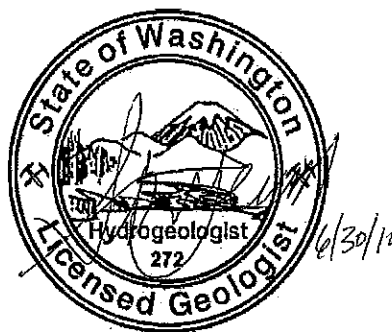


June 30, 2010

To: Dave McClure, Klickitat County Department of Natural Resources

cc: WRIA 30 Planning and Advisory Committee

From:

**Jeremy Michael Shaha**Jeremy Shaha, LG
Senior Staff Hydrogeologist**Steve J. Germiot**Steve Germiot, LHG, CGWP
Senior Associate Hydrogeologist**Re: Swale Creek Subbasin Water Level Monitoring Report, WRIA 30**

Project Objectives

In 2007, the Water Resource Planning and Advisory Committee (PAC) for Water Resource Inventory Area (WRIA) 30 received funding from the Washington State Department of Ecology (Ecology) to conduct a more detailed assessment of hydrologic and water use conditions in both the Swale Creek and Little Klickitat subbasins of WRIA 30 (Figure 1). The assessment provided additional information to help address data gaps regarding water availability on a subbasin scale, and thus support Ecology's processing of pending applications for new water rights in the subbasin (Aspect Consulting, 2007).

As part of the 2007 water availability study, water level monitoring networks were established for the two subbasins. Since June 2007, water level measurements have continued to be collected on a semi-annual basis in the well networks to begin assessment of long-term trends in groundwater levels, which helps determine sustainability of existing groundwater withdrawals and thus water availability. The semi-annual measurements have generally been collected corresponding to pre-irrigation (spring) and post-irrigation (autumn) conditions.

Subsequently, Ecology has provided additional funding (Grant No. G1000101) to provide annual water level monitoring data analysis and reporting. This memorandum provides a summary of the Swale Creek subbasin water level measurements to date (since June 2007).

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Setup of Water Level Monitoring Network

The Swale Creek subbasin water level monitoring network was initially setup during the 2007 assessment of hydrologic and water use conditions (Aspect Consulting, 2007). The initial water level monitoring network consisted of a total of 25 wells (June 2007). In addition, several of the City of Goldendale's water level monitoring network wells (T03/R16-7X1, T03/R16-17N1, and T03/R16-18NW1) were added to the existing water level monitoring network in November 2007. However, because these wells were not included in the June 2007 water level monitoring network, they have not yet been surveyed. These wells will be surveyed during the expansion of the Little Klickitat subbasin water level monitoring network.

Since June 2007, there are several well owners that we have consistently been unable to get permission for continued water level measurements, including: T03/R14-11D1, T03/R14-23E1, and T03/R15-34M1. Therefore, these wells are no longer included in the water level monitoring network. As of May 2010 (most recent round of water level measurements), the Swale Creek subbasin water level monitoring network still consists of 25 wells. Table 1 presents information regarding construction of the wells in the network, and their water level measurements to date. Figure 2 depicts the locations of the wells included in the current Swale Creek subbasin water level monitoring network. Figure 2 does not include the location of the three wells that have not yet been surveyed (T03/R16-7X1, T03/R16-17N1, and T03/R16-18NW1).

In February 2009, a dedicated monitoring well (SWC-MW-1) was installed in the alluvium aquifer in the vicinity of Warwick (Figure 2). A pressure transducer was installed in this monitoring well in order to provide nearly continuous water level data. An additional pressure transducer was also installed in the nearby Miller well (T03/R15-20H1) for comparison. A summary of the installation activities for these wells are provided in Aspect Consulting (2009). Water level data from these wells is provided in Figure 3.

Water Level Measurements

Depth-to-water measurements were conducted in all network wells using either an electric water level indicator (tape) or a sonic water level indicator (sounder)¹. The former provides greater precision, but has the significant disadvantage of potentially becoming permanently caught on wiring or other appurtenances within the well casing. The latter has less precision but is much faster to use and, more importantly, does not have the risk of becoming caught in the well. The QAPP for this project provides a quality control (QC) comparability evaluation between the tape and sonic sounder based on measurements collected since 2007; the evaluation documents reliability of the sonic sounder for measuring depths-to-water less than about 250 feet (Aspect Consulting, 2010).

All depth-to-water measurements were made in accordance with the project-specific QAPP, and relative to the top of well casing or other defined measuring point at the wellhead. The selected measuring point for each well was marked in magic marker if possible, and was documented in the field form so that it can be reproduced during subsequent measurement

¹ Global Water WL600 or equivalent instrument.

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rounds. Other pertinent information regarding the well or the measuring of water levels in it were also recorded in the field notes.

If a downhole water level indicator was used for the depth-to-water measurement, the lower couple of feet of tape was rinsed and wiped with a clean paper towel. Any rust or other visible material on the water level indicator after a measurement was also wiped off using a clean paper towel prior to the next measurement.

A table of static water level measurements from either the respective well logs or previous monitoring event was carried in the field. Measurements that varied greatly from past measurements in a given well (accounting for differences between spring and fall) were repeated for confirmation.

Description of Well Monitoring Network Aquifers

A generalized geologic history of the Little Klickitat subbasin is provided in the WRIA 30 Level 1 watershed assessment (WPN and Aspect Consulting, 2004). Water-bearing hydrostratigraphic units within the study area include (from youngest to oldest):

- Alluvium;
- Wanapum basalt (Priest Rapids, Roza, and Frenchman Springs members); and
- Grand Ronde basalt.

The Wanapum and Grande Ronde basalts are formations within the Columbia River Basalt Group (CRBG). Groundwater in the CRBG primarily occurs in the top of the individual flows (“flow top”), which became vesicular (porous) as gas bubbles escaped the flows during cooling, and/or at the flow bottoms (sometimes referred to as “pillows”). Flow tops and bottoms – collectively referred to as interflow zones - are usually porous and permeable, and therefore transmit water more readily than the intervening massive portions of the basalt flow interior, which generally constitute flow barriers, except where fractured. For wells completed in the interflow zones between the various basalt units, water levels are considered to be representative of the underlying basalt aquifer. A permeable flow top is normally present for each flow, while permeable flow bottoms range from relatively thick units to completely absent. The lateral continuity of water-bearing interflow zones is highly variable. Within Swale Creek subbasin, a majority of the wells completed in the CRBG are completed in the interflow zones of the Wanapum basalt aquifer (Priest Rapids, Roza, and Frenchman Springs members). The water level monitoring network includes no wells completed solely in the Grande Ronde basalt aquifer.

In addition, terrestrial sediments can be deposited between the underlying flow top and overlying flow bottom during time periods between basalt flows. These sediments are collectively considered part of the Ellensburg Formation and can be either relatively permeable or impermeable; depending on composition, thickness, and lateral extent. Both the lateral continuity and thickness of the water-bearing interflow zones are highly variable.

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Alluvium Aquifer

The alluvium aquifer generally consists of clay, silt and shale with some gravel (T03/R15-14D1) and sandstone (T03/15-23H1). As previously discussed, because the shallowest water-bearing interflow zone of the Wanapum basalt often immediately underlies the alluvium and is in direct hydraulic continuity, it is considered part of the alluvium aquifer (Aspect Consulting, 2007). Of the 26 wells (including SWC-MW-1) included in the Swale Creek subbasin water level monitoring network, there are currently 8 wells completed in the alluvium aquifer. Figure 2 provides the location of these wells.

Wanapum Basalt Aquifer

Of the 26 wells (including SWC-MW-1) included in the Swale Creek subbasin water level monitoring network, there are currently 18 wells completed in the Wanapum basalt aquifer. Figure 2 provides the location of these wells.

Summary of Groundwater Level Measurements

Table 1 provides a summary of the groundwater level measurements from the Swale Creek subbasin water level monitoring network to date. Evaluation of long-term trends in groundwater levels provides insight regarding aquifer response to precipitation patterns and sustainability of the existing level of groundwater withdrawal.

Long-Term Groundwater Level Trends

Long-term groundwater level trends can be evaluated for the 25 wells (not including SWC-MW-1) included in the Swale Creek subbasin water level monitoring network. Groundwater level measurements for 22 of these wells have been made on a semi-annual basis (pre-irrigation and post-irrigation) since June 2007. In addition, semi-annual water level measurements for the City of Goldendale's water level monitoring network wells (T03/R16-7X1, T03/R16-17N1, and T03/R16-18NW1) have been made since November 2007. Figure 4 provides long-term groundwater level hydrographs for these wells, all of which are completed in either the alluvium or Wanapum basalt aquifer.

Alluvium Aquifer

Based on the alluvium well groundwater hydrographs presented on Figure 4 (dashed hydrographs), a majority of the alluvium aquifer wells monitored since June 2007 have not shown any decline in groundwater levels. The only exception is alluvium well T03/R15-14D1, which shows a nearly 5-foot decrease in groundwater levels over the 3-year period. Conversely, alluvium well T04/R17-32P1 showed an approximately 10-foot increase over the same time period. Due to the limited period of groundwater level measurements and the relatively small changes in groundwater levels, it is currently not possible to provide a definitive explanation for the changes at these wells. However, most notably, the alluvium well with a 26-year monitoring record (T03/R14-25C1) shows a very stable long-term water level trend (Figure 4).

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Wanapum Basalt Aquifer

As with many of the alluvium aquifer wells discussed above, a majority of the wells completed in the Wanapum basalt aquifer show seasonal variations in groundwater levels ranging between 5 and 15 feet. For these wells, the lowest groundwater levels were consistently observed during post-irrigation measurements (November) and the highest groundwater levels were consistently observed during pre-irrigation measurements (April - June). The seasonal high groundwater levels follow the wet season, when the greatest amount of recharge to the aquifer occurs. Meanwhile, the seasonal low groundwater levels follow the dry/irrigation season, when there is little recharge to the aquifer and increased withdrawals. One exception to this is well T04/R17-30A1, which had a higher groundwater level during the November 2007 measurement. However, it is important to note that not all of the Wanapum basalt aquifer wells show seasonal variations in groundwater levels.

As with the alluvium aquifer, a majority of the wells completed in the Wanapum basalt aquifer do not show a consistent trend in groundwater levels over the time period of measurement. The exceptions are wells T03/R14-14Q1, T03/R14-29A1, T03/R16-7X1, T04/R17-30A1, and T03/R16-18NW1. Generally, groundwater levels in these wells have declined between 10 and 20 feet over the period of monitoring. However, the locations of these wells are scattered across Swale Creek subbasin and the decreases in the groundwater levels do not appear to be related to a subbasin-wide trend.

The decline in groundwater levels at the above wells may be partially attributed to the below-average precipitation observed in the area since the late 1990s, and, longer term, since 1984. Figure 5 presents both the annual precipitation and the mean annual precipitation (upper portion of figure) and the cumulative departure from the mean annual precipitation (lower portion of figure) in Goldendale (NOAA Station #453222) and at Satus Pass for the period of record (1931 - 2009)². Note that individual months with more than 5 days of missing data were not used for monthly or annual precipitation statistics, so those years are not displayed on Figure 5. With the exception of 1995-1998 (based on Goldendale data³) and 2006 (based on Satus Pass data), annual precipitation has been at or below the mean annual precipitation since 1984.

One of the basalt wells discussed above which has had a significant decline in groundwater levels is well T03/R14-29A1. This well is located to the west of Warwick fault (just outside Swale Valley), where the primary source of recharge is likely from the Columbia Hills. Due to the limited recharge area, this well is likely to be relatively sensitive to recent precipitation trends. Therefore, we infer that below-average precipitation explains at least a portion of the almost 15-foot decline in groundwater levels observed since 2001. Further evidence for this area's dependence on precipitation trends is the almost 5-foot increase in groundwater levels observed at the well during the spring of 2007, following an above-average precipitation year

² The cumulative departure plot is an effective way to illustrate longer-term trends in precipitation which influence groundwater levels regionally (e.g. extended wet or drought periods). The absolute values on the plot's y axis have little meaning since they depend on the year started. However, the scale of the y axis and shape of the curve are not dependent on year started.

³ The 1995 and 1998 data points for Goldendale are not plotted on Figure 8 because of gaps in the daily record; however, even with the missing the data, the annual precipitation is at or above average.

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in 2006. Although the remaining wells with longer-term decreasing groundwater level trends do not have nearly as obvious of a correlation to precipitation, they may be more sensitive to precipitation trends relative to other wells in Swale Valley.

Recommendations

It is recommended that the water level monitoring network continue to be monitored on at least a semi-annual basis (pre-irrigation and post-irrigation measurements). Particular effort should be made to continue to collect water levels in the wells showing declining water level trends (T03/R15-14D1, T03/R14-14Q1, T03/R14-29A1, T03/R16-7X1, T04/R17-30A1, and T03/R16-18NW1). Care should be taken to note any fluctuating water levels observed in these wells during subsequent water level measurements.

Limitations

Work for this project was performed and this memorandum prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Klickitat County for specific application to the referenced property. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

References

- Aspect Consulting, 2007, Hydrologic Information Report Supporting Water Availability Assessment, Swale Creek and Little Klickitat Subbasins, WRIA 30, Prepared for WRIA 30 Water Resource Planning & Advisory Committee, June 29, 2007.
- Aspect Consulting, 2009, Installation of Monitoring Well in Swale Valley, Swale Creek Subbasin, WRIA 30, Prepared for Klickitat County Department of Natural Resources, June 9, 2009.
- Aspect Consulting, 2010, Quality Assurance Project Plan for Water Level Monitoring – WRIA 30, April 9, 2010.
- WPN and Aspect Consulting, 2004, WRIA 30 Level I Watershed Assessment, January 2005.

Attachments:

- Table 1 – Water Level Monitoring Network Data for Little Klickitat Subbasin
- Figure 1 – Swale Creek Subbasin
- Figure 2 – Swale Creek Subbasin Water Level Monitoring Network
- Figure 3 – Continuous Alluvium Aquifer Hydrographs
- Figure 4 – Groundwater Hydrographs
- Figure 5 – Long-term Precipitation Analysis

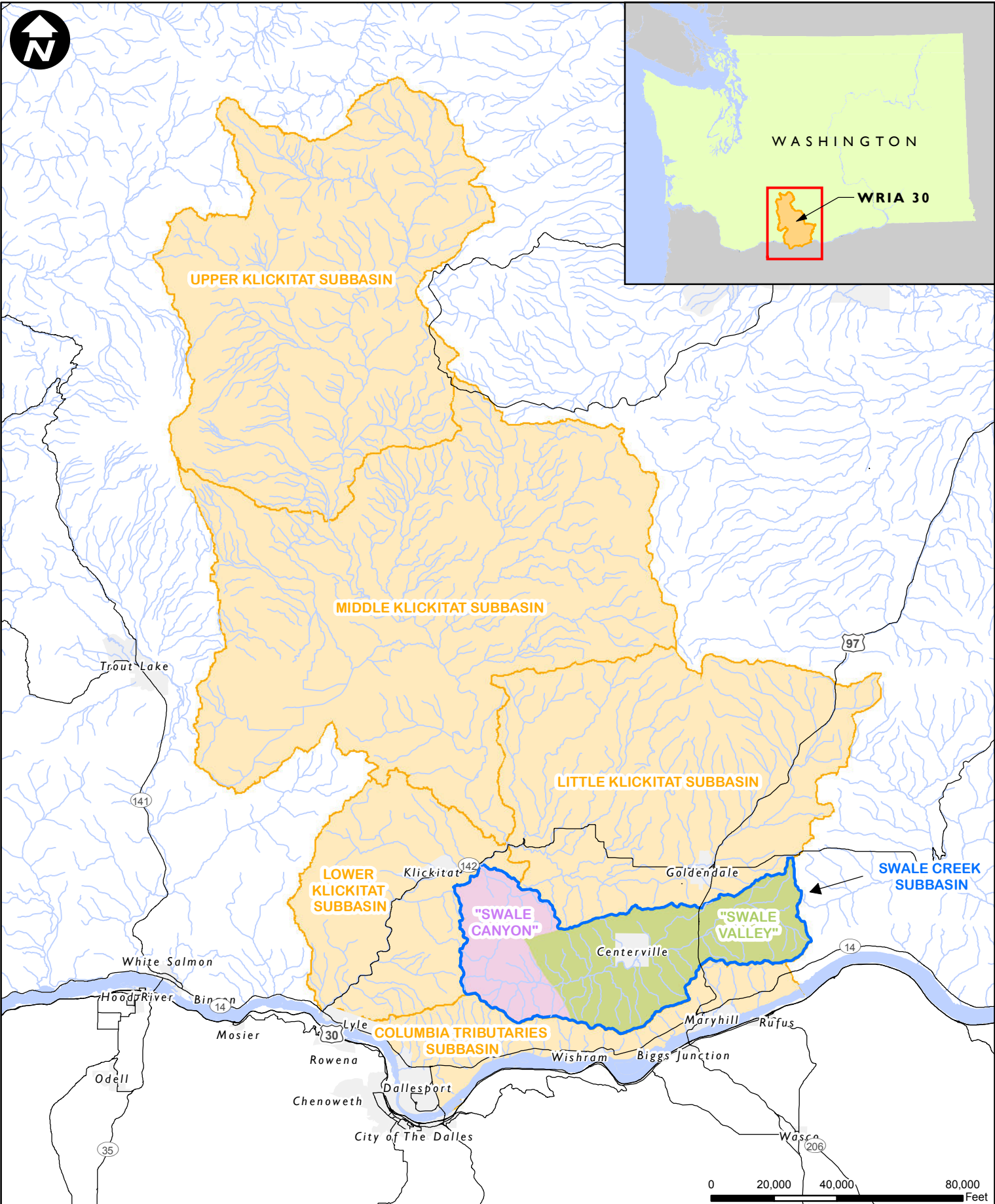
Table 1 - Water Level Monitoring Network Data
Swale Creek Subbasin Annual Monitoring Report
WRIA 30, Washington

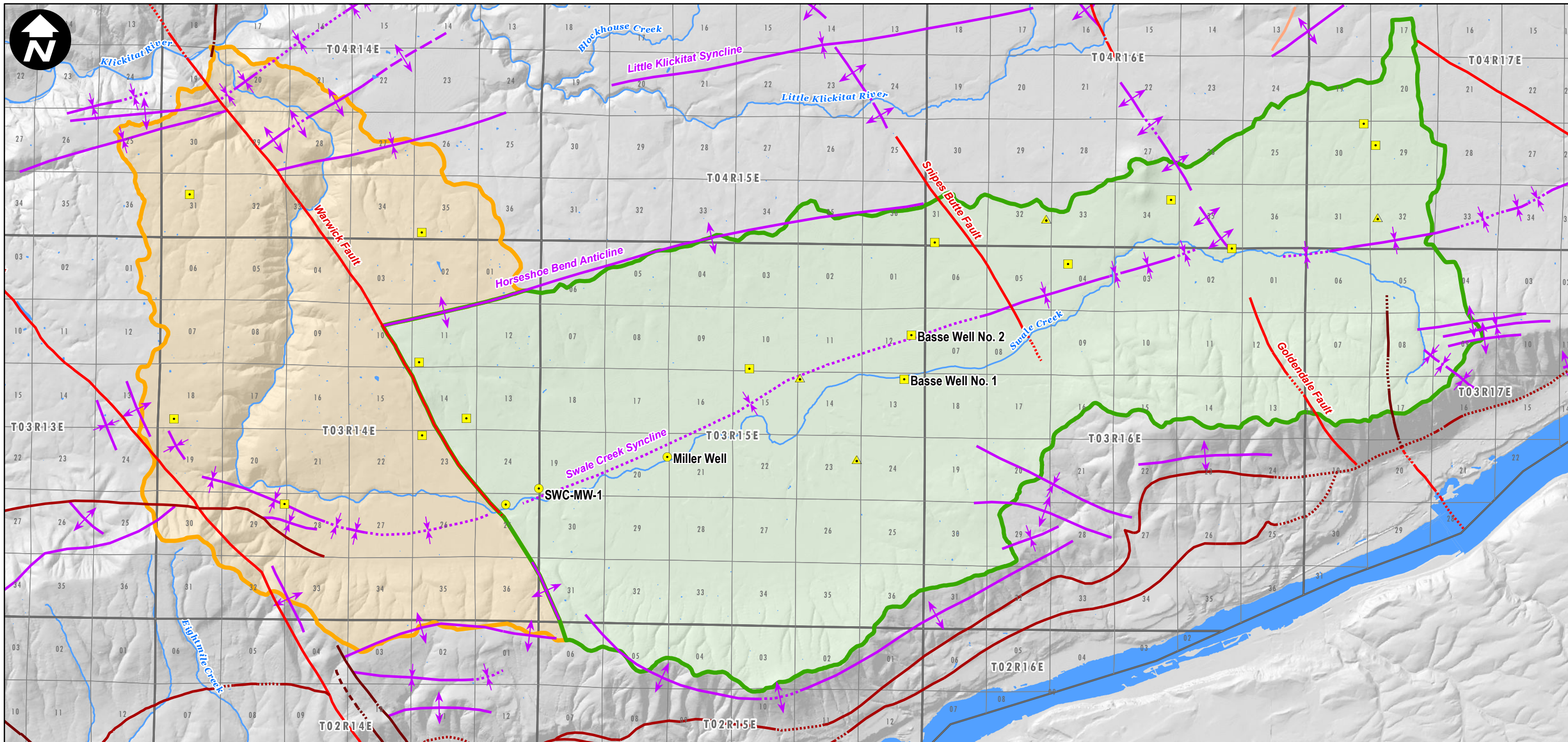
Contact Information		Ecology Well Log Data						Well Survey Data				June 2007 Measurements			November 2007 Measurements			April 2008 Measurements			December 2008 Measurements			April 2009 Measurements			December 2009 Measurements			May 2010 Measurements		
Well Owner	Well Address/Name	Ecology Well Log ID	TRS Label	Completion Date	Dia (in)	Depth (ft)	Aquifer	Northing ¹ (SPS 83; ft)	Easting ¹ (SPS 83; ft)	Wellhead Elevation ² (ft MSL)	Casing Stick-up (ft)	Depth to Water (ft bTOC)	GW Elevation ² (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation ² (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation ² (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation ² (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation ² (ft)	Comments	Depth to Water (ft bTOC)	GW Elevation ² (ft)	Comments			
Brown	392 Harms Road	149031	T03/R14-11D1	11/14/98	6	440	Wanapum	158400.6	1504803.3	2053.2	0.87	206.9	1846.3	Rising water level	200.3	1852.9		200.4	1852.8		-	-	No permission	-	-	No permission	-	-	No permission	-	-	No permission
Mike & Diane Richards	1195 Niva Rd.	142145	T03/R14-11N1	10/16/97	6	205	Wanapum	153730.0	1505374.3	2012.7	0.59	69.9	1942.8		70.1	1942.6		69.8	1942.8	Rising water levels	71.0	1941.7	Recovering water level	68.4	1944.3		69.2	1943.5		68.6	1944.1	
Gordon Swank	905 Randall Road	136750	T03/R14-14Q1	10/18/79	6	200	Wanapum	149063.4	1509276.0	1719.7	0.54	7.3	1712.5		-	-		6.6	1713.1		7.8	1711.9		12.3	1707.5		16.1	1703.6		14.8	1704.9	
Bob Edwards	10 Meadowlark Lane	354742	T03/R14-18N1	5/20/97	6	695	Wanapum	149041.9	1484973.1	2153.7	1.43	516.7	1637.0		518.3	1635.4		517.9	1635.7		519.5	1634.2		518.3	1635.3		-	-	No measurement	518.6	1635.1	
Ron & Deborah Disch	986 Randall Road	145052	T03/R14-23D1	4/17/98	6	103	Wanapum	147652.3	1505602.8	1697.5	0.47	34.6	1662.9		41.8	1655.7		28.6	1668.9		43.4	1654.1		31.8	1665.7		41.2	1656.3		29.8	1667.7	
William and Donna Lancaster	650 Harms Road	257441	T03/R14-23E1	7/13/00	6	262	Wanapum	145770.2	1505131.1	1662.1	2.21	76.8	1585.3		-	-	No permission	-	-	No permission	-	-	No permission	-	-	No permission	-	-	No permission	-	-	No permission
Dave Mattson ³	Centerville Road (Warwick)	-	T03/R14-25C1	-	-	80	Alluvium and Wanapum	141882.6	1512560.9	1580.8	-	-	-	No ecology well log; obstructed at 22.8 ft bloc	>21.3	NA	No ecology well log; obstructed at 21.3 ft	22.3	1558.5	Obstructed at 22.8 ft	23.4	-	Obstructed at 23.36 ft	21.8	1559.0		-	-	Obstructed at 25 ft	-	-	Obstructed
Lonnie Magnusson ³	Centerville Road (W. of Harms)	257442	T03/R14-29A1	8/7/00	6	353	Wanapum	141946.6	1494168.8	1678.3	2.11	63.2	1615.2	Rising water level	55.7	1622.5		55.9	1622.5		59.7	1618.6		61.4	1616.9		62.7	1615.6		66.2	1612.1	
Dale Bowdish	2215 Centerville Hwy	138310	T03/R15-10P1	6/16/94	6	143	Wanapum	153172.6	1532826.4	1610.6	1.76	36.9	1573.7		37.4	1573.2		30.5	1580.1		36.3	1574.3		30.8	1579.8		40.7	1569.9		36.8	1573.8	
City of Goldendale ³	Basse #2	314650	T03/R15-12H1	11/14/01	16	679	Wanapum	155984.6	1546301.3	1621.4	1.5	61.0	1560.5		67.0	1554.4		44.3	1577.1	Basse Wells were not recently pumped	65.9	1555.6	Fluctuating water level	55.5	1565.9		58.5	1562.9		106.0	1515.4	
City of Goldendale ³	Basse #1	314651	T03/R15-13B1	10/31/01	16	905	Wanapum	152313.6	1545722.6	1595.9	1.625	31.4	1564.5		36.2	1559.7		19.6	1576.3	Basse Wells were not recently pumped	38.5	1557.4	Fluctuating water level	27.3	1568.6		31.0	1564.9		66.5	1529.4	
Ron Crawford	510 Dalles Mountain Rd.	144994	T03/R15-14D1	8/7/79	6	82	Alluvium and Wanapum	152412.8	1536954.3	1605.5	-	33.7	1571.9		36.0	1569.5		29.4	1576.1		35.6	1569.9		30.2	1575.3		38.5	1567.0		33.2	1572.3	
Jim Miller ³	Garner Road (N. of Bridge)	140705	T03/R15-20H1	-	6	54	Alluvium and Wanapum	145871.4	1525996.3	1574.8	1.34	5.5	1569.3		6.2	1568.6		3.2	1571.5		5.8	1568.9		3.0	1571.8		5.3	1569.5		4.6	1570.2	
Kay Cameron	645 Cameron Rd	137418	T03/R15-23H1	8/2/93	6	140	Alluvium and Wanapum	145638.2	1541689.0	1634.7	1.5	56.6	1578.1		-	-	No permission	-	-	No permission	60.2	1574.5		56.8	1577.9		60.7	1574.0		57.8	1576.9	
Dennis Jaekel	End of Jaekel Road	138800	T03/R15-34M1	8/21/79	6	480	Wanapum	132776.8	1531588.3	1940.2	0.7	387.4	1552.8		398.2	1542.0	Pumping water level	396.0	1544.2		-	-	No permission	-	-	No permission	-	-	No permission	-	-	No permission
Marvin Norris	728 Hocter Road	411866	T03/R16-2A1	5/18/05	6	123	Wanapum	163199.1	1572954.6	1855.2	-	57.8	1797.4		58.2	1797.0		59.5	1795.8		63.4	1791.9		60.4	1794.8		64.2	1791.0		59.8	1795.4	
Roberta Hocter	36 Hocter Road	139455	T03/R16-4F1	2/8/81	10	512	Wanapum	161914.2	1559334.0	1740.3	1.3	80.4	1659.9		82.5	1657.8		79.5	1660.8		81.6	1658.7		79.4	1660.9		81.5	1658.8		79.6	1660.7	
Puget Sound Energy ³	Old Basse Well	296331	T03/R16-7X1	4/24/69	12	302	Alluvium and Wanapum	-	-	-	-	-	-		22.2	-		15.2	-		21.4	-		17.3	-		23.0	-		26.6	-	
John Starr ³	1915 Centerville Hwy	139604	T03/R16-17N1	9/27/79	8	320	Wanapum	-	-	-	-	-	-		26.8	-		22.3	-		26.4	-		23.9	-		26.5	-		-	-	No permission
Terry Linden ³	Ty's Well	137572	T03/R16-18NW1	6/15/72	16	983	Wanapum	-	-	-	-	-	-		32.5	-		20.7	-		32.5	-		30.1	-		41.2	-		-	-	Irrigating with pump
Bruce Buchanan	440 Schilling Road	302764	T04/R14-31L1	10/12/00	6	506	Wanapum	167675.2	1486274.0	1785.9	2.94	267.1	1518.7		265.4	1520.5		264.9	1521.0		265.2	1520.7		265.9	1520.0		264.8	1521.1		-	-	No permission
Erick & Mary Jean Risheim	280 Harms Road	138094	T04/R14-35N1	7/28/94	6	300	Wanapum	164498.8	1505579.5	1914.5	1.83	135.2	1779.3		135.4	1779.1		134.9	1779.6		134.3	1780.2		133.6	1780.9		133.6	1780.9		133.0	1781.5	
Robert & Bonnie Butler	181 Van Hoy Road	303003	T04/R16-31M1	8/26/00	6	103	Wanapum	163668.5	1548245.4	1662.2	1.17	22.3	1639.9		25.1	1637.1		21.4	1640.8		23.3	1638.9		21.5	1640.7		23.8	1638.4		-	-	No permission
JP Enderby	3517 S. Columbus Ave.	136513	T04/R16-32J1	5/25/82	6	67	Alluvium and Wanapum	165643.7	1557437.9	1733.9	0.81	62.0	1671.9		63.4	1670.5		60.0	1673.8		61.8	1672.1		59.6	1674.3		61.6	1672.3		60.1	1673.8	
Karl Enyert ³	Clyde Story Road (S. of Gravel Pit)	296593	T04/R16-34H1	10/12/71	6	500	Wanapum	167237.9	1567894.2	1804.2	0.49	52.7	1751.5		56.3	1748.0		52.3	1752.0		55.8	1748.4		52.2	1752.0		55.3	1748.9		-	-	No permission
Wayne Hocter	138 Willis Road	146522	T04/R17-29D1	4/4/91	6	108	Wanapum	171742.5	1584907.1	1999.1	0.58	63.5	1935.6		65.4	1933.7		64.2	1934.9		65.0	1934.1		63.4	1935.7		64.0	1935.1		62.5	1936.6	
Wayne Hocter	488 #4 Road	146520	T04/R17-30A1	9/28/73	6	430	Wanapum	173572.1	1583929.0	1997.6	-	277.4	1720.2	Rising water level	278.4	1719.2		287.6	1710.0	Rising water levels	293.8	1703.8		280.0	1717.6		297.5	1700.1		-	-	Sonic provides invalid measurement.
Dennis Hocter	250 Willis Rd.	139632	T04/R17-32P1	4/29/70	8	228	Alluvium and Wanapum	165764.2	1585021.8	1914.5	-	59.4	1855.2		-	-	No permission	-	-	No permission	66.3	1848.2		52.0	1862.5		55.5	1859.0		49.9	1864.6	

¹ Northing and Easting coordinates are in Washington South State Plane coordinate system (NAD 1983 datum)

² All elevations are in NAVD 1988 datum

³ Indicates wells included in the City of Goldendale's groundwater level monitoring program





Groundwater Level Monitoring Network

Wells by Completion Aquifer:

- Alluvium
- ▲ Alluvium and Wanapum
- Wanapum

Swale Valley 👉

Swale Canyon 👉

Township and range

Faults

- Right lateral strike slip fault
- - - Right-lateral strike-slip fault, approximately located
- ⋯ Right lateral strike slip fault, concealed
- Left-lateral strike-slip fault
- Fault, unknown offset
- ⋯ Fault, unknown offset, concealed
- Thrust fault
- ⋯ Thrust fault, concealed
- Normal fault
- ⋯ Normal fault, concealed
- - - Normal fault, inferred

Sections

Folds

- ↕ Anticline
- ↕ Anticline, approximately located
- ⋯ Anticline, concealed
- ↕ Syncline
- ⋯ Syncline, concealed
- ↕ Monocline, synclinal bend
- ⋯ Monocline, synclinal bend, concealed

0 4,000 8,000 16,000 24,000 32,000 Feet

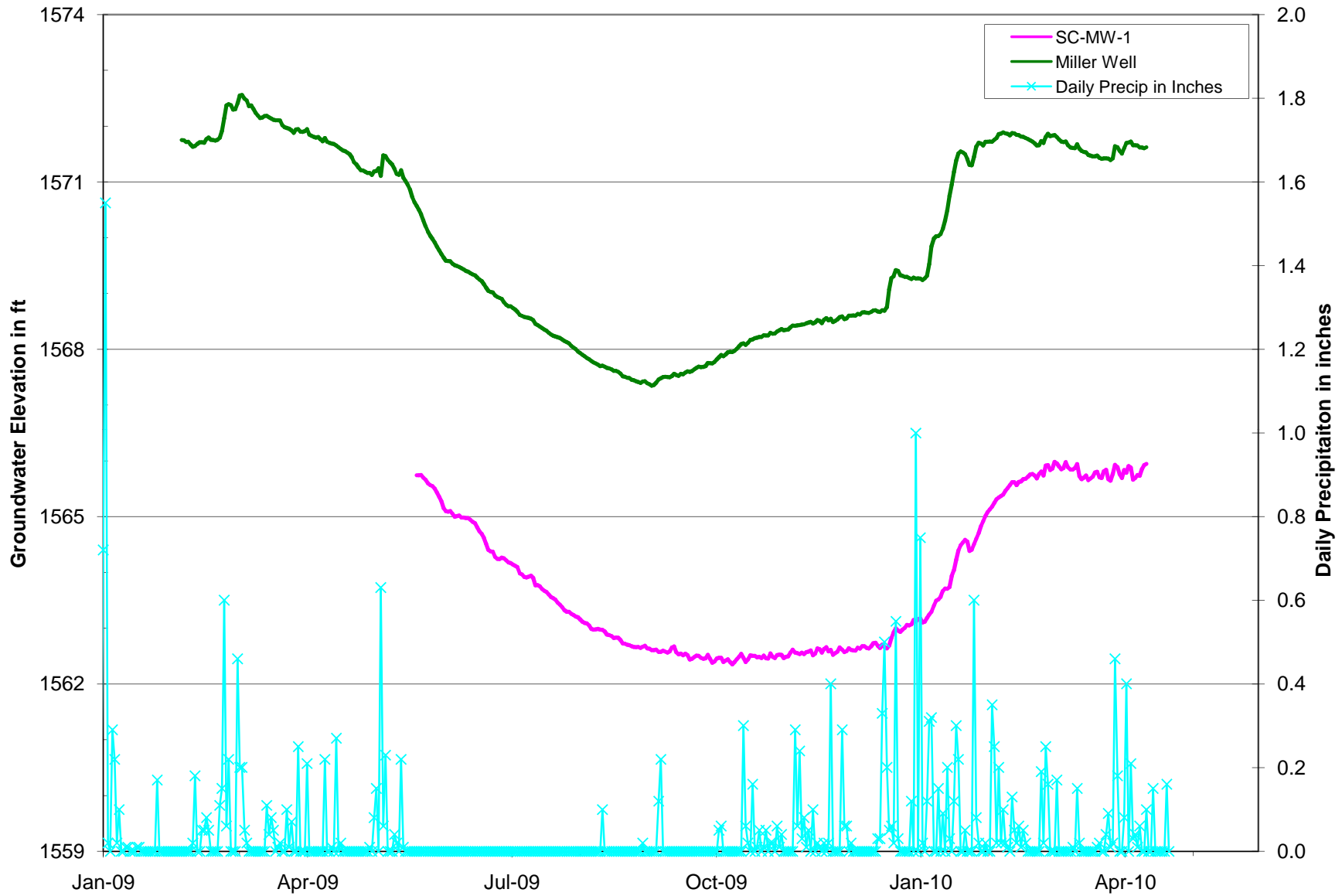
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Swale Creek Subbasin Water Level Monitoring Network

Swale Creek Subbasin Annual Monitoring Report
WRIA 30, Washington

DATE: June 2010	PROJECT NO. 070024
DESIGNED BY: JMS	
DRAWN BY: PPW	FIGURE NO. 2
REVISED BY: KAF	

T:\projects_8\WRIA30\070024\Delivered\SwaleCreekSubbasinWaterLevelMon_MonitoringReport.mxd

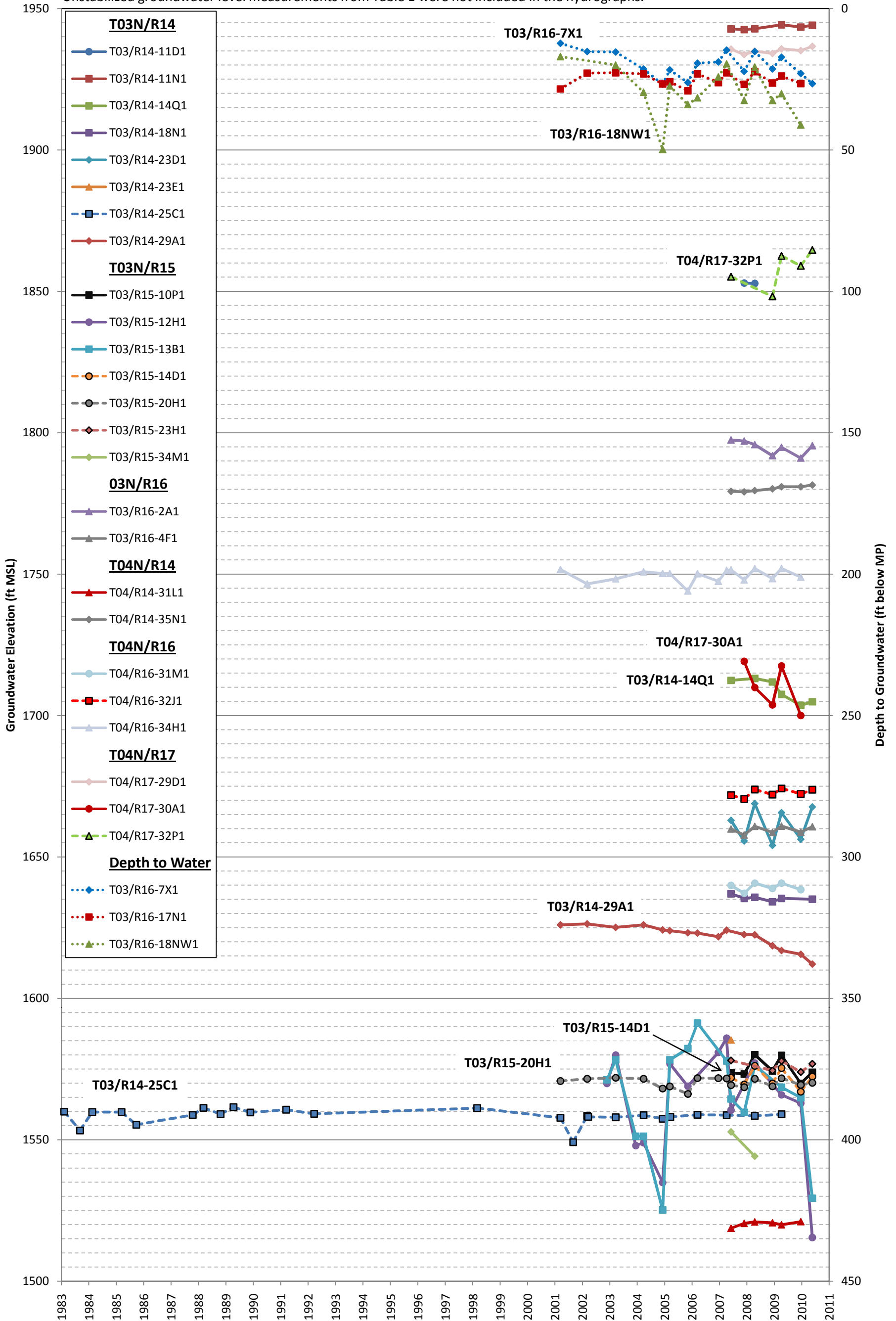


Notes:

Dashed hydrographs are indicative of wells completed in the alluvium aquifer.

Dotted hydrographs are presented as depth-to-water (secondary axis).

Unstabilized groundwater level measurements from Table 1 were not included in the hydrographs.



Notes:

Goldendale annual precipitation data from Goldendale (NOAA #453222) and Goldendale 2E (NOAA #453226).

Satus Pass annual precipitation data from Satus Pass 2 SSW (NOAA #457342)

Individual months with more than 5 days of missing data were not used for either monthly or annual statistics.

