Water Use and Recharge Estimates in the Umatilla and Walla Walla Drainage Basins, Oregon

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This report answers a series of five questions about water use and ground-water recharge that were submitted to the Water Resources Department by the Umatilla County Critical Groundwater Task Force. The answers are based on the best available data but are subject to many uncertainties. Methods and assumptions are included in the report so that the results can be revised as better data becomes available and so that the reader can independently assess the merits of the results.

1. Estimated Irrigation Water Use

Irrigation water use is estimated for the Umatilla and Walla Walla basins. For the purposes of this report, the Umatilla basin also includes the Willow Creek drainage basin. Use estimates are summarized by basin, county, and ground water administrative areas as shown in Table 1. Because water use is not measured or reported for most rights in these basins, the estimates in Table 1 are based on an estimate of the total irrigated lands that are listed on valid primary water rights. Since water rights track potential use, these figures are likely to be greater than actual use in any given year. As such, it would be better to characterize these data as estimates of the amount of water necessary to irrigate lands listed on valid water rights, including transmission and field losses. This potential demand for water is referred to as irrigation water demand in this report. Although a variety of factors limit the accuracy of these estimates, they are believed to be a conservative estimate of the amount of irrigated land listed on valid water rights and the amount of water that would be required to irrigate all of those lands in any given year.

Reasonably good estimates of water use are available for some of the Critical Ground Water Areas in the Umatilla Basin since water use is measured for most water rights subject to critical area rules. These estimates are reported in Table 2 and are compared to the overall water-use estimates presented in Table 1.

Conclusions

About 164,000 acres of irrigable land are listed on currently valid water rights in Umatilla County. Many of these lands have multiple primary or supplemental water rights that allow irrigation from several sources of surface or ground water. The amount of water necessary to irrigate lands listed on these rights is probably around 493,000 acre-feet per year using current irrigation practices but could be as little as 164,000 acre-feet per year if all delivery systems were pressurized and if all irrigation systems were converted to high-efficiency devices. Actual water use is likely to be somewhat less than 493,000 acre-feet per year since not all demands can be met by the current water supplies and not all permitted lands are irrigated in any given year.

About 19,000 acres of land on primary water rights and 21,000 acres on supplemental rights are subject to critical ground-water area allocations within the county. About 26,000 acre-feet of water has been allocated annually over the past few years for these lands. This is sufficient water to irrigate about 43% of the total lands subject to allocation in the county or about 93% of all lands subject to allocation on primary rights, assuming an irrigation demand of 1.5 acre-feet/year. Although the allocated water is insufficient to irrigate all lands listed on these rights, many of these lands have access to other water sources to supplement the restricted supplies available from critical sources. Because use from these other sources is not systematically

tracked, the amount of land that is idle because of restrictive allocations cannot be easily determined.

Analysis

Because Umatilla County is the official focus of the Critical Ground Water Task Force, this discussion is limited to the results for Umatilla County. However, the figures in Tables 1 and 2 should allow the reader to apply a similar analysis to Morrow and Gilliam counties.

About 164,000 acres of land are listed on valid primary water rights in Umatilla county. Of these, about 121,000 acres (74%) use surface-water sources and about 43,000 acres (26%) use ground-water sources. About 80,000 acres are listed on valid supplemental rights, of which about 54,000 acres (68%) use surface-water sources and about 25,000 (32%) use ground-water sources. Since supplemental rights can only be filed over primary rights, the 164,000 acres listed on primary rights represents an estimate of the maximum number of irrigable acres that are listed on currently valid water rights.

Data published by Cuenca and others (1992) indicate that the net irrigation requirements (evapotranspiration minus effective precipitation) for most crops that can be grown in the area range from about 1.93 to 3.17 acre-feet/acre/year. These estimates do not include transmission and irrigation field losses. However, field observations suggest that modern irrigation practices can reduce the total irrigation water demand (net irrigation requirements plus irrigation field losses) to about 1.50 acre-feet/year for many crops. A total demand of 1.50 acre-feet/acre/year is probably only attainable with pressurized water-delivery systems combined with drip irrigation or efficient low-pressure center-pivot irrigation systems. Higher irrigation demands are more likely for combinations of un-pressurized water-delivery systems, low-efficiency sprinkler systems, and flood irrigation. This suggests that 1.50 acre-feet/acre/year is a conservative estimate of the amount of water necessary to meet most crop water-use requirements in Umatilla County under ideal circumstances. Actual water use is likely to be greater because most irrigation operations involve some transmission and field losses.

Since an inventory of irrigation practices was not compiled for this analysis, water demand in the area is assumed to fall somewhere between 1.50 and 3.00 acre-feet/acre/year. This suggests that irrigation water demand in Umatilla County, based on lands listed on current water rights, lies somewhere between 246,000 and 493,000 acre-feet per year. Although the maximum water demand is considered to be about 493,000 acre-feet per year, actual water use is probably somewhat less since many water users have adopted conservation methods to decrease their transmission and field losses over the past several decades. Also, not all demands can be met by the current water supplies and not all permitted lands are irrigated in any given year.

About 43,000 acres of land are listed on primary ground-water rights and about 25,000 acres are listed on supplemental ground-water rights within Umatilla County. This represents about 26% of all acreage listed on all primary rights and about 32% of all acreage listed on all supplemental rights. The available ground-water sources include bedrock aquifers in the Columbia River Basalt Group and water table aquifers in alluvial sediments that overlie the basalts in some areas. Information is not currently available to precisely indicate how many water rights are served by

each of these sources. However, the available data suggests that roughly 80-90% of these rights use a basalt source.

About 19,000 acres of primary ground-water rights and 21,000 acres of supplemental ground-water rights are subject to water-use restrictions in the Butter Creek, Stage Gulch, Ordnance Basalt, and Ordnance Gravel Critical Ground Water Areas. Because of declining water levels, new permitted uses are not allowed in these areas. In addition, water use is controlled by annual allocations in the Butter Creek and Stage Gulch Critical Areas and portions of the Ordnance Gravel Critical Area in an attempt to stabilize declines. Allocations are based on the best available estimates of sustained annual yield (the amount of water that can be withdrawn annually without causing long-term water level declines), a figure that can be adjusted in the future if merited by water level trends. Allocations have been stable for the past few years and closely approximate actual water use as measured by flow meters. Allocations for 2007 are summarized in Table 2 by critical area and then by county.

Ground-water allocations in the critical areas are made separately for each of several subareas, some of which overlap several counties. In addition, allocations within a subarea are made on the basis of priority date regardless of whether the rights are primary or supplemental. Since allocations by county are not readily available, they were estimated by assuming that allocations were proportional to the total allocated lands (primary and supplemental) in each county. This assumption introduces some error into the allocation estimates for each county but does not affect the total allocations listed for each critical area.

About 26,000 acre-feet of ground water was allocated in critical areas within Umatilla County in 2007. Assuming an irrigation demand of 1.5 acre-feet/year, this is sufficient water to irrigate about 17,000 acres, about 43% of the total acreage subject to allocation in the county or about 93% of all lands listed on primary rights subject to allocation in the county. If actual irrigation demands are greater than 1.5 acre-feet/year, less land can be irrigated with the allocated water. These figures clearly show that water allocations in these critical areas are insufficient to meet the irrigation demands of all lands listed on water rights subject to allocations. However, they cannot be used to determine the number of acres that are not irrigated because of restrictive allocations since many of these lands are listed on other primary or supplemental rights that use sources not subject to the critical area allocations. A comprehensive analysis of water availability versus water demand in the critical areas (or for the entire county) would require water-use reporting for all water sources or some system of data collection such as remote sensing combined with extensive field surveys to determine the actual irrigated acreage and the sources of water used on those lands.

Methods and Limitations

Water rights are issued by the state of Oregon to establish a priority for distributing water. When demand exceeds supply for a specific stream or aquifer, junior rights are regulated off, as necessary, to ensure that senior rights have first access to the available water. Junior users may have one or more supplemental rights from other sources that may be used to irrigate lands on primary rights when the primary source of water is not available. However, water rights are not a guarantee that water will be available from the specified source. In fact, water is often not

available to satisfy all demands. Also, not all lands on valid rights are irrigated every year. In this context, water rights represent a potential demand for water rather than actual water use.

Water rights have a designated use, a designated source, a maximum allowable rate of withdrawal, and one or more designated points of appropriation where water can be withdrawn from the source. In addition, irrigation rights have a designated place of use (the irrigated acreage) and a yearly allowable water use or duty, which is expressed as the maximum allowable volume of water that can be applied per acre each year. Since many water rights cannot be satisfied from a single source for the entire irrigation season, water law allows multiple rights to be filed on the same acreage. Thus a permittee might have a primary surface-water right on 40 acres and a supplemental ground-water right on all or portions of the same acreage. If the primary source becomes unavailable during the irrigation season, the supplemental source can then be used to irrigate the crop. If the supplemental ground-water source cannot meet the full demands of the irrigated lands, an additional surface-water right can be filed (if a different source is available) to supplement the primary surface-water and supplemental ground-water sources. In some instances, a second primary right can also be issued on the same acreage to make up for a deficiency in the original primary right. In general, most of these subsequent rights limit overall water use to the maximum duty specified on the primary right, generally 4.0 acre-feet of water per acre of land for surface water rights and 3.0 acre-feet of water per acre of land for ground water rights.

Since multiple water rights can be overlain on the same parcel of land, the sum of the maximum allowable irrigation rates on all rights will overestimate irrigation water demand on any given parcel. Also, since crop water-use requirements vary over an irrigation season, the maximum allowable irrigation rate applied over the irrigation season will overestimate water use. Since irrigation demand is determined by the available irrigable land and by crop water-use requirements, an analysis of these factors should provide a good estimate of the potential water use in an area. This method of analysis was used for this report because reasonable estimates of irrigable acreage can be made using water right data.

The Oregon Water Resources Department tracks water rights in the Water Rights Information System database (WRIS). For each irrigation right, the database tracks the total number of irrigated acres in each quarter-quarter section of land. The database also tracks whether the rights are primary or supplemental and whether the rights are for a surface-water, ground-water, or storage source. Since multiple rights can be filed on the same lands, a sum of all of the listed acreages in each quarter-quarter section can produce a large overestimate of irrigation demand. However, the sum of all primary rights cannot exceed the total amount of acres in the quarter-quarter section (generally around 40 acres). Furthermore, since supplemental rights can only be filed over primary rights, the total number of acres listed on supplemental rights cannot exceed the total number of primary rights in a quarter-quarter section. Therefore, to reduce the over-counting of irrigable lands, the total number of acres in each quarter-quarter section was used as an upper limit on the number of available primary acres in each quarter-quarter section. All over-counts cannot be eliminated using this methodology as some quarter-quarter sections will not be fully covered by irrigation rights but the sum of overlapping rights may equal or exceed the total available acreage in the quarter-quarter section. However, this procedure is probably the best method for minimizing over-counts given the available data. More accurate estimates of irrigable acreage on water rights will be available in the future as the places of use for all rights are digitized into a GIS format.

Using the general method described above, the number of irrigated acres listed on valid water rights was determined using the following procedure. A GIS coverage was used to generate a table of the total number of acres in each quarter-quarter section. The location of the center of each quarter-quarter was used to determine which basin, county, or ground-water administrative area the quarter-quarter section was in. Place-of-use data was downloaded from the WRIS database using the online Place of Use Summary Report query. The query requested all place of use data for current rights in the Umatilla Basin. Acreages on primary ground-water and surface-water rights were then separately summed up for each quarter-quarter. If the total of all acres listed on primary rights was greater than the number of acres in the quarter-quarter section, the total number of primary acres was reduced to the number of acres in the quarter-quarter section. The number of primary ground-water and surface-water acres was then reduced in proportion to this total. Acreages on supplemental ground-water and supplemental surface-water rights were also separately summed for each quarter-quarter section. If the total number of acres listed on supplemental rights was greater than the total number of acres listed on primary rights (as adjusted above) then the number of acres on supplemental rights was reduced to equal the total number of primary acres. The number of supplemental ground-water and surface-water acres was then reduced in proportion to this total. The resulting data were used to generate the figures shown in Table 1. About 35,000 acres of primary surface water acres and 25,000 acres of supplemental surface water acres were added as a separate line item in Table 1 for the Hermiston Irrigation District since these acreages are not tabulated by quarter-quarter section in the water rights database. This addition will likely lead to some over counting since these acres cannot be constrained by the total number of acres in each quarter-quarter section. Table 2 was generated from the same dataset but was further constrained by a table that listed all water rights subject to Critical Ground Water Area allocations. The irrigation demand and water-use estimates derived from these tables reflect the estimated acres of irrigable land in each county. Therefore, water that is transported from a source located in one county and used to irrigate land in another county is not counted as irrigation demand or water use in the source county. For example, approximately 16,000 acres in Morrow County are irrigated by points of diversions located within Umatilla County (mostly associated with the West Extension Irrigation District and the County Line Water Improvement District).

All underlying data for the analysis in this report was preserved in several data tables. These tables can be provided in an electronic or paper form if requested from the Department.

2. Estimated Irrigation Water Use, Certificates Only

Estimates of water use by certificates only cannot be easily extracted from the data described in section 1 above. Therefore, no attempt was made to answer this question.

3. Domestic Ground-Water Use in the Umatilla and Walla Walla Basins

Estimates of domestic ground-water use are summarized in Table 3. These estimates are based on data in the Oregon Water Resources well log database. Estimates of use by aquifer unit were not made as this would have entailed a review of each log.

Domestic ground-water usage in Umatilla County is estimated to be as low as 920 acre-feet per year to as high as 5806 acre-feet per year. The lower estimate assumes that each well represents one household, water is used for in-house purposes only (drinking, food preparation, bathing, washing clothes and dishes, and flushing toilets), each household has an average occupancy of 3 persons, and that the average per capita in-house use is 70 gallons per day (the approximate average per-capita in-house use in the United States for a non-conserving household as reported in Vickers, 2001). The higher estimates assume an additional use of ¼- or ½-acre of irrigation of lawn and garden per well at a rate of 2.5 acre-feet per acre per year. The analysis also assumes that each domestic well in the basin has a well log on file at the Water Resources Department, each well log represents a domestic well that is currently in use, each household has only one domestic well, and all well water is consumptively used. Because of the many assumptions, the estimates in Table 3 have high uncertainties.

The estimates in Table 3 were made by downloading well log data for all water wells located in Umatilla, Gilliam, Morrow, and Wallowa counties. This dataset was then filtered to remove wells that are not located within sections that have their centers in the Umatilla Basin. The dataset was further filtered to remove all but domestic wells that were identified as new work only (no deepenings, alterations, abandonments, or conversions). Duplicate versions of well logs were also eliminated. The data was then summarized by section and each section was assigned to a basin, county, and ground-water administrative area based on the location of the center of the section. A total of 6002 wells meeting these criteria were identified within the basin boundaries. Many well logs were not included because they had no designated use or designated type of work. Also, some wells were eliminated because they were not located to at least the section level.

4. Recharge Estimates in the Umatilla and Walla Walla Basins

The most recent comprehensive estimates of recharge to ground water in the Umatilla drainage basin were made by the U.S. Geological Survey in Hansen and others (1994). The Hansen report is a summary of ground-water conditions in the Columbia Plateau, an area that includes a large portion of southeastern Washington, portions of western Idaho, and portions of north-central Oregon. Recharge estimates were made for pre-development conditions and for conditions in the early 1980s. Recharge, as defined in the Hansen report, includes any precipitation or applied irrigation water that percolates below the root zone to reach the water table. The initial recharge estimates for the Hansen report were made by Bauer and Vaccaro (1990) using an energy-soil-water balance model (Bauer and Vaccaro, 1987) that computes recharge using inputs of daily streamflow, daily precipitation, daily maximum and minimum temperatures, soil properties, irrigation application rates, land-use classification, and topographic data. Daily precipitation records from the 22-year period of 1956 to 1977 were used to calculate an average annual precipitation that was assumed to be representative of the long-term average annual precipitation for the study area. Initial recharge estimates by Bauer and Vaccaro (1990) were modified by

Hansen and others (1994) based on insights gained during the calibration of ground-water models. The Hansen report shows the spatial variability of recharge on maps and summarizes recharge for selected drainage basins. Although the underlying datasets should allow a breakout of recharge by county, this information is not directly available in the report.

Maps in the Hansen report indicate that recharge in the Umatilla, Willow Creek, and Walla Walla drainage basins under pre-development conditions ranged from 0.02 to more than 10 inches per year and was largely controlled by precipitation. Recharge rates in the early 1980s show a similar range but are higher in the lower parts of these basins because of the deep percolation of applied irrigation water in lands developed for irrigated agriculture. Recharge to these drainage basins in the early 1980s is shown in Table 4.

Table 4. Estimated ground-water recharge by basin (from Hansen and others, 1994).

Drainage Basin	Recharge (cfs)	Recharge (acre-feet/year)
Umatilla River	719.8	521,000
Walla Walla River*	152.3	110,000
Willow Creek	104.0	75,000
Total	976.1	706,000

* Includes areas in Washington state

A direct comparison of the recharge estimates in Table 4 and the water-use estimates in Table 1 would be misleading. The recharge estimates shown in Table 4 and the spatial maps of recharge in the Hansen report show ground-water recharge that is available at the water table. Only a portion of this recharge is available at depth in the ground-water system at any locality. For example, most recharge in the Umatilla and the Willow Creek basins occurs in high altitude areas which have high precipitation and steep terrain. Most recharge in these areas probably follows short flow paths to discharge at nearby streams (Hansen and others, 1994). Therefore, most of the recharge in these basins is probably not available to the deep basalt ground-water system that is used as a source of irrigation water in the lower parts of the basins. Also, the recharge estimates in Table 4 do not include recharge from the leakage of stream water to the ground-water system (either natural or induced by the pumping of wells). The portion of recharge that is available from any of these sources at depth depends upon the dynamics of the ground-water flow system and cannot easily be determined without the aid of a ground-water flow model. In additions, the areas described in the two tables are not equivalent. The Umatilla Basin of Table 1 includes the Willow Creek and the Umatilla River drainage basins. The areas reported for these basins in the Hansen report is about 750 square miles less than the areas as calculated from Oregon Water Resources digital maps. Some of this difference is probably due to rounding errors but most may be due to the use of different basin boundaries. Recharge estimates for the same areas described in Table 1 cannot be determined without obtaining and analyzing the spatial datasets that were used to generate the Hansen report.

5. Recharge and Sustainable Pumping Estimates in the Basalt Aquifers

The Umatilla County Critical Groundwater Task Force has asked OWRD to predict how much natural and artificial recharge in the basalt aquifers may be required to sustain 10 years of 2005 ground-water use without seeing water-level declines, past 2005 levels, under average climatic conditions.

General observations indicate that water-level declines are largely associated with wells that tap deeper basalt aquifers. These deeper aquifers provide the bulk of all ground water that is pumped from the basalt aquifer system. Therefore, the following discussion, is limited to the deeper basalt aquifers.

The conservative answer to this question is that it will take an annual volume of artificial recharge equal to the annual volume of pumping from the basalt aquifers over a ten-year period to prevent further declines. The answer is based on several assumptions, including:

1. Artificially recharged water is injected at locations that can be captured by all production wells (The existence of barriers to flow in the basalt system will make this a difficult assumption to meet).

2. There is no effective recharge to the deep basalt aquifers by deep percolation of applied irrigation water.

3. The deeper basalt aquifers are poorly connected to surface water sources (persistent declines in the deeper basalts generally support this assumption).

The volume of required injection water required to keep water levels from declining beyond 2005 levels will be less if the basalt aquifers have moderate or good connections to surface water sources in the basin. However, any such reduction will come at the expense of surface water sources.

References

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Explanation of processes used to prepare report for Umatilla County Critical Groundwater Taskforce

Prepared by Pat Hayzlett

The purpose of this research and subsequent report was to calculate the total water rights in the OWRD's Umatilla Drainage Basin, limited to the confines of Umatilla County and excluding the Walla Walla Sub-Basin. The Taskforce asked that this total be represented as an annual volume of water, a figure which is not easily attainable. Within the same confines, the Taskforce asked for an additional calculation to include the total water rights actually certificated, again represented as an annual volume of water.

Disclaimer:

- OWRD's May 2006 report to the Critical Groundwater Taskforce was extracted from the OWRD's old database system. This 2007 report uses data extracted from OWRD's new database system, which came online in May of 2007. Water right data inquiries are now available to the public through the OWRD's web site located at http://www.wrd.state.or.us/OWRD/WR/wris.shtml.

  The disclaimer located on that web page, and quoted below, also applies to this report as well as all documents or reports subsequently produced from these results.

  "The new WRIS (Water Rights Information System) is a warehouse of information pertaining to water right applications, permits, certificates, transfers, leases and related information. What we hope to provide is a relatively straightforward interface to very complex information.

  *The information reflected on these pages is derived by interpretations of paper records. Please refer to the actual water rights records for the details on any water right. Care was taken in the creation of the data but it is provided "**as is**". The Water Resources Department cannot accept any responsibility for errors, omission, or accuracy of the information. There are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this information. However, notification of any errors would be appreciated."*

- As you are probably aware, OWRD is backlogged in data entry for transfers. For this report, we have tried to compensate for those records yet to be coded by utilizing averages for our report totals. At this time, the only way to obtain an accurate number representing the allowable annual volume of water for any defined geographical area is to perform a hand count. This would be very labor intensive and could not be completed in the amount of time provided by the request.

- OWRD is actively working to bring the database up to date, but this process takes time. As the Salem staff progress with data entry, the database will constantly change and reflect those updates. While subsequent queries of the database might reveal different numbers and make it look like OWRD is issuing new water rights, it could merely reflect data entry updates which might move the water right to a different location or perhaps change the use code. In addition, corrections are made to existing data when an error is found and/or reported. These corrections may be as simple as changing the county in which the water right was initially coded, or changing a primary record to supplemental, or changing the stream ID associated with a point of diversion. But, that one change could potentially affect the totals for two different queries (subtract here, add there).

- Remember: OWRD's WRIS database is fluid and constantly changing. The final data used for this report was extracted on 07/06/2007 using a query period of 06/01. Any subsequent inquiry of the WRIS database made to double check this report may not yield the same results.

Explanation of the structure of the database:

- As stated in the disclaimer, water rights are very complex. With the current OWRD database structure, mass inquiries cannot be made which will tie the Place of Use (POU) and the Place of Diversion (POD) records together for the purpose of tabulating totals. We can inquire about any ONE water right to obtain all information about that particular right itself (POU, POD, scanned documents, maps, genealogy, etc…) but not for two or more water rights at the same time. There are thousands of water rights in the Umatilla Drainage Basin and individual water right inquiries would be an extremely labor intensive way to obtain a total water volume; this is not a task that OWRD could accomplish within the given time frame.

- The POU records in the WRIS database could not be used to arrive at a total allowable annual volume of water because those records alone do not list cfs or acre-feet measurements of water. The cfs or acre-feet measurements associated with each water right are stored solely in their associated POD records and simply "pulled in" during an individual water right inquiry to combine with the POU data. The only field in the POU side of the data that we could total would be the total acres. Standard conversions could then have been applied to total acres to arrive at an estimated annual volume of water for irrigation purposes. However, that figure would not represent a complete picture. Water rights for irrigation are the only ones with acres associated with them, and there are many other valid uses for water within the area. Besides, the POU records do not tell us where the water is extracted from (Umatilla County, Morrow County, etc…). In addition, the POU records can not tell us if there is double coverage of water rights for any given acre. Therefore, the only portion of the database that we could query to obtain water right information concerning volumes of water which are tied to the boundaries of a geographic area were the POD records themselves.

- There are both differing seasons as well as ways to measure the volume limits of every water right. Each one is unique in its own way. Some water right limits are measured in cfs and others are measured in total acre-feet allowed per year. There are even water rights which seem to have no limitation at all (see Figure 1 as example). Most irrigation water rights which are limited by measuring cfs will also be limited in their annual volume. This limit is known as the water right "duty". For example, a water right might allow up to 1 cfs of water to be appropriated or diverted every hour of every day from April 1st through October 31st, or until a total of 3 acre-feet per acre, per year (duty) has been reached, whichever comes first. Once their duty has been reached, the water right holder is not allowed to appropriate any more water for the remainder of the year under that same water right. However, not all water rights have a duty associated with them either. Therefore, we had to utilize averaging to account for the uniqueness of individual water rights.

- In the POD data, the cfs column is used for water rights which have a specific cfs rate limitation on them. The acre-feet column is used for water rights which have a specific annual acre-feet limitation on them. If you look at the data, you will see that summarizing these two columns independently of one another is not duplicating water volumes. Individual records which list a cfs measurement do not list annual acre-feet and vice versa. In addition, where multiple uses may be allowed from one POD, the cfs or acre-feet measurements may only be an estimate for each type of use so that the maximum allowable cfs or acre-feet is divided equally between all uses. We know this is not an accurate picture of the way water is actually divided between uses. Livestock don't generally receive as much water from a POD as crop irrigation does. However, this is how the data is stored in the database and we have to deal with it. We know the total acre-feet for irrigation in this report is probably low and the total for domestic/livestock/other uses is probably high. Since the Taskforce did not ask for a breakdown between uses, we didn't worry about the splits between uses. The bottom line total volume is as accurate as we can get. The actual usage information must come from other areas of data collection.

Explanation of record extraction selection criteria:

- For purposes of this report, June 1st (06/01) was selected as one of the criteria to be used to extract the data from WRIS. In order to ascertain HOW we should go about extracting a number which represents an annual volume of water out of the WRIS data available, I first queried the POD database for the OWRD's Umatilla Drainage Basin for each of the 24 bi-monthly periods (1st of the month and 16th of the month for 12 months). I put the total cfs and annual acre-feet numbers from those queries into a spreadsheet and averaged each of the two fields. I then ran the same line of queries again, but included an additional limitation to select only those records within Umatilla County and also within the Umatilla Drainage Basin. I then averaged the second set of results.

- After comparing the two sets of averages (Umatilla Drainage Basin vs. Umatilla County within the Basin), I found them to be similar by percentages with Umatilla County being, in a few periods, slightly lower than the overall basin average in cfs and slightly higher than the overall basin average for acre-feet. During a conference call with Salem staff, it was agreed that the numbers obtained from WRIS for the period of June 1st (06/01) would best represent the annual average for the area in question without underestimating the volumes and would, therefore, be the period we all used to extract the data from WRIS. Karl Wozniak in Salem has used the same query date criteria of June 1st (06/01) when preparing the actual water USE reports. Both the Salem and Pendleton reports used the same list of Township/Range/Section numbers to define the Walla Walla Sub-Basin and filter out that "area" before data was totaled. Therefore, we are fairly confident that we are both counting the data involved for the same geographic area.

- Once all of the POD records for the entire Umatilla Drainage Basin were downloaded, I separated water right records for the other counties, separated the records for the Walla Walla Sub-basin, and then divided the remaining records by ground water, surface water and storage water. I then downloaded 24 separate queries to account for the entire Instream and Minimum Flow category seasons, since querying the database for 06/01 would only have returned 1/24th of the annual volume that we needed to account for in our reports. I made sure to separate out the other counties and the Walla Walla Sub-basin for those records.

Explanation of logic used for the calculations phase, once the POD records were filtered:

- Nearly all water rights which fall under the use category of Irrigation have a "duty" (annual limit per acre) which represents a total annual volume of water the owner may appropriate in one "irrigation season" to apply to land under irrigation. A "season" may extend for a period of a few days up to and including an entire year. For water rights originating from the Umatilla River Decree, a "year" is coded as January 1 through December 31 in the database. Subsequent to publishing the decree, an " irrigation season" was later defined by the courts as March 1 through October 31. For water rights originating subsequent to the Decree, a year or season MAY have been defined as 365 days in the database, depending on the wording of the water right itself. For all irrigation type water rights, the total number of days they can appropriate water has been adjusted in our calculations to reflect the TRUE irrigation season of March 1 through October 31. Also, depending on the source and the area the water is to be appropriated from, the average duty can vary greatly throughout the County. Once again, averages had to come into play.
- Any water rights not included in the data, ones which are valid outside of the normal "irrigation season" of 3/1 through 10/31 and therefore outside of the June 1st query criteria, have been compensated for by averaging the data that we did download using June 1st as our "point in the year", since that period best represented the entire area's annual average as determined prior to downloading any of this data.
- Landowners may hold several different TYPES of water rights to cover the same piece of ground so that when surface water becomes unavailable to them, they may use their supplemental ground water or stored water. There is no way to tell, based on the data, which water right type is actually in effect at any given time on a global basis. Therefore, again, I had to use averages for this report.
- I then chose some of the water rights at random to look up the actual number of hours that each water right holder could appropriate water over the course of the number of days in that water right's "season" and still remain within the duty allowed for that water right. I then averaged the results that I obtained. Since the average duties vary greatly between Ground Water and Surface Water, the calculations are slightly different for each water right type. But, the basic formula remains the same.

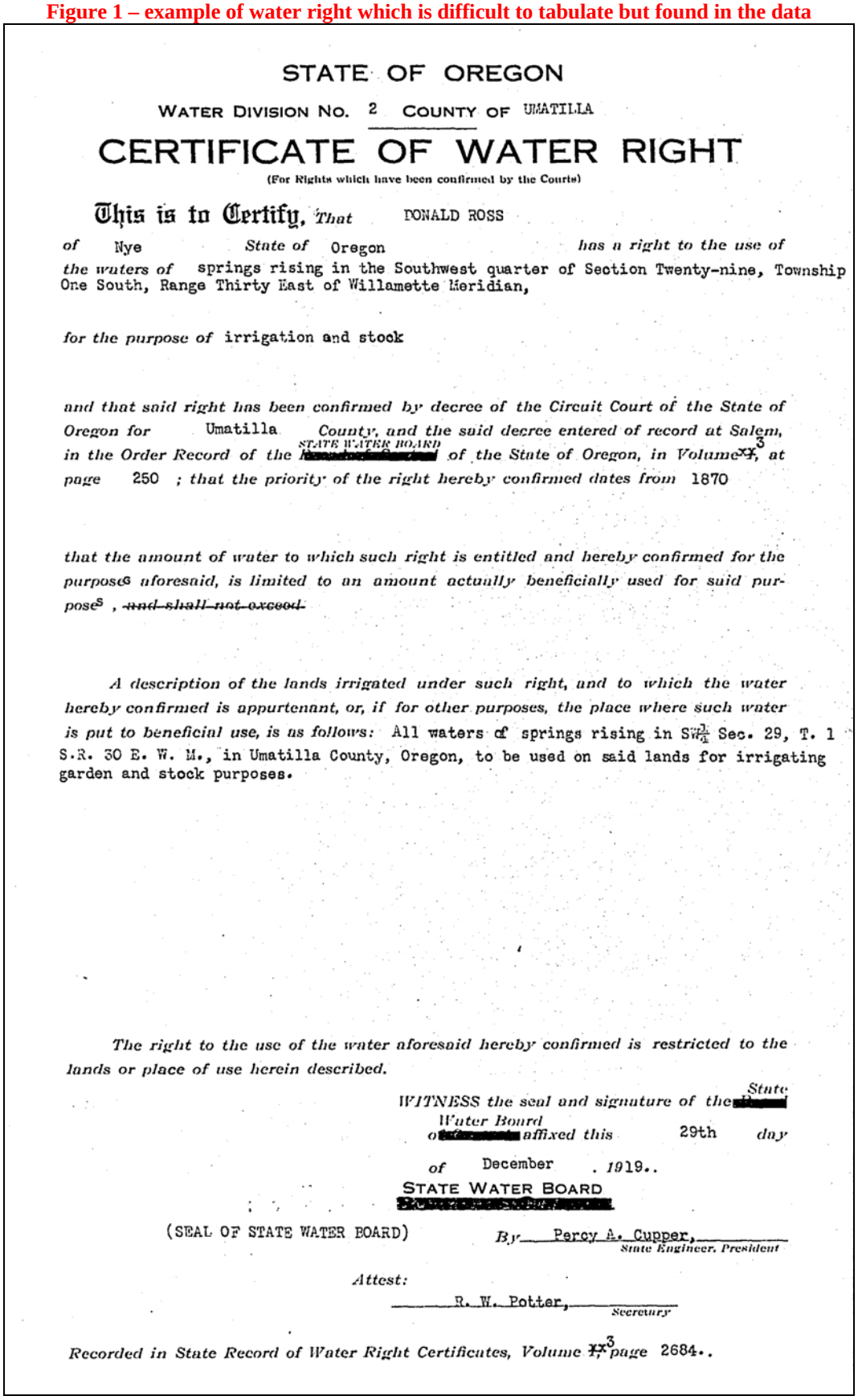
- After reviewing the actual associated documents for many large and small water rights, after calculating an average number of hours for those I checked and after conferring with staff knowledgeable about the water rights in this area, conclusions were then reached about how to summarize the AVERAGE annual allowable water rights represented in cfs even though acreages were not available to create that total. Those records which are measured in acre-feet are already representing an annual volume of water and did not need to be converted. See figures 2, 3 and 4 for the averages I used to arrive at this summary.
- Primary water rights were separated from the supplemental water rights, with calculations completed on them independently. This data cannot be used to determine which water right is actually in use at any given time, nor can it be used to calculate an actual number of acres under irrigation. There are simply too many variables involved to determine which water right is being used to appropriate water covering any one acre at any given time. However, I knew the Taskforce would like to see those totals represented independent of one another.
- The final formula used to calculate an average annual volume of water where water rights were represented in cfs is as follows:

  total cfs (minus the amount represented by water right applications), multiplied by 1.98 (a standard conversion of cfs to acre-feet in 24 hours), divided by 24 (reduce to acre-feet in 1 hour), multiply that number by the average number of hours in a day in which a water right holder could appropriate water and still remain within the average annual duty (GW and SW are different, irrigation and other uses are different), multiplied that number by the average number of days in a season (Ground Water and Surface Water are different). These results were then added to the total from the water rights which were already representing an annual acre-feet measurement. Of course, Instream, Minimum Flow and Storage records are already represented in the data as an annual volume of water. These records were simply totaled. No conversion was necessary.
- **The result from above yielded an estimated annual allowable volume of water, broken down by Ground Water, Surface Water, Storage and Instream/Minimum Flows for all of Umatilla County within the Umatilla Basin boundaries and excluding the Walla Walla Sub-basin.**

Final Note:

- Since one water right may be comprised of many different points of diversion covering many different types of uses, it is impossible to tell from the water right data alone exactly how much water is ACTUALLY being used for any one purpose at any given time. The WRIS database uses “estimates” of allowable use which may or may not be an accurate representation of actual use. The totals reflected in this report are simply my "best guess", based on averages, of a total representing how much water CAN be appropriated for one year from within the boundaries of that portion of Umatilla County which falls inside of the Umatilla Drainage Basin. For planning purposes, the results of this report, the actual use data compiled in Salem’s Water Use Report (included along with this report) and the published Annual Water Availability Report should all be used.

Figure 1 – example of water right which is difficult to tabulate but found in the data



STATE OF OREGON

WATER DIVISION NO. 2 COUNTY OF UMATILLA

CERTIFICATE OF WATER RIGHT

(For Rights which have been confirmed by the Courts)

This is to Certify, *That* DONALD ROSS

of Nye *State of* Oregon *has a right to the use of the waters of* springs rising in the Southwest quarter of Section Twenty-nine, Township One South, Range Thirty East of Willamette Meridian,

for the purpose of irrigation and stock

and that said right has been confirmed by decree of the Circuit Court of the State of Oregon for Umatilla *County, and the said decree entered of record at Salem, in the Order Record of the* STATE WATER BOARD *of the State of Oregon, in Volume* ~~X~~ 3 *at page* 250 *; that the priority of the right hereby confirmed dates from* 1870

that the amount of water to which such right is entitled and hereby confirmed for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes , ~~*and shall not exceed*~~

A description of the lands irrigated under such right, and to which the water hereby confirmed is appurtenant, or, if for other purposes, the place where such water is put to beneficial use, is as follows: All waters of springs rising in SW¼ Sec. 29, T. 1 S.R. 30 E. W. M., in Umatilla County, Oregon, to be used on said lands for irrigating garden and stock purposes.

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

WITNESS the seal and signature of the State Water Board *of the State affixed this* 29th *day of* December *.* 1919..

STATE WATER BOARD

(SEAL OF STATE WATER BOARD) *By* Percy A. Cupper, *State Engineer, President*

Attest:

R. W. Potter, *Secretary*

Recorded in State Record of Water Right Certificates, Volume ~~X~~ 3 *page* 2684..

Figure 2: (Refers to the Umatilla Drainage Basin that falls within Umatilla County, excluding the Walla Walla Sub-basin)

Ground Water Data Statistics and Averages:

1. There are 1398 records in the Umatilla County Ground Water POD data extracted from the OWRD's WRIS database; all measured in cfs. Note: this is not a count of total water rights and it does not include the Walla Walla Sub-Basin. It is merely the total number of Ground Water records in the data that I used for this report.
2. After calculating the number of days in a season for each record in the ground water data and adjusting the number of days in a season for the older irrigation water rights, I found that **the average number of days in a ground water season is 244.68 for irrigation uses and 362.45 for other uses**.
3. Of the 1398 records in the data, approximately 88% are for irrigation. Total primary irrigation is about 66% of the data and total supplemental is about 21% of the data, all of which have an **average duty** (average annual limit) **of 2.99 acre-feet per acre** (roughly $1/80^{th}$ of a cfs per acre). The remaining records in the Ground Water data, about 12%, are for uses which do not have a duty associated with them, other than the maximum cfs allowed AT the point of diversion.
4. A spot check was performed on many of the Ground Water primary irrigation water rights, looking at the actual certificates themselves by hand, to see approximately how many hours per day they would each be able to maintain their maximum allowable cfs diversion rate for the exact number of days in their unique season and still stay within their individual duty (annual limit of acre-feet per acre). This spot check resulted in an **average of 12 hours per day** for Ground Water irrigation uses instead of using a 24 hour-day in the acre-feet calculation. In other words, the irrigation water rights which were checked could appropriate their maximum rate for an average of 12 hours per day throughout their individual unique "season" and still stay within their own individual duty (annual limit). Some were a little higher, some were lower. But, the AVERAGE number of hours they could all appropriate Ground Water for irrigation and stay within their duty was 12 hours per day. For uses other than irrigation, there is no annual limit. Therefore, 24 hours per day was used to tabulate those records.
5. For Ground water, the average number of days in an irrigation season is 244.68 and the average number of days in non-irrigation seasons is 362.45.
6. To simplify: For the final formula used to calculate the estimated annual allowable volume of Ground Water, short of an actual hand count, we took the total cfs in the Ground Water data, subtracted applications, separated irrigation uses from other uses and multiplied each total by 1.98 to convert cfs to acre-feet for a period of 24 hours, divided the irrigation use totals by 2 to reduce acre-feet total to 12 hours per day instead of 24 (no division on the other uses) and multiplied the irrigation number by 244.68 days (average number of days in a ground water irrigation season) and the other uses number by 362.45 days. We would then have added any water rights measured in acre-feet to the total, but there were none TO be added in the Ground Water data. This calculation was performed for each water right type (permits, certificates, decrees, etc…), and then totaled again making it easy for the Critical Groundwater Taskforce to extract the numbers they are seeking for their 2050 plan.

Figure 3: (Refers to the Umatilla Drainage Basin that falls within Umatilla County, excluding the Walla Walla Subbasin)

Surface Water Data Statistics and Averages:

1. There are 1502 records in the Umatilla County Surface Water POD data extracted from the OWRD's WRIS database; all measured either cfs or acre-feet. Note: this is not a count of total water rights and it does not include the Walla Walla Sub-Basin. It is merely the total number of Surface Water records in the data that I used for this report.
2. After calculating the number of days in a season for each record in the surface water data and adjusting the number of days in a season for the older irrigation water rights, I found that **the average number of days in a surface water season is 244.92 for irrigation and 301.38 for other uses**.
3. Of the 1503 records in the data, approximately 76% are for irrigation. Total primary irrigation is about 67% of the data and total supplemental about 9% of the data, all of which have an **average duty** (average annual limit) **of 4.08 acre-feet per acre**. The remaining records in the Surface Water data, about 24%, are for uses which do not have a duty associated with them, other than the maximum cfs allowed AT the point of diversion.
4. A spot check was performed on many of the Surface Water primary irrigation water rights, looking at the actual certificates themselves by hand, to see approximately how many hours per day they would each be able to maintain their maximum allowable cfs rate for the exact number of days in their unique season and still stay within their individual duty (annual limit of acre-feet per acre). This spot check resulted in an **average of 12 hours per day** for Surface Water irrigation uses instead of using a 24 hour-day in the acre-feet calculation. Non-irrigation uses have no duty and could therefore appropriate water for 24 hours a day for the life of their "season".
5. For Surface Water, the average number of days in an irrigation season is 244.92 and the average number of days in non-irrigation seasons is 301.38.
6. To simplify: For the final formula that we used to calculate the estimated annual allowable volume of Surface Water, short of an actual hand count, we took the total cfs in the Surface Water data, subtracted applications, separated irrigation uses from other uses and multiplied each total by 1.98 to convert cfs to acre-feet for a period of 24 hours, divided the irrigation use totals by 2 to reduce acre-feet total to 12 hours per day instead of 24 (no division on the other uses) and multiplied the irrigation number by 244.92 days (average number of days in a ground water irrigation season) and the other uses number by 301.38 days. We then added any water rights measured in annual acre-feet to the total. This calculation was performed for each water right type (permits, certificates, decrees, etc…), and then totaled again making it easy for the Critical Groundwater Taskforce to extract the numbers they are seeking for their 2050 plan.

Figure 3: (Refers to the Umatilla Drainage Basin that falls within Umatilla County, excluding the Walla Walla Sub-basin)

Storage Water Data Statistics and Averages:

1. The Storage Water calculations were straight forward. All water rights for water going into storage are measured in annual acre-feet volumes of water. I simply separated them into groups for claims, decrees, certificates, etc…, and added it all up, removing applications from the final volume totals.

Figure 4: (Refers to the Umatilla Drainage Basin that falls within Umatilla County, excluding the Walla Walla Sub-basin)

Instream and Minimum Flow Data Statistics and Averages:

1. The Instream and Minimum Flow calculations were straight forward. All water rights for Instream uses and Minimum Flows are measured in annual acre-feet volumes of water. However, Instream and Minimum Flows have 24 bimonthly periods in WRIS. I had to download all 24 of them to obtain an annual volume. I simply separated them into groups for claims, decrees, certificates, etc…, and added it all up. Applications were NOT removed because all applications in this particular data set were for minimum flows established in the Basin Program which have not yet been converted to a certificate.