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WATER USE STUDY PLAN

Water Resource Inventory Area 48
Twisp, Washington

Prepared for: Methow Watershed Council

Project No. 080180-001-01 • June 16, 2009 Draft

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1 Introduction

This Water Use Study Plan (Study Plan) outlines a methodology to estimate single domestic (residences) water use in Water Resource Inventory Area (WRIA) 48 served by water right permit-exempt wells (exempt wells). Aspect Consulting, LLC (Aspect Consulting) has prepared this Study Plan on behalf of the Methow Watershed Council (MWC), under Phase 4 (Watershed Plan Implementation) of the watershed planning process. The work outlined in this Study Plan will be used to refine the current estimate of single domestic water use assumed in Chapter 173-548 Washington Administrative Code (WAC) for tracking allocation of the established reserve. Updating the estimate of water use to quantify the unallocated portion of the reservation is a high priority issue identified in the *Methow Basin (WRIA 48) Watershed Plan* (Methow Basin Planning Unit, 2005).

1.1 Purpose and Objectives

This Study Plan presents a methodology for quantifying groundwater withdrawals from exempt wells in WRIA 48. Under a separate proposed task to be completed outside of this scope of work, septic return flows associated with residences served by exempt wells will also be quantified. Ultimately, the estimated withdrawals and return flows will be used to determine the consumptive use of single domestic users associated with exempt well withdrawals, which in turn will be used to support planned revisions of the 1976 Instream Flow Rule for the Methow River (Chapter 173-548 WAC).

The Instream Flow Rule established a reservation of 2 cubic feet per second (cfs) of water in each of 7 reaches of the Methow River for future single domestic and stock water uses. The 2 cfs reservation in each reach establishes the maximum allowable withdrawal, expressed as a reduction in instream flow within that reach associated with beneficial uses authorized under the rule. Based on this, the water use estimate will focus on estimating the maximum impact to surface water flows due to exempt well withdrawals.

Peak water withdrawals from exempt wells are expected to occur during the summer, when outdoor water uses are at a maximum. There is expected to be a lag between the occurrence of peak withdrawals at an individual well and when the impacts of those withdrawals are realized in the Methow River. Review of area hydrogeologic information and studies indicates that the lag is likely on the order of 1 month. The impacts to surface water flows from multiple exempt wells pumping during the peak use period will tend to be smoothed out or averaged over a time period equal to the lag. For purposes of evaluating allocation of the 2 cfs reserve, the maximum impact to surface water flows is expected to equal the average daily use over the 1 month period of maximum use. This assumption will be confirmed as part of this Study Plan.

To best support a revision of the Instream Flow Rule, the water use estimate should meet the following objectives:

- Be defensible and accepted by the Washington State Department of Ecology (Ecology).
- Be applicable to lots served by exempt well (both developed and future developed).
- Allow for identification of the timing (season or month) and magnitude of maximum average use and maximum impacts to surface water flows.
- Account for potential year-round use (i.e., assume primary residence) even where occupation is currently seasonal.
- Be representative of conditions in WRIA 48. However, water use data from basins with similar characteristics outside WRIA 48 may also be considered.
- Ideally produce a single value that represents peak exempt well water use and resultant impacts to surface water flows in WRIA 48. A decision to use a single value will be made after the variability of water use is assessed.
- Include estimates of both indoor and outdoor use.

Based on discussions with the MWC and Ecology, we recommend using an analogous method, using existing water use data from public water systems, to meet the purpose and objectives of this study. The recommended method is detailed in Section 3.

1.2 Existing Water Use Estimates

Several existing estimates of water use within WRIA 48 and the vicinity are available (Table 1); however, none of these studies specifically evaluated water use for residences served by exempt wells. Water use estimates in Table 1 were primarily derived from public water system data collected within the indicated region of interest. Public water systems obtain water use data directly by metering individual connections or indirectly by dividing total volume of water used in the system by the number of connections served.

The *Methow Basin (WRIA 48) Watershed Plan* (Watershed Plan) includes estimates for average day demand (ADD) and maximum day demand (MDD) of 600 gallons per day (gpd) and 1,200 gpd, respectively, based on meter records from the Town of Twisp Water System (Golder, 2002). These meter data were found to be consistent with other eastern Washington cities. These estimates were selected by the planning unit to be used as a preliminary estimate of water use to assess allocation against the reserve to date, and deferred the task of refining the estimate of water use to Phase 4 Watershed Planning.

Highlands Associates (1993) provided a summary of several additional water use estimates, including an estimate of 220 gpd to 260 gpd, based on Town of Twisp water use data, and an estimate for indoor water use of 185 gpd, based on data from the United States Department of Housing and Urban Development. Water use estimates from watershed plans for nearby WRIAs are also summarized in Table 1. These estimates of total water use range from 367 gpd to 980 gpd.

Table 1. Selected Existing Water Use Estimates

Estimated Use (gpd)	Region	Source
600 ADD	WRIA 48	*Methow Basin (WRIA 48) Watershed Plan*, 2005
1,200 MDD	WRIA 48	*Methow Basin (WRIA 48) Watershed Plan*, 2005
220-260 ADD	WRIA 48	Town of Twisp data (Highlands Associates, 1993)
185 ADD (indoor)	WRIA 48	Dept of HUD (Highlands Associates, 1993)
360 ADD	Nationwide	American Water Works Association (Highlands Associates, 1993)
403 ADD	Statewide	Washington Rural Water Association (Highlands Associates, 1993)
490-980 ADD	Spokane	Watershed Plan - WRIA 55/57
367 ADD	Waterville	Watershed Plan - WRIA 44/50
670 ADD	Mansfield	Watershed Plan - WRIA 44/50
900 ADD	Yakima	Watershed Plan - WRIA 37/38/39
380 ADD	WRIA 45	Watershed Plan - WRIA 45
700-900 ADD	WRIA 49	Watershed Plan - WRIA 49
1,500 MDD	Eastern WA	WDOH Water System Design Manual (WSDM), 2001
350 MDD	Statewide	WDOH WSDM statutory minimum for analogous system design
200 ADD	Statewide	WDOH WSDM minimum observed

Most of these estimates represent total water use, combining indoor and outdoor uses as a single value. In addition, these estimates focused on average daily demand based on annual water use and generally did not account for seasonality or attempt to estimate peak water use. As discussed previously, two objectives of the current Study Plan are to differentiate between indoor and outdoor water use and to evaluate seasonality of water use, including estimating peak water use for purposes of determining what portion of the reserve has been allocated to existing single domestic use and what portion of the reserve is available for future allocation.

Indoor water use is typically less than outdoor water use. Water use during the winter months (base use), when outdoor water use is assumed to be minimal, has been used to estimate year-round indoor use per equivalent residential unit (ERU) of about 200 gpd (WDOH, 2001). Examination of available water system records for winter months in WRIA 48 could confirm whether indoor water use in WRIA 48 is consistent with other studies.

1.3 Study Plan Organization

Following this introductory section, this Study Plan is organized as follows:

- Section 2 presents an **Overview of Alternative Methods** to estimate water use, including relative advantages and disadvantages of each method.
- Section 3 presents the **Recommended Method** to estimate water use, based on initial review of available data and discussions with the MWC and Ecology. This section describes specific tasks that will be completed to estimate water use from exempt wells.
- Section 4 describes the **Reporting** that will document work performed and results generated under this Study Plan.
- Section 5 lists **References** cited in this Study Plan.

2 Overview of Alternative Methods Considered

The following methods to estimate water use at residences served by exempt wells in WRIA 48 were previously presented to the MWC and Ecology for consideration and discussion. These methods could be combined, such that results of one method could be used to either confirm or expose uncertainties in the results of another method. A general overview of each method, with associated advantages and disadvantages is provided. Section 3 presents the recommended (proposed) method for evaluating water use in WRIA 48.

2.1 Method 1 - Analogous System Method

The analogous system method is one of three approaches approved by the Washington State Department of Health (WDOH) for new water system capacity planning and is described in Chapter 246-290-241 WAC (Water System Design Criteria) and in the *Water System Design Manual* (WDOH, 2001). Under this method, water use metering data from existing water systems having similar characteristics to the system under consideration (in this case, residences served by exempt wells) are used to estimate water demand requirements. Analogous systems are defined by Chapter 246-290-241 WAC as "those with similar characteristics, such as demographics, housing sizes, income levels, lot sizes, climate, water pricing structure, water use efficiency practices, use restrictions, and soils and landscaping." The effects of these system characteristics on water use are summarized in Appendix A.

This method could be applied using only data from water systems located within WRIA 48, or could also include water systems located outside WRIA 48 that are determined to be analogous to conditions within WRIA 48. In general, this method would include:

- Identifying Group A and B public water systems in WRIA 48 and, as available, plot the approximate service areas of each onto a map. Select water systems, if any, outside of WRIA 48 would also be identified.

- Determining the characteristics of properties currently served, or with the potential to be served in the future, by exempt wells. Property characteristic data would include at a minimum parcel size and annual precipitation data, both of which are readily available and significantly influence outdoor water use.
- Selecting water systems to use as sources of water use data based on the adequacy of available data (e.g., water use and number of connections by service type, service area, metering frequency) and the degree to which the selected water systems reflect characteristics of properties served by exempt wells in WRIA 48 (e.g., similar precipitation and lot sizes).
- Peak water use (defined as average daily use over the month of maximum use) for exempt wells would be estimated based on selected analogous water systems with weekly or monthly water use data. Average annual water use (expressed as ADD) would also be estimated, using data from all selected water systems considered representative of WRIA 48.
- Water systems with weekly or monthly water use data could also be used to determine average indoor use, which is assumed to be uniform throughout the year and approximately equal to average winter use when outdoor uses are at a minimum. Data from these water systems could also be used to estimate average and peak outdoor use. Average outdoor use would be equal to the average annual use minus the estimated indoor use. Peak outdoor use would be equal to the monthly or quarterly peak use minus the indoor use.

The advantages of this method are that it relies on existing water system data and a limited set of readily available water system characteristics, and that water system data will likely be sufficient to evaluate indoor use and seasonal outdoor use. The limitation of this method is that source data would be from public water systems, which may not be completely analogous to exempt well residences.

2.2 Method 2 - Empirical Formula

Under this method, ADD and MDD would be estimated using empirical formulas developed by WDOH to assist water system design engineers in system design and planning. In this case, MDD would be assumed to represent peak water use (defined as average daily use over the month of maximum use). Use of MDD would likely overestimate peak water use, as MDD is the maximum day of use, rather than the average daily use over the month of maximum use.

The WDOH developed an empirical correlation between average annual precipitation and ADD (WDOH, 2001). Data from three primary sources were used in the WDOH analysis: water system plans on record with WDOH; surveys completed by water system managers; and results of a similar study conducted in California. Water use data were plotted against average precipitation data and the following formula describing the relationship between these parameters were developed from best-fit curves:

$$ADD = (8000/AAP) + 200$$

Where ADD is average day demand in gpd per ERU and AAP is average annual precipitation in inches per year. The WDOH recommends that for system design the MDD should equal twice the ADD.

Under this method, the above equations would be used with representative precipitation data from the Methow Watershed to estimate ADD and MDD at properties served by exempt wells. The primary advantage of this method is that it requires only precipitation data, which is readily available. The disadvantages of this method are that is does not account for other factors affecting water use, such as parcel size, and using MDD would likely overestimate the average daily use over the month of maximum water use.

2.3 Method 3 - Direct Source Metering

Under this method, a representative number of exempt wells would be equipped with water meters to record groundwater withdrawals throughout the year. This method would provide a direct measurement of water use from exempt wells; however, it would still require an evaluation of the characteristics of the parcels (e.g., precipitation, parcel size) served by the metered exempt wells to determine if they were representative of conditions throughout WRIA 48. To account for variability in parcel characteristics and individual water use patterns, this method would require meter installation at a sufficient number of wells to produce a representative sample of the total exempt well population and achieve defensible results. While this effort might be implemented more easily if, for example, exempt well water meters were installed upon issuance of a building permit, it would still take several years of new residential construction to ensure a representative number of residences are metered.

The primary advantages of this method are that it would provide a direct measurement of groundwater withdrawals from exempt wells and, depending on the frequency at which the water meters were read, would provide data to identify the period of maximum use. The disadvantages of this method are that meters would be costly to install, read, and maintain; potentially a large number of metered locations would be required; and it would take several years of metering to provide sufficient data to assess seasonal, annual, and spatial variability in water use.

3 Recommended Method

In the spring of 2009, discussions were held with the MWC and Ecology regarding potential methods to estimate water use at residences served by exempt wells. All parties agreed that an analogous method presents the most efficient approach for developing a water use estimate that meets the objectives of the Study Plan. The recommended approach detailed below takes into consideration input from these discussions. The recommended approach consists of five tasks and an optional sixth task. Tasks 1 through 4 focus on identifying and compiling analogous water system data representative of residences served by exempt wells in WRIA 48. Task 5 utilizes an alternative method for estimating outdoor water use to verify results of the analogous method. An optional Task

6 outlines an adaptive management approach whereby future metering of exempt wells could be used to confirm or refine results of the analogous method.

3.1 Task 1 - Conduct Literature Review

Under this task, previous water use estimates in WRIA 48 and select areas of eastern Washington will be compiled and reviewed to identify average values for indoor water use. To the extent available, outdoor water use data will also be compiled for comparison purposes. Existing studies indicate indoor water use remains relatively constant regardless of region and time of year, such that indoor water use in other areas of Washington State should be applicable to WRIA 48. This task has largely been completed through earlier efforts of the watershed planning process and preparation of this Study Plan, although additional relevant data from outside of WRIA 48 may be available for use in implementing this Study Plan.

3.2 Task 2 - GIS Mapping

Under this task, a base map will be created displaying basin characteristics that influence water use in WRIA 48, such as annual precipitation or irrigation service area boundaries. The base map will be created in a geographic information system (GIS) database using readily-available spatial data, including Assessor's parcel layers from Okanogan County, the distribution of annual precipitation from the Watershed Planning Phase 2 Report (Golder, 2002), major irrigation district boundaries, and major public water system service area boundaries. Some of these boundaries may need to be digitized from existing maps. The locations of public water systems will be plotted on the base map by quarter-quarter section to confirm that selected sources are geographically distributed throughout the watershed.

The GIS database and base map will be used to identify the range of characteristics of parcels potentially served by exempt wells, particularly annual precipitation and parcel size.

3.3 Task 3 - Compile and Review Public Water System Data

Under this task, water use and service connection data will be obtained from Group A and B water systems across WRIA 48. There are over 200 Group A and B public water systems in WRIA 48, and only a subset of these water systems will be evaluated. Water systems for use in estimating exempt well withdrawals will be selected based on geographic location, availability and completeness of data (water use, service connections, period of record, and frequency of reporting), and characteristics of the service area (i.e., precipitation and parcel size). Water systems will be selected to ensure that to the extent possible the variability in the characteristics of parcels potentially served by exempt wells is reflected by the characteristics of the selected water systems.

The selected water system data will be reviewed to identify potential sources of water use variability that could bias the results. For example, a system with significant non-residential uses that does not record water use by service type would not be representative of single domestic use.

Only two Group A water systems (Towns of Twisp and Winthrop) regularly report water use directly to WDOH. A few additional Group A water systems have Water System Plans on file with WDOH; however, most water use and system characteristics data are maintained locally. Obtaining these data will require coordination with water system managers, including site visits to collect relevant data.

Public water system data will be screened to ensure that connections also receiving irrigation water from a separate source (e.g., irrigation district) are not included in the water use estimate. This will be accomplished by using information obtained from the water system managers, the base map developed in Task 2, and existing studies such as Highlands Associates (2008).

3.4 Task 4 - Estimate Total (Indoor and Outdoor) Water Use by Exempt Well Parcels

Under this task, total (indoor and outdoor) water use per exempt well parcel will be estimated based on the public water system data. The proportion of indoor and outdoor water use will also be estimated. Based on an initial review of existing studies, indoor water use is relatively uniform, both geographically and throughout the year. Therefore, seasonal and geographic variations in total water use are anticipated to be largely reflected in outdoor water use.

The range of total residential water use (minimum, maximum, mean, and median) will be estimated from the water system data from systems selected in Task 3. At a minimum, these estimates will be based on annual use. Water system data with monthly or quarterly reporting will be used to estimate maximum monthly or seasonal water use. Indoor water use will be estimated based on water use data collected during winter months (base use) and compared to results of indoor use estimates established in existing literature (Task 1).

3.5 Task 5 - Verify Water Use Results

The objective of this task is to confirm and/or assess uncertainties in the water use estimates based on the method outlined in Tasks 1 through 4, using supplement data sources and additional lines of evidence. First, a comparative analysis will be performed to verify the results with data for water systems located outside WRIA 48 with similar climatic and land use characteristics to exempt well parcels within WRIA 48. Assuming suitable water system data are identified, this approach would follow the same procedures outlined above in Tasks 3 and 4.

Variability in outdoor water use is likely the largest source of uncertainty in estimating total water use. A second verification step will involve estimating outdoor water use for a representative number of existing residences. Using the GIS base map developed in Task 2 and parcel water source information from the Okanogan County Planning Department, a representative subset of developed parcels in WRIA 48 served by exempt wells will be identified. Using aerial photographs, the irrigated area on each selected parcel served by an exempt well will be estimated. The monthly irrigation demand of a reference crop (pasture or turf) occupying the irrigated area on each exempt well parcel will then be calculated using methods consistent with Ecology Guidance 1210 and the Washington Irrigation Guide (WIG). Washington State University (WSU) under contract to Ecology

is currently updating the WIG; however, the update may not be completed prior to implementation of this Study Plan. Assumptions will be made consistent with the anticipated revisions for purposes of establishing a representative crop irrigation requirement for water study purposes.

The monthly irrigation demand will be combined with the estimated indoor water use to calculate average annual and peak monthly water use at the selected parcels. These estimates will be compared to the total (indoor and outdoor) water use estimates derived from water system data in Task 4.

3.6 Optional Task 6 - Adaptive Management Program (Metering Program)

Ecology and the MWC have also considered the feasibility of implementing an adaptive management program through metering of exempt wells in WRIA 48. Should such a program be implemented, results could be used to verify or refine estimates of water use from Tasks 1 through 5. The metering program could be set up as either a voluntary program (using existing and new exempt wells) or as a mandatory requirement for all new wells drilled in the basin. An effective adaptive management program will allow consideration of the completion of work, additional data, and changing priorities. Basin specific metering data could be compiled and reviewed as part of the 5-year review of the Detailed Implementation Plan (DIP). Elements of a metering program might include:

- Establish project objectives and evaluate whether metering will meet those objectives.
- Determine if metering will be voluntary or mandatory, and how to implement meter installation (e.g., require as part of building inspection for new construction).
- Develop specifications for metering equipment and installation.
- Define data collection procedures, roles, and responsibilities. Identify who will read the meters, how frequently meters will be read, and how data will be compiled, stored, and transmitted to relevant parties.
- Determine how results will be used to refine or verify the water use estimates described in this scope of work or used to track debits from the Instream Flow Rule reservations.

4 Reporting

Results of the water use study will be documented in a report to the MWC. The report will include documentation of all data sources used in the study, a summary of available data, and estimates of annual and peak monthly (expressed as daily average) water use. The report will also present a discussion of source of uncertainty in the water use estimates and a recommended value for annual average and peak monthly water use by exempt wells in WRIA 48.

A draft report will be prepared for Ecology and MWC review, followed by a meeting to discuss comments on the draft report. A second draft report will be prepared, incorporating MWC and Ecology comments and distributed for review. Any additional comments will then be incorporated into a final draft.

5 References

Golder, 2002. Phase II- Level 1 Watershed Technical Assessment for the Methow River Basin, Final Draft, Golder Associates, Seattle, Washington, June 2002.

Highlands Associates, 1993, Population and Growth Data for the Methow River Basin, Highlands Associates, Omak, Washington, September, 1993.

Highlands Associates, 2008, Reserve Use Since 1976, Final Report, Highlands Associates, Omak, Washington, July, 2008.

Klohn-Leonoff Inc., 1993

Methow Basin Planning Unit, 2005, Methow Basin (WRIA 48) Watershed Plan. June 20, 2005.

NRCS, 1997

Washington State Department of Health (WDOH), 2001, Water System Design Manual, Department of Health Publication Number 331-123. August, 2001.

Limitations

Work for this project was performed and this report 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 Methow Watershed Council for specific application to the referenced property. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

APPENDIX A

Factors Affecting Water Use

A.1 Factors Affecting Water Use

This appendix presents a summary of the numerous factors that can affect residential water use. Although most of these factors will not be directly incorporated into the water use evaluation, it is important to be aware of them in interpreting water use data and the study results.

Water use is influenced by natural and anthropogenic conditions. Some variables and their probable effect on water use are described below. These have been grouped into general categories including natural conditions, property characteristics, water costs, water source and water system characteristics, and temporal conditions. The most important variables are likely precipitation, evapotranspiration, lot size, and occupancy (full or part time). Washington State Department of Health (WDOH) determined that average annual precipitation the variable that most strongly correlates with water use (WDOH, 2001). WDOH also observed that lot size is an important variable affecting water use, with lots greater than 1 acre using up to 60% more water than lots less than 1 acre. The difference between larger and smaller lots is greater in eastern than western Washington. However, WDOH did not attempt to formulate a relationship between lot size and water use because the correlation between these data was not sufficient to quantify the relationship.

Assuming that indoor water use is largely constant, the variables discussed below apply primarily to outdoor water use. Although the effects of these variables on water use is not always quantifiable, it is important to consider these variables when interpreting public water system data and developing estimates of water use from exempt wells.

A.2 Discussion of Individual Variables

A.2.1 Natural Conditions

Precipitation: Outdoor water use decreases with increasing average annual precipitation. Precipitation is likely the most important variable affecting water use (DOH, 2001).

Evapotranspiration: Outdoor water use increases with increasing evapotranspiration. No studies were identified relating evapotranspiration to residential water use.

Temperature: Outdoor water use increases with average air temperature. A major factor influencing evapotranspiration rates is air temperature, which is often used to estimate evapotranspiration.

Wind: Outdoor water use increases with average wind speed. Average wind speed is a major factor influencing evapotranspiration. Some methods for estimating evapotranspiration account for average wind speed.

Soil: Soil texture may affect outdoor water use. According to the Washington Irrigation Guide (WIG), crop irrigation demand, or the amount of water needed to sustain a residential lawn, for example, is similar for crops in coarse-grained and fine-grained soils. However, soil texture may influence irrigation efficiency if irrigation scheduling is not suited to a particular soil texture (NRCS, 1997).

Aspect: East- and south-facing slopes are subject to higher levels of shortwave solar radiation than other aspects.

A.2.2 Parcel Characteristics

Lot Size: An important factor affecting outdoor water use. Lots greater than 1 acre that can use up to 60 percent more water than lots less than 1 acre. Increased water use with increased lot size is more pronounced in eastern than western Washington (WDOH, 2001).

Covenants or Restrictions: Property owners may be restricted in the amount of water they can use through binding agreements with their neighborhood covenants or water purveyor, especially in arid climates and where limited source water exists. In some developments, covenants may require property owners to maintain a given amount of landscaping or common space, potentially increasing water use over what the homeowner may have chose if the decision was left solely to them.

Landscaping: The type and extent of landscaping affects outdoor water use. While lawn or pasture might require considerable watering, some landscaping techniques such as xeriscaping and use of native plants will reduce water demand.

A.2.3 Water Cost

Water System versus Exempt Well: Most water purveyors charge a fee for the water they provide, either to cover costs of water production or as a means of making a profit. Exempt well owners only pay for the cost of electricity used to pump the water from the ground. The cost of obtaining water is likely an important factor affecting water use.

Water Pricing Structure: There are several options used by water purveyors to assess fees on water use. Water use may be curbed by stepped fees that increase with water use. Water use may increase with flat fees and stepped fees that decrease with water use.

A.2.4 Socioeconomic

Household Income: Data indicate water use increases with increased income, primarily affecting outdoor water use. Aside from a household's ability to absorb increased water production costs in the form of fees or electrical rates, higher income households tend to have larger homes and lots with greater irrigation needs (WDOH, 2001).

Property Value: Assessed property values may be used as a proxy for income levels, which have been linked to greater water use.

Occupancy: Water use will increase with occupancy (full time, part time, recreational lot). Some studies have assigned coefficients to account for water use by part-time and

recreational users. If part-time users are seasonal, it is important to determine whether predominant water use occurs in summer or winter.

A.2.5 Water Source

Well Depth: Water use may decrease with increased well completion depth for two reasons. First, exempt wells are generally drilled deeper when the aquifer does not provide sufficient yield, resulting in greater drawdown in the well during pumping. Second, pumping costs increase with well depth and increased drawdown.

Completion Material: In general, wells completed in competent bedrock tend to be less productive than wells completed in alluvial aquifers.

Availability of Irrigation Source: Parcels obtaining irrigation water from an irrigation district, ditch company, or other water right will likely use less water from an exempt well. Water withdrawn from exempt wells served by an irrigation source may be limited to indoor use. Approximately 395 exempt-well parcels obtaining irrigation water from an irrigation source were identified in WRIA 48 (Highlands Associates, 2008).

A.2.6 Water System

Condition of System: The overall condition of a water system may have bearing on reporting of water use data by water purveyors. For example, some water purveyors calculate water use per equivalent residential unit (ERU) by dividing the volume of water withdrawn at the source by the number of ERUs. If a water system is experiencing substantial water loss from leakage, then the reported water use per ERU will be inflated.

System Pressure: Water use decreases with decreasing system pressure (WDOH, WSDM; check reference).

A.2.7 Temporal

Irrigation Season: The irrigation season or growing season in the Methow Valley generally lasts from May through October, based on the operating season for irrigation canals and ditches. Outdoor water use outside of the irrigation season is likely small.

Timing of Precipitation: Precipitation occurring in the growing season reduces the demand for outdoor water use. Areas with less precipitation during the growing season would be expected to use more water.

Arrival of Seasonal and Part-time Residents: Water use will increase with the arrival of seasonal and part-time residents.

Tourist Season: Water systems supporting a large influx of tourists can experience greater water demands during the tourist season. For example, average daily demand in Winthrop was found to be approximately twice that of Twisp with the difference attributed to tourists (Klohn-Leonoff Inc., 1993).

A.2.8 Conservation

Irrigation Technique: Outdoor water use will vary with the method and efficiency of the irrigation equipment (e.g., impact versus microhead sprinkler).

Conservation Efforts: Indoor and outdoor water conservation measures decrease water use. The extent that conservation measures are implemented and used varies. Conservation practices include improved irrigation system efficiency, irrigation timing, leak detection and minimization, alternate day watering schedules, installation of low water use fixtures, toilet tank displacement devices, leak detection, and other unaccounted efforts.