

**Phase 1 Report
Hydrogeologic Investigation**

Drainage Problem Area
City of West Richland, Washington

for
City of West Richland

February 14, 2019



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File No. 3234-005-00

February 14, 2019

Prepared for:

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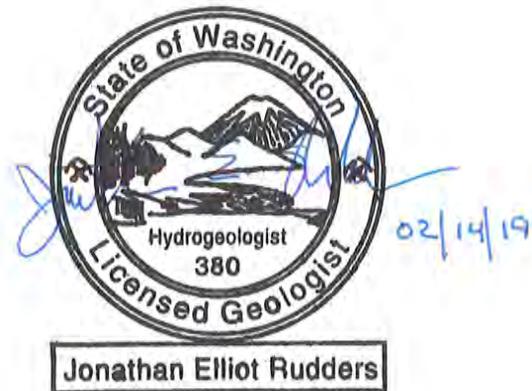
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Table of Contents

INTRODUCTION.....	1
SCOPE OF SERVICES	1
PHYSIOGRAPHY.....	2
CLIMATE SUMMARY.....	2
LAND USE	2
Existing Land Use.....	2
History of Residential Development	3
SUMMARY OF GEOLOGIC AND HYDROGEOLOGIC SETTING.....	4
Geologic Setting.....	4
Hydrogeologic Setting.....	5
CRBG Unit.....	5
Sedimentary Unit.....	6
DATA COMPILATION.....	7
Data Sources.....	7
Subsurface Database	7
Mapping.....	8
Summary of Results.....	8
GROUNDWATER OBSERVATIONS	9
PRECIPITATION TRENDS	10
WATER USE AND IRRIGATION REQUIREMENTS	10
Water Use.....	10
Irrigation Requirements (Consumptive Use)	12
DRAINAGE COMPLAINTS.....	13
AVAILABLE STORAGE	13
CONCLUSIONS.....	14
GAPS IN DPA UNDERSTANDING	15
LIMITATIONS.....	15
REFERENCES	16
LIST OF FIGURES	
Figure 1. Vicinity Map	
Figure 2. Surficial Geology Map	
Figure 3. Thickness of Sediments Overlying Basalt	
Figure 4. Top of Basalt Elevation	
Figure 5. Depth to Top of Limiting Stratigraphic Unit	
Figure 6. Hydrogeologic Cross-Section A-A'	
Figure 7. Hydrogeologic Cross-Section B-B'	
Figure 8. Drainage Complaints	

APPENDICES

Appendix A. Development History: Oldest and Newest Permit Date Range

Appendix B. Historic Aerial Photos

Figures B-1 through B-8. Historical Aerial Photographs

Appendix C. Water Well Reports

Appendix D. Subsurface Database

Table D-1. Compilation of Water Well Report Observations

Table D-2. Completion of Test Pit Observations

Appendix E. Shallow Groundwater Mapping

Table E-1. September 2017 and October 2018 Groundwater Monitoring Results

Figures E-1 through E-4. Draft City Groundwater Maps

Appendix F. Precipitation Trends

Table F-1. Precipitation Data - Kennewick Climate Station

Table F-2. Cumulative Departure in Precipitation

Figure F-1. Monthly Precipitation

Figure F-2. Cumulative Departure in Precipitation

Appendix G. Blaney-Criddle Method for Calculating Consumptive Use

Table G-1. Blaney-Criddle Method for Calculating Consumptive Use

Appendix H. Compilation of Recent Drainage Complaints

Table H-1. Compilation of Recent Drainage Complaints

Appendix I. Report Limitations and Guidelines for Use

INTRODUCTION

This report summarizes results of the initial phase of our investigation characterizing the hydrogeologic conditions that underly a drainage problem area (DPA) within the City of West Richland, Washington (herein referred to as the City). Based on observation of water levels within infiltration structures such as drywells and infiltration trenches, the City has identified a DPA in an area of relatively new development in the City. The DPA is situated within a topographic plateau roughly bounded by Polaris Way on the south, South 54th Avenue on the east, Collins Road on the north and Onyx Avenue on the west, approximately as shown on the Vicinity Map, Figure 1.

The City has observed shallow water levels in DPA manholes, drywells and infiltration trenches during their monitoring operations, and noted slow or restricted drainage in a number of these facilities. The observed groundwater levels and drainage problems appear to fluctuate seasonally, with levels rising through the summer lawn irrigation season and peaking during late fall. The City has also received complaints from residents within the DPA related to flooding of basements and other structures.

SCOPE OF SERVICES

This investigation will be conducted in phases. The objectives of the Phase 1 investigation are to: (1) develop a hypothesis or conceptual model describing the hydrologic conditions that are causing the observed elevated groundwater levels and drainage problems; (2) identify data gaps that limit our understanding of the observed drainage problem and its cause(s); and (3) develop recommendations for a supplemental Phase 2 investigation intended to fill some or all of the identified data gaps.

Our specific scope of services for Phase 1 of this investigation included:

1. Review existing information regarding hydrogeologic conditions within the DPA and surrounding area.
2. Review data and information provided by the City.
3. Download historic precipitation data from the Richland, Washington (Station No. 457015) and Kennewick, Washington (Station No. 454154) climate stations.
4. Evaluate whether local precipitation trends potentially could have influenced the rise in DPA groundwater levels using cumulative departure analysis.
5. Tabulate subsurface data from previous DPA explorations regarding observed soil stratigraphy.
6. Tabulate groundwater level data including depth to and elevation of the groundwater table beneath the DPA.
7. Create plan view maps of the DPA showing depth to/elevation of the groundwater table and the subsurface distribution of geologic features that are interpreted to have caused or contributed to the DPA.
8. Create two hydrogeologic cross sections across the DPA.
9. Review a figure, provided by the City, that presented development history within the DPA as a function of building permit date.

10. Develop a conceptual model of the shallow hydrogeologic conditions that describes the potential cause(s) of elevated groundwater water levels and the most likely water source in the DPA.
11. Identify gaps that limit our understanding of the hydrogeologic conditions causing the observed DPA groundwater level rise.
12. Develop general recommendations for a Phase 2 hydrogeologic investigation intended to address the identified gaps in our understanding of DPA extent and causes.

PHYSIOGRAPHY

The DPA and surrounding area is located within the central portion of the Columbia Plateau physiographic province. The existing topography of the area developed during the Pleistocene Epoch (about 1.5 million to 10,000 years ago) and the Holocene Epoch (10,000 years ago to today). In the Pleistocene a sequence of catastrophic flood events, generated by the failure of ice dams in western Montana and northern Idaho, stripped away overlying sediments within the area surrounding the site, leaving erosional features in the underlying basalt surface and depositing coarse-grained outburst flood deposits (Whiteman et al. 1994). More recent stream erosion and wind deposition has slightly modified this landscape.

The DPA encompasses an area of approximately 490 acres and is situated within a plateau that is somewhat isolated topographically from the surrounding area. The topography of the DPA, which varies in elevation from about 610 to 660 feet, descends in all directions except to the northeast where the DPA sits at the base of a basalt upland locally known as Flat Top Hill. Ground surface elevation on Flat Top Hill reaches 760 feet. The Yakima River is located about 1.5 miles northeast of the DPA and is at an elevation of about 400 feet. (Elevations in this report refer to the North American Vertical Datum of 1988 [NAVD 88], unless otherwise specified.)

The area surrounding the DPA is drained by the Yakima River and its perennial and intermittent tributaries. South of the DPA, the area is drained by an east-west system of discontinuous small lakes (including Lost Lake) with generally discontinuous and ephemeral natural surface drainage systems.

CLIMATE SUMMARY

The climate of the West Richland area is arid to semi-arid. Based on summary information associated with Richland Climate Station No.457015, mean maximum temperature is 65.6 degrees Fahrenheit (°F) and mean minimum temperature is 42.6°F. Daily high temperatures commonly exceed 100 °F in the summer and as a result lawn irrigation is very common in the DAP. Mean annual precipitation is reported at 7.1 inches per year and mean annual snowfall is reported at 7.8 inches per year. About 3.7 inches of precipitation and 7.6 inches of snowfall occur during the 4-month period from November through February.

LAND USE

Existing Land Use

Existing land use within the DPA is dominated by single-family residential use. West of Belmont Avenue and its extension, the DPA is characterized by dense residential development with lot sizes on the order

of ¼-acre. East of Belmont Avenue and its extension, lot sizes are larger and generally in the range of 1¼ to 2½ acres. Within residential areas, impermeable surfaces and lawn irrigation systems are common. The City maintains stormwater collection and infiltration infrastructure west of Belmont Avenue and its extension. The stormwater collection system consists primarily of drywells and stormwater collection/ infiltration swales. Stormwater is not collected and directed out of the area via subsurface drains and pipes.

The area surrounding the DPA is characterized by a mix of semi-arid shrub steppe grasslands, basalt outcrops, actively farmed irrigated ground, and residential subdivisions. Dense residential land use occurs south and southeast of the DPA within the area roughly bounded by Belmont Boulevard on the west, Paradise Way on the north, Bombing Range Road on the east, and Keene Road on the south. Dispersed residences occur to the east of the DPA. Farmed areas exist to the northwest, west and southwest of the DPA and generally consist of irrigated circles serviced by center pivots.

A summary of DPA development boundaries, as well as associated building permit dates, was provided to GeoEngineers by the City and is attached to this report within Appendix A.

History of Residential Development

GeoEngineers conducted a review of aerial photographs for the period from 1996 through 2018 as a basis for identifying the timing of DPA transition from shrub and grassland to residential use. Aerial photographs are provided in Figures B-1 through B-8 of Appendix B. Our observations are summarized below:

- In July 1996 (Figure B-1), the DPA was largely undeveloped and consisted of grassland. A total of 8 to 10 dispersed residences and a network of unimproved roadways were present. Irrigated lawn acreage appeared to be less than four acres.
- In June 2003 (Figure B-2), dense residential developments were emerging within the extreme southeast portion of the DPA (Desert Paradise and Paradise South). However, no dense residential developments were present within the remainder of the DPA. The number of dispersed residences east of Belmont Boulevard and extension had increased to approximately 30. A grid of gravel roads also was present within this portion of the DPA. Ground disturbance, apparently in anticipation of future home construction was evident in the northwest portion of the DPA (Collins Ridge/Collins Heights). Total irrigated lawn acreage appeared to be on the order of 15 acres.
- By June 2006 (Figure B-3), dense residential developments were emerging within the northwest portion of the DPA (Collins Ridge) and the southeast portion of the DPA (Swanson Heights), and approximately 50 homes had been constructed in these areas. Irrigated lawns had been installed within the Desert Paradise and Paradise South developments. The number of dispersed residences within the remainder of the DPA had increased to approximately an additional 40 homes. Enterprise Middle School had been constructed along the southeast margin of the DPA. Total irrigated lawn acreage within the DPA appeared to be on the order of 25 acres.
- By September 2009 (Figure B-4), the dense residential developments identified in June 2006 (Collins Ridge and Swanson Heights) had increased to approximately 70 homes. The number of dispersed residences was similar to 2006. Portions of the gridded roadways appear to have been paved. Total irrigated acreage within the DPA appeared to be on the order of 30 acres.

- By November 2011 (Figure B-5), the dense residential developments identified in June 2009 (Collins Ridge and Swanson Heights) had increased to approximately 80 homes. Approximately 40 homes had been constructed within the Paradise Estates and Sunset Ridge developments. Many of these newer homes did not yet have irrigated lawns. The Mountain View Estates development had been constructed within the southwest portion of the DPA. Total irrigated acreage within the DPA appeared to be in the range of 35 acres. Earthwork appeared to be in progress to expand the Collins Ridge, Paradise Estates, and Sunset Ridge developments.
- By July 2013 (Figure B-6), buildout had progressed within the Collins Ridge, Paradise Estates, and Sunset Ridge developments and most of the newer homes had irrigated lawns. Earthwork appeared ongoing within the Collins Ridge and Paradise Estates developments. Total irrigated acreage within the DPA appeared to be on the order of 65 acres.
- The time period between July 2013 (Figure B-6) and August 2016 (Figure B-7) was a period of abundant residential development west of Belmont Boulevard and its extension. The Sunset Ridge, Paradise Estates, Collins Ridge, and Collins Heights developments each experienced complete or nearly-complete buildout and road paving. Westwood Estates experienced approximately 50 percent buildout. Total irrigated acreage within the DPA appeared to be on the order of 100 acres.
- By July 2018 (Figure B-8), Westwood Estates experienced complete buildout and road paving. Earthwork and home construction were ongoing within the Sunset Heights development. Total irrigated acreage within the DPA appeared to be on the order of 120 acres.

SUMMARY OF GEOLOGIC AND HYDROGEOLOGIC SETTING

Geologic Setting

The DPA is located within the southeastern portion of the Pasco Basin, a structural and topographic low within south-central Washington. Geologic conditions within and surrounding the DPA generally are defined by three general stratigraphic units including, from oldest to youngest: (1) Miocene-age (about 17.5 to 5.5 MA) basalt flows of the Columbia River Basalt Group (CRBG) and contemporaneous sedimentary interbeds of the Ellensburg Formation; (2) sediments associated with the Miocene-age to Pliocene-age (about 6.0 to 2.6 MA) Ringold Formation; and (3) Pleistocene-age glaciofluvial (flood) deposits and more recent eolian and alluvial deposits. Surficial geology within and surrounding the study area is summarized in the Surficial Geology Map, Figure 2.

A recent stratigraphic framework for the CRBG is described by Reidel and Tolan (2013). Therein, the CRBG was subdivided into five formations that include, from youngest to oldest, the Saddle Mountains Basalt, Wanapum Basalt, Grande Ronde Basalt (including the Picture Gorge Basalt), Imnaha Basalt, and the Steens Basalt (Reidel and Tolan 2013). Total CRBG thickness within the Pasco Basin is more than 15,000 feet (Drost et al. 1997). Sedimentary interbeds exist within and between specific basalt formations, members, and flows within the CRBG. Collectively, these sedimentary interbeds are termed the Ellensburg Formation, despite differences in age, location, lithology and continuity (Reidel and Tolan 2013).

The uppermost CRBG unit underlying the DPA is the Saddle Mountains Basalt. Two of its youngest units, the Ice Harbor Member and the Elephant Mountain Member are exposed at the surface on Flat Top Hill and in numerous locations surrounding the DPA.

The CRBG is deformed by a series of northwest- to west-trending folds and associated faults that form the Yakima Fold Belt. The large ridge to the south and west of the DPA which is defined by Badger Mountain and Red Mountain is one of these fold/fault structures. Flat Top Hill which is on the southern boundary of the DPA is a smaller version of one of these fold/fault structures. Within the Yakima Fold Belt these highlands are uplifted folds in which the CRBG is deformed into anticlines. These anticline ridges are separated by broad lows, or synclines, in which sedimentary strata are commonly found.

In the Pasco Basin, and the project area, the primary syncline filling sedimentary strata consists of the fluvial-lacustrine Ringold Formation. The Ringold Formation consists of interbedded, variably-cemented and indurated claystone, siltstone, sand and gravel (conglomerate) that are younger than and overlie the CRBG (Lindsey 1996). The Ringold Formation is variously subdivided into sub-units referred to as the upper Ringold Formation (also mapped as the member of Savage Island and the member of Taylor Flat) and the middle Ringold Formation, the lower Ringold Formation, and the basal Ringold Formation also collectively referred to as the member of Wooded Island (Lindsey 1996; Drost et al. 1997; Heywood et al. 2016). Indurated conglomerate exposed on Bombing Range Road and in old gravel pits in and near the DPA are interpreted to belong to the middle Ringold Formation/member of Wooded Island. Clayey strata described on well logs as underlying the DPA are interpreted to belong to upper Ringold and/or lower Ringold.

During the Pleistocene, topography within and near the DPA was modified by floodwaters associated with catastrophic flooding caused by periodic failure of Glacial Lake Missoula. Floodwaters eroded CRBG and Ringold Formation deposits and left glaciofluvial sediments in excess of 200 feet in thickness within portions of the Pasco Basin (Drost et al. 1997). These glaciofluvial deposits, locally known as Pasco gravels, generally consist of unsorted mixtures of silt, sand, gravel, cobbles and boulders. In places, Pasco gravels are interbedded with relatively fine-grained deposits that are designated Touchet Beds. Collectively, Pasco gravels and Touchet Beds form the Hanford Formation. Pleistocene deposits are locally overlain by Holocene-age (less than about 12,000 years old) wind-blown dune sand deposits of limited thickness.

Hydrogeologic Setting

Groundwater underlying the DPA occurs within two primary hydrogeologic units, herein termed the CRBG unit and the sedimentary unit.

CRBG Unit

Groundwater in the CRBG unit is most readily transmitted through the broken, vesicular and scoriaceous interflow zones that characterize the top and/or bottom of each basalt flow (GWMA 2009, 2011; Kahle et al. 2011; Ely et al. 2014). The interflow zones are separated by the less porous and less transmissive entablature and colonnade, which comprise 90 to 95 percent of the typical total flow volume. The flows may be locally interlayered with sedimentary deposits. The horizontal hydraulic conductivity within interflow zones is as much as five orders of magnitude greater than the flow interiors. Drost et al. (1997) reports a median hydraulic conductivity of 2.3 feet per day for the Saddle Mountains Basalt.

In general, groundwater within the CRBG unit flows from upland areas to surface drainage features such as the Columbia River and its tributaries (Kahle et al. 2011; Ely et al. 2014). Groundwater flow is controlled by topography, geologic structures, basement topography, recharge and discharge conditions, unit continuity, and permeability variations. Basalt permeability is controlled by primary rock texture and

secondary jointing and fracturing. In many locations, the permeability of the CRBG interflow zones has been reduced by secondary mineralization of zeolites and/or clay infilling joints and fractures.

Recharge to shallow water-bearing zones within the CRBG is generated from precipitation, infiltration of irrigation water, and by leakage from overlying aquifers (if any). The arid to semi-arid nature of the Project Area limits the amount of available natural recharge from precipitation. Groundwater discharge from shallow water-bearing zones within the CRBG occurs as springs, base flow to surface water systems, slow leakage to aquifers with lower potentiometric heads, and water supply wells.

Sedimentary Unit

The sedimentary unit consists of all sediment that overlies the CRBG, including the Ringold Formation and Hanford Formation. These strata exceed 800 feet in thickness within the center of the Pasco Basin near the Columbia River (Heywood et al. 2016) and thin significantly along the basin margins. Aquifers within the sedimentary unit range from unconfined to confined and can be in hydraulic connection with adjacent streams and rivers.

Pasco gravels generally consist of free-draining sand and gravel with relatively high permeability. The Pasco gravels range from about 20 to 150 feet in thickness and, where sufficiently thick, can support relatively high-yield groundwater production wells (Drost et al. 1997; GWMA 2009, 2011; Kahle et al. 2011; Heywood et al. 2016). Drost et al. (1997) reports a median hydraulic conductivity of 880 feet per day for Pasco gravels.

The Ringold Formation forms a relatively complex assemblage of perched aquifers, unconfined aquifers, confined aquifers, and confining units (GWMA 2009, 2011; Heywood et al. 2016). The combination of weakly cemented and indurated Ringold Formation that likely underlies the DPA is interpreted to have a median hydraulic conductivity of 4.1 feet per day (Drost et al. 1997).

On driller's logs and logs of geotechnical explorations, identification of Pasco gravels from permeable portions of the Ringold Formation can be difficult (Drost et al. 1997). However, based on Ringold outcrops in the DPA area, scarcity of flood deposits in local gravel pits, and interpretation of more descriptive well logs, we interpret the majority of the sedimentary strata underlying the DPA to be the Ringold Formation which is more dense, more frequently cemented, and less permeable than Pasco gravels.

Recharge to the sedimentary unit is primarily from infiltration of precipitation, infiltration of surface water along losing stream reaches, seepage of irrigation water from crops and lawns, septic systems, and potentially through upwards leakage from the underlying Saddle Mountains Basalt. In urban areas, like the DPA, additional recharge results from infiltration of stormwater runoff from impervious surfaces associated with roads, parking lots, and buildings. Discharge from the sedimentary unit generally occurs as base flow to surface water such as streams, lakes and ponds located in low-lying areas and coulees. Subsurface discharge to the underlying basalt aquifer system also may occur locally.

Because of the generally poor infiltration characteristics of basalt, the sedimentary unit is of primary significance as a target for stormwater infiltration within the DPA and surrounding area. Infiltration capacity of the sedimentary unit is controlled by physical heterogeneities associated with the sediment deposits and moisture content. Vadose zone heterogeneities and moisture variations result in complex flow paths that include downward percolation, lateral movement, and perched water in the vadose zone.

Perched groundwater occurs where discrete areas or lenses of fine-grained materials or bedrock exist and act to inhibit downward percolation. In coarse strata vertical moisture movement in the vadose zone can be measured at several feet per day, depending on moisture content. Vertical movement of moisture through fine vadose zone strata will be several orders of magnitude lower.

Within the DPA and surrounding area, the lateral extent of the sedimentary aquifer is controlled by bedrock and fine-grained sediment geometry. These physical controls on aquifer distribution result in a sedimentary vadose zone and aquifer system that is variable and discontinuous. Hydraulic continuity between different parts of these systems can be limited.

DATA COMPILATION

Data Sources

GeoEngineers reviewed and compiled subsurface information provided by the City, including:

- Geotechnical reports related to DPA development.
- Water level data associated with the City's stormwater structure monitoring program.
- Water use data for the DPA and surrounding area for the period from January 2012 through October 2018.
- Chronologic information regarding development in and around the DPA.
- A summary of the complaints received by the City related to high groundwater within the DPA.
- As-built plans for infiltration structures within the DPA, such as drywells and infiltration trenches.
- A report summarizing leak detection operations within the DPA, dated November 15, 2018 and prepared by American Leak Detection of Hayden, Idaho.

GeoEngineers reviewed water well reports (well logs) on file with the Washington State Department of Ecology (Ecology) for the following study area:

- Section 1 of Township 9 North, Range 27 East.
- The north half of Section 12 of Township 9 North, Range 27 East.
- Section 6 of Township 9 North, Range 28 East.
- The north half of Section 7 of Township 9 North, Range 28 East.

Compiled well logs within the study area are provided in Appendix C. Each well log has been assigned a designation based on its location – these designations are provided in the upper right-hand corner of the well log.

Subsurface Database

GeoEngineers developed a database of existing subsurface data. Compiled data are summarized in Appendix D, within the following tables:

- Compilation of Water Well Report Observations, Table D-1.

- Compilation of Test Pit Observations, Table D-2.

Mapping

Maps and sections that graphically summarize aspects of the compiled data are provided in the following figures:

- Thickness of Sediments Overlying Basalt, Figure 3: This figure presents approximate thickness of sediments overlying CRGB (which is equivalent to depth to top of basalt). Data used to support this figure primarily was obtained from water well report observations (Table D-1). Hydrogeologic cross-section lines that are the basis for Figures 5 and 6 also are shown in this figure.
- Top of Basalt Elevation, Figure 4: This figure summarizes the elevation distribution of the top of basalt surface. Data used to support this figure are from water well report observations (Table D-1) and ground surface elevations from the U.S. Geologic Survey.
- Depth to Top of Limiting Stratigraphic Unit, Figure 5: This figure presents approximate depth to the uppermost layer that is likely to limit water infiltration. Depending on location, the limiting layer could be composed of basalt, fine-grained sediment, caliche, or cementation of pore space. Data used to support this figure was obtained from existing test pit observations (Table D-2).
- Hydrogeologic Cross-Section A-A', Figure 6: This section originates near the southwest corner of the study area and trends northeast to Flat Top Hill.
- Hydrogeologic Cross-Section B-B', Figure 7: This section originates near the northwest corner of the study area and trends east across Bombing Range Road.

Summary of Results

Sediment thickness and depth to basalt varies considerably over the study area (Figures 3, 6 and 7). In the DPA the top of basalt slopes to the south and east and overlying sediment generally thickens in the same directions. Generally, the west half of the DPA consists of an elevated basalt plateau. Within the plateau, basalt is shallow – generally less than 50 feet below ground surface (bgs). The top of basalt surface descends to the east within roughly the east half of the DPA, and exceeds 200 feet bgs below South 58th Avenue. A buried paleocanyon in the basalt surface, within which depth to basalt also exceeds 200 feet, originates near the southwest corner of the DPA and trends west.

As noted earlier, the sediments overlying basalt consist of a complex sequence of interbedded clay, silt, sand and gravel (Figures 6 and 7). Some of the well logs in the area indicate this material is dense and/or cemented, brown and tan in color, and may contain caliche. Given the nearby presence of Ringold Formation outcrops immediately east of the DPA, these strata are interpreted to be part of the Ringold Formation and have relatively low permeability.

Test pit explorations (Table D-2) generally, but not always, describe shallow sediments in greater detail than water well reports. Combining our well log interpretations, test pit interpretations, the presence of caliche and Ringold outcrops leads us to conclude that the stratigraphic interval limiting downwards infiltration of water, and hence high water levels in the DPA, is composed of this mix of Ringold low permeability material.

In this report, the limiting stratigraphic unit is the uppermost soil or rock that limits infiltration of water. Depending on the information presented in individual test pit logs, the limiting stratigraphic unit is variably composed of basalt, fine-grained sediment, cemented pore space, or a caliche layer. The depth to limiting stratigraphic unit across the DPA is shown on Figure 5. Depth to top of the limiting stratigraphic unit across the DPA ranges from approximately 2 feet bgs to more than 15 feet bgs. Portions of the area where the depth to limiting stratigraphic unit was observed at less than 10 feet bgs are outlined in Figure 5. These areas occurred throughout the Paradise Estates development, the northeast portion of the Collins Heights development, and within portions of the Belmont Heights and Sunset Heights developments. We suspect that shallow depths to the limiting stratigraphic unit are present within other portions of the DPA but could not be identified because data were not available.

GROUNDWATER OBSERVATIONS

The City conducted two groundwater monitoring events where water levels were measured in the stormwater system in and around the DPA. The monitoring events took place in September 2017 and October 2018. The results of these two monitoring events are presented in Table E-1 of Appendix E.

The groundwater observations were evaluated in two ways. The first was to map the depth to water from the surface as it was measured by the City, and the second was to map the elevation of the groundwater. Evaluating the depth to the groundwater demonstrates how close to the surface the shallow groundwater is while evaluating the elevation of the groundwater allows us to observe the direction of groundwater flow and the subsurface topography of the water table.

To evaluate areas where the groundwater was closest to the surface, contours were calculated and mapped using the depth to water from the rim of dry wells and manholes of the stormwater system for both September 2017 and October 2018. These maps are provided in Appendix E Figures E-1 and E-2, respectively. Both maps show groundwater less than 2 feet from the surface in the center of the project area west of Belmont Boulevard, east of Amber Boulevard, extending north of Paradise of Avenue to Marble Avenue. An additional area of shallow groundwater is to the north of the site, east of Hilltop Avenue, which are supported by the drainage complaints in Figure 8.

Comparing the results from September 2017 (Figure E-1) to October 2018 (Figure E-2) is difficult. It is unclear whether the shallow groundwater table surface was substantially different in October 2018 relative to September 2017 or if the differences are due to the increased data density collected in October 2018. The area of shallow groundwater does appear larger in 2018; however, this might be an artifact of having more measuring points.

In order to evaluate groundwater elevation, flow direction, and the generally topography of the water table the groundwater elevation was calculated using the depth to groundwater measured in the stormwater structure monitoring program and the rim elevations provided in the as-builts for the developments. These elevations were mapped, and contours were calculated yielding the potentiometric or groundwater elevation maps for September 2017 and October 2018. These maps are provided in Appendix E as Figures E-3 and E-4, respectively.

Both maps have evidence of mounding with groundwater elevations above 654 feet ROS No. 3910 in the center of the study area. Mounding is a localized increase in groundwater elevation where groundwater

will flow out radially from the center of the mound. Groundwater mounding frequently is centered around zones where water infiltration is high relative to the surrounding area. The mounding appears to be greater in October 2018 (Figure E-4); however, it is difficult to determine what might be due to increased water application or an artifact of the increased number of data points collected in 2018.

Both maps show a steep gradient in the northern portion of the DPA indicating groundwater is flowing from south to north along Hilltop Avenue. Increased mounding in the developments to the south may steepen the gradient and increase drainage north along Hilltop Avenue. In summary, the groundwater observations indicate groundwater is mounding below the densely-developed portions of the DPA causing groundwater levels in some areas to rise to less than 2 feet bgs on at least a seasonal basis.

PRECIPITATION TRENDS

To evaluate whether precipitation trends could be an influence on DPA groundwater levels, we obtained monthly precipitation data from the Kennewick, Washington Climate Station (No. 454154) and Richland, Washington Climate Station (No. 457015) for the period from January 1980 through November 2018 (the precipitation period of record). These data are tabulated in Table F-1 and summarized in Figure F-1 of Appendix F. We calculated the cumulative departure from average monthly precipitation in Table F-2 and plotted cumulative departure in Figure F-2. Cumulative departure is a graphical representation of the variation of precipitation from month to month as compared to the average precipitation over a selected time frame. The cumulative departure plot (Figure F-2) illustrates long-term precipitation trends, with above-average precipitation forming a graphical rise and below-average precipitation forming a graphical decline. Examination of this plot suggests the following:

- Two long-term cycles in precipitation (approximate 6-year periods of above-average precipitation trends followed by approximate 6-year below-average periods) are evident between about 1980 and 2005.
- The cumulative departure is generally stable to decreasing during the period of development within the DPA (about 2005 through present).

The data evaluation described above suggests that the observed increase in groundwater levels within the DPA cannot be explained (either in part or in full) by long-term trends in precipitation.

WATER USE AND IRRIGATION REQUIREMENTS

Water Use

Residential developments within the DPA are served by imported water from the West Richland water utility. A dense distribution of residences, and irrigated lawns, occurs west of Belmont Boulevard and its extension, within roughly the west half of the DPA. East of Belmont Boulevard and its extension, homes and associated irrigated lawns are scattered but generally spaced on the order of about 1¼ to 2½ acres.

On November 14, 2018, the City provided GeoEngineers with a database of water meter records for an area that roughly corresponds with the DPA. The period of record within the database (herein termed the water use period of record) is from January 2012 through October 2018. GeoEngineers used the provided

information to develop annual estimates of total water use within the geographic area bounded by the database. A summary of our evaluation is provided below in Table 1.

We estimate that the total quantity of imported water during the water use period of record was approximately 3,462 acre-feet, neglecting any water imported to the DPA from the Columbia Irrigation District. Water use estimates also do not include any water associated with domestic wells operated within the DPA.

Water use generally increased during the water use period of record. The annual rate of water importation increased from a minimum of approximately 283 acre-feet in 2012 to a maximum of 621 acre-feet during 2018 (the roughly 10-month period that extended from January 2018 through October 2018).

TABLE 1. WATER USE SUMMARY

Year ¹	Total Water Use	Estimated Domestic Water Use	Estimated Irrigation Water Use
	(acre-feet)	(acre-feet)	(acre-feet)
2012	283	105	178
2013	373	126	247
2014	465	144	321
2015	522	162	360
2016	602	175	427
2017	596	190	406
2018 (January through October)	621	163	458
Total	3,462	1,065	2,397

Note: ¹ The year assigned to a given measurement coincided with the year associated with the date of measurement. Portions of the water use for January measurements could have occurred during the previous year.

To arrive at estimates for domestic and irrigation water use, we calculated the number of homes that reported water consumption for each respective year. We assumed the average number of people per home is 2.6 and per capita domestic water use is 90 gallons per day. As shown in Table 1, this approach yielded annual domestic water use estimates that ranged from 105 acre-feet in 2012 to 190 acre-feet in 2017, for a total of 1,065 acre-feet for the period of record.

West of Belmont Avenue and its extension, residences are served by City sewer and most of this imported domestic water exits the DPA through the City sewer system. East of Belmont Avenue and its extension, residences are primarily serviced by individual septic systems, and imported domestic water enters the DPA groundwater system through infiltration.

The domestic water use estimates presented above represent only about 31 percent of the water use total. This suggests that on the order of 69 percent of the DPA water use is used outside of the home. We assume that this outside-of-home water use is primarily used to irrigate lawns. The DPA irrigation water use estimates summarized in Table 1, therefore, range from 162 acre-feet in 2012 to 433 acre-feet in (January through October) 2018.

Irrigation Requirements (Consumptive Use)

Irrigation water is consumptively used by the irrigated vegetation through plant growth and evapotranspiration. The difference between the delivered water and the consumptively used water generally is the water that seeps past the root zone and into the vadose zone. This section provides our estimate of irrigation consumptive use and water that seeps into the vadose zone.

We used the Blaney-Criddle Method (Shulz 1989) to estimate the consumptive use of the irrigated lawn acreage within the DPA. Consumptive use broadly refers to the amount of water required by a specific plant for growth and evapotranspiration. The Blaney-Criddle Method calculates consumptive use as the product of crop use coefficient (K) and consumptive use factor (F). Calculations associated with the Blaney-Criddle Method are summarized in Table G-1 of Appendix G and are based on the following data:

- Mean monthly air temperature and mean monthly precipitation, which were obtained from the Western Region Climate Center for the Richland, Washington Climate Station (No. 457015).
- Percent of annual daytime hours occurring during each month, which was adapted for 46 degrees latitude based on Table 7 from Thornthwaite and Mather (1957).
- A crop use coefficient of 1.00 and temperature criteria of 50 degrees, which were adapted from James et al. (2001) for turf.

Based on the above inputs, net consumptive use of turf within the DPA is estimated to be approximately 40.6 inches per year. Consumptive use by year is compared to irrigation use estimates in Table 2.

TABLE 2. CONSUMPTIVE USE COMPARISON

Year	Estimated Lawn Area	Estimated Irrigation Water Use ¹	Consumptive Use Requirement ²	Water Exceeding Consumptive Use ³
	(acres)	(acre-feet)	(acre-feet)	(acre-feet)
2012	50	178	169	9
2013	65	247	220	27
2014	75	321	254	67
2015	90	360	305	55
2016	100	427	339	88
2017	110	406	373	33
2018 (January through October)	120	458	406	52
			Total	331

Note:

¹ Estimated irrigation use is adapted from Table 1.

² Development of consumptive use requirements is described in Table G-1 of Appendix G.

³ Difference between Estimated Irrigation Water Use and Consumptive Use Requirements.

These calculations suggest that the irrigation water use exceeded consumptive use by approximately 9 acre-feet in 2012 to 88 acre-feet in 2016. Total irrigation water use in excess of consumptive use

during the period of record is estimated to be approximately 331 acre-feet (approximately 108 million gallons).

DRAINAGE COMPLAINTS

In a communication dated November 26, 2018, the City provided a summary of four recent complaints they have received from residents within the DPA that are related to an elevated groundwater table. These are summarized in Figure 8 and Table H-1 of Appendix H. A total of four complaints, dated between September 2017 and November 2018, have been received by the City. Each of these occurs during the late summer and fall, near the following the end of the irrigation season. The first three complaints were located within the Paradise Estates development within the southwest portion of the DPA. The most recent complaint occurred within the Collins Ridge development in the northwest portion of the DPA. Each of these complaints are associated with either an area where either: (1) the depth to the limiting stratigraphic unit is less than approximately 10 feet; or (2) no subsurface test pit explorations were available.

AVAILABLE STORAGE

The area of the DPA is approximately 490 acres. Based on our review of previous geotechnical explorations (Table D-2), depth to top of the limiting stratigraphic unit ranges from 2 to more than 15 feet. If we assume that there is an average of 12 feet of relatively porous material below the DPA and that widespread flooding effects to basements, crawl spaces, and pools will occur when the groundwater table reaches 8 feet below ground surface, there is approximately 4 feet of porous material available for water storage. Assuming an effective porosity of 0.25 and neglecting lateral groundwater migration, we estimate that the available storage beneath the DPA is on the order of approximately 490 acre-feet.

Within the context of ongoing development within the DPA, available storage primarily is filled by over-irrigation, direct injection of stormwater, and septic discharge.

- Previously, we used water use records to suggest that over-irrigation in the range of approximately 60 acre-feet per year could be occurring within the DPA.
- If we assume that, under current development conditions, 20 acres of impervious surfaces are directly injecting runoff through drywells and other infiltration structures, we derive an estimate of approximately 12 acre-feet of direct stormwater injection for a typical water year.
- Under current development conditions, on the order of 80 homes within the DPA discharge to septic tanks. Assuming 2.6 people per home and a per capita water use of 90 gallons per day, septic tank discharge within the DPA is estimated to be approximately 21 acre-feet per year.

At the rates assumed in the above bullets, 490 acre-feet of available storage would be filled within approximately 5 years. The rate of storage removal is likely be higher in the west half of the DPA, where the bulk of residential development (and irrigation/direct stormwater injection) has occurred.

Clearly, some of the infiltrating water exits the DPA through lateral groundwater migration, which is not accounted for in this simplistic water budget. However, the rapidity with which the City has observed post-

development groundwater level increases suggests that lateral groundwater migration of infiltrated water is inhibited by low soil permeability and/or aquifer boundaries.

CONCLUSIONS

Existing subsurface information indicate that the study area is underlain by a complex sedimentary sequence overlying basalt. Although cross-sections A-A' and B'B' (Figures 6 and 7) suggest that a sufficient thickness of relatively permeable sediment could be present to support infiltration of over-irrigation, septic discharge, and stormwater beneath the DPA, the sediment is of variable grain-size distribution, density, and cementation. The depth to limiting stratigraphic unit (which is variably formed by basalt, fine-grained sediment, caliche, and/or cementation of pore spaces) throughout portions of the DPA is less than 10 feet bgs (Figure 5). Perching of groundwater in these areas can flood basements and other below-ground structures.

GeoEngineers reviewed 53 test pit exploration logs for the DPA and surrounding area (Table D-2), each of which was excavated prior to construction of the respective development project. None of the test pits encountered groundwater to the depth explored. After residential build-out, a rapid rise in groundwater level has been observed within the DPA. This rise in groundwater level cannot be explained through precipitation trends (Appendix F). Because of the topographic isolation of the DPA, it also cannot be explained by large-scale farm irrigation, canal leakage, or other agricultural influences. We conclude that the increase in groundwater level is related to residential development and associated changes in the DPA water budget. Based on the water use and available storage estimates developed herein, we further conclude that seepage from irrigation of lawns (approximately 64 percent), stormwater injection (approximately 13 percent), and septic discharge (approximately 23 percent) each play a role in reducing available shallow subsurface water storage beneath the DPA and causing the elevated groundwater conditions observed within the DPA. However, we suspect that the primary control on DPA water level rise is over-irrigation of residential lawns. This conclusion is based on our evaluation of City water use data and the City's observation that groundwater levels rise through the summer lawn irrigation season and peak during the -fall.

Based on review of existing information, the current conceptual model potentially explaining the origin of the DPA is as follows:

- Relatively shallow basalt surface underlies the area, generally dipping to the east and west. Depth to basalt below the DPA, which is equivalent to overlying sediment thickness, ranges from 50 feet in the center to 150 to 200 feet to the east and west. The top of basalt forms a generally impermeable, or very low permeability surface beneath the overlying sediment.
- The sediment strata overlying basalt consists primarily of low permeability Ringold Formation clay, silt, and gravel containing variable cement and caliche. These strata appear to be thinnest beneath the central part of the DPA.
- Prior to development, land use in the DPA featured dispersed rural residences and natural shrub steppe. Very little water was applied to this area and the primary source of natural infiltration water and aquifer recharge was natural precipitation, most of which was lost to evapotranspiration during the summer. Irrigated agriculture was notably absent from the area now occupied by the DPA.

- With the advent of development, irrigated lawns and impermeable surface (streets and buildings) became prevalent within the DPA. As a result, significantly more water infiltrates to the vadose zone within the DPA relative to pre-development conditions. The mechanisms creating increased infiltration primarily occurs through lawn watering, the removal of evapotranspiration through the loss of native vegetation, and construction of impermeable surfaces where stormwater runoff is concentrated at specific infiltration sites.
- Concentration of precipitation runoff into specific infiltration sites and the abundance of seepage water moving below lawn root zones resulted in more water entering the vadose zone and aquifer system than was historically the case.
- As the area of development increased the rate and volume of water entering the subsurface increased and eventually this recharge exceeded the capacity of the low permeability Ringold Formation to transmit the water out of the DPA. As that occurred shallow groundwater levels rose to the or near the ground surface causing the problems now occurring in the DPA. Where these low permeability materials are thinnest may correspond to the area of highest water levels.

Growth of the developed area may or may not lead to the expansion of the DPA. That will depend on the specific hydrogeologic conditions beneath areas of expansion and the associated capacity of the Ringold material to hold and transmit water way from the area.

GAPS IN DPA UNDERSTANDING

This Phase 1 investigation is based on a review of existing information, which was sufficient to derive general conclusions regarding the hydrogeologic framework underpinning the observed DPA water level rise. However, existing data are insufficient to achieve the following City objectives: (1) delineate the causes and extent of elevated groundwater within specific portions of the DPA; (2) predict the extent that groundwater impacts could spread to other portions of the DPA.; and/or (3) identify actions that could mitigate observed and future groundwater impacts. Specifically, gaps in the current understanding of the DPA include the following:

- The specific hydrogeologic units that cause perching conditions within specific portions of the DPA.
- The horizontal and vertical distribution in the infiltration capacity of DPA sediments.
- The pathways that transport infiltrated water off the DPA.
- The seasonal fluctuation in shallow groundwater levels beneath the DPA.
- How shallow groundwater levels beneath the DPA respond to precipitation events.
- The rate of groundwater level rise within the DPA and, consequently, the likelihood and timing that drainage impacts could expand to other portions of the DPA.

LIMITATIONS

We prepared this report for use by the City of West Richland to assist in the characterization of the hydrogeologic conditions that underly the DPA. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of hydrogeology

in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Appendix I, "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

REFERENCES

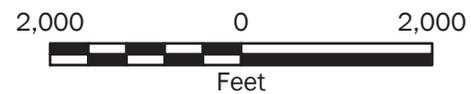
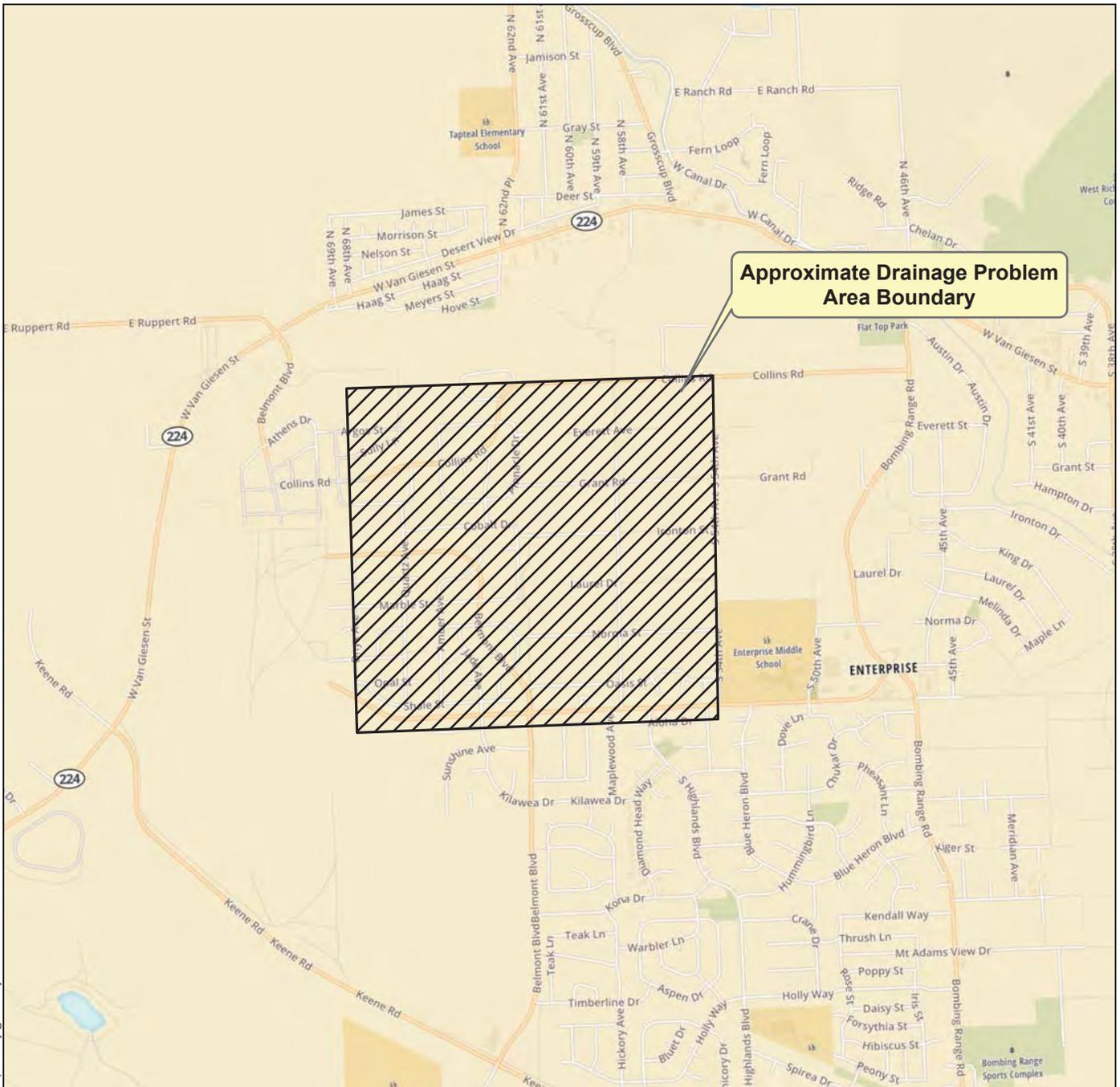
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Vicinity Map

**Drainage Problem Area
City of West Richland, Washington**



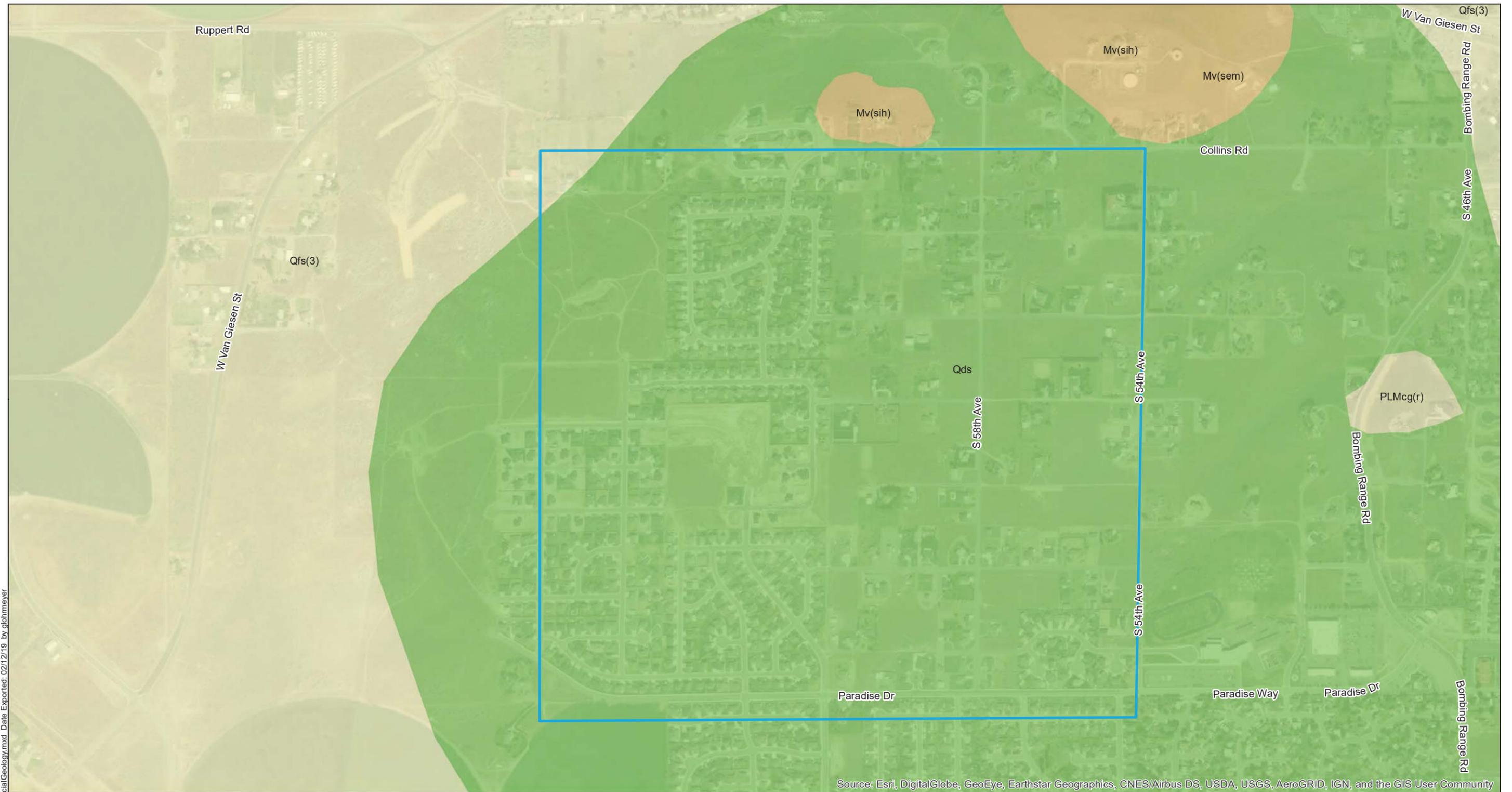
Figure 1

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2018

Projection: NAD 1983 UTM Zone 10N



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3. bgs = below ground surface

Data Source: Aerial from ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

- Approximate Drainage Problem Area Boundary
- Area where Depth to Limiting Stratigraphic Unit was Observed at 10 feet bgs or less (Approximate Boundary)

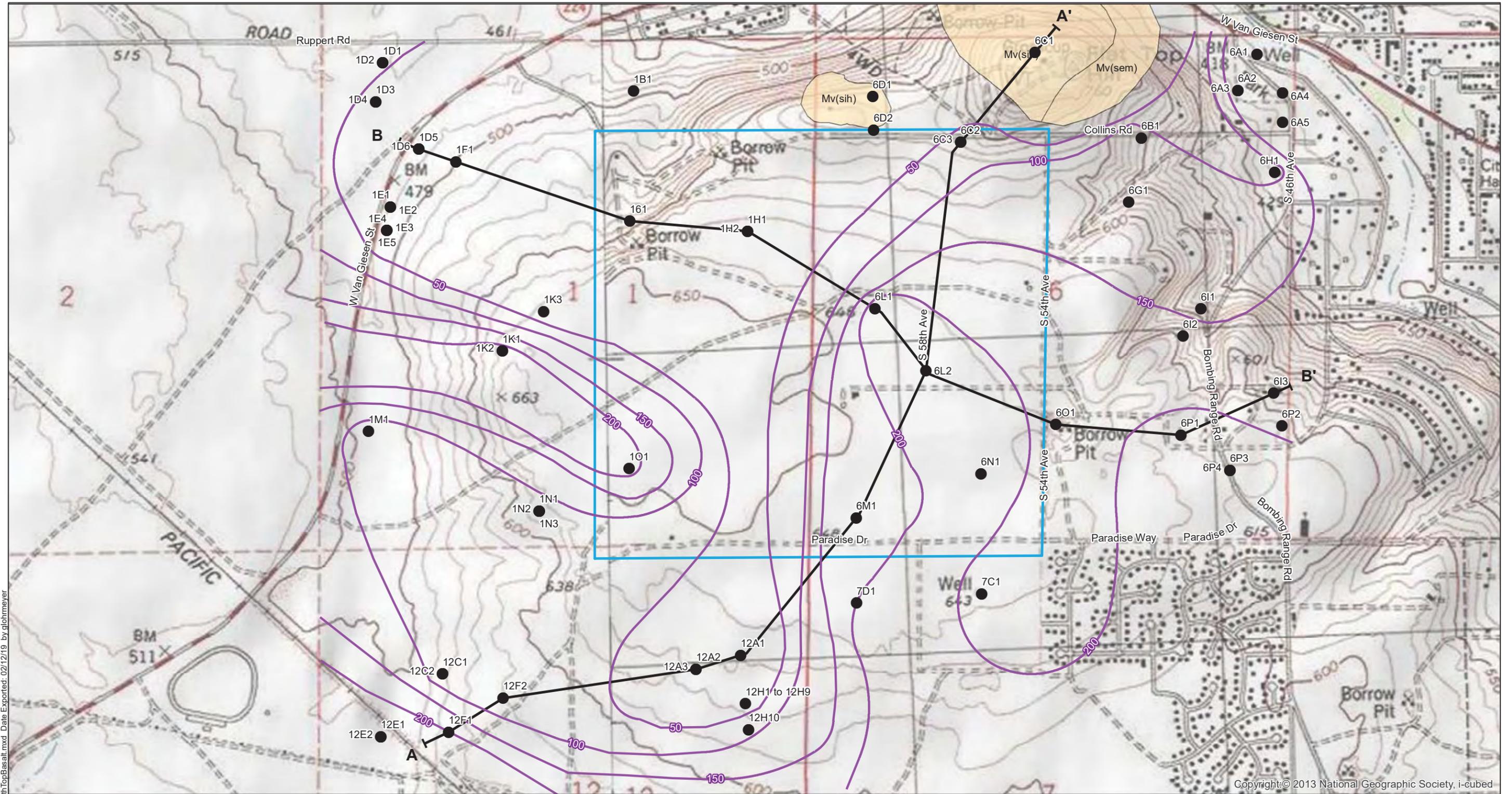
Surficial Geologic Units - 100K

- Qds Quaternary alluvium, dune sand, loess, and artificial fill
- Qfs Pleistocene continental glacial, glaciolacustrine, and outburst flood deposits, Fraser-age
- PLM Pliocene-Miocene continental sedimentary rocks
- Mv Miocene Columbia River Basalt Group, Saddle Mountains Basalt

1,000 0 1,000

Feet

Surficial Geology Map	
Drainage Problem Area City of West Richland, Washington	
	Figure 2

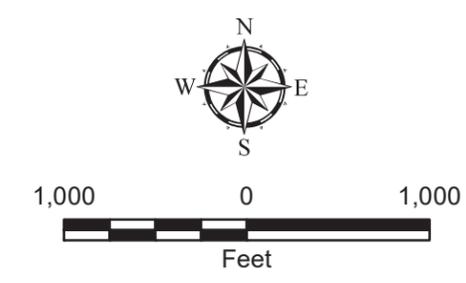


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 3. Depth to basalt data for 6D1 and 6P4 appear anomalous within the context of adjacent data. These wells could be mislocated and were omitted from contour development.
 4. Basalt at or near ground surface distribution is adapted from Figure 2.
 Data Source: Topo from USGS and ESRI
 Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

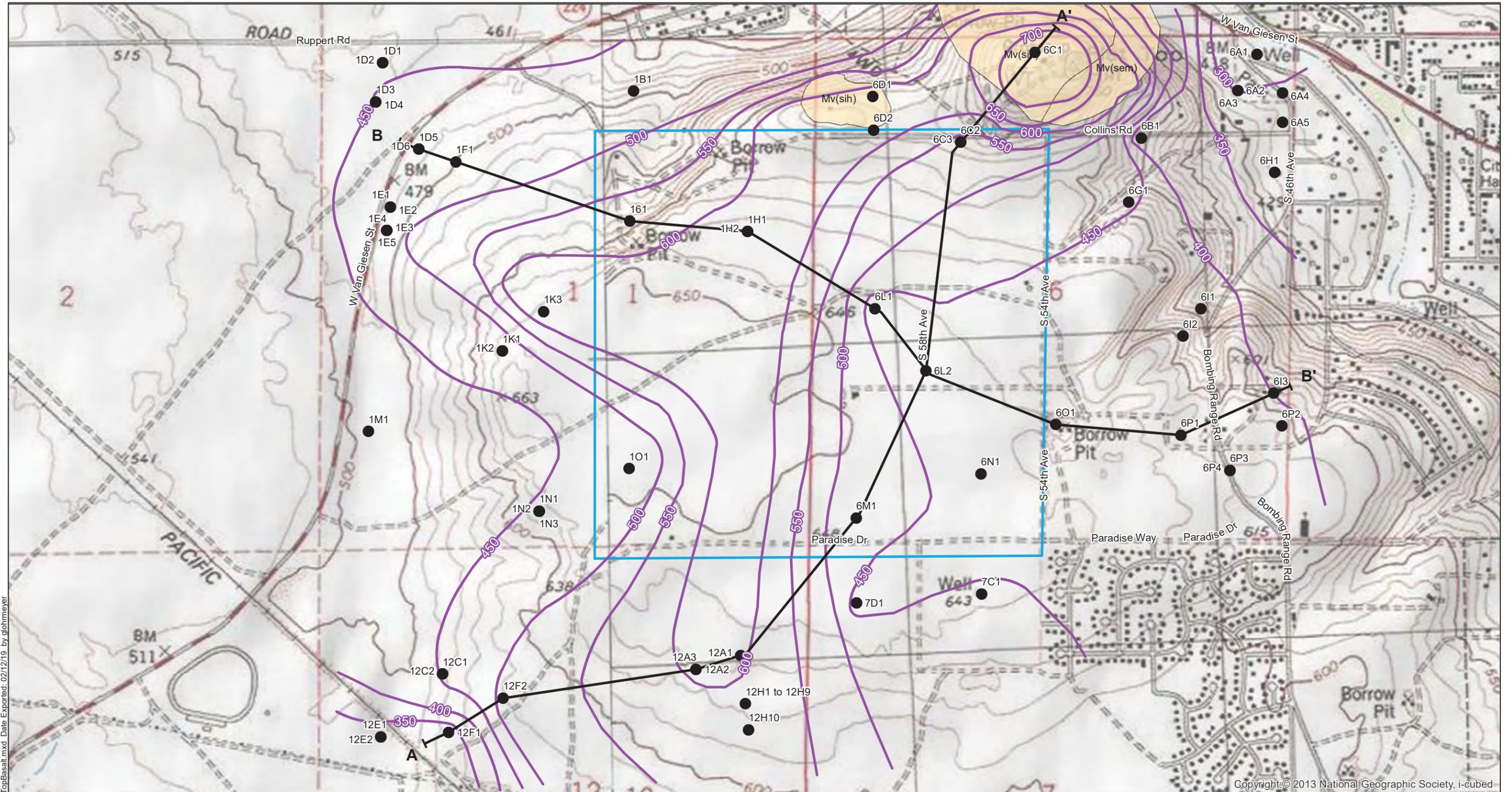
Legend

- 1D1 ● Interpreted Water Well Report Location
- 100— Approximate Depth to Top of Basalt Contour (50-foot Interval)
- A A' — Cross-Section
- Approximate Drainage Problem Area Boundary
- Mv(sih) or Mv(sem) Basalt at or near ground surface ⁴



Thickness of Sediments Overlying Basalt	
Drainage Problem Area City of West Richland, Washington	
	Figure 3

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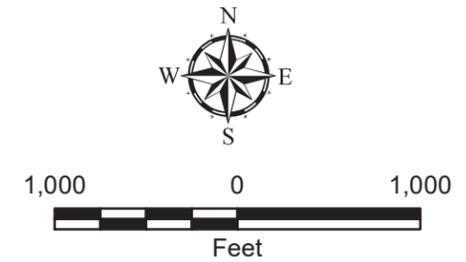
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Notes:

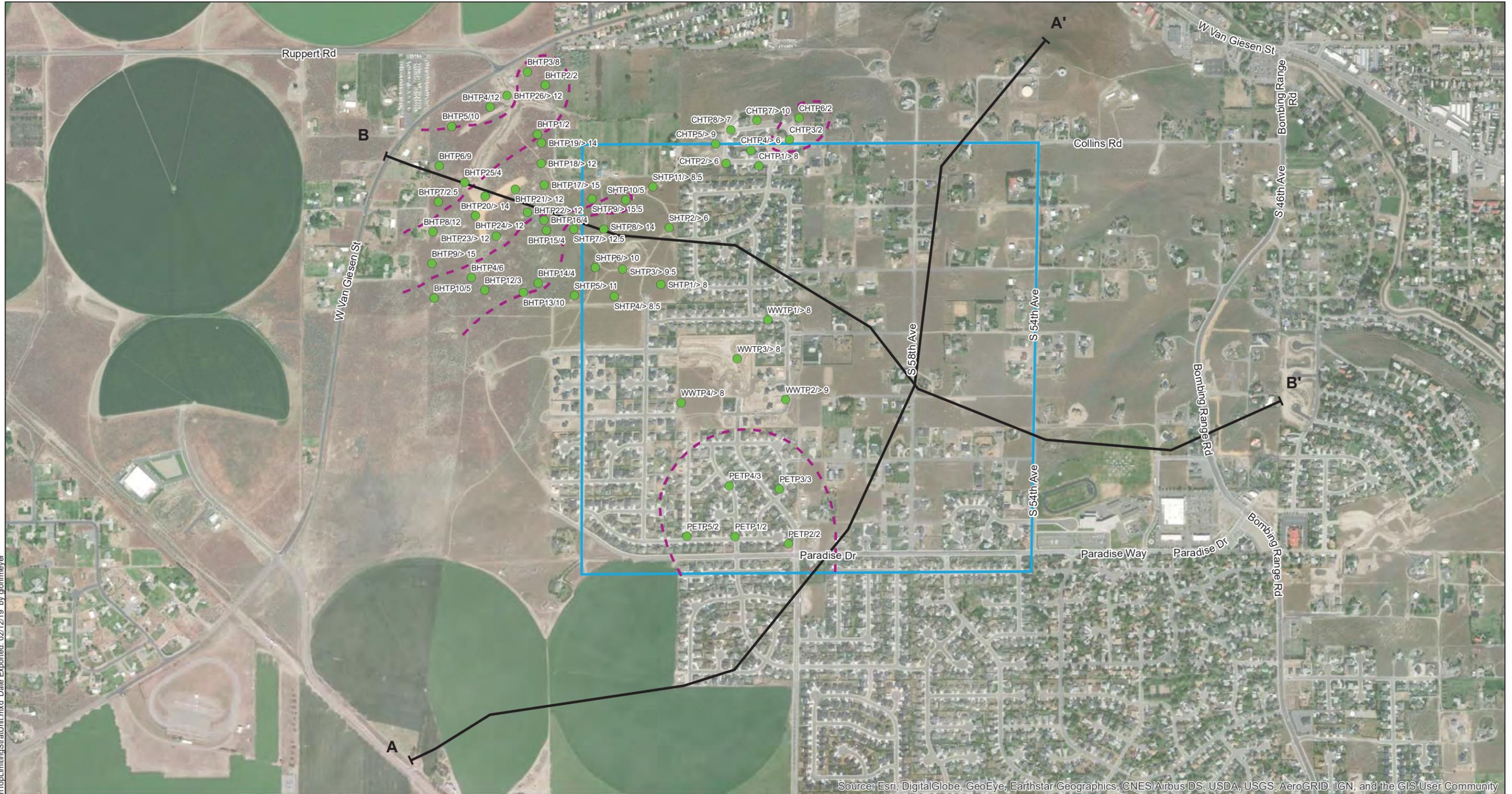
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3. Basalt elevation data for 6D1 and 6P4 appear anomalous within the context of adjacent data. These wells could be mislocated and were omitted from contour development.
4. Basalt at or near ground surface distribution is adapted from Figure 2.
5. Elevation contours are referenced to the North American Vertical Datum of 1988 (NAVD88).
Data Source: Topo from USGS and ESRI
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

- 1D1 ● Interpreted Water Well Report Location
- 600 — Approximate Top of Basalt Elevation Contour (50-foot Interval)
- A — A' — Cross-Section
- Approximate Drainage Problem Area Boundary
- Basalt at or near ground surface⁴



Top of Basalt Elevation	
Drainage Problem Area City of West Richland, Washington	
	Figure 4



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

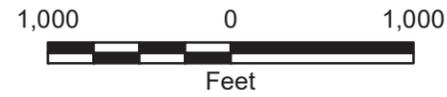
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 3. bgs = below ground surface

Data Source: Aerial from ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

- BHTP1/2 ● Test Pit Exploration and Depth to Top of Limiting Stratigraphic Unit (feet bgs)
- Approximate Drainage Problem Area Boundary
- ▭ Area where Depth to Limiting Stratigraphic Unit was Observed at 10 feet bgs or less (Approximate Boundary)
- Cross-Section

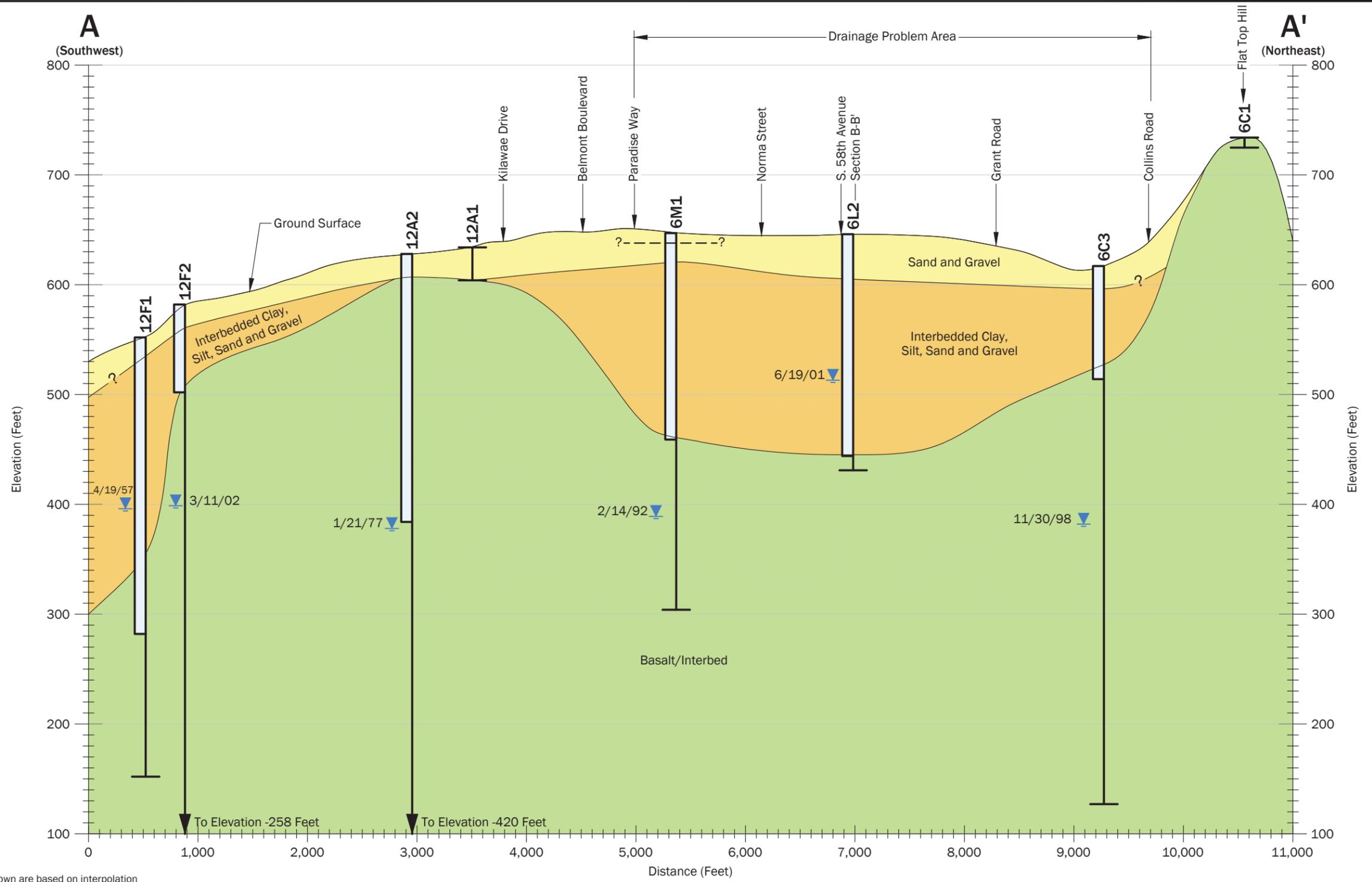


Depth to Top of Limiting Stratigraphic Unit

Drainage Problem Area
 City of West Richland, Washington



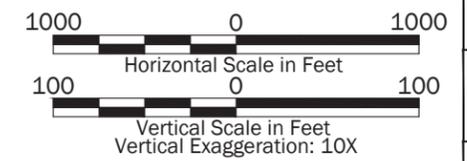
Figure 5



- Notes:**
1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
 2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.
 3. Subsurface information is interpreted based on information provided in Water Wells Reports provided by the Washington State Department of Ecology. Well locations are approximate and based on location information within the report.

Legend

- Existing Well
- Reported Water Level and Date of Measurement
- Cased Interval
- Open/Lined Interval
- Bottom of Borehole
- Sand and Gravel
- Interbedded Clay, Silt, Sand and Gravel
- Basalt/Interbed
- Interpreted Lithologic Contact
- Interpreted Top of Limiting Stratigraphic Unit



Hydrogeologic Cross-Section A-A'

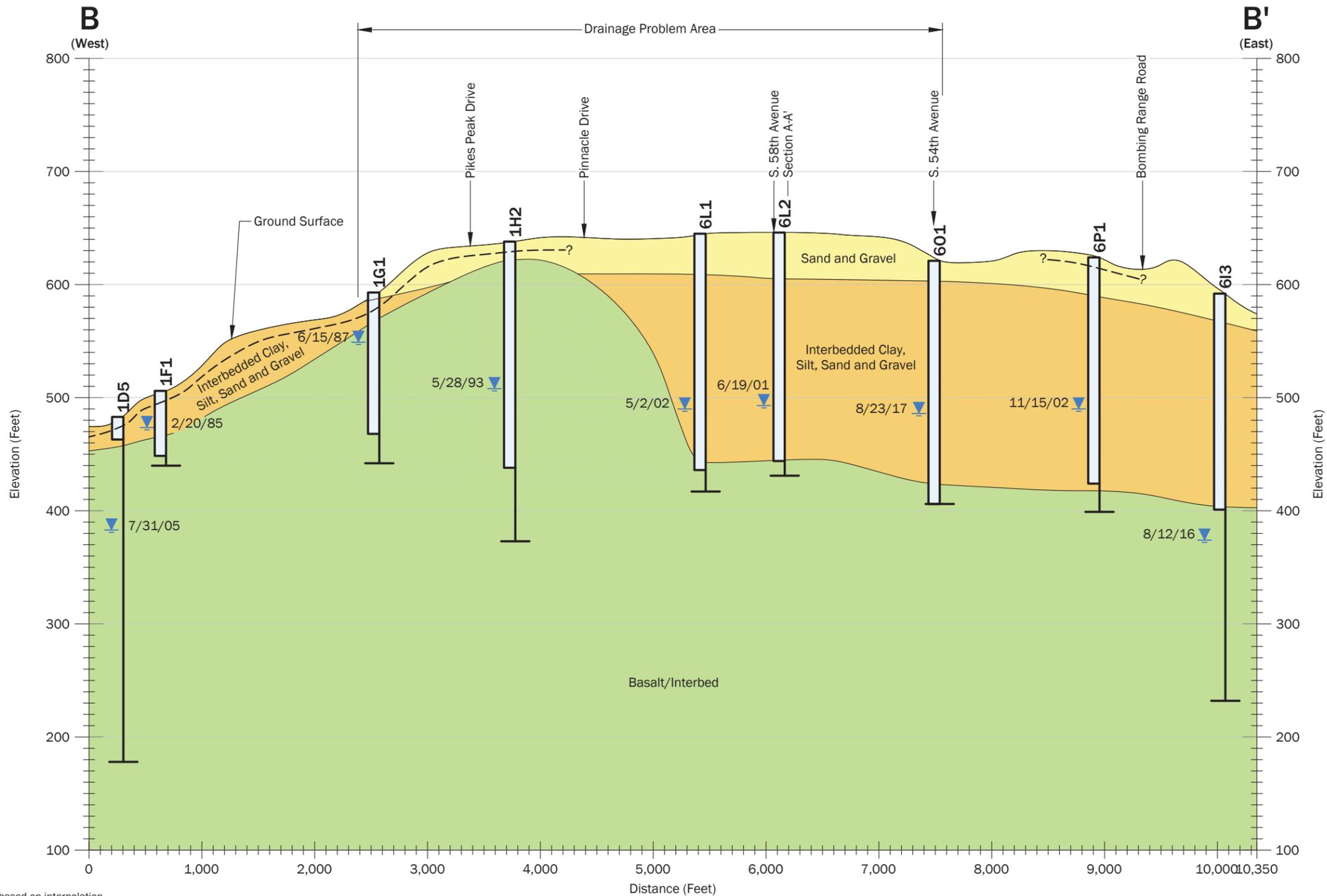
Drainage Problem Area
West Richland, Washington

GEOENGINEERS

Figure 6

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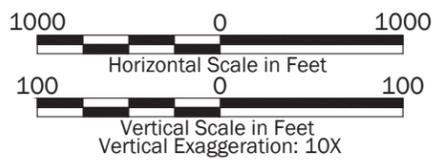


- Notes:**
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Datum: NAVD 88, unless otherwise noted.

Legend

- Existing Well
- Reported Water Level and Date of Measurement
- Cased Interval
- Open/Lined Interval
- Bottom of Borehole
- Sand and Gravel
- Interbedded Clay, Silt, Sand and Gravel
- Basalt/Interbed
- Interpreted Lithologic Contact
- Interpreted Top of Limiting Stratigraphic Unit

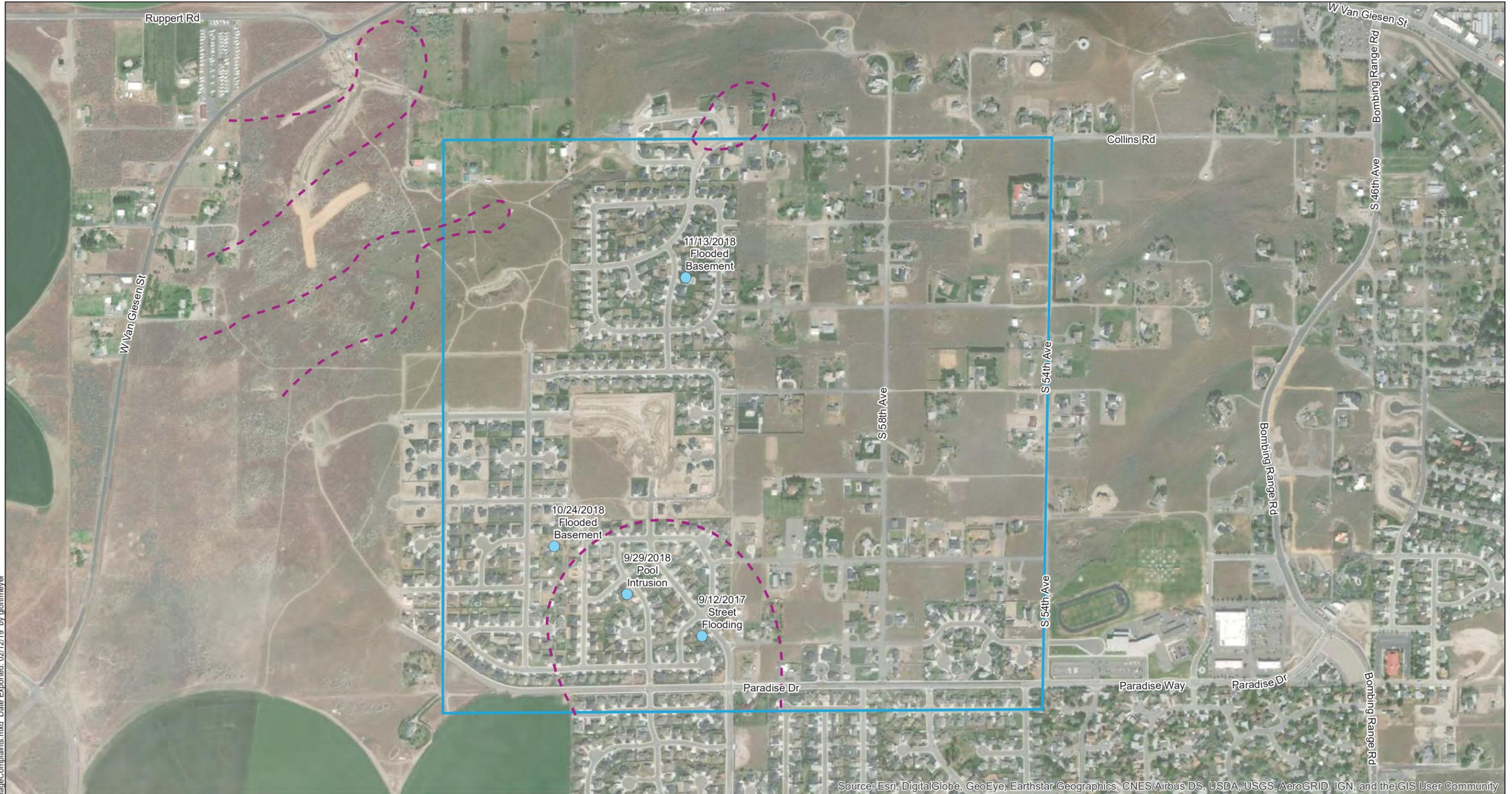


Hydrogeologic Cross-Section B-B'

Drainage Problem Area
West Richland, Washington

GEOENGINEERS

Figure 7



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

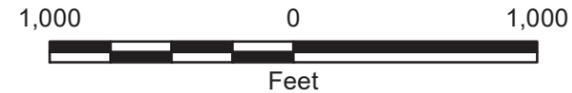
Notes:
 1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
 3. bgs = below ground surface

Data Source: Aerial from ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

- Drainage Complaint
- Approximate Drainage Problem Area Boundary
- Area where Depth to Limiting Stratigraphic Unit was Observed at 10 feet bgs or less (Approximate Boundary)

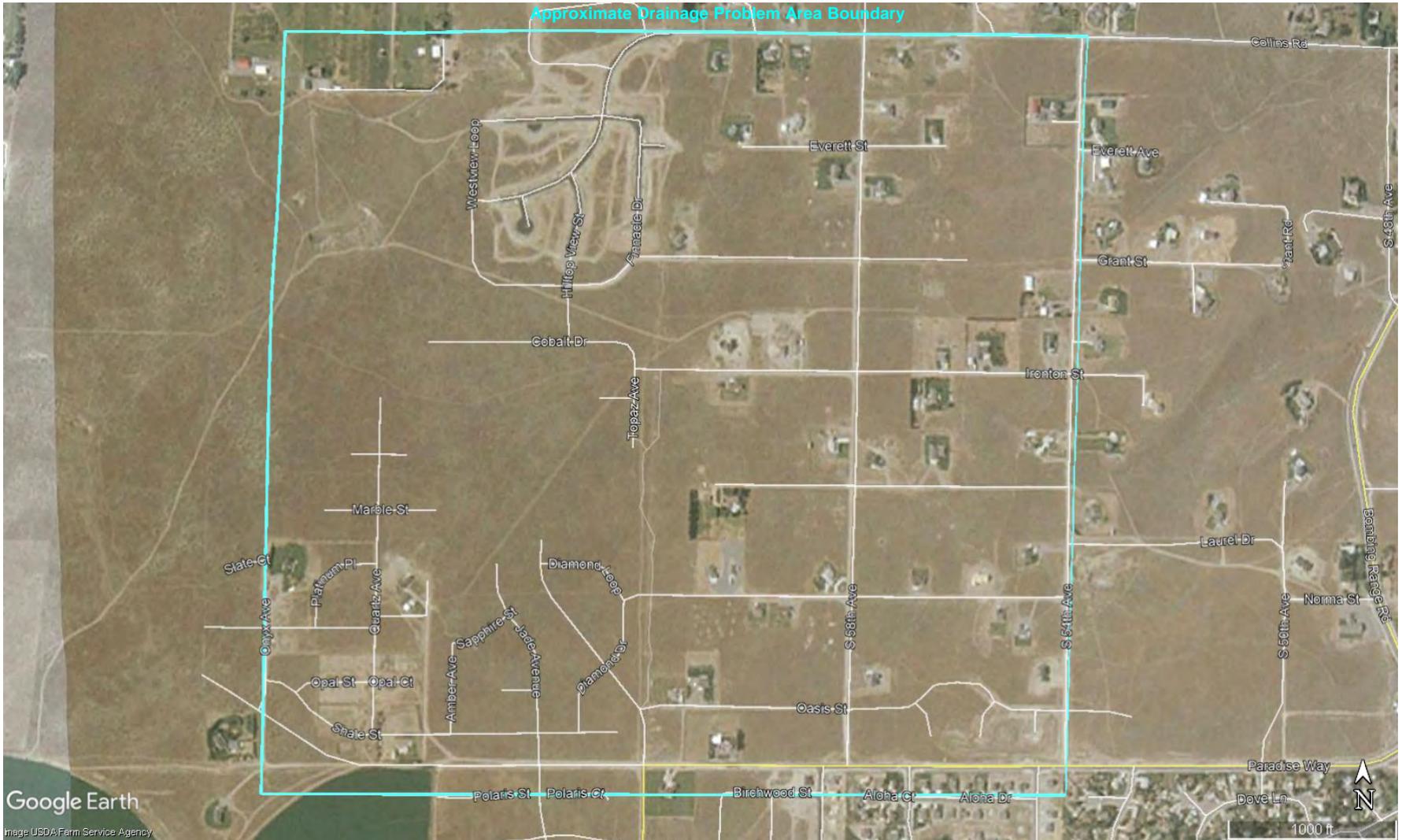


Drainage Complaints	
Drainage Problem Area City of West Richland, Washington	
	Figure 8

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APPENDIX A
Development History: Oldest and Newest
Permit Date Range

APPENDIX B
Historic Aerial Photos



Historic Aerial Photograph – June 2003

Drainage Problem Area
City of West Richland, Washington



Figure B-2

Note

1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.



Google Earth
Image USDA Farm Service Agency

Historic Aerial Photograph – June 2006

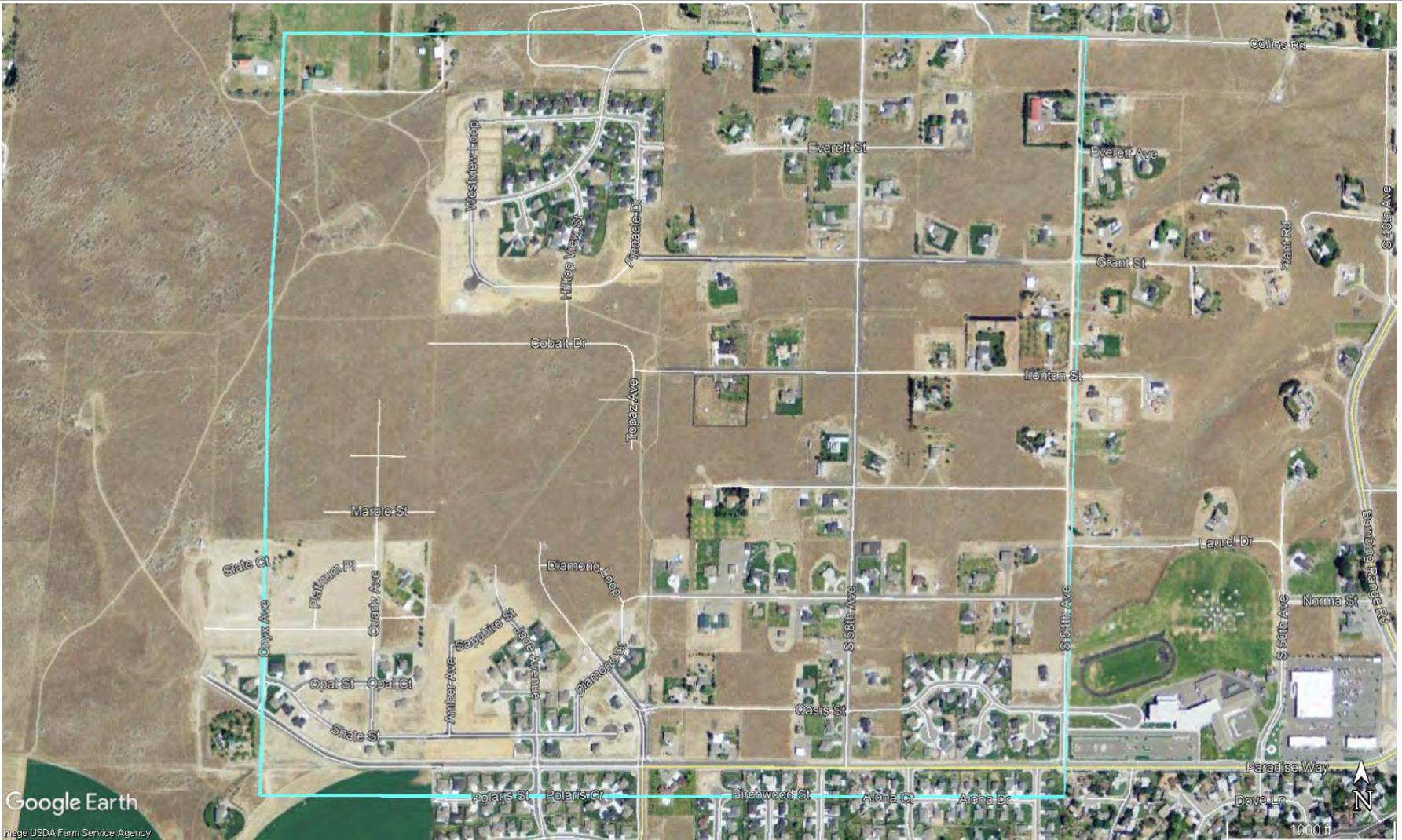
Drainage Problem Area
City of West Richland, Washington



Figure B-3

Note

1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.



Historic Aerial Photograph - November 2011

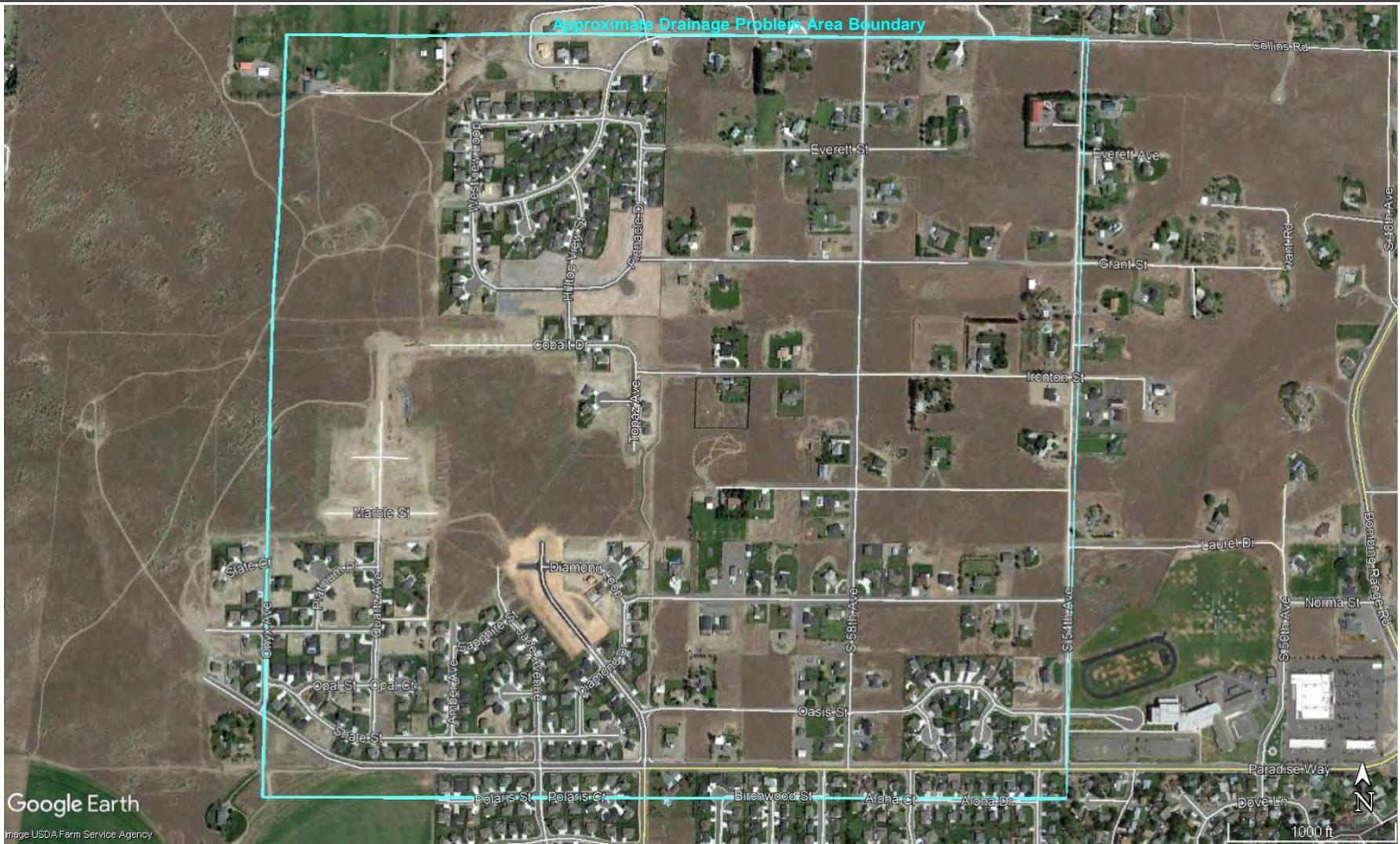
Drainage Problem Area
City of West Richland, Washington



Figure B-5

Note

1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.



Google Earth
Image USDA Farm Service Agency

Historic Aerial Photograph - July 2013

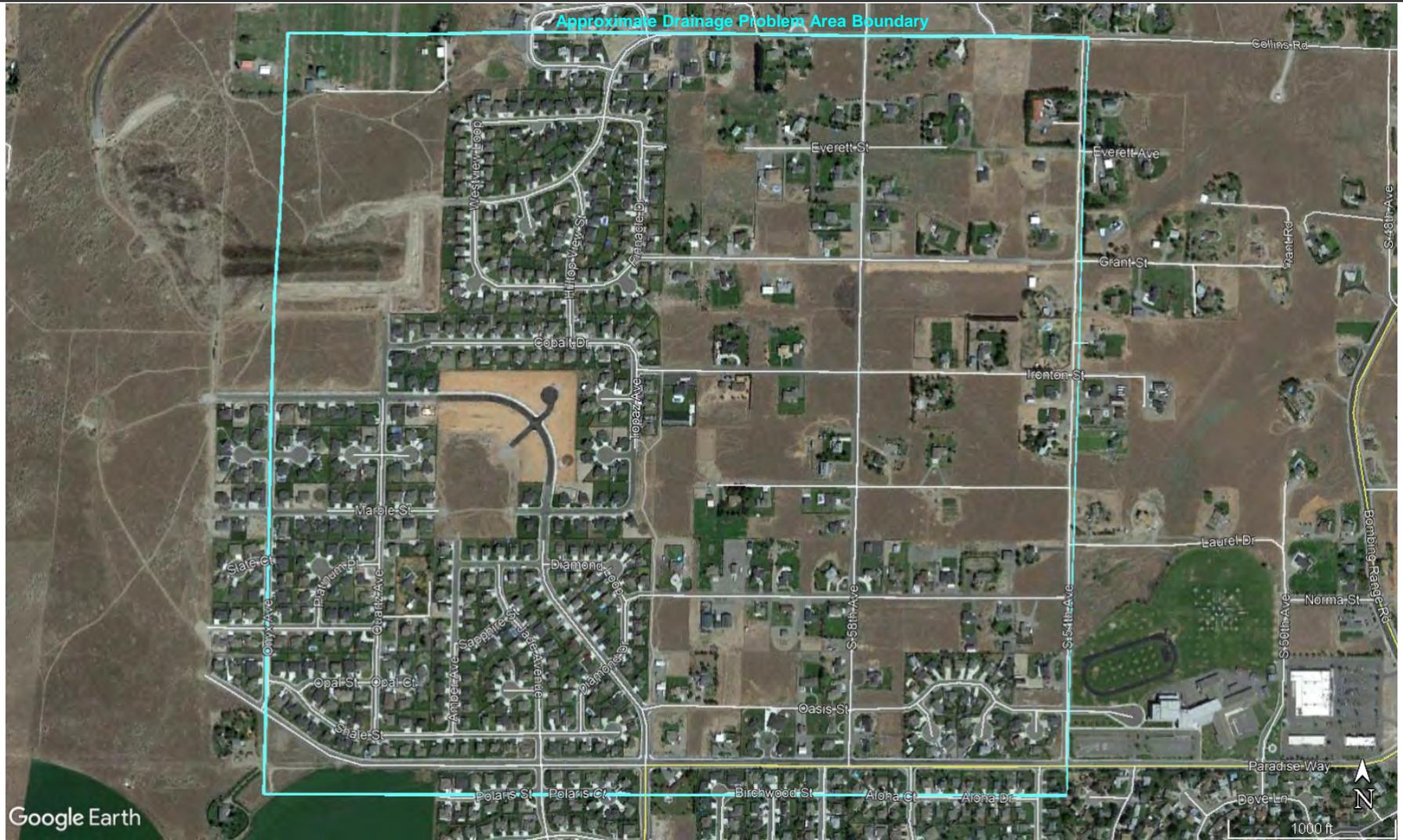
Drainage Problem Area
City of West Richland, Washington



Figure B-6

Note

1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.



Historic Aerial Photograph - August 2016

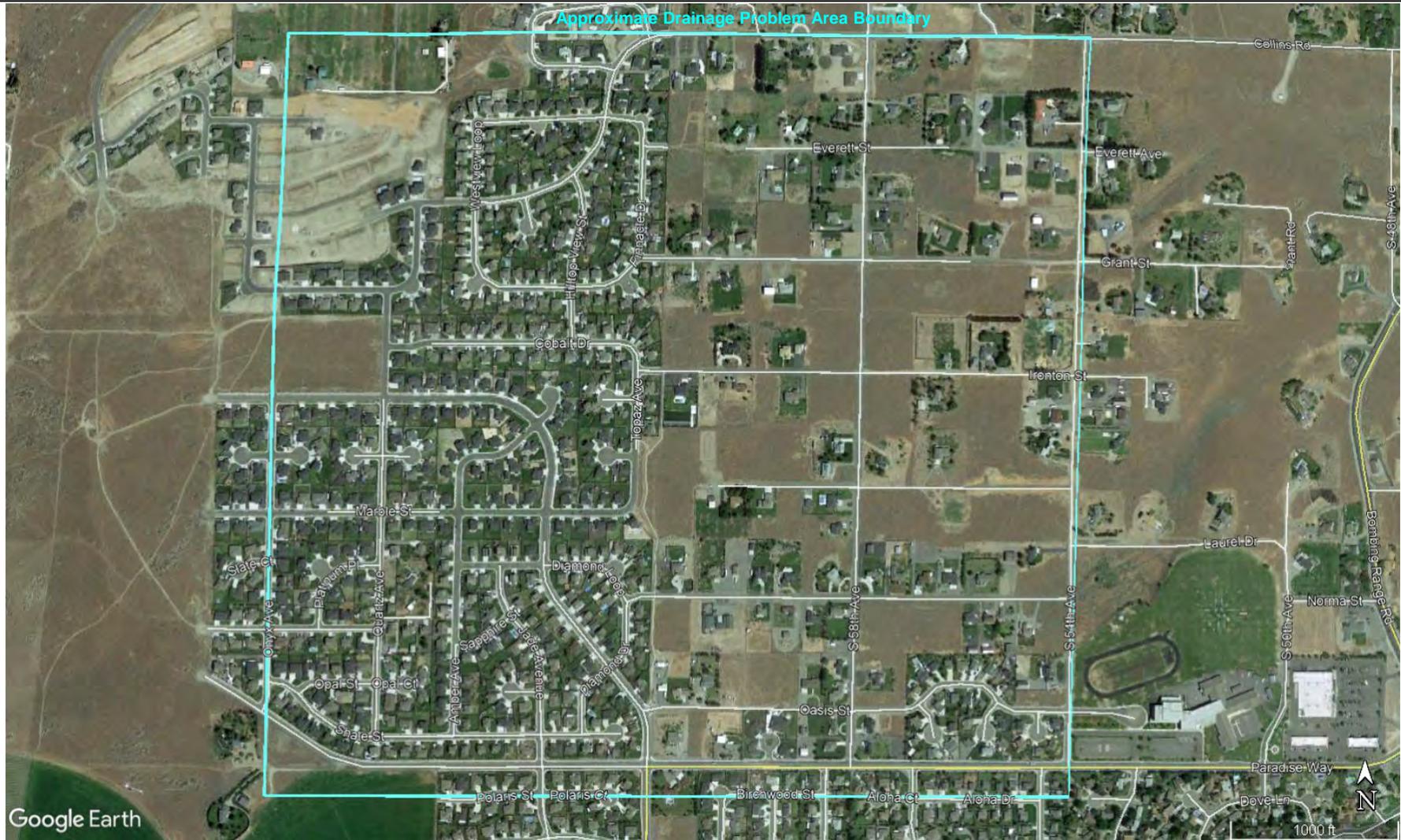
Drainage Problem Area
City of West Richland, Washington



Figure B-7

Note

- 1. Aerial photograph was obtained from Google Earth on February 11, 2019.



Historic Aerial Photograph – July 2018

Drainage Problem Area
City of West Richland, Washington



Figure B-8

Note

- 1. Aerial photograph was obtained from Google Earth on February 11, 2019.

APPENDIX C
Water Well Reports

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

36677

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. WA0182
Unique Well I.D. # ABW508
Water Right Permit No.

(1) OWNER: Name WOODCOCK, LESLIE J. Address RT. 2 BOX 2261 BENTON CITY, WA 99320-

(2) LOCATION OF WELL: County BENTON - NW 1/4 NW 1/4 Sec 01 T 09 N., R 27 WM
(2a) STREET ADDRESS OF WELL (or nearest address),

(3) PROPOSED USE: DOMESTIC (10) WELL LOG

(4) TYPE OF WORK: Owner's Number of well (if more than one) DEEPEINED Method: ROTARY
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 in formation.

(5) DIMENSIONS: Diameter of well 10 inches
Drilled 100 ft. Depth of completed well 180 ft.
MATERIAL FROM TO
BLACK MEDIUM BASALT 90 120
HARD BLACK BASALT 120 170
BROKEN BASALT WITH WATER 170 180
180

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from +1 ft. to 179 ft.
WELDED " Dia. from ft. to ft.
" Dia. from ft. to ft.

Perforations: YES
Type of perforator used TORCH
SIZE of perforations in. by in.
perforations from 160 ft. to 100 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: NO
Manufacturer's Name
Type Dia. slot size Model No. ft. to ft.
Dia. slot size from ft. to ft.

Gravel packed: NO
Gravel placed from ft. to ft. Size of gravel ft.

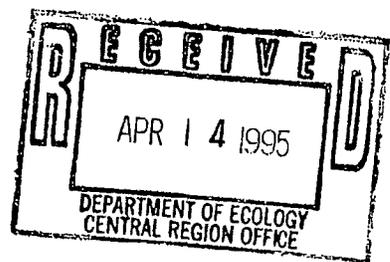
Surface seal: NO To what depth? ft.
Material used in seal
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 90 ft. below top of well Date 04/04/95
Artesian Pressure lbs. per square inch Date
Artesian water controlled by
Work started 04/03/95 Completed 04/04/95

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? NO If yes, by whom?
Yield: gal./min with ft. drawdown after hrs.
Recovery data
Time Water Level Time Water Level Time Water Level
WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING (Person, firm, or corporation) (type or print)
ADDRESS: E 6010 BROADWAY
[SIGNED] *Les A Kelly* License No. 2215
Contractor's Registration No. PQ-ND-EI#248JC Date 04/06/95
Date of test / /
Bailer test gal./min. ft. drawdown after hrs.
Air test 70 gal./min. w/ stem set at 175 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? NO



104

File Original with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W13573
UNIQUE WELL I.D. # AGH 804
Water Right Permit No. _____

106789

(1) OWNER: Name Mark & Cindy Enghusen Address 7604 Woodford, W. Rich 99320

(2) LOCATION OF WELL: County Benton SE 1/4 NW 1/4 Sec 1 T. 9 N.R. 27 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Woodford

TAX PARCEL NO.: _____

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
 New Well Method _____
 Deepened Dug Bored
 Reconditioned Cable Driven
 Decommission Rotary Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 145 feet. Depth of completed well 145 ft

(6) CONSTRUCTION DETAILS
Casing installed: Welded Liner installed Threaded
6 " Diam. from 12 ft to 58 ft
4 " Diam. from -5 ft to 145 ft

Perforations: Yes No
Type of perforator used Saw
SIZE of perforations 90 in by 8 in
90 perforations from 85 ft to 145 ft.

Screens: Yes No K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand _____
Material placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

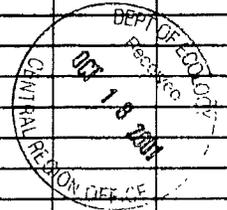
(7) PUMP: Manufacturer's Name _____
Type _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 35 ft below top of well Date 8-16-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc)

(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
Yield _____ gal/min with _____ ft. drawdown after _____ hrs
Yield: _____ gal/min with _____ ft drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level
Date of test _____
Bailer test _____ gal/min with air test ft drawdown after 2 hrs
Artest 20-25 gal/min with _____ ft drawdown after _____ hrs
Artesian flow _____ g p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Sand	0	16
Sand Gravel	16	32
Soft Brown Basalt	32	55
Red Basalt	54	57
hard Black Basalt	57	65
Brown Basalt	65	72
hard Black Basalt	72	85
Grey hard Basalt	85	113
Soft Black Basalt	113	132
hard Blue Clay	132	136
hard Tan Clay	136	145



Work Started 8-15-01 Completed 8-16-01

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.
Type or Print Name David Cox License No 2351
(Licensed Driller/Engineer)
Trainee Name _____ License No _____
Drilling Company R.W. Cox Drilling
(Signed) David Cox License No 2351
(Licensed Driller/Engineer)
Address P.O. Box 5324 Benton City WA 99320
Contractor's Registration No 5W6XD02256 Date 8-16-01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

The Department of Ecology does NOT warrant the Data and/or the Information on this Well Report.

The Department of Ecology does NOT warrant the Data and/or the Information on this Well Report. I Report.

161



WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle)

Construction
 Decommission ORIGINAL INSTALLATION Notice
of Intent Number 178921

PROPOSED USE: Domestic Industrial Municipal
 DeWater Irrigation Test Well Other

TYPE OF WORK: Owner's number of well (if more than one) _____
 New well Reconditioned Method: Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 305 ft.
Depth of completed well 305 ft.

CONSTRUCTION DETAILS
Casing Welded 8 " Diam. from 12 ft. to 24 ft.
Installed: Liner installed " Diam. from _____ ft. to _____ ft.
 Threaded 6 " Diam. from 7 ft. to 243 ft.

Perforations: Yes No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: Yes No K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: Yes No To what depth? 24' ft.
Material used in seal Bentonite

Did any strata contain unusable water? Yes No
Type of water? SANDY Depth of strata 123
Method of sealing strata off: OVER BORE & CASING

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 130 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

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.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

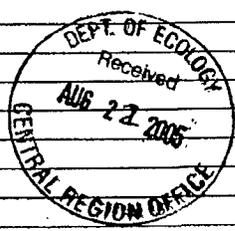
Date of test _____
Bailer test 50 gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 50 gal./min. with stem set at 280 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

CURRENT
Notice of Intent No. W181849
Unique Ecology Well ID Tag No. AKA 065
Water Right Permit No. _____
Property Owner Name John Harris E
Well Street Address off Ruppert rd
City W Rich County Benton-83-
Location SW 1/4-1/4 NW 1/4 Sec L Twn 9 R 21 FROM or WWM circle one
Lat/Long (s, t, r) _____ Lat Deg _____ Lat Min/Sec _____
Still **REQUIRED** Long Deg _____ Long Min/Sec _____
Tax Parcel No. _____

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
SAND	0	2
BLACK BASALT	2	18
RED BASALT	18	21
GREY BASALT	21	82
BLACK BASALT	82	100
SAND, SANDSTONE	100	123
GREY BASALT	123	264
BROKEN BASALT WATER	264	282
Blue Clay	282	305



Start Date 8-4-05 Completed Date 8-9-05

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) ROD COX
Driller/Engineer/Trainee Signature [Signature]
Driller or trainee License No. 2302
If TRAINEE, Driller's Licensed No. _____
Driller's Signature _____

Drilling Company BW COX DRILLING
Address P.O. Box 5324
City, State, Zip Benton City, Wash 99320
Contractor's Registration No. BW10XP02256 Date 8-9-05
Ecology is an Equal Opportunity Employer.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

162



WATER WELL REPORT

Notice of Intent Number W303163 427698

Property Owner Last Name Gray First Name Keith & PAM

Organization Name _____

Well Tag ID Number (e.g., AAA-001) BCJ 40 740 Variance Granted? (Circle One) Yes No

Water Right Permit Required? (Circle One) Yes or No If Yes, enter Water Right Permit Here (Required) _____

RECEIVED
SEP 19 2011

DEPARTMENT OF ECOLOGY - CENTRAL REGION OFFICE

Well Use (Circle All That Apply):		Type of Work (Circle One):		Method (Circle One):	
<input checked="" type="checkbox"/> Agricultural Irrigation	<input type="checkbox"/> Commercial	<input type="checkbox"/> Alteration	<input type="checkbox"/> Deepened Well	<input type="checkbox"/> Cable	<input type="checkbox"/> Driven
<input checked="" type="checkbox"/> Domestic	<input type="checkbox"/> Group Domestic	<input type="checkbox"/> Hydrofracturing	<input checked="" type="checkbox"/> New	<input type="checkbox"/> Dug	<input type="checkbox"/> Hydrofracturing
<input type="checkbox"/> Individual Irrigation	<input type="checkbox"/> Municipal	<input type="checkbox"/> Replacement		<input type="checkbox"/> Jetted	<input checked="" type="checkbox"/> Rotary
<input type="checkbox"/> Parks and recreation	<input type="checkbox"/> Stockwater	<input type="checkbox"/> Other _____		<input type="checkbox"/> Other _____	
<input type="checkbox"/> Test Well					
<input type="checkbox"/> Other _____					

Drilling Start Date 8-30-11 Drilling Completion Date 9-1-11

Well Location Only (No Mailing Address, No PO Box, Cross Streets are ok)

Well Street Address 7407 VAN GIESEN

Well City West Richland Well County Benton-03 Well Zip Code 99353

Tax Parcel Number 101972010525003

If claiming tax parcel exemption (Circle One) Tribal Federal Property Right of Way Railroad Land

NW	NE	NW	NE
SW	SE	SW	SE
NW	NE	NW	NE
SW	SE	SW	SE

Place an "X" in ¼, ¼

Township 9 N Range 27 Section 1

Latitude _____ Decimal Degrees; Longitude _____ West Decimal Degrees

CONSTRUCTION INFORMATION - SECURELY ATTACH (STAPLE) ADDITIONAL SHEETS OF INFORMATION (NO DRAWINGS) AS NEEDED.

Diameter of Well _____ ft 6x8 in, Drilled 290 ft _____ in Depth of Completed Well 290 ft _____ in

Casings (At least one Casing must have 6 in of stickup and all fields must be filled out for each casing entered)

Type (Circle One) Concrete Plastic Steel Other _____ Diameter 8" inches Stickup 1' inches Depth 35' in, TO _____ ft _____ in

Type (Circle One) Concrete Plastic Steel Other _____ Diameter 6" inches Stickup 12' inches Depth 228' in, TO _____ ft _____ in

Liners? Circle One Yes No (If yes, then complete the below fields that apply)

Type 1 (Circle One) PVC Steel Other _____ Diameter _____ in, From _____ ft _____ in TO _____ ft _____ in

Type 2 (Circle One) PVC Steel Other _____ Diameter _____ in, From _____ ft _____ in TO _____ ft _____ in

Perforations? Circle One Yes No (If yes, then complete the below fields that apply)

Type of Perforator (Circle One) Drill Mills Knife Saw cut Star Torch Cut Other _____ Perforation size _____ in by _____ in Total Perforations _____

Perforation 1 from _____ ft _____ in, TO _____ ft _____ inches Perforation 2 from _____ ft _____ in, TO _____ ft _____ inches

Screens? (Circle One) Yes No (If yes, then complete the below fields that apply)

Mfr 1 _____ Type _____ Diam _____ in Slot Size _____ From _____ ft _____ in TO _____ ft _____ in

Mfr 2 _____ Type _____ Diam _____ in Slot Size _____ From _____ ft _____ in TO _____ ft _____ in

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

Sand/Gravel Packing? (Circle One) Yes No (If yes, then complete the below fields that apply)

Packing Material 1 Circle One 10-20 20-40 8-12 Coarse Sand Pea Gravel From _____ ft _____ in TO _____ ft _____ in

Packing Material 2 Circle One 10-20 20-40 8-12 Coarse Sand Pea Gravel From _____ ft _____ in TO _____ ft _____ in

Surface Seal Was there an existing surface seal? (Yes or No) Depth of Seal 35 ft _____ in

Type of Seal Material (Circle One) Bentonite Bentonite Slurry Concrete Dry Bentonite Neat Cement Neat Cement Grout

Pump - Pump Installed? (Circle One) Yes No If yes, Mfr Name _____ Pump Type _____ HP _____

Static Water Level (Circle One and fill in the blanks if needed)

Yes Measured Level (Below top of well) 140' in Date Measured 9-1-11

Flowing Artesian (Circle One) Greater Than or Equal To _____ GPM _____ PSI Artesian Water Controlled by (e.g. Cap, Valve, etc.) _____

Dry Hole _____

Unusable Water Strata? (Circle One) Yes No If Yes is circled, method of sealing strata off OVERBORE CASING

Strata 1 (Specify Unusable Water Type) SANDY From _____ ft _____ in TO _____ ft _____ in

Strata 2 (Specify Unusable Water Type) _____ From _____ ft _____ in TO _____ ft _____ in

General Well Tests (Circle all that apply and fill in the blanks)

Bailer Test Date of test _____ (Circle One) Greater Than or Equal To _____ GPM, with _____ Drawdown after _____ hrs _____ min

Air Test Date of test 9/1/11 (Circle One) Greater Than or Equal To 50' GPM, with stem set at 280 _____ in

Test Duration 1 hrs _____ min

Pump Test Date of test _____ Test performed by _____

Note: Drawdown=the amount the water level is lowered below the static level

Yield _____ gpm, with _____ ft _____ in; Drawdown after _____ hrs _____ min

Yield _____ gpm, with _____ ft _____ in; Drawdown after _____ hrs _____ min

Yield _____ gpm, with _____ ft _____ in; Drawdown after _____ hrs _____ min

Note: Recovery=The time taken at zero when the pump is turned off. Water level is measured from the well top to...Ask Lars for wording

Time _____ hrs _____ min; Water Level _____ ft _____ in

Time _____ hrs _____ min; Water Level _____ ft _____ in

Time _____ hrs _____ min; Water Level _____ ft _____ in

Time _____ hrs _____ min; Water Level _____ ft _____ in

Well Lithology Details - Your lithology MUST be reported to the drilled depth of the well. Please check your "From" and "To" feet and inches for accuracy.

Layer Formation Description	From	To	Layer Formation Description	From	To
<u>SOIL, SAND</u>	<u>0</u>	<u>28'</u>	<u>BLACK BASALT</u>	<u>225'</u>	<u>245'</u>
<u>BLACK BASALT</u>	<u>28</u>	<u>48</u>	<u>FRACTURED BASALT</u>	<u>245</u>	<u>290</u>
<u>RED BASALT</u>	<u>48</u>	<u>65</u>	<u>WATER</u>		
<u>BLACK BASALT</u>	<u>65</u>	<u>138</u>			
<u>CLAY SAND</u>	<u>138</u>	<u>164</u>			
<u>BROKEN BASALT, SAND</u>	<u>164</u>	<u>225</u>			

Comments - Enter any other important well construction and/or location details here.

CERTIFICATION - I hereby certify that I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington Well construction standards. Materials used and the information reported within the Well Report are true to my best knowledge and belief.

(Circle One) Driller Trainee Engineer Name (Print) ROD CLAY Drilling Company BW COX DRILLING LLC

Driller/Engineer/Trainee Signature _____ Address P.O. BOX 5324

Driller/Trainee/PE License No. 7310 City, State, Zip GRANT CITY WASH 99320

Phone Number 309-627-4446 Email Address _____

If TRAINEE, Mentor Driller License No. _____ Mentor Driller Signature _____

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

163

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 000181

Water Right, Permit No. _____

1) OWNER: Name Becan Properties Address W. 929 Sprague Spokane, WA 99204

(2) LOCATION OF WELL: County Benton SW NW Sec. 1 T. 9 N. R. 27 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Off old inland empire highway

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 160 feet. Depth of completed well 160 feet.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 23 ft.
Welded 4" PVC" Diam. from -6 ft. to 160 ft.
Liner installed
Threaded " Diam. from _____ ft. to _____ ft.
Perforations: 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.
Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Gravel packed: Yes No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.
Surface seal: Yes No To what depth? 22' ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land surface elevation above mean sea level _____ ft.
Static level 30 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(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: 10 gal./min. with _____ ft. drawdown after _____ hrs.
" Estimated airlift " " " "
" " " " " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level

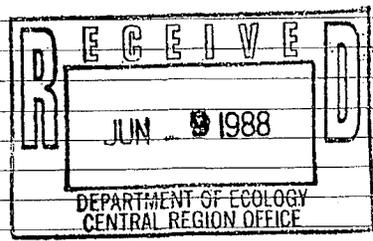
Date of test _____
Bailey test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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 information.

MATERIAL	FROM	TO
Sand	0	15
Basalt, Red, Soft	15	21
Basalt, Red honey combed, Medium	21	40
Basalt, Gray, w/water on top 2-3GPM	40	95
Basalt, Brown, w/water 2-3 GPM	95	103
Basalt, Dark gray, Medium	103	150
Basalt gravel, Tan w/water 4-6GPM	150	154
Basalt, Dark gray, Medium Hard	154	160

lea. 4" PVC Liner Installed
lea. 6" Drive shoe Utilized



JUN 7 1988

Work started 05/26/88, 19. Completed 05/27/88, 19.

WELL CONSTRUCTOR CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC.
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address E. 6010 Broadway Spokane, WA 99212

(Signed) [Signature] License No. 1472
(WELL DRILLER)

Contractor's Registration No. PO-ND-EI*248 JE Date 05/27/88, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

441011

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W36997
Unique Well I.D. # ABL059
Water Right Permit No.

(1) OWNER: Name HOMER, HUGH W. Address 586 S. 38TH AVE. #123 W. RICHLAND, WA 99352-

(2) LOCATION OF WELL: County BENTON - SW 1/4 NW 1/4 Sec 01 T 09 N., R 27 WM
(2a) STREET ADDRESS OF WELL (or nearest address)

(3) PROPOSED USE: DOMESTIC (10) WELL LOG

(4) TYPE OF WORK: Owner's Number of well 1
(If more than one) Method: ROTARY
NEW WELL 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 in formation.

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 218 ft. Depth of completed well 218 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from +2 ft. to 38 ft.
WELDED 4 " Dia. from -5 ft. to 218 ft.
" Dia. from ft. to ft.
Perforations: YES
Type of perforator used SKILL SAW
SIZE of perforations in. by in.
perforations from 170 ft. to 210 ft.
perforations from ft. to ft.
perforations from ft. to ft.
MATERIAL FROM TO
TOPSOIL 0 5
YELLOW CLAY 5 20
BROKEN BLACK BASALT 20 40
BLACK HARD BASALT 40 90
BLACK MEDIUM BASALT 90 110
YELLOW CLAY 110 125
GRAY CLAY 125 130
BLACK HARD BASALT 130 150
FRACTURED BASALT 150 155
BLACK MEDIUM BASALT 155 200
BLACK HARD BASALT 200 205
FRACTURED BASALT WITH WATER 205 218

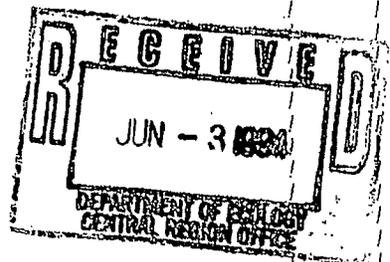
Screens: NO
Manufacturer's Name
Type Model No.
Dia. slot size from ft. to ft.
Dia. slot size from ft. to ft.

Gravel packed: NO
Gravel placed from ft. to ft. Size of gravel

Surface seal: YES To what depth? 18 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off OVERBORE

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

(8) WATER LEVELS: Land-surface elevation
Static level 110 ft. below top of well Date 05/16/94
Artesian Pressure lbs. per square inch Date
Artesian water controlled by



Work started 05/13/94 Completed 05/16/94

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? NO If yes, by whom?
Yield: gal./min with ft. drawdown after hrs.
Recovery data
Time Water Level Time Water Level Time Water Level
WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING
(Person, firm, or corporation) (Type or print)
ADDRESS E 6010 BROADWAY
[SIGNED] *A Kelly* License No. 8215
Contractor's Registration No. PO-ND-EI*248JE Date 05/18/94

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

1ES

441010

WATER WELL REPORT

Start Card No. W45147

STATE OF WASHINGTON

Unique Well I.D. # ABL272

Water-Right Permit No.

(1) OWNER: Name WILDENBORG, WILLIAM Address 7000 W. VAN GRISSEN LT310 W. RICHLAND, WA 99352-

(2) LOCATION OF WELL: County BENTON
 (a) STREET ADDRESS OF WELL (or nearest address) SW 1/4 NW 1/4 Sec 01 T 09 N., R 27E WH

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one) 1
 Method: ROTARY
 NEW WELL

(5) DIMENSIONS: Diameter of well 6 inches
 Drilled 220 ft. Depth of completed well 220 ft.

(6) CONSTRUCTION DETAILS:
 Casing installed: 6 " Dia. from +2 ft. to 48 ft.
 WELDED 4 " Dia. from -4 ft. to 220 ft.
 " Dia. from ft. to ft.

Perforations: YES
 Type of perforator used SKILL SAW
 SIZE of perforations in. by in.
 perforations from 200 ft. to 220 ft.
 perforations from ft. to ft.
 perforations from ft. to ft.

Screens: NO
 Manufacturer's Name
 Type Model No.
 Diam. slot size from ft. to ft.
 Diam. slot size from ft. to ft.

Gravel packed: NO
 Gravel placed from ft. to ft. Size of gravel

Surface seal: YES To what depth? 18 ft.
 Material used in seal BENTONITE
 Did any strata contain unusable water? NO
 Type of water? Depth of strata ft.
 Method of sealing strata off OVERBORE

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

(8) WATER LEVELS: Land-surface elevation
 Static level 120 ft. above mean sea level ... ft.
 Date 10/10/94
 Artesian Pressure lbs. per square inch
 Artesian water controlled by

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

Was a pump test made? NO If yes, by whom?
 Yield: gal./min with ft. drawdown after hrs.

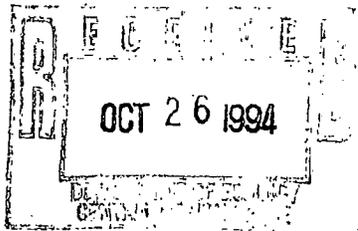
Recovery data
 Time Water Level Time Water Level

Date of test / /
 Bailer test gal./min. ft. drawdown after hrs.
 Air test 30 gal./min. w/ stem set at 200 ft. for 1 hrs.
 Artesian flow g.p.m. Date
 Temperature of water Was a chemical analysis made? NO

(10) WELL LOG

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 in formation.

MATERIAL	FROM	TO
TOPSOIL	0	5
YELLOW CLAY	5	20
BROKEN BLACK BASALT	20	50
HARD BLACK BASALT	50	110
	95	
YELLOW CLAY	110	130
GRAY CLAY	130	135
HARD BLACK BASALT	135	200
BROKEN BASALT WITH WATER	200	220
	220	



Work started 10/12/94 Completed 10/14/94

WELL CONSTRUCTOR CERTIFICATION:
 I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING
 (Person, firm, or corporation) (Type or print)

ADDRESS E 6010 BROADWAY

(SIGNED) *Sy A. Kelly* License No. 2215

Contractor's
 Registration No. PO-ND-EI*248JE Date 10/19/94

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

(RFI)

Application No. _____
Permit No. _____

OWNER: Name SULLIVAN, E. Neil & William E. Address Route 1, Box 5056, W. Richland, WA 99352
LOCATION OF WELL: County BENTON NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1 T. 9 N. R. 27 E. W.M. D
Bearing and distance from section or subdivision corner _____

(3) PROPOSED USE: Domestic Industrial Municipal
Irrigation Test Well Other
(4) TYPE OF WORK: Owner's number of well (if more than one) _____
New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 65 ft. Depth of completed well 65 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10 " Diam. from +1 ft. to 59 ft.
Threaded " Diam. from _____ ft. to _____ ft.
Welded " Diam. from _____ ft. to _____ ft.
Perforations: 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.

Screens: Yes No
Manufacturer's Name _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 20 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land surface elevation _____ ft.
above mean sea level _____ ft.
Static level 35 ft. below top of well Date 2/20/85
Artesian pressure _____ lbs. per square inch Date 2/20/85
Artesian water is controlled by _____ (Cap, valve, etc.)

(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: 100+ gal./min. with _____ ft. drawdown after _____ hrs.
ESTIMATED AIRLIFT " " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level
Date of test _____
Bajler test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG:
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
Top soil	0	2
Sand	2	40
Basalt, broken w/water	40	65
NO PVC Liner Installed		
10" Drive shoe installed		
RECEIVED		
MAR - 9 1985		
RECEIVED		
MAR 13 1985		
DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE		

Work started 2/20/85 1985 Completed 2/20 1985

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 PONDEROSA DRILLING & DEVELOPMENT INC.
(Person, firm, or corporation) (Type or print)
Address E. 6010 Broadway, Spokane, WA 99212
[Signed] Thomas R. Richardson
Thomas R. Richardson (Well Driller)
License No. 1295 Date 2/20 1985
2/19/85

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

1K1

File Original with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W-093750

UNIQUE WELL I.D. # AET-525

Water Right Permit No. _____

OWNER: Name Joe & Linda picker Address P.O. Box 2792 Pasco WA 99301

(2) LOCATION OF WELL: County Benton NE 1/4 SW 1/4 Sec 1 T 9 N.R. 27E WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Paradise Ln.

TAX PARCEL NO.: _____

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
 New Well Method:
 Deepened Dug Bored
 Reconditioned Cable Driven
 Decommission. Rotary Jetted

(5) DIMENSIONS: Diameter of well 6" inches
 Drilled 220 feet. Depth of completed well 220 ft.

(6) CONSTRUCTION DETAILS
 Casing Installed:
 Welded 6" Diam. from +1.5 ft. to 83.5 ft.
 Liner installed 5" Diam. from -30 ft. to 190 ft.
 Threaded _____ Diam. from _____ ft. to _____ ft.

Perforations: Yes No
 Type of perforator used torch cut
 SIZE of perforations 1/2" in. by 12" in.
15 perforations from 205 ft. to 220 ft.

Screens: Yes No K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot Size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand _____
 Material placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? +20 ft.
 Material used in seal _____
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
 Static level 165 ft. below top of well Date 5-5-99
 Artesian pressure _____ lbs. per-square inch Date _____
 Artesian water is controlled by _____
 (Cap, valve, etc.)

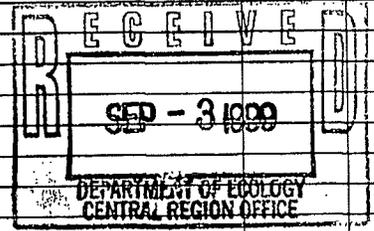
(9) WELL TESTS: Drawdown is amount water level is lowered below static level
 Was a pump test made? Yes No If yes, by whom? _____
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

 Date of test _____
 Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airtest 30 gal./min. with _____ ft. drawdown after 4 hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
 Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Sand	0	3
Sand & Gravel	3	6
Brown Clay	6	10
Sand & Gravel	10	24
Brown clay	24	80
HO Gray clay	80	92
Brown clay	92	130
Cemented Gravel	130	160
Gray clay	160	203
Red Porous Basalt	203	220
Water Bearing 30 GPM		



Work Started 4-30 99 Completed 5-5 99

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name TOOD HANEY License No. 2343
 (Licensed Driller/Engineer)

Trainee Name _____ License No. _____

Drilling Company STATEWIDE WELL DRILLING
 (Signed) J M Elzy License No. 2543
 (Licensed Driller/Engineer)

Address 101 KAU Trail Rd PASCO WA 99301

Contractor's Registration No. STATEW0770Q Date 4/00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

File Original and First Copy with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No.

Permit No.

(1) OWNER: Name John Harris Address Rt 2 Box 2223 Benton City WA 99320

(2) LOCATION OF WELL: County Benton Lot SP-523 NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 1 T 9 N. R 27 W.M.
(ing) and distance from section or subdivision corner 200ft. NE CORNER

(3) PROPOSED USE: Domestic Industrial Municipal
Irrigation Test Well Other

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 285 ft. Depth of completed well 285 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from -1 ft. to 174 ft.
Threaded " Diam. from ft. to ft.
Welded " Diam. from ft. to ft.

Perforations: 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.

Screens: Yes No
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes No Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes No To what depth? 46 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation ft.
above mean sea level ft.
Static level 90 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(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.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Pump test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes No

(10) WELL LOG:
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
Sand	0	3
Crack Basalt	3	15
Broken Basalt Redch	15	77
Sand Brown	33	120
Hard Black Basalt	120	185
Breakend Basalt Baring	165	185
Water App 7 Gpm		
Hard Black Basalt	185	265
Sand Stone + Shale	265	285
Baring water App 40 Gpm		

RECEIVED
NOV 14 1979
DEPT. OF ECOLOGY

Work started 5-1-79, 1979. Completed 10-26-79, 1979

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 St. George Drilling (Person, firm, or corporation) (Type or print)
Address 701 So 45 AVE W. Richland
[Signed] Robert E. St. George Jr. (Well Driller)
License No. 0483 Date 10-26-79, 1979

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

1W1

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE48742

(SUBMIT ONE WELL REPORT PER WELL INSTALLATION)
Construction/Decommission ("x" in box)

Construction 496189
 Decommission



Type of Well ("x" in box)
 Resource Protection
 Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Property Owner CITY OF RICHLAND

Consulting Firm STRATA

Site Address 500' WEST OF PARADISE WAY AND ONYX AVE

Unique Ecology Well IDTag No. _____

City RICHLAND

County BENTON-3

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Location SE1/4-1/4 SW1/4 Sec 1 Twn 9N R 27

EWM or WWM

Driller Engineer Trainee

Name (Print Last, First Name) DELVALLE, AARON

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED)

Long Deg _____ Min _____ Sec _____

Driller/Engineer /Trainee Signature [Signature]

Driller or Trainee License No. 3074

Tax Parcel No. _____

Cased or Uncased Diameter 8" Static Level _____

If trainee, licensed driller's Signature and License Number: _____

Work/Decommission Start Date 7-12-13

Work/Decommission Completed Date 7-12-13

Construction Design	Well Data	Formation Description
DRILLED TO 20' BGS WITH 8" HOLLOW STEM AUGERS	B-3	0-15.5' ALLUVIUM SAND AND GRAVEL TAN 15.5-20' ALLUVIUM SAND AND GRAVEL WITH CLAY

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

112

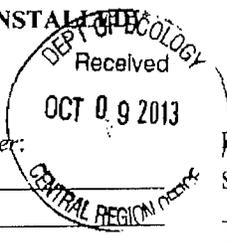
Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE48742

(SUBMIT ONE WELL REPORT PER WELL INSTALLATION)
Construction/Decommission ("x" in box)

Construction
 Decommission 496188



Type of Well ("x" in box)

Resource Protection
 Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Property Owner CITY OF RICHLAND

Site Address 500' WEST OF PARADISE WAY AND ONYX AVE

Consulting Firm STRATA

City RICHLAND

Unique Ecology Well IDTag No. _____

County BENTON-3

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Location SE1/4-1/4 SW1/4 Sec 1 Twn 9N R 27

EWM or WWM

Driller Engineer Trainee

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

Name (Print Last, First Name) DELVALLE, AARON

still REQUIRED) Long Deg _____ Min _____ Sec _____

Driller/Engineer /Trainee Signature [Signature]

Tax Parcel No. _____

Driller or Trainee License No. 3074

Cased or Uncased Diameter 8" Static Level _____

If trainee, licensed driller's Signature and License Number: _____

Work/Decommission Start Date 7-12-13

Work/Decommission Completed Date 7-12-13

Construction Design	Well Data	Formation Description
DRILLED TO 20' BGS WITH 8" HOLLOW STEM AUGERS	B-2	0-20' ALLUVIUM SAND AND GRAVEL TAN

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

IN3

Please print, sign and return to the Department of Ecology

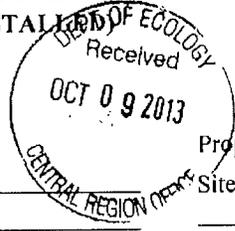
RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE48742

(SUBMIT ONE WELL REPORT PER WELL INSTALLATION)

Construction/Decommission ("x" in box)

Construction
 Decommission 496187



Type of Well ("x" in box)

Resource Protection
 Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Property Owner CITY OF RICHLAND

Site Address 500' WEST OF PARADISE WAY AND ONYX AVE

Consulting Firm STRATA

Unique Ecology Well IDTag No. _____

City RICHLAND

County BENTON-3

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Location SE1/4-1/4 SW1/4 Sec 1 Twn 9N R 27

EWM or WWM

Driller Engineer Trainee

Name (Print Last, First Name) DELVALLE, AARON

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 3074

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED)

Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8" Static Level _____

Work/Decommission Start Date 7-12-13

Work/Decommission Completed Date 7-12-13

If trainee, licensed driller's Signature and License Number: _____

Construction Design	Well Data	Formation Description
DRILLED TO 20' BGS WITH 8" HOLLOW STEM AUGERS	B-1	0-20' ALLUVIUM SAND AND GRAVEL TAN

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

101

File Original with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W122252
UNIQUE WELL ID # HEM 784
Water Right Permit No _____

(1) OWNER Name TEREJ, Aleks Address 1320 Adair Richland WA 99352

(2) LOCATION OF WELL County Benton SW 1/4 SE 1/4 Sec 1 T. 9 N. R. 27 W. Q

(2a) STREET ADDRESS OF WELL (or nearest address) _____
TAX PARCEL NO _____

(3) PROPOSED USE Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK Owner's number of well (if more than one) _____
 New Well Method Dug Bored
 Deepened Cable Driven
 Reconditioned Rotary Jetted
 Decommission

(5) DIMENSIONS Diameter of well 6 inches
Drilled 200 feet Depth of completed well 200 feet

(6) CONSTRUCTION DETAILS
Casing Installed
 Welded 6" Diam from +2 ft to 200 ft
 Liner installed _____ Diam from _____ ft to _____ ft
 Threaded _____ Diam from _____ ft to _____ ft

Perforations Yes No
Type of perforator used _____
SIZE of perforations _____ in by _____ in
_____ perforations from _____ ft to _____ ft

Screens Yes No K-Pac Location _____
Manufacturer's Name _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
Material placed from _____ ft to _____ ft

Surface seal Yes No To what depth? 20 ft
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP Manufacturer's Name _____
Type _____ HP _____

(8) WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 170 ft below top of well Date 5-17-00
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (Cap, valve etc)

(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
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level

Date of test _____
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Airstest BT 20 gal/min with _____ ft drawdown after 1 hrs
Artesian flow _____ g p m Date _____
Temperature of water 57° Was a chemical analysis made? Yes No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

JUN 12 11 AM '00	MATERIAL	FROM	TO
	Top Soil	0	2
	Sandy Brown	2	32
	CLAY & SILT	72	81
	Brown Silt	81	179
	Sand & Gravel (Water)	179	200

RECEIVED

JUN 14 2000

DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 5-14-00 Completed 5-17-00

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Lyle Amos License No. 1224
(Licensed Driller/Engineer)

Trainee Name _____ License No. _____
Drilling Company Triple A Drilling
(Signed) Lyle A. Amos License No. 1224
(Licensed Driller/Engineer)
Address 2202 W. Wanklyn Benton City, WA

Contractor's Registration No. TRIPDI0589 Date 5-20-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

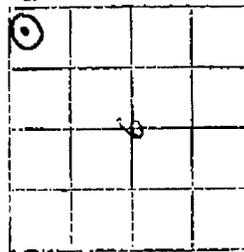
STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

No. **A-6355**

WELL LOG

Date **10-15, 1962**
Record by **Well driller**
Source **driller's record**

Location: **State of WASHINGTON**
County **Benton**
Area



Map **N 5 1/4 NE 1/4 sec. 6 T. 2 N., R. 28 E.** Diagram of Section
Drilling Co. **Smith & Sons Drilling Company**
Address **2103 North 52nd Passo, Washington**

Method of Drilling **_____** Date **8/20, 21, 22, 62**
Owner **Town of West Richland**

Address **Rt. 1, Box 222, West Richland, Wash.**
Lead surface datum **ft. above/below _____**

Course Log	Interval (feet)	Remarks (feet)	Depth (feet)
---------------	--------------------	-------------------	-----------------

Give a verbal description of strata and lithology in secondary in section. If not of water-bearing, no logs and record this level. Give depth in feet below surface unless otherwise indicated. Correlate with stratigraphic column. If feasible, following log of materials, list all logs, perforations, screens etc.

Silty sand and gravel	10.5	10.5	10.5
Black sand	8.4	19	19
Black sand	7	26	26
Sandy gravel	9	35	35
Silty sand gravel - water	13	48	48
Silty sand gravel - water	10	58	58
Silty sand gravel - water	9	67	67
Very clean sand	2	69	69
2" minus gravel and sand - water	7	76	76
Cemented gravel - no water	17	93	93
Clay - no water	4	97	97
Sand and gravel - water	29	126	126
Brown volcanic ash, few large cobbles - water	38	164	164
Blue clay - no water	12	176	176
Broken honey-comb basalt - water	13	189	189

Turn up **(over)** Sheet **_____** of **_____** sheets

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WELL LOG—Continued No. /

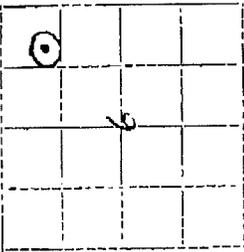
COOR- LATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Depth forward	—	
	Broken basalt with blue clay - water	3	192
	Broken basalt with gray shale	5	197
	Very broken basalt, sluffs in - water	12	209
	Loose broken basalt - water	36	245
	Broken basalt, volcanic ash binder - water	5	250
	PUMP TEST:		
	Dim: 16" x 250'		
	SWL: 25 ft. (8-20-62)		
	DD: 23.34 ft.		
	Yield: 1,001 <i>gpm</i>		
	Rapid recovery		
	CASING: 16" diam. casing from 0 to 177 ft.		
	16" diam. hole in rock from 177 to 200 ft.		
	12" diam. hole in rock from 200 to 250 ft.		
	16" Drive shoe set at 177 ft.		
	Perforated casing or screens:		
	Perforated 16" casing from 100 to 125 ft.		
	12 per ft. size 3/8 x 3		

Town of Richland
S-6, T-9, R-28
Wtr, 16, 250
Beiton

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

Appl. 8214

WELL LOG

Record by.....Driller.....
 Source.....Driller's Record.....
 Location: State of WASHINGTON
 County.....Benton.....
 Area.....
 Map.....
 ...NE¼ sec. 6, T.9 N., R. 28 E.  Diagram of Section
 Drilling Co.....Cascade Drilling Company.....
 Address.....308 North 12th, Pasco, Washington.....
 Method of Drilling.....Cable/Driven Date.....June 14, 1966.

Owner.....Ray Moller.....
 Address.....1025 Cedar, Richland, Washington
 Land surface, datum.....ft. ^{above} _{below}
 SWL.....28.7" Date.....June 14, 1966 Dims.....6" x 90' 2

CORRE- LATION	MATERIAL	From (feet)	To (feet)
	Domestic and irrigation use		
	Soil	0	28
	Gravel, fine, and sand	28	29
	Soil	29	30
	Gravel, fine	30	36
	Sand, coarse (gravel, trace)	36	42
	Sand, compact, gravel & sedi	42	63
	Clay, dirt and dec. basalt	63	73
	Basalt, sediment	73	75
	Basalt, very hard, fractured	75	90' 2
	WATER AT 82' and 88'		
	Casing: 6' from 0 to 7 6'		
	Surface sealed with Bentonite and cement grout to depth of 3'		
	Yield: 36 gpm with 2' 5" dd after 150 hrs.		
	Date of test: 6/28/66		

(Transcribe driller's terminology literally but paraphrase, as necessary, in parenthesis, if material water-bearing. An asterisk indicates a water-bearing zone. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)

6 D2
p. 1062

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

6A3
W 045183

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 045183
UNIQUE WELL I.D. # _____

Water Right Permit No. _____

145086

OWNER: Name MARK AOUITY Address 5995 40th AVE, W. RICHLAND

(2) LOCATION OF WELL: County Benton NE 1/4 NE 1/4 Sec 6 T. 9 N. R. 28 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) _____

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 200 feet. Depth of completed well 200 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 175 ft.
Welded " Diam. from _____ ft. to _____ ft.
Liner installed " Diam. from _____ ft. to _____ ft.
Threaded " Diam. from _____ ft. to _____ ft.

Perforations: 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.

Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 136 ft.
Material used in seal Bentonite cement
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 124 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(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.
" " " " " "
" " " " " "

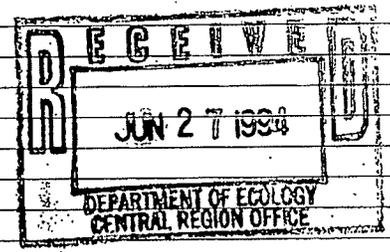
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level
_____ _____ _____ _____ _____ _____

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 30 gal./min. with stem set at 180 ft. for 2 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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 information.

MATERIAL	FROM	TO
Brown Sand	0	3
Brown clay	3	81
Brown Sand Gravel	81	121
Brown clay	121	136
Blue Gray clay	136	162
Broken Black Basalt	162	179
Reddish Brown Basalt	179	200
Broken Bearing Water		



Work Started 5-25-94 19. Completed _____ 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St. George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 701 3045 AVE. W. RICHLAND

(Signed) Pat E. St. George license No. 0487 (WELL DRILLER)

Contractor's Registration No. 601-048715 Date 5-26-94 19

(USE ADDITIONAL SHEETS IF NECESSARY)



6A5

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. ae21131

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

Construction
 Decommission 483190

ORIGINAL INSTALLATION Notice of Intent Number:

sc47720

Consulting Firm geoengineers inc

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) thompson, dave

Driller/Engineer /Trainee Signature [Signature]

Driller or Trainee License No. 2493

If trainee, licensed driller's Signature and License Number:

Type of Well ("x" in box)

Resource Protection
 Geotech Soil Boring

Property Owner city of west richland

Site Address bombing range rd

City west richland

County benton-3

Location ne 1/4-1/4 ne 1/4 Sec 6 Twn 9 R 28

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 7.75" Static Level n/a

Work/Decommission Start Date 3-26-2013

Work/Decommission Completed Date 3-26-2013

Construction Design

Well Data

Formation Description

<p>Hollow stem auger backfilled using holeplug bottom of hole <u>25'</u></p>	<p>B / 323400200 Natural cap no groundwater</p> <p>DEPT OF ECOLOGY Received MAY 07 2013 CENTRAL REGION OFFICE</p>	<p>sand ,, silt</p> <p>25'</p> <p>13 APR 29 A 7:03 DEPT. OF ECOLOGY FISCAL B BUDGET</p>
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The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

6C1

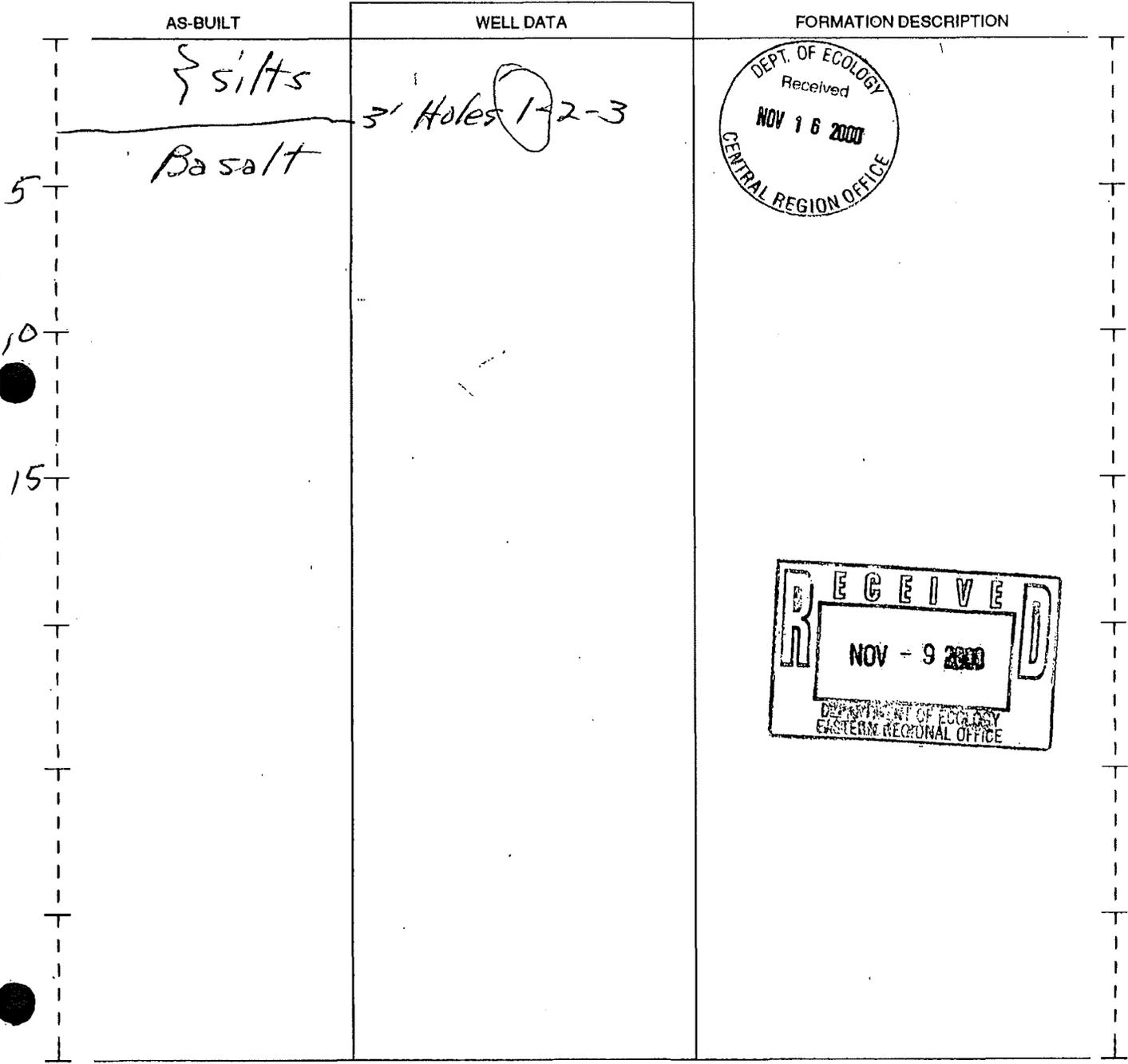
82478

RESOURCE PROTECTION WELL REPORT

START CARD NO. SO 5810

PROJECT NAME: W Richland tower
 WELL IDENTIFICATION NO. _____
 DRILLING METHOD: Auger
 DRILLER: 1721
 FIRM: Johnson Exploration Inc
 SIGNATURE: Larry Johnson
 CONSULTING FIRM: 571 NW
 REPRESENTATIVE: ~~Paul~~ Nelson
Paul

COUNTY: Benton
 LOCATION: NE 1/4 NW 1/4 Sec 6 Twn 9N R28
 STREET ADDRESS OF WELL: 5390B Astoria Rd
W Richland 99353
 WATER LEVEL ELEVATION: _____
 GROUND SURFACE ELEVATION: _____
 INSTALLED: 10-12-00
 DEVELOPED: _____



SCALE: 1" = _____ PAGE _____ OF _____

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

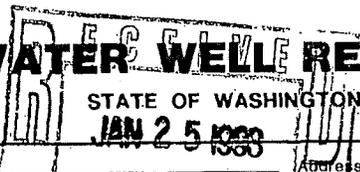
BCA-5703 Collins Rd

6C2

WATER WELL REPORT

8190 Start Card No. 016394

File Original and First Copy with Department of Ecology
 Second Copy—Owner's Copy
 Third Copy—Driller's Copy



Water Right Permit No. _____

(1) OWNER: Name Bob Loveall Address 1215 Stevens Dr. Rich, WA.

(2) LOCATION OF WELL: County Benton N.W. Sec. 6 T. 9 N., R. 28E W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Lot 50 Collins Rd W. Rich.

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (If more than one) _____
 Abandoned New well Method: Dug Bored
 Deepened Cable Driven
 Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 8x6x4 inches.
 Drilled 332 feet. Depth of completed well 332 ft.

(6) CONSTRUCTION DETAILS:
 Casing installed: 8" Diam. from +1 ft. to 100 ft.
 Welded 6" Diam. from +2 ft. to 268 ft.
 Liner installed Threaded

Perforations: 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.

Screens: Yes No
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot-size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel _____
 Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 100 ft.
 Material used in seal Bentonite + cement
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
 Static level 278 ft. below top of well Date 1-13-93
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
 Was a pump test made? Yes No If yes, by whom? B+H
 Yield: 16.6 gal./min. with 10' ft. drawdown after 24 hrs.
 " 16.6 " " 10' " " 5 min "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
<u>Total Recovery in 5 min</u>					

Date of test 1-13-93
 Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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 information.

MATERIAL	FROM	TO
<u>brown sand</u>	<u>0</u>	<u>1</u>
<u>basalt cobbles, silt</u>	<u>1</u>	<u>5</u>
<u>compacted gravel, cobbles + silt</u>	<u>5</u>	<u>18</u>
<u>basalt boulders, cobbles, silt</u>	<u>18</u>	<u>41</u>
<u>compacted gravel, silt</u>	<u>41</u>	<u>61</u>
<u>brown sand, silt</u>	<u>61</u>	<u>66</u>
<u>compacted gravel, silt, gray clay</u>	<u>66</u>	<u>88</u>
<u>gray clay</u>	<u>88</u>	<u>94</u>
<u>rusty black basalt med hard</u>	<u>94</u>	<u>109</u>
<u>rusty black basalt hard</u>	<u>109</u>	<u>117</u>
<u>grayish black basalt hard</u>	<u>117</u>	<u>201</u>
<u>sandy silty tan clay</u>	<u>201</u>	<u>209</u>
<u>gray clay firm</u>	<u>209</u>	<u>269</u>
<u>black basalt hard</u>	<u>269</u>	<u>285</u>
<u>broken black basalt med hard</u>	<u>285</u>	<u>292</u>
<u>broken black basalt porous</u>	<u>292</u>	<u>332</u>

Work started 8-19, 1992 completed 1-13, 1993

WELL CONSTRUCTOR CERTIFICATION:
 I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME B+H Drilling #2 (TYPE OR PRINT)
 Address Box 343 Burbank, WA.
 (Signed) M. J. Butler License No. 0065
 Contractor's Registration No. BHDR12X135ND date 1-20, 1993

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 136315
UNIQUE WELL I.D.# AFH-548
Water Right Permit No. AFH-548

101729

(1) OWNER: Name Randy Powers Address PO Box 4285 W-Richland, WA

(2) LOCATION OF WELL: County Benton NW 1/4 NW 1/4 Sec. 6 T 9 N R 28 E W 1/2

(2a) STREET ADDRESS OF WELL: (or nearest address) Williamette Heights W. Richland

TAX PARCEL NO. D

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
 New Well Method: Dug Bored
 Deepened Cable Driven
 Reconditioned Rotary Jetted
 Decommission

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 210 feet. Depth of completed well 210 feet.

(6) CONSTRUCTION DETAILS
Casing Installed: 6 ft. Diam. from 12 ft. to 200 ft.
 Welded
 Liner installed
 Threaded

Perforations: Yes No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft to _____ ft

Screens: Yes No K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft. to _____ ft.
Diam. _____ Slot Size _____ from _____ ft to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand _____
Material placed from _____ ft to _____ ft.

Surface seal: Yes No To what depth? 210 ft
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 135 ft. below top of well Date 5-14-01
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

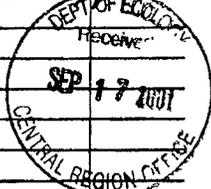
(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes No If yes, by whom? _____
Yield _____ gal./min. with _____ ft. drawdown after _____ hrs
Yield: _____ gal./min. with _____ ft drawdown after _____ hrs
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft drawdown after _____ hrs.
Airtest 135 60 gal./min. with _____ ft. drawdown after 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water 56 Was a chemical analysis made? Yes No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation. Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Top Soil	0	6
Sand & gravel	6	32
Light Brown clay	32	79
Dark Brown clay	79	126
Dark grey clay	126	189
Rusty clay & weathered Basalt	189	190
Porous Basalt with yellow stringers of Hardpan (water)	190	210

Well was blowing air and gurgling when cased



RECEIVED

SEP 13 2001

DEPARTMENT OF ECOLOGY WELL DRILLING UNIT

Work Started 5-11-01 Completed 5-14-01

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name LO AMOS License No. 1224
(Licensed Driller/Engineer)

Trainee Name _____ License No _____

Drilling Company Triple A Drilling Inc
(Signed) John O. Amos License No. 1224
(Licensed Driller/Engineer)

Address Benton City, WA 99370

Contractor's Registration No. TRIPLOT02539 Date 5-14-01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-8006

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

611



WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle) 185458
 Construction
 Decommission ORIGINAL INSTALLATION Notice of Intent Number _____

CURRENT

Notice of Intent No. w 160935

Unique Ecology Well ID Tag No. AKH939

Water Right Permit No. _____

Property Owner Name Tracey Smith

Well Street Address 851 Bombing Range RD

City West Richland County Benton

Location NW 1/4-1/4 NE 1/4 Sec 6" Tw n 9N R 28e EWM or WWM circle one one

Lat/Long (s, t, r) Lat Deg _____ Lat Min/Sec _____

Still REQUIRED) Long Deg _____ Long Min/Sec B

Tax Parcel No. 1-0698-402-0128-000

PROPOSED USE: Domestic Industrial Municipal
 DeWater Irrigation Test Well Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
 New well Reconditioned Method: Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS: Diameter of well 6" inches, drilled 282 ft.
 Depth of completed well 282 ft.

CONSTRUCTION DETAILS
 Casting Welded 6" Diam. from +1 ft. to 138 ft.
 Installed: Liner installed _____ Diam. from _____ ft. to _____ ft.
 Threaded _____ Diam. from _____ ft. to _____ ft.

Perforations: Yes No
 Type of perforator used _____
 SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: Yes No K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand _____
 Materials placed from _____ ft. to _____ ft.

Surface Seal: Yes No To what depth? 20 ft.
 Material used in seal bentonite
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

PUMP: Manufacturer's Name _____
 Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
 Static level 100 ft. below top of well Date 7-27-05
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (cap, valve, etc.)

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.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

 Date of test _____
 Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airtest 50 gal./min. with stem set at 240 ft. for 3 hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

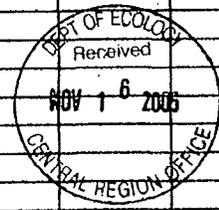
CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
topsoil+ sand + gravel	0	30
tan sand + clay + sandstone	30	50
gray sand + medium gravel	50	70
course gravel + fine gravel	70	80
gravel + trace H2O	80	90
Tan Clay + Sand	90	103
Gray clay	103	135
Black basalt hard	135	140
Red soft basalt	140	150
basalt shalt stone black and tan	150	158
hard gray basalt	158	238
soft basalt +brown claystone + H2O	238	250
blue shale + sand stone + H2O	250	275
soft basalt + H2O	275	282

DEPT OF ECOLOGY
 PHYSICAL & BUDGET
 NOV 10 10 18 34

RECEIVED
 NOV 10 2005
 Water Resources Program
 Department of Ecology



Start Date 7-26-05 Completed Date 7-27-05

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) Thomas St. George
 Driller/Engineer/Trainee Signature [Signature]
 Driller or trainee License No. 2781

If TRAINEE, Driller's Licensed No. _____
 Driller's Signature _____
 Drilling Company St. George Well Drilling Co.
 Address 701 S 45th Ave.
 City, State, Zip West Richland, Wa, 99353
 Contractor's Registration No. stgeogw954k4 Date 7-27-05

Ecology is an Equal Opportunity Employer.

The Dep. The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

612 p.10fz

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. C
Permit No. _____

(1) OWNER: Name FRANK PANIZKO Address 1428 STEVEN'S DRIVE RICHLAND WA
(2) LOCATION OF WELL: County BENTON NE 1/4 SW 1/4 Sec. 6 T. 9 N. R. 20 E. W.M. L.
Lot 154 Willamette Heights

PROPOSED USE: Domestic Industrial Municipal
Irrigation Test Well Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 300 ft. Depth of completed well 300 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 183 ft.
Threaded " Diam. from _____ ft. to _____ ft.
Welded " Diam. from _____ ft. to _____ ft.

Perforations: 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.

Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 180 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(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.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Flow test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Pump flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No
OK MAS

(10) WELL LOG:
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
SAND + SILT	0	3
LT BROWN CLAY	3	183
SMALL GRAVEL		
BROKEN BASALT (3 qm)	183	185
BASALT	185	280
FRACTURED BASALT	280	295
BLUE GREEN CLAYSTONE	295	300

RECEIVED

NOV 8 1974

DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

RECEIVED

NOV 12 1974

DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 9/11/74, 19____ Completed 9/16, 1974

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 Hatch Drilling Co Inc
(Person, firm, or corporation) (Type or print)

Address PO Box 741 Richland

[Signed] G. D. Bejlan
(Well Driller)

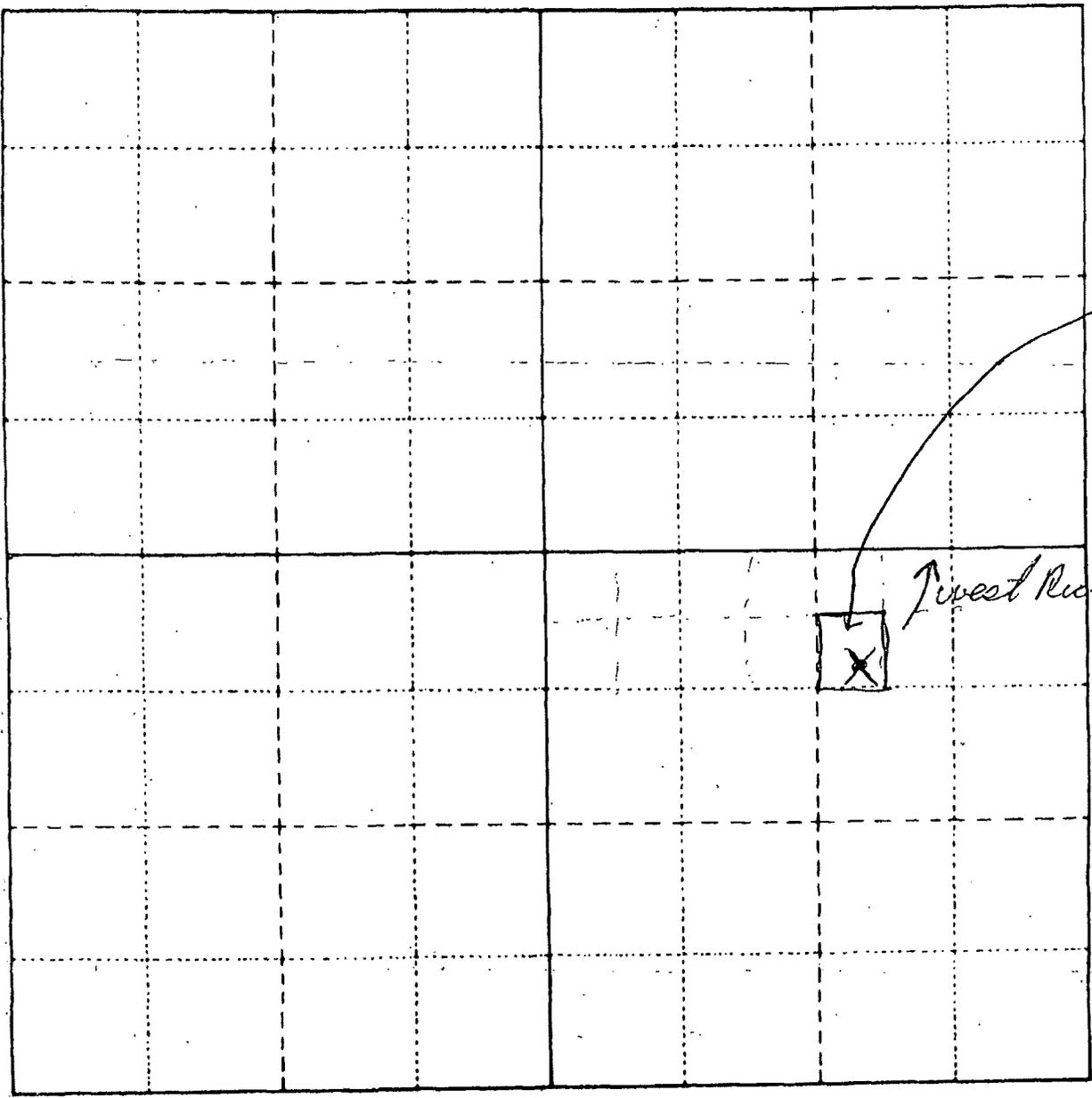
License No. 0036 Date 9/25, 1974

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

6I2 p. 2 of 2

Sec. 6 Twp. T 9 N N. R. 28 E

N



lot No 154

West Richland 1/2 mile

0019

613

The Department of Ecology does NOT warrant the Data and/or the Information on this Well Report



WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

DEPARTMENT OF ECOLOGY
State of Washington

Construction/Decommission ("x" in circle)

Construction

Decommission ORIGINAL INSTALLATION

Notice of Intent Number

PROPOSED USE: Domestic Industrial Municipal
 DeWater Irrigation Test Well Other

TYPE OF WORK: Owner's number of well (if more than one) _____
 New well Reconditioned Method: Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 360 ft.
Depth of completed well 352 ft.

CONSTRUCTION DETAILS
Casing Welded 8" Diam. from 112 ft. to 191 ft.
Installed: Liner installed 6" Diam. from 156 ft. to 352 ft.
 Threaded. _____" Diam. From _____ ft. to _____ ft.

Perforations: Yes No
Type of perforator used SAW

SIZE of perfs 1/8 in. by 6 in. and no. of perfs 90 from 335 ft. to 352 ft.

Screens: Yes No K-Pac Location _____

Manufacturer's Name _____
Type _____ Model No. _____
Diam. Slot size from _____ ft. to _____ ft.
Diam. Slot size from _____ ft. to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: Yes No To what depth? 20 ft.
Material used in seal Benarite

Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ HP.

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 218 ft. below top of well Date 8-12-16

Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

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.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

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

Airtest 50 gal./min. with stem set at 310 ft. for 2 hrs.

Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

CURRENT

Notice of Intent No. WE-24944

Unique Ecology Well ID Tag No. BIF-939

Water Right Permit No. _____

Property Owner Name Joseph Mayo

Well Street Address Laurel Dr.

City W. Richland County Benton

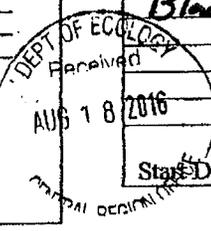
Location NE 1/4-1/4 SE 1/4 Sec 6 Twn 9 R28 EWM
(s, t, r Still REQUIRED) Or WWM

Lat/Long Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 106984020189003

CONSTRUCTION OR DECOMMISSION PROCEDURE		
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)		
MATERIAL	FROM	TO
Tan Sand + Gravel	0	20
Brown Sand	20	26
Tan Clay	26	40
Brown Sandstone	40	80
Grey Clay	80	86
Brown Sandstone + Clay	86	126
Gravel + Tan Silt	126	146
Grey Clay	146	189
Black Basalt	189	215
Red Basalt	215	222
Black Basalt	222	298
Grey Clay	298	333
Green Clay	333	337
Black Porous Basalt	338	360
- H ₂ O -		

Start Date 8-8-16 Completed Date 8-12-16



WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) Nash Burns
Driller/Engineer/Trainee Signature [Signature]
Driller or trainee License No. 3816
IF TRAINEE: Driller's License No. _____
Driller's Signature: _____

Drilling Company Nelson Drilling LLC
Address 600 W Vineyard Dr.
City, State, Zip Pasco, Wn., 99301
Contractor's Registration No. NE50DL895W Date 8-12-16

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

642

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 136319
UNIQUE WELL ID # AGB 158
Water Right Permit No _____

99388

(1) OWNER Name Steve Van Steeg Address 1045 S 58th

(2) LOCATION OF WELL County Benton NW 1/4 SW 1/4 Sec 6 T 9 R 28 EWM

(2a) STREET ADDRESS OF WELL (or nearest address) Williamette Heights, W. Richland, WA
TAX PARCEL NO 1-0698-302-0170-000 Lot 170

(3) PROPOSED USE Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK Owner's number of well (if more than one) _____
 New Well Method
 Deepened Dug Bored
 Reconditioned Cable Driven
 Decommission Rotary Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 215 feet Depth of completed well 215 ft

(6) CONSTRUCTION DETAILS
Casing Installed
 Welded 6 Diam from 12 ft to 202 ft
 Liner installed _____ Diam from _____ ft to _____ ft
 Threaded _____ Diam from _____ ft to _____ ft

Perforations Yes No
Type of perforator used _____
SIZE of perforations _____ in by _____ in
_____ perforations from _____ ft to _____ ft

Screens Yes No K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
Material placed from _____ ft to _____ ft

Surface seal Yes No To what depth? 20 ft
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP Manufacturer's Name _____
Type _____ HP _____

(8) WATER LEVELS Land-surface elevation above mean sea level _____ ft
Static level 153 ft below top of well Date 6-19-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc)

(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
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level

Date of test _____
Bailey test _____ gal/min with _____ ft drawdown after _____ hrs
Airtest BT 30 gal/min with _____ ft drawdown after 1 hrs
Artesian flow _____ g p m Date _____
Temperature of water 57° Was a chemical analysis made? Yes No

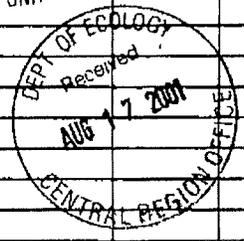
(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered

MATERIAL	FROM	TO
Top Soil	0	1
Sand + Gravel	1	41
Light Brown Clay	41	70
Sandstone (Brown)	70	126
Brown Clay	126	143
Cemented Sand + Gravel	143	165
Dark Gray Clay	165	196
Brown Clay	196	201
Weathered Basalt (water)	201	215

RECEIVED

AUG 14 2001

DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT



Work Started 6-19-01 Completed 6-19-01

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Lo Amos License No 1224
(Licensed Driller/Engineer)

Trainee Name _____ License No _____
Drilling Company Triple A Drilling

(Signed) Lo Amos License No 1224
(Licensed Driller/Engineer)

Address Benton City, WA 99320

Contractor's Registration No TR1PLD2025B Date 6-19-01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006

The Dep. The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 083674

Water Right Permit No.

6117
6M1

N

(1) OWNER: Name David H. Steffen Address 2037 Rainier Ave. Richland, WA

(2) LOCATION OF WELL: County Benton SE 1/4, SW 1/4 SW 1/4 SW 1/4 Sec 6 T 9 N. R 28 W.M.

(3) STREET ADDRESS OF WELL (or nearest address)

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned New well Deepened Reconditioned Method: Dug Cable Rotary Bored Driven Jetted

(5) DIMENSIONS: Diameter of well 10" 6" inches.
Drilled 343 feet. Depth of completed well 343 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +2' ft. to 188 ft.
Welded 4" Diam. from 163 ft. to 343 ft.
Liner installed Threaded

Perforations: Yes No
Type of perforator used Skill saw
SIZE of perforations 6" long in. by 1/8" wide in.
111 perforations from -323 ft. to 343 ft.

Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 20+ ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 258 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(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: 33-35 gal./min. with _____ ft. drawdown after _____ hrs.
" Approx. air lift 33 to 35 GPM "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Date of test _____
Barter test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Artest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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 information

MATERIAL	FROM	TO
Sandy soil brown soft	0	2
Caliche gravel cobbles med. hard	2	4
Sand gravel hard	4	26
Tan clay gravel medium hard	26	28
Clay green medium	28	46
Clay shale gray medium	46	74
Sandstone brown medium	74	88
Clay stone brown tan medium	88	114
Caliche gravel medium hard	114	133
Cemented gravel red/brown sand medium hard	133	150
Clay brown medium	150	156
Silt stone gray medium	156	186
Pouris basalt black hard	186	190
Basalt black hard	190	206
Burnt basalt red/brown medium	206	212
Basalt black hard	212	217
Basalt gray very hard	217	287
Fractured basalt blue shale med.	287	294
Sandstone green white gray soft-medium	294	303
Sandstone blue green soft	303	326 tra
Pouris burnt basalt red/black med.	326	343 water

FEB 28 1992

Work started 2-10-92 19. Completed 2-14 1992

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Ponderosa Drilling & Development, Inc.
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address E. 6010 Broadway Spokane, WA 99212

(Signed) Steve Mills License No. 1335
(WELL DRILLER) (Steve Mills)
Contractor's Registration No. PO-ND-EI*248JE Date 2-19 1992

(USE ADDITIONAL SHEETS IF NECESSARY)



6N1

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No 64-24076
Permit No 64-24070P

(1) OWNER Name E.O. Kraus Address Rt 1 Box 316 W. Richland wa 9882
(2) LOCATION OF WELL County Benton SE 1/4 SW 1/4 - 5th & 6th Sts. T. 2 N. R. 28 E. M. Lot 231 Willamette Hts

(3) PROPOSED USE Domestic Industrial Municipal
Irrigation Test Well Other

(4) TYPE OF WORK
New well Method Dug B red
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS Diameter of well 8 in. to 8 in.
Drilled 325 ft. Depth of completed well 325 ft.

(6) CONSTRUCTION DETAILS
Casing installed 8 Diam from 0 ft to 220 ft
Threaded Diam from ft to ft
Welded Diam from ft to ft

Perforations Yes No
Type of perforator used _____
SIZE of perforator in. by _____ in.
perforations from _____ ft. to _____ ft.
perforations from _____ ft. to _____ ft.
perforations from _____ ft. to _____ ft.

Screens Yes No
Manufacturer's Name _____ Model N _____
Type _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed Yes No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal Yes No To what depth? 40 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Name of or sealant _____

(7) PUMP Manufacturer's Name submersible
Type HP 10

(8) WATER LEVELS Lead surface elev. of _____ ft.
Static level 22.1 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap valve, etc.)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was pump test made? Yes No If yes by whom? _____
Yield _____ gal/min with _____ ft. drawdown after _____ hr

Recovery of to (time taken as zero with pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Batter test _____ gal/min with _____ ft. drawdown after _____ hr
Artesian flow _____ g.p.m. D to _____
Character of water _____ Was chemical analysis made? Yes No

(10) WELL LOG

Formation Describe by color character etc. of material and structure and how below is of aquifers and the kind and nature of the material to be stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top soil	0	2
Gravel 5m Cobble	2	40
Clay	40	79
Clay with gravel	79	148
Sand zone	148	188
Clay Blue	188	210
Blue-grey gravel	210	220
Bank Hard Gray	220	275
1" Brown Red	275	290
Sandstone with gravel	290	325

water at 295.10 GPM
" " 290 300 GPM

RECEIVED

AUG 24 1976

DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started _____ 19____ Completed _____ 19____

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 St George Drilling Co
(Person firm, corporation) (Type or print)

Address 701 504th W. Richland W

(Signed) Rich S. H. [Signature]
(Well Driller)

License No 0482 Date _____ 19____

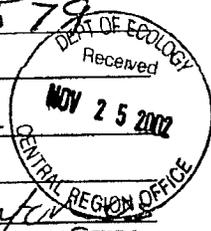
The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

GPI

KCN WATER WELL REPORT

Original & 1st copy Ecology 2nd copy owner 3rd copy driller
 Construction/Decommission (x in circle)
 Construction 126760
 Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____

CURRENT Notice of Intent No W 160724
 Unique Ecology Well ID Tag No AGM-579
 Water Right Permit No (A)



PROPOSED USE Domestic Industrial Municipal
 DeWater Irrigation Test Well Other

TYPE OF WORK Owner's number of well (if more than one) _____
 New Well Reconditioned Method Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS Diameter of well 6 inches drilled 225 ft
 Depth of completed well 225 ft

Property Owner Name Hedgecock
 Well Street Address 516 EASCAP
 City Richland County Benton
 Location NE 1/4- 1/4 NE 1/4 Sec 6 Twn 9 R28 EWM circle or one WWM
 Lat/Long (s t r still) Lat Deg _____ Lat Min/Sec _____
 Long Deg _____ Long Min/Sec _____
 Tax Parcel No 1-0698 402 0193-000

CONSTRUCTION DETAILS
 Casing Welded 6 Diam from 71 ft to 200 ft
 Installed Liner installed _____ Diam from _____ ft to _____ ft
 Threaded _____ Diam from _____ ft to _____ ft

Perforations Yes No
 Type of perforator used _____
 SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens Yes No K Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No _____
 Diam _____ Slot Size _____ from _____ ft to _____ ft
 Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
 Materials placed from _____ ft to _____ ft

Surface Seal Yes No To what depth? 30 ft
 Materials used in seal Bentonite
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

CONSTRUCTION OR DECOMMISSION PROCEDURE
 Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Brown Sand	0	3
Cemented Gravel	3	7
Brown Sand Gravel	7	55
Brown clay	55	135
Brown clay Gravel	135	143
Gray clay	143	200
Tan clay + Brown Basalt	200	206
Brown course	206	225
Basalt Bearing		
Water Apr 12 06 pm		

PUMP Manufacturer's Name _____ HP _____
 Type _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
 Static level 134 ft below top of well Date _____
 Artesian pressure _____ lbs per square inch Date _____
 Artesian water is controlled by _____ (cap valve etc)

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
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
 Time Water Level Time Water Level Time Water Level
 _____ _____ _____ _____ _____ _____
 Date of test _____
 Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
 Artest 120 gal/min with stem set at 220 ft for 2 hrs
 Artesian flow _____ g p m Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

Start Date 1/14/02 Completed Date 1/5/02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Driller Engineer Trainee Name (Print) Peter F. E. George Drilling Company St George Drilling
 Driller/Engineer/Trainee Signature Peter F. E. George Address 701 545 AVE
 Driller or Trainee License No 0483 City State Zip W. Richland Wa. 99355
 Contractor's Registration No 601045-75 Date 1/15/02

If trainee, licensed driller's Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

WATER WELL REPORT

Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (circle)

- Construction 149140
- Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____

CURRENT Notice of Intent No W-171095
 Unique Ecology Well ID Tag No AKH-849
 Water Right Permit No _____

Property Owner Name Paul & Kerry Wood K
 Well Street Address 4601 Norma St.
 City W Rich County Benton
 Location NW 1/4 1/4 SE 1/4 Sec. 6 Twn. 9 R28 ^(EWM circle) or one
 Lat/Long (s/r still REQUIRED) Lat Deg _____ Lat Min/Sec _____
 Long Deg _____ Long Min/Sec _____
 Tax Parcel No _____

PROPOSED USE Domestic Industrial Municipal
 DeWater Irrigation Test Well Other _____

TYPE OF WORK Owner's number of well (if more than one) _____
 New Well Reconditioned Method Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS Diameter of well 8 1/2 inches drilled 380 ft
 Depth of completed well 380 ft

CONSTRUCTION DETAILS
 Casing Welded 8 Diam from 0 ft to 40 ft
 Installed Liner installed 6 Diam from 0 ft to 200 ft
 Threaded 4 1/2 Diam from 60 ft to 380 ft

Perforations Yes No
 Type of perforator used 1/2" Drill
 SIZE of perms 1/2 in by 1/2 in and no of perms 120 from 340 ft to 380 ft

Screens Yes No K Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No _____
 Diam _____ Slot Size _____ from _____ ft to _____ ft
 Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
 Materials placed from _____ ft to _____ ft

Surface Seal Yes No To what depth? 200 ft
 Materials used in seal Bentonite
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

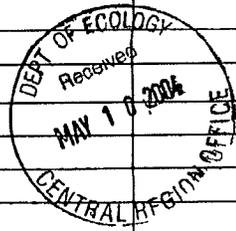
PUMP Manufacturer's Name _____
 Type _____ HP _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
 Static level 360 ft below top of well Date 4-22-04
 Artesian pressure _____ lbs per square inch Date _____
 Artesian water is controlled by _____ (cap valve etc)

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
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
 Time Water Level Time Water Level
 _____ _____
 Date of test _____
 Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
 Airstest 40 gal/min with stem set at 360 ft for 4 hrs
 Artesian flow _____ g p m Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

CONSTRUCTION OR DECOMMISSION PROCEDURE
 Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information. Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
<u>Silty Topsoil</u>	<u>0</u>	<u>12</u>
<u>Tan Sand</u>	<u>12</u>	<u>30</u>
<u>Brown clay</u>	<u>30</u>	<u>136</u>
<u>Clay & Gravel</u>	<u>136</u>	<u>198</u>
<u>Basalt</u>	<u>198</u>	<u>295</u>
<u>Brown clay</u>	<u>295</u>	<u>335</u>
<u>Water Bearing Porous Basalt</u>	<u>335</u>	<u>375</u>
<u>Basalt</u>	<u>375</u>	<u>380</u>



Start Date 4-17-04 Completed Date 4-23-04

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) TEOD HANEY Drilling Company Statewide Well Drilling
 Driller/Engineer/Trainee Signature [Signature] Address 101 KAU Trail rd
 Driller or Trainee License No 2343 City State Zip Pasco WA 99301
 Contractor's Registration No STATSWD01522 Date 4/06
 Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

If trainee, licensed driller's Signature and License no _____

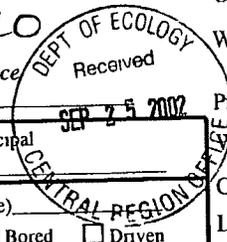
The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy Ecology 2nd copy owner 3rd copy driller

CURRENT Notice of Intent No W160715
Unique Ecology Well ID Tag No AGM 569
Water Right Permit No _____

Construction/Decommission (x in circle) 122220
 Construction
 Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____



Property Owner Name HOJU MOON R
Well Street Address 57th Fronten
City West Richland County Denton
Location SE 1/4 1/4 20 1/4 Sec 6 Twn 9 R 28 EWM circle or one WWM
Lat/Long (s, r still) Lat Deg _____ Lat Min/Sec _____
REQUIRED) Long Deg _____ Long Min/Sec _____
Tax Parcel No _____

PROPOSED USE Domestic Industrial Municipal
 DeWater Irrigation Test Well Other
TYPE OF WORK Owner's number of well (if more than one) _____
 New Well Reconditioned Method Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS Diameter of well 6 inches drilled 280 ft
Depth of completed well 280 ft

CONSTRUCTION DETAILS
Casing Welded 6 Diam from 1 ft to 229 ft
Installed Liner installed _____ Diam from _____ ft to _____ ft
 Threaded _____ Diam from _____ ft to _____ ft

Perforations Yes No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens Yes No K Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal Yes No To what depth? 30 ft
Materials used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer's Name _____
Type _____ HP _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 155 ft below top of well Date _____
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

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
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level

Date of test _____
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Artest 110 gal/min with stem set at 280 ft for 2 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Brown Sand	0	2
Coarse Gravel	2	6
Brown Sand Gravel	6	37
Brown clay	37	93
Brown sand Gravel	93	135
Brown clay	135	141
Gray clay	141	220
poorly Blocky	220	251
Brown Basalt		
Draining Water		
Blocky Gravel	251	280
Draining Water		
Apr 110 Gpm		

Start Date 9/27/02 Completed Date 9/29/02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief
 Driller Engineer Trancee Name (Print) Peter St George Drilling Company St. George Drilling
Driller/Engineer/Trancee Signature Peter St George Address 701 5045 AVE
Driller or Trancee License No 0483 City State Zip West Richland Wa 99353
Contractor s _____
Registration No 601 048315 Date 9/29/02

If trantee, licensed driller s _____
Signature and License no _____

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with the Division of Water Resources
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. 12446
Permit No. G 300389 P

(1) OWNER: Name R. D. Dierks Address 319 Sanford Ave., Richland
(2) LOCATION OF WELL: County Benton NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 7 T. 9 N. R. 28E W.M.
ing and distance from section or subdivision corner 1800 feet East and 500 feet South of the NW corner of Sect 7

(3) PROPOSED USE: Domestic Industrial Municipal
Irrigation Test Well Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 540 ft. Depth of completed well 540 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10" Diam. from 0 ft. to 166 ft.
Threaded " Diam. from _____ ft. to _____ ft.
Welded " Diam. from _____ ft. to _____ ft.

Perforations: 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.

Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 40 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land surface elevation _____ ft. above mean sea level.
Static level 248 ft. below top of well Date 11/28/72
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(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.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG:
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
Sandy soil	0	3
Sandy & gravel	3	58
Brown sandy clay	58	99
Green clay	99	117
Green clay & gravel	117	133
Green clay	133	142
Grey clay	142	164
Brown basalt	164	185
Grey basalt	185	280
Green claystone (water bear	280	320
Porous basalt (water-bear)	320	325
Black basalt	325	455
Brown fractured basalt	455	460
Green claystone	460	470
Blue & brown claystone	470	505
Black basalt	505	540

Approx. 10 gpm 280-320 ft.
20 gpm 320-325
60-70 gpm 455-505

Work started 6 19 72 Completed 11-25 19 72

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 H & H Drilling Inc.
(Person, firm, or corporation) (Type or print)
Address Route 1, Box 13-H--Richland

[Signed] James E. Flansburg
(Well Driller)
License No. 6783 Date 11-28-72, 19 72

12A1

RESOURCE PROTECTION WELL REPORT



This is a report of the activities of a licensed Washington well driller and serves as the official record of work done within the borehole and casing and describes the amount of water encountered.

Construction

Type of Well: Geotech Soil Boring
Number of Wells: 4
Type of Work: New
Method: Auger
Drilling Start Date: 6/26/2017
Drilling Completion Date: 6/26/2017
Received by Ecology: 8/1/2017 1:55 PM

Dimensions:

Borehole Diameter: 5 in
Depth of completed well: 30 ft 0 in

Construction Details

Casings:

From Depth	To Depth	Type	Diameter	Stickup
N/A				

Perforations:

Type	Size	Total Perforations	From Depth	To Depth
N/A				

Screens:

Manufacturer	Type	Dia-meter	Slot Size	From Depth	To Depth
N/A					

Sand/Gravel Packings:

Material	From Depth	To Depth
N/A		

Individual Well Details

Well	Driller's Identifier	Water Level
1	b1	Dry Hole
2	b2	Dry Hole
3	b3	Dry Hole
4	b4	Dry Hole

Additional Well Construction Information

None

Construction Notice of Intent Number: SE62587
Decommissioning Notice of Intent Number: AE43741
Unique Ecology Well ID Tag Number: N/A
Property Owner Name: Richland School District
Property Owner Address: 300 N Valley St, Richland, WA 99352

Well Location:

Well Street Address: Galena St
City, State, Zip: West Richland, WA
County: Benton
Township: 9N **Range:** 27E **Section:** 12 in the NE 1/4 of the NE 1/4

Well Head Elevation:

Elevation Datum:

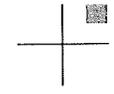
Elevation Method:

Latitude (DD): **Longitude (DD):**

Datum:

Horizontal Coordinate Collection Method:

Tax parcel No.:



Lithology

Layer: Describe by color, character, size of material and structure, and the kind and nature of the material in each layer penetrated, with at least one entry for each change of information.

From	To	Material
0 ft 0 in	30 ft 0 in	Sand and some gravel

Well Construction Certification: I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Material used and information reported above are true to the best of my knowledge and belief.

Driller/Engineer/Trainee Printed Name: RITCH GIBSON
Driller or trainee License Number: 1816
If trainee, Driller's License Number:

Drilling Company: GEOLOGIC DRILL EXPLORATIONS INC
Address: 14811 W COULEE HITE RD
City, State, Zip: SPOKANE, WA, 99224

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

12C1

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. _____
Permit No. _____

(1) **OWNER:** Name Harold W. Alexander Address Route 2, Box 2207, Benton City, WA 99320

(2) **LOCATION OF WELL:** County BENTON — 1/4 NW 1/4 Sec. 12 T. 9 N., R. 27E W.M.
_____ing and distance from section or subdivision corner

(3) **PROPOSED USE:** Domestic Industrial Municipal
Irrigation Test Well Other

(4) **TYPE OF WORK:** Owner's number of well (if more than one) _____
New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 180 ft. Depth of completed well 180 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6" Diam. from +1 ft. to 90 ft.
Threaded " Diam. from _____ ft. to _____ ft.
Welded " Diam. from _____ ft. to _____ ft.

Perforations: 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.

Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 19 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) **PUMP:** Manufacturer's Name _____
Type: _____ H.P. _____

(8) **WATER LEVELS:** Land-surface elevation _____ ft.
Static level 70 ft. below top of well Date 11/20/85
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(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: 5 gal./min. with _____ ft. drawdown after _____ hrs.
" ESTIMATED AIRLIFT " " "
" " " " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

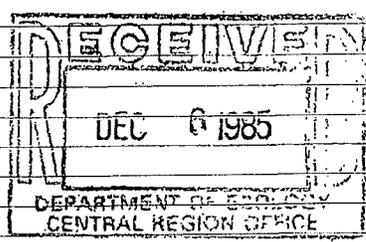
Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG:

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
Sand	0	65
Sand & Gravel	65	90
Basalt, soft w/water	90	115
Basalt, medium	115	158
Clay blue	158	180
NO PVC Liner Installed		
6" Drive shoe installed		

NOTE: SET PUMP ABOVE 158'



Work started 11/18/85 19____ Completed 11/20 1985

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 PONDEROSA DRILLING & DEVELOPMENT INC.
(Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] James M. Doyle
James M. Doyle (Well Driller)

License No. 1287 Date 11/20 1985

(USE ADDITIONAL SHEETS IF NECESSARY)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. AB
Permit No. GH

1222

(1) OWNER: Name Harold W. Alexander Address Route 2, Box 2207, Benton City, WA 99320
 LOCATION OF WELL: County BENTON $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 12 T. 9 N., R. 27E W.M.
 Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 (4) TYPE OF WORK: Owner's number of well (if more than one) 2
 New well Method: Dug Bored
 Deepened Cable Driven
 Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 6 inches.
 Drilled 195 ft. Depth of completed well 195 ft.

(6) CONSTRUCTION DETAILS:
 Casing installed: 6 " Diam. from +1 ft. to 83 ft.
 Threaded " Diam. from _____ ft. to _____ ft.
 Welded " Diam. from _____ ft. to _____ ft.
 Perforations: 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.

Screens: Yes No
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel: _____
 Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 75 ft.
 Material used in seal bentonite
 Did any strata contain unusable water? Yes No
 Type of water? silty Depth of strata 75-80
 Method of sealing strata off casing

(7) PUMP: Manufacturer's Name _____
 Type: _____ HP

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
 Static level 60 ft. below top of well Date 2/03/87
 Artesian pressure _____ lbs. per square inch. Date _____
 Artesian water is controlled by _____ (Cap, valve, etc.)

(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: 45 gal./min. with _____ ft. drawdown after _____ hrs.
 " ESTIMATED AIRLIFT " " "
 " " " " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

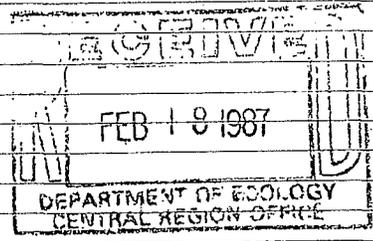
Date of test _____
 Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG:
 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
Sand & silt	0	75
Sand & silt w/water (10-15 GPM)	75	80
Basalt, soft	80	83
Basalt, medium	83	126
Basalt, hard	126	160
Clay, gray	160	180
Basalt, fractured w/water @ 45 GPM	180	190
Basalt, medium	190	195

NO PVC Liner Installed
 6" Drive shoe utilized

Note: Customer will install his own PVC to protect pump from clay zone at 160' to 180'



Work started 2/02/ 19 87 Completed 2/03 19 87

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 PONDEROSA DRILLING & DEVELOPMENT INC.
 (Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] James M. Doyle
 James M. Doyle (Well Driller)

License No. 1287 Date 2/03 19 87

The Department of Ecology does NOT warrant the Data and/or the Information on this Well Report.

RESOURCE PROTECTION WELL REPORT

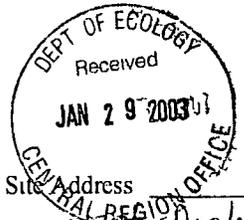
Notice of Intent No 512734

1261

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in circle)

Construction 127108
 Decommission Original Construction Notice of Intent Number _____



Type of Well (x in circle)

Resource Protection
 Geotech Soil Boring E

Property Owner city of west Richland

Site Address _____

Unique Ecology Well ID Tag No B-10 + B-11

City West Richland County Benton

Consulting Firm SHANNON + WILSON

Location SW 1/4 1/4 NW 1/4 Sec 12 Twn 9N R 27 EWM or one WWM

Driller or Trainee Name Randy Wilder

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____

Driller or Trainee Signature [Signature]

Long Deg _____ Long Min/Sec _____

Driller or Trainee License No 2578

Tax Parcel No _____

If trainee licensed driller's Signature and License no _____

Cased or Uncased Diameter _____ Static Level _____

Work/Decommission Start Date 12-17-02

Work/Decommission Completed Date 12-17-02

Construction/Design	Well Data	Formation Description
Abandoned with Bentonite		sand
6" Borehole		

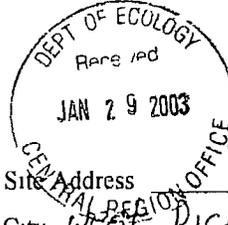
1262

RESOURCE PROTECTION WELL REPORT

Notice of Intent No 512734
(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission (*x* in circle)

Construction 127109
 Decommission Original Construction Notice
of Intent Number _____



Type of Well (*x* in circle)

Resource Protection
 Geotech Soil Boring **E**

Property Owner city of west richland

Site Address _____
City West Richland County Benton

Unique Ecology Well ID Tag No B-10 + B-11

Location SW 1/4 1/4 NW 1/4 Sec 12 Twn 9N R 27 circle or one WWM

Consulting Firm Shannon + Wilson

Driller or Trainee Name Randy Wilder

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____

Driller or Trainee Signature [Signature]

Driller or Trainee License No 2578

Tax Parcel No _____

If trainee licensed driller's Signature and License no _____

Cased or Uncased Diameter _____ Static Level _____

Work/Decommission Start Date 12-17-02

Work/Decommission Completed Date 12-17-02

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

Construction/Design

Well Data

Formation Description

<p>Abandoned with Bentonite</p> <p>8" Borehole</p>		<p>Sand</p>
--	--	-------------

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

12F1
G423315P

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

LOG No. Appl. 4575

4-19-57 10

well driller			
driller's record			
State of WASHINGTON			
City: Benton			
Section: 12 E			
Range: 9 N			
Township: R 27 E			

Co. Hall Harmon Equip. Co.
Yakima, Wash.
Date of Drilling: _____
John C. McElroy
Richland, Wash.
face, datum: _____

No. 127E-12E

MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Depth forward	

No log.
PUMP TEST:
Dim. 3 3/8" x 10" - 8"
PWL: 156 ft.
D: 16 ft.
Yield: 350 g.p.m.
Type & size of pump: Test pump
6" bowls
Type & size of motor: 110 h.p.
Continental
Estimated well capacity, based on
test is 800 g.p.m. at 196' pumping
level.
CASING: 10" diam. from 0 to 14 ft.
" diam. from 14 to 270 ft.

WELL LOG.—Continued

No. _____

CONFER- LATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Sand Clay & Gravel	200	200
	Basalt	40	240
	Clay	30	270
	Basalt	130	400
	Note: Water Bearing From 380' to 400'		

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle) **113547**
 Construction
 Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____

CURRENT Notice of Intent No W 136645
 Unique Ecology Well ID Tag No AC-B-049
 Water Right Permit No 64-2331R
 Property Owner Name HAYD W. Alexander

PROPOSED USE Domestic Industrial Municipal
 DeWater Irrigation Test Well Other

TYPE OF WORK Owner's number of well (if more than one) _____
 New Well Reconditioned Method Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS Diameter of well 12 inches drilled 8-0 ft
 Depth of completed well 8-0 ft

CONSTRUCTION DETAILS
 Casing Welded 16 Diam from 1 ft to 30 ft
 Installed Liner installed 12 Diam from 1 ft to 399 ft
 Threaded _____ Diam from _____ ft to _____ ft

Perforations Yes No
 Type of perforator used _____
 SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens Yes No K Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No _____
 Diam _____ Slot Size _____ from _____ ft to _____ ft
 Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
 Materials placed from _____ ft to _____ ft

Surface Seal Yes No To what depth? 30 ft
 Materials used in seal Cement
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

PUMP Manufacturer's Name _____
 Type _____

WATER LEVELS Land surface elevation above mean sea level _____
 Static level 13 ft below top of well Date _____
 Artesian pressure _____ lbs per square inch Date _____
 Artesian water is controlled by _____ (cap valve etc.)

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
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
 Time Water Level Time Water Level Time Water Level

 Date of test _____
 Bailor test _____ gal/min with _____ ft drawdown after _____ hrs
 Airtest 1100 gal/min with stem set at 390 ft for 14 hrs
 Artesian flow _____ g p m Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

Well Street Address Rt 2 Box 2207 F
 City Benton City County Benton
 Location SE 1/4 1/4 NW 1/4 Sec 12 Twn 9 Rd 27 ^{BWM circle} or ^{one} _{WWM}
 Lat/Long (s, r still) Lat Deg _____ Lat Min/Sec _____
 REQUIRED) Long Deg _____ Long Min/Sec _____
 Tax Parcel No _____

CONSTRUCTION OR DECOMMISSION PROCEDURE
 Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Brown Sand	0	21
Brown Sand & Clay	21	46
Known		
Brown Sand Gravel	46	74
with Brown clay		
Gray + Brown Basalt	74	165
Soft Gray Sand	165	175
Black Green clay	175	201
Gray clay	201	210
Gray Basalt Medium	210	339
Soft Gray porous Basalt	339	347
Black Green clay (thin)	347	361
Black + Green		
Gray Shale + Gray	361	373
Basalt		
Gray Basalt Medium	373	480
Hard Gray Basalt	480	491
Medium Gray Basalt	491	639
Hard Gray Basalt	639	649
Black porous Basalt	649	680
Green shale water		
Hard Gray Basalt	680	779
Green Sand + Water	779	830
Hard Gray Basalt	830	840
1" hole from 1 to 399		
8" Hole from 399 to 840		
1-31-02		

Start Date 3-31-02 Completed Date 3-11-02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

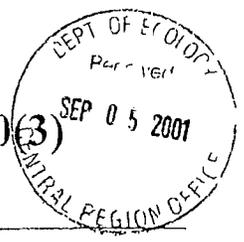
Driller Engineer Trainee Name (Print) LeTee E. Shogren Drilling Company ESG Energy Drilling
 Driller/Engineer/Trainee Signature [Signature] Address 7015 645 Ave
 Driller or Trainee License No _____ City State Zip W. Richland 99353
 Contractor's Registration No 601041-715 Date 3-15-02
 Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

If trainee, licensed driller's Signature and License no _____

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.



DEPARTMENT OF ECOLOGY



Showing of Compliance with RCW 90.44 100(3)

Water Right Certificate or Permit Number 34-7331-3

Parcel tax identification number 1 1297 200 0000 000

Landowner(s) name HAROLD ALEXANDER

Part of complying with RCW 90 44 100(3) is for the project proponent to notify the Department of Ecology (Ecology) that the statutory criteria of RCW 90 44 100(3) have been satisfied Please attach to this document the water well report for the additional or replacement well and any additional information you have to support your affidavit

Affidavit

I, HAROLD ALEXANDER, do certify that I caused the well described in the attached water well report to be drilled as an additional or replacement well(s) for use under Water Right Number 64-2335P This notice and attached documents describe and support my assertion that the replacement or additional well(s) complies with RCW 90.44 100(3) (a-g) and RCW 90 44 100(4)

- a The well is an additional or replacement well(s) that will tap the same body of public ground water as the original well,
- b If a replacement well is constructed, the use of the original well(s) shall be discontinued and the original well(s) shall be properly decommissioned,
- c The combined withdrawal of water from the additional or replacement well(s) and the original well authorized by the water right certificate does not enlarge the water right conveyed by the original water right certificate to the extent the certificate has been developed (perfected) and maintained by use of water,
- d The construction and use of the additional or replacement well(s) does not interfere with or impair water rights with an earlier priority date,
- e The additional or replacement well(s) is located no closer than the original well to a well or surface water body it might interfere with,
- f A specified manner of construction for the additional or replacement well(s) has been complied with, if required, and the new well was constructed in compliance with chapter 18 104 RCW and chapter 173-160 WAC,
- g The additional or replacement well(s) is located within the area described as the point of withdrawal in the public notice published for the original application for water right, or the most current legal description published for the right Both the original well and the additional or replacement well(s) are located in SEE LEGAL DESCR NEXT PAGE (legal description)

Therefore the well is in compliance with the requirements for a statutorily granted amendment to the water right permit or certificate

I understand the acceptance of this affidavit and any attachments by the Department of Ecology shall not be construed as affirming the validity of any water right permit or certificate. The responsibility to comply with RCW 90 44 100(3) is with the water right permit or certificate holder asserting an amendment pursuant to RCW 90 44 100(3)

Howard Alexander
Name

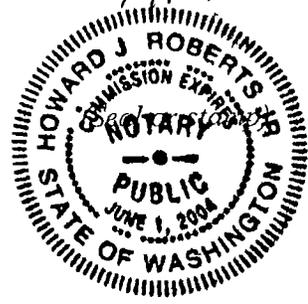
Sept 4 01
Date

Acknowledgement

State of Washington
County of Benton

I certify that I know or have satisfactory evidence that Howard Alexander is the person who appeared before me and said person acknowledged that (he/she) signed this affidavit and acknowledged it to be (his/her) free and voluntary act for the uses and purposes mentioned in the affidavit

Dated 9/4/01



Howard Alexander Howard Roberts
(Signature)
Benton County
Residing in
Finance Director
Title
My appointment expires 6/1/04

If you have any questions please contact the Water Resources Section of the closest regional office. Please submit copies of new well logs and decommissioned well logs along with this completed and notarized form to the nearest regional office

Northwest Regional Office
3190 - 160th Avenue SE
Bellevue WA 98008-5452
(425) 649-7000, TDD (425) 649 4259

Southwest Regional Office
P O Box 47775
Olympia, WA 98504-7775
(360) 407-6300, TDD (360) 407-6306

Eastern Regional Office
N 4601 Monroe, Suite 202
Spokane WA 99205 1295
(509) 456-2926 TDD (509) 458 2055

Central Regional Office
15 W Yakima Ave, Suite 200
Yakima, WA 98902-3452
(509) 575-2597, TDD (509) 454 7673

Vancouver Field Office
2108 Grand Boulevard
Vancouver, WA 98661-4622
(360) 690-7171 TDD (360) 690-7147

Nooksack Field Office
1204 Railroad Ave Suite 200
Bellingham, WA 98225
(360) 738-6250, TDD (425) 649-4259

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

1241

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

- Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [Signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number: _____

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 30 feet B.G.S.	B-5 Elementary school geotech	0-1.5 Sand. 1.5-6 Sand w/gravels. 6-30 Sand, tan, fine.
-------------------------------------	----------------------------------	---

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 JUL 10 2018
 Dept of Ecology
 Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

The Department of Ecology does NOT warrant the data and/or the information on this Well Report

1242

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well ID Tag No. _____

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 TwN 9N R 27

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer/Trainee Signature [Signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 25 feet B.G.S. Pull out the auger and pour in 8 bags of 3/8" bentonite chips up to 1 foot from the surface, then cuttings to the surface.

B-1 Elementary school geotech

0-5.5 Sand w/small gravels.
5.5-10 Sand coarse, tan, dry.
10-25 Fine tan sand.

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Central Regional Office

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The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

1243

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 2835

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46,281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r Lat Deg ___ Min ___ Sec ___

still REQUIRED) Long Deg ___ Min ___ Sec ___

Tax Parcel No.

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

If trainee, licensed driller's Signature and License Number:

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 25 feet B.G.S. Pull out the augers and pour in 10 bags of 3/8" bentonite chips up to 1 foot bgs, then cuttings to the surface.

B-3 Elementary school geotech

0-2 Sand.
2-6 Sand w/gravel.
6-25 Sand, tan

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Dept of Ecology
Central Regional Office

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

1214

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

EWM or WWM

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____
Long Deg _____ Min _____ Sec _____

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature *Mike L*

Driller or Trainee License No. 2833

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

If trainee, licensed driller's Signature and License Number:

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 30 feet B.G.S. Pull out the augers and pour in 12 bags of 3/8" bentonite chips up to 1 foot from the surface, then cuttings to the surface.

B-5
Elementary school geotech

0-1.5 Sand.
1.5-6 Sand w/gravels.
6-30 Sand, tan, fine.

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Dept of Ecology
Central Regional Office

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

12H5

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
Decommission

Type of Well ("x" in box)

- Resource Protection
Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r Lat Deg Min Sec

still REQUIRED) Long Deg Min Sec

Tax Parcel No.

Cased, or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 30 feet B.G.S. Pull out the auger and pour in 11 bags of 3/8" bentonite chips up to 1 foot from the surface, then cuttings to the surface.

B-2 Elementary school geotech

0-6 Sand w/small gravels. 6-30 Sand, fine, tan, dry.

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Dept of Ecology Central Regional Office

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1246

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee
 Name (Print Last, First Name) CORN, MIKE
 Driller/Engineer /Trainee Signature *Mike*
 Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number: _____

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design

Well Data

Formation Description

<p>H.S.A. to a depth of 25 feet B.G.S.</p>	<p>B-1 Elementary school geotech</p>	<p>0-5.5 Sand w/small gravels. 5.5-10 Sand coarse, tan, dry. 10-25 Fine tan sand.</p> <div style="text-align: center;"> <p>RECEIVED</p> <p>JUL 10 2018</p> <p>Dept of Ecology Central Regional Office</p> <p>RECEIVED</p> <p>JUL 10 2018</p> <p>Dept of Ecology Central Regional Office</p> </div>
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12H7

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [Signature]

Driller or Trainee License No. 2833

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

If trainee, licensed driller's Signature and License Number: _____

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 30 feet B.G.S.

B-2
Elementary school geotech

0-6 Sand w/small gravels.

6-30 Sand, fine, tan, dry.

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Central Regional Office

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The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

1218

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number: _____

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [Signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number: _____

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design

Well Data

Formation Description

<p>H.S.A. to a depth of 30 feet B.G.S.</p>	<p>B-6 Elementary school geotech</p>	<p>0-2.5 Sand 2.5-12 Sand w/gravel layers. 12-30 Sand, fine, tan</p>
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Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

The Department of Ecology does NOT warrant the Data and/or the Information on this Well Report

12119

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____
still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [Signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Construction Design

Well Data

Formation Description

H.S.A. to a depth of 30 feet B.G.S. Pull out the augers and pour in 11 bags of 3/8" bentonite chips up to 1 foot bgs, then cuttings to the surface.

B-6 Elementary school geotech

0-2.5 Sand
2.5-12 Sand w/gravel layers.
12-30 Sand, fine, tan

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JUL 10 2018

Dept of Ecology
Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

The Department of Ecology does NOT warrant the Data and/or the Information on this Well Report

APPENDIX D
Subsurface Database

Table D-1
Compilation of Water Well Report Observations ¹
 City of West Richland
 Benton County, Washington

Water Well Report Designation	Owner ²	Date Completed	Location					Well Elevation ³ (feet)	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Basalt (feet bgs)	Top of Basalt Elevation ³ (feet)	Summary - Limiting Stratigraphic Unit		Notes
			Quarter-Quarter Section	Quarter Section	Section	Township	Range						Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
1B1	Neil Sullivan	11/06/81	NW	NE	1	9N	27E	495	232	144	40	455	40	Basalt	
1D1	Leslie J. Woodcock	05/07/85	NW	NW	1	9N	27E	464	80	22	55	409	55	Basalt	
1D2	Leslie J. Woodcock	04/04/95	NW	NW	1	9N	27E	464	180	90	55	409	55	Basalt	Deepening of 1D1
1D3	E.O. Kraus	07/05/79	NW	NW	1	9N	27E	470	150	65	14	456	14	Basalt	
1D4	Mark and Cindy Enghusen	08/16/01	SE	NW	1	9N	27E	470	145	35	32	438	32	Basalt	
1D5	Jerry England	07/15/05	NW	NW	1	9N	27E	482	305	100	26	456	26	Basalt	
1D6	Jerry England	08/14/05	NW	NW	1	9N	27E	482	160	--	26	456	26	Basalt	
1E1	John Harris	08/09/05	SW	NW	1	9N	27E	486	305	130	2	484	2	Basalt	
1E2	Keith and Pam Gray	09/01/11	SW	SW	1	9N	27E	486	290	140	28	458	28	Basalt	
1E3	Becan Properties	05/27/88	SW	NW	1	9N	27E	493	160	30	15	478	15	Basalt	
1E4	Hugh W. Homer	05/16/94	SW	NW	1	9N	27E	493	210	110	20	473	5	Clay	
1E5	William Wildenborg	10/14/94	SW	NW	1	9N	27E	493	220	120	20	473	5	Clay	
1F1	E. Neil and William E. Sullivan	02/20/85	NW	NW	1	9N	27E	507	65	35	40	467	40	Basalt	
1G1	Robert Butler	06/15/87	SW	NE	1	9N	27E	593	151	44	21	572	12	Clay	
1H1	Hanz Anselm	11/09/94	SE	NE	1	9N	27E	637	240	87	6	631	6	Basalt	
1H2	Roger Smith	05/28/93	SE	NE	1	9N	27E	637	265	130	16	621	16	Basalt	
1K1	Joe and Linda Picker	05/05/99	NE	SW	1	9N	27E	655	220	165	203	452	6	Clay	
1K2	Gerald and Maggie Higgins	11/09/98	NE	SW	1	9N	27E	655	208	150	185	470	24	Sandy Clay	
1K3	John Harris	10/26/79	NE	SW	1	9N	27E	651	285	90	3	648	3	Basalt	
1M1	Herold Alexander	09/10/05	SW	SW	1	9N	27E	499	353	160	90	409	90	Basalt	
1N1	Aaron Delvalle	07/12/13	SE	SW	1	9N	27E	633	20	>20	>20	<613	>20		
1N2	Aaron Delvalle	07/12/13	SE	SW	1	9N	27E	633	20	>20	>20	<613	>20		
1N3	Aaron Delvalle	07/12/13	SE	SW	1	9N	27E	633	20	>20	>20	<613	>20		
1O1	Terri Ahlers	05/17/00	SW	SE	1	9N	27E	656	200	170	>200	<456	32	Clay and Silt	
6A1	Town of West Richland	10/15/62	NE	NE	6	9N	28E	416	250	25	176	240	93	Clay	
6A2	Ray Moller	06/14/66	NE	NE	6	9N	28E	431	90.2	28.6	63	368	63	Weathered Basalt	
6A3	Mark Noulty	05/25/94	NE	NE	6	9N	28E	431	200	124	162	269	3	Clay	
6A4	RA Paasch	--	NE	NE	6	9N	28E	422	60	50	>60	<362	>60		
6A5	City of West Richland	03/26/13	NE	NE	6	9N	28E	429	25	>25	>25	<404	>25		
6B1	Willetu Barm	01/26/92	NW	NE	6	9N	28E	555	261	45	159	396	46	Silt	
6C1	--	10/12/00	NE	NW	6	9N	28E	738	3	--	3	735	0	Silt	
6C2	Bob Loveall	01/13/93	--	NW	6	9N	28E	633	332	238	94	539	88	Clay	
6C3	Robert Loveall	11/30/98	--	NW	6	9N	28E	633	490	235	98	535	21	Silt and Gravel	
6D1	Randy Powers	05/14/01	NW	NW	6	9N	28E	618	210	135	189	429	32	Clay	
6D2	CW Flowers	08/07/89	--	--	6	9N	28E	628	316.5	261	13	615	13	Basalt	
6G1	William F. Brown	06/23/73	SE	NE	6	9N	28E	586	160	80	128	458	128	Basalt	
6H1	Ricky Hamilton	05/21/17	NE	NE	6	9N	28E	432	110	64	95	337	35	Clay	
6I1	Tracey Smith	07/27/05	NW	NE	6	9N	28E	544	282	100	135	409	30	Clay and Sandstone	

Water Well Report Designation	Owner ²	Date Completed	Location					Well Elevation ³ (feet)	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Basalt (feet bgs)	Top of Basalt Elevation ³ (feet)	Summary - Limiting Stratigraphic Unit		Notes
			Quarter-Quarter Section	Quarter Section	Section	Township	Range						Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
6I2	Frank Panisko	09/16/74	NE	SW	6	9N	28E	587	300	180	183	404	3	Clay	
6I3	Joseph Mugo	08/12/16	NE	SE	6	9N	28E	589	360	218	189	400	26	Clay	
6L1	Brett and Tracy Mooney	05/02/02	--	SW	6	9N	28E	646	228	155	203	443	36	Silt	
6L2	Steve Versteeg	06/19/01	NW	SW	6	9N	28E	647	215	153	201	446	41	Clay	
6M1	David H. Steffen	02/14/92	SW	SW	6	9N	28E	650	343	258	186	464	26	Clay Gravel	
6N1	E.O. Kraus	--	SE	SW	6	9N	28E	646	325	221	210	436	40	Clay	
6O1	Mike and Talia Lewis	08/23/17	NW	NE	6	9N	28E	621	215	135	198	423	18	Clay and Gravel	
6P1	Hedge Cock	11/15/02	NE	NE	6	9N	28E	623	225	134	206	417	35	Clay	
6P2	Paul and Kerry Wood	04/23/04	NW	SE	6	9N	28E	611	380	260	198	413	30	Clay	
6P3	Hoiu Moon	09/30/02	SE	SE	6	9N	28E	625	280	155	220	405	37	Clay	
6P4	Tony Garrett	11/16/97	SE	SE	6	9N	28E	625	175	111	7	618	7	Basalt	
7C1	B.D. Dierks	11/25/72	NE	NW	7	9N	28E	644	540	248	185	459	58	Sandy Clay	
7D1	Ray Crissen	09/07/89	NW	NW	7	9N	28E	646	217	168	200	446	50	Clay	
12A1	Richland School District	06/26/17	NE	NE	12	9N	27E	634	30	>30	>30	<604	>30		
12A2	Milo Bauder	08/14/81	--	NE	12	9N	27E	632	905	250	25	607	25	Basalt	
12A3	Milo Bauder	04/10/86	--	--	12	9N	27E	632	1050	180	25	607	25	Basalt	Deepening of 12A2
12C1	Harold W. Alexander	11/20/85	--	NW	12	9N	27E	543	180	70	90	453	90	Basalt	
12C2	Harold W. Alexander	02/03/87	--	NW	12	9N	27E	543	195	60	80	463	80	Basalt	
12E1	City of West Richland	12/17/02	SW	NW	12	9N	27E	522	20	--	>20	<502	>20		
12E2	City of West Richland	12/17/02	SW	NW	12	9N	27E	522	20	--	>20	<502	>20		
12F1	John C. McElroy	04/19/57	SE	NW	12	9N	27E	555	400	156	200	355	200	Basalt	
12F2	Harold W. Alexander	03/11/02	SE	NW	12	9N	27E	584	399	183	74	510	21	Sandy Clay	
12H1	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	>30	>30	<595	>30		
12H2	Richland School District	08/24/17	SE	NE	12	9N	27E	625	25	>25	>25	<595	>25		
12H3	Richland School District	08/24/17	SE	NE	12	9N	27E	625	25	>25	>25	<595	>25		
12H4	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H5	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H6	Richland School District	08/24/17	SE	NE	12	9N	27E	625	25	>25	>25	<595	>25		
12H7	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H8	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H9	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H10	Dan Knowlton	04/30/94	SE	NE	12	9N	27E	619	60	42	>60	<559	>60		

Notes:

¹ Water well reports observations are adapted from water well reports on file with the Washington State Department of Ecology.

² The owner as listed on the Water Well Report, which may or may not correspond with the current well owner.

³ Well elevations were adapted from the U.S. Geological Survey and are provided relative to the North American Vertical Datum of 1988 (NAVD 88).

bgs = below ground surface; -- = not provided

Table D-2
Compilation of Test Pit Observations ¹
 City of West Richland
 Benton County, Washington

Exploration Designation	Investigation ²	Designation by Initial Investigator	Date of Exploration	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Limiting Stratigraphic Units			Summary - Limiting Stratigraphic Unit		Notes
						Depth to Top of Basalt (feet bgs)	Depth to Cementation (feet bgs)	Depth to Fine-Grained Sediment (feet bgs)	Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
BHTP1	HDJ Design Group (2014)	TP-1	02/20/14	2.5	>2.5	2	--	--	2	Basalt	
BHTP2	HDJ Design Group (2014)	TP-2	02/20/14	15	>15	>15	2	--	2	Cementation/Stratification	
BHTP3	HDJ Design Group (2014)	TP-3	02/20/14	16	>16	>16	8	--	8	Caliche Layer	
BHTP4	HDJ Design Group (2014)	TP-4	02/20/14	12	>12	12	--	--	12	Basalt	
BHTP5	HDJ Design Group (2014)	TP-5	02/20/14	10	>10	10	--	--	10	Basalt	
BHTP6	HDJ Design Group (2014)	TP-6	02/20/14	9	>9	9	--	--	9	Basalt	
BHTP7	HDJ Design Group (2014)	TP-7	02/20/14	5	>5	5	2.5	--	2.5	Cementation/Stratification	
BHTP8	HDJ Design Group (2014)	TP-8	02/20/14	15	>15	>15	12	--	12	Cementation	
BHTP9	HDJ Design Group (2014)	TP-9	02/20/14	15	>15	>15	--	--	>15		
BHTP10	HDJ Design Group (2014)	TP-10	02/20/14	14	>14	>14	5	--	5	Cementation	
BHTP11	HDJ Design Group (2014)	TP-11	02/20/14	14	>14	>14	6	--	6	Cementation	
BHTP12	HDJ Design Group (2014)	TP-12	02/20/14	14	>14	>14	3	--	3	Cementation	
BHTP13	HDJ Design Group (2014)	TP-13	02/20/14	14	>14	>14	10	--	10	Cementation	
BHTP14	HDJ Design Group (2014)	TP-14	02/20/14	15	>15	>15	4	--	4	Cementation	
BHTP15	HDJ Design Group (2014)	TP-15	02/20/14	15	>15	>15	4	--	4	Cementation	
BHTP16	HDJ Design Group (2014)	TP-16	02/20/14	15	>15	>15	4	--	4	Cementation	
BHTP17	HDJ Design Group (2014)	TP-17	02/20/14	15	>15	>15	--	--	>15		
BHTP18	HDJ Design Group (2014)	TP-18	02/20/14	12	>12	>12	--	--	>12		
BHTP19	HDJ Design Group (2014)	TP-19	02/20/14	14	>14	>14	--	--	>14		Strong HCL reaction noted at 10 feet bgs.
BHTP20	HDJ Design Group (2014)	TP-20	02/20/14	14	>14	>14	--	--	>14		Strong HCL reaction noted at 12 feet bgs.
BHTP21	HDJ Design Group (2014)	TP-21	02/20/14	12	>12	>12	--	--	>12		Strong HCL reaction noted at 3 feet bgs.
BHTP22	HDJ Design Group (2014)	TP-22	02/20/14	12	>12	>12	--	--	>12		
BHTP23	HDJ Design Group (2014)	TP-23	02/20/14	12	>12	>12	--	--	>12		
BHTP24	HDJ Design Group (2014)	TP-24	02/20/14	12	>12	>12	--	--	>12		
BHTP25	HDJ Design Group (2014)	TP-25	02/20/14	6	>6	6	4	--	4	Cementation	Carbonate-cemented bedrock noted at 6 feet - interpreted as basalt.
BHTP26	HDJ Design Group (2014)	TP-26	02/20/14	12	>12	>12	--	--	>12		Strong HCL reaction noted at 4 feet bgs.
CHTP1	Shannon &Wilson, Inc. (2010)	TP-1	07/22/10	8	>8	>8	--	--	>8		
CHTP2	Shannon &Wilson, Inc. (2010)	TP-2	07/22/10	6	>6	>6	--	--	>6		
CHTP3	Shannon &Wilson, Inc. (2010)	TP-3	07/22/10	2	>2	2	--	--	2	Basalt	
CHTP4	Shannon &Wilson, Inc. (2010)	TP-4	07/22/10	6	>6	>6	--	--	>6		
CHTP5	Shannon &Wilson, Inc. (2010)	TP-5	07/22/10	9	>9	>9	--	--	>9		
CHTP6	Shannon &Wilson, Inc. (2010)	TP-6	07/22/10	2	>2	2	--	--	2	Basalt	
CHTP7	Shannon &Wilson, Inc. (2010)	TP-7	07/22/10	10	>10	>10	--	--	>10		
CHTP8	Shannon &Wilson, Inc. (2010)	TP-8	07/22/10	7	>7	>7	--	--	>7		
PETP1	Intermountain (2009)	TP-1	02/03/10	12.5	>12.5	>12.5	2	--	2	Cementation	Caliche layer noted at 2 feet bgs.
PETP2	Intermountain (2009)	TP-2	02/03/10	9	>9	>9	2	--	2	Cementation	Caliche layer noted at 2 feet bgs.
PETP3	Intermountain (2009)	TP-3	02/03/10	12	>12	>12	3	--	3	Cementation	Caliche layer noted at 3 feet bgs.
PETP4	Intermountain (2009)	TP-4	02/03/10	13	>13	>13	3	--	3	Cementation	
PETP5	Intermountain (2009)	TP-5	02/03/10	12	>12	>12	2	--	2	Cementation	
SHTP1	PBS Engineering + Environmental (2016)	TP-1	04/08/16	8	>8	>8	--	--	>8		Carbonate-stained gravel noted at 5 feet bgs, with overlying moist soil.
SHTP2	PBS Engineering + Environmental (2016)	TP-2	04/08/16	6	>6	>6	--	--	>6		
SHTP3	PBS Engineering + Environmental (2016)	TP-3	04/08/16	9.5	>9.5	>9.5	--	--	>9.5		Carbonate-stained gravel noted at 5 feet bgs, with overlying moist soil.
SHTP4	PBS Engineering + Environmental (2016)	TP-4	04/08/16	8.5	>8.5	>8.5	--	--	>8.5		
SHTP5	PBS Engineering + Environmental (2016)	TP-5	04/08/16	11	>11	>11	--	--	>11		
SHTP6	PBS Engineering + Environmental (2016)	TP-6	04/08/16	10	>10	>10	--	--	>10		

Exploration Designation	Investigation ²	Designation by Initial Investigator	Date of Exploration	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Limiting Stratigraphic Units			Summary - Limiting Stratigraphic Unit		Notes
						Depth to Top of Basalt (feet bgs)	Depth to Cementation (feet bgs)	Depth to Fine-Grained Sediment (feet bgs)	Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
SHTP7	PBS Engineering + Environmental (2016)	TP-7	04/08/16	12.5	>12.5	>12.5	--	--	>12.5		
SHTP8	PBS Engineering + Environmental (2016)	TP-8	04/08/16	14	>14	>14	--	--	>14		
SHTP9	PBS Engineering + Environmental (2016)	TP-9	04/08/16	15.5	>15.5	>15.5	--	--	>15.5		
SHTP10	PBS Engineering + Environmental (2016)	TP-10	04/08/16	9.5	>9.5	>9.5	5	--	5	Cementation	
SHTP11	PBS Engineering + Environmental (2016)	TP-11	04/08/16	10.5	>10.5	>10.5	--	--	>10.5		
WWTP1	Intermountain (2011)	TP-1	01/06/11	8	>8	>8	--	--	>8		Soil described as very dense below 5.5 feet bgs.
WWTP2	Intermountain (2011)	TP-2	01/06/11	9	>9	>9	--	--	>9		Soil described as very dense below 5 feet bgs.
WWTP3	Intermountain (2011)	TP-3	01/06/11	8	>8	>8	--	--	>8		Soil described as dense to very dense below 3.5 feet bgs.
WWTP4	Intermountain (2011)	TP-4	01/06/11	8	>8	>8	--	--	>8		Soil described as very dense below 2 feet bgs.

Notes:

¹ Test pit observations are adapted from geotechnical reports provided by the City of West Richland.

² Investigation references:

HDJ Design Group, 2014. Geotechnical investigation report, Belmont Heights, West Richland, Washington. Report prepared by HDJ Design Group, PLLC of Pasco, Wash. April.

Intermountain Materials Testing & Geotechnical, 2011. REPORT, Field Permeability Testing, Proposed Westwood Development, Ironton Drive, West Richland, WA. Reported prepared by Intermountain Materials Testing & Geotechnical, Pasco, Wash. for Hayden Homes, LLC, Redmond, Oregon. January 11.

Intermountain Materials Testing & Geotechnical, 2009. REPORT, Field Permeability Testing, Proposed Paradise Estates Development, Paradise Way and Belmont Blvd, West Richland, WA. Reported prepared by Intermountain Materials Testing & Geotechnical, Pasco, Wash. for KDS Development LLC, Issaquah, Wash. February 10.

PBS Engineering + Environmental, 2016. Preliminary Geotechnical Engineering Report, Sunset Heights Development, Benton County Parcel 101971000004000, West Richland, Washington. Reported prepared by PBS Engineering + Environmental, Richland, Wash. for Epic Development, Richland, Wash. May 31.

Shannon & Wilson, Inc., 2010. Geotechnical engineering study: Collins Heights Subdivision, Phase 1, West Richland, Washington. Report prepared by Shannon & Wilson, Inc., Richland, Wash. for Tetra Tech Engineering and Architecture Services, Richland, Wash., September 7.

bgs = below ground surface

APPENDIX E
Shallow Groundwater Mapping

Table E-1
September 2017 and October 2018 Groundwater Monitoring Results
 Drainage Problem Area
 City of West Richland, Washington

Reference ID	Observation Location Type	Rim Elevation (ft) ^{1,2}	Depth to Water: Rim to Water (in)		Depth to Water: Rim to Water (ft)		Elevation (ft) ^{1,2}		Groundwater Elevation (ft) ^{1,2}	
			14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18
B-7	MHOB?	Could Not Locate	--	-100	--	-8.3	--	NA		
B-8	MHOB?	Could Not Locate	--	DRY	--	DRY	--	DRY		
B-9	MHOB?	Could Not Locate	--	-97	--	-8.1	--	NA		
B-10	DW	640.00	-102	DRY	-8.5	DRY	631.50	DRY		
B-11	DW	650.00	--	DRY	--	DRY	--	DRY		
B-12	DW	648.50	-133	-142	-11.1	-11.8	637.42	636.67		
B-13	DW	647.00	-83	-92.5	-6.9	-7.7	640.08	639.29		
B-14	DW	649.00	-102	-114	-8.5	-9.5	640.50	639.50		
B-15	MHSB	650.00	--	-81	--	-6.8	--	643.25		
B-17	DW	652.41	--	-53	--	-4.4	--	647.99		
B-18	DW	652.18	--	-55	--	-4.6	--	647.60		
B-19	DW	653.46	--	-75	--	-6.3	--	647.21		
B-20	DW	653.48	--	-81	--	-6.8	--	646.73		
B-21	DW	651.99	-78	-84	-6.5	-7.0	645.49	644.99		
B-22	DW	653.00	-137	-147.5	-11.4	-12.3	641.58	640.71		
B-23	DW	641.00	DRY	DRY	DRY	DRY	DRY	DRY		
B-24	DW	641.00	DRY	DRY	DRY	DRY	DRY	DRY		
B-25	DW	644.00	--	DRY	--	DRY	--	DRY		
B-26	DW	652.25	-88	-100.5	-7.3	-8.4	644.92	643.88		
C-2	DW	649.03	DRY	--	DRY	--	DRY	--		
C-5	MHOB	642.85	--	-82.5	--	-6.9	--	635.98		
C-6	DW	640.00	DRY	DRY	DRY	DRY	DRY	DRY		
C-7	MH	640.27	--	DRY	--	DRY	--	DRY		
F-1	DW	647.91	--	-180	--	-15.0	--	632.91		
F-2	DW	645.40	--	DRY	--	DRY	--	DRY		
F-3	DW	640.74	--	DRY	--	DRY	--	DRY		
O-6	DW	643.18	-170	-168	-14.2	-14.0	629.01	629.18		
O-7	DW	643.18	DRY	DRY	DRY	DRY	DRY	DRY		
O-8	DW	643.87	DRY	DRY	DRY	DRY	DRY	DRY		
O-9	DW	644.85	DRY	-165	DRY	-13.8	DRY	631.10		
O-10	DW	645.99	-157	-160	-13.1	-13.3	632.91	632.66		
O-11	DW	647.10	-138	-141	-11.5	-11.8	635.60	635.35		
Q-3	DW(2)	617.84	DRY	DRY	DRY	DRY	DRY	DRY		

Reference ID	Observation Location Type	Rim Elevation (ft) ^{1,2}	Depth to Water: Rim to Water (in)		Depth to Water: Rim to Water (ft)		Elevation (ft) ^{1,2}		Groundwater Elevation (ft) ^{1,2}	
			14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18
Q-4 NORTH (Q-4a)	DW	614.45	-151.5	-154.5	-12.6	-12.9	601.83	601.58		
Q-4 WEST (Q-4b)	DW		-169.5	-124	-14.1	-10.3	600.33	604.12		
Q-5	DW	613.03	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
Q-6	DW	615.63	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
Q-7	DW	628.07	--	DRY	--	DRY	--	DRY	DRY	
Q-8	DW	634.50	--	-112.5	--	-9.4	--	625.13		
Q-9	DW	643.85	-139.5	-134	-11.6	-11.2	632.23	632.68		
Q-10	DW	UNKNOWN	--	DRY	--	DRY	--	DRY	DRY	
Q-11	DW	UNKNOWN	--	-59	--	-4.9	--	NA	NA	
Q-12	DW	UNKNOWN	-82.5	-87	-6.9	-7.3	NA	NA	NA	
Q-13	DW	UNKNOWN	-23	-35	-1.9	-2.9	NA	NA	NA	
Q-14	DW	635.79	--	-52	--	-4.3	--	631.46		
Q-15	DW	640.43	--	-66.5	--	-5.5	--	634.89		
Q-16	DW	641.73	-53	-45.5	-4.4	-3.8	637.31	637.94		
Q-17	DW	644.29	-65.5	-61.5	-5.5	-5.1	638.83	639.17		
Q-69	DW	632.55	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-1	MHOB	658.96	--	DRY	--	DRY	--	DRY	DRY	
R-2	MHOB	657.76	--	DRY	--	DRY	--	DRY	DRY	
R-3	MHOB	656.05	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-4	MHOB	654.21	--	DRY	--	DRY	--	DRY	DRY	
R-5	MHOB	655.42	--	DRY	--	DRY	--	DRY	DRY	
R-6	MHOB	656.35	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-7	MHOS	651.17	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-8	MHOB	647.88	--	DRY	--	DRY	--	DRY	DRY	
R-9	MHOB	651.11	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-10	MHOB	650.33	--	DRY	--	DRY	--	DRY	DRY	
R-11	MHOB	651.61	--	DRY	--	DRY	--	DRY	DRY	
R-12	MHOB	651.66	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-13	MHOB	653.55	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-14	MHOB	653.71	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-15	MHOB	655.14	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-16	MHOB	655.67	--	DRY	--	DRY	--	DRY	DRY	
R-17	MHOB	657.48	DRY	DRY	DRY	DRY	DRY	DRY	DRY	
R-18	MHOB	657.13	Below IE	-85	Below IE	-7.1	Below IE	650.05		
R-19	MHOB	657.73	Below IE	-88	Below IE	-7.3	Below IE	650.40		
R-20	MHOB	653.83	--	-58.5	--	-4.9	--	648.96		
R-21	MHOB	653.05	DRY	-45	DRY	-3.8	DRY	649.30		
R-22	MHOB	653.53	Below IE	-71.5	Below IE	-6.0	Below IE	647.57		
R-23	MHOB	652.96	-28	-40	-2.3	-3.3	650.63	649.63		

Reference ID	Observation Location Type	Rim Elevation (ft) ^{1,2}	Depth to Water: Rim to Water (in)		Depth to Water: Rim to Water (ft)		Elevation (ft) ^{1,2}		Groundwater Elevation (ft) ^{1,2}	
			14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18
R-24	MHOB	653.54	-36	-46	-3.0	-3.8	650.54	649.71		
R-25	MHOB	655.37	-31	-40.5	-2.6	-3.4	652.79	652.00		
R-26	MHOB	654.33	--	-56.5	--	-4.7	--	649.62		
R-27	MHOB	655.16	--	-26	--	-2.2	--	652.99		
R-28	MHOB	655.61	--	-23.5	--	-2.0	--	653.65		
R-29	MHOB	651.97	--	-49	--	-4.1	--	647.89		
R-30	MHOB	654.18	DRY	-60	DRY	-5.0	DRY	649.18		
R-31	MHOB	652.49	-24	-34	-2.0	-2.8	650.49	649.66		
R-32	MHOB	652.19	-17	-26	-1.4	-2.2	650.77	650.02		
R-33	DW	656.87	--	-112.5	--	-9.4	--	647.50		
R-34	DW	656.90	--	-99	--	-8.3	--	648.65		
R-35 EAST	DW	655.99	--	-92	--	-7.7	--	648.32		
R-35 MIDDLE	DW	656.19	--	-94.5	--	-7.9	--	648.32		
R-35 WEST	DW	656.54	--	-98	--	-8.2	--	648.37		
R-36 NORTH	DW	655.12	-117	-109	-9.8	-9.1	645.37	646.04		
R-36 SOUTH	DW	655.40		-110.5	-9.8	-9.2	645.65	646.19		
R-37 EAST	DW	654.06	--	-117	--	-9.8	--	644.31		
R-37 WEST	DW	653.99	--	-112	--	-9.3	--	644.66		
R-38 NORTH	DW	653.74	--	-115	--	-9.6	--	644.16		
R-38 SOUTH	DW	653.18	--	-116	--	-9.7	--	643.51		
R-39 EAST	DW	651.21	-77	-66.5	-6.4	-5.5	644.79	645.67		
R-39 NORTH	DW	651.35		-66		-5.5	651.35	645.85		
R-39 WEST	DW	651.61		-66.5		-5.5	651.61	646.07		
R-40	DW	653.28	--	-75.5	--	-6.3	--	646.99		
R-41	DW	653.90	-89.5	-75.5	-7.5	-6.3	646.44	647.61		
R-42	DW	653.94	-86.5	-78	-7.2	-6.5	646.73	647.44		
R-42	DW	653.94	-87	--	-7.3	--	646.69	--		
R-43	DW	650.40	-70	-59	-5.8	-4.9	644.57	645.48		
R-44	DW	646.98	-61	-63	-5.1	-5.3	641.90	641.73		
R-45	DW	648.47	-56	-62	-4.7	-5.2	643.80	643.30		
R-46	DW	649.86	-87	-88	-7.3	-7.3	642.61	642.53		
R-47	DW	650.57	-102	-103	-8.5	-8.6	642.07	641.99		
R-48	DW	647.75	DRY	--	DRY	--	DRY	--		
R-49	DW	645.37	DRY	--	DRY	--	DRY	--		
R-50	DW	643.50	DRY	--	DRY	--	DRY	--		
R-51	DW	643.16	DRY	--	DRY	--	DRY	--		
R-52	DW	642.01	DRY	--	DRY	--	DRY	--		
R-53	DW	641.69	DRY	--	DRY	--	DRY	--		
R-54	DW	644.18	DRY	--	DRY	--	DRY	--		

Reference ID	Observation Location Type	Rim Elevation (ft) ^{1,2}	Depth to Water: Rim to Water (in)		Depth to Water: Rim to Water (ft)		Elevation (ft) ^{1,2}		Groundwater Elevation (ft) ^{1,2}	
			14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18
R-55	DW	642.25	DRY	--	DRY	--	DRY	--		
R-56	DW	640.00	DRY	--	DRY	--	DRY	--		
R-57	DW	639.98	DRY	--	DRY	--	DRY	--		
R-58	DW	637.99	DRY	--	DRY	--	DRY	--		
R-59	DW	635.41	DRY	--	DRY	--	DRY	--		
R-71	MHOB	653.29	-25	-32	-2.1	-2.7	651.21	650.62		
R-75	MHOB	653.99	-51	-54.5	-4.3	-4.5	649.74	649.45		
R-76	MHOB	655.30	-49	-56.5	-4.1	-4.7	651.22	650.59		
R-77	MHOB	657.06	-48	-47.5	-4.0	-4.0	653.06	653.10		
R-78	MHOB	656.95	-47	-44.5	-3.9	-3.7	653.03	653.24		
R-79	MHOB	656.76	--	-35	--	-2.9	--	653.84		
R-80	MHOB	655.27	--	-28.5	--	-2.4	--	652.90		
R-81	MHOB	653.56	--	-15	--	-1.3	--	652.31		
R-82	MHOB	656.87	--	-32	--	-2.7	--	654.20		
R-83	MHOB	656.51	-39.5	-27	-3.3	-2.3	653.22	654.26		
R-84	MHOB	656.62	-43.5	-28	-3.6	-2.3	653.00	654.29		
R-85	MHOB	657.15	-47	-43	-3.9	-3.6	653.23	653.57		
R-86	MHOB	657.21	-51	-46.5	-4.3	-3.9	652.96	653.34		
R-87	MHOB	659.35	--	-79.5	--	-6.6	--	652.73		
R-88	MHOB	658.59	--	-50.5	--	-4.2	--	654.38		
R-89	MHOB	659.84	Below IE	-80.5	Below IE	-6.7	Below IE	653.13		
R-90	MHOB	658.84	--	-62	--	-5.2	--	653.67		
R-91	MHOB	659.29	--	-65	--	-5.4	--	653.87		
R-92	MHOB	659.15	--	-67	--	-5.6	--	653.57		
R-93	MHOB	660.85	--	-84	--	-7.0	--	653.85		
R-94	MHOB	661.52	--	DRY	--	DRY	--	DRY		
R-95	MHOB	660.72	--	DRY	--	DRY	--	DRY		
R-96	MHOB	661.89	--	DRY	--	DRY	--	DRY		
R-97	MHOB	660.81	--	DRY	--	DRY	--	DRY		
R-98	MHOB	659.28	DRY	DRY	DRY	DRY	DRY	DRY		
R-99	MHOB	658.23	DRY	DRY	DRY	DRY	DRY	DRY		
R-100	DW	655.48	-96	-89.5	-8.0	-7.5	647.48	648.02		
R-101	DW	655.48	-96	-85	-8.0	-7.1	647.48	648.40		
R-102	MHOB	658.89	--	DRY	--	DRY	--	DRY		
R-103	MHOB	659.12	DRY	-72.5	DRY	-6.0	DRY	653.08		
R-104	MHOB	659.50	--	DRY	--	DRY	--	DRY		
R-105	MHOB	661.87	--	DRY	--	DRY	--	DRY		
R-106	MHOB	661.90	--	DRY	--	DRY	--	DRY		
R-107	DW	659.09	-105	-100.5	-8.8	-8.4	650.34	650.72		

Reference ID	Observation Location Type	Rim Elevation (ft) ^{1,2}	Depth to Water: Rim to Water (in)		Depth to Water: Rim to Water (ft)		Elevation (ft) ^{1,2}		Groundwater Elevation (ft) ^{1,2}	
			14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18
R-108	DW	659.09	-105	-98	-8.8	-8.2	650.34	650.92		
R-109	DW	658.81	--	-99.5	--	-8.3	--	650.52		
R-110	DW	658.88	--	-98	--	-8.2	--	650.71		
R-111 EAST	DW	658.05	--	-93	--	-7.8	--	650.30		
R-111 WEST	DW	657.93	--	-91	--	-7.6	--	650.35		
R-112 EAST	DW	657.86	--	-79	--	-6.6	--	651.28		
R-112 WEST	DW	657.97	--	-79	--	-6.6	--	651.39		
R-113	DW	657.55	--	-78	--	-6.5	--	651.05		
R-114 NORTH	DW	655.97	--	-46.5	--	-3.9	--	652.10		
R-114 SOUTH	DW	656.07	--	-47	--	-3.9	--	652.15		
R-115 EAST	DW	656.93	--	-43.5	--	-3.6	--	653.31		
R-115 WEST	DW	657.05	--	-45	--	-3.8	--	653.30		
R-116 EAST	DW	654.50	-42	-36	-3.5	-3.0	651.00	651.50		
R-116 WEST	DW	654.39		-35	-3.5	-2.9	650.89	651.47		
R-117 NORTH	DW	653.70	-82.5	-82.5	-6.9	-6.9	646.83	646.83		
R-117 SOUTH	DW	653.60		-71.5	-6.9	-6.0	646.73	647.64		
R-118 EAST	DW	654.91	--	-92	--	-7.7	--	647.24		
R-118 WEST	DW	655.20	--	-95	--	-7.9	--	647.28		
R-119	MHOB	658.18	--	-56.5	--	-4.7	--	653.47		
R-120	MHOB	658.11	-62	-56.5	-5.2	-4.7	652.94	653.40		
R-121	MHOB	659.66	--	-47.5	--	-4.0	--	655.70		
R-122	MHOB	658.48	--	-62.5	--	-5.2	--	653.27		
R-123	MHOB	658.03	--	-57	--	-4.8	--	653.28		
R-124	MHOB	657.45	--	-56.5	--	-4.7	--	652.74		
R-125	MHOB	657.51	--	-50.5	--	-4.2	--	653.30		
S-1	MHOB	649.40	--	-72	--	-6.0	--	643.40		
S-2	MHOB	648.97	--	DRY	--	DRY	--	DRY		
S-3	MHOB	647.50	--	DRY	--	DRY	--	DRY		
S-4	MHOB	UNKNOWN	--	-87.5	--	-7.3	--	NA		
S-5	MHOB	644.55	--	DRY	--	DRY	--	DRY		
S-6	MHOB	UNKNOWN	--	DRY	--	DRY	--	DRY		
S-7	MHOB	UNKNOWN	--	-78.5	--	-6.5	--	NA		
S-10	MHOB	642.91	--	-82.5	--	-6.9	--	636.04		
S-11	MHOB	643.70	DRY	-89.5	DRY	-7.5	DRY	636.24		
S-14	MHOB	UNKNOWN	--	-97.5	--	-8.1	--	NA		
S-31	MHOB	Could Not Locate	--	-82.5	--	-6.9	--	NA		
S-32	MHOB	643.16	--	-72	--	-6.0	--	637.16		
S-33	MHOB	647.68	DRY	-79.5	DRY	-6.6	DRY	641.06		
S-34	MHOB	646.56	--	DRY	--	DRY	--	DRY		

Reference ID	Observation Location Type	Rim Elevation (ft) ^{1,2}	Depth to Water: Rim to Water (in)		Depth to Water: Rim to Water (ft)		Elevation (ft) ^{1,2}		Groundwater Elevation (ft) ^{1,2}	
			14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18	14-Sep-17	6-Oct-18
T-34 NORTH	DW	645.59	--	DRY	--	DRY	--	--	--	DRY
T-34 SOUTH	DW	645.05	--	DRY	--	DRY	--	--	--	DRY

Notes:

¹ *Italicized values indicate that the rim elevation value has been estimated.*

² Elevations are referenced to the ROS #3910 city datum.

MHOB = man hole with open bottom

DW = dry well

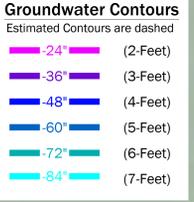
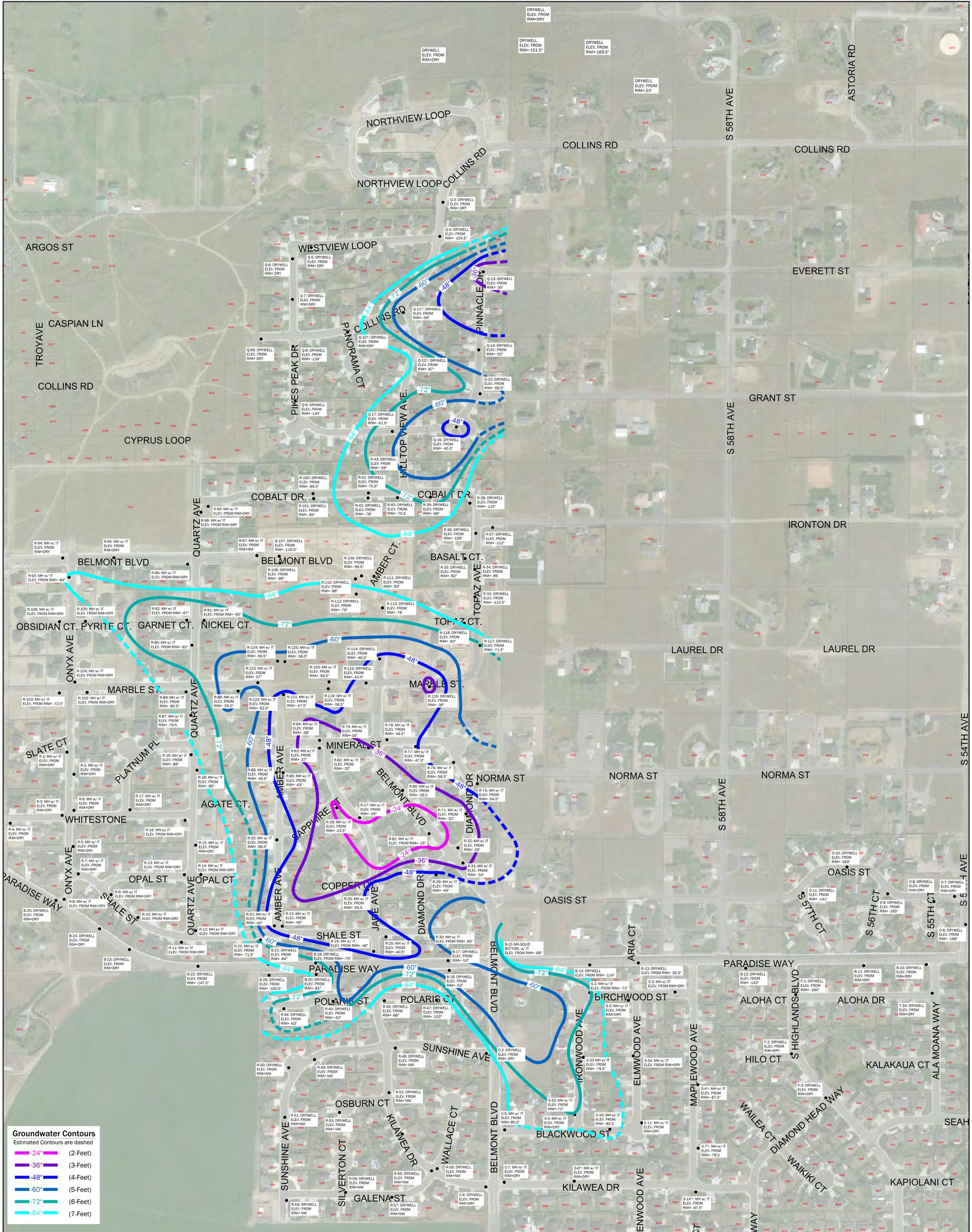
MHSB = man hole with sealed bottom

IE = invert elevation

NA = Not Applicable. Assigned to values where the Rim Elevation was not available or could not be estimated.

UNKNOWN = the measurement location could not be located in the as-builts provided.

in = inches; ft = feet; -- = not measured or no value reported for gauging event



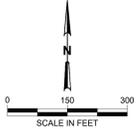
Notes:

- The locations of all features shown are approximate.
- This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
- Depths measured from Rim.

Data Source: Aerial from Bing Maps.
Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend

- Exploration Location
- NM = Not Measured
- *Rim Elevation Unknown

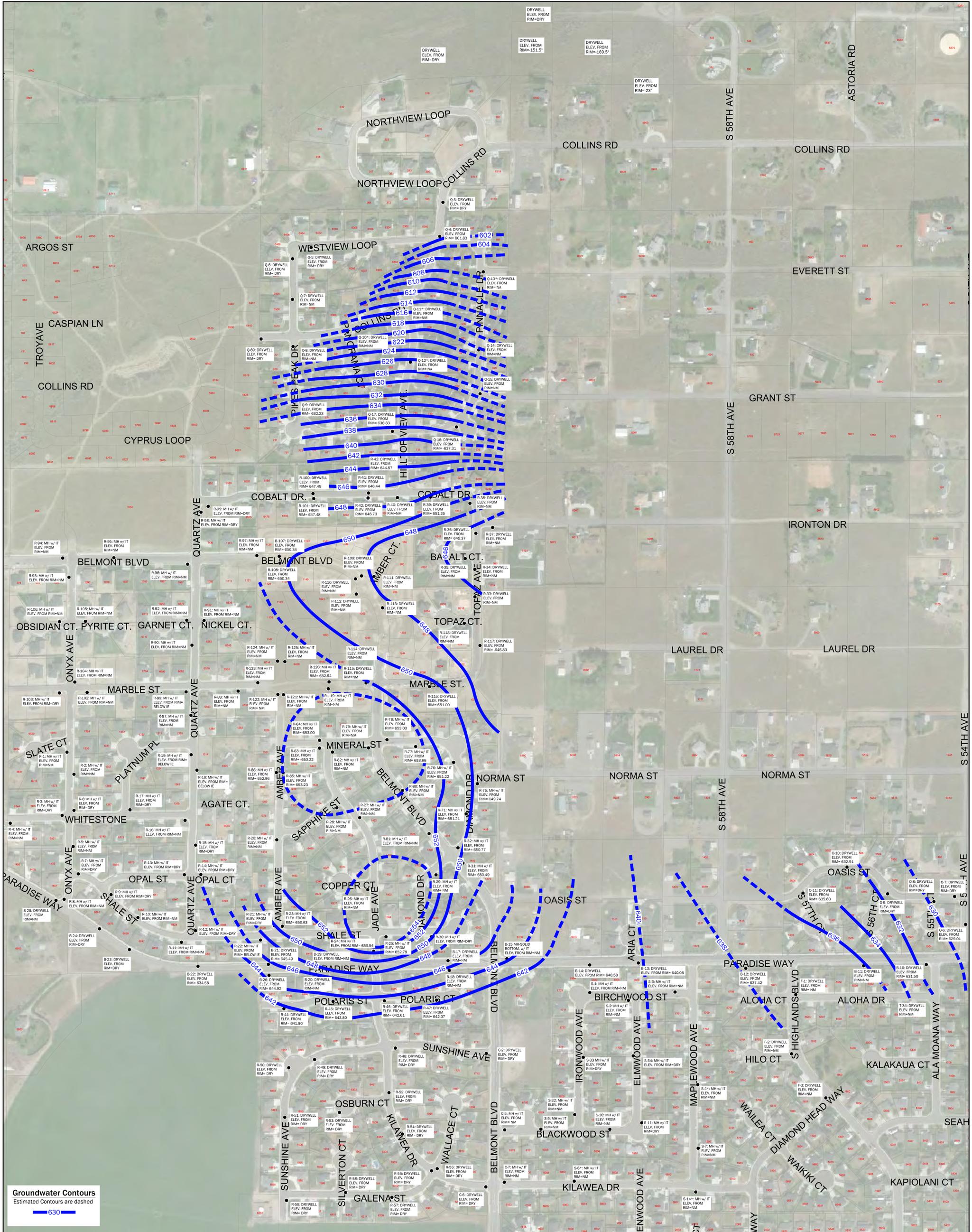


Draft City Groundwater Map September 2018 Depth to Water

Drainage Problem Area
City of West Richland



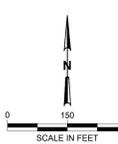
Figure E-2



Groundwater Contours
Estimated Contours are dashed

- Notes:**
- The locations of all features shown are approximate.
 - This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
 - Depths measured from Rim.
- Data Source: Aerial from Bing Maps.
- Projection: NAD83 Washington State Planes, South Zone, US Foot

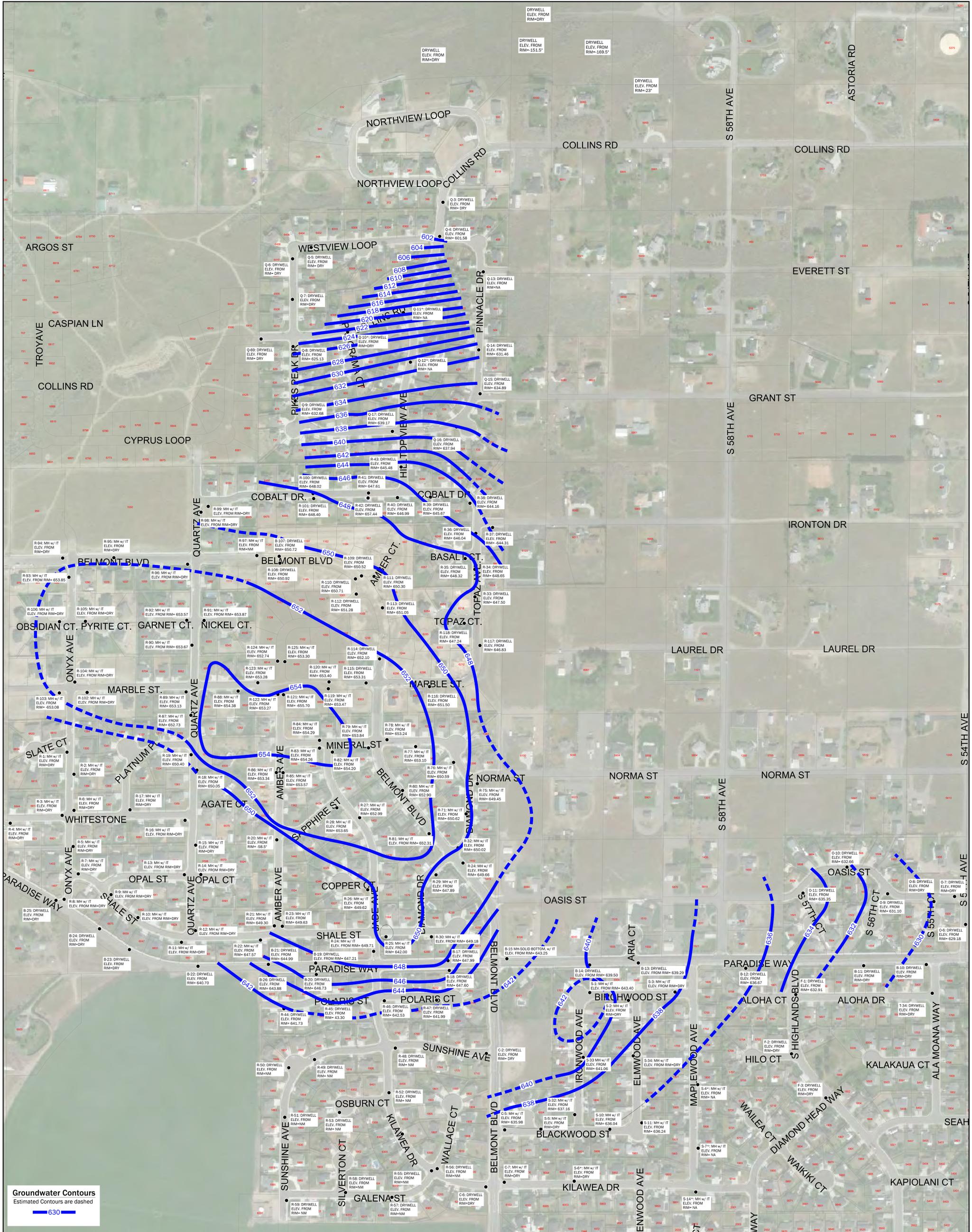
- Legend**
- Exploration Location
 - NM = Not Measured
 - *Rim Elevation Unknown



Draft City Groundwater Map
September 2017 Potentiometric Surface Map

Drainage Problem Area
City of West Richland

GEOENGINEERS **Figure E-3**



Groundwater Contours
Estimated Contours are dashed

- Notes:**
- The locations of all features shown are approximate.
 - This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
 - Depths measured from Rim.
- Data Source: Aerial from Bing Maps.
Projection: NAD83 Washington State Planes, South Zone, US Foot

- Legend**
- Exploration Location
 - NM = Not Measured
 - *Rim Elevation Unknown

Draft City Groundwater Map

September 2018 Potentiometric Surface Map

Drainage Problem Area
City of West Richland

GEOENGINEERS **Figure E-1**

APPENDIX F

Precipitation Trends

Table F-1
Precipitation Data - Kennewick Climate Station ¹
 Drainage Problem Area
 City of West Richland, Washington

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Jan-80	2.26		1.82	
Feb-80	1.30		1.58	
Mar-80	0.66		0.43	
Apr-80	0.29		0.50	
May-80	1.76		1.77	
Jun-80	0.62		0.89	
Jul-80	0.52		0.01	
Aug-80	0.11		0.06	
Sep-80	1.63		----	z
Oct-80	1.05		0.81	
Nov-80	0.66		1.09	
Dec-80	1.64		1.73	
Jan-81	0.50		0.42	
Feb-81	0.77		0.70	
Mar-81	0.83		0.75	
Apr-81	0.12		0.27	
May-81	0.90		1.15	
Jun-81	0.87		0.79	
Jul-81	0.00	a	0.14	
Aug-81	0.06		0.00	
Sep-81	0.57		0.57	
Oct-81	0.14	a	0.38	
Nov-81	0.92		1.09	
Dec-81	1.47		0.91	
Jan-82	0.86		0.75	
Feb-82	0.45		0.61	
Mar-82	0.45		0.48	
Apr-82	0.83		0.71	
May-82	0.26		0.43	
Jun-82	0.75		0.70	
Jul-82	0.14		0.24	
Aug-82	0.07		0.08	
Sep-82	1.16		0.50	
Oct-82	1.90		1.59	
Nov-82	0.59		0.65	
Dec-82	1.53		1.65	
Jan-83	1.19		1.23	
Feb-83	1.48		1.61	
Mar-83	1.41		1.13	
Apr-83	0.31		0.39	
May-83	0.42		0.20	
Jun-83	0.46		0.47	
Jul-83	0.28		0.22	
Aug-83	0.18		0.07	
Sep-83	0.27		0.10	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Oct-83	0.67		0.64	
Nov-83	2.20		2.30	
Dec-83	2.22		1.47	
Jan-84	0.23		0.16	
Feb-84	0.88		0.92	
Mar-84	1.73		1.23	
Apr-84	0.81		0.66	
May-84	0.69		0.70	
Jun-84	0.48		0.72	
Jul-84	0.00		0.05	
Aug-84	0.00		0.00	
Sep-84	0.52		0.93	a
Oct-84	0.15		0.02	
Nov-84	1.98		2.03	
Dec-84	0.79		0.75	
Jan-85	0.42		0.44	
Jan-85	0.84		0.56	a
Mar-85	0.51		0.40	
Apr-85	0.11		0.19	
May-85	0.08		0.26	
Jun-85	0.27		0.30	
Jul-85	0.02		0.01	
Aug-85	0.22		0.18	
Sep-85	0.52		0.39	
Oct-85	0.44		0.42	
Nov-85	1.33		1.14	
Dec-85	0.65		0.78	
Jan-86	2.16		2.06	a
Feb-86	1.56		1.07	
Mar-86	1.42		1.25	
Apr-86	0.05		0.08	
May-86	0.89		0.82	
Jun-86	0.00		0.06	b
Jul-86	0.20		0.39	
Aug-86	0.02		0.06	
Sep-86	0.63		0.84	
Oct-86	0.38		0.72	
Nov-86	0.93		0.73	
Dec-86	0.88		0.84	
Jan-87	1.15		1.13	
Feb-87	0.43		0.50	
Mar-87	0.89		1.36	
Apr-87	0.20		0.37	
May-87	0.40		0.75	
Jun-87	0.15		0.05	
Jul-87	0.12		0.16	a
Aug-87	0.03		0.03	
Sep-87	0.00		0.07	
Oct-87	0.00		0.00	
Nov-87	0.28		0.27	
Dec-87	1.14		1.64	
Jan-88	0.72		0.78	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Feb-88	0.02		0.07	
Mar-88	0.50		0.78	
Apr-88	0.41		0.62	
May-88	0.90		0.80	
Jun-88	0.35		0.31	
Jul-88	0.18		0.14	
Aug-88	0.00		0.00	
Sep-88	0.38		0.30	
Oct-88	0.03		0.01	
Nov-88	0.79		1.19	
Dec-88	0.38		0.53	
Jan-89	0.90		0.74	
Feb-89	1.20		1.21	
Mar-89	1.68		1.58	
Apr-89	0.62	a	1.03	
May-89	0.48		0.90	
Jun-89	0.06		0.08	
Jul-89	0.00		0.03	
Aug-89	0.37		0.42	
Sep-89	0.00		0.00	
Oct-89	0.61		0.54	
Nov-89	1.15		1.03	
Dec-89	0.38		0.52	
Jan-90	0.53		0.70	
Feb-90	0.69		0.76	
Mar-90	0.38		0.23	
Apr-90	0.75		0.56	
May-90	0.59		0.76	
Jun-90	0.16		0.17	
Jul-90	0.07		0.15	
Aug-90	0.42		0.71	
Sep-90	0.00		0.00	
Oct-90	0.81		1.04	
Nov-90	0.22		0.45	
Dec-90	0.63		0.77	
Jan-91	0.55		0.47	a
Feb-91	0.51		0.49	
Mar-91	0.87		1.10	
Apr-91	0.24		0.39	
May-91	1.39		1.04	
Jun-91	0.22		0.57	
Jul-91	0.08		0.11	
Aug-91	0.26		0.14	
Sep-91	0.00		0.00	
Oct-91	0.60		0.60	
Nov-91	2.16		2.26	
Dec-91	0.69		0.80	
Jan-92	0.72		0.68	
Feb-92	1.11		1.32	
Mar-92	0.22		0.28	
Apr-92	1.34		1.22	
May-92	0.03		0.05	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Jun-92	0.52		0.64	
Jul-92	1.50		0.97	
Aug-92	0.63		0.50	
Sep-92	0.35		0.46	
Oct-92	0.43		0.37	
Nov-92	1.26		1.58	
Dec-92	1.11		1.06	
Jan-93	1.48		1.71	
Feb-93	0.89		0.81	
Mar-93	0.87		0.86	
Apr-93	1.58		1.41	
May-93	0.62		0.65	k
Jun-93	0.46		0.72	
Jul-93	0.34		0.45	
Aug-93	0.93		----	z
Sep-93	0.02		0.07	
Oct-93	0.37		0.03	
Nov-93	0.15		0.17	
Dec-93	0.93		1.12	
Jan-94	1.09		----	z
Feb-94	0.89		0.16	g
Mar-94	0.03		0.03	
Apr-94	0.28		0.66	
May-94	1.61		1.44	f
Jun-94	0.29		0.64	
Jul-94	0.41		0.54	m
Aug-94	0.00		----	z
Sep-94	0.07		----	z
Oct-94	0.96		1.25	b
Nov-94	0.99		0.65	
Dec-94	1.08		0.95	
Jan-95	2.04		2.06	i
Feb-95	0.46		0.33	
Mar-95	1.16		----	z
Apr-95	1.30		1.58	f
May-95	0.38		0.41	t
Jun-95	1.17		1.25	h
Jul-95	0.40		0.60	k
Aug-95	0.13		----	z
Sep-95	0.41		0.38	x
Oct-95	0.58		----	z
Nov-95	0.82		1.04	i
Dec-95	1.96		2.03	j
Jan-96	1.43		0.96	
Feb-96	1.36		1.49	f
Mar-96	1.34		1.70	d
Apr-96	0.90		0.33	e
May-96	0.98		0.98	
Jun-96	0.31		0.20	
Jul-96	----	z	0.26	
Aug-96	0.00		0.00	
Sep-96	0.18		0.14	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Oct-96	1.15		1.05	
Nov-96	2.42		1.97	
Dec-96	3.20	a	2.29	
Jan-97	1.51		1.67	
Feb-97	0.69		0.37	
Mar-97	0.63		0.86	
Apr-97	0.77		0.73	
May-97	0.59		0.53	
Jun-97	0.29		0.26	
Jul-97	0.55		0.26	
Aug-97	0.05		0.17	a
Sep-97	0.34		0.38	
Oct-97	1.01		0.82	g
Nov-97	1.06		0.86	
Dec-97	0.31		0.47	
Jan-98	1.30		1.32	
Feb-98	0.94		0.99	
Mar-98	0.72		0.63	
Apr-98	0.17		0.17	
May-98	0.75		0.59	
Jun-98	----	z	0.53	
Jul-98	0.09		1.63	
Aug-98	0.31		0.00	
Sep-98	0.30		0.17	
Oct-98	0.09		0.08	
Nov-98	1.35		----	z
Dec-98	1.04		0.37	
Jan-99	0.64		0.69	
Feb-99	0.63		0.71	
Mar-99	0.16		0.04	
Apr-99	0.21		0.20	
May-99	0.49		0.17	
Jun-99	0.17		0.00	
Jul-99	0.28		0.00	
Aug-99	0.29		0.12	
Sep-99	0.00		0.00	
Oct-99	0.60		0.43	
Nov-99	0.41		0.26	
Dec-99	0.17		0.36	
Jan-00	1.38		1.21	
Feb-00	1.60		1.38	
Mar-00	1.03		0.91	
Apr-00	0.03		0.86	
May-00	0.86		0.73	
Jun-00	0.60		0.58	
Jul-00	0.02		0.03	
Aug-00	0.00		0.11	
Sep-00	0.67		0.88	
Oct-00	1.07		0.99	
Nov-00	1.12		1.00	
Dec-00	0.53		0.48	
Jan-01	0.69		0.42	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Feb-01	0.30		0.32	
Mar-01	1.09		0.49	
Apr-01	0.92		1.00	
May-01	0.24		0.18	
Jun-01	0.35	c	0.43	
Jul-01	0.06		0.16	
Aug-01	0.28		0.27	
Sep-01	0.00		----	z
Oct-01	0.51		0.25	
Nov-01	1.13	a	1.50	
Dec-01	0.52		0.66	
Jan-02	0.24		0.40	
Feb-02	0.78		0.69	
Mar-02	0.22		0.20	
Apr-02	0.26		0.44	
May-02	0.22		0.29	
Jun-02	0.88		0.80	
Jul-02	0.40		0.26	
Aug-02	0.22		0.03	
Sep-02	0.00		0.00	
Oct-02	0.07		0.07	
Nov-02	0.30		0.23	
Dec-02	1.61		2.42	
Jan-03	1.77		1.79	
Feb-03	0.94		0.73	
Mar-03	0.30		0.28	
Apr-03	0.79		1.32	
May-03	0.54		0.17	
Jun-03	0.00		0.00	
Jul-03	0.00		0.00	
Aug-03	0.05		0.18	
Sep-03	0.26		0.35	
Oct-03	0.14	a	0.13	
Nov-03	0.27		0.17	
Dec-03	1.71		1.60	
Jan-04	1.00		1.27	
Feb-04	0.74		1.21	
Mar-04	0.19		0.25	
Apr-04	0.44		0.23	
May-04	0.57		1.56	
Jun-04	1.06		1.33	
Jul-04	0.02		0.00	
Aug-04	0.42		0.53	
Sep-04	0.16		0.17	
Oct-04	0.28		0.38	
Nov-04	0.58		0.32	
Dec-04	0.77		0.74	
Jan-05	0.81		0.67	
Feb-05	0.03		0.06	
Mar-05	0.36		0.44	
Apr-05	0.77		0.43	
May-05	0.36		0.72	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Jun-05	0.43		0.33	
Jul-05	0.08		0.19	
Aug-05	0.04		0.09	
Sep-05	0.08		0.60	
Oct-05	1.31		0.55	
Nov-05	0.78		0.89	
Dec-05	1.81		2.33	
Jan-06	2.16		1.67	
Feb-06	0.29		0.27	
Mar-06	0.44		0.38	
Apr-06	1.15		1.03	
May-06	1.18		0.73	
Jun-06	1.20		1.03	
Jul-06	0.01		0.05	
Aug-06	0.00		0.00	
Sep-06	0.25		0.17	
Oct-06	0.62		0.42	
Nov-06	1.17		1.17	
Dec-06	1.73		1.69	
Jan-07	0.34		0.38	
Feb-07	0.85		1.08	
Mar-07	0.57		0.79	
Apr-07	0.48		0.40	
May-07	0.38		0.33	
Jun-07	0.72		0.78	
Jul-07	0.02		0.11	
Aug-07	0.05		0.11	
Sep-07	0.17		0.50	
Oct-07	0.38		0.23	
Nov-07	0.98		1.22	
Dec-07	1.06		0.78	
Jan-08	1.50		1.14	
Feb-08	0.49		0.62	c
Mar-08	0.38		0.51	
Apr-08	0.24		0.20	
May-08	0.27		0.30	
Jun-08	0.75		0.68	
Jul-08	0.00		0.01	
Aug-08	0.32		0.23	
Sep-08	0.05		0.10	
Oct-08	0.14		0.28	
Nov-08	0.51		0.84	
Dec-08	1.59		0.74	
Jan-09	1.28		1.12	
Feb-09	0.86		0.99	
Mar-09	1.29		1.11	
Apr-09	0.35		0.38	
May-09	0.56		0.44	
Jun-09	0.01		0.07	
Jul-09	0.08		0.14	
Aug-09	0.08		0.07	
Sep-09	0.11		0.24	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Oct-09	1.16		1.01	
Nov-09	0.35		0.45	
Dec-09	0.59		1.02	
Jan-10	1.82		1.55	
Feb-10	0.54		0.42	a
Mar-10	0.18		0.13	
Apr-10	0.35		0.21	
May-10	1.51		1.33	
Jun-10	1.33		0.73	
Jul-10	0.17		0.17	
Aug-10	0.06		0.10	
Sep-10	1.47		0.84	
Oct-10	0.87		0.98	
Nov-10	1.47		1.61	
Dec-10	2.28		1.97	a
Jan-11	0.46		0.71	
Feb-11	0.44		0.22	
Mar-11	1.02		0.92	
Apr-11	0.30		0.53	
May-11	1.30		1.19	
Jun-11	0.86		0.19	a
Jul-11	0.05		0.02	
Aug-11	0.08		0.01	
Sep-11	0.03		0.02	a
Oct-11	0.48		0.58	
Nov-11	0.14		0.27	
Dec-11	0.08		0.19	
Jan-12	0.99		0.93	
Feb-12	0.52		0.60	
Mar-12	0.96		1.04	
Apr-12	0.70		0.78	a
May-12	0.26		0.33	
Jun-12	1.62		1.84	
Jul-12	0.70		0.32	
Aug-12	0.09		0.01	
Sep-12	0.00		0.00	
Oct-12	1.16		1.00	
Nov-12	1.07		0.99	a
Dec-12	1.37		1.42	
Jan-13	0.42		0.30	
Feb-13	0.03		0.13	a
Mar-13	0.34		0.50	
Apr-13	0.52		0.38	
May-13	0.70		0.73	
Jun-13	1.36		0.92	
Jul-13	0.00		0.00	
Aug-13	0.28		0.23	
Sep-13	1.20		0.85	
Oct-13	0.22		0.16	
Nov-13	0.31		0.42	
Dec-13	0.11		0.19	a
Jan-14	0.50		0.42	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Feb-14	0.81		0.52	
Mar-14	0.49		0.76	c
Apr-14	0.33		0.36	a
May-14	0.23		0.11	
Jun-14	0.42		0.22	
Jul-14	0.02		0.02	
Aug-14	0.36		0.34	
Sep-14	0.01		0.02	
Oct-14	0.71		0.70	
Nov-14	0.43		0.42	
Dec-14	1.28		1.13	
Jan-15	1.03		0.96	
Feb-15	0.66		0.64	
Mar-15	0.34		0.73	
Apr-15	0.15		0.03	
May-15	0.99	a	1.21	
Jun-15	0.00		0.00	
Jul-15	0.00		0.02	
Aug-15	0.00		0.00	
Sep-15	0.22		0.10	
Oct-15	0.37		0.54	
Nov-15	0.63		0.66	
Dec-15	1.78		1.90	
Jan-16	1.29		1.46	
Feb-16	0.46		0.36	
Mar-16	1.10		0.84	
Apr-16	0.21		0.09	
May-16	1.73		0.66	
Jun-16	0.43		0.41	
Jul-16	0.32		0.22	
Aug-16	0.00		0.00	
Sep-16	0.26		0.26	
Oct-16	2.53		1.82	
Nov-16	0.29		0.46	
Dec-16	0.74		0.79	
Jan-17	1.54		0.91	
Feb-17	1.84		1.82	
Mar-17	1.64		1.46	
Apr-17	1.01		1.13	
May-17	0.41		0.47	
Jun-17	0.48		0.40	
Jul-17	0.00		0.00	
Aug-17	0.02		0.04	
Sep-17	0.50		0.31	
Oct-17	0.63		0.53	
Nov-17	1.30		1.38	
Dec-17	0.94		1.07	
Jan-18	1.25	a	1.09	
Feb-18	0.46		0.36	
Mar-18	0.53		0.27	
Apr-18	1.34		1.10	
May-18	0.58		0.36	

Month	Kennewick Climate Station ¹		Richland Climate Station ²	
	Total Monthly Precipitation (inches)	WRCC Footnote ³ (inches)	Monthly Precipitation (inches)	WRCC Footnote ³ (inches)
Jun-18	0.08		0.26	a
Jul-18	0.00	a	0.00	
Aug-18	0.00	a	0.00	
Sep-18	0.00		0.02	
Oct-18	0.86		0.38	
Nov-18	0.47	c	0.45	c

Notes:

¹ Precipitation totals for Kennewick, Washington (Station No. 454154) were obtained on November 28, 2018 from the Western Regional Climate Center (www.wrcc.dri.edu).

² Precipitation totals for Richland, Washington (Station No. 457015) were obtained on November 28, 2018 from the Western Regional Climate Center (www.wrcc.dri.edu).

³ Footnotes are provided the following explanation by WRCC: a = 1 day missing, b = 2 days missing, c = 3 days, etc., z = 26 or more days missing, A = Accumulations present

Table F-2
Cumulative Departure in Precipitation ¹
Drainage Problem Area
City of West Richland, Washington

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jan-80	2.26	1.08	1.18	1.18
Feb-80	1.30	0.76	0.54	1.72
Mar-80	0.66	0.74	-0.08	1.63
Apr-80	0.29	0.55	-0.26	1.37
May-80	1.76	0.69	1.07	2.44
Jun-80	0.62	0.53	0.09	2.52
Jul-80	0.52	0.19	0.33	2.85
Aug-80	0.11	0.16	-0.05	2.80
Sep-80	1.63	0.33	1.30	4.10
Oct-80	1.05	0.65	0.40	4.50
Nov-80	0.66	0.90	-0.24	4.26
Dec-80	1.64	1.12	0.52	4.78
Jan-81	0.50	1.08	-0.58	4.20
Feb-81	0.77	0.76	0.01	4.21
Mar-81	0.83	0.74	0.09	4.29
Apr-81	0.12	0.55	-0.43	3.86
May-81	0.90	0.69	0.21	4.06
Jun-81	0.87	0.53	0.34	4.40
Jul-81	0.00	0.19	-0.19	4.21
Aug-81	0.06	0.16	-0.10	4.11
Sep-81	0.57	0.33	0.24	4.35
Oct-81	0.14	0.65	-0.51	3.84
Nov-81	0.92	0.90	0.02	3.86
Dec-81	1.47	1.12	0.35	4.21
Jan-82	0.86	1.08	-0.22	3.99
Feb-82	0.45	0.76	-0.31	3.67
Mar-82	0.45	0.74	-0.29	3.38
Apr-82	0.83	0.55	0.28	3.66
May-82	0.26	0.69	-0.43	3.22
Jun-82	0.75	0.53	0.22	3.44
Jul-82	0.14	0.19	-0.05	3.39
Aug-82	0.07	0.16	-0.09	3.30
Sep-82	1.16	0.33	0.83	4.13
Oct-82	1.90	0.65	1.25	5.38
Nov-82	0.59	0.90	-0.31	5.07
Dec-82	1.53	1.12	0.41	5.48
Jan-83	1.19	1.08	0.11	5.58
Feb-83	1.48	0.76	0.72	6.30
Mar-83	1.41	0.74	0.67	6.97
Apr-83	0.31	0.55	-0.24	6.73
May-83	0.42	0.69	-0.27	6.45
Jun-83	0.46	0.53	-0.07	6.38
Jul-83	0.28	0.19	0.09	6.47
Aug-83	0.18	0.16	0.02	6.49
Sep-83	0.27	0.33	-0.06	6.43

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Oct-83	0.67	0.65	0.02	6.44
Nov-83	2.20	0.90	1.30	7.75
Dec-83	2.22	1.12	1.10	8.84
Jan-84	0.23	1.08	-0.85	7.99
Feb-84	0.88	0.76	0.12	8.11
Mar-84	1.73	0.74	0.99	9.10
Apr-84	0.81	0.55	0.26	9.35
May-84	0.69	0.69	0.00	9.35
Jun-84	0.48	0.53	-0.05	9.30
Jul-84	0.00	0.19	-0.19	9.11
Aug-84	0.00	0.16	-0.16	8.94
Sep-84	0.52	0.33	0.19	9.14
Oct-84	0.15	0.65	-0.50	8.63
Nov-84	1.98	0.90	1.08	9.72
Dec-84	0.79	1.12	-0.33	9.38
Jan-85	0.42	1.08	-0.66	8.72
Jan-85	0.84	0.76	0.08	8.80
Mar-85	0.51	0.74	-0.23	8.57
Apr-85	0.11	0.55	-0.44	8.12
May-85	0.08	0.69	-0.61	7.51
Jun-85	0.27	0.53	-0.26	7.25
Jul-85	0.02	0.19	-0.17	7.08
Aug-85	0.22	0.16	0.06	7.13
Sep-85	0.52	0.33	0.19	7.32
Oct-85	0.44	0.65	-0.21	7.11
Nov-85	1.33	0.90	0.43	7.54
Dec-85	0.65	1.12	-0.47	7.07
Jan-86	2.16	1.08	1.08	8.15
Feb-86	1.56	0.76	0.80	8.95
Mar-86	1.42	0.74	0.68	9.63
Apr-86	0.05	0.55	-0.50	9.12
May-86	0.89	0.69	0.20	9.32
Jun-86	0.00	0.53	-0.53	8.78
Jul-86	0.20	0.19	0.01	8.80
Aug-86	0.02	0.16	-0.14	8.65
Sep-86	0.63	0.33	0.30	8.95
Oct-86	0.38	0.65	-0.27	8.68
Nov-86	0.93	0.90	0.03	8.71
Dec-86	0.88	1.12	-0.24	8.47
Jan-87	1.15	1.08	0.07	8.54
Feb-87	0.43	0.76	-0.33	8.21
Mar-87	0.89	0.74	0.15	8.35
Apr-87	0.20	0.55	-0.35	8.00
May-87	0.40	0.69	-0.29	7.70
Jun-87	0.15	0.53	-0.38	7.32
Jul-87	0.12	0.19	-0.07	7.25
Aug-87	0.03	0.16	-0.13	7.12
Sep-87	0.00	0.33	-0.33	6.79
Oct-87	0.00	0.65	-0.65	6.14
Nov-87	0.28	0.90	-0.62	5.52
Dec-87	1.14	1.12	0.02	5.54
Jan-88	0.72	1.08	-0.36	5.18
Feb-88	0.02	0.76	-0.74	4.43

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Mar-88	0.50	0.74	-0.24	4.19
Apr-88	0.41	0.55	-0.14	4.05
May-88	0.90	0.69	0.21	4.25
Jun-88	0.35	0.53	-0.18	4.07
Jul-88	0.18	0.19	-0.01	4.06
Aug-88	0.00	0.16	-0.16	3.90
Sep-88	0.38	0.33	0.05	3.95
Oct-88	0.03	0.65	-0.62	3.33
Nov-88	0.79	0.90	-0.11	3.22
Dec-88	0.38	1.12	-0.74	2.48
Jan-89	0.90	1.08	-0.18	2.29
Feb-89	1.20	0.76	0.44	2.73
Mar-89	1.68	0.74	0.94	3.67
Apr-89	0.62	0.55	0.07	3.74
May-89	0.48	0.69	-0.21	3.52
Jun-89	0.06	0.53	-0.47	3.05
Jul-89	0.00	0.19	-0.19	2.86
Aug-89	0.37	0.16	0.21	3.07
Sep-89	0.00	0.33	-0.33	2.74
Oct-89	0.61	0.65	-0.04	2.69
Nov-89	1.15	0.90	0.25	2.95
Dec-89	0.38	1.12	-0.74	2.20
Jan-90	0.53	1.08	-0.55	1.65
Feb-90	0.69	0.76	-0.07	1.58
Mar-90	0.38	0.74	-0.36	1.22
Apr-90	0.75	0.55	0.20	1.41
May-90	0.59	0.69	-0.10	1.31
Jun-90	0.16	0.53	-0.37	0.94
Jul-90	0.07	0.19	-0.12	0.82
Aug-90	0.42	0.16	0.26	1.07
Sep-90	0.00	0.33	-0.33	0.75
Oct-90	0.81	0.65	0.16	0.90
Nov-90	0.22	0.90	-0.68	0.23
Dec-90	0.63	1.12	-0.49	-0.27
Jan-91	0.55	1.08	-0.53	-0.80
Feb-91	0.51	0.76	-0.25	-1.05
Mar-91	0.87	0.74	0.13	-0.92
Apr-91	0.24	0.55	-0.31	-1.24
May-91	1.39	0.69	0.70	-0.54
Jun-91	0.22	0.53	-0.31	-0.85
Jul-91	0.08	0.19	-0.11	-0.96
Aug-91	0.26	0.16	0.10	-0.87
Sep-91	0.00	0.33	-0.33	-1.20
Oct-91	0.60	0.65	-0.05	-1.25
Nov-91	2.16	0.90	1.26	0.01
Dec-91	0.69	1.12	-0.43	-0.42
Jan-92	0.72	1.08	-0.36	-0.78
Feb-92	1.11	0.76	0.35	-0.43
Mar-92	0.22	0.74	-0.52	-0.95
Apr-92	1.34	0.55	0.79	-0.17
May-92	0.03	0.69	-0.66	-0.83
Jun-92	0.52	0.53	-0.01	-0.85
Jul-92	1.50	0.19	1.31	0.47

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Aug-92	0.63	0.16	0.47	0.93
Sep-92	0.35	0.33	0.02	0.95
Oct-92	0.43	0.65	-0.22	0.73
Nov-92	1.26	0.90	0.36	1.09
Dec-92	1.11	1.12	-0.01	1.08
Jan-93	1.48	1.08	0.40	1.48
Feb-93	0.89	0.76	0.13	1.61
Mar-93	0.87	0.74	0.13	1.73
Apr-93	1.58	0.55	1.03	2.76
May-93	0.62	0.69	-0.07	2.68
Jun-93	0.46	0.53	-0.07	2.61
Jul-93	0.34	0.19	0.15	2.76
Aug-93	0.93	0.16	0.77	3.53
Sep-93	0.02	0.33	-0.31	3.22
Oct-93	0.37	0.65	-0.28	2.94
Nov-93	0.15	0.90	-0.75	2.19
Dec-93	0.93	1.12	-0.19	2.00
Jan-94	1.09	1.08	0.01	2.01
Feb-94	0.89	0.76	0.13	2.13
Mar-94	0.03	0.74	-0.71	1.42
Apr-94	0.28	0.55	-0.27	1.15
May-94	1.61	0.69	0.92	2.06
Jun-94	0.29	0.53	-0.24	1.82
Jul-94	0.41	0.19	0.22	2.04
Aug-94	0.00	0.16	-0.16	1.88
Sep-94	0.07	0.33	-0.26	1.62
Oct-94	0.96	0.65	0.31	1.93
Nov-94	0.99	0.90	0.09	2.02
Dec-94	1.08	1.12	-0.04	1.98
Jan-95	2.04	1.08	0.96	2.93
Feb-95	0.46	0.76	-0.30	2.63
Mar-95	1.16	0.74	0.42	3.05
Apr-95	1.30	0.55	0.75	3.80
May-95	0.38	0.69	-0.31	3.48
Jun-95	1.17	0.53	0.64	4.12
Jul-95	0.40	0.19	0.21	4.33
Aug-95	0.13	0.16	-0.03	4.30
Sep-95	0.41	0.33	0.08	4.38
Oct-95	0.58	0.65	-0.07	4.30
Nov-95	0.82	0.90	-0.08	4.23
Dec-95	1.96	1.12	0.84	5.06
Jan-96	1.43	1.08	0.35	5.41
Feb-96	1.36	0.76	0.60	6.01
Mar-96	1.34	0.74	0.60	6.61
Apr-96	0.90	0.55	0.35	6.95
May-96	0.98	0.69	0.29	7.24
Jun-96	0.31	0.53	-0.22	7.02
7/1/96 ²	0.26	0.19	0.07	7.09
Aug-96	0.00	0.16	-0.16	6.92
Sep-96	0.18	0.33	-0.15	6.78
Oct-96	1.15	0.65	0.50	7.27
Nov-96	2.42	0.90	1.52	8.80
Dec-96	3.20	1.12	2.08	10.87

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jan-97	1.51	1.08	0.43	11.30
Feb-97	0.69	0.76	-0.07	11.23
Mar-97	0.63	0.74	-0.11	11.12
Apr-97	0.77	0.55	0.22	11.33
May-97	0.59	0.69	-0.10	11.23
Jun-97	0.29	0.53	-0.24	10.99
Jul-97	0.55	0.19	0.36	11.35
Aug-97	0.05	0.16	-0.11	11.23
Sep-97	0.34	0.33	0.01	11.24
Oct-97	1.01	0.65	0.36	11.60
Nov-97	1.06	0.90	0.16	11.76
Dec-97	0.31	1.12	-0.81	10.95
Jan-98	1.30	1.08	0.22	11.17
Feb-98	0.94	0.76	0.18	11.35
Mar-98	0.72	0.74	-0.02	11.33
Apr-98	0.17	0.55	-0.38	10.94
May-98	0.75	0.69	0.06	11.00
6/1/98 ²	0.53	0.53	0.00	10.99
Jul-98	0.09	0.19	-0.10	10.90
Aug-98	0.31	0.16	0.15	11.04
Sep-98	0.30	0.33	-0.03	11.01
Oct-98	0.09	0.65	-0.56	10.45
Nov-98	1.35	0.90	0.45	10.90
Dec-98	1.04	1.12	-0.08	10.82
Jan-99	0.64	1.08	-0.44	10.38
Feb-99	0.63	0.76	-0.13	10.25
Mar-99	0.16	0.74	-0.58	9.66
Apr-99	0.21	0.55	-0.34	9.32
May-99	0.49	0.69	-0.20	9.11
Jun-99	0.17	0.53	-0.36	8.75
Jul-99	0.28	0.19	0.09	8.84
Aug-99	0.29	0.16	0.13	8.97
Sep-99	0.00	0.33	-0.33	8.64
Oct-99	0.60	0.65	-0.05	8.59
Nov-99	0.41	0.90	-0.49	8.10
Dec-99	0.17	1.12	-0.95	7.15
Jan-00	1.38	1.08	0.30	7.45
Feb-00	1.60	0.76	0.84	8.28
Mar-00	1.03	0.74	0.29	8.57
Apr-00	0.03	0.55	-0.52	8.05
May-00	0.86	0.69	0.17	8.21
Jun-00	0.60	0.53	0.07	8.28
Jul-00	0.02	0.19	-0.17	8.11
Aug-00	0.00	0.16	-0.16	7.95
Sep-00	0.67	0.33	0.34	8.29
Oct-00	1.07	0.65	0.42	8.71
Nov-00	1.12	0.90	0.22	8.93
Dec-00	0.53	1.12	-0.59	8.34
Jan-01	0.69	1.08	-0.39	7.94
Feb-01	0.30	0.76	-0.46	7.48
Mar-01	1.09	0.74	0.35	7.83
Apr-01	0.92	0.55	0.37	8.20
May-01	0.24	0.69	-0.45	7.74

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jun-01	0.35	0.53	-0.18	7.56
Jul-01	0.06	0.19	-0.13	7.43
Aug-01	0.28	0.16	0.12	7.55
Sep-01	0.00	0.33	-0.33	7.22
Oct-01	0.51	0.65	-0.14	7.07
Nov-01	1.13	0.90	0.23	7.31
Dec-01	0.52	1.12	-0.60	6.70
Jan-02	0.24	1.08	-0.84	5.86
Feb-02	0.78	0.76	0.02	5.88
Mar-02	0.22	0.74	-0.52	5.36
Apr-02	0.26	0.55	-0.29	5.06
May-02	0.22	0.69	-0.47	4.59
Jun-02	0.88	0.53	0.35	4.94
Jul-02	0.40	0.19	0.21	5.15
Aug-02	0.22	0.16	0.06	5.20
Sep-02	0.00	0.33	-0.33	4.88
Oct-02	0.07	0.65	-0.58	4.29
Nov-02	0.30	0.90	-0.60	3.70
Dec-02	1.61	1.12	0.49	4.18
Jan-03	1.77	1.08	0.69	4.87
Feb-03	0.94	0.76	0.18	5.05
Mar-03	0.30	0.74	-0.44	4.61
Apr-03	0.79	0.55	0.24	4.84
May-03	0.54	0.69	-0.15	4.69
Jun-03	0.00	0.53	-0.53	4.16
Jul-03	0.00	0.19	-0.19	3.97
Aug-03	0.05	0.16	-0.11	3.85
Sep-03	0.26	0.33	-0.07	3.78
Oct-03	0.14	0.65	-0.51	3.27
Nov-03	0.27	0.90	-0.63	2.64
Dec-03	1.71	1.12	0.59	3.23
Jan-04	1.00	1.08	-0.08	3.15
Feb-04	0.74	0.76	-0.02	3.13
Mar-04	0.19	0.74	-0.55	2.58
Apr-04	0.44	0.55	-0.11	2.46
May-04	0.57	0.69	-0.12	2.34
Jun-04	1.06	0.53	0.53	2.87
Jul-04	0.02	0.19	-0.17	2.70
Aug-04	0.42	0.16	0.26	2.95
Sep-04	0.16	0.33	-0.17	2.78
Oct-04	0.28	0.65	-0.37	2.41
Nov-04	0.58	0.90	-0.32	2.09
Dec-04	0.77	1.12	-0.35	1.74
Jan-05	0.81	1.08	-0.27	1.47
Feb-05	0.03	0.76	-0.73	0.74
Mar-05	0.36	0.74	-0.38	0.35
Apr-05	0.77	0.55	0.22	0.57
May-05	0.36	0.69	-0.33	0.23
Jun-05	0.43	0.53	-0.10	0.13
Jul-05	0.08	0.19	-0.11	0.02
Aug-05	0.04	0.16	-0.12	-0.10
Sep-05	0.08	0.33	-0.25	-0.35
Oct-05	1.31	0.65	0.66	0.31

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Nov-05	0.78	0.90	-0.12	0.19
Dec-05	1.81	1.12	0.69	0.88
Jan-06	2.16	1.08	1.08	1.96
Feb-06	0.29	0.76	-0.47	1.48
Mar-06	0.44	0.74	-0.30	1.18
Apr-06	1.15	0.55	0.60	1.78
May-06	1.18	0.69	0.49	2.26
Jun-06	1.20	0.53	0.67	2.93
Jul-06	0.01	0.19	-0.18	2.75
Aug-06	0.00	0.16	-0.16	2.59
Sep-06	0.25	0.33	-0.08	2.51
Oct-06	0.62	0.65	-0.03	2.48
Nov-06	1.17	0.90	0.27	2.75
Dec-06	1.73	1.12	0.61	3.36
Jan-07	0.34	1.08	-0.74	2.62
Feb-07	0.85	0.76	0.09	2.70
Mar-07	0.57	0.74	-0.17	2.53
Apr-07	0.48	0.55	-0.07	2.46
May-07	0.38	0.69	-0.31	2.14
Jun-07	0.72	0.53	0.19	2.33
Jul-07	0.02	0.19	-0.17	2.16
Aug-07	0.05	0.16	-0.11	2.05
Sep-07	0.17	0.33	-0.16	1.89
Oct-07	0.38	0.65	-0.27	1.61
Nov-07	0.98	0.90	0.08	1.70
Dec-07	1.06	1.12	-0.06	1.63
Jan-08	1.50	1.08	0.42	2.05
Feb-08	0.49	0.76	-0.27	1.78
Mar-08	0.38	0.74	-0.36	1.42
Apr-08	0.24	0.55	-0.31	1.10
May-08	0.27	0.69	-0.42	0.68
Jun-08	0.75	0.53	0.22	0.90
Jul-08	0.00	0.19	-0.19	0.71
Aug-08	0.32	0.16	0.16	0.86
Sep-08	0.05	0.33	-0.28	0.59
Oct-08	0.14	0.65	-0.51	0.07
Nov-08	0.51	0.90	-0.39	-0.31
Dec-08	1.59	1.12	0.47	0.15
Jan-09	1.28	1.08	0.20	0.35
Feb-09	0.86	0.76	0.10	0.45
Mar-09	1.29	0.74	0.55	1.00
Apr-09	0.35	0.55	-0.20	0.79
May-09	0.56	0.69	-0.13	0.66
Jun-09	0.01	0.53	-0.52	0.14
Jul-09	0.08	0.19	-0.11	0.03
Aug-09	0.08	0.16	-0.08	-0.06
Sep-09	0.11	0.33	-0.22	-0.28
Oct-09	1.16	0.65	0.51	0.23
Nov-09	0.35	0.90	-0.55	-0.32
Dec-09	0.59	1.12	-0.53	-0.85
Jan-10	1.82	1.08	0.74	-0.11
Feb-10	0.54	0.76	-0.22	-0.33
Mar-10	0.18	0.74	-0.56	-0.89

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Apr-10	0.35	0.55	-0.20	-1.10
May-10	1.51	0.69	0.82	-0.28
Jun-10	1.33	0.53	0.80	0.52
Jul-10	0.17	0.19	-0.02	0.50
Aug-10	0.06	0.16	-0.10	0.39
Sep-10	1.47	0.33	1.14	1.53
Oct-10	0.87	0.65	0.22	1.75
Nov-10	1.47	0.90	0.57	2.32
Dec-10	2.28	1.12	1.16	3.48
Jan-11	0.46	1.08	-0.62	2.86
Feb-11	0.44	0.76	-0.32	2.54
Mar-11	1.02	0.74	0.28	2.81
Apr-11	0.30	0.55	-0.25	2.56
May-11	1.30	0.69	0.61	3.16
Jun-11	0.86	0.53	0.33	3.49
Jul-11	0.05	0.19	-0.14	3.35
Aug-11	0.08	0.16	-0.08	3.27
Sep-11	0.03	0.33	-0.30	2.97
Oct-11	0.48	0.65	-0.17	2.80
Nov-11	0.14	0.90	-0.76	2.04
Dec-11	0.08	1.12	-1.04	1.00
Jan-12	0.99	1.08	-0.09	0.91
Feb-12	0.52	0.76	-0.24	0.66
Mar-12	0.96	0.74	0.22	0.88
Apr-12	0.70	0.55	0.15	1.03
May-12	0.26	0.69	-0.43	0.59
Jun-12	1.62	0.53	1.09	1.68
Jul-12	0.70	0.19	0.51	2.19
Aug-12	0.09	0.16	-0.07	2.12
Sep-12	0.00	0.33	-0.33	1.79
Oct-12	1.16	0.65	0.51	2.30
Nov-12	1.07	0.90	0.17	2.47
Dec-12	1.37	1.12	0.25	2.72
Jan-13	0.42	1.08	-0.66	2.06
Feb-13	0.03	0.76	-0.73	1.32
Mar-13	0.34	0.74	-0.40	0.92
Apr-13	0.52	0.55	-0.03	0.89
May-13	0.70	0.69	0.01	0.89
Jun-13	1.36	0.53	0.83	1.72
Jul-13	0.00	0.19	-0.19	1.53
Aug-13	0.28	0.16	0.12	1.65
Sep-13	1.20	0.33	0.87	2.52
Oct-13	0.22	0.65	-0.43	2.08
Nov-13	0.31	0.90	-0.59	1.50
Dec-13	0.11	1.12	-1.01	0.48
Jan-14	0.50	1.08	-0.58	-0.10
Feb-14	0.81	0.76	0.05	-0.05
Mar-14	0.49	0.74	-0.25	-0.30
Apr-14	0.33	0.55	-0.22	-0.53
May-14	0.23	0.69	-0.46	-0.99
Jun-14	0.42	0.53	-0.11	-1.10
Jul-14	0.02	0.19	-0.17	-1.27
Aug-14	0.36	0.16	0.20	-1.08

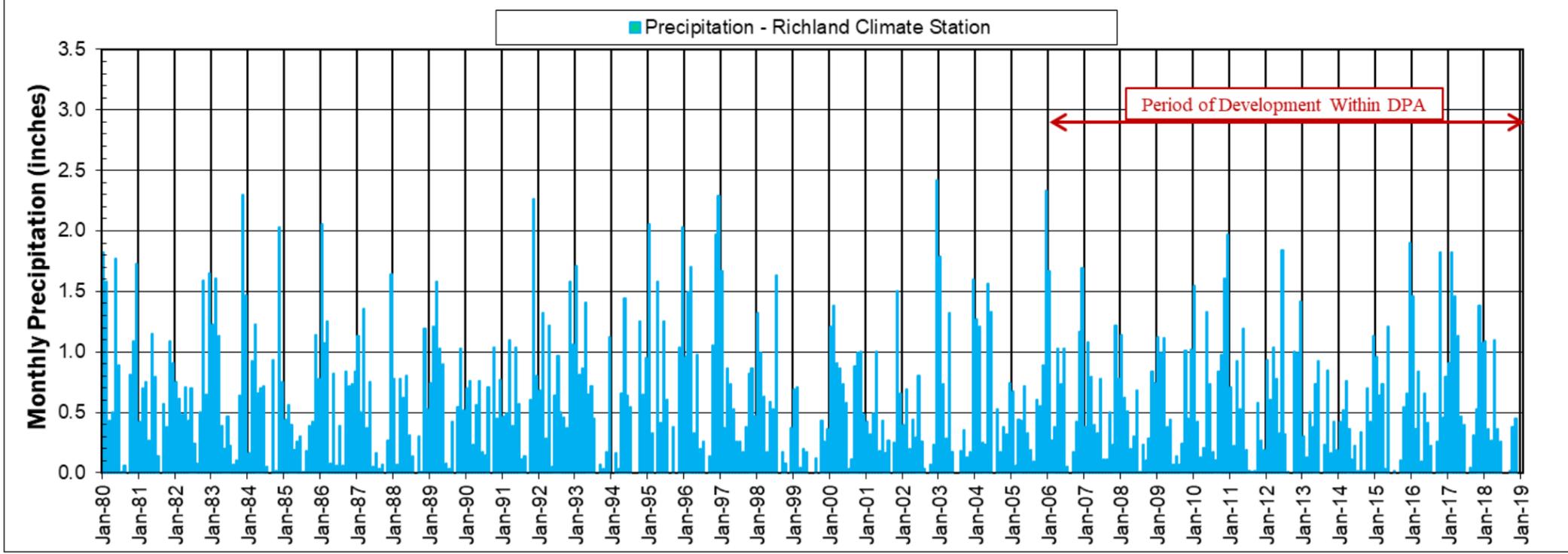
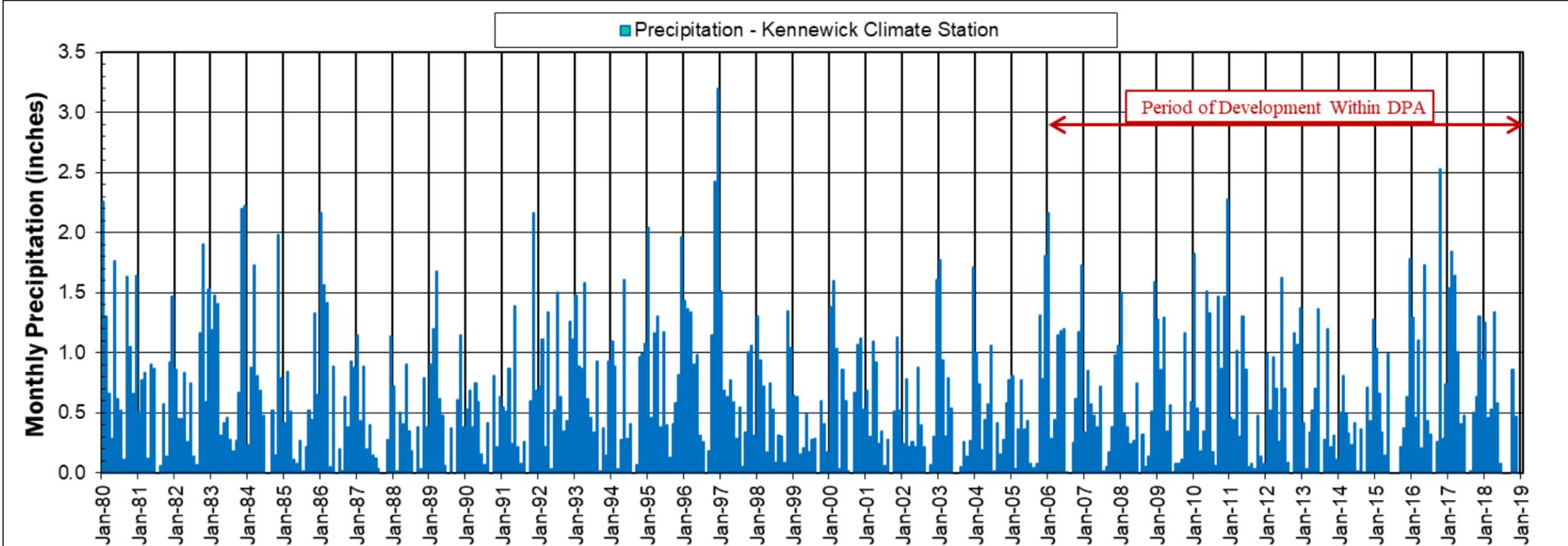
Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Sep-14	0.01	0.33	-0.32	-1.39
Oct-14	0.71	0.65	0.06	-1.34
Nov-14	0.43	0.90	-0.47	-1.80
Dec-14	1.28	1.12	0.16	-1.65
Jan-15	1.03	1.08	-0.05	-1.70
Feb-15	0.66	0.76	-0.10	-1.80
Mar-15	0.34	0.74	-0.40	-2.20
Apr-15	0.15	0.55	-0.40	-2.61
May-15	0.99	0.69	0.30	-2.31
Jun-15	0.00	0.53	-0.53	-2.84
Jul-15	0.00	0.19	-0.19	-3.03
Aug-15	0.00	0.16	-0.16	-3.20
Sep-15	0.22	0.33	-0.11	-3.31
Oct-15	0.37	0.65	-0.28	-3.59
Nov-15	0.63	0.90	-0.27	-3.86
Dec-15	1.78	1.12	0.66	-3.20
Jan-16	1.29	1.08	0.21	-2.99
Feb-16	0.46	0.76	-0.30	-3.29
Mar-16	1.10	0.74	0.36	-2.93
Apr-16	0.21	0.55	-0.34	-3.28
May-16	1.73	0.69	1.04	-2.24
Jun-16	0.43	0.53	-0.10	-2.34
Jul-16	0.32	0.19	0.13	-2.21
Aug-16	0.00	0.16	-0.16	-2.38
Sep-16	0.26	0.33	-0.07	-2.45
Oct-16	2.53	0.65	1.88	-0.57
Nov-16	0.29	0.90	-0.61	-1.18
Dec-16	0.74	1.12	-0.38	-1.56
Jan-17	1.54	1.08	0.46	-1.10
Feb-17	1.84	0.76	1.08	-0.02
Mar-17	1.64	0.74	0.90	0.87
Apr-17	1.01	0.55	0.46	1.33
May-17	0.41	0.69	-0.28	1.04
Jun-17	0.48	0.53	-0.05	0.99
Jul-17	0.00	0.19	-0.19	0.80
Aug-17	0.02	0.16	-0.14	0.66
Sep-17	0.50	0.33	0.17	0.83
Oct-17	0.63	0.65	-0.02	0.81
Nov-17	1.30	0.90	0.40	1.21
Dec-17	0.94	1.12	-0.18	1.03
Jan-18	1.25	1.08	0.17	1.20
Feb-18	0.46	0.76	-0.30	0.89
Mar-18	0.53	0.74	-0.21	0.68
Apr-18	1.34	0.55	0.79	1.47
May-18	0.58	0.69	-0.11	1.35
Jun-18	0.08	0.53	-0.45	0.90
Jul-18	0.00	0.19	-0.19	0.71
Aug-18	0.00	0.16	-0.16	0.55

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Sep-18	0.00	0.33	-0.33	0.22
Oct-18	0.86	0.65	0.21	0.43
Nov-18	0.47	0.90	-0.43	0.00

Notes:

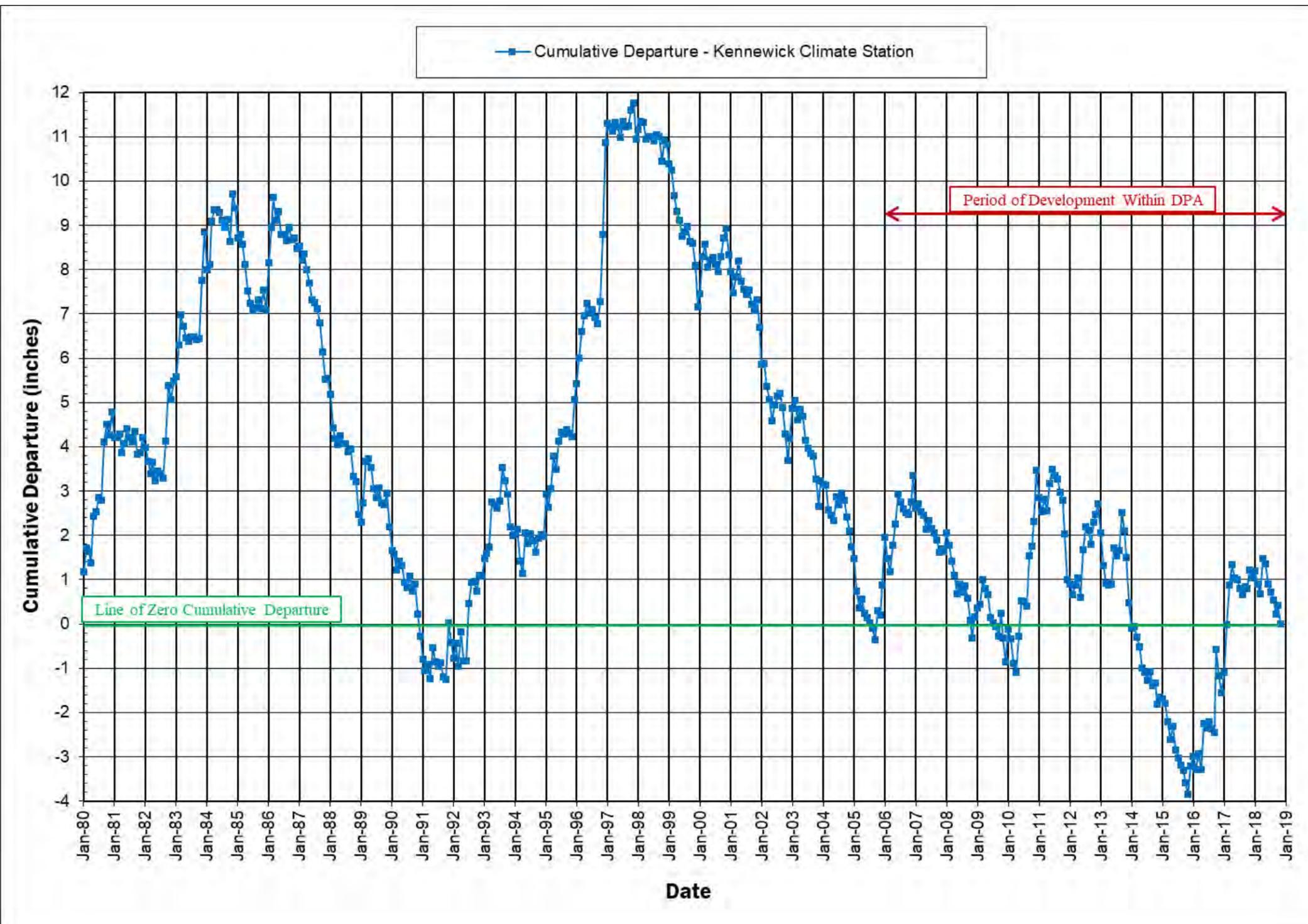
¹Precipitation totals for Kennewick, Washington (Station No. 454154) were obtained on November 28, 2018 from the Western Regional Climate Center (www.wrcc.dri.edu).

²The monthly precipitation for Richland, Washington (Station No. 457015) were used because the monthly total for Kennewick, Washington was missing.



Notes:
 1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
 GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Monthly Precipitation	
Drainage Problem Area City of West Richland, Washington	
	Figure F-1



Notes:

1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
- GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Cumulative Departure in Precipitation

Drainage Problem Area
City of West Richland, Washington



Figure F-2

APPENDIX G
Blaney-Criddle Method for Calculating Consumptive Use

Table G-1

Blaney-Criddle Method for Calculating Consumptive Use ¹

Drainage Problem Area
City of West Richland, Washington

Month	Mean Monthly Air Temperature ² t (degrees F)	Percent of Annual Daytime Hours ³ p (percent)	Consumptive Use Factor F	Crop Use Coefficient ⁴ K	Consumptive Use U _c (inches)	Precipitation ⁵ (inches)	Net Consumptive Use ⁶ U _{cn} (inches)	Volumetric Net Consumptive Use ⁷						
								2012 U _{cn} (acre-feet)	2013 U _{cn} (acre-feet)	2014 U _{cn} (acre-feet)	2015 U _{cn} (acre-feet)	2016 U _{cn} (acre-feet)	2017 U _{cn} (acre-feet)	2018 U _{cn} (acre-feet)
January	33.4	6.4	2.1	0.0	0.0	1.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
February	39.3	6.5	2.5	0.0	0.0	0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
March	46.5	8.2	3.8	0.0	0.0	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
April	53.8	9.1	4.9	1.0	4.9	0.49	4.4	18.4	23.9	27.6	33.2	36.8	40.5	44.2
May	61.7	10.4	6.4	1.0	6.4	0.57	5.9	24.4	31.7	36.6	43.9	48.8	53.7	58.6
June	68.7	10.5	7.2	1.0	7.2	0.50	6.7	28.0	36.4	42.0	50.4	56.0	61.5	67.1
July	74.9	10.7	8.0	1.0	8.0	0.21	7.8	32.4	42.1	48.6	58.3	64.8	71.3	77.8
August	74.0	9.9	7.3	1.0	7.3	0.25	7.0	29.3	38.1	44.0	52.8	58.7	64.6	70.4
September	65.6	8.4	5.5	1.0	5.5	0.27	5.2	21.8	28.4	32.8	39.3	43.7	48.0	52.4
October	54.0	7.6	4.1	1.0	4.1	0.51	3.6	15.0	19.4	22.4	26.9	29.9	32.9	35.9
November	42.3	6.4	2.7	0.0	0.0	0.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
December	35.1	6.0	2.1	0.0	0.0	1.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	54.1	100.0	NA	NA	43.4	7.11	40.6	169	220	254	305	339	373	406

Notes:

- ¹ Blaney-Criddle Method adapted from Schulz (1989).
- ² Mean monthly air temperature was obtained from the Western Region Climate Center for the Richland, Washington Climate Station (No. 457015).
- ³ Percent of annual daytime hours occurring during each month adapted for 46 degrees latitude based on Table 7 from Thornthwaite and Mather (1957).
- ⁴ A crop use coefficient of 1.00 and temperature criteria of 50 degrees were adapted from James et. al. (2001) for pasture/turf.
- ⁵ Precipitation data obtained from Western Region Climate Center (2003).
- ⁶ Net consumptive use is defined as consumptive use minus precipitation (for months where consumptive use is greater than zero).
- ⁷ Volumetric net consumptive use is based on the following irrigated acreages (as a function of calendar year).

Year	2012	2013	2014	2015	2016	2017	2018
Irrigated Acreage	50	65	75	90	100	110	120

APPENDIX H
Compilation of Recent Drainage Complaints

Table H-1
Compilation of Recent Drainage Complaints ¹
Drainage Problem Area
City of West Richland, Washington

Complaint Number	Date of Complaint	Address	Location	Nature of Complaint
1	09/12/17	1508 Diamond Drive	1500 Block of Diamond Drive	Flooding was observed in street. A broken sprinkler was initially suspected but later City investigation suggested an elevated groundwater condition.
2	09/29/18	6409 Sapphire Street	6400 Block of Sapphire Street	Damage to evacuated pool caused by hydrostatic pressure gradient.
3	10/24/18	6500 Agate Court	6500 Block of Agate Court	Flooding in basement.
4	11/13/18	604 Hilltop View Street	600 block of Hilltop View Street	Flooding in basement.

Notes:

¹ Four recent drainage complaints were provided to GeoEngineers by the City of West Richland on November 26, 2018.

APPENDIX I

Report Limitations and Guidelines for Use

APPENDIX I REPORT LIMITATIONS AND GUIDELINES FOR USE¹

This appendix provides information to help you manage your risks with respect to the use of this report.

Hydrogeologic and/or Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for use by the City of West Richland. This report may be made available in its entirety to others for information only. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a hydrogeologic and/or geotechnical study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Each hydrogeologic and/or geotechnical study is unique and prepared solely for the specific client and project site. No one except the City of West Richland should rely on this report without first conferring with GeoEngineers. This report should not be applied for any purpose or project except the one originally contemplated.

A Hydrogeologic and/or Geotechnical Report Is Based on a Unique Set of Project-Specific Factors

This report has been prepared to assist with the evaluation of an area containing elevated groundwater levels within the City of West Richland, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This hydrogeologic and geotechnical report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods,

¹ Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

Most Hydrogeologic and/or Geotechnical Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

A Hydrogeologic and/or Geotechnical Report Could Be Subject To Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having GeoEngineers confer with appropriate members of the design team after submitting the report. Also retain GeoEngineers to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a hydrogeologic and/or geotechnical report. Reduce that risk by having GeoEngineers participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

Read These Provisions Closely

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or hydrogeology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

