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CHAPTER FOUR - B

CURRENT TRENDS IN WATER RIGHT TRANSFERS
Technical Aspects of Consumptive Use

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INTRODUCTION

This chapter focuses on the technical aspects of evaluating beneficial use (i.e., tentative determination), and specifically quantifying the consumptive use component, associated with the water right transfer and change process. Technical considerations and alternative approaches are presented for the following:

- Computation of total beneficial analysis of the existing right as a starting point in evaluating the validity and total quantity of water right available to transfer/change;
- Quantification of the consumptive use component of the water right; and
- Application of Ecology's Annual Consumptive Quantity (ACQ) Guidance.

It is important in the early stages of considering a change to an existing water right to define the issues that need to be evaluated and the data required to complete that evaluation. Preliminary "due diligence" evaluation of existing rights is critical prior to submitting an applications for change. This allows for the best strategy to ensure timely processing and successful transfer.

This chapter focuses on the two of the four criteria which need to be evaluated in processing a transfer/change. The four criteria include: 1) determining whether the water right has been put to full beneficial use and, if not, what portion of the original authorization is subject to relinquishment and invalid due to lack of use; 2) quantifying the consumptive use component available for transfer when expanding, changing or adding a purpose of use (to address the potential for enlargement); 3) evaluating hydraulic continuity and/or compliance with the same body of public groundwater requirements; and 4) assessing the potential for impairment (injury) to existing water rights.

Although the methodology for computing water use and assessing the consumptive and non-consumptive components are similar, there are differences in determining the amount of water available for certain types of transfer/changes. Under the statutory relinquishment (forfeiture) provision, the amount available for transfer is determined based on the highest annual water use occurring during the most recent five years of use, assuming that the right remained in good standing since first authorized. Recent changes in the water code (RCW 90.03.380 (1)) require determination of the annual consumptive quantity (ACQ) where the proposed change seeks to add acreage to an existing irrigation right or add purpose(s) of use. Ecology has developed a policy (POL-1210 - Calculating and Applying the Annual Consumptive Quantity) and guidance (GUID-1210 – Determining Irrigation Efficiency and Consumptive Use) for implementation of the ACQ policy. Under the ACQ methodology, the annual consumptive quantity is based on the average of the two highest years of water use in the most recent 5 years.

VERIFYING BENEFICIAL USE OF AN EXISTING WATER RIGHT

How much water is available for transfer and change? Water rights include an authorization of a maximum instantaneous quantity (Qi) and maximum annual quantity (Qa). The Qi is a

maximum flow rate, expressed in gallons per minute (gpm) for a groundwater withdrawal and cubic feet per second (cfs) for a surface water diversion. The annual quantity Qa is typically expressed in acre-feet per year (afy). Quantifying the Qi and Qa that has been put to beneficial use is generally the starting point for all transfers, unless the water right was recently changed and the level of beneficial use documented.

Total beneficial use includes both consumptive and non-consumptive uses, which vary depending on the purpose of use (e.g. irrigation, industrial, fish propagation etc.). That portion of the total water diverted from a surface water source or withdrawn from a well that returns to the water source and is therefore not "consumed" is considered the non-consumptive component. Examples of non-consumptive uses include, irrigation return flow (irrigation water that is not consumed by the crop and recharges past the root zone); NPDES discharges from industrial processes; and water used in fish hatchery operations. Determination of the consumptive component is discussed later in this chapter.

Meter data provides the most direct and defensible data for demonstrating beneficial use. Ecology's metering rule (WAC 173-173) includes guidance on metering methodology and reporting for different types of withdrawals. In general, most meters include a direct read out of instantaneous flow rate and a "totalizer" that tallies the total volume over a given period of time. Generally speaking, prior to adoption of WAC 173-173 there has been limited metering of historical water use, other than by municipalities and those operating large diversions. Phasing in of the "metering rule" requirements over time to include a broader population of water users in the State will undoubtedly improve the quantification of total water use. However, in the absence of direct meter readings there are a number of indirect measures that, when used in combination, can provide sufficient documentation of use. Conducting a thorough evaluation of actual water use is important since it may vary notably from the original authorization. Historically there have been water rights issued based on pumping facilities present ("pumps and pipes") versus actual water put to use. Information obtained from Ecology's Water Rights Tracking System (WRTS) database information reflects the original authorized quantities, often referred to as the "paper" water right, which often differs from what is actually being put to beneficial use.

Ecology maintains files on existing water rights which may contain useful information for understanding the basis (e.g., acres irrigated and crop type assumptions) for the original water right. Often the Report of Examination also includes useful data.

Although the basic concepts of verifying total beneficial use apply to all purposes of use, the type and availability of data may vary considerably. Examples range from having to prepare a written affidavit of use where no documentation exists, or documenting water use within an industrial process, to use of electrical records. The example data presented below focuses principally on verifying the beneficial use of an irrigation water right, which represents a large percentage of the acquisitions and changes to existing water rights. Data needs for demonstrating beneficial use of other uses are also noted.

What Data Are Needed?

Collecting as much of the following information as possible to provide multiple lines of evidence is recommended in the absence of meter data. The starting point is talking with the landowner or water users. Data from the last 5 years are most critical, however as much data as possible over the past, say, 15 years is preferable, particularly when potential exemptions to relinquishment may apply, and to avoid surprises (e.g., protests of prior lack of use). Useful data include:

- **Pumping Records** - (ideally) periodic reading from a flow meter on the well or diversion pump (annual totalizer). Although a large number of certificates historically required the installation of a flow meter, few actually were or they are no longer functioning. Direct recording of total annual pumpage is generally not available. Information on irrigation scheduling coupled with irrigation system capacity can provide an indirect measure of annual quantity;

- **Electrical Records** – electrical utility meter readings associated with the pumping equipment. With owners consent, these records can be obtained from the utility district. For industrial facilities, it is often not possible to separate out electrical use for water conveyance from the energy demand of the manufacturing process;

- **Well Construction Information** – including geologic log and well construction details prepared by the driller at the time of well completion. If not available from the owner, then check Ecology's well log files. Last resort is contacting the drilling company, if known;

- **Aquifer and Well Yield Data** - including static (non-pumping) water level, pumping level, pumping capacity, and pumping test data (if available). It is often necessary to obtain this information in the field particularly when changing the point of withdrawal, but some data may be contained in Ecology's water right files;

- **Aerial Photos** – low altitude, during the prior 5 to 10 years. These can be helpful for documenting agricultural land use and water use practices (mostly applicable to eastern Washington), or wastewater discharge systems for industrial sites. Aerial photo data can be manipulated using graphical information system (GIS) software to estimate crop types;

- **Irrigation Equipment/Method (Irrigation Rights)** - including the type of irrigation system, layout, pressure requirements at well head for operation. For orchard sites, sprinkler systems are used for both tree watering and also for temperature control (frost protection and fruit cooling);

- **Crop Records (Irrigation Rights)** – including annual rotation by crop type during the prior 5 to 10 years. This information is generally supplied by the farmer. In addition, some government programs require crop records. For example, if the farmer participated in the USDA crop reduction program (CRP), then crop data may be available with the Farm Service Agency;

- **Process Water Use (Industrial Rights)** – documenting water use by industrial process along with NPDES data for quantifying discharge.

What is Involved in Computing Beneficial Use?

Multiple lines of evidence provide strongest documentation. Compare the water requirement assumptions presented in the Report of Examination to present conditions and usage. Conduct a site visit to inspect (and photo document) diversion/pumping facilities and place of use (e.g., acreage). Use of aerial photos can be helpful (low altitude photos are required and timing (season) of the photo is important).

Often, due to the lack of information, obtaining a detailed declaration signed by the existing water users, is the primary means of verifying past use.

The following briefly summarizes the technical analysis of the following data sources:

Using Pumping Records – when available, this information provides a direct measure of the quantity of water pumped, and can be directly compared to the total annual quantity limit (Qa - expressed as acre-feet/year) on the certificate. Alternatively, pump run-times (records of how long the pumps were run each day) multiplied by the established pumping rates used with the irrigation system can be used to estimate annual quantity; and

Using Electrical Records – electrical meter readings (kW-hr) can be used as an indirect measure of total water pumped when flow meter data are not available. Most large capacity irrigation wells are on single meters, however water supply pumps/conveyance at industrial facilities are generally combined with other larger energy uses. The following information is needed:

- Monthly electrical consumption by well (over the entire irrigation season);
- pump type, size (horsepower rating), efficiency, and pumping level;
- for irrigation rights - type of irrigation equipment being used, system efficiency, and total head requirements (key factor is pressure required at the well head to operate the irrigation equipment properly; and
- pumping period.

Useful reference guides include:

Groundwater and Wells, Driscoll, 1986.

Costs of Groundwater Pumping Systems for Irrigation in the Eastern Columbia Basin, WSU, Bulletin 0882, 1979.

Cost Comparison between Electric Motors and Engines for Irrigation Pumping, University of California, Publication 1933.

Using Crop Data and Irrigation Information – a water duty (acre-feet of water/acre of crop/year) which represents total water applied, can be estimated based on derivation of an irrigation water budget that essentially has two key components:

- evapotranspiration (ET) – which is the amount of water consumed by a plant (crop requirement) and is crop specific; and

- irrigation efficiency – which represents the amount of water that needs to be applied in addition to the crop requirement (ET) to meet irrigation system "losses". These system losses are generally related to the type of irrigation system (e.g. pivot, hand line etc.) that is being used. The irrigation efficiency accounts for both consumptive and non-consumptive components of irrigation supply.

It is important to develop a map showing the total acreage comprising the designated "place of use" for the existing water right and the field designations. A fairly recent low altitude aerial photo of the farm can provide an ideal base for a map showing the place of use, irrigation system layout, well locations, and field designations.

Source guides for determining CIR and a water duty for the purposes of estimating total water use include:

State of Washington Irrigation Guide (WIG) prepared by USDA, SCS, in cooperation with the Washington State Cooperative Extension Service, 1985 (amended 1990, amended 1992 for select western Washington crops)

Irrigation Requirements for Washington – Estimates and Methodology WSU, Research Bulletin XB0925, 1982 (reprinted 2001 EB1513)

National Irrigation Guide, 1997

WSU Public Agricultural Weather System (PAWS)

In addition to published data, other useful sources for determining a water duty for an area include the assumptions used in the Report of Examination and adjudication reports.

Pumping Facilities and Capacity – in addition to quantifying the annual quantity of water (Qa) put to beneficial use, it is necessary to verify that the maximum instantaneous pumping rate is adequate to support the claimed use. This is particularly important when using indirect methods of analysis. This information is generally not available and will require re-plumbing the existing discharge line with a flow meter and conducting a pumping test to evaluate well yield. This is an opportune time to also assess the overall condition of the well and pump (well efficiency) and collect water quality samples.

Declaration (Affidavit) by Existing Water Right Holder/User – obtaining a written declaration from the existing water user (farmer), which documents the use of water during the most recent 5-year period, is very useful. In many cases a complete set of data for establishing

water use is lacking, making the declaration an important element of demonstrating beneficial use. Use of an affidavit as the sole documentation of historical beneficial use is certainly more prone to challenge by Ecology or other parties than other forms of quantitative use data.

QUANTIFYING CONSUMPTIVE USE

Water rights are authorized for a specific purpose of use or uses when issued, the nature of which directly relates to the amount of water that is consumptive - or "lost" to other uses within the watershed, and non-consumptive – water that is "returned" to the watershed as a result of the intended beneficial use. However the consumptive versus non-consumptive components of water rights are not specifically quantified in the water right authorization. Although for a given type of use the nature and relative percentage of these components can often be inferred from the water right report of examination, it nonetheless requires use specific quantification.

A consumptive use analysis is required as part of the water right change/transfer process to evaluate the potential for enlargement of a water right associated with a proposed change or transfer. The potential change in the consumptive use "balance" needs to be evaluated when changing the purpose of use or place of use. With the change in the purpose use, say from irrigation to power generation, the annual amount of irrigation return flow (non-consumptive use) would need to be compared to the estimated treated wastewater discharge "blowdown" from the energy process. Irrespective of the purpose of use, the technical analysis requires researching water use components and documenting the historical consumptive use given the specific site conditions. For estimating consumptive use associated with irrigation, it is important to consider the different methods available for estimating crop irrigation requirements and irrigation efficiency, derived from guidance/reference documents or based on farm specific data. For an industrial use, it is often advisable to perform a detailed process analysis to quantify consumptive use, since there are few reference documents available. Alternatively, it is often sufficiently accurate to estimate industrial consumptive use by subtracting the quantity of wastewater discharge (data generally required by NPDES permit) from total water use records (or estimates).

In the majority of watersheds throughout the State of Washington, irrigation constitutes the largest number and quantity of existing water rights. It is not surprising then, that changes and transfers of existing irrigation rights are the most common. The following presents a more detailed discussion of the consumptive use of an irrigation rights for illustration of such an analysis.

Irrigation Consumptive Use Balance

The irrigation water budget can be described by the following simplified equations:

Total Water Use = Consumptive Use (CU) + Return Flow (RF); where

CU= Crop Irrigation Requirement (CIR) + Consumptive Portion of Irrigation Efficiency;

CIR = Evapotranspiration (ET) – Rainfall during the Growing Season;

Irrigation Efficiency = canopy losses, spray evaporative loss, wind drift, deep percolation, runoff, leaks, non-uniform application.

The first step in the water balance is estimating total water use based on the methods described earlier in this chapter. The other key terms that need to be derived include the crop irrigation requirement (CIR) and irrigation efficiency.

The crop irrigation requirement requires an estimate of ET and rainfall for the growing season. Rainfall can be readily obtained from several sources including NOAA's National Climate Data Center web site. There are however several methods of deriving representative ET values for different crops and locals. There is a large number of methods for deriving evapotranspiration, which is the loss of water from a vegetated surface through soil evaporation and plant transpiration. The simplest approach is to utilize the reference documents listed in this chapter which provide information for crops grown in the State of Washington. Note however that in many cases the ET values in these reference documents were derived using different computational methods, all of which carry some limitations. Consequently, it is advisable to look at the range of values for ET across the reference documents and determine the most appropriate value based on site conditions and underlying assumptions in the methodology.

The most commonly used methods for deriving ET values include:

- Modified Blanney-Criddle (which is temperature-based; and is the method used to derive the values in the Washington Irrigation Guide);
- Penman-Montieth (which is energy-based; and is the standard adopted by USDA);
- FAO Radiation (radiation-based); and
- Pan Evaporation

Where applicable, the CIR also needs to account for other consumptive demands such as frost protection, cooling, germination, and leaching requirements – all of which are crop specific. Information on these practices is generally available through the agricultural extension agency.

Irrigation efficiency is the other major component of the irrigation water budget and often based on industry averages or estimated indirectly as the resulting difference between total water use and the crop irrigation requirement. The Washington Irrigation Guide provides information on typical efficiencies by irrigation type. In addition, Ecology's ACQ guidance document provides a table of estimated system efficiencies that can provide a starting point. It is advisable to gain a thorough understanding of the particular irrigation system used, crop rotation, and irrigation scheduling approach prior to estimating the irrigation efficiency.

APPLYING ECOLOGY'S ACQ GUIDANCE (GUID – 1210)

This recent Annual Consumptive Quantity (ACQ) guidance, adopted in October 2005, was developed to provide a methodology for calculating and applying the annual consumptive quantity (ACQ) in accordance with RCW 90.03.380 (1). Annual Consumptive Quantity means

the estimated or actual annual amount of water diverted pursuant to the water right, reduced by the estimated annual amount of return flow, averaged over the two years of greatest use within the most recent five-year period of continuous beneficial use of the water right. The guidance document (GUID-1210) is included at the end of this chapter.

The underlying methodology for computing the consumptive use component is similar to that presented above. Although default values, identified as "reasonable assumptions" for key parameters such as irrigation efficiency are provided in the document, it is important to note that site specific derivation is encouraged and use of these values is not required. This is particularly important with regard to selecting the most appropriate methodology for estimating ET for computation of the crop irrigation requirement.

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