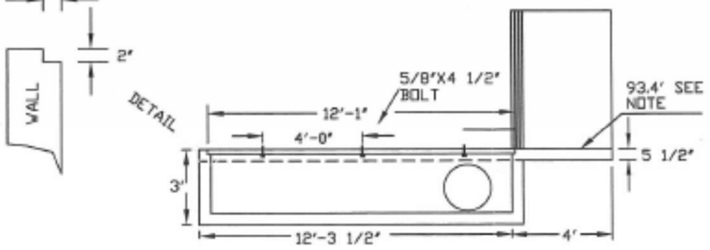
STRUCTURE PERSPECTIVE VIEW



NOTES
INSTALL THE STRUCTURE ABOUT 135' UPSTREAM FROM THE END OF THE SPOIL PILE WITH THE APRON AT LEAST AT AN ELEVATION OF 93.4' AS STAKED IN THE FIELD. SET THE ELEVATION OF THE APRON EVEN WITH THE CHANNEL BOTTOM.
SUPPLY PIPE TO BE 260'-21" CLASS 100 PVC.
INSTALL CONCRETE ACCORDING TO NATURAL RESOURCES CONSERVATION SERVICE SPECIFICATION 42, REINFORCED CONCRETE FOR MINOR STRUCTURES.
USE 4000 PSI STRENGTH CONCRETE, NEED 5.4 CU. YD.
CONCRETE TO BE VIBRATED, ALL EXPOSED EDGES TO BE EDGED WITH AN EDGING TOOL.

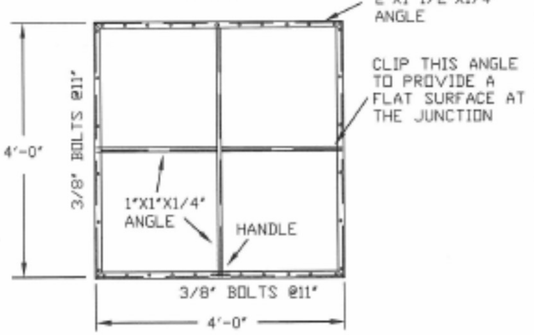
SECTION A



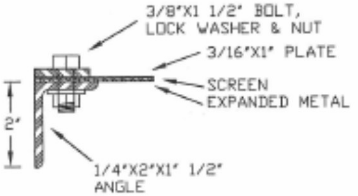
NOTE
NOTCH IS ON ALL 4 SIDES OF THE BOX.
BOLTS ARE TO HOLD DOWN THE SCREEN, USE A 1"X4"X¼"BAR WITH A 3/4" DIAMETER HOLE 1" FROM ONE END.

SCREEN FRAME DETAIL

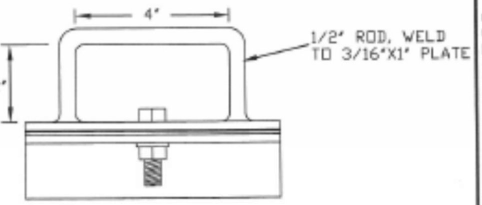
3 NEEDED



SCREEN FRAME DETAIL ELEVATION VIEW



FRAME HANDLE DETAIL ELEVATION VIEW



NOTES
EXPANDED METAL TO BE CARBON STEEL, FLATTENED, 13 GAGE, 3/4" SHORT OPENING WIDTH.
SCREEN TO BE TYPE 304 STAINLESS STEEL, 20 GAGE MINIMUM WITH 3/32" HOLES SPACED 5/32" STAGGERED.

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BERNARD J. HEWES
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CHECK & SCREEN STRUCTURE
UMATILLA COUNTY, OREGON
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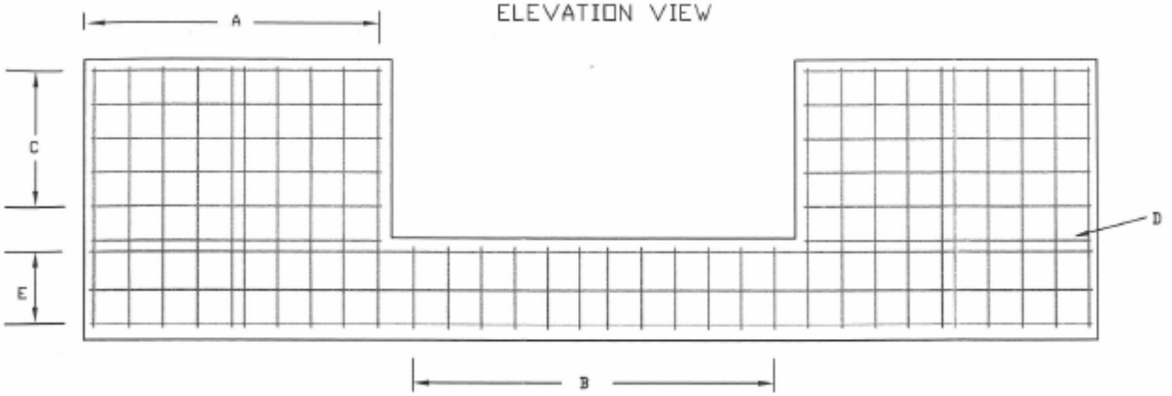
SHEET 6 OF 7

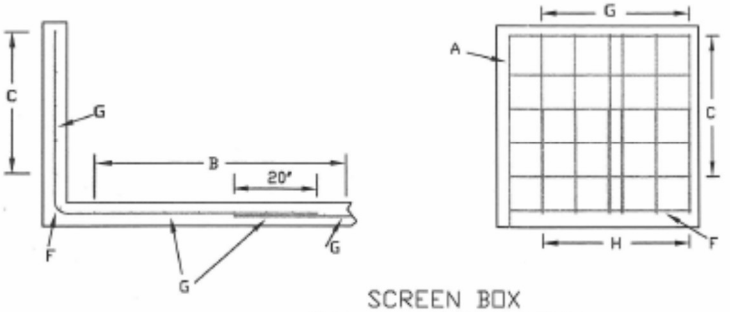
HEADWALL LOOKING DOWNSTREAM
ELEVATION VIEW



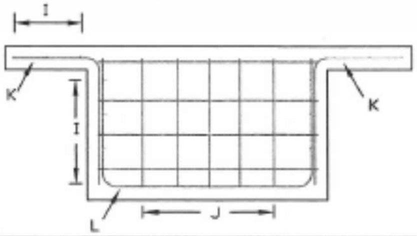
DOWNSTREAM SIDE WALL AND APRON

END ELEVATION VIEW

SIDE ELEVATION VIEW



SCREEN BOX
END ELEVATION VIEW



REINFORCING STEEL SCHEDULE

ALL NUMBER 4 BARS, 8" NOMINAL SPACING

BAR	NO.	SHAPE	A	B	C
A	20	STRAIGHT	6'-1"	--	--
B	12	A B	2'-7"	3'-7"	--
C	10	A B	5'-7"	3'-9"	--
D	2	STRAIGHT	5'-8"	--	--
E	3	STRAIGHT	19'-8"	--	--
F	2	STRAIGHT	3'-7"	--	--
G	12	A B	3'-7"	5'-1"	--
H	12	A B	2'-0"	2'-0"	--
I	14	STRAIGHT	12'-0"	--	--
J	5	A B	2'-6"	3'-8"	--
K	38	A B	1'-9"	2'-6"	--
L	19	A B C	2'-6"	4'-3"	2'-6"

1080 FEET NEEDED WITHOUT ANY WASTE

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WWBWC/HBDIC UPPER RECHARGE PROJECT
REINFORCING STEEL DETAILS
UMATILLA COUNTY, OREGON
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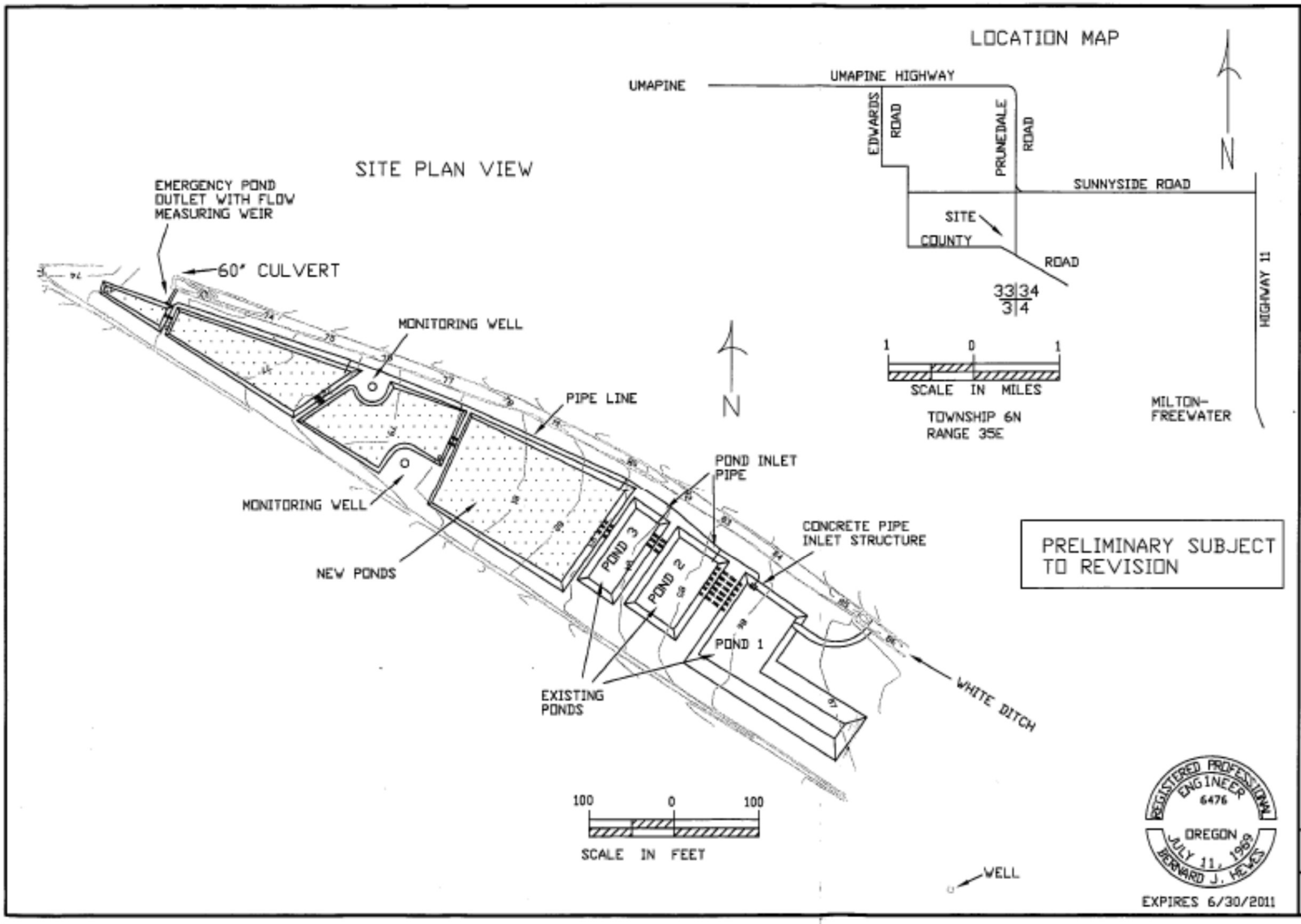
SHEET 7
OF 7



WWBWC/HBDIC LOWER RECHARGE PROJECT
LOCATION MAP & SITE MAP
UMATILLA COUNTY, OREGON

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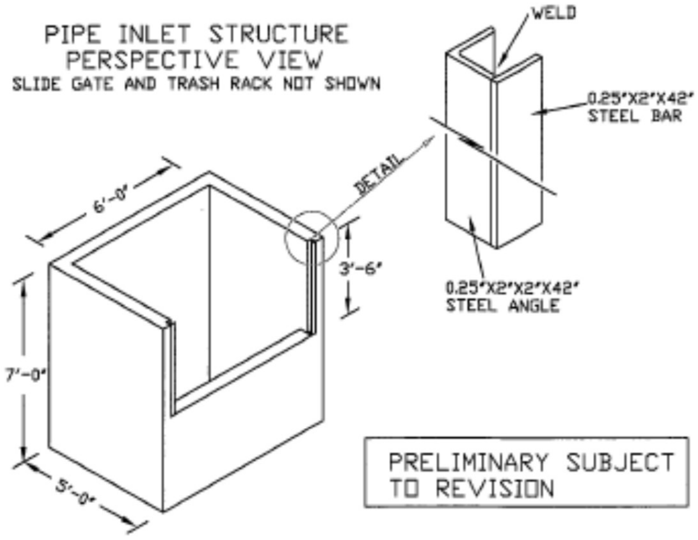
SHEET 1
OF 4

PIPE INLET STRUCTURE PERSPECTIVE VIEW

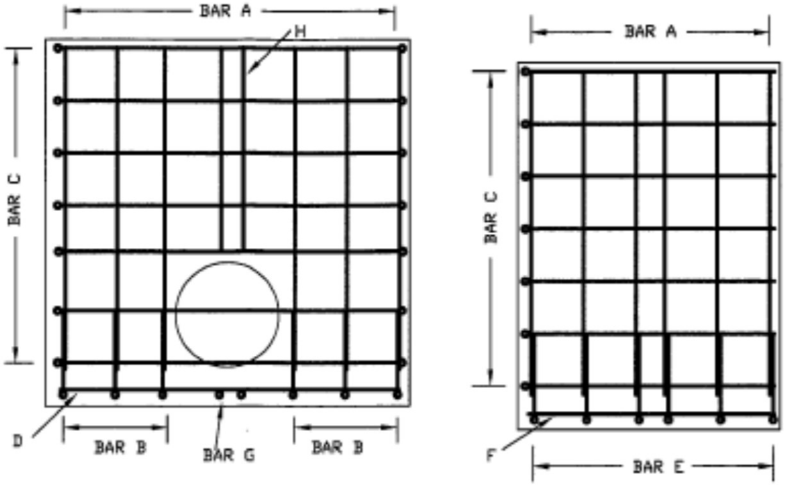
SLIDE GATE AND TRASH RACK NOT SHOWN



PRELIMINARY SUBJECT TO REVISION

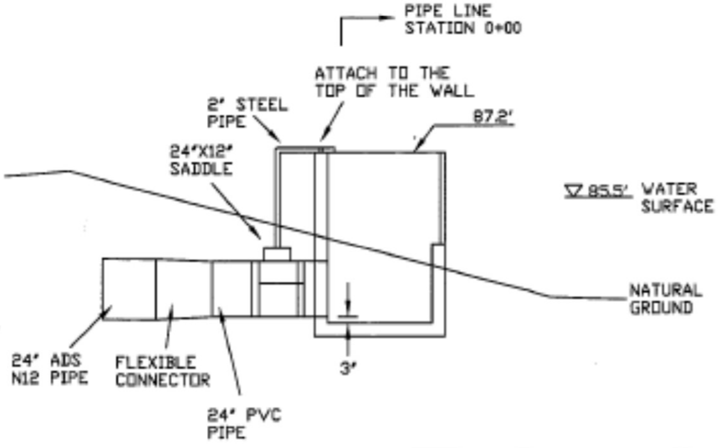
REINFORCING STEEL DETAILS

BACK ELEVATION VIEW   SIDE ELEVATION VIEW



CROSS SECTION VIEW

SLIDE GATE AND TRASH RACK NOT SHOWN



REINFORCING STEEL SCHEDULE

ALL NUMBER 4 BARS, 12" NOMINAL SPACING

BAR	NO.	SHAPE	A	B	C
A	18	straight	6'-2"	--	--
B	6	A|_B_|C	1'-7"	6'-6"	3'-1"
C	7	A|_B_|C	4'-7"	6'-6"	4'-7"
D	2	straight	6'-6'	--	--
E	6	A|_B_|C	1'-7"	6'-6'	1'-7"
F	2	straight	4'-6'	--	--
G	2	_A_B	6'-6"	3'-1'	--
H	2	straight	3'-11'	--	--

NOTES

INSTALL THE PIPE INLET STRUCTURE ACCORDING TO CONSTRUCTION SPECIFICATION 42, REINFORCED CONCRETE FOR MINOR STRUCTURES, USE 4000 PSI STRENGTH CONCRETE, APPROXIMATELY 3.0 CU. YD. NEEDED.

REINFORCING STEEL TO BE #4 BARS, NEED 400 FEET ASSUMING NO WASTE.

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JULY 11, 1969
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WWBWC/HBDIC LOWER RECHARGE PROJECT
PIPE INLET STRUCTURE
UMATILLA COUNTY, OREGON
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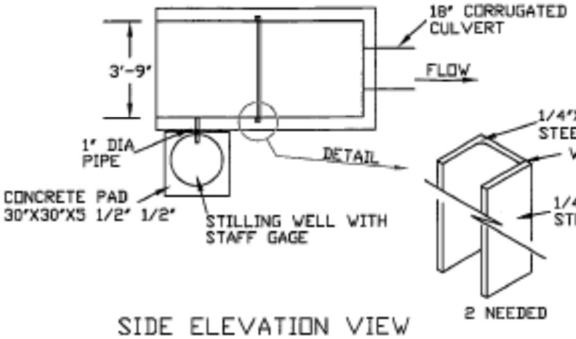
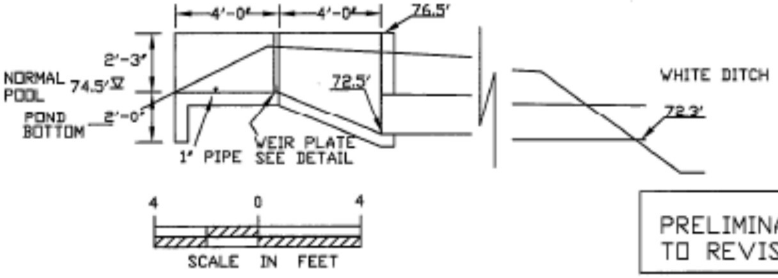
SHEET 2
OF 4

POND EMERGENCY OUTLET
PLAN VIEW

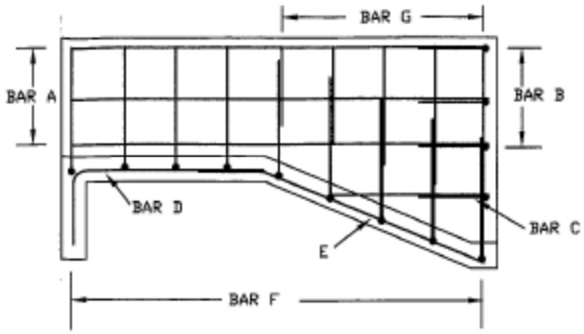


SIDE ELEVATION VIEW
STILLING WELL NOT SHOWN

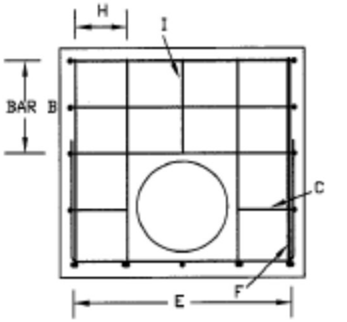


PRELIMINARY SUBJECT TO REVISION

REINFORCING STEEL DETAILS
SIDE ELEVATION VIEW



PIPE INLET END ELEVATION VIEW



NOTES

INSTALL CONCRETE IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION 42, "REINFORCED CONCRETE FOR MINOR STRUCTURES". USE 4000 PSI STRENGTH CONCRETE, NEED ABOUT 2.2 CU. YD.

REINFORCING STEEL ALL #4 BARS, NEED 260 FEET WITH NO WASTE.

CULVERT PIPE MAY BE STEEL OR HIGH DENSITY POLYETHYLENE.

SET THE WEIR PLATE IN A RABBET CUT INTO A 1 1/2"X1 3/4" BOARD AND SET INTO THE SOCKETS. THE WEIR PLATE TO BE STEEL 1/8"X3"X48".

SET THE STILLING WELL AT LEAST 2' INTO THE CONCRETE BASE. USE A MINIMUM PIPE DIAMETER OF 18" EITHER PVC OR STEEL.

SET THE STAFF GAGE ZERO POINT IN THE STILLING WELL LEVEL WITH THE CREST OF THE WEIR PLATE. INSTALL THE 1" PIPE TO THE STILLING WELL WITH 1" BETWEEN THE FLOOR AND PIPE.

REINFORCING STEEL SCHEDULE
ALL #4 BARS, 12" NOMINAL SPACING

BAR	NO.	SHAPE	A	B	C
A	6	straight	7'-8"	--	--
B	3	A B C	1'-3"	4'-3"	1'-3"
C	2	A B	1'-3"	1'-1"	--
D	5	A B	1'-6"	4'-0"	--
E	5	A B	1'-3"	4'-8"	--
F	9	A B C	2'-4"	4'-3"	2'-4"
G	10	straight	varies	--	--
H	4	A B	1'-3"	4'-1"	--
I	1	straight	1'-10"	--	--

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UMATILLA COUNTY, OREGON

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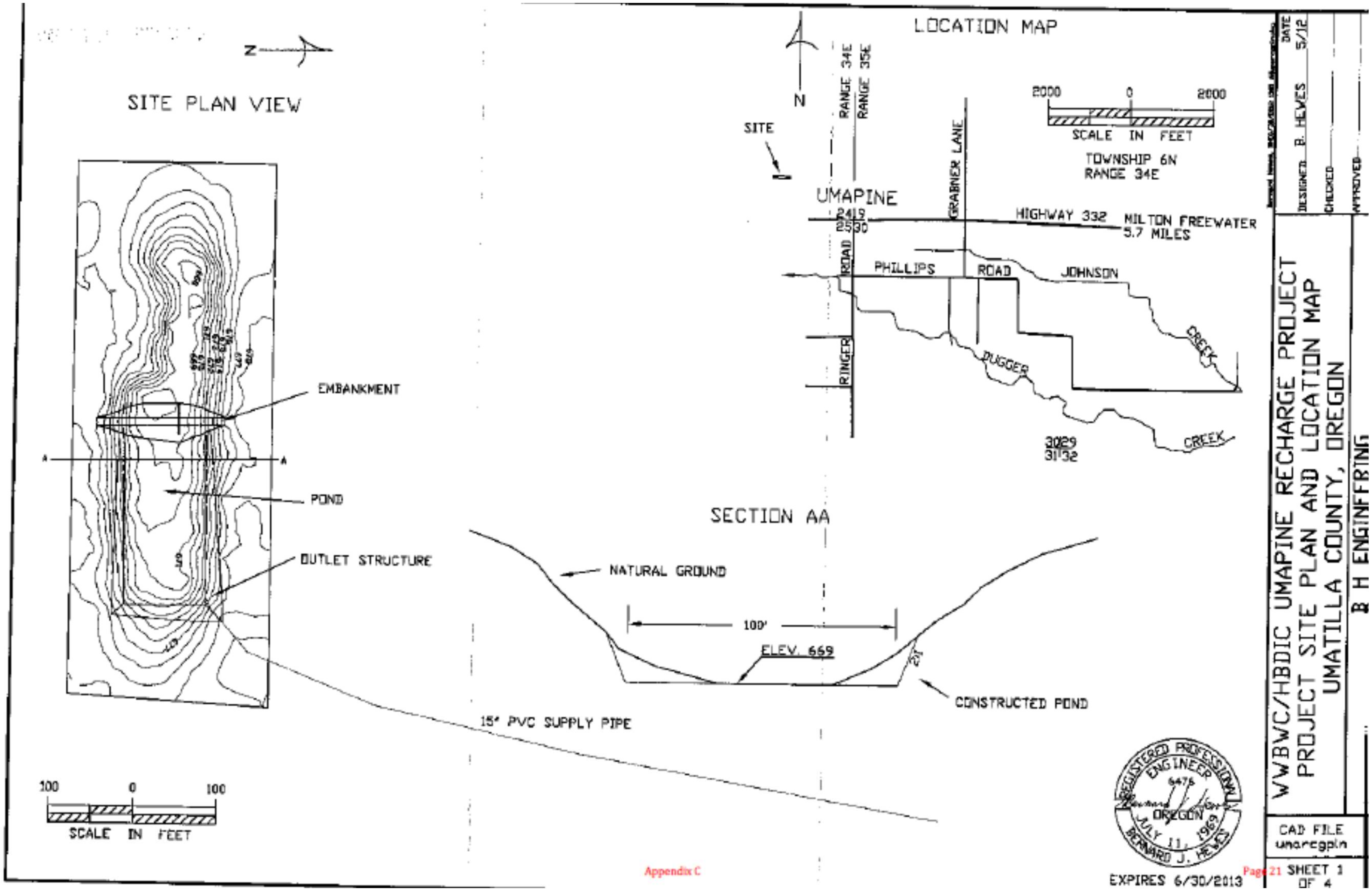
SITE PLAN VIEW
N
EMBANKMENT
A
A
POND
OUTLET STRUCTURE
15" PVC SUPPLY PIPE
100
0
100
SCALE IN FEET
SECTION AA
NATURAL GROUND
100'
ELEV. 669
2:1
CONSTRUCTED POND
LOCATION MAP
N
SITE
RANGE 34E
RANGE 35E
UMAPINE
2419
2530
GRABNER LANE
HIGHWAY 332
MILTON FREEWATER
5.7 MILES
ROAD
PHILLIPS
ROAD
JOHNSON
CREEK
RINGER
DUGGER
CREEK
3029
3132
2000
0
2000
SCALE IN FEET
TOWNSHIP 6N
RANGE 34E
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WWBWC/HBDIC UMAPINE RECHARGE PROJECT
PROJECT SITE PLAN AND LOCATION MAP
UMATILLA COUNTY, OREGON
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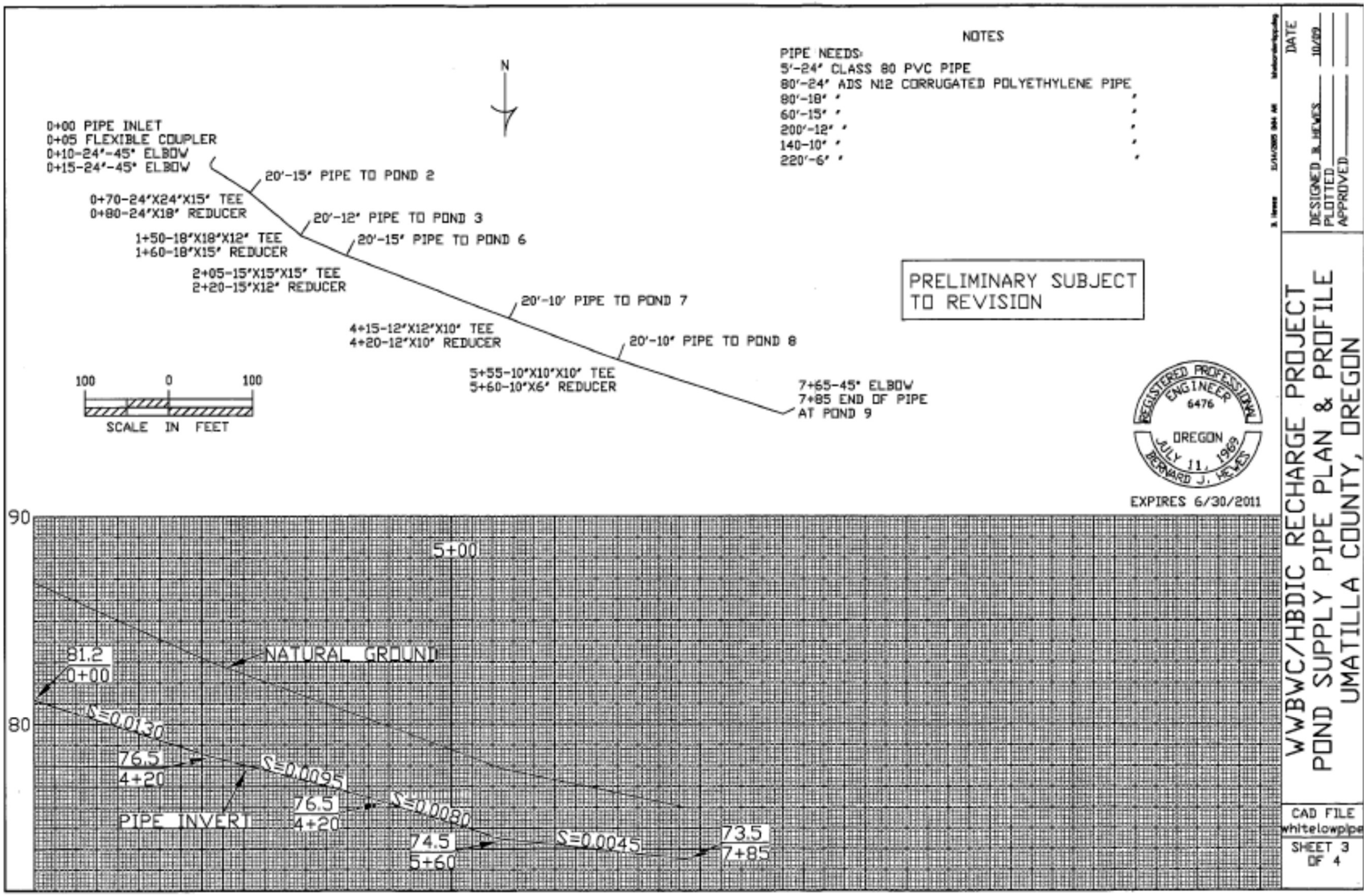
OF 4


NOTES
PIPE NEEDS:
5'-24" CLASS 80 PVC PIPE
80'-24" ADS N12 CORRUGATED POLYETHYLENE PIPE
80'-18" "
60'-15" "
200'-12" "
140'-10" "
220'-6" "
N
0+00 PIPE INLET
0+05 FLEXIBLE COUPLER
0+10-24"-45° ELBOW
0+15-24"-45° ELBOW
20'-15" PIPE TO POND 2
0+70-24"X24"X15" TEE
0+80-24"X18" REDUCER
20'-12" PIPE TO POND 3
1+50-18"X18"X12" TEE
1+60-18"X15" REDUCER
20'-15" PIPE TO POND 6
2+05-15"X15"X15" TEE
2+20-15"X12" REDUCER
20'-10' PIPE TO POND 7
4+15-12"X12"X10" TEE
4+20-12"X10" REDUCER
20'-10" PIPE TO POND 8
5+55-10"X10"X10" TEE
5+60-10"X6" REDUCER
7+65-45° ELBOW
7+85 END OF PIPE
AT POND 9
PRELIMINARY SUBJECT TO REVISION
100
0
100
SCALE IN FEET
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JULY 11, 1969
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90
80
5+00
NATURAL GROUND
81.2
0+00
S=0.0130
76.5
4+20
S=0.0095
PIPE INVERT
76.5
4+20
S=0.0080
74.5
5+60
S=0.0045
73.5
7+85
WWBWC/HBDIC RECHARGE PROJECT
POND SUPPLY PIPE PLAN & PROFILE
UMATILLA COUNTY, OREGON
DATE
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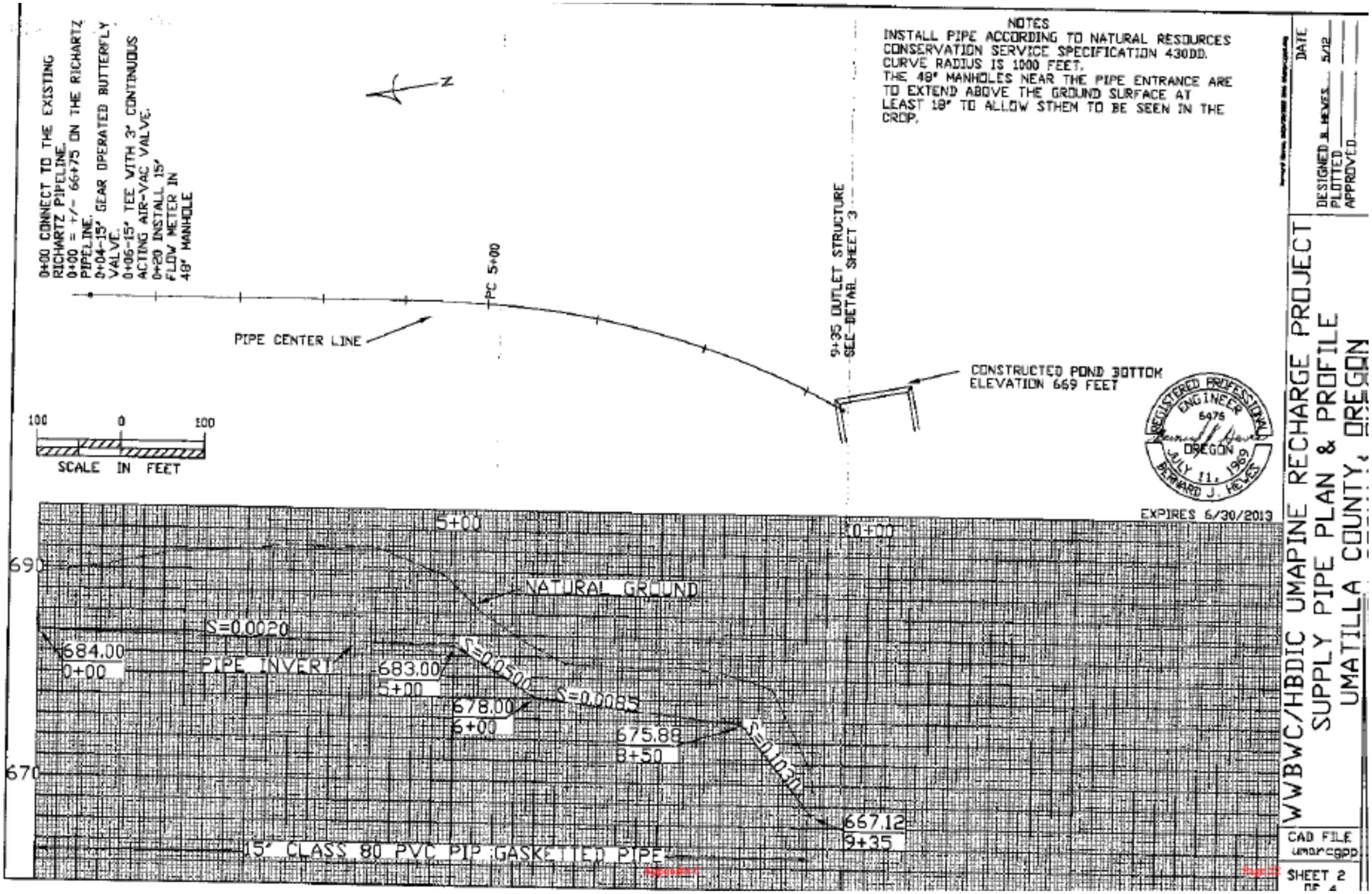
SHEET 3
OF 4



0+00 CONNECT TO THE EXISTING RICHARTZ PIPELINE.
0+00 = +/- 66+75 ON THE RICHARTZ PIPELINE.
0+04-15' GEAR OPERATED BUTTERFLY VALVE.
0+06-15' TEE WITH 3" CONTINUOUS ACTING AIR-VAC VALVE.
0+20 INSTALL 15' FLOW METER IN 48" MANHOLE

NOTES

INSTALL PIPE ACCORDING TO NATURAL RESOURCES CONSERVATION SERVICE SPECIFICATION 430DD.
CURVE RADIUS IS 1000 FEET.
THE 48" MANHOLES NEAR THE PIPE ENTRANCE ARE TO EXTEND ABOVE THE GROUND SURFACE AT LEAST 18" TO ALLOW STHEM TO BE SEEN IN THE CROP.

DATE
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WWBWC/HBDIC UMAPINE RECHARGE PROJECT
SUPPLY PIPE PLAN & PROFILE
UMATILLA COUNTY, OREGON

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SHEET 2
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JULY 11, 1989
BERNARD J. HEYES
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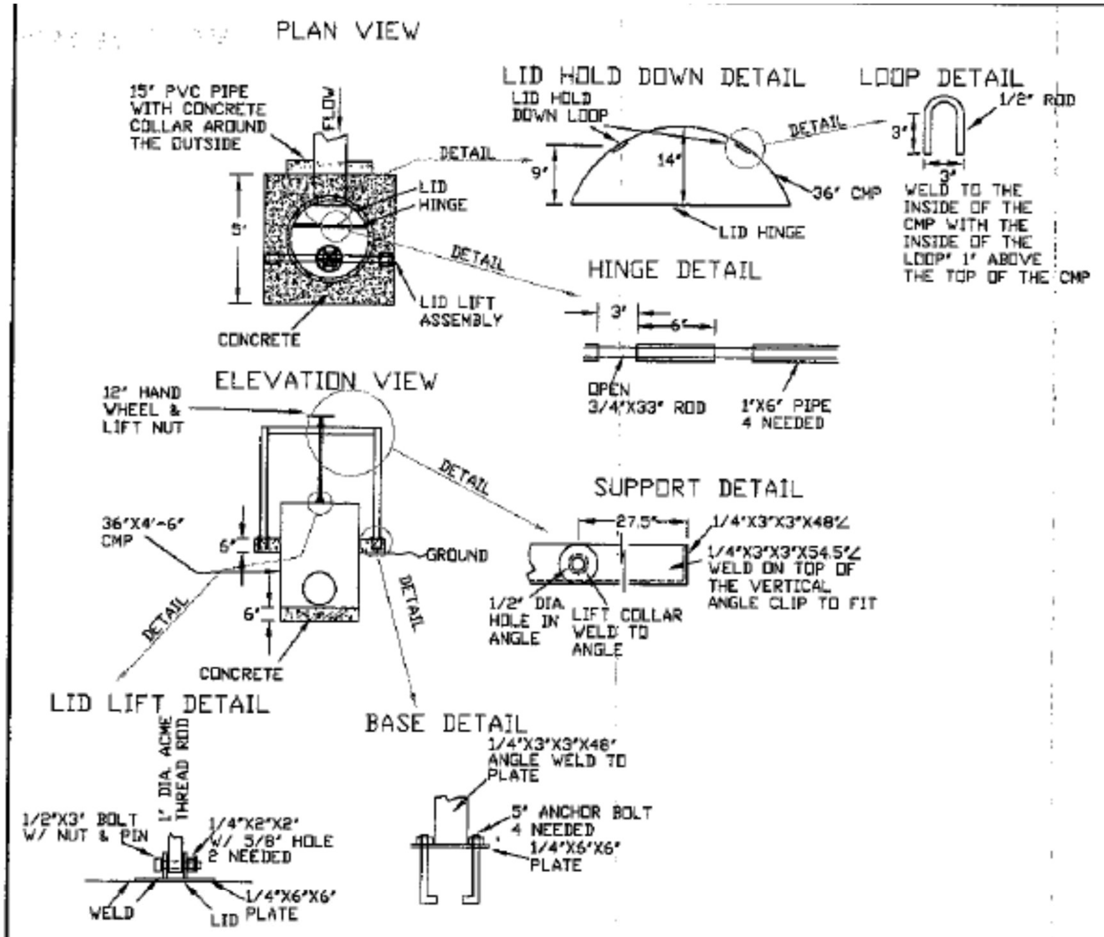

NOTES

AT THE ESTIMATED DESIGN FLOW THE LID OPENING SHOULD BE ABOUT 6'.
USE 4000 PSI STRENGTH CONCRETE, NEED 0.5 CU. YD. REINFORCE THE UPPER SLAB WITH A #4 BAR LOCATED 3' FROM THE OUTER EDGE, NEED 4-4'-6' BARS.
LID FOR THE OUTLET TO BE FABRICATED OUT OF 3/16' STEEL AND BE 40' IN DIAMETER.
USE 1' PIPE PIECES THROUGH THE LOOPS ON THE CMP TO TIGHTLY HOLD THE LID DOWN.

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JULY 11, 1989
BERNARD J. HEWES

EXPIRES 6/30/2013

DATE 5/12
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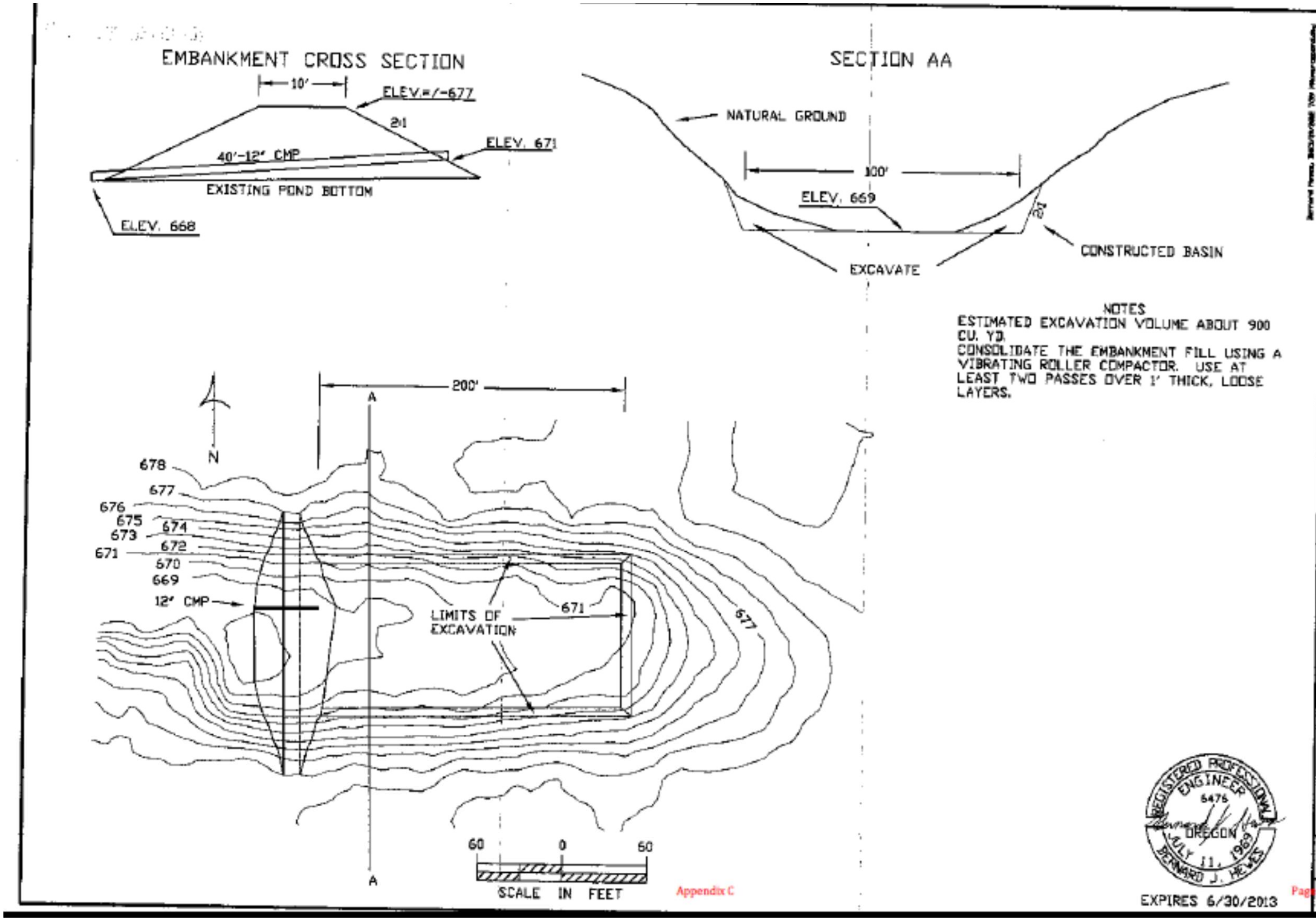
CHECKED
APPROVED

WWBWC/HBDIC UMAPINE RECHARGE PROJECT
MISCELLANEOUS DETAILS
UMATILLA COUNTY, OREGON
B H ENGINEERING

CAD FILE
umarcgout

SHEET 3
OF 4



NOTES

ESTIMATED EXCAVATION VOLUME ABOUT 900 CU. YD.

CONSOLIDATE THE EMBANKMENT FILL USING A VIBRATING ROLLER COMPACTOR. USE AT LEAST TWO PASSES OVER 1' THICK, LOOSE LAYERS.

BERNARD J. HEWES
6476
JULY 11, 1969

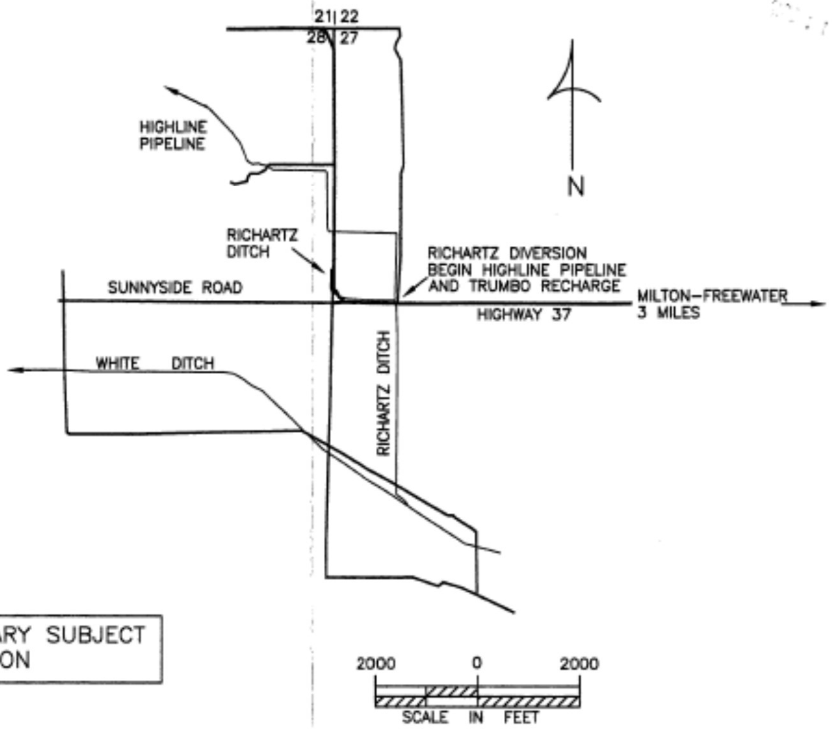
EXPIRES 6/30/2013

WWBWC/HBDIC UMAPINE RECHARGE PROJECT
BASIN DETAILS
UMATILLA COUNTY, OREGON
B H ENGINEERING

DESIGNED B. HEWES
DATE 5/12
CHECKED
APPROVED

CAD FILE
umarcgpond

SHEET 4
OF 4



PRELIMINARY SUBJECT TO REVISION

SECTION 27
TOWNSHIP 6N
RANGE 35E

6476
BERNARD J. HEWES
JULY 11, 1969

EXPIRES 6/30/2013

WWBWC/HBDIC TRUMBO LANE RECHARGE
LOCATION MAP
UMATILLA COUNTY, OREGON

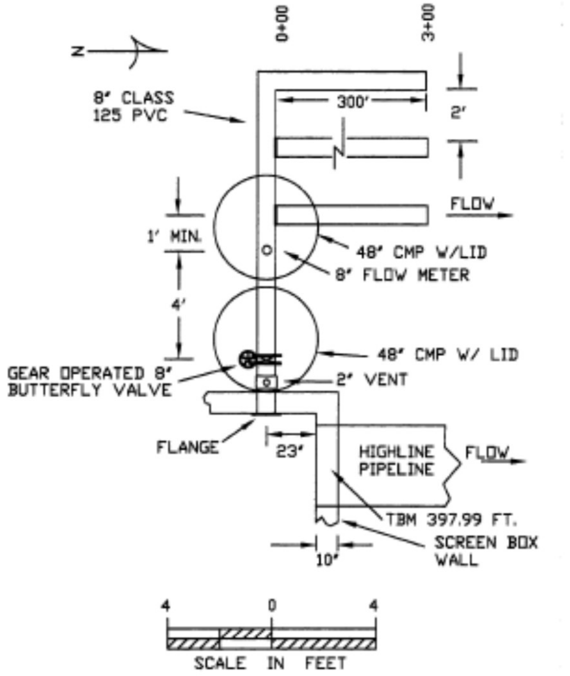
B H ENGINEERING

DESIGNED B. HEWES DATE 9/12
CHECKED
APPROVED

CADFILE
trumboloc

SHEET 1
OF 2

RECHARGE SYSTEM PLAN VIEW



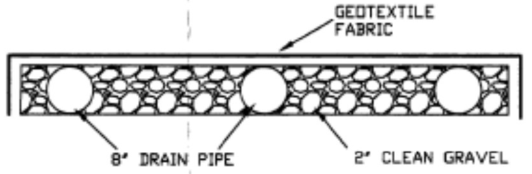
NOTES

BOTTOM OF THE HOLE FOR THE 8" OUTLET PIPE IS 20" ABOVE THE FLOOR AND 23" FROM THE INSIDE OF THE NORTH WALL. MINIMUM DIAMETER OF THE HOLE IS 10".

PLACE CAULK BETWEEN THE FLANGE AND THE WALL WHEN SETTING THE 8" PIPE. FORCE NON-SHRINK GROUT BETWEEN THE PIPE AND HOLE WALL. AFTER THE GROUT IS SET CLEAN UP ANY VOIDS WITH CAULKING COMPOUND.

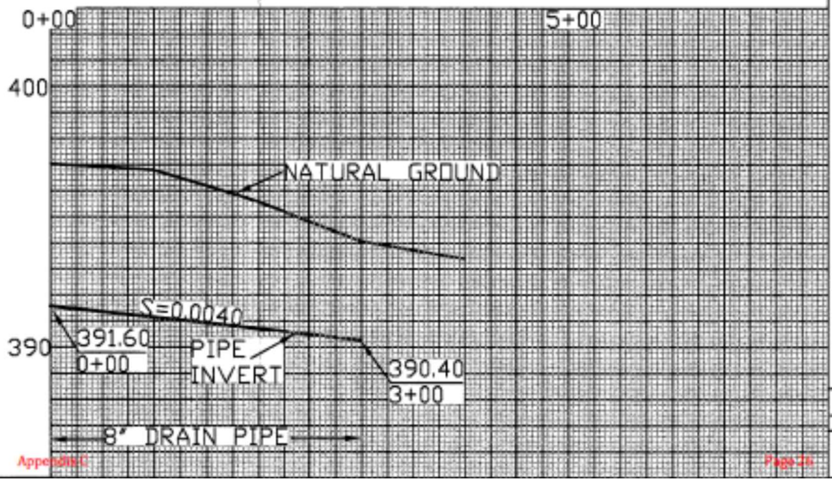
THE 8" RECHARGE PIPE CAN BE EITHER CORRUGATED ABS PERFORATED DRAIN PIPE OR SMOOTH WALL LEACH FIELD PIPE. INSTALL A WYE NEAR 0+00 AND 2+00 ON EACH LINE FOR A CLEAN OUT. PLACE A REMOVABLE CAP ON THE END OF EACH DRAIN LINE FOR CLEANING OUT.

DRAIN PIPE CROSS SECTION
ELEVATION VIEW



PRELIMINARY SUBJECT
TO REVISION

6476
JULY 11, 1969
BERNARD J. HEWES
EXPIRES 6/30/2013

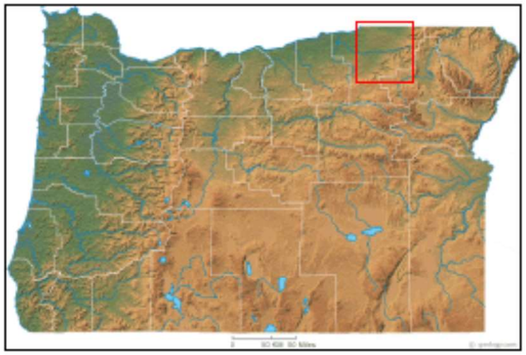


DESIGNED B. HEWES	9/12
PLOTTED	
APPROVED	

WWBWC/HBDIC TRUMBO LANE RECHARGE
PLAN & PROFILE
UMATILLA COUNTY OREGON

CAD FILE
trumboplar

SHEET 2
OF 2



LOCATION MAP

Chuckhole
Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council

INDEX OF DRAWINGS

SHEET NO.	TITLE
1	Cover Sheet & Location Map
2	Plan View
3	Details 1
4	Details 2
5	Details 3
6	Details 4

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Review and Acceptance

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Owner Date

Cover Sheet

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595–8990

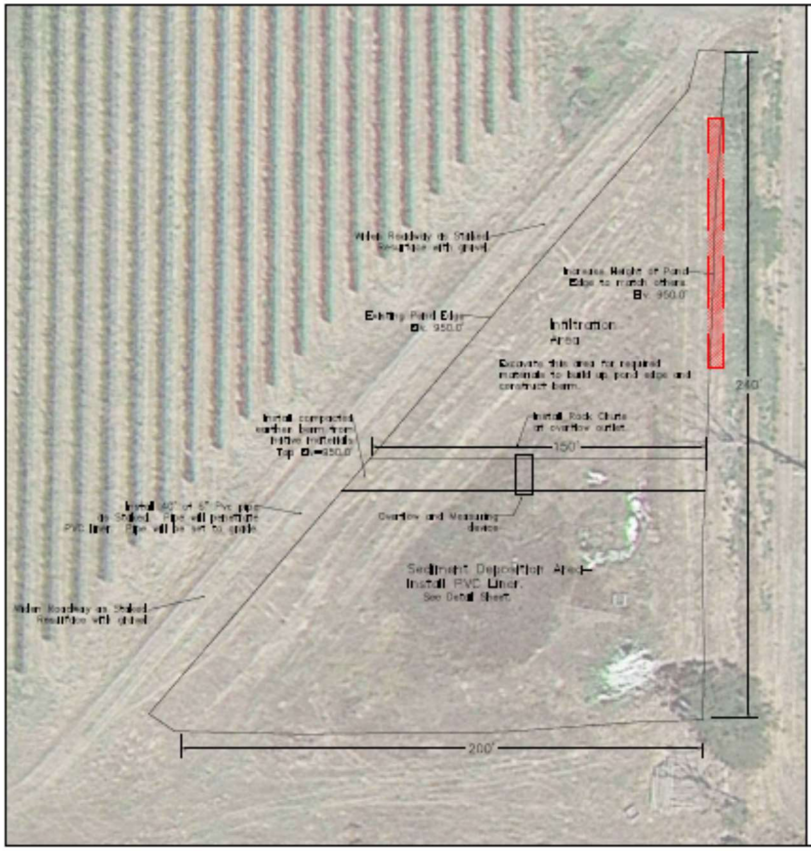
DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:
REVISED BY:
SCALE:
DATE:
REVISED DATE:

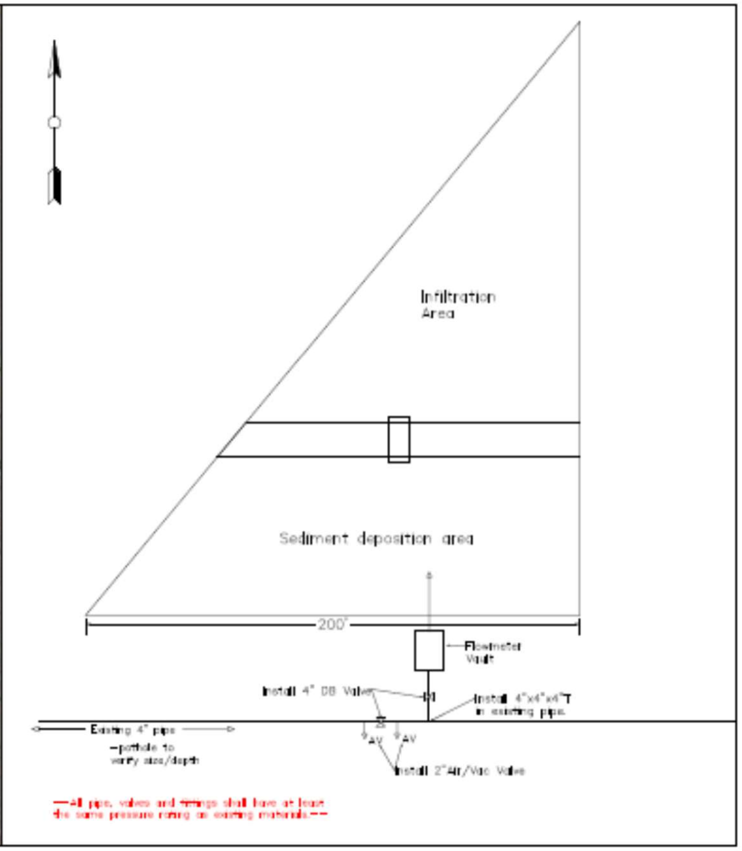
Chuckhole Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 1

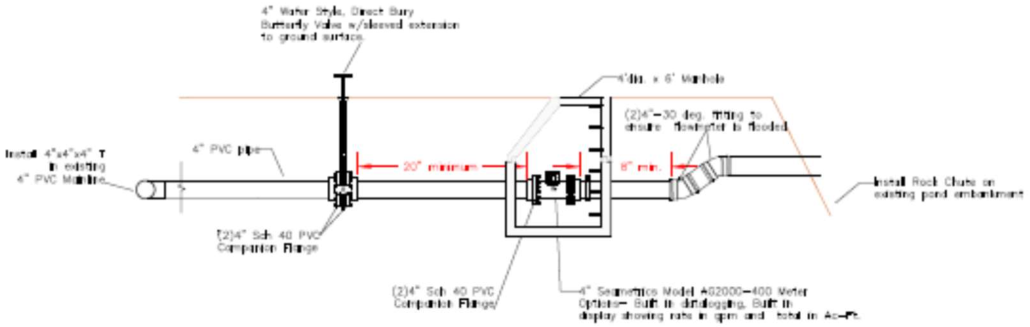
SHEET NO. 1 OF 6



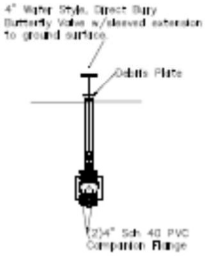


—All pipe, valves and fittings shall have at least the same pressure rating as existing materials.—

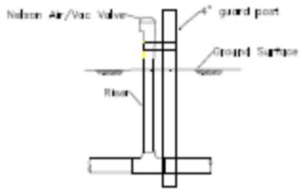
Plan View	Lance Horning Engineering Corvallis, OR 97333 (509) 595—8990	DESIGNED BY: DRAWN BY: CHECKED BY: APPROVED BY: REVISED BY: SCALE: DATE: REVISED DATE:	Chuckhole Shallow Aquifer Recharge Project Walla Walla Basin Watershed Council Milton Freewater, OR	SIGNATURE:	SHEET: 2 SHEET NO. 2 of 6



Flowmeter Vault



Butterfly Valve



Air Vent

Details 1

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595-8990

DESIGNED BY: ______
DRAWN BY: ______
CHECKED BY: ______
APPROVED BY: ______
REVISED BY: ______
SCALE: ______
DATE: ______
REVISED DATE: ______

Chuckhole Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE: ______

SHEET: 3

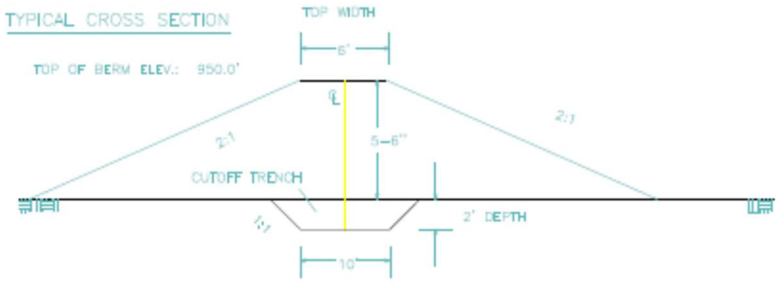
SHEET NO. 3 OF 6

Notes–

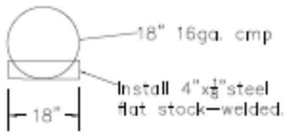
1) Organic materials shall not be used in the berm.

2) Berm shall be compacted in 6" lifts to 95% Proctor.

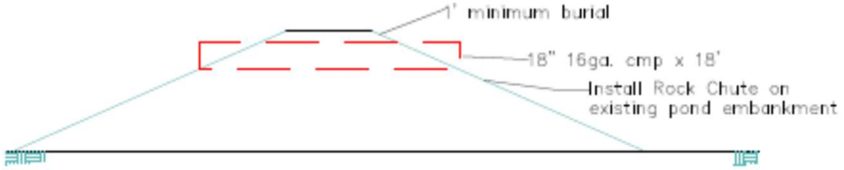
3) Contractor responsible to add water as required for compaction.



Berm– Section View



Overflow Culvert with Weir

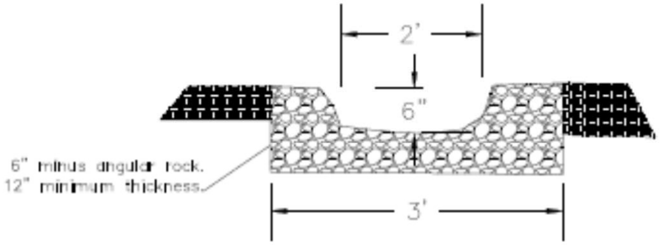


Overflow– Section View

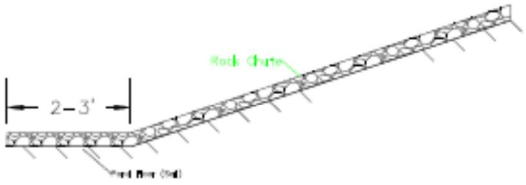
Details 2	Lance Horning Engineering Corvallis, OR 97333 (509) 595–8990	DESIGNED BY: DRAWN BY: CHECKED BY: APPROVED BY: REVISED BY: SCALE: DATE: REVISED DATE:	Chuckhole Shallow Aquifer Recharge Project Walla Walla Basin Watershed Council Milton Freewater, OR SIGNATURE:

SHEET 4

SHEET NO. 4 OF 6



Rock Chute– Section View



Rock Chute Profile

Details 3

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595–8990

DESIGNED BY:
DRAWN BY:
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APPROVED BY:
REVISED BY:
SCALE:
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Chuckhole Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

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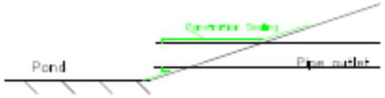
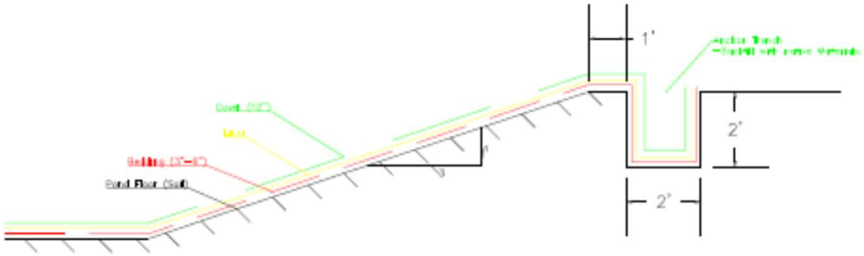
SHEET: 5

SHEET NO. 5 OF 6



Typical Liner Penetration



PVC Liner Details

Liner Details:

1. Remove organic materials.
2. Excavate 1' of materials and stockpile for use as cover materials (If Acceptable).
3. Grade side slopes to 3:1(or flatter).
4. If sharp materials are present in sub-grade materials bedding shall be installed. Project manager shall determine if bedding is required.
5. Liner shall be PVC 30 mil. Liner size shall be determined after sub-grade is completed.
6. Install liner to manufacturer's recommendations.
7. Install 12" of cover materials. Stockpiled materials may be used if acceptable.

Details 4

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595-8990

DESIGNED BY: ________
DRAWN BY: ________
CHECKED BY: ________
APPROVED BY: ________
REVISED BY: ________
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DATE: ________
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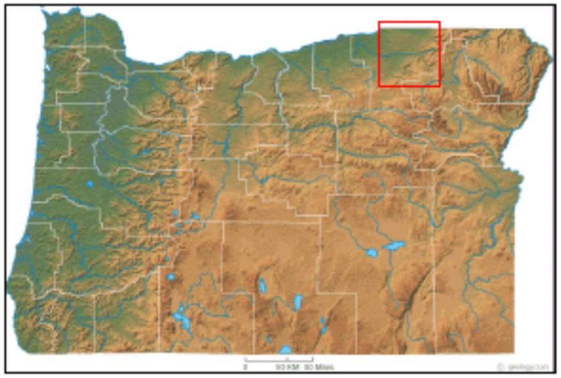
Chuckhole Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE: ________________

SHEET: 6

SHEET NO. 6 OF 6



LOCATION MAP

Fruitvale
Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council

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Owner

Date

Cover Sheet

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595-8990

DESIGNED BY:
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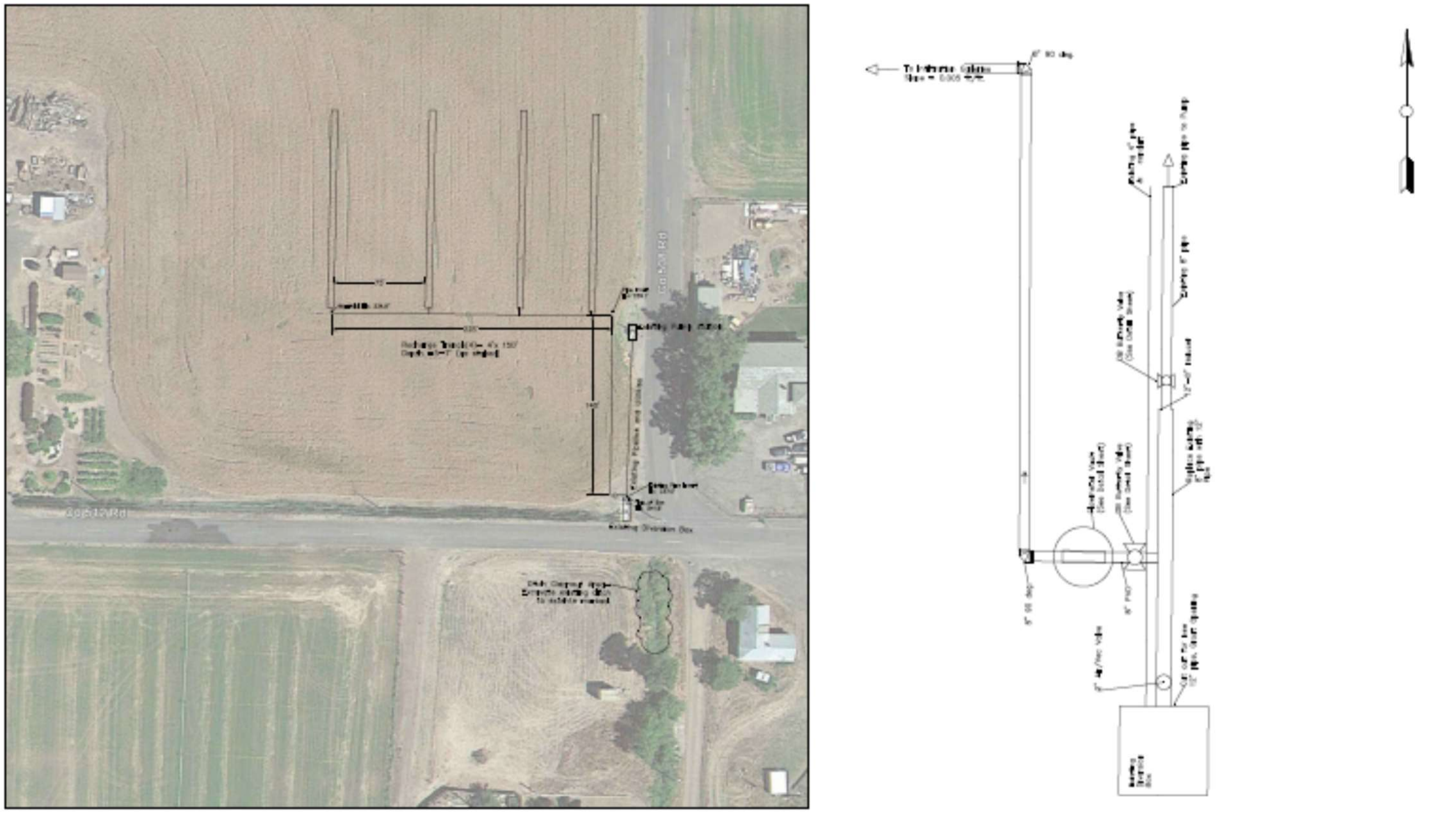
Fruitvale Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 1

SHEET NO. 1 OF 4



Plan View

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595—8990

DESIGNED BY:
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CHECKED BY:
APPROVED BY:
REVISED BY:
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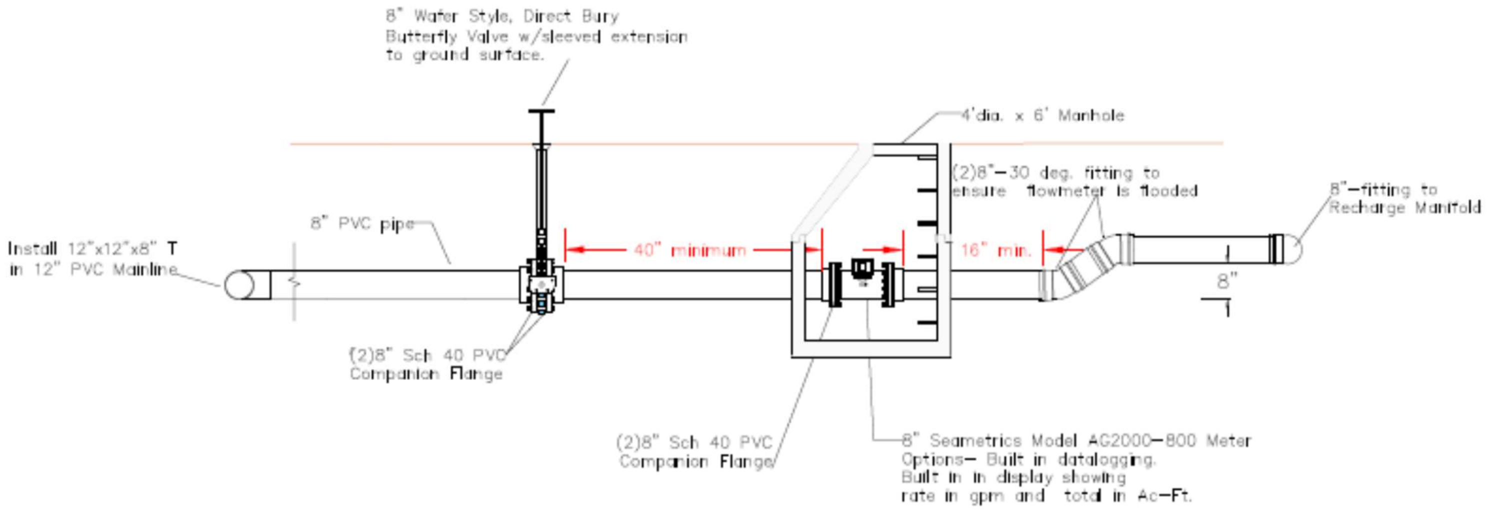
Fruitvale Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 2

SHEET NO. 2 OF 4



Flowmeter Vault

Details 1

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595-8990

DESIGNED BY: ______
DRAWN BY: ______
CHECKED BY: ______
APPROVED BY: ______
REVISED BY: ______
SCALE: ______
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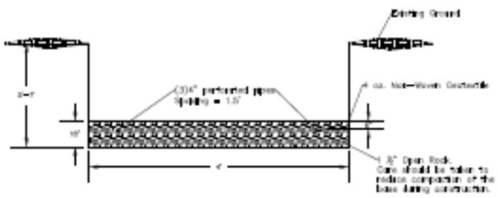
Fruitvale Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

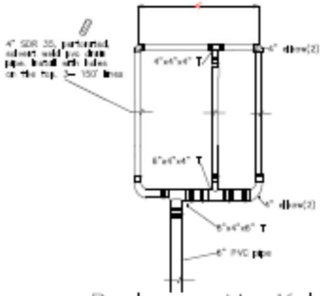
SIGNATURE: ____________________

SHEET: 3

SHEET NO. 3 OF 4



Recharge Area– Trench



Recharge Manifold

Construction Notes

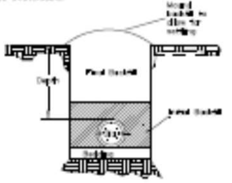
1) Bedding shall be used on foundations containing materials larger than ¾" inch.

2) The initial backfill material shall consist of soil or granular material that is free from rocks greater than ¾" in diameter.

3) The final backfill shall be free from material larger than 3 inches.

4) All exposed pipe and pipe within 12 inches of the ground surface shall be galvanized.

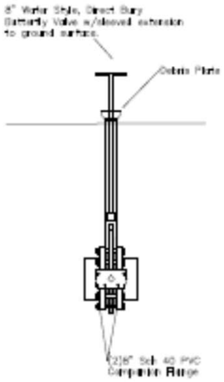
5) Pipe will be installed with no reverse grades unless unavoidable.



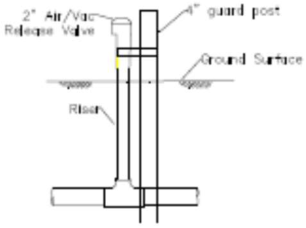
Pipe Specifications:
Diameter (O.D.) – 12"& 8" PVC
Min. Pressure Rating 80 psi

Drawing is not to Scale

Trench Detail–Pipeline



Butterfly Valve



Air Vent

Details 2

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Engineering
Corvallis, OR 97333
(509) 595–8990

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Fruitvale Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE: ____

SHEET: 4

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LOCATION MAP

Mud Creek
Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council

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Mud Creek Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE: ______________________

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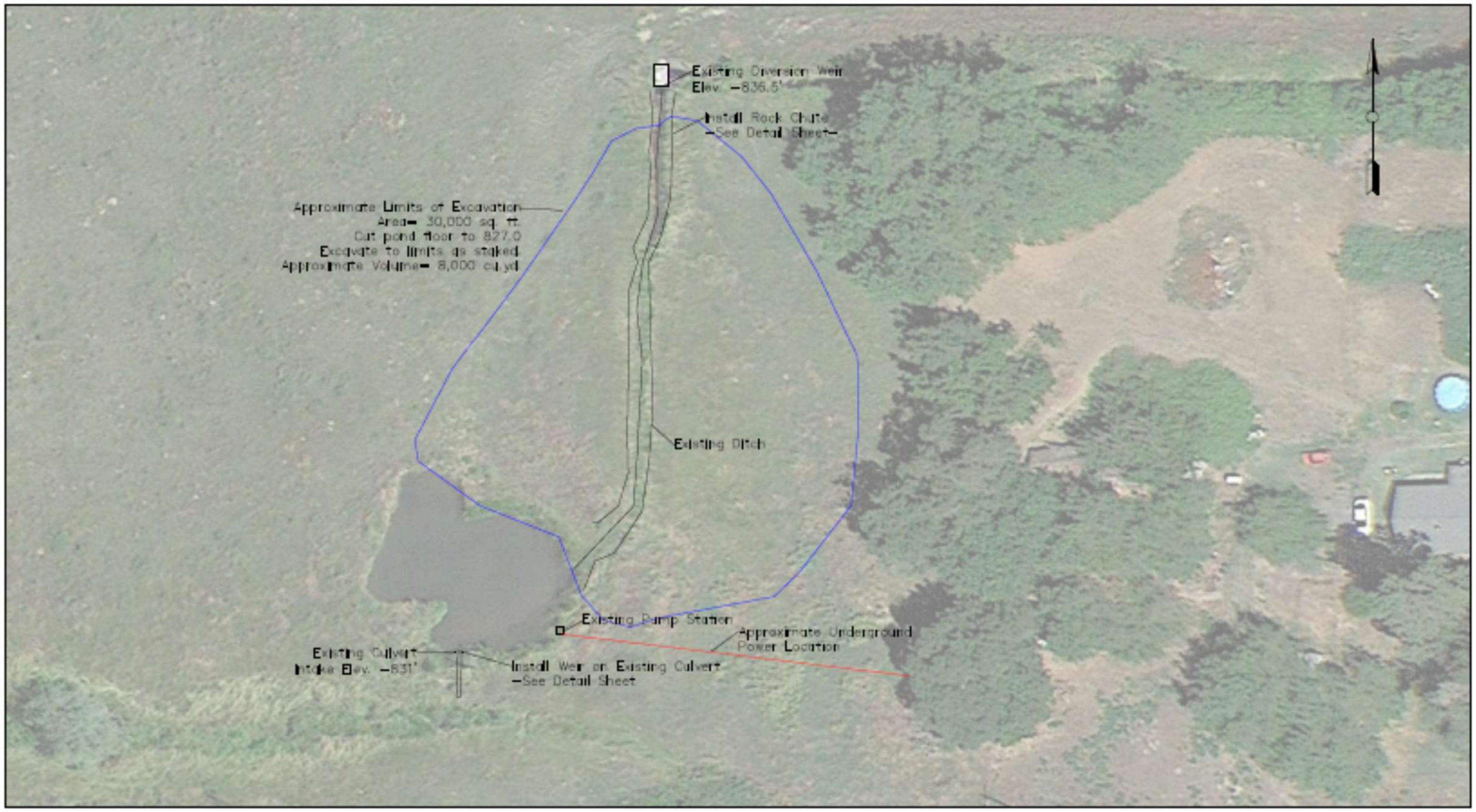

Plan View

Lance Horning
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Corvallis, OR 97333
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Mud Creek Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE: ____________________

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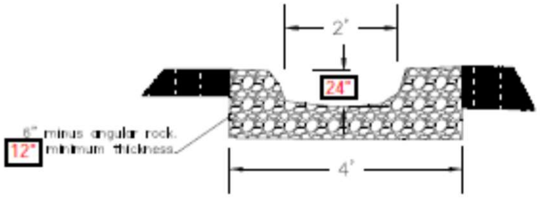
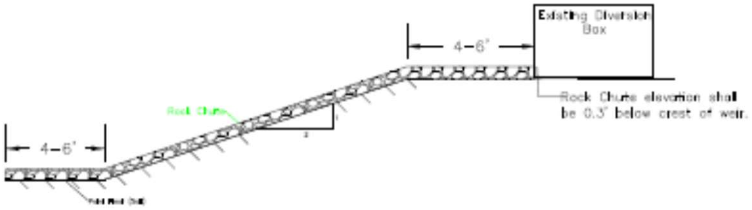
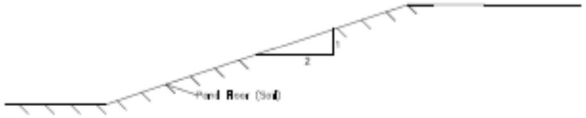


Rock Chute– Section View

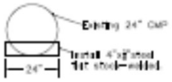


Rock Chute elevation shall be 0.3' below crest of weir.

Rock Chute Profile



Pond Side Slope Requirements



Install 4"x$\frac{3}{8}$" steel flat stock–welded.

Weir– Existing culvert

Details 1

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595–8990

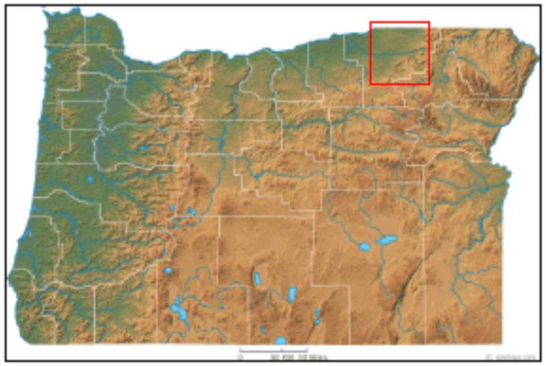
DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:
REVISED BY:
SCALE:
DATE:
REVISED DATE:

Mud Creek Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 3

SHEET NO. 3 OF 3



LOCATION MAP

Triangle Road
Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council

INDEX OF DRAWINGS

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Owner

Date

Cover Sheet

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595–8990

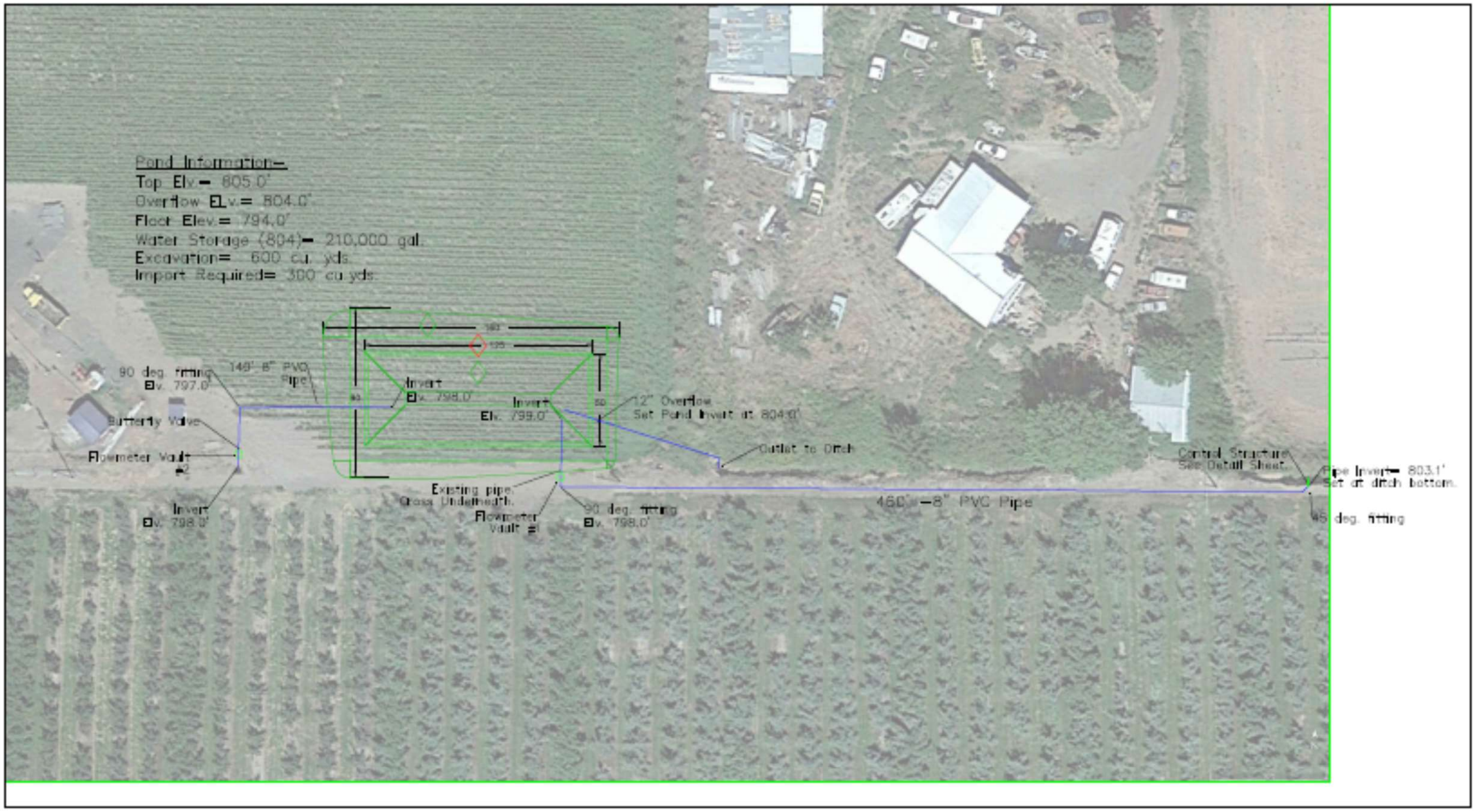
DESIGNED BY: LH
DRAWN BY:
CHECKED BY:
APPROVED BY:
REVISED BY:
SCALE:
DATE:
REVISED DATE: 10/28/16

Triangle Road Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 1

SHEET NO. 1 OF 4



Pond Information=
Top Elv.= 805.0'
Overflow ELv.= 804.0'
Floor Elev.= 794.0'
Water Storage (804)= 210,000 gal.
Excavation= 600 cu. yds.
Import Required= 300 cu yds.

Plan View

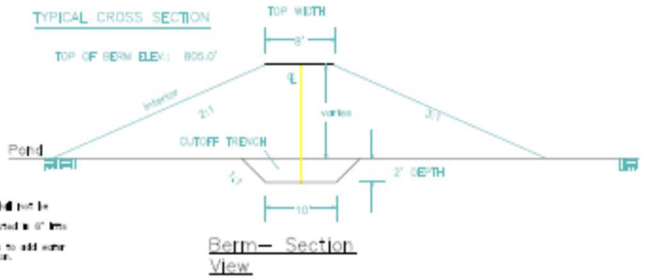
Lance Horning
Engineering
Corvallis, OR 97333
(509) 595-8990

DESIGNED BY: LH
DRAWN BY:
CHECKED BY:
APPROVED BY:
REVISED BY:
SCALE:
DATE:
REVISED DATE: 10/28/16

Triangle Road Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

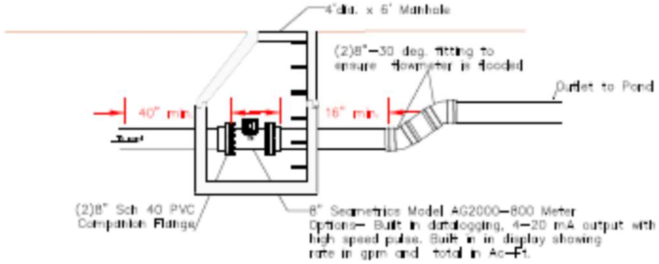
SIGNATURE: ______________________

SHEET: 2
SHEET NO. 2 OF 4

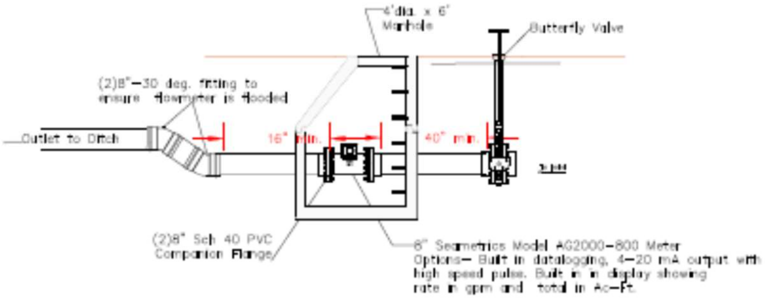


Notes–
1) Organic materials shall not be used in the berm.
2) Berm shall be compacted in 6" lifts to 95% Proctor.
3) Contractor responsible to add water as required for compaction.

Pond Embankment



Flowmeter Vault #1



Flowmeter Vault #2

Details 1

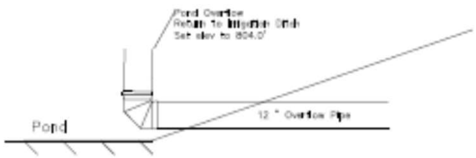
Lance Horning
Engineering
Corvallis, OR 97333
(509) 595–8990

DESIGNED BY: LH
DRAWN BY:
CHECKED BY:
APPROVED BY:
REVISED BY:
SCALE:
DATE:
REVISED DATE: 10/28/16

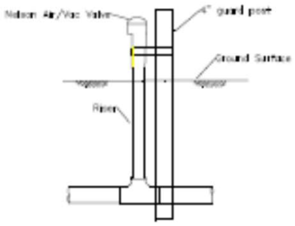
Triangle Road Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 3
SHEET NO. 3 OF 4

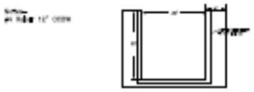


Pond Overflow



Air Vent

Control Structure– Plan View



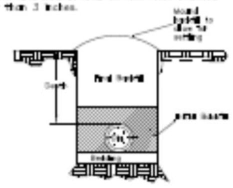
Control Board Section

Construction Notes

1) Bedding shall be used on foundations containing materials larger than ¾" inch.

2) The initial backfill material shall consist of soil or granular material that is free from rocks greater than ¾" in diameter.

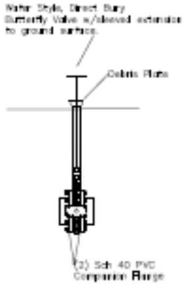
3) The final backfill shall be free from material larger than 3 inches.



Pipe Specifications:
Diameter (Dia.) = 8" & 12" PVC
Min. Pressure Rating 80 psi
Minimum Burial– 3'

Drawing is not to Scale.

Trench Detail



Butterfly Valve

Section View

Details 2

Lance Horning
Engineering
Corvallis, OR 97333
(509) 595–8990

DESIGNED BY: LH
DRAWN BY:
CHECKED BY:
APPROVED BY:
REVISED BY:
SCALE:
DATE:
REVISED DATE: 10/28/08

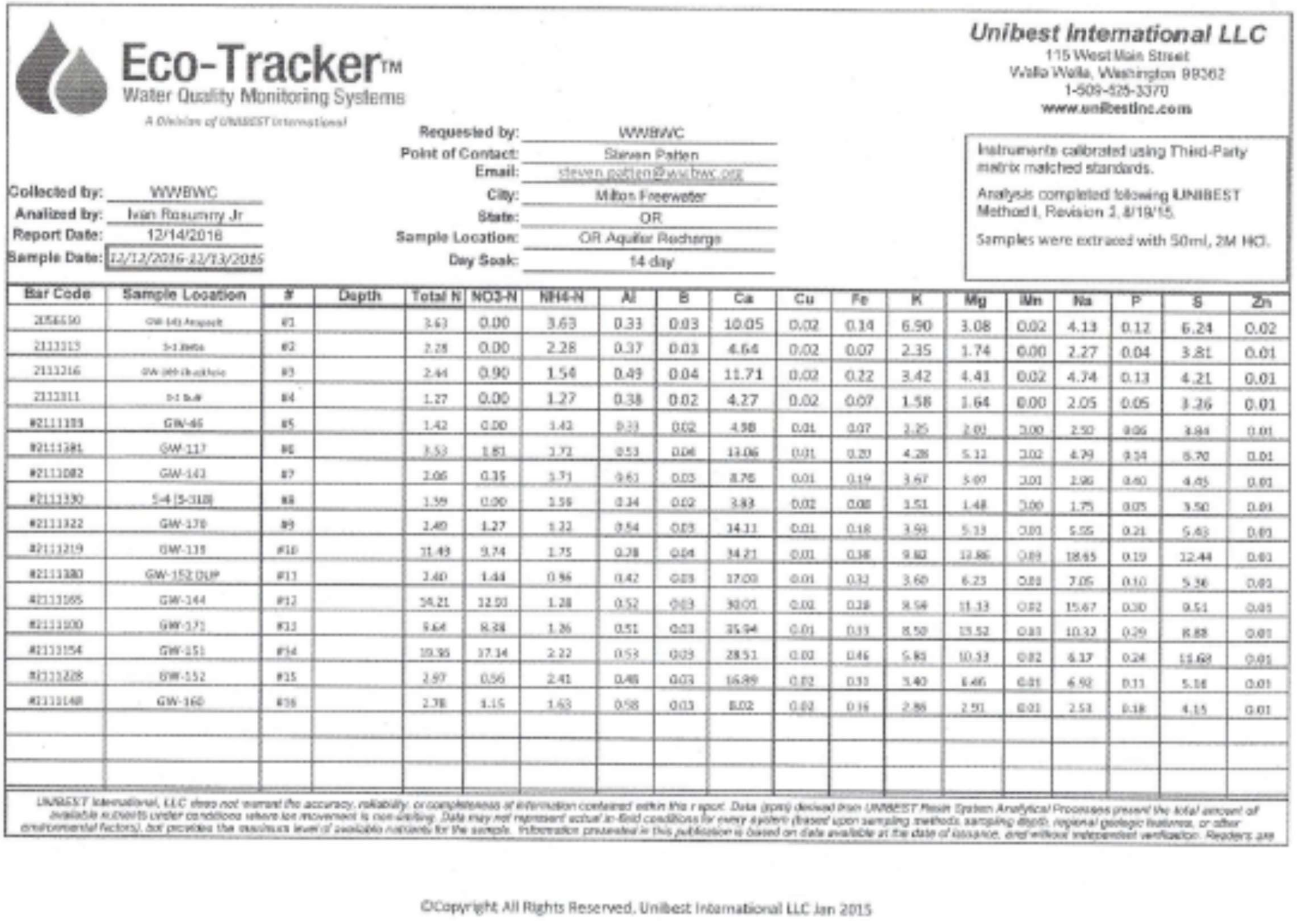
Triangle Road Shallow Aquifer Recharge Project
Walla Walla Basin Watershed Council
Milton Freewater, OR

SIGNATURE:

SHEET: 4

SHEET NO. 4 OF 4

APPENDIX D – WATER QUALITY RESULTS



Eco-Tracker™
Water Quality Monitoring Systems
A Division of UNIBEST International

Unibest International LLC
115 West Main Street
Walla Walla, Washington 99362
1-509-525-3370
www.unibestinc.com

Instruments calibrated using Third-Party matrix matched standards.

Analysis completed following UNIBEST Method I, Revision 2, 8/19/15.

Samples were extraced with 50ml, 2M HCl.

Collected by: WWBWC
Analized by: Ivan Rosumny Jr
Report Date: 12/14/2016
Sample Date: 12/12/2016-12/13/2016

Requested by: WWBWC
Point of Contact: Steven Patten
Email: steven.patten@wwbwc.org
City: Milton Freewater
State: OR
Sample Location: OR Aquifer Recharge
Day Soak: 14 day

Bar Code	Sample Location	#	Depth	Total N	NO3-N	NH4-N	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	S	Zn
2056550	GW-143 Anspach	#1		3.63	0.00	3.63	0.33	0.03	10.05	0.02	0.14	6.90	3.08	0.02	4.13	0.12	6.24	0.02
2111313	S-1 Betts	#2		2.28	0.00	2.28	0.37	0.03	4.64	0.02	0.07	2.35	1.74	0.00	2.27	0.04	3.81	0.01
2111216	GW-169 [illegible]	#3		2.44	0.90	1.54	0.49	0.04	11.71	0.02	0.22	3.42	4.41	0.02	4.74	0.13	4.21	0.01
2111311	S-1 Bull	#4		1.27	0.00	1.27	0.38	0.02	4.27	0.02	0.07	1.58	1.64	0.00	2.05	0.05	3.26	0.01
#2111193	GW-46	#5		1.42	0.00	1.42	0.33	0.02	4.98	0.01	0.07	2.25	2.01	0.00	2.50	0.06	3.84	0.01
#2111381	GW-117	#6		3.53	1.81	1.72	0.53	0.04	13.06	0.01	0.20	4.28	5.12	0.02	4.79	0.14	6.70	0.01
#2111082	GW-143	#7		2.06	0.35	1.71	0.61	0.03	8.76	0.01	0.19	3.67	5.07	0.01	2.96	0.40	4.65	0.01
#2111330	S-4 (S-318)	#8		1.59	0.00	1.59	0.34	0.02	3.83	0.02	0.08	1.51	1.48	0.00	1.75	0.05	3.50	0.01
#2111322	GW-170	#9		2.49	1.27	1.22	0.54	0.03	14.11	0.01	0.18	3.93	5.13	0.01	5.55	0.21	5.43	0.01
#2111219	GW-135	#10		11.49	9.74	1.75	0.28	0.04	34.21	0.01	0.38	9.82	12.86	0.09	18.65	0.19	12.44	0.01
#2111380	GW-152 DUP	#11		2.40	1.44	0.96	0.42	0.03	17.00	0.01	0.32	3.60	6.23	0.01	7.05	0.10	5.36	0.01
#2111165	GW-144	#12		14.21	12.93	1.28	0.52	0.03	30.01	0.02	0.28	8.54	11.13	0.02	15.67	0.30	9.51	0.01
#2111100	GW-171	#13		9.64	8.38	1.26	0.51	0.03	35.94	0.01	0.33	8.50	13.52	0.03	10.32	0.29	8.88	0.01
#2111154	GW-151	#14		19.36	17.14	2.22	0.53	0.03	28.51	0.02	0.46	5.83	10.33	0.02	6.17	0.24	11.68	0.01
#2111208	GW-152	#15		2.97	0.56	2.41	0.48	0.03	16.89	0.02	0.33	3.40	6.46	0.01	6.92	0.11	5.18	0.01
#2111148	GW-160	#16		2.78	1.15	1.63	0.58	0.03	8.02	0.02	0.16	2.86	2.51	0.01	2.53	0.18	4.15	0.01

UNIBEST International, LLC does not warrant the accuracy, reliability, or completeness of information contained within this report. Data (ppm) derived from UNIBEST Resin System Analytical Processes present the total amount of available nutrients under conditions where ion movement is non-limiting. Data may not represent actual in-field conditions for every system (based upon sampling methods, sampling depth, regional geologic features, or other environmental factors), but provides the maximum level of available nutrients for the sample. Information presented in this publication is based on data available at the date of issuance, and without independent verification. Readers are

Eco-Tracker™

Water Quality Monitoring Systems

A Division of UNIBEST International

Unibest International LLC

640 Water Center Loop
Walla Walla, Washington 99362
1-509-525-3370
www.unibestinc.com

Requested by: Steven Patten
Point of Contact: Steven Patten
Email: steven.patten@wwbwc.org
City: Milton Freewater
State: Oregon
Sample Location: Various
Day Soak: 1 day

Collected by: Steven Patten
Analized by: Ivan Rosumny Jr
Report Date: 6/1/2017
Sample Date: 5/30-5/31

All results are in ppm in extracted solution.
Samples were extraced with 50ml, 2M HCl.

Bar Code	Sample Location	#	Depth	Total N	NO3-N	NH4-N	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	S	Zn
#2111307	GW_142	#1	1	4.12	0.41	3.71	0.31	0.04	7.60	0.01	0.09	3.10	2.26	0.07	2.31	0.15	9.05	0.02
#2111307	GW_119	#1	1	27.82	24.31	3.51	0.26	0.05	48.13	0.01	0.00	12.06	20.05	0.01	23.89	0.13	19.23	0.01
#2111192	GW_144	#1	1	43.95	40.29	3.66	0.49	0.05	46.74	0.02	0.00	10.69	18.37	0.01	21.39	0.09	19.67	0.01
#2111177	GW_170	#1	1	3.41	0.00	3.41	0.27	0.05	19.99	0.01	0.00	5.07	7.66	0.01	8.58	0.06	15.49	0.01
#2103265	S-5 Eastside	#1	1	2.92	0.00	2.92	0.19	0.02	4.24	0.01	0.02	2.24	1.64	0.01	1.92	0.04	8.04	0.01
#2103256	GW_171	#1	1	16.46	13.52	2.94	0.21	0.02	37.11	0.01	0.00	7.96	15.12	0.01	9.15	0.08	12.51	0.01
#2103252	GW_160	#1	1	8.89	4.99	3.90	0.21	0.03	10.98	0.01	0.00	3.88	4.10	0.01	3.17	0.05	9.36	0.01
#2103292	GW_151	#1	1	23.75	21.15	2.60	0.23	0.03	29.62	0.01	0.02	7.13	11.12	0.01	7.33	0.06	13.56	0.01
#2103204	GW_152	#1	1	5.46	1.95	3.51	0.27	0.02	15.92	0.01	0.01	4.00	6.15	0.00	5.76	0.04	10.33	0.01
#2103190	S-1 Zerba	#1	1	3.64	0.00	3.64	0.29	0.02	3.57	0.01	0.01	1.49	1.37	0.01	1.73	0.03	8.44	0.01
#2103184	GW_117	#1	1	10.29	7.36	2.93	0.24	0.02	16.40	0.01	0.00	5.45	6.36	0.00	4.89	0.06	11.76	0.01
#2103225	GW_46	#1	1	3.09	0.00	3.09	0.17	0.01	4.86	0.00	0.00	3.26	1.97	0.00	2.38	0.06	7.42	0.01
#2103289	GW_169	#1	1	6.21	3.40	2.81	0.17	0.03	14.37	0.02	0.01	3.90	5.04	0.01	5.28	0.05	7.82	0.02
#2103212	S-2 Duff	#1	1	3.34	0.00	3.34	0.28	0.02	4.40	0.01	0.01	2.14	1.65	0.01	2.08	0.04	8.58	0.01
#2103228	S-4 Frattwale	#1	1	2.58	0.05	2.53	0.19	0.01	3.40	0.01	0.01	1.83	1.31	0.00	1.63	0.03	7.09	0.01
#2103233	GW_141 SBP	#1	1	6.94	3.59	3.35	0.22	0.02	10.51	0.01	0.03	4.52	4.07	0.00	4.95	0.07	10.46	0.02

UNIBEST International, LLC does not warrant the accuracy, reliability, or completeness of information contained within this report. Data (ppm) derived from UNIBEST Resin System Analytical Processes present the total amount of available nutrients under conditions where ion movement is non-limiting. Data may not represent actual in-field conditions for every system (based upon sampling methods, sampling depth, regional geologic features, or other environmental factors), but provides the maximum level of available nutrients for the sample. Information presented in this publication is based on data available at the date of issuance, and without independent verification. Readers are solely responsible for assessing the relevance, accuracy, and use of the content. UNIBEST will not responsible for, or held liable for any loss, damage, or cost incurred from the authorized or unauthorized use of the

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Bellingham, WA	[illegible]	[illegible]	[illegible]	[illegible]
Portland, OR	[illegible]	[illegible]	[illegible]	[illegible]
Corvallis, OR	[illegible]	[illegible]	[illegible]	[illegible]

June 16, 2017

Page 1 of 1

Mr. Troy Baker
Walla Walla Basin Watershed Council
810 South Main Street
Milton-Freewater, OR 97862

RE: 17-12504 - Post Recharge

Dear Mr. Troy Baker,

Your project: Post Recharge, was received on Wednesday May 31, 2017.

All samples were analyzed within the accepted holding times and were appropriately preserved and analyzed according to approved analytical protocols, unless noted in the data or QC reports. The quality control data was within laboratory acceptance limits, unless specified in the data or QC reports.

If you have questions phone us at 800 755-9295.

Respectfully

Lawrence J Henderson, PhD
Director of Laboratories, Vice President

Enclosures: Data Report
QC Reports
Chain of Custody

FORM: COVER Rev 2

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[illegible]
Corvallis, OR Microbiology/Chemistry (d)
[illegible]
Bend, OR Microbiology (e)
[illegible]

WSDOE Lab C567

DATA REPORT

Page 1 of 1

Client Name: Walla Walla Basin Watershed Council
810 South Main Street
Milton-Freewater, OR 97862

Reference Number: **17-12504**
Project: Post Recharge

Lab Number: 28832
Field ID: GW-144
Sample Description: NW Umapine
Matrix: Water
Sample Date: 5/30/17
Extraction Date: 6/5/17
Extraction Method: 3540C

Report Date: 6/16/17
Date Analyzed: 6/7/17
Analyst: CO
Analytical Method: 8141B.MOD
Batch: 8141B_170605
Approved By: led,pdm

Authorized by:

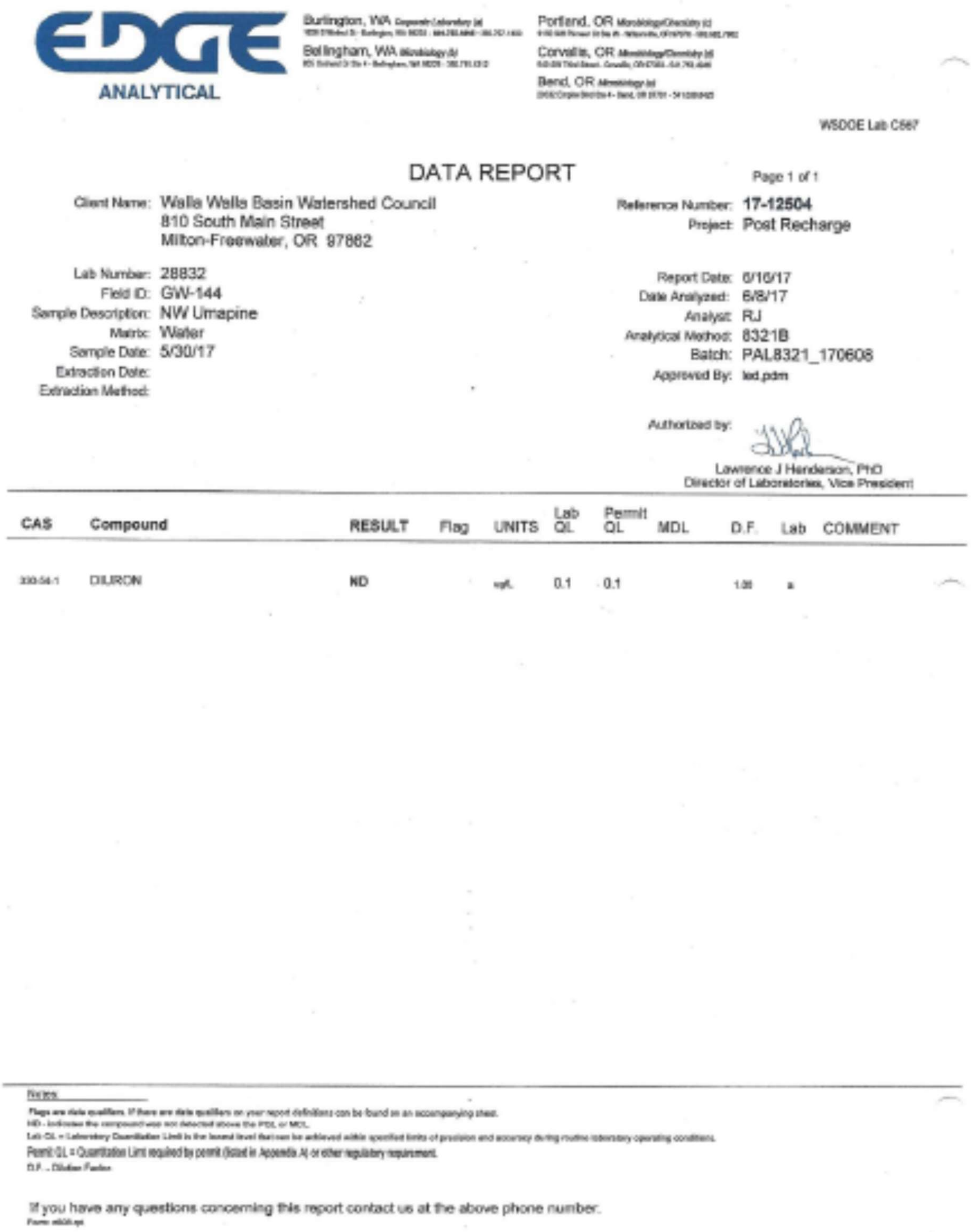
Lawrence J Henderson, PhD
Director of Laboratories, Vice President

CAS	Compound	RESULT	Flag	UNITS	Lab QL	Permit QL	MDL	D.F.	Lab	COMMENT
86-50-0	AZINPHOS-METHYL (Guthion)	**ND**		ug/L	0.5	0.5		1.00	a	
1-88-2	CHLORPYRIFOS	**ND**		ug/L	0.1	0.1		1.00	a	
121-75-5	MALATHION	**ND**		ug/L	0.1	0.1		1.00	a	

Notes:

Flags are data qualifiers. If there are data qualifiers on your report definitions can be found on an accompanying sheet.
ND - indicates the compound was not detected above the PQL or MDL.
Lab QL = Laboratory Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
Permit QL = Quantitation Limit required by permit (listed in Appendix A) or other regulatory requirement.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.
Form: d608.rpt



EDGE ANALYTICAL

Burlington, WA
Bellingham, WA
Portland, OR
Corvallis, OR
Bend, OR

WSDOE Lab C567

DATA REPORT

Page 1 of 1

Client Name: Walla Walla Basin Watershed Council
810 South Main Street
Milton-Freewater, OR 97862

Reference Number: **17-12504**
Project: Post Recharge

Lab Number: 28832
Field ID: GW-144
Sample Description: NW Umapine
Matrix: Water
Sample Date: 5/30/17
Extraction Date:
Extraction Method:

Report Date: 6/16/17
Date Analyzed: 6/8/17
Analyst: RJ
Analytical Method: 8321B
Batch: PAL8321_170608
Approved By: ted.pdm

Authorized by:
Lawrence J Henderson, PhD
Director of Laboratories, Vice President

CAS	Compound	RESULT	Flag	UNITS	Lab QL	Permit QL	MDL	D.F.	Lab	COMMENT
330-54-1	DIURON	**ND**		ug/L	0.1	0.1		1.00	a	

Notes:

Flags are data qualifiers. If there are data qualifiers on your report definitions can be found on an accompanying sheet.
ND - Indicates the compound was not detected above the PQL or MDL.
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D.F. – Dilution Factor

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Corvallis, OR Microbiology/Chemistry (d)
[illegible]
Bend, OR Microbiology (e)
[illegible]

WSDOE Lab C567

DATA REPORT

Page 1 of 1

Client Name: Walla Walla Basin Watershed Council
810 South Main Street
Milton-Freewater, OR 97862

Reference Number: **17-12504**
Project: Post Recharge

Lab Number: 28833
Field ID: GW-171
Sample Description: Fruit Vale
Matrix: Water
Sample Date: 5/30/17
Extraction Date: 6/5/17
Extraction Method: 3540C

Report Date: 6/16/17
Date Analyzed: 6/7/17
Analyst: CO
Analytical Method: 8141B.MOD
Batch: 8141B_170605
Approved By: led,pdm

Authorized by:

Lawrence J Henderson, PhD
Director of Laboratories, Vice President

CAS	Compound	RESULT	Flag	UNITS	Lab QL	Permit QL	MDL	D.F.	Lab	COMMENT
86-50-0	AZINPHOS-METHYL (Guthion)	**ND**		ug/L	0.5	0.5		1.00	a	
1-88-2	CHLORPYRIFOS	**ND**		ug/L	0.1	0.1		1.00	a	
121-75-5	MALATHION	**ND**		ug/L	0.1	0.1		1.00	a	

Notes:

Flags are data qualifiers. If there are data qualifiers on your report definitions can be found on an accompanying sheet.
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Permit QL = Quantitation Limit required by permit (listed in Appendix A) or other regulatory requirement.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.

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[illegible] - Corvallis, OR [illegible]
Bend, OR Microbiology (e)
[illegible] - Bend, OR [illegible]

WSDOE Lab C567

DATA REPORT

Page 1 of 1

Client Name: Walla Walla Basin Watershed Council
810 South Main Street
Milton-Freewater, OR 97862

Reference Number: **17-12504**
Project: Post Recharge

Lab Number: 28833
Field ID: GW-171
Sample Description: Fruit Vale
Matrix: Water
Sample Date: 5/30/17
Extraction Date:
Extraction Method:

Report Date: 6/16/17
Date Analyzed: 6/8/17
Analyst: RJ
Analytical Method: 8321B
Batch: PAL8321_170608
Approved By: lad.pdm

Authorized by:

Lawrence J Henderson, PhD
Director of Laboratories, Vice President

CAS	Compound	RESULT	Flag	UNITS	Lab QL	Permit QL	MDL	D.F.	Lab	COMMENT
330-54-1	DIURON	**ND**		ug/L	0.1	0.1		1.00	a	

Notes:
Flags are data qualifiers. If there are data qualifiers on your report definitions can be found on an accompanying sheet.
ND - indicates the compound was not detected above the PQL or MDL.
Lab QL = Laboratory Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
Permit QL = Quantitation Limit required by permit (listed in Appendix A) or other regulatory requirement.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.
Form: [illegible]

EDGE ANALYTICAL LABORATORIES

QUALITY CONTROL REPORT
SURROGATE REPORT

Reference Number: 17-12504
Report Date: 06/16/17

Lab No	Analyte	Result	Qualifier	Units	Method	Limit
8141B_170605 26832	TRIPHENYLPHOSPHATE (Surr)	95		%	8141B.MOD	
8141B_170605 26832	TRIPHENYLPHOSPHATE (Surr)	94		ug/L	8141B.MOD	

---

*Notation:

A surrogate is a pure compound added to a sample in the laboratory just before processing so that the overall efficiency of a method can be determined.

The Acceptance Limits (or Control Limits) approximate a 99% confidence interval around the mean recovery.

PAL
Pacific Agricultural Laboratory
21830 S.W. Alexander Ln. • Sherwood, OR 97140 • Ph 503.626.7943 • pacaglab.com

Edge Analytical
1620 S. Walnut
Burlington, WA 98233

Report Number: P170673
Report Date: June 16, 2017
Client Project ID: 17-12504

Analytical Report

Client Sample ID: 28832
Matrix: water

PAL Sample ID: P170673-01
Sample Date: 5/30/17

Method: Modified EPA 8321B (LC-MS/MS)

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
6/05/17	6/8/17	DCPMU	Not Detected	0.060 ug/L	
6/05/17	6/8/17	Diuron	Not Detected	0.060 ug/L	

Surrogate Recovery: 104 %
Surrogate Recovery Range: 60-140
(TPP-d15 used as Surrogate)

Client Sample ID: 28833
Matrix: water

PAL Sample ID: P170673-02
Sample Date: 5/30/17

Method: Modified EPA 8321B (LC-MS/MS)

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
6/05/17	6/8/17	DCPMU	Not Detected	0.060 ug/L	
6/05/17	6/8/17	Diuron	Not Detected	0.060 ug/L	

Surrogate Recovery: 102 %
Surrogate Recovery Range: 60-140
(TPP-d15 used as Surrogate)

Rick Jordan, Laboratory Manager

Pacific Agricultural Laboratory

21830 S.W. Alexander Ln. • Sherwood, OR 97140 • Ph 503.626.7943 • pacaglab.com

Edge Analytical
1620 S. Walnut
Burlington, WA 98233

Report Number: P170673
Report Date: June 16, 2017
Client Project ID: 17-12504

Quality Assurance

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
6/5/17	6/8/17	7060501-BLK1	DCPMU	Not Detected	< 0.060 ug/L	
6/5/17	6/8/17	7060501-BLK1	Diuron	Not Detected	< 0.060 ug/L	

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
6/5/17	6/8/17	7060501-BS1	Diuron	92	76-104	
6/5/17	6/8/17	7060501-BSD1	Diuron	93	76-104	

Analyte Information

Method: Modified EPA 8321B (LC-MS/MS)
DCPMU is the primary breakdown product of Diuron.

Rick Jordan, Laboratory Manager

APPENDIX E – WELL LOGS FOR MONITORING WELLS

GW_23

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

RECEIVED
JAN 30 1970
STATE ENGINEER
SALEM, OREGON

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

UMAT
3941

State Well No. 5N/35-3ac
State Permit No.

(1) OWNER:
Name Richard L. Robins
Address Rt #2 Box 366 Milton Freewater

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

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

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

(5) CASING INSTALLED: Threaded ☐ Welded ☑
6 " Diam. from 0 ft. to 96½ ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

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

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

(8) WATER LEVEL: Completed well.
Static level 75 ft. below land surface Date Nov 15-69
Artesian pressure lbs. per square inch Date

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☑ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Bailer test 12 gal./min. with 77 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 54 Was a chemical analysis made? ☐ Yes ☑ No

(10) CONSTRUCTION:
Well seal—Material used Bentonite
Depth of seal 34 ft.
Diameter of well bore to bottom of seal 48 in.
Were any loose strata cemented off? ☐ Yes ☑ No Depth
Was a drive shoe used? ☑ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Umatilla Driller's well number
NE ¼ NE ¼ Section 3 T. 5N R. 35 E W.M.
Bearing and distance from section or subdivision corner
Well Located 30 ft W. 140 ft S
of NE Corner of S.3 T. 5N R. 35

(12) WELL LOG: Diameter of well below casing 6
Depth drilled 118 ft. Depth of completed well 118 ft.
Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Dug well To 34'			
Brown Cement Gravel	34	40	
Med. Brown Gravel			
Some water	40	47	
Brown Cement Gravel	47	80	
Med Gravel clean			
Some water	80	83	
Cement Gravel (Brown)	83	101	
Cleaner possibly Some water	101	102	
Cement Gravel	102	118	

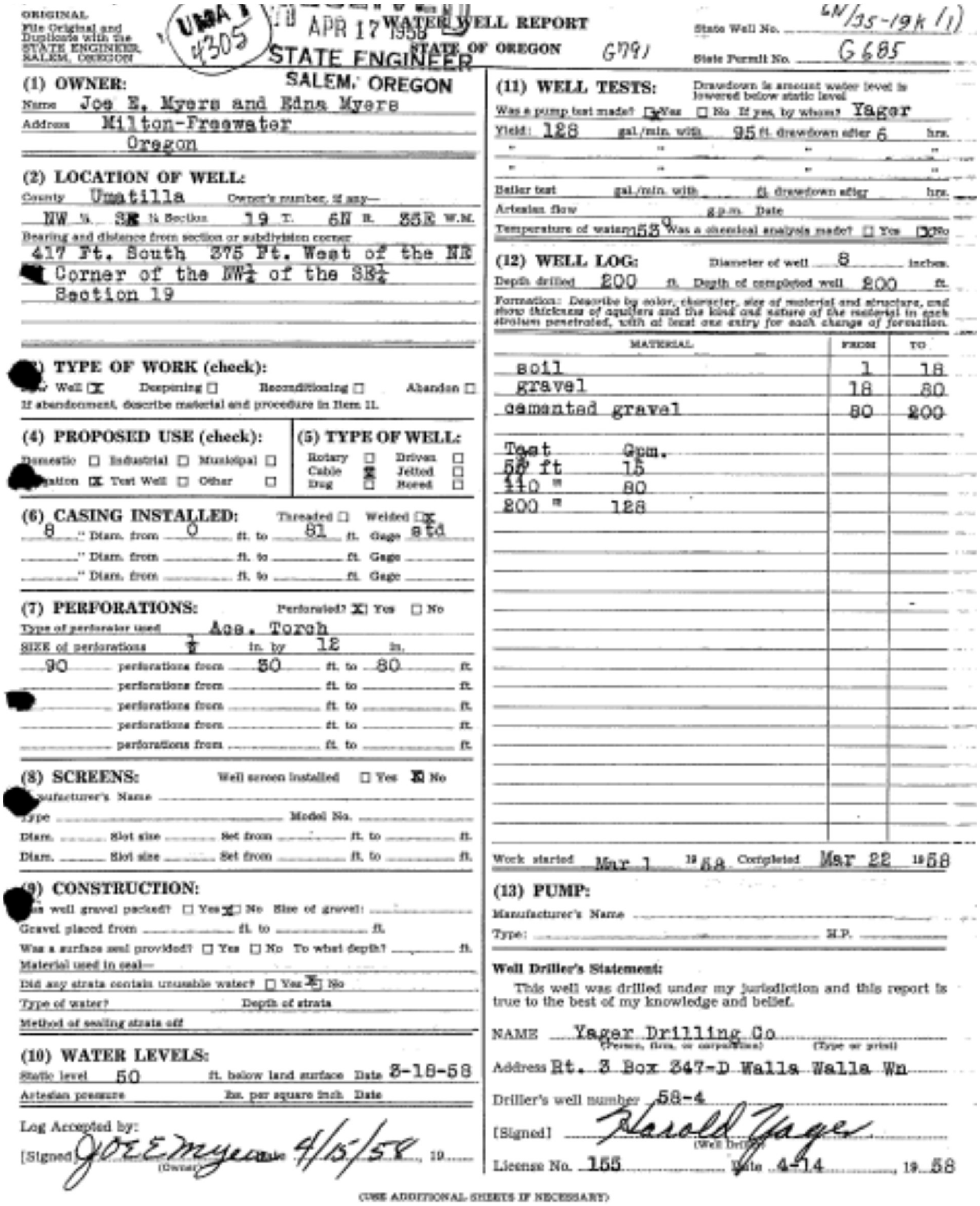
Work started Nov 11 1969 Completed Nov 15 1969
Date well drilling machine moved off of well Nov 18 1969

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Lowell M. Marlatt Date Nov 15, 1969
(Drilling Machine Operator)
Drilling Machine Operator's License No. 11

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME Lowell W. Marlatt
(Person, firm or corporation) (Type or print)
Address Rt. #2 Box 114 Milton-Freewater Ore
[Signed] Lowell M. Marlatt
(Water Well Contractor)
Contractor's License No. 265 Date Nov 15, 1969

(USE ADDITIONAL SHEETS IF NECESSARY)

GW_31



ORIGINAL
File Original and Duplicate with the STATE ENGINEER, SALEM, OREGON

UMA 1
4305

APR 17 1958
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

G791

State Well No. 6N/35-19k (1)
State Permit No. G685

(1) OWNER:
Name Joe E. Myers and Edna Myers
Address Milton-Freewater
Oregon

(2) LOCATION OF WELL:
County Umatilla Owner's number, if any—
NW ¼ SE ¼ Section 19 T. 6N R. 35E W.M.
Bearing and distance from section or subdivision corner
417 Ft. South 375 Ft. West of the NE
Corner of the NW¼ of the SE¼
Section 19

[illegible]) TYPE OF WORK (check):
[illegible] Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
[illegible]ation ☒ Test Well ☐ Other ☐

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

(6) CASING INSTALLED: Threaded ☐ Welded ☒
8" Diam. from 0 ft. to 81 ft. Gage std
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☒ Yes ☐ No
Type of perforator used Ace. Torch
SIZE of perforations ¼ in. by 12 in.
90 perforations from 50 ft. to 80 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
[illegible]ufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

[illegible]) CONSTRUCTION:
[illegible]s well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.
Material used in seal—
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 50 ft. below land surface Date 3-18-58
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Joe E Myers (Owner) Date 4/15/58, 19

(11) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Yager
Yield: 128 gal./min. with 95 ft. drawdown after 6 hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 58° Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well 8 inches.
Depth drilled 200 ft. Depth of completed well 200 ft.
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
soil	1	18
gravel	18	80
cemented gravel	80	200
Test Gpm.		
50 ft 15		
110 " 80		
200 " 128		

Work started Mar 1 1958 Completed Mar 22 1958

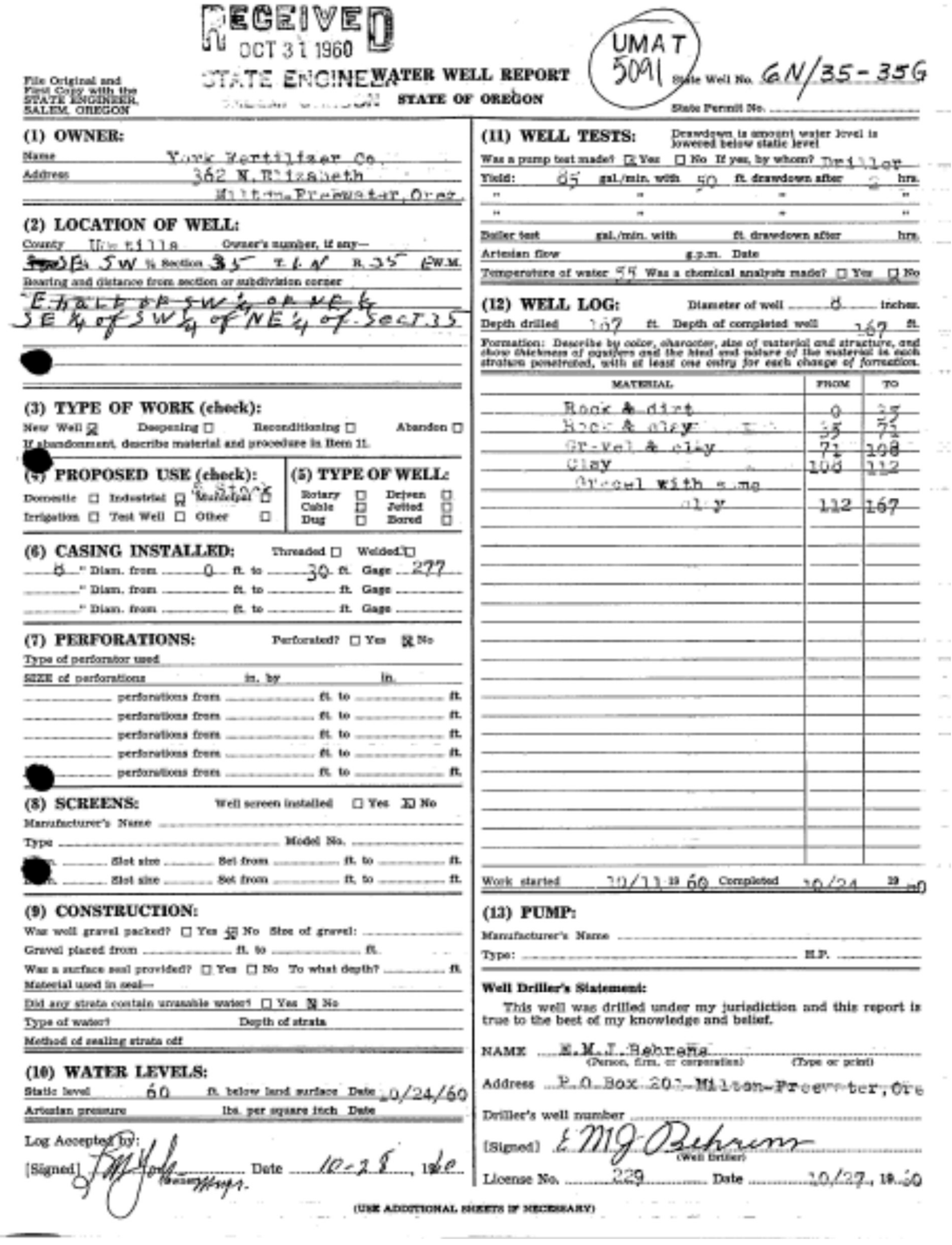
(13) PUMP:
Manufacturer's Name
Type: H.P.

Well Driller's Statement:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Yager Drilling Co (Person, firm, or corporation) (Type or print)
Address Rt. 3 Box 347-D Walla Walla Wn
Driller's well number 58-4
[Signed] Harold Yager (Well Driller)
License No. 155 Date 4-14, 1958

(USE ADDITIONAL SHEETS IF NECESSARY)

GW_32



RECEIVED
OCT 31 1960
STATE ENGINEER

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

WATER WELL REPORT
STATE OF OREGON

UMAT 5091

State Well No. 6N/35-35G
State Permit No.

(1) OWNER:
Name York Fertilizer Co.
Address 362 N. Elizabeth
Milton-Freewater, Oreg.

(2) LOCATION OF WELL:
County Umatilla Owner's number, if any—
SE¼ SW ¼ Section 35 T. 6 N R. 35 E W.M.
Bearing and distance from section or subdivision corner
~~E. half of SW¼ of NE¼~~
SE¼ of SW¼ of NE¼ of Sect 35

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

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

(6) CASING INSTALLED: Threaded ☐ Welded ☐
8" Diam. from 0 ft. to 30 ft. Gage 277
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

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

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

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.
Material used in seal—
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 60 ft. below land surface Date 10/24/60
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Date 10-28, 1960

(11) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller
Yield: 85 gal./min. with 50 ft. drawdown after 2 hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 55 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well 8 inches.
Depth drilled 167 ft. Depth of completed well 167 ft.
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Rock & dirt	0	35
Rock & clay	35	71
Gravel & clay	71	108
Clay	108	112
Gravel with some clay	112	167

Work started 10/11 1960 Completed 10/24 1960

(13) PUMP:
Manufacturer's Name
Type: H.P.

Well Driller's Statement:

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

NAME E.M.J. Behrens (Person, firm, or corporation) (Type or print)
Address P.O Box 20[illegible] Milton-Freewater, Ore
Driller's well number
[Signed] E M J Behrens (Well Driller)
License No. 229 Date 10/27, 1960

(USE ADDITIONAL SHEETS IF NECESSARY)

GW_33

5

STATE OF OREGON

FEB 24 1994
WATER RESOURCES DEPT.
SALEM, OREGON

UMAT
5977

6N/35E/21ba
W30353

WATER WELL REPORT

(as required by ORS 537.765)

(1) OWNER:

Well Number: ____

Name Lee AndRews

Address Rt#2 Box 189A

City Milton Freewater State OR Zip 97862

(2) TYPE OF WORK:

☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable

☐ Other ____

(4) PROPOSED USE:

☒ Domestic ☐ Community ☐ Industrial ☒ Irrigation

☐ Thermal ☐ Injection ☐ Other ____

(5) BORE HOLE CONSTRUCTION:

Special Construction approval Yes ☐ No ☒ Depth of Completed Well 97 ft.

Explosives used Yes ☐ No ☒ Type ____ Amount ____

HOLE			SEAL			Amount
Diameter	From	To	Material	From	To	[✓ sacks] or pounds
12	0	20	Bentonite	0	20	78
8	20	105				

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E

☐ Other ____

Backfill placed from ____ ft. to ____ ft. Material ____

Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	8	+1	59	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) ____

(7) PERFORATIONS/SCREENS:

☐ Perforations Method NONE

☐ Screens Type ____ Material ____

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

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

☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
200+		105	1 hr.

Temperature of water 58° Depth Artesian Flow Found ____

Was a water analysis done? ☐ Yes By whom NONE

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other NO

Depth of strata: ____

(9) LOCATION OF WELL by legal description:

County Umatilla Latitude ____ ' " Longitude ____ ' "

Township 6 N ~~or S~~, Range 35 E ~~or W~~, WM.

Section 21 NE ¼ NW ¼

Tax Lot 100 Lot ____ Block ____ Subdivision ____

Street Address of Well (or nearest address) Rt#2 Box 189A Milton Freewater, OR 97862

(10) STATIC WATER LEVEL:

27 ft. below land surface. Date 1-22-94

Artesian pressure ____ lb. per square inch. Date ____

(11) WATER BEARING ZONES:

Depth at which water was first found 50

From	To	Estimated Flow Rate	SWL
50	105	200+	27

(12) WELL LOG:

Ground elevation ____

Material	From	To	SWL
Soil	0	1	
Soil & Gravel	1	8	
Gravel & Clay	8	32	
Cement & Gravel	32	105	27

RECEIVED
APR 20 1994
WATER RESOURCES DEPT.
SALEM, OREGON

Date started 1-18-94 Completed 1-22-94

(unbonded) Water Well Constructor Certification:

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

WWC Number ____

Signed ____ Date ____

(bonded) Water Well Constructor Certification:

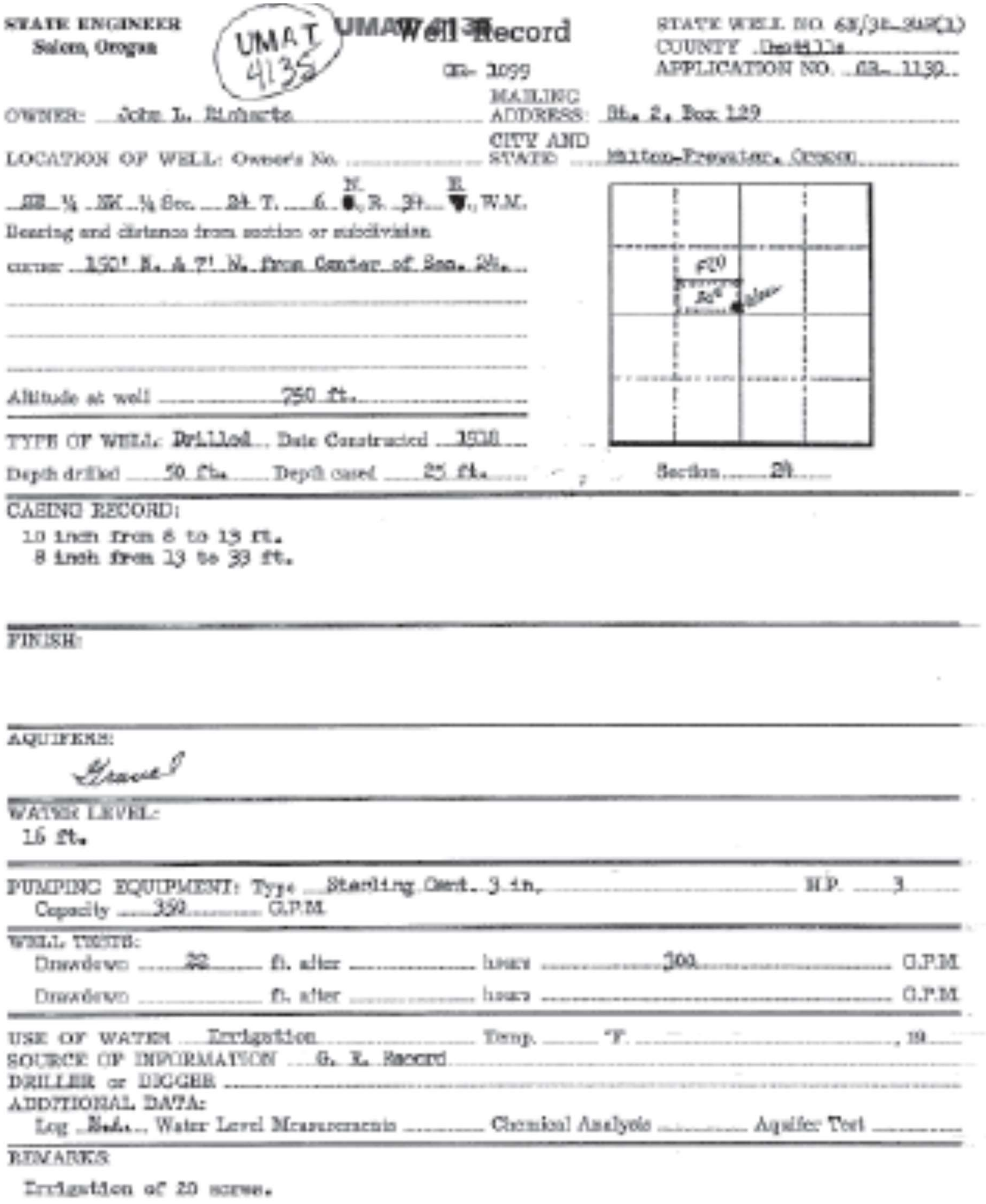
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. all work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 575

Signed Clarence Summers Date 1-23-94

WHITE COPIES - WATER RESOURCES DEPARTMENT YELLOW COPY - CONSTRUCTOR PINK COPY - CUSTOMER 9809C 10/86

GW_34



STATE ENGINEER
Salem, Oregon

UMAT 4135

Well Record

GR- 1099

STATE WELL NO. 6N/34-24F(1)
COUNTY Umatilla
APPLICATION NO. GR- 1130

OWNER: John L. Richards
MAILING ADDRESS: Rt. 2, Box 129

LOCATION OF WELL: Owner's No. ....
CITY AND STATE: Milton-Freewater, Oregon

SE ¼ NW ¼ Sec. 24 T. 6 N., R. 34 E., W.M.

Bearing and distance from section or subdivision corner 150' E. & 7' N. from Center of Sec. 24.

Altitude at well 750 ft.

TYPE OF WELL: Drilled Date Constructed 1938

Depth drilled 50 ft. Depth cased 25 ft.

Section 24

CASING RECORD:
10 inch from 8 to 13 ft.
8 inch from 13 to 33 ft.

FINISH:

AQUIFERS:
Gravel

WATER LEVEL:
16 ft.

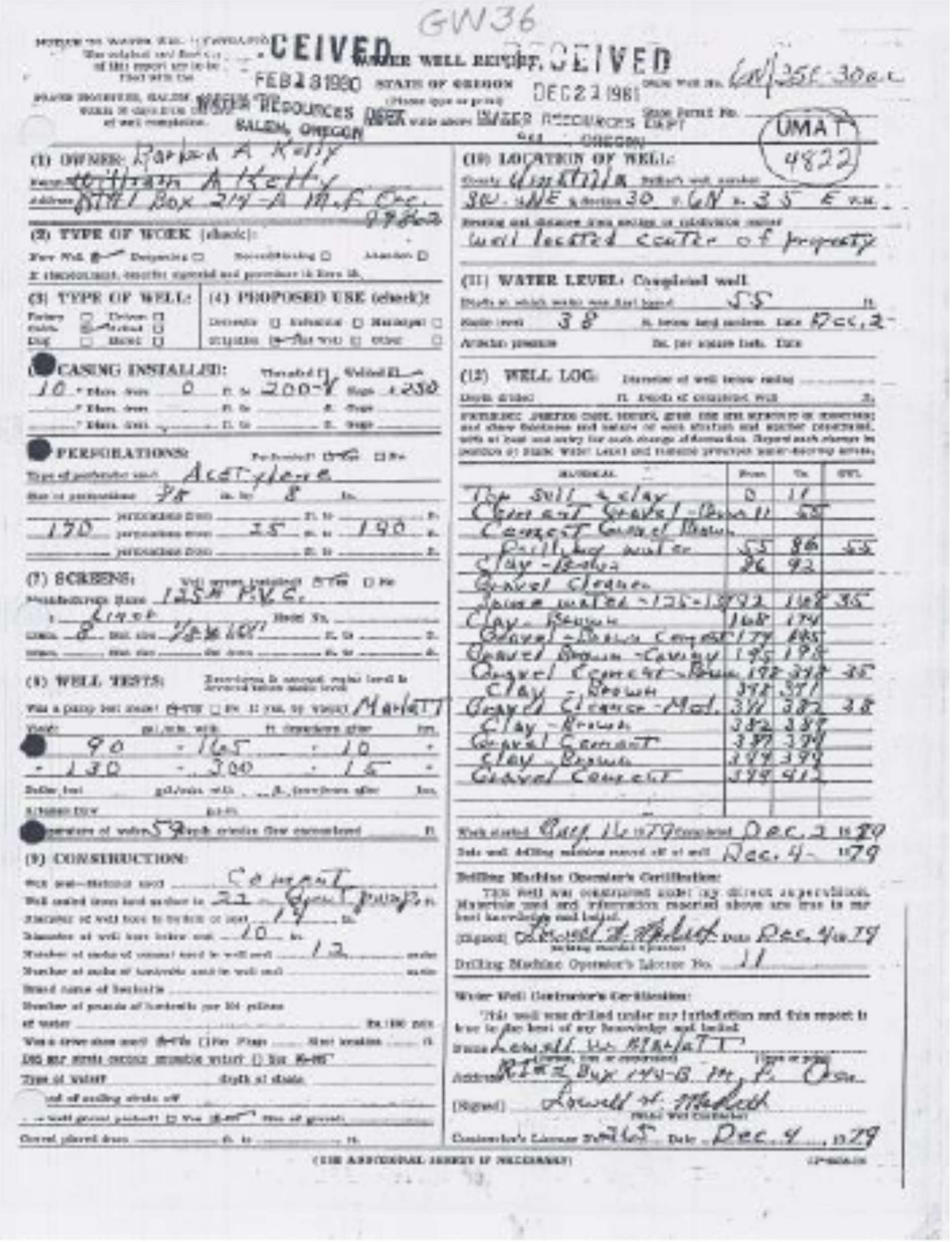
PUMPING EQUIPMENT: Type Sterling Cent. 3 in. H.P. 3
Capacity 350 G.P.M.

WELL TESTS:
Drawdown 22 ft. after .... hours 300 G.P.M.
Drawdown .... ft. after .... hours .... G.P.M.

USE OF WATER Irrigation Temp. .... °F. ...., 19....
SOURCE OF INFORMATION G. R. Record
DRILLER or DIGGER ....
ADDITIONAL DATA:
Log No., Water Level Measurements .... Chemical Analysis .... Aquifer Test ....

REMARKS:
Irrigation of 20 acres.

GW_36



GW36

RECEIVED FEB 13 1980 WATER RESOURCES DEPT SALEM, OREGON

WATER WELL REPORT

STATE OF OREGON

RECEIVED DEC 23 1981 WATER RESOURCES DEPT SALEM, OREGON

GW/35E-30cc

UMAT 4822

(1) OWNER: Barbara A Kelly

William A Kelly

Address Rt#1 Box 214-A M.F. Ore. 97862

(2) TYPE OF WORK (check):

(3) TYPE OF WELL:

(4) PROPOSED USE (check):

(5) CASING INSTALLED:

10 " Diam. from 0 ft. to 200-8 ft. Gage .250

(6) PERFORATIONS:

Type of perforator used Acetylene

Size of perforations 3/8 in. by 8 in.

170 perforations from 25 ft. to 190 ft.

(7) SCREENS:

Manufacturer's Name 125# P.V.C.

Liner

Diam. 8 Slot size 3/8 x 1/4"

(8) WELL TESTS:

Was a pump test made? If yes, by whom? Marlatt

90 - 165 - 10

130 - 300 - 15

Temperature of water 59

(9) CONSTRUCTION:

Cement

Well sealed from land surface to 22 - Gravel pump

14 in.

10 in.

12

(10) LOCATION OF WELL:

County Umatilla

SW 1/4 NE 1/4 Section 30 T. 6N R. 35 E W.M.

Well located center of property

(11) WATER LEVEL: Completed well.

55 ft.

Static level 38 ft. below land surface. Date Dec. 2

(12) WELL LOG:

MATERIAL	From	To	SWL
Top soil & clay	0	11	
Cement Gravel - Brown	11	55	
Cement Gravel Brown			
Drilling water	55	86	55
Clay - Brown	86	92	
Gravel Cleaner			
Some water - 125 - 135	92	168	35
Clay - Brown	168	174	
Gravel - Brown Cement	174	185	
Gravel Brown - Caving	195	198	
Gravel Cement - Brown	198	348	35
Clay - Brown	348	371	
Gravel Cleaner - Med.	371	382	38
Clay - Brown	382	387	
Gravel Cement	387	394	
Clay - Brown	394	399	
Gravel Cement	399	412	

Work started Aug. 11 1979 Completed Dec. 2 1979

Date well drilling machine moved off of well Dec. 4 1979

Drilling Machine Operator's Certification:

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

[Signed] Lowell W. Marlatt Date Dec. 4 1979

Drilling Machine Operator's License No. 11

Water Well Contractor's Certification:

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

Name Lowell W. Marlatt

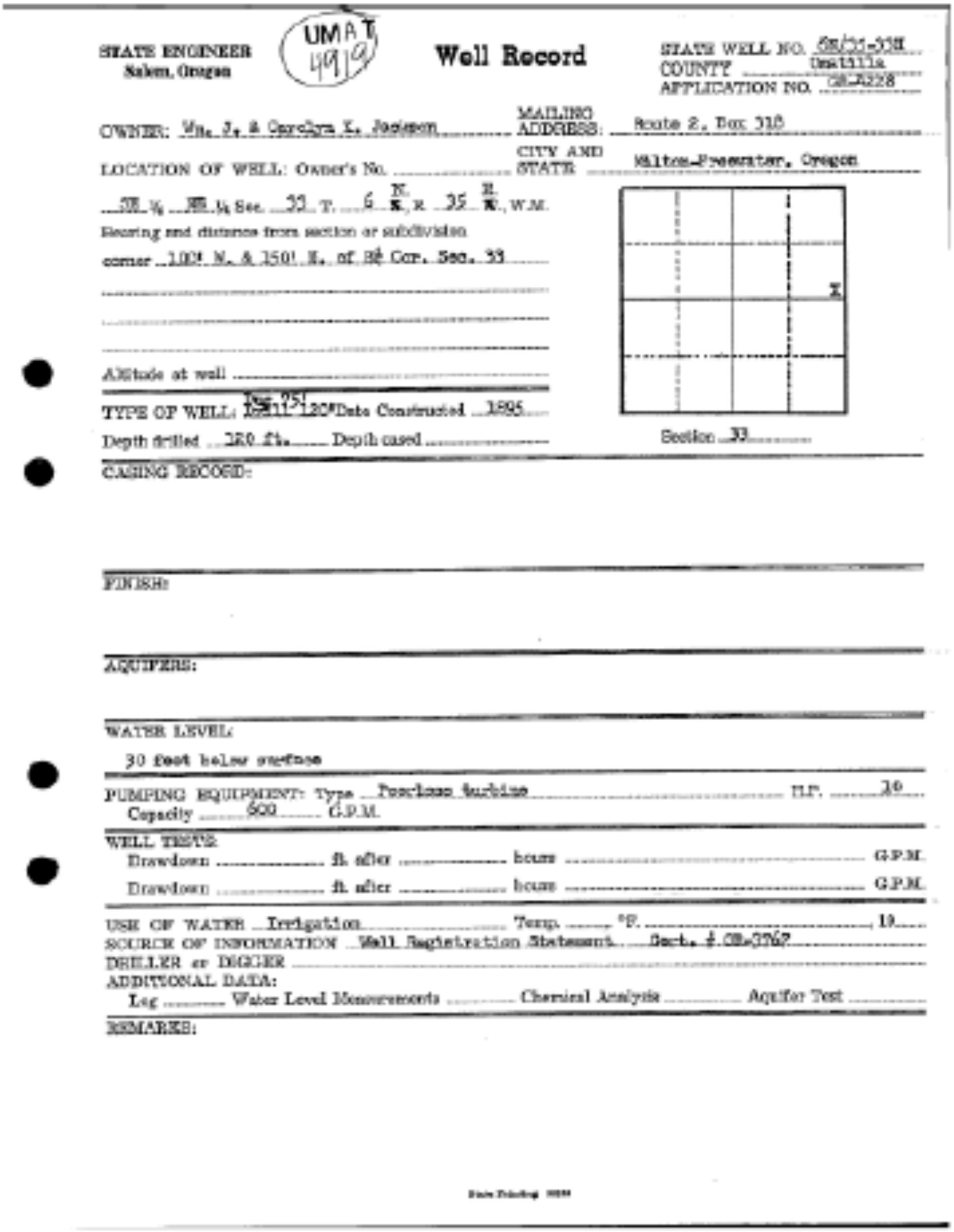
Address Rt#2 Box 149-B M. F. Ore.

[Signed] Lowell W. Marlatt

Contractor's License No. 765 Date Dec. 4 1979

(USE ADDITIONAL SHEETS IF NECESSARY)

GW_39



STATE ENGINEER
Salem, Oregon

UMAT
4919

Well Record

STATE WELL NO. 6N/35-33H
COUNTY Umatilla
APPLICATION NO. GR-2228

OWNER: Wm. J. & Carolyn K. Jackson

MAILING ADDRESS: Route 2, Box 318

LOCATION OF WELL: Owner's No. ____

CITY AND STATE: Milton-Freewater, Oregon

SE ¼ NE ¼ Sec. 33 T. 6 N. R. 35 E. W.M.

Bearing and distance from section or subdivision corner 100' N. & 150' E. of E¼ Cor. Sec. 33

X

Section 33

Altitude at well ____

TYPE OF WELL: Dug 75' Drill 120' Date Constructed 1895

Depth drilled 120 ft. Depth cased ____

CASING RECORD:

FINISH:

AQUIFERS:

WATER LEVEL:

30 feet below surface

PUMPING EQUIPMENT: Type Peerless turbine H.P. 10

Capacity 600 G.P.M.

WELL TESTS:

Drawdown ____ ft. after ____ hours ____ G.P.M.

Drawdown ____ ft. after ____ hours ____ G.P.M.

USE OF WATER Irrigation Temp. ____ °F. ____, 19____

SOURCE OF INFORMATION Well Registration Statement Cert. # GR-3767

DRILLER or DIGGER ____

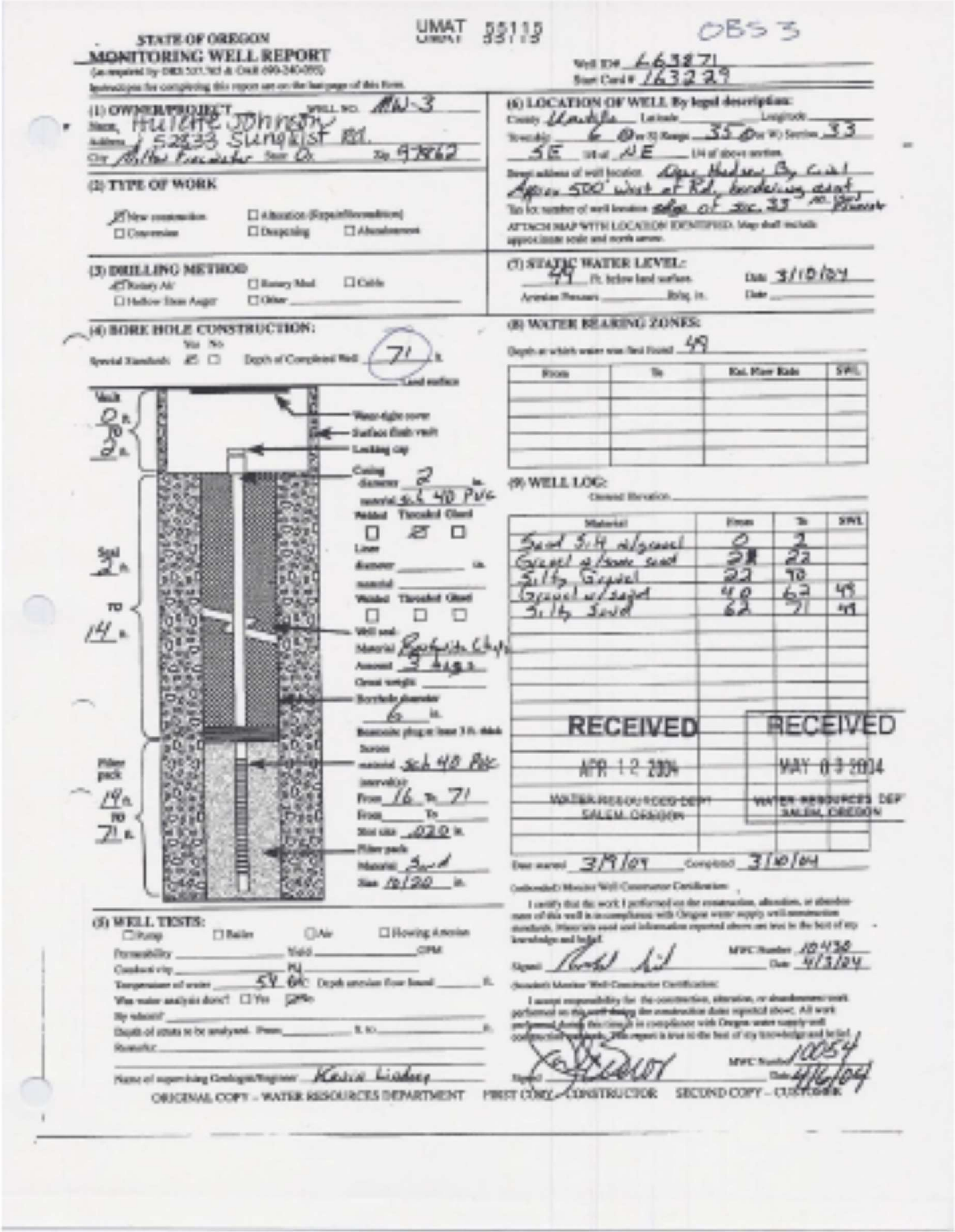
ADDITIONAL DATA:

Log ____ Water Level Measurements ____ Chemical Analysis ____ Aquifer Test ____

REMARKS:

State Printing [illegible]

GW_45



UMAT 55115

OBS 3

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

Well ID# L63871
Start Card # 163229

(1) OWNER/PROJECT WELL NO. MW-3
Name Hulette Johnston
Address 52833 Sunquist Rd.
City Milton Freewater State Or. Zip 97862

(2) TYPE OF WORK
☒ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:
Special Standards: Yes ☒ No ☐ Depth of Completed Well 71 ft.

Vault 0 ft. to 2 ft.
Seal 2 ft. to 14 ft.
Filter pack 14 ft. to 71 ft.

Casing diameter 2 in.
material sch 40 PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter in.
material
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material Bentonite Chips
Amount 3 bags
Grout weight
Borehole diameter 6 in.
Bentonite plug at least 3 ft. thick
Screen material sch 40 PVC
interval(s):
From 16 to 71
From To
Slot size .020 in.
Filter pack:
Material Sand
Size 10/20 in.

(5) WELL TESTS:
☐ Pump ☐ Bailer ○ Air ☐ Flowing Artesian
Permeability Yield GPM
Conductivity PH
Temperature of water 54 °F/C Depth artesian flow found ft.
Was water analysis done? ☐ Yes ☒ No
By whom?
Depth of strata to be analyzed. From ft. to ft.
Remarks:

Name of supervising Geologist/Engineer Kevin Lindsey

(6) LOCATION OF WELL By legal description:
County Umatilla Latitude Longitude
Township 6 N (N or S) Range 35 E (E or W) Section 33
SE 1/4 of NE 1/4 of above section.
Street address of well location Appx. Hudson Bay Canal
Appox 500' west of Rd, bordering east
Tax lot number of well location edge of sec. 33 no street address
ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
49 Ft. below land surface. Date 3/10/04
Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:
Depth at which water was first found 49

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground Elevation

Material	From	To	SWL
Sand silt w/gravel	0	2	
Gravel w/some sand	2	22	
Silty Gravel	22	40	
Gravel w/sand	40	62	49
Silty Sand	62	71	49

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WATER RESOURCES DEPT
SALEM, OREGON

RECEIVED
MAY 03 2004
WATER RESOURCES DEPT
SALEM, OREGON

Date started 3/9/04 Completed 3/10/04

(unbonded) Monitor Well Constructor Certification:

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

Signed MWC Number 10438
Date 4/3/04

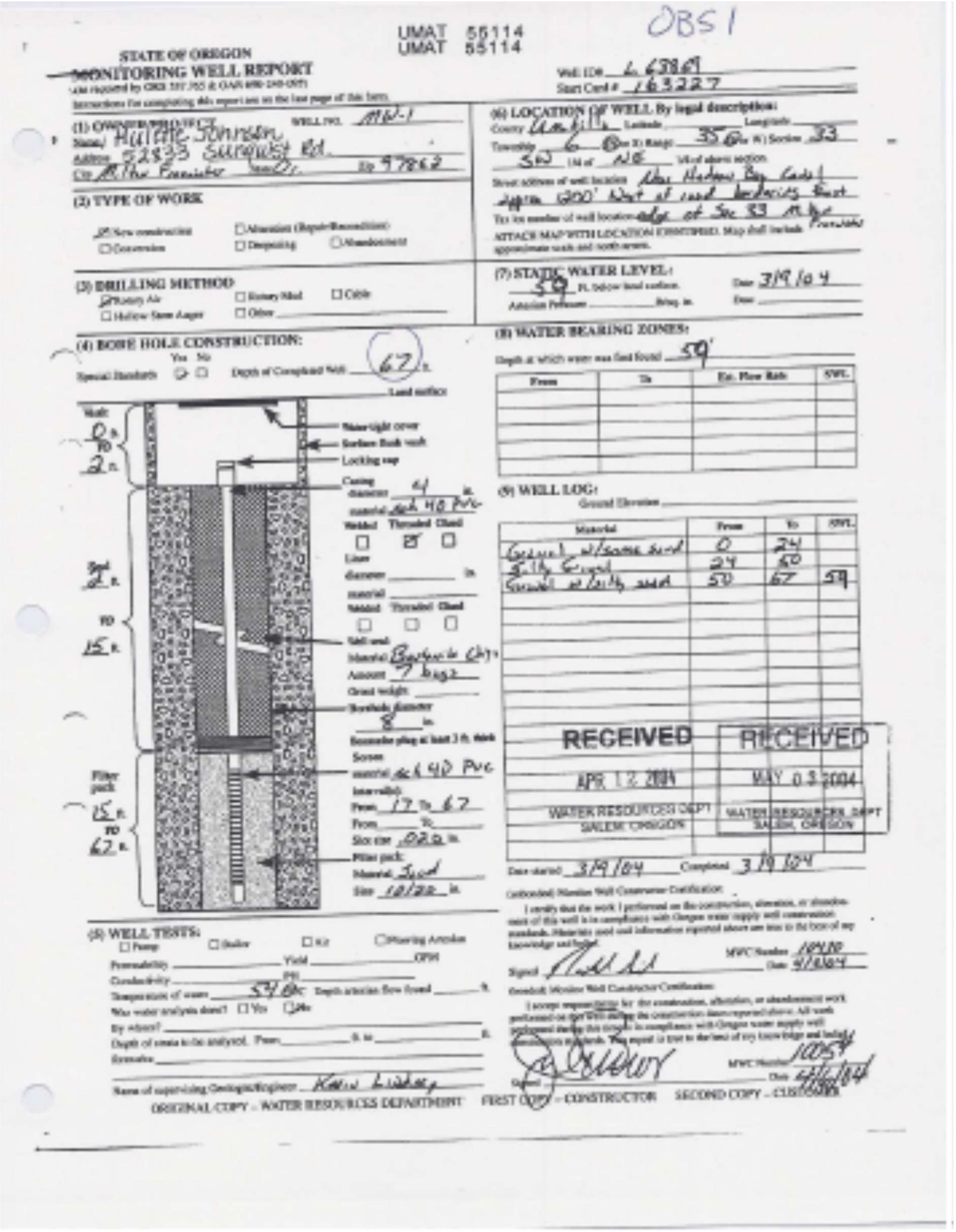
(bonded) Monitor Well Constructor Certification:

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

Signed MWC Number 10054
Date 4/6/04

ORIGINAL COPY – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

GW_46



UMAT 55114
UMAT 55114

OBS1

STATE OF OREGON
MONITORING WELL REPORT

Well ID# L 63869
Start Card # 163227

(1) OWNER/PROJECT WELL NO. MW-1
Name Hulette Johnson
Address 52835 Sunquist Rd.
City Milton Freewater State Or. Zip 97862

(2) TYPE OF WORK
☑ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:
Depth of Completed Well 67 ft.
Land surface
Vault 0 ft. TO 2 ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 4 in.
material sch 40 PVC
Welded ☐ Threaded ☑ Glued ☐
Liner diameter in.
Welded ☐ Threaded ☐ Glued ☐
Seal 2 ft. TO 15 ft.
Well seal
Material Bentonite Chips
Amount 7 bags
Grout weight
Borehole diameter 8 in.
Screen material sch 40 PVC
From 17 To 67
Slot size .020 in.
Filter pack 15 ft. TO 67 ft.
Filter pack
Material Sand
Size 10/20 in.

(6) LOCATION OF WELL By legal description:
County Umatilla Latitude Longitude
Township 6 Range 35 Section 33
SW 1/4 of NE 1/4 of above section
Street address of well location Near Hudson Bay Canal
approx 1200' West of road bordering East
edge of Sec 33 Milton Freewater

(7) STATIC WATER LEVEL:
59 ft. below land surface. Date 3/19/04

(8) WATER BEARING ZONES:
Depth at which water was first found 59'

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground Elevation

Material	From	To	SWL
Gravel w/some sand	0	24	
Silty Gravel	24	50	
Gravel w/silty sand	50	67	59

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APR 12 2004
WATER RESOURCES DEPT
SALEM, OREGON

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MAY 03 2004
WATER RESOURCES DEPT
SALEM, OREGON

Date started 3/19/04 Completed 3/19/04

MWC Number 10480
Date 4/8/04

MWC Number 10054
Date 4/8/04

(5) WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Temperature of water 54 °F
Was water analysis done? ☐ Yes ☑ No
Name of supervising Geologist/Engineer Kevin Lindsey

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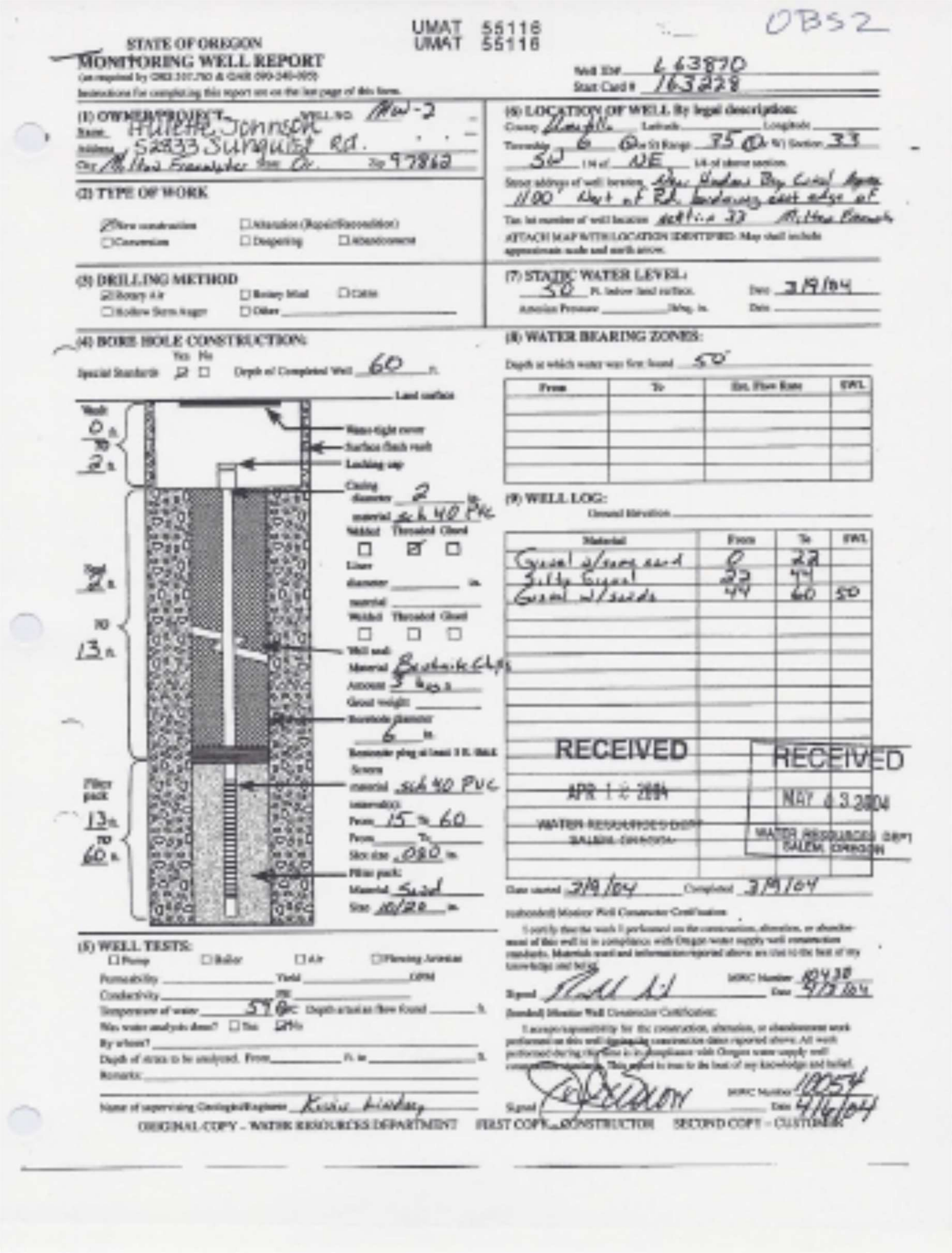
GW_47



UMAT 55116
UMAT 55116

OBS2

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

Well ID# L63870
Start Card # 163228

(1) OWNER/PROJECT WELL NO. MW-2
Name Hulette Johnson
Address 52833 Sunquist Rd.
City Milton Freewater State Or. Zip 97862

(2) TYPE OF WORK
☒ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:
Special Standards Yes ☒ No ☐ Depth of Completed Well 60 ft.

Land surface
Vault 0 ft. to 2 ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 2 in. material sch 40 PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ___ in. material ___
Welded ☐ Threaded ☐ Glued ☐
Seal 2 ft. to 13 ft.
Well seal: Material Bentonite Chips
Amount 3 bags
Grout weight: ___
Borehole diameter 6 in.
Bentonite plug at least 3 ft. thick
Filter pack 13 ft. to 60 ft.
Screen material sch 40 PVC
Interval(s): From 15 To 60
From ___ To ___
Slot size .020 in.
Filter pack: Material Sand
Size 10/20 in.

(5) WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water 59 °F/C Depth artesian flow found ___ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___
Name of supervising Geologist/Engineer Kevin Lindsey

(6) LOCATION OF WELL by legal description:
County Umatilla Latitude ___ Longitude ___
Township 6 N or S Range 35 E or W Section 33
SW 1/4 of NE 1/4 of above section.
Street address of well location Near Hudson Bay Canal Approx 1100' West of Rd. [illegible] east edge of
Tax lot number of well location section 33 Milton Freewater
ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
50 ft. below land surface. Date 3/9/04
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found 50'

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground Elevation ___

Material	From	To	SWL
Gravel w/some sand	0	22	
Silty Gravel	22	44	
Gravel w/sands	44	60	50

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SALEM, OREGON

RECEIVED
MAY 0 3 2004
WATER RESOURCES DEPT
SALEM, OREGON

Date started 3/9/04 Completed 3/9/04

(unbonded) Monitor Well Constructor Certification
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
Signed ___ MWC Number 10438
Date 3/9/04

(bonded) Monitor Well Constructor Certification
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
Signed ___ MWC Number 10054
Date 4/16/04

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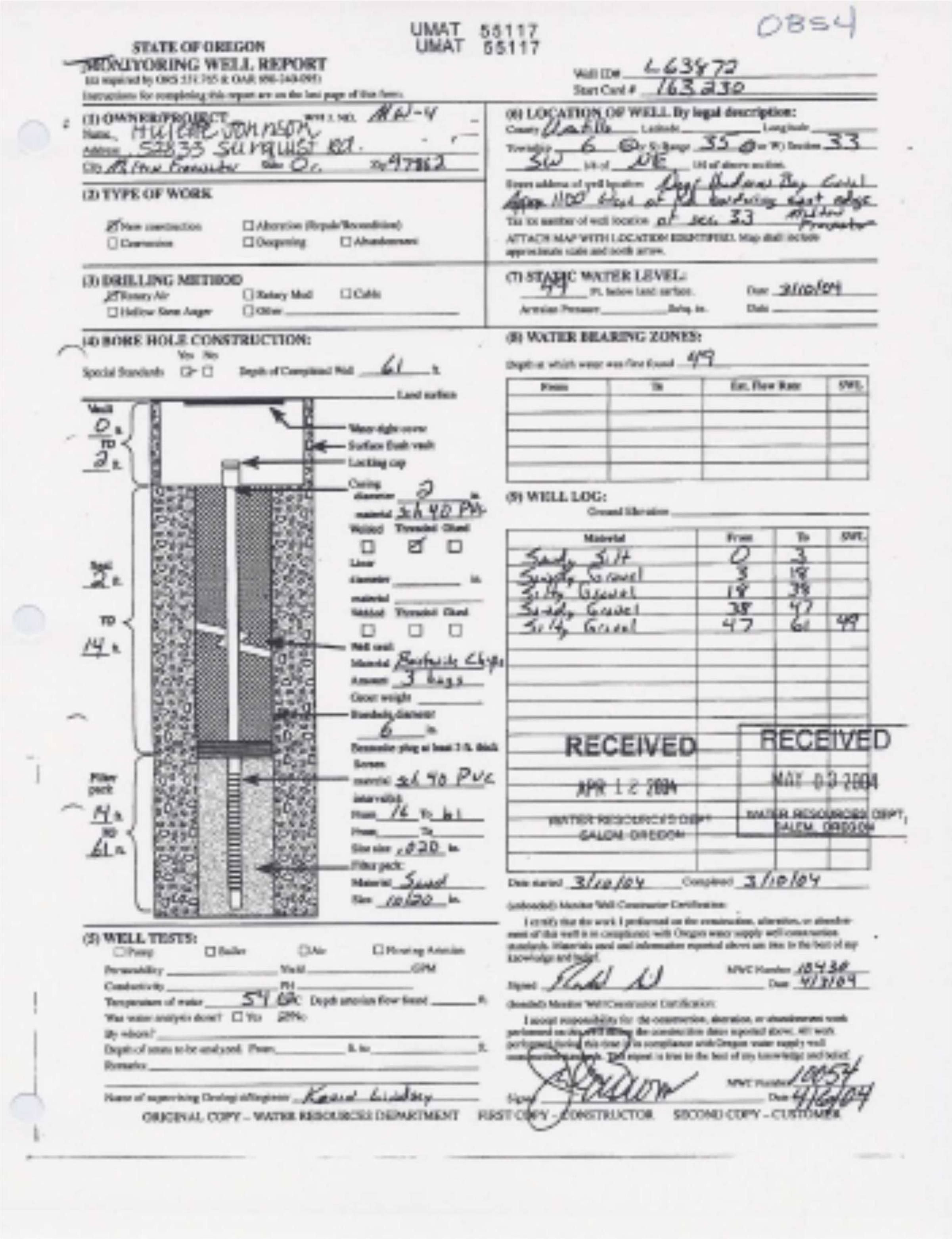
GW_48



UMAT 55117
UMAT 55117

0854

STATE OF OREGON
MONITORING WELL REPORT

Well ID# L63472
Start Card # 163230

(1) OWNER/PROJECT — WELL NO. MW-4
Name Hulette Johnson
Address 53833 Sunquist Rd.
City Milton Freewater State Or. Zip 97862

(2) TYPE OF WORK
☑ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:
Special Standards Yes ☑ No ☐ Depth of Completed Well 61 ft.

Land surface
Vault 0 ft. TO 2 ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 2 in.
material Sch 40 PVC
Welded ☐ Threaded ☑ Glued ☐
Liner diameter ____ in.
material ____
Welded ☐ Threaded ☐ Glued ☐
Seal 2 ft. TO 14 ft.
Well seal:
Material Bentonite Chips
Amount 3 bags
Grout weight ____
Borehole diameter 6 in.
Bentonite plug at least 3 ft. thick
Screen material sch 40 PVC
Interval(s): From 16 To 61
From ____ To ____
Slot size .020 in.
Filter pack 14 ft. TO 61 ft.
Filter pack:
Material Sand
Size 10/20 in.

(5) WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ____ Yield ____ GPM
Conductivity ____ PH ____
Temperature of water 54 °F Depth artesian flow found ____ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ____
Depth of strata to be analyzed. From ____ ft. to ____ ft.
Remarks: ____
Name of supervising Geologist/Engineer Kevin Lindsey

(6) LOCATION OF WELL By legal description:
County Umatilla Latitude ____ Longitude ____
Township 6 (N or S) Range 35 (E or W) Section 33
SW 1/4 of NE 1/4 of above section.
Street address of well location Dept Anderson Bay Canal Appx 1100' West of Rd bordering east edge of sec. 33 Milton Freewater
ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
49 ft. below land surface. Date 3/10/04
Artesian Pressure ____ lb/sq. in. Date ____

(8) WATER BEARING ZONES:
Depth at which water was first found 49

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
Sandy Silt	0	3	
Sandy Gravel	3	18	
Silty Gravel	18	38	
Sandy Gravel	38	47	
Silty Gravel	47	61	49

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APR 12 2004
WATER RESOURCES DEPT
SALEM, OREGON

RECEIVED
MAY 03 2004
WATER RESOURCES DEPT,
SALEM, OREGON

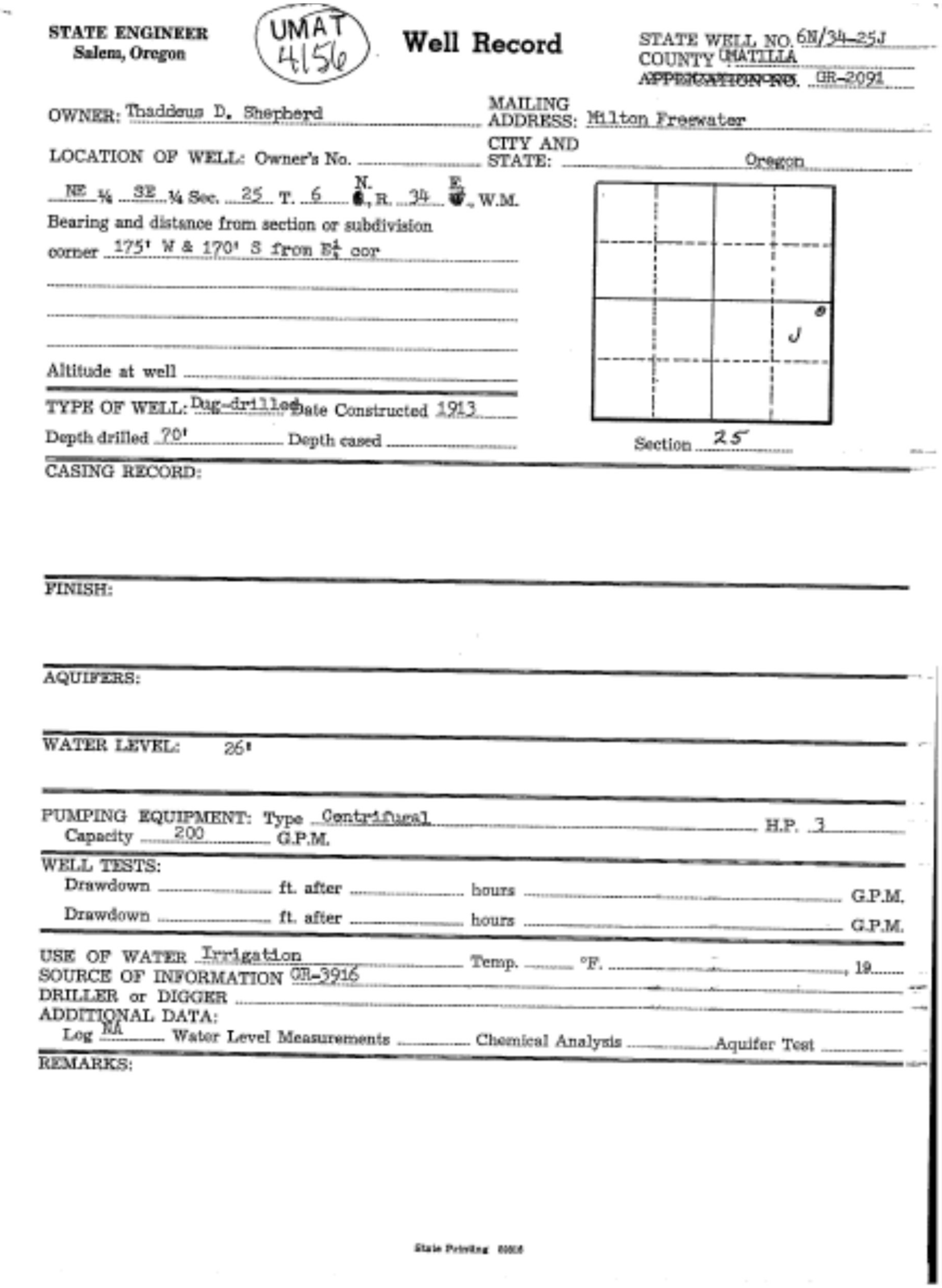
Date started 3/10/04 Completed 3/10/04

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
Signed ____ MWC Number 18438 Date 4/3/04

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
Signed ____ MWC Number 10054 Date 4/6/04

ORIGINAL COPY – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

GW_66 Tentatively identified well log



STATE ENGINEER
Salem, Oregon

UMAT
4156

Well Record

STATE WELL NO. 6N/34-25J
COUNTY UMATILLA
~~APPLICATION NO.~~ GR-2091

OWNER: Thaddeus D. Shepherd
MAILING ADDRESS: Milton Freewater
LOCATION OF WELL: Owner's No.
CITY AND STATE: Oregon

NE ¼ SE ¼ Sec. 25 T. 6 N., R. 34 E., W.M.
Bearing and distance from section or subdivision corner 175' W & 170' S from E¼ cor

Altitude at well

TYPE OF WELL: Dug-drilled Date Constructed 1913
Depth drilled 70' Depth cased

J

Section 25

CASING RECORD:

FINISH:

AQUIFERS:

WATER LEVEL: 26'

PUMPING EQUIPMENT: Type Centrifugal H.P. 3
Capacity 200 G.P.M.

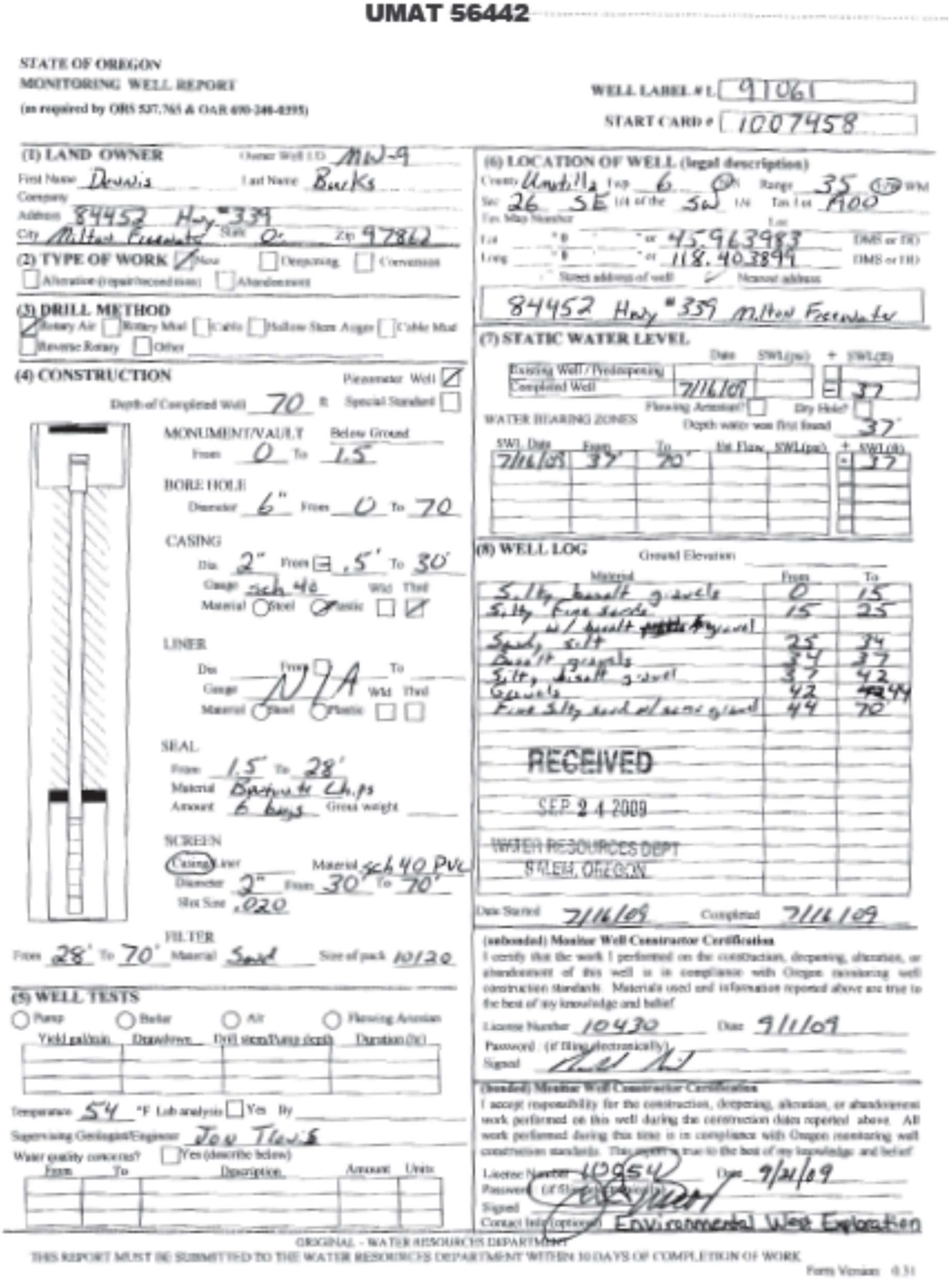
WELL TESTS:
Drawdown ft. after hours G.P.M.
Drawdown ft. after hours G.P.M.

USE OF WATER Irrigation Temp. °F. , 19
SOURCE OF INFORMATION GR-3916
DRILLER or DIGGER
ADDITIONAL DATA:
Log NA Water Level Measurements Chemical Analysis Aquifer Test

REMARKS:

State Printing 00016

GW_116



UMAT 56442

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 91061
START CARD # 1007458

(1) LAND OWNER Owner Well I.D. MW-9
First Name Dennis Last Name Burks
Company
Address 84452 Hwy #339
City Milton Freewater State Or Zip 97862

(2) TYPE OF WORK ☑ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION Piezometer Well ☑
Depth of Completed Well 70 ft. Special Standard ☐

MONUMENT/VAULT Below Ground
From 0 To 1.5

BORE HOLE
Diameter 6" From 0 To 70

CASING
Dia 2" From ☐ .5' To 30'
Gauge sch 40 Wld Thrd
Material ○ Steel ● Plastic ☐ ☑

LINER
Dia From ☐ To
Gauge N/A Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 1.5' To 28'
Material Bentonite Chips
Amount 6 bags Grout weight

SCREEN
[✓ Casing] Liner Material sch 40 PVC
Diameter 2" From 30' To 70'
Slot Size .020

FILTER
From 28' To 70' Material Sand Size of pack 10/20

(5) WELL TESTS
○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer Jon Travis
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)
County Umatilla Twp 6 N Range 35 E WM
Sec 26 SE 1/4 of the SW 1/4 Tax Lot 1100
Tax Map Number Lot
Lat ° ' " or 45.963983 DMS or DD
Long ° ' " or 118.403899 DMS or DD
☐ Street address of well ☑ Nearest address
84452 Hwy #339 Milton Freewater

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	7/16/09		−	37

Flowing Artesian? ☐ Dry Hole? ☐
WATER BEARING ZONES Depth water was first found 37'

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
7/16/09	37'	70'			−	37
					☐	
					☐	
					☐	

(8) WELL LOG Ground Elevation

Material	From	To
Silty basalt gravels	0	15
Silty Fine sands w/ basalt ~~pebbles~~ gravel	15	25
Sandy, silt	25	34
Basalt gravels	34	37
Silty, basalt gravel	37	42
Gravels	42	~~42~~ 44
Fine Silty sand w/ some gravel	44	70

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WATER RESOURCES DEPT
SALEM, OREGON

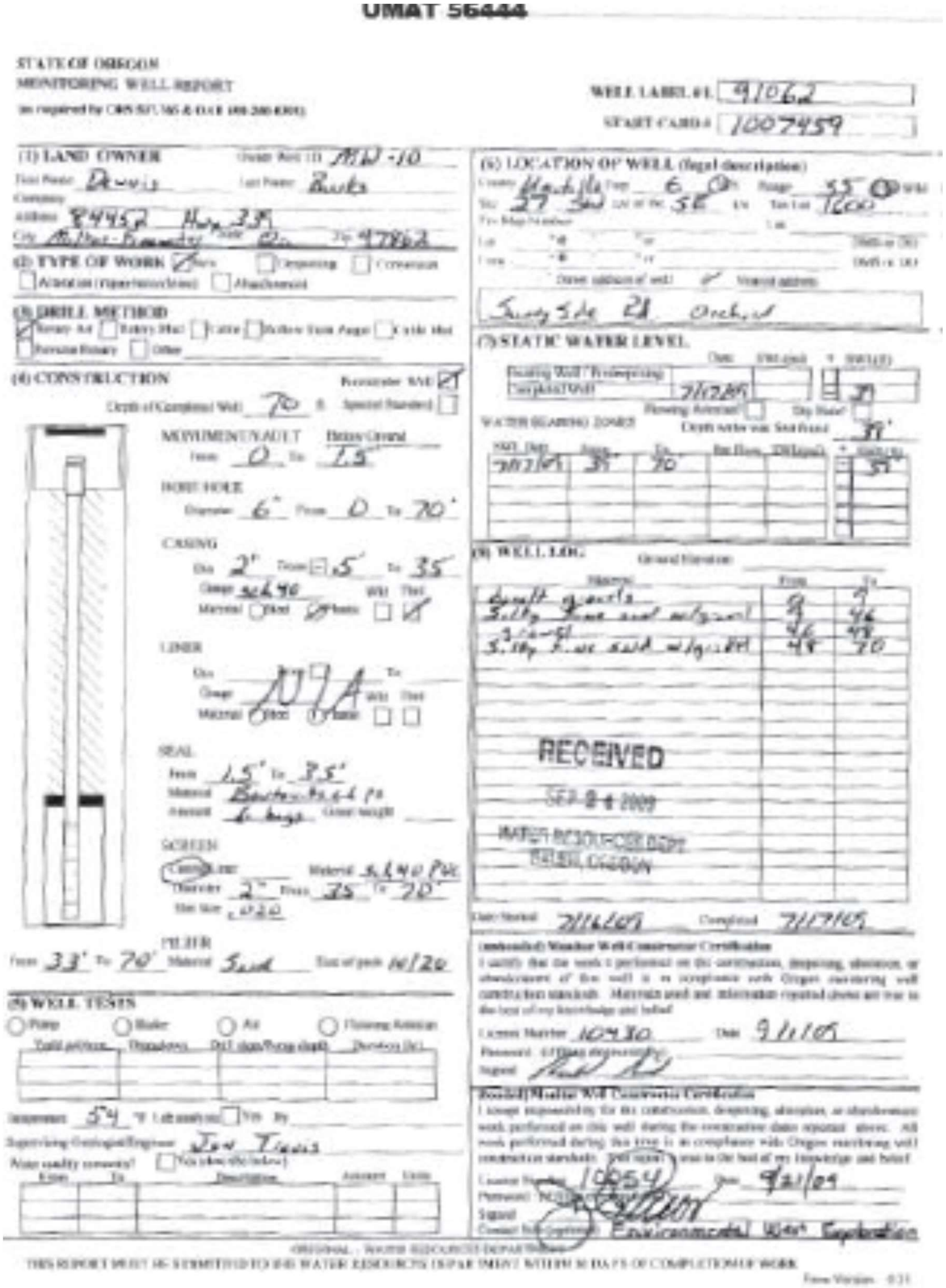
Date Started 7/16/09 Completed 7/16/09

(unbonded) Monitor Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
License Number 10430 Date 9/1/09
Password : (if filing electronically)
Signed

(bonded) Monitor Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.
License Number 10054 Date 9/21/09
Password (if filing electronically)
Signed
Contact Info (optional) Environmental West Exploration

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
Form Version: 0.31

GW_117



UMAT 56444

STATE OF OREGON
MONITORING WELL REPORT

WELL LABEL #: L 91062
START CARD # 1007459

(1) LAND OWNER — Owner Well ID MW-10
First Name Dennis — Last Name Burks
Address 84452 Hwy 37
City Milton-Freewater — State Or. — Zip 97862

(2) TYPE OF WORK ☑ New ☐ Deepening ☐ Conversion ☐ Alteration ☐ Abandonment

(3) DRILL METHOD ☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION ☑
Depth of Completed Well 70 ft.
MONUMENT/VAULT — From 0 To 1.5
BORE HOLE — Diameter 6" From 0 To 70'
CASING — Dia 2" From .5' To 35'; Gauge sch 40; Material ☑ Plastic ☐ ☑
LINER — N/A
SEAL — From 1.5' To 35'; Material Bentonite pe; Amount 6 bags
SCREEN — Material sch 40 PVC; Diameter 2" From 35 To 70'; Slot Size .020
FILTER — From 33' To 70' Material Sand; Size of pack 10/20

(5) WELL TESTS ○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Temperature 54 °F ☐ Yes By
Supervising Geologist/Engineer Jon Travis
Water quality concerns? ☐

(6) LOCATION OF WELL (legal description)
County Umatilla — Twp 6 N — Range 35 E WM
Sec 27 SW 1/4 of the SE 1/4 — Tax Lot 1600
✓
Sunnyside 21 Orchard

(7) STATIC WATER LEVEL

	Date			
	7/17/05			37

Depth water was first found 37'

7/17/05	37	70				37

(8) WELL LOG

basalt gravels	0	9
Silty fine sand w/gravel	9	46
gravel	46	48
Silty fine sand w/gravel	48	70

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SEP 24 2009
WATER RESOURCES DEPT
SALEM, OREGON

Date Started 7/16/05 — Completed 7/17/05

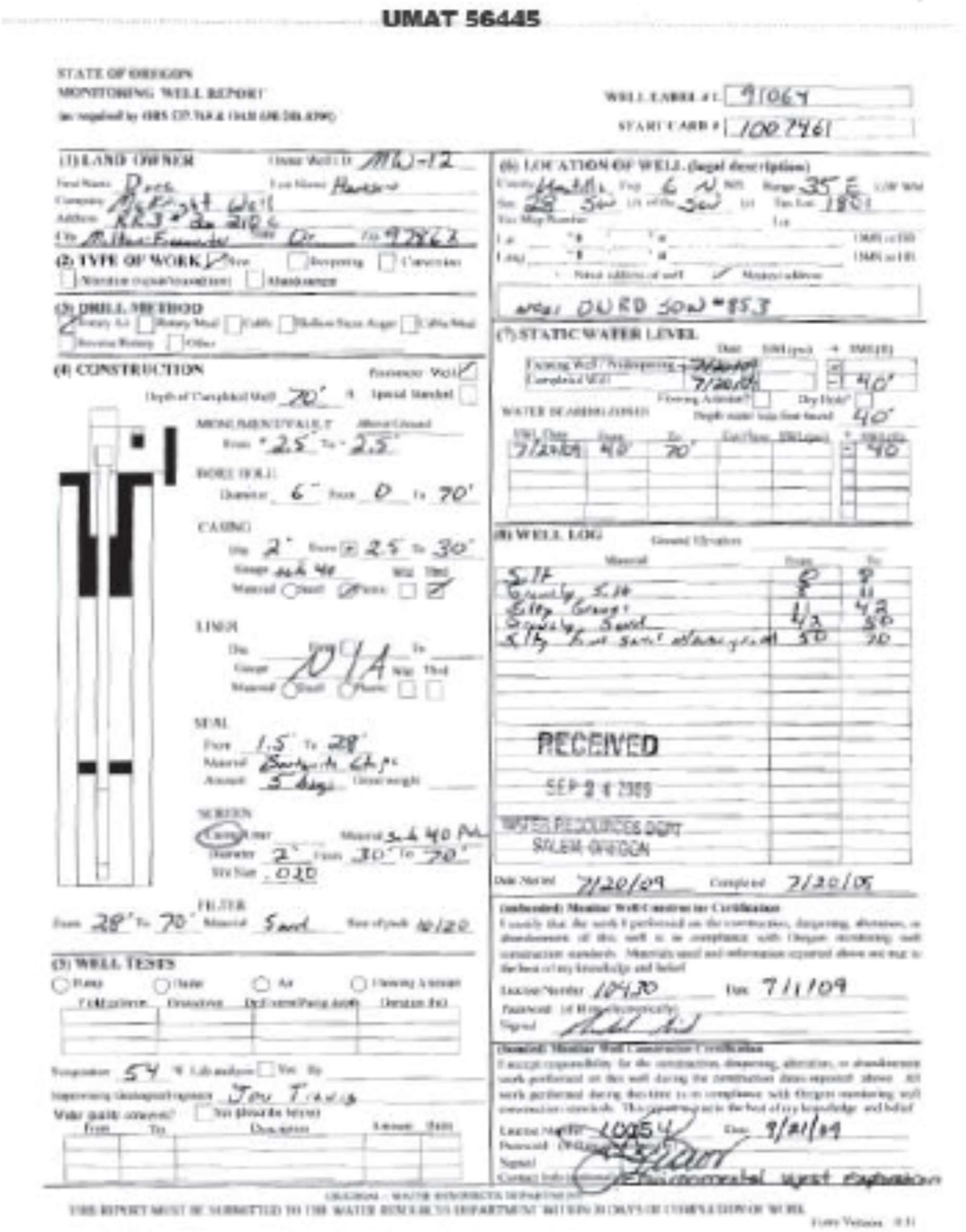
License Number 10430 — Date 9/1/05

License Number 10054 — Date 9/21/09

Environmental Water Exploration

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

GW_118



UMAT 56445

STATE OF OREGON
MONITORING WELL REPORT

WELL LABEL # L 91064
START CARD # 1007461

(1) LAND OWNER Owner Well I.D. MW-12
First Name Dave Last Name Harkins
Company McKnight Well
Address RR3 Box 2106
City Milton-Freewater State Or Zip 97862

(2) TYPE OF WORK ☑ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION Piezometer Well ☑
Depth of Completed Well 70' ft. Special Standard ☐

MONUMENT/VAULT Above Ground
From +2.5' To -2.5'

BORE HOLE
Diameter 6" From 0 To 70'

CASING
Dia 2" From + 2.5 To 30'
Gauge sch 40 Wld ☐ Thrd ☑
Material ○ Steel ● Plastic

LINER
N/A

SEAL
From 1.5' To 28'
Material Bentonite Chips
Amount 5 bags Grout weight

SCREEN
[✓ Casing]/Liner Material sch 40 PVC
Diameter 2" From 30' To 70'
Slot Size .020

FILTER
From 28' To 70' Material Sand Size of pack 10/20

(5) WELL TESTS
○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer Jon Travis
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)
County Umatilla Twp 6 N N/S Range 35 E E/W WM
Sec 28 SW 1/4 of the SW 1/4 Tax Lot 1801
Tax Map Number Lot
Lat
Long
Street address of well ✓ Nearest address
near OWRD SOW #853

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening	[illegible]		
Completed Well	7/20/09		- 40'

Flowing Artesian? ☐ Dry Hole? ☐
WATER BEARING ZONES Depth water was first found 40'

SWL Date	From	To	Est Flow	SWL(psi)	+ SWL(ft)
7/20/09	40'	70'			- 40

(8) WELL LOG Ground Elevation

Material	From	To
Silt	0	8
Gravelly Silt	8	11
Silty Gravel	11	42
Gravelly Sand	42	50
Silty fine sand w/ some gravel	50	70

RECEIVED
SEP 2 4 2009
WATER RESOURCES DEPT
SALEM, OREGON

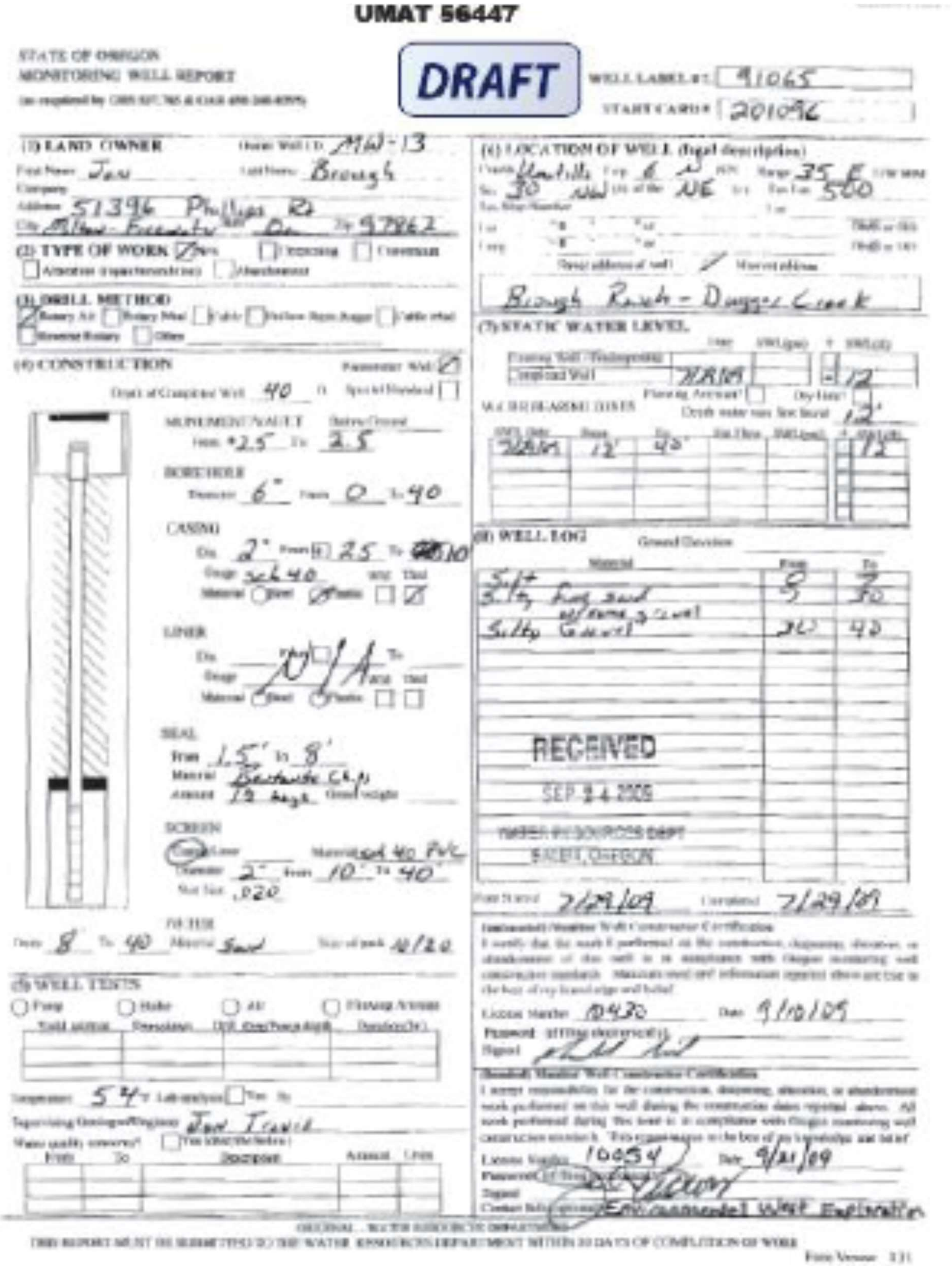
Date Started 7/20/09 Completed 7/20/05

(unbonded) Monitor Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
License Number 10430 Date 7/1/09
Password (if filing electronically)
Signed

(bonded) Monitor Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.
License Number 10054 Date 9/21/09
Password (if filing electronically)
Signed
Contact Info (optional) Environmental West Exploration

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
Form Version: 0.31

GW_119



UMAT 56447

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

DRAFT

WELL LABEL #: 91065
START CARD # 201096

(1) LAND OWNER Owner Well I.D. MW-13
First Name Jon Last Name Brough
Company
Address 51396 Phillips Rd
City Milton-Freewater State Or Zip 97862

(2) TYPE OF WORK ☑ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION Piezometer Well ☑
Depth of Completed Well 40 ft. Special Standard ☐

MONUMENT/VAULT Below Ground
From +2.5 To 2.5

BOREHOLE
Diameter 6" From 0 To 40

CASING
Dia 2" From +2.5 To 10
Gauge sch 40 Wld Thrd
Material ○ Steel ✓ Plastic ☐ ☑

LINER
Dia From ☐ To
Gauge N/A Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 1.5' To 8'
Material Bentonite Chips
Amount 12 bags Grout weight

SCREEN
[✓ Casing]/Liner Material sch 40 PVC
Diameter 2" From 10' To 40
Slot Size .020

FILTER
From 8 To 40 Material Sand Size of pack 10/20

(5) WELL TESTS
○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer Jon Travis
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)
County Umatilla Twp 6 N N/S Range 35 E E/W WM
Sec 30 NW 1/4 of the NE 1/4 Tax Lot 500
Tax Map Number Lot
Lat ° ' " DMS or DD
Long ° ' " DMS or DD
Street address of well ✓ Nearest address
Brough Ranch - Dugger Creek

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening				
Completed Well	7/28/09		-	12

Flowing Artesian? ☐ Dry Hole? ☐
WATER BEARING ZONES Depth water was first found 12'

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
7/28/09	12'	40'				12

(8) WELL LOG Ground Elevation

Material	From	To
Silt	0	5
Silty fine sand	5	30
Silty Gravel w/ some sand & gravel	30	40

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WATER RESOURCES DEPT
SALEM, OREGON

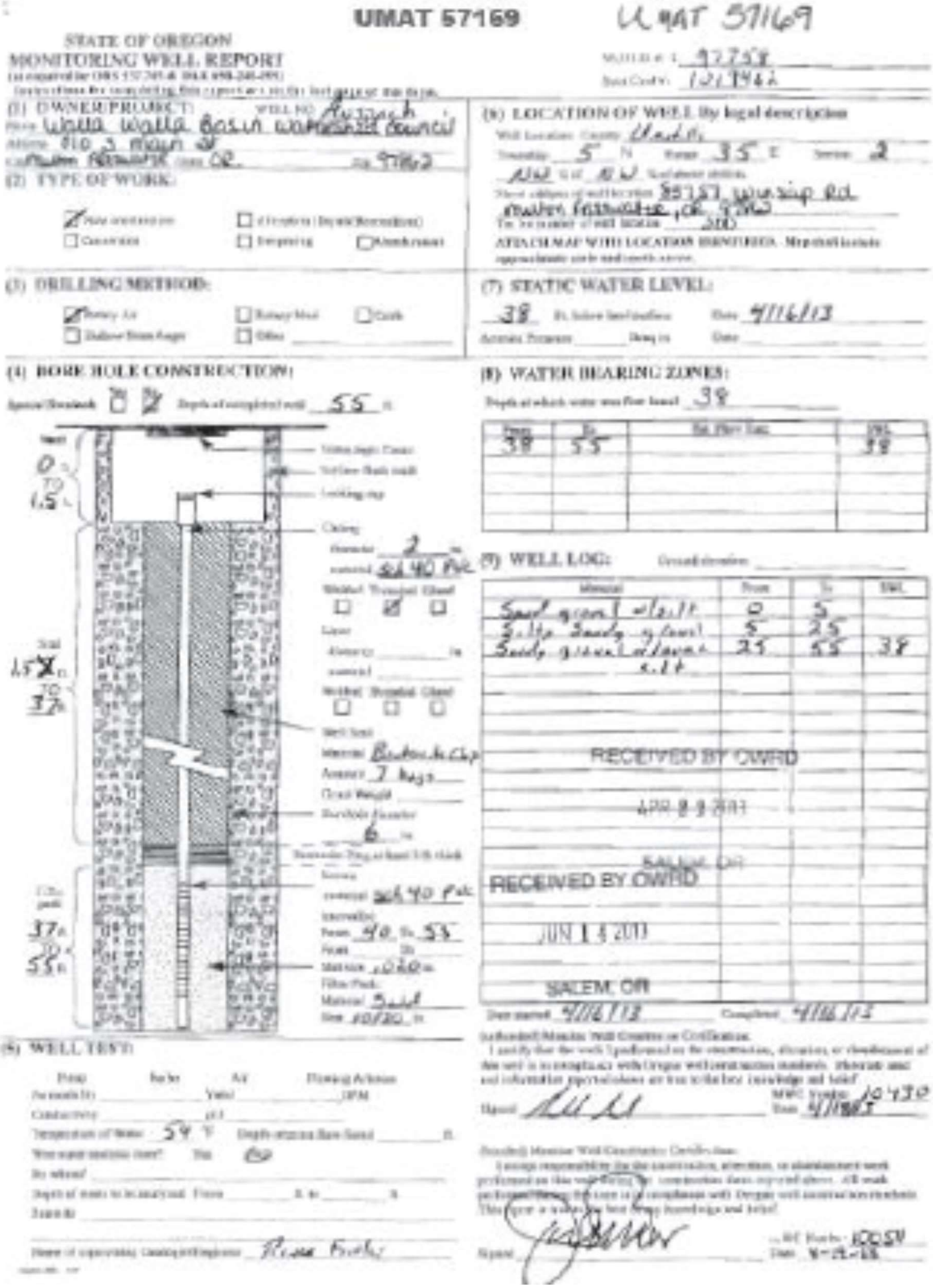
Date Started 7/29/09 Completed 7/29/09

(unbonded) Monitor Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
License Number 10430 Date 9/10/09
Password (if filing electronically)
Signed

(bonded) Monitor Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.
License Number 10054 Date 9/21/09
Password (if filing electronically)
Signed
Contact Info (optional) Environmental West Exploration

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
Form Version: 3.31

GW_141



UMAT 57169 U MAT 57169

STATE OF OREGON

MONITORING WELL REPORT

Well ID # L 97758

Start Card # 1219462

(1) OWNER/PROJECT: Well No. Autoroch

Walla Walla Basin Watershed Council

810 S Main St

Milton Freewater OR 97862

(2) TYPE OF WORK:

☑ New construction ☐ Alteration ☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD:

☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:

Depth of completed well 55 ft.

0 TO 1.5

1.5 TO 37

37 TO 55

Casing

Diameter 2 in.

Material Sch 40 PVC

☐ ☑ ☐

Well Seal

Material Bentonite Chip

Amount 7 bags

Borehole Diameter 6 in.

Screen

Material Sch 40 PVC

From 40 to 55

Slot size .020 in.

Filter Pack

Material Sand

Size 10/20

(5) WELL TEST:

Temperature of Water 54 °F

No

Name of supervising Geologist/Engineer Rene Fischer

(6) LOCATION OF WELL by legal description:

Well Location: County Umatilla

Township 5 N Range 35 E Section 2

NW 1/4 of NW 1/4

Street address of well location 85757 Winesap Rd

Milton Freewater, OR 97862

300

ATTACH MAP WITH LOCATION IDENTIFIED.

(7) STATIC WATER LEVEL:

38 ft. below land surface Date 4/16/13

(8) WATER BEARING ZONES:

Depth at which water was first found 38

From	To	Est. Flow Rate	SWL
38	55		38

(9) WELL LOG:

Material	From	To	SWL
Sand gravel w/silt	0	5	
Silty Sandy gravel	5	25	
Sandy gravel w/some silt	25	55	38

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JUN 1 4 2013

SALEM, OR

Date started 4/16/13 Completed 4/16/13

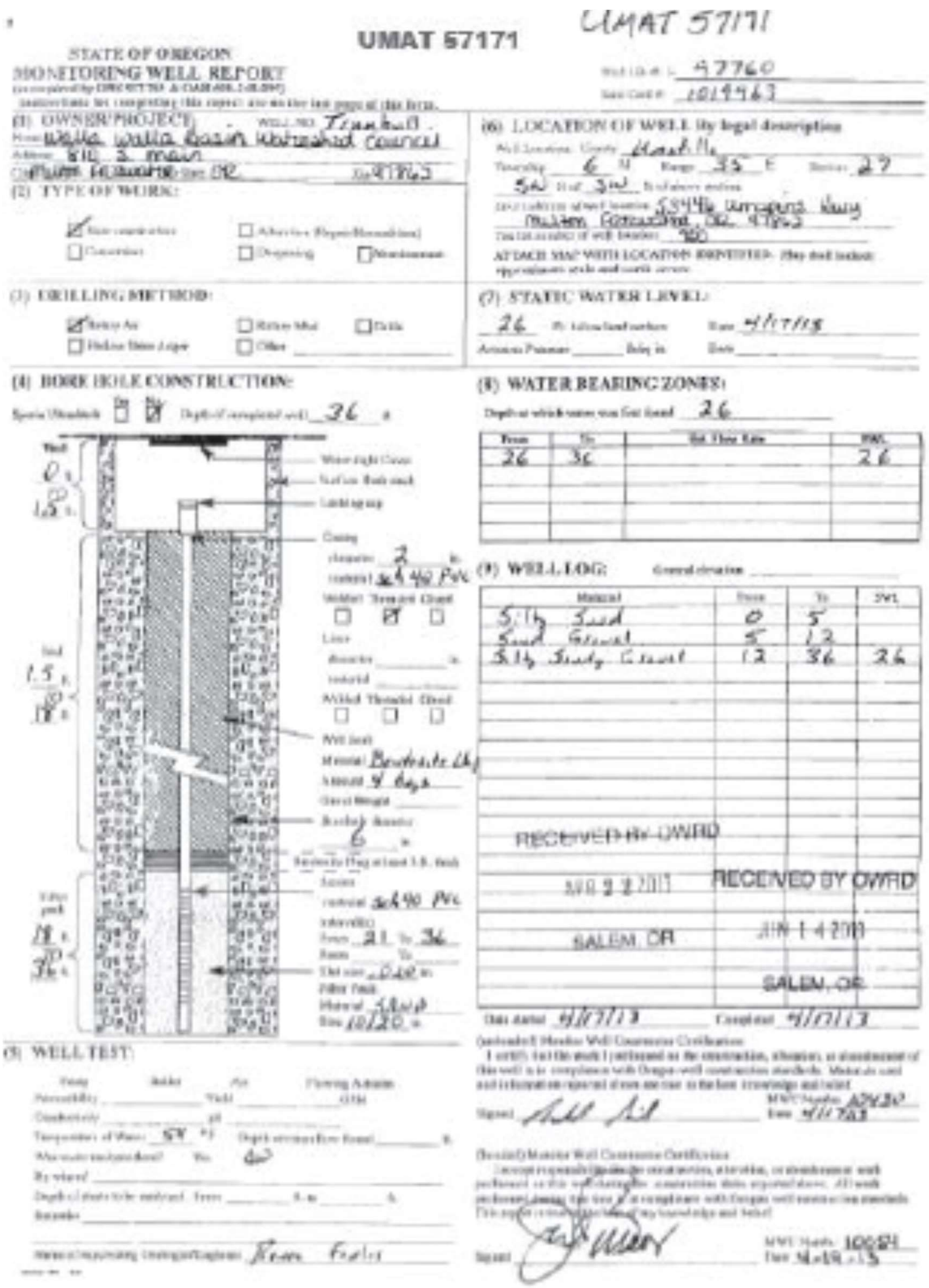
MWC Number 10430

Date 4/18/13

Number 10054

Date 4-25-13

GW_142



UMAT 57171

UMAT 57171

STATE OF OREGON
MONITORING WELL REPORT

47760
1019963

(1) OWNER/PROJECT: Trumbull
Walla Walla Basin Watershed Council
810 S. Main
Milton Freewater OR 97862

(2) TYPE OF WORK:

(3) DRILLING METHOD:

(4) BORE HOLE CONSTRUCTION:

Depth of completed well 36 ft

Seal 0 ft to 1.5 ft

Casing diameter 2 in., material sch 40 PVC

Seal 1.5 ft to 18 ft

Material Bentonite chips

Amount 4 bags

Borehole diameter 6 in.

Filter pack 18 ft to 36 ft

Screen material sch 40 PVC

Interval(s) From 21 To 36

Slot size .020 in.

Filter pack material Sand, Size 10/20

(5) WELL TEST:

Temperature of Water 54

Name of supervising Geologist/Engineer Ryan Fuller

(6) LOCATION OF WELL by legal description

County Umatilla

Township 6 N Range 35 E Section 27

SW ¼ of SW ¼

53946 Umapine Hwy
Milton Freewater, OR 97862

(7) STATIC WATER LEVEL:

26 ft below land surface, Date 4/17/13

(8) WATER BEARING ZONES:

Depth at which water was first found 26

From	To		SWL
26	36		26

(9) WELL LOG:

Material	From	To	SWL
Silty Sand	0	5	
Sand Gravel	5	12	
Silty Sandy Gravel	12	36	26

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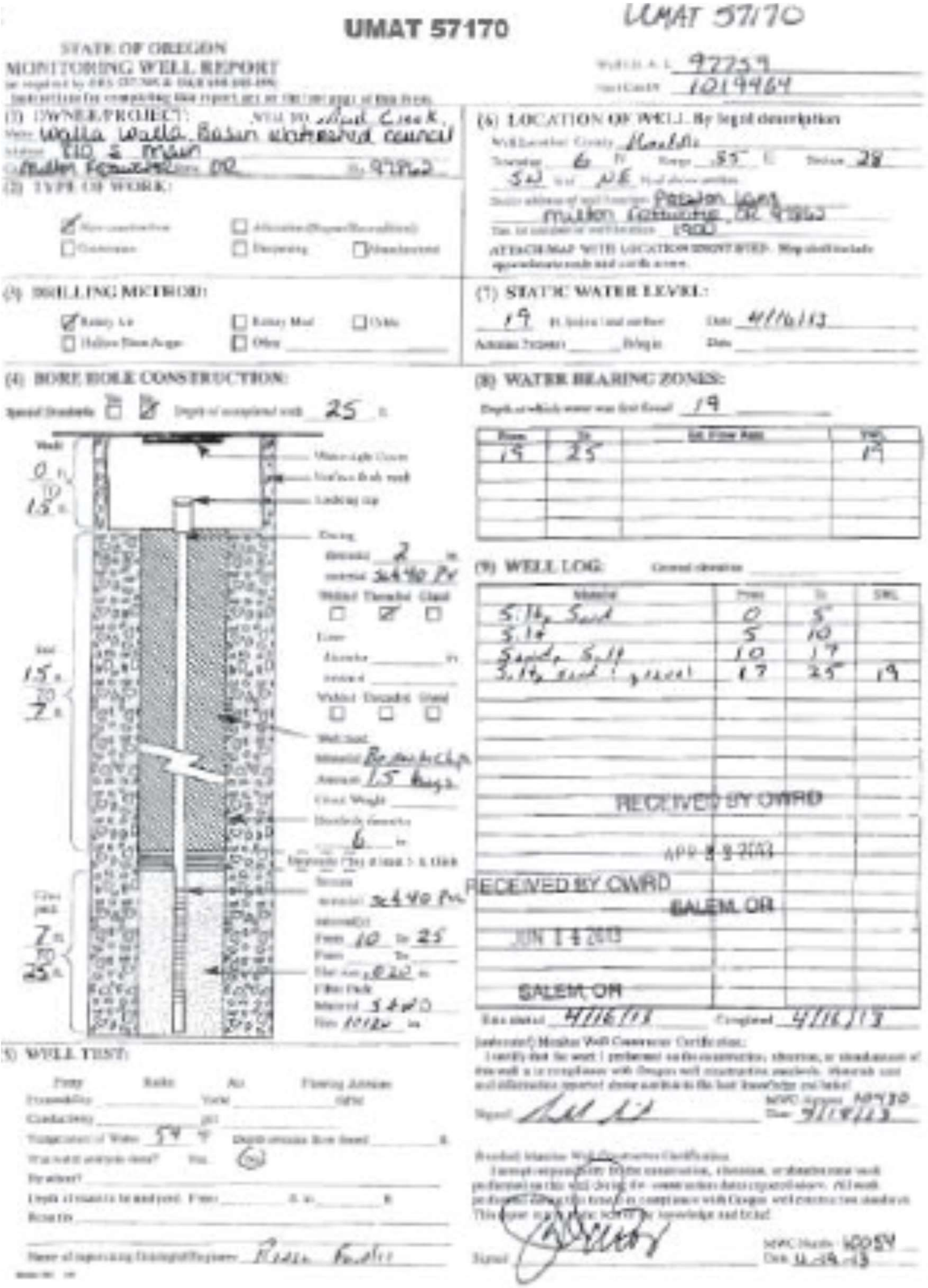
Date started 4/17/13 Completed 4/17/13

MWC Number 10621

GW_143



UMAT 57170

UMAT 57170

STATE OF OREGON
MONITORING WELL REPORT

Well I.D. # L 97759
Start Card # 1019464

(1) OWNER/PROJECT: WELL NO. Mud Creek
Name Walla Walla Basin Watershed Council
Address 810 S Main
City Milton Freewater State OR Zip 97862

(2) TYPE OF WORK:

☑ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD:

☑ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes ☐ No ☑ Depth of completed well 25 ft.

Seal 0 ft. to 1.5 ft.
Watertight Cover
Surface flush vault
Locking cap

Seal 1.5 ft. to 7 ft.
Casing diameter 2 in. material sch 40 PVC
Welded ☐ Threaded ☑ Glued ☐
Liner diameter ____ in. material ____
Welded ☐ Threaded ☐ Glued ☐
Well seal material Bentonite chips
Amount 15 bags
Grout Weight ____
Borehole diameter 6 in.

Filter pack 7 ft. to 25 ft.
Screen material sch 40 PVC
Interval(s) From 10 to 25
From ____ To ____
Slot size .020 in.
Filter Pack Material SAND
Size 10/20

(5) WELL TEST:

Pump Bailer Air Flowing Artesian
Permeability ____ Yield ____ GPM
Conductivity ____
Temperature of Water 54 °F Depth artesian flow found ____ ft.
Was water analysis done? Yes [✓ No]
By whom? ____
Depth of strata to be analyzed. From ____ ft. to ____ ft.
Remarks ____

Name of supervising Geologist/Engineer Roger Fowler

(6) LOCATION OF WELL by legal description:

Well Location: County Umatilla
Township 6 N Range 35 E Section 28
SW 1/4 NE 1/4
Street address of well location Pessian Lane
Milton Freewater, OR 97862
Tax lot number of well location 1900

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

19 ft. below land surface Date 4/16/13
Artesian Pressure ____ lb/sq in. Date ____

(8) WATER BEARING ZONES:

Depth at which water was first found 19

From	To	Est. Flow Rate	SWL
19	25		19

(9) WELL LOG: Ground elevation ____

Material	From	To	SWL
Silty Sand	0	5	
Silt	5	10	
Sandy Silt	10	17	
Silty sand & gravel	17	25	19

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APR 2 9 2013
SALEM, OR

RECEIVED BY OWRD
JUN 1 4 2013
SALEM, OR

Date started 4/16/13 Completed 4/16/13

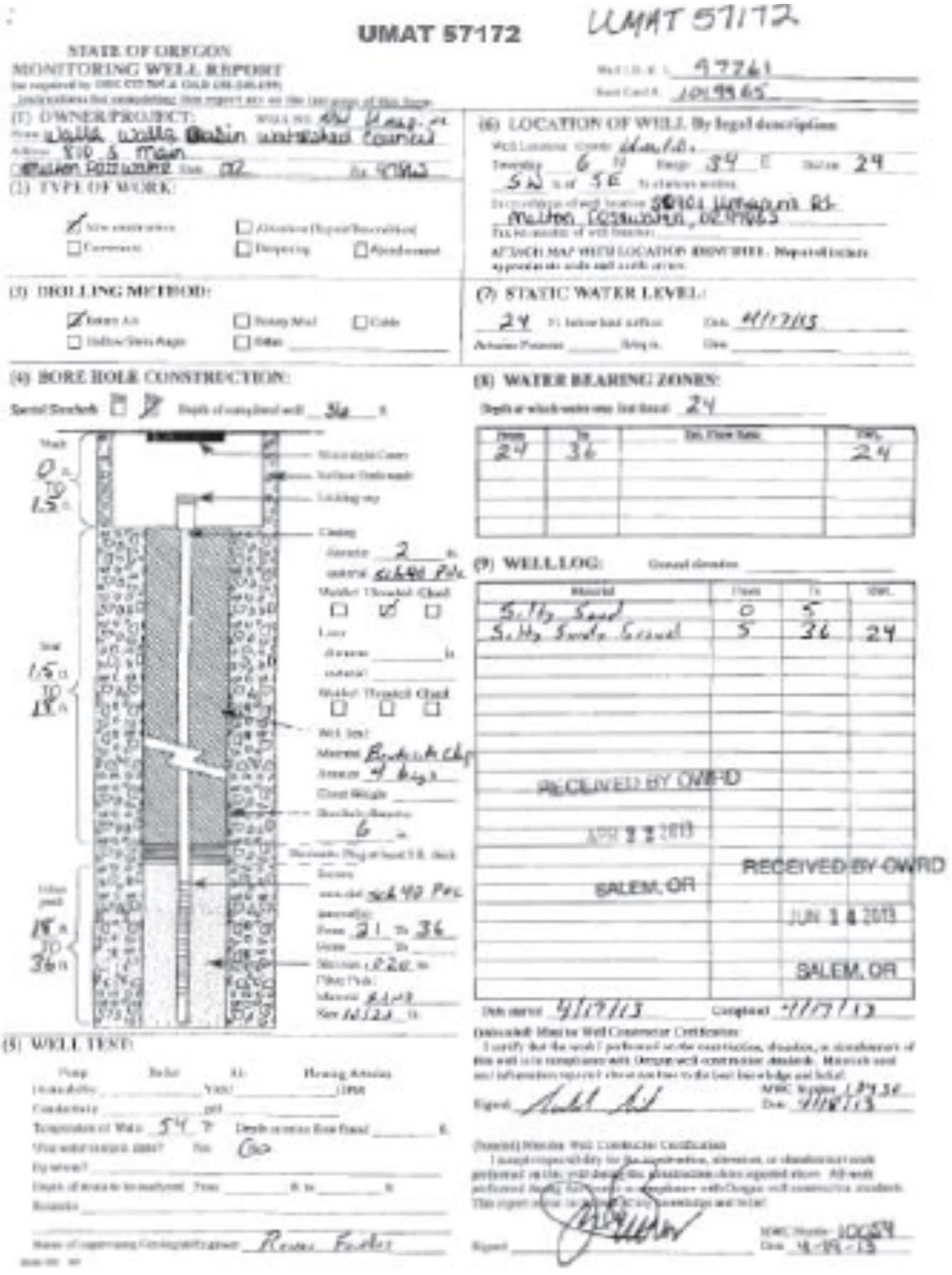
(unbonded) Monitor Well Constructor Certification:

MWC License No. 10930 Date 9/18/13

(bonded) Monitor Well Constructor Certification:

MWC Number 10059 Date 11-18-13

GW_144



UMAT 57172

UMAT 57172

STATE OF OREGON
MONITORING WELL REPORT

Well I.D. # L 97761
Start Card # 1019965

(1) OWNER/PROJECT:
Walla Walla Basin Watershed Council
810 S Main
Milton Freewater OR 97862

(2) TYPE OF WORK:
☑ New construction

(3) DRILLING METHOD:
☑ Rotary Air

(4) BORE HOLE CONSTRUCTION:
Depth of completed well 36 ft.

Vault 0 ft. TO 1.5 ft.
Seal 1.5 ft. TO 18 ft.
Filter pack 18 ft. TO 36 ft.

Casing diameter 2 in.
material sch40 PVC
Welded ☐ Threaded ☑ Glued ☐

Well Seal:
Material Bentonite Chips
Amount 4 bags

Borehole diameter 6 in.

Screen material sch 40 PVC
From 21 to 36
Slot size .020 in.

Filter Pack:
Material silica
Size 10/20

(5) WELL TEST:
Temperature of Water 54 °F
Was water sample taken? Yes [✓ No]

Name of supervising Geologist/Engineer Renee Fisher

(6) LOCATION OF WELL by legal description:
Well Location County Umatilla
Township 6 N Range 34 E Section 24
SW ¼ of SE ¼
Street address of well location 85901 Umapine Rd
Milton Freewater, OR 97862

(7) STATIC WATER LEVEL:
24 Ft. below land surface Date 4/17/13

(8) WATER BEARING ZONES:
Depth at which water was first found 24

From	To	Est. Flow Rate	SWL
24	36		24

(9) WELL LOG:

Material	From	To	SWL
Silty Sand	0	5	
Silty Sandy Gravel	5	36	24

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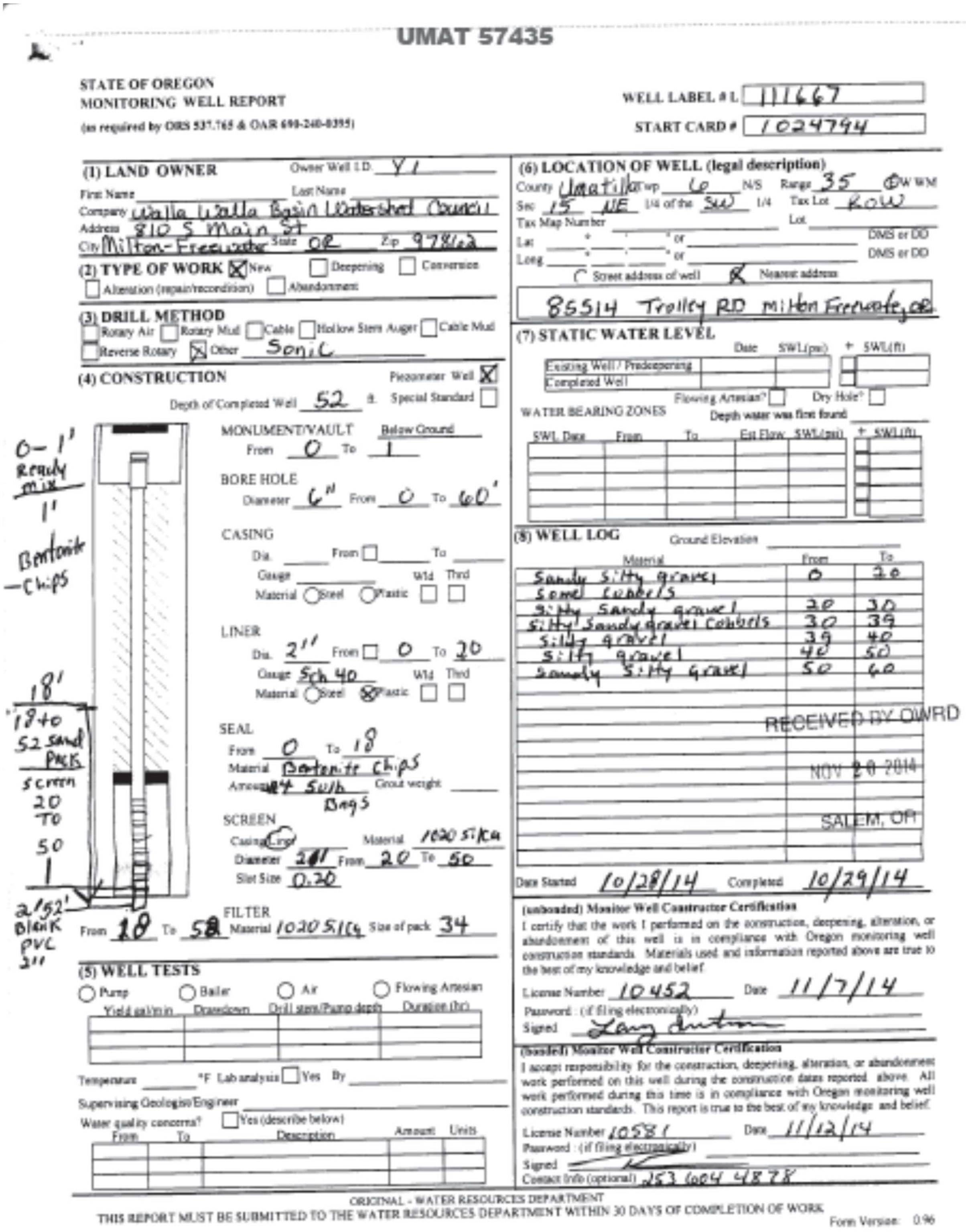
JUN 14 2013
SALEM, OR

Date started 4/17/13 Completed 4/17/13

(Unbonded) Monitor Well Constructor Certification
MWC Number 18436
Date 4/18/13

(Bonded) Monitor Well Constructor Certification
MWC Number 10024
Date 4-19-13

GW_151



UMAT 57435

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 111667
START CARD # 1024794

(1) LAND OWNER Owner Well I.D. Y1
First Name ______ Last Name ______
Company Walla Walla Basin Watershed Council
Address 810 S Main St
City Milton-Freewater State OR Zip 97862

(2) TYPE OF WORK ☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other Sonic

(4) CONSTRUCTION Piezometer Well ☒
Depth of Completed Well 52 ft. Special Standard ☐

0-1' Ready mix
1'
Bentonite -Chips
18'
18 to 52 sand PACK
screen 20 TO 50
2/52' Blank PVC 2''

MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 6" From 0 To 60'

CASING
Dia. ______ From ☐ ______ To ______
Gauge ______ Wld ☐ Thrd ☐
Material ○ Steel ○ Plastic

LINER
Dia. 2'' From ☐ 0 To 20
Gauge Sch 40 Wld ☐ Thrd ☐
Material ○ Steel ⊗ Plastic

SEAL
From 0 To 18
Material Bentonite Chips
Amount 4 50lb Bags Grout weight ______

SCREEN
Casing/(Liner) Material 1020 Silica
Diameter 2" From 20 To 50
Slot Size 0.20

FILTER
From 18 To 52 Material 1020 Silica Size of pack 34

(5) WELL TESTS
○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature ______ °F Lab analysis ☐ Yes By ______
Supervising Geologist/Engineer ______
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)
County Umatilla Twp 6 N/S Range 35 Ⓔ/W WM
Sec 15 NE 1/4 of the SW 1/4 Tax Lot ROW
Tax Map Number ______ Lot ______
Lat ______ or ______ DMS or DD
Long ______ or ______ DMS or DD
○ Street address of well ☒ Nearest address
85514 Trolley RD milton Freewater, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐
WATER BEARING ZONES Depth water was first found ______

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG Ground Elevation ______

Material	From	To
Sandy Silty gravel	0	20
some cobbels		
Silty Sandy gravel	20	30
Silty Sandy gravel Cobbels	30	39
Silty gravel	39	40
Silty gravel	40	50
Sandy Silty gravel	50	60

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NOV 20 2014
SALEM, OR

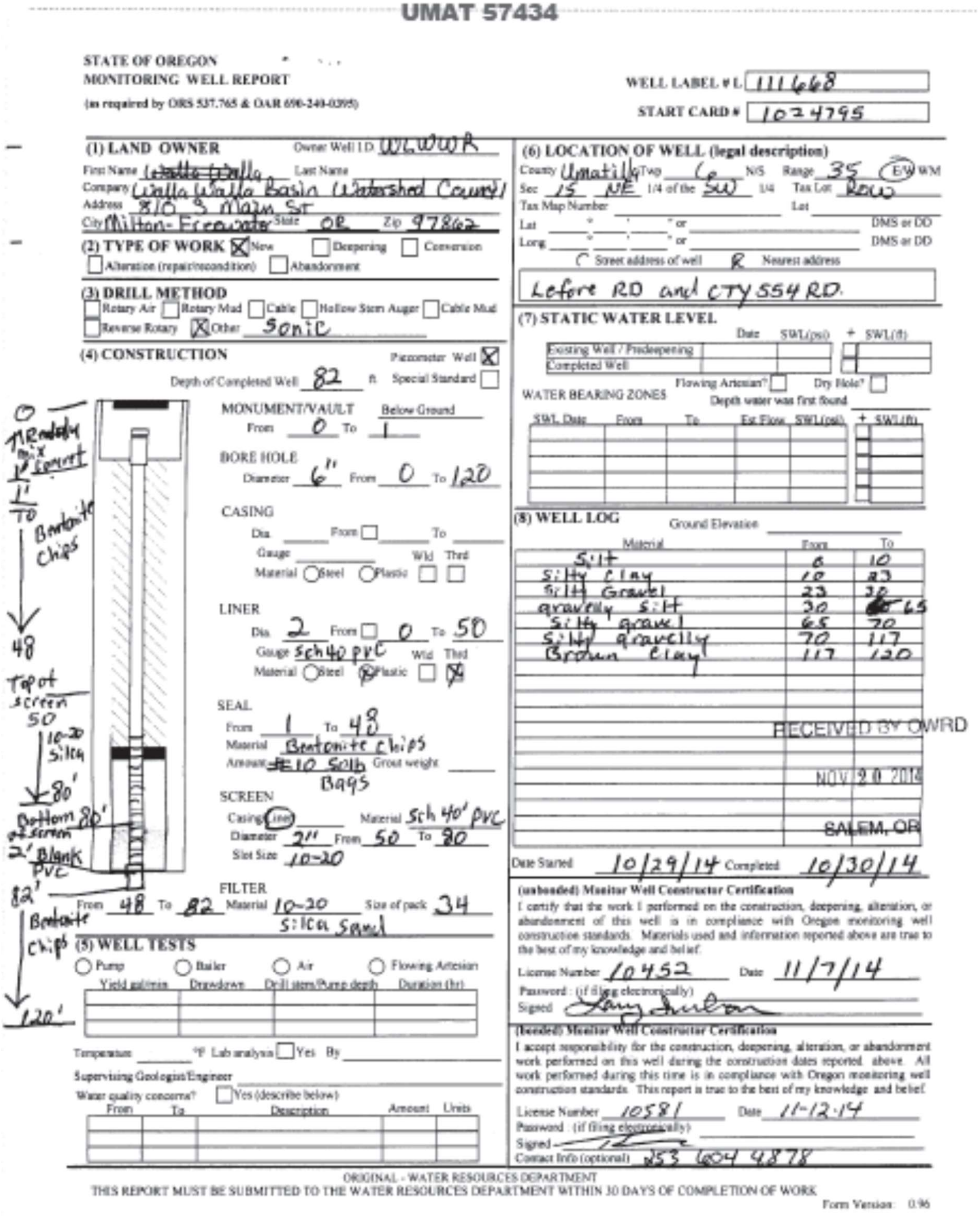
Date Started 10/28/14 Completed 10/29/14

(unbonded) Monitor Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
License Number 10452 Date 11/7/14
Password : (if filing electronically) ______
Signed Larry Dutton

(bonded) Monitor Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.
License Number 10581 Date 11/12/14
Password : (if filing electronically) ______
Signed ______
Contact Info (optional) 253 604 4878

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
Form Version: 0.96

GW_152



UMAT 57434

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 111668
START CARD # 1024795

(1) LAND OWNER Owner Well I.D. WLWWR
First Name ~~Walla Walla~~ Last Name
Company Walla Walla Basin Watershed Council
Address 810 S Main St
City Milton-Freewater State OR Zip 97862

(2) TYPE OF WORK ☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other Sonic

(4) CONSTRUCTION Piezometer Well ☒
Depth of Completed Well 82 ft. Special Standard ☐

MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 6" From 0 To 120

CASING
Dia. ____ From ☐ ____ To ____
Gauge ____ Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

LINER
Dia. 2 From ☐ 0 To 50
Gauge Sch 40 PVC Wld Thrd
Material ○ Steel ● Plastic ☐ ☒

SEAL
From 1 To 48
Material Bentonite chips
Amount #10 50lb Bags Grout weight ____

SCREEN
Casing/[✓ Liner] ____ Material Sch 40' PVC
Diameter 2" From 50 To 80
Slot Size 10-20

FILTER
From 48 To 82 Material 10-20 silica sand Size of pack 34

(5) WELL TESTS
○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature ____ °F Lab analysis ☐ Yes By ____
Supervising Geologist/Engineer ____
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)
County Umatilla Twp 6 N/S Range 35 [✓ E]/W WM
Sec 15 NE 1/4 of the SW 1/4 Tax Lot ROW
Tax Map Number ____ Lot ____
Lat ____° ____' ____" or ____ DMS or DD
Long ____° ____' ____" or ____ DMS or DD
○ Street address of well [✓ Nearest address]
Lefore RD and CTY 554 RD.

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found ____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG Ground Elevation ____

Material	From	To
Silt	6	10
Silty clay	10	23
Silty Gravel	23	30
gravelly silt	30	65
Silty gravel	65	70
Silty gravelly	70	117
Brown clay	117	120

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NOV 20 2014
SALEM, OR

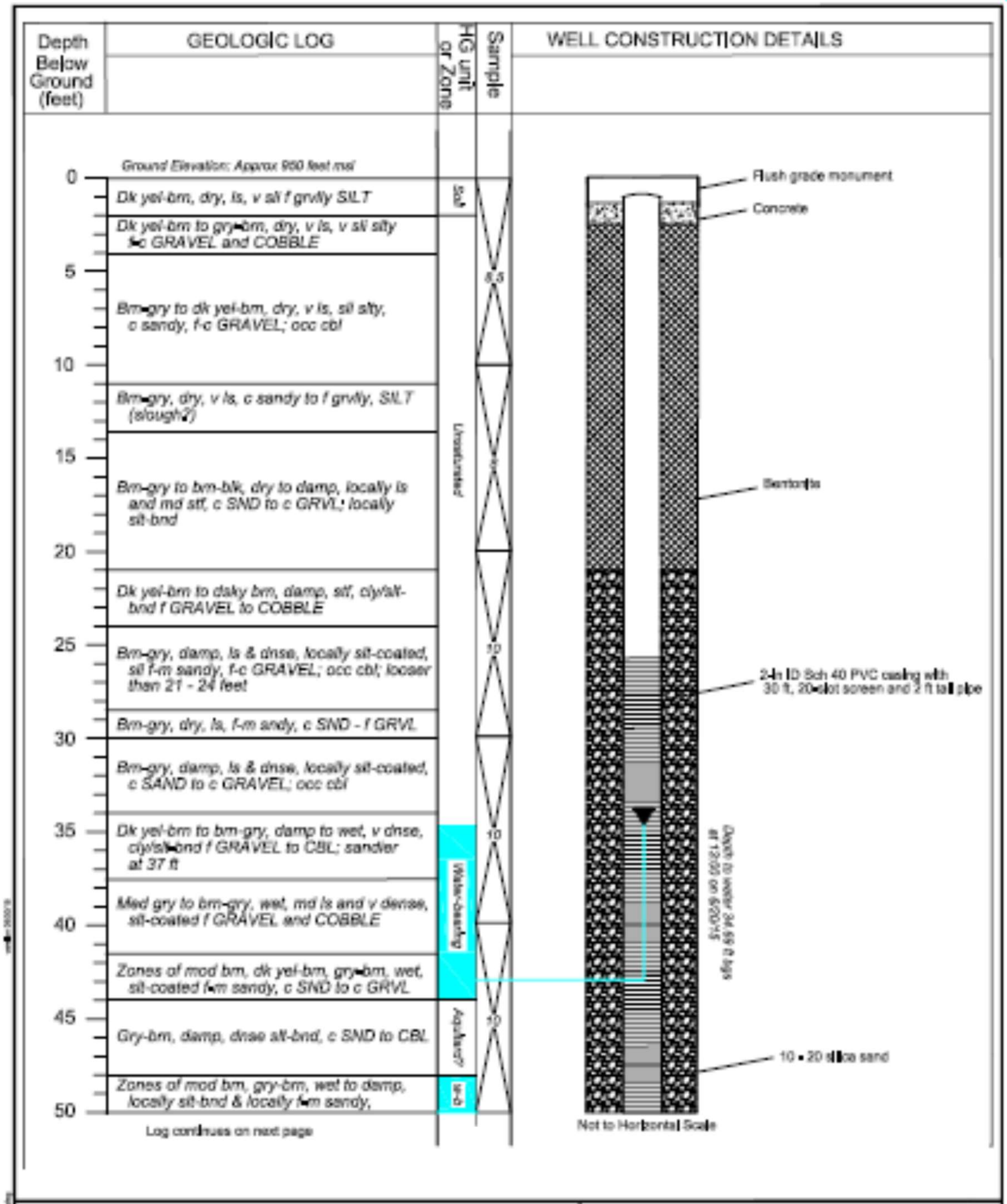
Date Started 10/29/14 Completed 10/30/14

(unbonded) Monitor Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
License Number 10452 Date 11/7/14
Password : (if filing electronically)
Signed Larry Inilson

(bonded) Monitor Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.
License Number 10581 Date 11-12-14
Password : (if filing electronically)
Signed
Contact Info (optional) 253 604 4878

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
Form Version: 0.96

GW_160, Page 1 of 3



Ground Elevation: Approx 950 feet msl

Dk yel-brn, dry, ls, v sli f grvly SILT

Dk yel-brn to gry-brn, dry, v ls, v sli slty f-c GRAVEL and COBBLE

Brn-gry to dk yel-brn, dry, v ls, sli slty, c sandy, f-c GRAVEL; occ cbl

Brn-gry, dry, v ls, c sandy to f grvly, SILT (slough?)

Brn-gry to brn-blk, dry to damp, locally ls and md stf, c SND to c GRVL; locally slt-bnd

Dk yel-brn to dsky brn, damp, stf, cly/slt-bnd f GRAVEL to COBBLE

Brn-gry, damp, ls & dnse, locally slt-coated, sli f-m sandy, f-c GRAVEL; occ cbl; looser than 21 - 24 feet

Brn-gry, dry, ls, f-m sndy, c SND - f GRVL

Brn-gry, damp, ls & dnse, locally slt-coated, c SAND to c GRAVEL; occ cbl

Dk yel-brn to brn-gry, damp to wet, v dnse, cly/slt-bnd f GRAVEL to CBL; sandier at 37 ft

Med gry to brn-gry, wet, md ls and v dense, slt-coated f GRAVEL and COBBLE

Zones of mod brn, dk yel-brn, gry-brn, wet, slt-coated f-m sandy, c SND to c GRVL

Gry-brn, damp, dnse slt-bnd, c SND to CBL

Zones of mod brn, gry-brn, wet to damp, locally slt-bnd & locally f-m sandy,

Log continues on next page

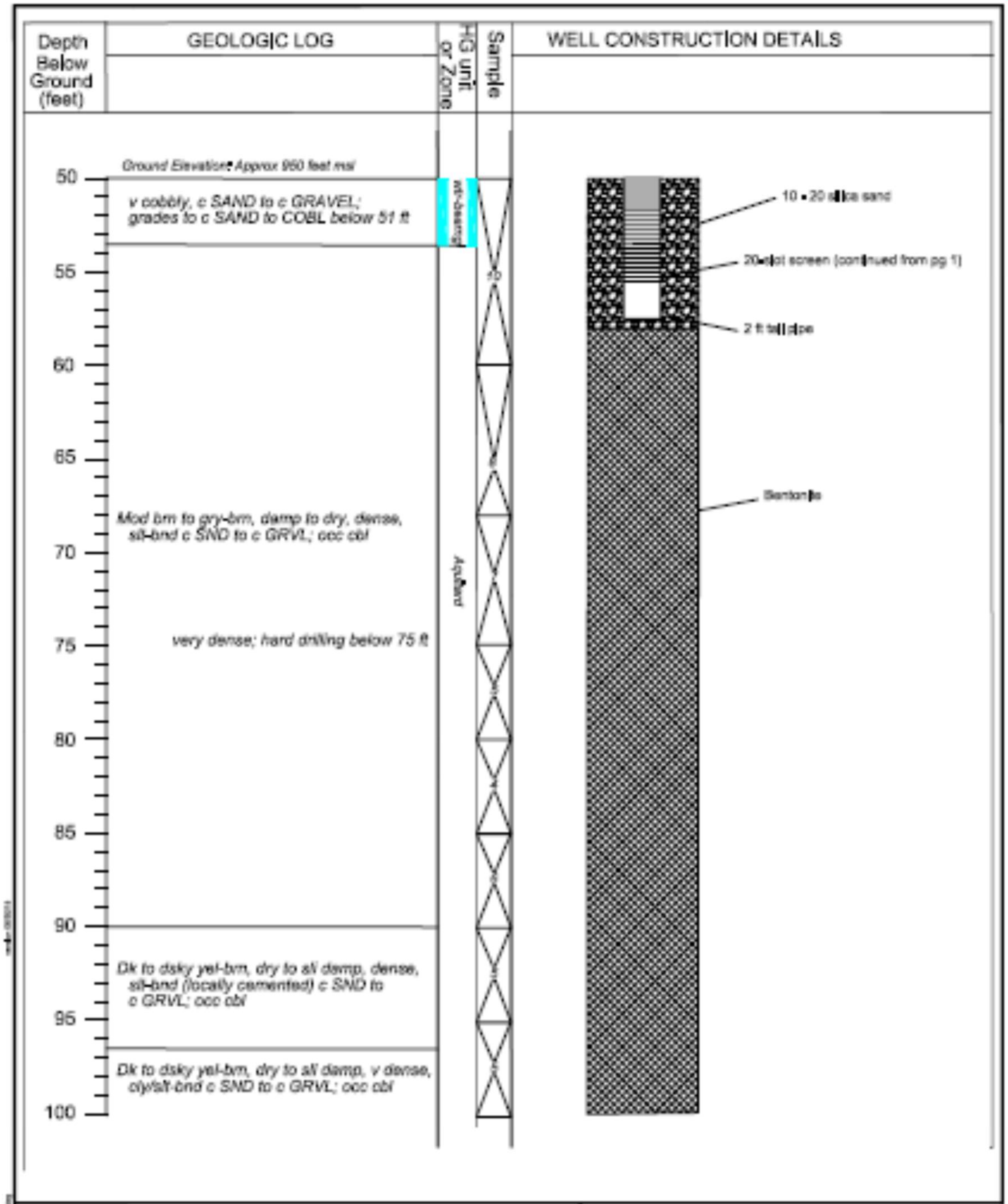
PROJECT NAME: Eastside ASR Feasibility
DRILLING METHOD: Sonic, 6-inch casing, 4-inch sample
DRILLER: Pete Rosenberg (driller), Jacob, Josh (helpers)
FIRM: Holt Services, Inc
CONSULTING FIRM: Northwest Land & Water, Inc
REPRESENTATIVE: Jim Mathieu, Hydrogeologist
LOCATION: SE 1/4 NE 1/4 Sec 36 T6N, R35E
WELL NAME: GW_160; aka CR-1
WELL TAG & START CARD: L111671 & 1026739

Figure 3 (page 1 of 3)
GW_160 Geologic Log & Monitoring Well As-Built

Eastside Milton-Freewater, OR
Walla Walla Basin Watershed Council

NORTHWEST Land & Water, Inc.

GW_160, Page 2 of 3

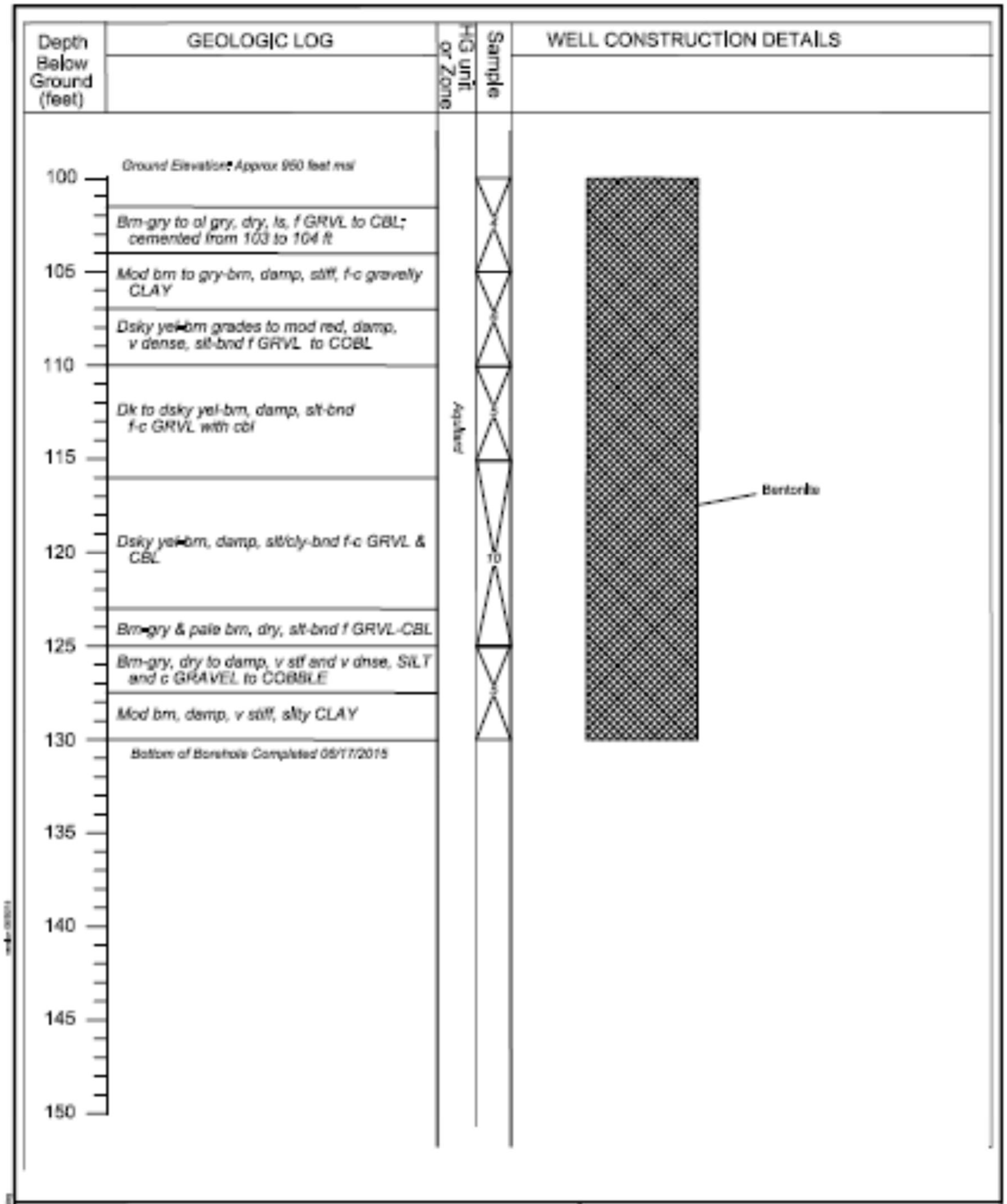


PROJECT NAME: Eastside ASR Feasibility
DRILLING METHOD: Sonic, 6-inch casing, 4-inch sample
DRILLER: Pete Rosenberg (driller), Jacob, Josh (helpers)
FIRM: Holt Services, Inc
CONSULTING FIRM: Northwest Land & Water, Inc
REPRESENTATIVE: Jim Mathieu, Hydrogeologist
LOCATION: SW 1/4 NE 1/4 Sec 36 T6N, R35E
WELL NAME: GW_160; aka CR-1
WELL TAG & START CARD: L111671 & 1026739

Figure 3 (page 2 of 3)
GW_160 Geologic Log & Monitoring Well As-Built

Eastside Milton-Freewater, OR
Walla Walla Basin Watershed Council

GW_160, Page 3 of 3



PROJECT NAME: Eastside ASR Feasibility
DRILLING METHOD: Sonic, 6-inch casing, 4-inch sample
DRILLER; Pete Rosenberg (driller), Jacob, Josh (helpers)
FIRM: Holt Services, Inc
CONSULTING FIRM: Northwest Land & Water, Inc
REPRESENTATIVE: Jim Mathieu, Hydrogeologist
LOCATION; SW 1/4 NE 1/4 Sec 36 T6N, R35E
WELL NAME: GW_160; aka CR-1
WELL TAG & START CARD: L111671 & 1026739

Figure 3 (page 3 of 3)
GW_160 Geologic Log & Monitoring Well As-Built

Eastside Milton-Freewater, OR
Walla Walla Basin Watershed Council

No well logs for: GW_35, GW_40, GW_41, GW_62, GW_63, GW_135, GW_150, GW_169, GW_170, and GW_171.