APPENDIX D

Chapter 5 Appendix

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D.1. WASHINGTON WATER RIGHT APPLICATION INVENTORY PROCESS

Data was provided to Golder by Ecology in two GIS files. The two files were joined by GIS and exported into an Excel file. The data included all water rights and water right applications within 1 mile of the Columbia River.

Three columns were inserted into the joined Excel file. A column headed "RecordType" was inserted after the column headed "Doc_Type". This column was used to sort water rights from water right applications. A column for calculations was inserted prior to the column headed "QA_Total" and a column headed "PurposeDesignation" was inserted just after the column headed "PURPOSE_LI". An AutoFilter was placed on the heading row, and sorted according to use.

An assumption was made that the primary use of a water right application would be listed first in the PURPOSE_LI column. The general use designation (GUD) assigned to each water right was based on the first purpose of use code (PUC) listed and all subsequent PUCs were ignored. Many of the water right applications list several PUCs, which may encompass more than one GUD. PUC codes for Washington are provided in Table 4-G.

The Agriculture GUD incorporates the dairy, frost protection, irrigation and stock watering PUCs. The Commercial and Industrial GUD incorporates the cooling for industrial purposes, commercial and industrial manufacturing, highway, mining, and railway PUCs. The Domestic GUD incorporates domestic general, domestic multiple, domestic single, heat exchange, domestic municipal and recreation PUCs. The Environment and Wildlife GUD incorporates the environmental quality, fire protection, fish propagation, and wildlife propagation PUCs. The Undefined GUD incorporates rights where the primary use was not provided or an unrecognized (non-standard) PUC. Records coded for power (PO) were assumed to refer to hydropower. Because water used to generate hydropower can be used downstream for other uses, all queries were filtered to exclude water right application records coded for PO to eliminate counting the water demand twice.

After GUDs were assigned to each record, the table was sorted by water record type. The records were sorted into two categories, water rights and water right applications. Water right application records include CertChg, ChgApp, Chng/ROE, and NewApp document types.

After the data was sorted by document type, the data was sorted by water source in the column headed RCW_CLASS. The water sources include G (ground water), S (surface water), and R (reservoir water). Because water used in reservoirs can be used downstream for other uses, the data was filtered to exclude reservoir water from all queries to eliminate counting the water demand twice.

The data was sorted for blanks in the column headed "QA_Total". When no Q_a (annual quantity) was reported, a Q_a was calculated in a separate column using the Q_i (instantaneous quantity) provided. An assumption was made that the Q_i would be used twenty-four hours a day every day of the year. The Qi provided for surface water is typically reported in cubic feet per second (CFS) and the Q_i provided for ground water is typically reported in gallons per minute (GPM). The equations below were used to determine the Q_a in acre-feet per year (AFY).

For Q_i reported in CFS:

$$(Qi)\left(\frac{0.0000229568\,AF}{1\,CF}\right)\left(\frac{60\,S}{1\,Min}\right)\left(\frac{60\,Min}{1\,Hour}\right)\left(\frac{24\,Hour}{1\,Day}\right)\left(\frac{365.25\,Day}{1Y}\right)=Qa$$

Or Q_i multiplied by 724.4615.

For Q_i reported in GPM:

$$(Qi)\left(\frac{0.0000229568\,AF}{1G}\right)\left(\frac{60\,Min}{1\,Hour}\right)\left(\frac{24\,Hour}{1\,Day}\right)\left(\frac{365.25\,Day}{1Y}\right)=Qa$$

Or Q_i multiplied by 1.6141.

D.2. WATER BANKS, WATER TRUSTS, AND WATER REUSE

Terminology

Water Bank – A *water bank* is an institutional mechanism that facilitates the legal transfer and market exchange of surface water, groundwater, or water storage. This mechanism may be administered by any type of entity, such as private, public, or non-profit.

Water Market – The term *water market* has been used interchangeably with the term *water bank*. For purposes of consistency, the term *water bank* will be used from this point forward.

Water Held in Trust – Per the Washington State trust water legislation (RCWs 90.38 and 90.42.040) *water can be held in trust by the State* to be put to instream uses and to protect it from relinquishment. Water cannot be held in trust by any entity except the State of Washington, but *water held in trust* can be a component of, and be managed by any Water Bank (even one that is not administered by the State). The term *water trust* defines an entity that operates only to manage *water held in trust*. (A *water bank* may choose to operate a *water trust* as a subset of the larger bank.)

Water Banks

Water banking can be defined as, "an institutional mechanism that facilitates the legal transfer and market exchange of various surface, groundwater, and storage elements," (Clifford, et.al., 2004). The purposes of a water bank can be to: create a more reliable source of water, ensure future water, **promote conservation**, act as a market mechanism, resolve issues of inequity, and/or insure intrastate instream flow requirement compliance.

Water banks can be the following types:

- Institutional banks – These deal in paper water rights.
- Surface storage banks – These deal in physical water. They are generally formed around a reservoir.
- Groundwater banks – These may deal in credits or entitlements for groundwater, or may deal in physical water. Aquifer Storage and Recovery (ASR) can also operate as a groundwater bank, storing physical water in the aquifer for later use.

Water Bank Establishment and Operation

Water banks are operated by an administrative body, which may be a private, non-profit, government, or other entity. Minimally, that body aggregates water supplies from willing sellers and facilitates the sale to buyers. The actual process of exchanging water rights depends on the specific type of bank established. Water banking is a relatively new concept in Washington State. A number of operations similar to water banking have been carried out in the State, but only one, the Yakima Basin Banking Project, has been instituted by legislation. Since water banking is new, and water issues vary between watersheds, the specifics of how an individual bank will operate are very dependent upon local needs and water issues. There are many operational decisions that must be made when the bank is established.

There are many options for the pricing of water in a water bank; the bank must decide on an approach, including fixed rates, adjusting prices, and other options. Additionally, the bank must decide how to approach forfeiture, leasing and other questions. Water banking may be done only on a stream reach by

stream reach basis, or may extend beyond into a larger watershed. Water banks may also administer water held in trust by the State, which is discussed in the section below.

In order to establish a water bank, the state should enact general authorizing legislation to create the bank. This legislation will strengthen the bank's authority and legitimacy. In addition, this policy will establish an operational framework to facilitate a flexible trading mechanism. Overall, the bank water administrator must have legal authority to execute the water banking mandate.

Water Held in Trust

Two pieces of legislation made it possible for water rights to be held in trust by the State to meet presently unmet water needs, which include needs for instream flow and fish. The first, the 1989 Yakima Basin Trust Water Rights Act (RCW 90.38), established the concept of a water trust. In 1991, RCW 90.42.040 authorized the State's water trust program, allowing that water rights may be sold, leased, or donated to a water trust managed by the State of Washington. This legislation allows that the State may acquire or hold trust water rights for instream flows, irrigation, municipal, or other beneficial uses. The water right holder designates the specific use of the trust right when it is put into trust. Water held in trust is managed by the Washington Department of Ecology (Ecology), but trust water may be a component of any water bank's operations, whether the bank is administered privately or publicly. (Examples of this are the Texas Water Bank which includes the Texas Water Trust and the Walla Walla lease bank which is operated by a non-profit called Oregon Water Trust, these are discussed below.)

RCW 90.38.010 describes waters eligible to be held as trust water rights:

"That portion of an existing water right, constituting net water savings, that is no longer required to be diverted for beneficial uses due to the installation of a water conservation project that improves an existing system."

In that definition, "net water savings" means the amount of water that through hydrological analysis is determined to be conserved and usable for other purposes without impairing existing water rights, reducing the ability to deliver water, or reducing the supply of water that otherwise would have been available to other water users.

Therefore, only the portion of the water right that has been used consumptively, and is no longer being consumed, is eligible to be put into trust.

Often, the benefit gained by the water right holder by placing water into the trust is that trust water is not subject to relinquishment. Water rights can be temporarily leased to the water trust for instream uses. This frees the water right holder of being forced to irrigate or relinquish their water right. Another key concept of the water trust program is that trust water retains its original priority date. (Unless the original water right is split between the trust and the original water right holder, in which case the water in the trust has an inferior priority date to the water retained by the original water right holder.)

Trust water right legislation includes the following provisions:

- All trust water rights must be placed in the State Trust Water Rights Program to be managed by the Department of Ecology and held in the name of the State of Washington. (However, this does not prohibit trust water transactions from being made within another water bank.)
- "A trust water right means any water right acquired by the state for management in the state's trust water rights program.

- A water right acquired by the state expressly conditioned to limit its use to instream purposes must be used as a trust water right in compliance with that condition.

- Trust water rights retain their priority date during the time they are held in trust and are not subject to relinquishment due to lack of use.

- Trust water rights can redirect the use of conserved water saved through state- or federally-funded conservation. The conserved water, or "net water savings" means the amount of water determined to be conserved and usable within a specified stream reach for other purposes without impairment or detriment to water rights existing at the time that a water conservation project is undertaken.

- Trust water rights must not reduce the ability to deliver, or supply water that otherwise would have been available to other existing water uses." (Ecology, 2003, pub # 30-11-005).

Ecology requires that, in order to be put into the trust, the change in water use cannot increase the instantaneous or annual quantity of water used, the water right must be eligible to be changed, the water right must not have been abandoned or relinquished for nonuse, the source of the water cannot change, the change cannot expand the water right, the change cannot increase the consumptive use of the water, and the change cannot be contrary to public interest.

Guidelines for the state water trust program were required under 90.42.080. Initially, in 1992, the state water trust program was to apply to only eight priority WRIAs. In 1993, the program was expanded to apply statewide. Many factors influence the amount of water that may be put into a water trust and transferred to other beneficial uses in any watershed. These factors are: the amount of water which has historically contributed to return flows, the amount to be salvaged water, the amount to have been used with reasonable efficiency, and other characteristics of the water right. Generally, there are two situations when water can be put into a trust, either the water right holder continues to use water, but becomes more efficient, and transfers the water made available by efficiency to the water trust, or, the water right holder permanently or temporarily stops using water and transfers this to the water trust.

Water can be put into the trust under many different agreements, including dry year lease options, temporary or permanent changes in the place or type of use of the water right, water banking managed by the state, **transfer of water conserved by a water conservation project**, or simply by gift. Ecology will consider applications to put water into trust based on an analysis of the following:

- Any plans or agreements pertinent to the water right (i.e. water conservation plan);

- Data availability and certainty of the water right;

- Benefits to the State, public, resources, and effects on third parties;

- Types of public benefits to be realized; and

- Availability of funding.

Water Banks in Washington

As was stated earlier, water banking is a relatively new establishment in the United States. In the 1980s, the first programs emerged that provided functions similar to water banks, the Columbia Basin Irrigation Project and the East Columbia Basin Irrigation Project. The first significant water bank was the 2001 pilot Yakima Basin banking project, which was formed through legislation to alleviate impacts of a

drought. Some of the transfers in 2001 were targeted to increase instream flows for fish during critical periods. The program continues to address many types of transfers, including those with environmental benefits. The price structure is market driven. This program was initially formed as a means of facilitating water transfers (somewhat like a conservancy board, but with a larger advisory board). The program provided a mechanism to facilitate transfers between buyers and sellers. The special feature of this bank is its ability to provide transfers quickly (generally within 15 days), which was important in drought response.

The Salmon Creek (Okanogan) Water Lease Bank operated from 2000-2002 as a part of the Washington Water Trust. The purpose of this bank was to provide flows in Salmon Creek for summer steelhead and spring Chinook.

Bonneville Power Administration's Water Transaction Program

Bonneville Power Administration (BPA) is required to implement innovative methods to increase tributary flows within the Columbia River Basin. One way of doing this is by funding water right acquisition. Ecology, Washington Water Trust, and other approved organizations may submit proposals for acquisitions that meet to the goals of the Water Transaction Program to BPA for funding consideration.

Columbia River Initiative

Rulemaking is currently on hold for the Columbia River Initiative. If established, it is intended that it will provide:

- Guidelines for managing the Columbia River Mainstem Water Management Account (Water Account).
- An administrator for the Water Account and set priorities for allocation of water from the Water Account.
- Requirements and procedures for issuing water rights during declared droughts to augment existing interruptible rights on the Columbia River mainstem. These are rights which could be curtailed when flows drop too low.
- Requirements and procedures to secure a reliable supply of water for water rights issued on the Columbia River mainstem in 2003 as well as for pre-moratorium applications for new water rights from the Columbia River mainstem pending since 1991.
- Requirements and procedures for issuing new surface and underground or "ground water" rights from the Columbia River mainstem for applications on file with Ecology since 1992, and for any future water-right applications received by the department.

Water Trusts in Washington

Washington Water Acquisition Program

Ecology's Washington Water Acquisition Program manages water trusts for the State. This program allows water-right holders to voluntarily receive monetary compensation for allowing all or a part of their water rights to be reverted back to the state (held in "trust" by the state) for the purpose of instream flows benefiting salmon. Water rights may be sold, leased, or donated to the State through this program. The program is focused on small streams within sixteen priority watersheds: Lower Yakima, Methow, Middle

Snake, Naches, Okanogan, Upper Yakima, Walla Walla, Wenatchee, Cedar-Sammamish, Chambers-Clover, Duwamish-Green, Elwah-Dungeness, Nooksack, Puywallup-White, Quilcene-Snow, and Snohomish.

Washington Water Trust

The Washington Water Trust is a private, non-profit organization established in 1998 that is dedicated to streamflow restoration and water quality improvement in rivers and streams in the state of Washington. The Washington Water Trust acts as an intermediary between water rights holders who want to sell, lease, or donate their water rights for instream flows and the Washington Department of Ecology. Although the Washington Water Trust operates the trust, all trust water rights that are put in to or out of the trust are overseen by the Ecology.

The Washington Water Trust focuses its acquisition on priority basins that historically supported salmon and steelhead and are feeling intense pressures from diversions. The eastern Washington priority basins are: Methow, Okanogan, Upper Yakima, Snake and Walla Walla. Further information about the Washington Water Trust can be found at www.thewatertrust.org.

Water Banks in other States:

Arizona – Water banks are storage facilities only.

Idaho – Water banking has been operational in Idaho since 1932. The first authorizing legislation was in 1979 (Idaho Code 42-1761 through 1766). There is a state water bank, and five local rental pools operated by local water districts. The rental pools have a higher preference to irrigation use within local areas, which creates a disincentive for depositors to lease water for instream uses. Legislation is currently changing, and there are flexible market based policies developing for instream flow protection. All water in the Idaho banks is protected from forfeiture. If the water rights are leased, 90% is paid to the water right holder and 10% covers administration of the bank.

Oregon – Water lease banks have generally become the preferred method of addressing stream flow needs. Deschutes Water Exchange uses the Instream Leasing Program to lease water for instream flows. An annual lease counts as one year of beneficial use (so the lease is only needed once every 5 years to avoid relinquishment).

The Walla Walla Lease Bank is operated by a nonprofit organization, the Oregon Water Trust in cooperation with the Walla Walla Irrigation District and the Hudson Bay District Improvement Company. Founded in 1993 by a group with diverse water interests, this was the first water trust in the nation. Participants have been only Walla Walla Irrigation District and non-district land holders so far.

Klamath Basin Leasing Program is based on payments for land idling. Cost to USBR has been about $74/AF and generally only low value crops (grass, hay, alfalfa) has been used.

Texas – In Texas, there is a State-run Texas Water Bank, authorized by statute. When water rights are held within the bank, they are exempt from cancellation per the Texas Water Code (Section 359.8). The Texas Water Trust is within the Water Bank. The Trust holds water rights dedicated to environmental needs.

WASHINGTON STATE UNIVERSITY CROP FORECAST STUDY (WANDSCHNEIDER, ET AL., 2006)

Crop Production and Water Use Forecasts for the State of Washington Based on Econometric Estimation and Expert Opinion

Final Report to the Department of Ecology, Washington State In Partial Fulfillment of Obligations under Memorandum of Agreement

October 16, 2006

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1 Introduction

The objective of this project is to provide county and regional projections of crop production and acreage for major crops, and assessments of commodity circumstances. These projections and assessments provide input into a larger project to develop agricultural water use projections for the Sate of Washington's Columbia River Water Management Program (House Bill 2860, 2006). The CRWMP program establishes opportunities for managing Columbia River water to benefit both instream and diversionary water uses through new storage, conservation, and voluntary regional agreements. Priorities include finding alternatives for some agricultural groundwater users, finding water supplies for pending water rights applications, finding new supplies of water for those who hold interruptible Columbia River water rights, and meeting new municipal, domestic, industrial, and irrigation water needs. In addition to funding for a number

of short term and long-term initiatives, the legislature directed the Department of Ecology to undertake a research program into projected future needs for water.

To these ends, the Department of Ecology, through a Memorandum of Understanding (MOU) asked researchers at Washington State University to perform two complementary analyses. A survey was developed to solicit expert opinions about the future crop production and water use for major crops. In addition, an econometric forecasting model was developed and applied to USDA National Agricultural Statistics Service data on production and acreage. Each of these forecasting/assessment approaches has its own weaknesses, but because of the very different sources and type of information output, the results are complementary forecasts to be interpreted together.

2 Survey of stakeholders

"One of the focuses of the Columbia River Water Management Program is stakeholder outreach and coordination with interested parties (from MOU)." The purpose of the survey is to solicit information from stakeholders about current and future agriculture prices, demand and supply and how these factors might affect future water demand. The survey work required completion of four main tasks. The first task was to identify a knowledgeable set of informants drawn from stakeholders with significant water and agriculture interest in the Columbia River Basin. The survey participants were selected to provide knowledgeable representation of their group's viewpoint about agricultural conditions and water use. Hence, the "sample frame" was deliberate rather than random. This limits any statistical analysis. Each respondent is taken as representative of his or her "type." Compilation of the contact list started from a list of desired stakeholder groups provided by the Washington Department of Ecology (hereafter, Ecology).

Researchers compiled a list of individuals and their contact information starting from this list and expanding to other individuals and stakeholder groups through informed contacts and the "snowball" technique of asking informant A who they would suggest talking to about topic X. An overall candidate list containing over 76 names was compiled. Of these, 51 responded to initial inquiries and were contacted by telephone, which has resulted in 14 complete interviews.

The second task was to develop a questionnaire instrument. Usually, survey instruments are developed over many versions and many months starting from focus groups and a bank of existing questions and questionnaires. In this case, time was very short, and the objective somewhat different than the usual survey. As noted above, no statistical analysis was intended or possible under the structure of the survey. The objective was to guide an informed respondent through a list of questions that were consistent and structured across informants, while leaving the answers open-ended to provide informants with utmost flexibility in responding. The resulting question format started with some basic questions about the informant's background and connection to the stakeholder group and the role of respondent and stakeholder group in the water-agriculture nexus. Subsequent sections concerned the respondent's beliefs about the current price-demand-supply conditions in agriculture and projected long-term agricultural demand (including specific crop and water use depending on stakeholder knowledge) for the next 5 and 20 years. The format ended with questions regarding water use and a final open opportunity for the informant to discuss "industry concerns."

The third task was to implement the survey by telephone interviews. Seventy-six (76) stakeholders were initially contacted by phone or email. There was no response from 25 stakeholders. Fifty-one (51) potential stakeholders were contacted by phone directly. The interviewee was asked to take the survey now or set up appointment. Most set up an

appointment and were contacted at a later time. Fourteen (14) responded to the survey. Seventeen (17) redirected the interviewer to another agency or association, or declined to take the survey. Eighteen (18) did not respond to requests for an interview time. Two (2) offered to send the surveys directly to their members, who never responded. The average interview took 25 minutes. Results are summarized in the tables presented at the end of this report. There are five tables numbered 1.1 through 1.5, with most of the tables broken into two (e.g., 1.1(a) and 1.1(b) to fit the data. The table below lists the titles and contents. Raw responses are available from Ecology in electronic format.

Table Number	Title	Contents (categories)
1.1(a) & 1.1(b)	Characteristics of Respondents	Respondent's: Name, Position, Organization, Count, Commodities, Mission, Interest, Experience
1.2(a) & 1.2(b)	The Current Situation, Prices and Outputs	Organization, Commodity; Mission, Interest, Prices, Factors affecting prices, Output, Factors influencing prices
1.3	Five Year Market Forecasts	Organization; Commodities; Five year forecasts for Price, demand, output; Comments, Factors
1.4(a) & 1.4(b)	Five Year Water Use Forecasts	Organization; Commodity; Mission; Water use functions; Water forecasts; Factors
1.5(a) & 1.5(b)	Twenty Year Water Use Factors; Industry Concerns	Organization; Commodities; Factors; Water use; Industry concerns

The fourth task comprises the compilation, synthesis and analysis of the results. These results are presented in the next section of the report. We also provide some comments regarding the limitations of the study and suggestions for future work.

Survey Results

2.a Informants

The informants comprised representatives of 5 commodity organizations (potatoes, apples, wine grapes, wheat, cattle), two government agencies (Farm Service Administration and

USDA - Natural Resource and Conservation Service), one processing/distribution association, one irrigation district, one conservation district, one irrigators association, and at least three private agricultural firms (some informants are or were both officials in organizations and farm operators). (See tables 1.1(a) and 1.1(b), "Characteristics of Respondents," below.)

The informant was generally a manager, owner, or other official. Three choose to answer as private citizens, while the rest answered in their official context. Most had many years of experience within their organizations, with 8 having at least 15 years experience, and two others having about 6-7 years experience. Respondents covered most of the major crops at issue, with particular individual representation of potatoes, apples, wine grapes, wheat, and cattle. While most informants represented production interests, some represented input, processing, and marketing concerns. Several were specifically interested in water and other resource use issues and many had policy interests. For most informants, water is regarded as a vital input which they are concerned to protect for continued agricultural use. Several have more direct responsibilities to use water, manage water, or help plan and direct water use.

2.b Current conditions

Potatoes. Contracting heavily influences prices for potatoes. The Potato Commission reported that 85% of potatoes are contracted. Hence the current price should be more influenced by last year's conditions and expectations than today's events. Informants generally reported low current year (2005-2006 season) output of potatoes, but average prices, presumably influenced by contracts. Overall, informants reported that prices were influenced by product quality and supply conditions. Supply conditions were, in turn, primarily associated with input prices, weather, and disease. (Evidently our informants took at least

one economics class.) The potato farm informant noted that prices affected this year's output, indicating a potential cyclical ("hog cycle" or "cob-web model") effect in potato prices.

Apples. The Apple Commission reported that prices for apples were above average and supply was below average for the year. Major factors cited included increasing demand from the international market, the healthy reputation of the crop, and the industry's ability to produce a consistent product over 12 months. The Apple Commission reported low output this year mainly due to weather conditions, where weather conditions were not specified. Weather conditions, ***water availability***, and labor availability were cited as potential output factors in any given year.

Tree crops, general. The two major treefruit informants represent the interests of food processors on the one hand and growers on the other (reclamation/irrigation district). Both reported that tree crop prices were below average and outputs were about average. Global market conditions were cited. The producer-associated informant cited concentrated market conditions in the industry. Informants cited weather and prices as determinants of this year's output, and included supply conditions, transportation, and regulation and competition for land from housing development as more general, typical year factors affecting output. Informant did not specify which types of regulations affected output and how.

Wine grapes. A wine grape grower reported that prices were average this year and that the major factor influencing prices were the prices of competitors this year and weather and general events such as 911– presumably because wine demand is influenced by consumer

state of mind. The grower stated that output (presumably for their enterprise) was above average and cited good growing conditions.

Wheat. The Wheat Commission informant reported that wheat prices were below average this year and cited the impact of fertilizer and fuel prices. The informant also reported average output for the year and cited weather, fuel and overseas competition as factors influencing output in any given year. In Washington, most wheat is raised on dryland farms, and so it is most affected by general climate conditions and by interaction with the main irrigated crops rather than directly by irrigation ***water supply***.

Cattle. Two of the three cattle industry informants predicted increases in prices, demand and supply, while the cattleman's association (representing ranch cattle) anticipates stable prices and output in the face of increasing demand. Again fuel and energy prices were mentioned. Other factors included environmental regulations, market competition, and issues related to BSE, FMD and drought.

2.c Intermediate future conditions, five years

Potatoes. The Potato Commission informant anticipates stable prices, demand and output for the intermediate future of five years. The informant sees growing population offsetting declining per capita demand. Factors affecting falling per capita demand include reduced home cooking of fresh potatoes, and increased health consciousness affecting consumption, presumably of prepared potato products such as French fries. The informant also cited changing demographics, ***water availability*** and pest issues as possible factors. Other informants also suggest stable conditions for potatoes. The enterprise owner points out that the fickle international market could change things.

Apples. The apple commission informant anticipates stable prices with an increase in demand over time. The informant cites difficulties in "maintaining prices." Major factors believed to affect the future of the apple industry include the cost of energy, the availability of labor, and immigration policy.

Tree crops, general. The two informants associated with treefruits anticipate stable prices, demand and supply over the next five years. One informant noted that price is largely determined in the world market. Informants cited fuel and energy costs and transportation as significant factors. The processor noted that the lack of reliable ***water supply*** is a huge issue. Other factors included global competition and trade. The irrigation informant also cited concern over market concentration. Apple market concentration may refer to concentration on certain cultivars (Red Delicious) or to industrial structure, and the meaning here was not apparent from the response.

Wine grapes. The wine grape grower anticipates stable prices and output but increased demand. The grower noted that conditions are "unique" to each winery. The grower anticipates new entries. [We infer that prices will be stable because of new overall supply from the new growers.]

Wheat. The Wheat Commission informant anticipates that prices and output would decline but that demand would increase. [Assuming Washington production falls, we infer that the informant believes competitors would fill the increased demand.] The informant believes that wheat growers will see higher input prices and lower product prices. Specific factors include the 2007 farm bill, the WTO (World Trade Organization), fuel and fertilizer prices, and the nature of future conservation programs.

[Authors' Notes: Washington wheat farmers are heavily dependent on international markets and government programs. Washington wheat is mostly white/noodle wheat rather than bread wheat. According to the Wheat Commission about 85 of Washington white wheat is exported (http://www.wawheat.com/markets.asp). Wheat production is heavily influenced by commodity support programs. The commodity support programs are complex, but some notion of their significance can be appreciated by noting that the "direct payment rate" for wheat under the 2002 is $.52 per bushel and that wheat direct payments have averaged $1.1 billion under the 2002 Act according to Claasen and Morehart of the USDA's Economic Research Service, 2006. The "direct payment" (DP) is paid to wheat farmers (subject to a participant cap) independent of current market or production conditions at: 85% * (DP base acreage) * (DP payment rate) * (DP yield).]

Cattle. The three informants representing the cattle industry generally anticipate increases in demand and supply with prices stable or increasing. Informants cite issues of animal safety (BSE, FMD), energy, and transportation as major factors affecting the market. The informant did not elaborate but we infer the energy and transportation had more to do with transportation costs than logistics.

Feed grains, hay. An irrigation informant (reclamation district) noted that there is "plenty of demand" for alfalfa but that fuel prices and transport were big issues. The cattle informant's optimistic outlook indicates potential increases in *derived demand* for cattle feed and pasture – more demand for cattle, implies greater demand for cattle feed. Hence, a resurgence in meat demand could lead to greater demand for irrigated pastures and for feedgrains like barley.

Other commodities, general remarks. One repeated theme was rising energy and fuel costs. The other side of this equation includes biofuels, perhaps plastics and other chemicals, and related opportunities for agriculture to compete with petroleum based products as their prices increase. The opportunities for new markets like bio-fuels were mentioned by only one respondent, but the rising production costs due to higher energy costs was a pervasive theme.

2.d Water use, intermediate future

Potatoes. The Potato Commission informant projects stable water demand for potatoes. Potato production, processing and marketing depend on water at a variety of levels. Potatoes are the most valuable large-scale irrigated crop in the Columbia valley. Potatoes are different from many crops in that they cannot be grown for long in one location because of disease and pest problems. Thus, growers need water for current production, but they also need to be able to water their rotational crops and have supplies of water ready in new areas that they may seek out in response to disease problems. Also, water is used extensively in potato processing. Thus, the potato industry looks to preserve water for current uses, and to safeguard sufficient water to meet changes in land as well as market needs.

Apples. The Apple Commission informant projects stable demand for water for apples. Water is used in several phases of apple production and processing. In production water is used for climate/weather control purposes (frost in spring and cooling in summer) as well as for irrigation – usually solid set. Apple processing also employs significant amounts of water. The Apple Commission reports that current irrigation and weather management systems

are very efficient, but it would seem that technological changes could affect water use in apples one way or the other.

Tree crops, general. The food processing informant anticipates increased water use efficiency (lower use of water per unit of output) but stable overall water use. Again, note that water is used for processing as well as irrigation.

Wine grapes. The wine grape grower projects decreases in water use per unit of production, but increases in total water use due to increased acreages of wine grapes?. Water is used for irrigation and for processing.

Wheat. Only a small fraction of Washington's large wheat acreage is irrigated (about 8%). Where irrigated, wheat tends to be a rotation crop – e.g., rotated with potatoes to reduce disease and pests. The WAWG reports that wheat growers may be most concerned about general water rights for their local regional communities, or their general farm operations (whether from wells or surface water).

Cattle. Feedlot owners use water critically but in small amounts. Beyond the need to water the cattle, feedlots sprinkle some water for dust control. Feedlot interests are concerned about changes in regulations [we infer water pollution controls] as well as water availability. Cattle ranches use water for watering cattle as well as for secondary irrigation of pasturage and for irrigated feed crops. Some water is also used for processing. Informants suggest some interest in water to expand pasture. One informant mentioned the attorney general's

"stock watering opinion" (AGO 2005 No. 17, which concludes that exempt groundwater use for stockwatering is not subject to a 5000 gpd maximum withdrawal).

Feed grains, hay. Water for feed crops including hay is an important component of water usage in the Columbia basin, both on cattle ranches themselves, and on separate farm operations where feed grains, hay or silage are grown.

Other commodities, general remarks. Issues raised by informants included: resolution of the Columbia River salmon issues, progress in state water projects, increased use of water for municipal purposes, need to recharge aquifers, funding for conservation projects, and awareness of conservation.

2.e Water use, longer term, and "industry concern" comments

Potatoes. The potato industry seems most concerned about long term water supplies for "new ground." The potato industry is beset by pest and disease problems that require crop rotation and eventual movement to new ground or yields will eventually decline. Since potatoes are totally an irrigated industry in Washington, future water availability is critical.

Apples. The apple industry is very concerned about the stability as well as (or more so than) the general availability of water. The "short year" (i.e., where production is curtailed by water shortages) is especially painful to apples and other tree crops as damage in one year can carry over to the next (e.g., damage to trees not yet in production). The apple industry is anxious to see more water supply capacity and is anxious about the encroachment of urban areas on orchard lands. Also see tree crops.

Tree crops, general. Informants representing both processors and irrigation stressed the dependence of the tree crop, alfalfa and vegetable industries on irrigation water. The

irrigation district informant saw some prospects for gains from increased water use efficiency, but this was a relatively isolated comment.

Wine grapes. The winery representative was concerned about the continued development of new wineries without new water. At the same time, they noted wasteful use of water in some cases and they implied relatively high value in other cases [wine grapes are high-valued crops]. There was some hint that the "use it or lose it" provision should be more strictly enforced and/or that rights to "excess" water should be transferable.

Wheat. The Wheat Commission informant reported that their main concern was the protection of Western water law. They predicted no changes in water use patterns over the intermediate and longer future.

Cattle. The three informants from the cattle industry see stable uses of water over the longer term. They express concern about changes in water law and regulations and, in one case, about "activist judges." Some expressed concern about CRWMP, but others hope that the CRWMP will "not just be a piece of paper."

Other commodities, general remarks. Several of the respondents represented water and land conservation organizations. They reported that their main role was to facilitate water use conservation, and they had relatively little to say about the projections and assessment regarding crops reported in the previous pages. Themes they raised included:

? Current waste in irrigation because of lack of incentives to conserve

? Conflict over water will continue, increase

- Incentives to conservation seen as tied to funding for conservation projects as well as to existing rules/institutions.

2.f Synthesis, summary and comments

- Several informants mentioned issues related to Salmon and endangered species. With some exceptions the thrust of the comments seemed to emphasize resolution of conflicts and clarification of rights as much as rivalry over amounts.
- The overall thrust of comments throughout the survey was pessimistic about future gains from increased water use efficiency, with water conservation professionals a somewhat dissenting voice. While one might expect that stakeholders who want more water are not going to volunteer that other alternatives exist, the relative lack of suggestions that there were some water use efficiencies waiting to be exploited was noteworthy.
- Water efficiency and transfer versus water supply. The issue of water "waste," loss for lack of use, and water transfers was a minor theme at best. Most respondents were keyed to provision of new water. Many informants expressed the hope that the CRWMP would lead to new water sources.
- The role of trade, markets and global competition in determining future agriculture patterns were recurring themes from some informants.

2.g Future work with surveys on stakeholder assessments and perspectives

Time and resource constraints placed limits on what could be done with the survey reported here. Three areas of development are suggested:

- Improve survey instrument. The survey did not have time for testing and development. Therefore, the nature of responses that were elicited was contingent on a relatively "naïve" survey. While we tried to key on the main project objectives and to keep the questions open to elicit helpful responses, informants were necessarily limited to responses within the framework. Greater time and resource for instrument development are needed to develop an instrument better tuned to project goals.
- Improve survey data by conducting two types of surveys. Given project objectives, knowledge might be improved by conducting two types of surveys. The first would be face to face unstructured interviews with key informants, including people like those contacted for the present study. The chief advantage to face to face surveys is "depth." More time with the informant, and more opportunity to probe, can result in more information per informant. An alternative to face-to-face interviews would be a series of focus groups with stakeholder groups. Group discussions can be synergistic and reveal more wisdom than individual interviews. An off-setting factor is that individual's are sometimes inhibited in their response to some kinds of questions in the group setting.

  Either the individual face-to-face or focus groups approach would complement the second method – a true scientific survey of members of the stakeholder groups. A mail, telephone, or internet scientific survey of membership lists of the different stakeholder groups would collect information about the views of typical members, and the dispersion of those views within the stakeholder group. Such a survey would be mostly "closed ended" (multiple choice and similar questions). Statistical analysis would be possible. The informant surveys and the scientific random sample surveys are compliments, not substitutes for each other. Informant surveys provide depth and

expertise at the expense of bias. Random sample surveys provide a truer picture of "typical" beliefs, knowledge, and opinions. The two are complements ideally suited for purposes of this project.

- Improve response rate by better contact and follow-up procedures and use of incentives. The present study had a low response rate. From an initial list of 72 contacts, only 14 interviews were completed. In order to increase responses, one would need the time and resources for: development of a larger contact list; formulation and implementation of a contact "approach" (e.g., through professional groups, etc.); more time for second and third contacts and other provisions of the "Dilman method" of survey implementation; and provision of appropriate incentives to informants; recalls and follow-ups (Dillman, 2000).

3 Econometric forecasts of acreage and production for major crops in the Columbia River Basin

This component of the project includes a literature review of existing forecasts and forecasting methods and original econometric forecasts based on existing National Agricultural Statistics Data. Both the econometric forecasts and the survey results have weaknesses as forecast methods, and are meant to be considered together as complements for assessing future water demands from Washington State Agriculture. Extensive tables with results are available separately, in electronic format.

3.a Washington State and the Columbia River Basin Crop production and Data

Appendix 3A includes a table and series of graphs of the NASS data used in this analysis. Table 2 shows the top twenty-five crops grown in the Columbia River Basin, their farm gate revenues and the percentage of total revenue represented by each crop for 2002. Data is from the USDA National Agricultural Statistics Service (NASS)– Washington. The table shows that over 95% of farm-gate revenue in the Columbia River Basin is accounted for by these twenty-five crops.

The data used in this analysis is composed of annual data series of crop production totals and harvested acreage by county as well as state-wide average yearly prices. Estimated farm-gate revenue was calculated using the production totals and the average prices for each crop and each county. We used the twenty-five counties that lie within the Columbia River Basin (see figure 1.), where possible, to develop production systems for the crops grown in that county. County-level data was not available for nine of the twenty-five crops. Data for five of these crops (apples, peaches, pears, apricots and cherries) were reported on a district level, where each district is comprised of three or four counties; in these cases the production systems were developed at the district level. For the other four crops (grapes, hops, lentils and dry peas), the analysis was conducted using a statewide production system.

Data on various input prices and exogenous variables such as rainfall and other climate-related variables, as well as full, county-level time series for the various crops would have enabled us to create structural acreage models that might be more useful in conducting this particular study. Also, data on canola and biodiesel crop related growth in Washington State simply was not readily available from the USDA data. Future research may require the use of survey data from canola and biodiesel growers associations in order to include these crops in production forecasts.

The graphs in figures (2.) – (13.) show the historic statewide trends of the twenty-five crops over the last twenty years. The crops that show a visible positive trend over the time period are silage corn, bluegrass seed, onions, peppermint, potatoes, sweet corn, cherries and grapes. The only crops that have a visible negative trend over the time period are asparagus, barley and carrots. Of the remaining crops, three had significant (at the 10% level) time trend parameters in regressions of the individual crop production against a time trend and a constant; pears and hay with a positive parameter and apricots with a negative parameter (see table 3 for results of all regressions).

There are several possibilities for further study in identifying past trends in crop production alone. One would be to conduct proper tests to determine how these data sets are actually moving over time, as opposed to simply identifying positive or negative trends. Another interesting extension of this summary could be in determining the spatial movement of these crops within the state over time. According to the 2002 UDSA Census of Agriculture, in the Columbia River Basin, there were was roughly 400,000 fewer acres in agricultural production than in 1997 (or about a 3.2% decrease), but the percentage change in land in agricultural production varied quite a bit across counties in the basin, with production differences ranging between -14.6% and 22.8%.

3.b Vector Autoregression (VAR) analysis

Historically, the most economically sound crop production forecasts have been based on structural production systems that determine what share of acreage is devoted to each crop by a profit-maximizing producer, based on crop prices and prices of labor and other inputs (Shumway, 1983; Moore and Negri, 1992; and Wu and Segerson, 1995). Structural economic models require data on a number of variables, which we have not been able to acquire for this

study (see the data section). The models used in these methods strictly comply with economic theory, but are sometimes described as having more strength in explanation than prediction of crop production (Allen, 1994).

Most forecasts that have been conducted using either of these methods have been short-term (usually harvest forecasts based on that year's planting data) in scope. Allen (1994) in a very comprehensive summary of economic forecasting in agriculture stated that few published long-term (multi-year) agricultural forecasts can be found in the literature. This focus of the literature on short-term forecasts is possibly due to the demand of farmers and farm-related government agencies for predictions of current-year crop yields and prices, and the historical interest of the agricultural economics literature in improving farm management practices (Just and Rauser, 1993).

Bessler (1984) introduced the concept of vector autoregression (VAR) to the agricultural forecasting literature, which differs from the structural models described above in that "identification is achieved by estimating reduced-form relationships, in which every variable in the multi-variate system is allowed to affect every other variable in the system with lags." Since then, VAR has been employed in many studies of crop yield and price forecasting and has been shown to perform very well against other methods (Allen, 1994; Dorfman and McIntosh, 1990).

3.c Estimation and forecasting

Estimation of a basic, non-structural VAR without cross-equation restrictions is relatively straightforward. It amounts Ordinary least Squares applied to each of the time-series of set of variables of interest; in this case, the acreage or production of a set of crops for a series of years. Consider a hypothetical VAR for the acreage for three crops: wheat, potatoes, and apples. The

VAR then includes three regressions, one for each crop acreage. Each regression has as its dependent variable the acreage for a given crop at time *t.* The explanatory (right-hand-side) variables are lagged values of acreage for *all* of the crops. Each of the three equations in a VAR(2) will have two lags of each of the three crop variables (totaling 6 explanatory variables in each equation). For example, the implied wheat equation would be:

$$y_t^{wheat} = \alpha + \beta_1 y_{t-1}^{wheat} + \beta_2 y_{t-2}^{wheat} + \beta_3 y_{t-1}^{apple} + \beta_4 y_{t-2}^{apple} + \beta_5 y_{t-1}^{potato} + \beta_6 y_{t-2}^{potato}.$$

The interpretation of this structure is that the last two years of acreage for each crop is hypothesized to help explain this year's acreage for each crop, as characterized by the estimated regression equation for each. A general introduction to Vector Autoregression and forecasting is provided in Greene (2003), Chapter 19.

Ideally, a VAR would incorporate all relevant variables representing all of the crops in a county or region of interest. However, given the number of crops, this is generally not feasible or practical for estimating a stable system of equations. Therefore, a representative set of crops is chosen based on three criteria. First a large set of the most important crops (criterion 1) are included for which a reasonable number of observations exist (criterion 2).[1] If the set of crops satisfying criteria 1 and 2 produce a *stable* estimated system (criterion 3), then all of these crops are included. Otherwise, a subset of these crops is included until a stable VAR is found. *Stability* of a VAVR is described below.

Certain relationships between the parameters must hold for there to be a stable relationship among the variables in a VAR system of equations. If there were no such true relationship among these variables, then it would make little sense estimating a VAR such as

[1] "Importance" for estimation purposes is based on acreage, such that crops with large acreage (averaged over all available years are more "important" than crops with small reported acreage (criterion 1). VARs can only make use of observations for which all crops have data. In a number of cases, one or more of the crops of interest is missing more observations that another important subset. In order to make the best use of the data, those crops with excessive missing data are omitted from the regressions (criterion 2).

this. This is a weak and necessary assumption to proceed, so we presume that there is an underlying stable relationship among the crops grown in the area. Even if such a stable relationship exists however, given incomplete and imperfect data as we have for this analysis, it is not uncommon to estimate a set of parameter estimates in a VAR. Stability of an estimated VAR is required in order to generate reasonable (unbiased and consistent) forecasts. Otherwise, forecasts tend to "explode" in unreasonable ways as predictions are forecasted into the future. For the county-level regressions, only rarely are stable VARs found for more than four of the important crops.

Once a stable system is identified, dynamic forecasts and confidence intervals are generated based on the estimated structure of the VAR. Estimation is carried out with the econometric software Stata (version 9.3) using the VAR Routine Details of the estimation and forecasting procedure can be found in the Stata documentation.

3.d Strengths and Weaknesses of VAR as a forecasting tool

VARs represent reduced forms of more complete underlying dynamical systems. Forecasts from VARs and their estimated confidence limits in principle account for and represent the deterministic factors driving the system and the un-accounted-for random elements in the system such as weather and market shocks. Because VARs in this form necessarily rely on historic patterns, future weather and market patterns that are "new" in the sense that they deviate from historic patterns lead to failure in forecasting. Furthermore, because VARs rely on historical data only, these forecasting models cannot account for changes in the structure of crop production and markets beyond the range of existing data. For example, although the data and therefore forecasting models implicitly incorporate technological changes in production and the

characteristics of markets during the sample period, the forecasts cannot account for future patterns of technology and market change that differ from the sample period.

3.e Summary of results

Data for some crops are available at the county level, some only at the district level and some are available only at the state level. The lowest possible level of aggregation is used for estimation of each crop, but these data were then aggregated for use in regressions with the more highly aggregated data. That is, crops available at the county level were used for county level estimation, but were also aggregated for use in the district and state level regressions. Similarly, district level regressions were estimated, but district level data were also aggregated to the state level for use in the state-level regressions.

County level regressions are based on crop acreage, because the use of crop acreage facilitates estimates of associated water use. However, no acreage data were available (given the time constraints for this report) for district or state-level data from NASS. Therefore, the district and state level regressions use production data rather than acreage data.

Due to the large amount of output, the specific regression results will not be discussed here, and are presented in Excel files accompanying this report. A brief guide to interpretation of these results is presented Appendix B.

3.f Recommendations for Future Modeling Work

The VAR framework and the data above have some weaknesses that could be addressed with additional time and resources. First, due primarily time constraints, there is very little structure imposed on the autoregression processes and forecasts for both acreage and crop production. In

particular, efficiency and credibility of forecasts may be gained by constraining the sum of acreage to be limited to some reasonable total. The analysis presented here imposes no such structure. Similarly, the VAR in this form does not restrict forecasts or their confidence intervals to be non-negative. One way this could be imposed is to apply logarithmic transformations to the data before estimation (and appropriate retransformation for forecasts) to ensure non-negativity. Also, the VAR models used are equivalent to reduced-forms of dynamic structural models. Characterizing a complete structural model and imposing the restrictions of that model might increase predictive efficiency.

Finally, the number of variables included in each VAR was small. It may be helpful in the future, with additional observations and more structure on the model, to attempt to include a broader set of data in the VARs, including price data and input cost indeces

4 References

Allen, P. G. (1994). Economic forecasting in agriculture. *International Journal of Forecasting,* 10, 81–135.

Bessler, D. A. (1984). An analysis of dynamic economic relationships: an application to the U.S. hog market. *Canadian Journal of Agricultural Economics,* 32, 109–124.

Claasen, R. and M Morehart. (2006). "Greening Income Support and Supporting Green," Economic Brief Number 1, USDA Economic Research Service, (March)

Dillman, , D.A. (2000). *Mail and Internet Surveys: the Tailored Design Method.* NY: John Wiley & Sons

Dorfman, J. H., & C. S. McIntosh (1990). Results of a price forecasting competition. *American Journal of Agricultural Economics,* 72, 804–808.

Greene, William. 2003. *Econometric Analysis*. 5th Edition. Prentice Hall, Upper Saddle River, New Jersey.

Just, R. E., & G. C. Rauser (1993). The governance structure of agricultural science and agricultural economics: A call to arms. *American Journal of Agricultural Economics,* 75 (October), 69–83.

Moore, M., & D. Negri (1992). A multicrop production model of irrigated agriculture applied to water allocation policy of the bureau of reclamation. *Journal of Agricultural and Resource Economics,* 17(1), 29–43.

Shumway, C. R. (1983). Supply, demand, and technology in a multiproduct industry: Texas field crops. *American Journal of Agricultural Economics*, 65, 748–760.

Wu, J., & K. Segerson (1995). The impact of policies and land characteristics on potential groundwater pollution in Wisconsin. *American Journal of Agricultural Economics,* 77(4), 1033–104

5 Appendix 1. CRWMG Survey Results

TABLE 1.1(a): Description of Respondents

	Respondent's Name	Position	Name of Organization	City/ County	Primary Commods	Other Agric. Commods.	Ag and water mg'mt mission	Primary interest	Experience, organization	Experience, position
1	Ron Hull	District Manager	Washington State Farm Service Agency	Grant	all		To help private land owners conserve soil and water. And be more productive	input supply	1.5 years	1.5
2	R.L. "Gus" Hughbanks & Frank Easter	State conservationist & state resource conservationist	USDA-NRCS-Washington State Office		non- specific		Provides assistance to farmers and landowner, who want to improve… mission statement.. Helping people help the land… don't control land… help apply conservation practices		25 +	5 years, 7 years
3	Chris Voigt	Exec Director	Washington State Potato Commission		potatoes	Other rotaitional crops. Wheat corn alfalfa	Monitor the water situation, and preserve water for the farmers	all of the above	1 year	1 year
4	Darcy Fugman-Small	owner and general manager	Woodward canyon		wine grapes	potatoes and tomatoes	Sustainable approach growing crops	growing, production, retail and wholesale internationally and domestically	since 2000	since 2000
5	Gretchen Borck	Dir. Issues & Organization	Washington Association of Wheat Growers	Ritzville	wheat	barley	To keep them farming, provide food, 90% membership is dryland farming, some with deep wells or irrigate. Don't need irrigation to grow. How will CWM System affect western water law and current water rights?	prod, export, lobbying	15 years	15 years
6	Dave Carlson	President	Washington Apple Commission	Wenat-chee	apples	some joint work with cherries and pears	Promotion of apples in the export market, water is essential	marketing intn	7 years	3.5
7	Citizen A	Owner	Farm enterprise		potatoes & asparagus		use water to grow crops	require water from basin apply to ground and crops and try to be as efficient as possible with high yield	32 years	15

TABLE 1.1(b): Description of Respondents (cont)

	Respondent's Name	Position	Name of Organization	City/ county	Primary Commodities	Other Agric. Commodities	Ag and water mg'mt mission	Primary interest	Experience, organization	Experience position
8	Citizen B	Staff	Cattle Feeders	Grant	cattle, corn, alfalfa, barley	wheat, potatoes waste	mission is to impact positively the profitability of feed lots, inputs of feed stuff (cost), anything that affects the viability of those feed stuffs	Int'l marketing, production,	operator for 30 years	9 months
9	Daryl Olsen	Board Rep	Columbia Snake River Irrigators Assoc.	Kennewick	all irrigated crops		water management	water management	16 yrs	16 yrs
10	Craig smith	vice president	Northwest Food Processor's Council	Portland, OR	Process 39 different, fruits & veg. In Columbia basin, potatoes & sweet corn	anything processed	Mission is to be a resource for the members to be more competitive in the global market place, primary interest is raw product availability, water to be predictable and dependable.	all activities, but primary is regulatory & policy issues	21 years	15
11	Jerry Barnes	Manager of Irrigation District	Whitestone Reclamation District	Okangan	tree fruits and alfalfa		gather and store water when it's available and distributed to various farms	input supply,	19 years	17 years
12	Citizen C	Member, former officer	Cattlemen's Association	Franklin	cattle, wheat hay, corn, potatoes	inputs for livestock industry, feed grains, potatoes, veg processors	can't find a better environmentalist than a rancher	production	rancher, irrigator farmer, dryland 3rd generation	
13	Michael Tobin	NYCD manager	North Yakima Conservation District	Yakima	don't support one commodity over another – "Would like all $200 million"		Providing technical & financial assistance for conservation and waterish one of them, and meet the need of resource users (mostly farmers) - very much like other conservation districts. Help private landowners conserve water technically & financially.	other- salmon recovery, primarily assisting landowners in compliance, & water quality TMDL total max daily load	17 years	11 year
14	Jack Fields	Exec. VP	Washington Cattleman's Association		cattlemen, cattle and livestock,	variety of cropping , drylalnd wheat & irrigated crops	to protect and preserve members property and water rights, and fight to ensure they are upheld, that individuals are able to utilize them, and that dept. of ecology follows their edict of the water right. Don't want water rights to change.	all… production, input, day to day cattle operations, regulations, marketing domestic & int'l, ensuring property rights,	25 months	25 months

TABLE 1.2(a): The Current Situation, Prices and Outputs

					Prices	major factors affecting price		Output	factors influencing output	
	Name of Organization	Commodity	Ag and water mg'mt mission	Primary interest	This year	this year	any give year	This year	This year	Any given year
1	Washington State Farm Service Agency - Grant	all	help private land owners conserve soil and water and be more productive	help find money to implement water conservation programs	N/A	Generally the prices are weak and not responding to the increased costs, increase in fuel & fert.		below average	lost funding for conservation, typically federally funds which were lost	
2	USDA-NRCS-Washington State Office	all	provides assistance to farmers and landowner, who want to improve/ apply conservation practices	deal with water quantity and quality; technical assistance for irrigation designs; farm bill programs		pay incentives to water management				
3	Washington State Potato Commission	Pots.	monitor the water situation and preserve water for the farmers,	policy advisor on potatoes & water, voice for potato industry regarding water issue	average	85% is contracted, price takers, growers negotiated the best prices they could get from processors	supply, over supply or poor quality	below average	weather	water supply, pest outbreaks
4	Woodward canyon	wine grapes	Sustainable approach growing crops	management	average	price of competitors	catastrophic events such as 911, bad growing season	above average	more fruit, good growing conditions	economy as whole
5	Washington Association of Wheat Growers	wheat	To keep them farming, provide food; dryland farming; some with deep wells or irrigate.	Work at pleasure of members and BOD, on issues of prod.	below average	cost of fuel and fertilizer	markets overseas	average	fert. Fuel, mother nature, too wet too cold to hot too fast	fuel, fert. And oversea competition
6	Washington Apple Commission	apples	promotion of apples exports	export promotion programs; political, industry awareness of environ issues	above average	increased export demand, health & nutrition govr'n & marketing, domestic & oversea, enhanced ability to deliver a consistently good eating experience 12 months of year	supply, foreign competition, energy prices, cost of transport	below average	weather, hail storms,	spring frost, labor availability, adequate water supply for irrigation, lesser is proper pollination weather during bloom time
7	Farm enterprise	Pots. & aspr'gs	use water to grow crops	manager of the farm, overall decisions	above average	undersupply in Washington, and undersupply in US	supply, cost inputs	below average	prices	push higher next year

TABLE 1.2(b): The Current Situation, Prices and Outputs (cont)

					Prices	major factors affecting price		Output	factors influencing output	
	Name of Organization	Commodity	Ag and water mg'mt mission	Primary interest	this year	this year	any give year	This year	This year	any given year
8	Cattle Feeders	cattle, corn alfalfa, barley	to improve profitability of feed lots	attend meetings and committees and DOE, lobbying for cattle feeders, what's going on legislative wise, stay involved	below average	live cattle is down, replacement cattle is up(input),	trade, availability for foreign markets, drought (reduces price by dumping)	ave	lack of foreign market, Japan Korea, neg. And some markets in china, positively some markets	rate of exchange of currency with CA and Mexico, not as beneficial to send cattle this direction
9	Columbia Snake River Irrigators Assoc.	all irrigated crops	water management	manage, admin, technical and legal services	above average	world markets	regulation	below ave	climate	regulation
10	Northwest Food Processor's Council	Process 39, fruits & veg. In Columbia basin, potatoes & sweet corn	Help members be more competitive in the global markets, primary interest is raw product availability, water to be predictable and dependable.	more involved in policy	below average	market conditions, global comp	water supply weather, govr'n policy	Ave	prices,	raw product availability, goverr'n regulation, trans availability
11	Whitestone Reclamation District	tree fruits and alfalfa	gather and store water when it's available and distributed to various farms	make sure that the mission of the district, is accomplished, gather & store water	below average	tree fruits, low compared to past & current costs, imports & oversupply, concentration of marketing	weather conditions here and competitive areas	Ave	weather damage	treefruit - competition from housing development
12	Cattlemen's Association	cattle, wheat hay, corn, potatoes	can't find a better environmentalist than a rancher	actively involved, do it every day, conserve where they can	average	educating the consumer that beef is good to eat, promotional campaign is reason why markets are so good	supply and demand, number of cattle available, processors available, Boise plant closed	ave	weather, feed availability, range conditions good, some drought	weather, spring rains & feed conditions, freight to haul cattle, paying high prices for fuel for trucks
13	North Yakima Conservation District	don't support one commodity over another - Would like all $200 million	Help private landowners conserve water technically & financially.	immensely intertwined						
14	Washington Cattleman's Association	cattlemen, cattle and livestock,	Protect and preserve members' property/ water rights; and that dept. of ecology follows their edict of the water right.	Represent members in Olympia on water rights issues, stock water, instream use, and water right related issue. With DOE on water quality issue. Liaison btw cattleman and DOE, regulation.	above average	higher costs are offset by massive input costs, fuel & fert, cattle on feed, supply from feeder cattle from Canada, availability for export markets for US products, domestic demand	Weather, drought, heat,	ave	haven't seen numbers yet from market, weather, precipitation and heat, access to water	availability of forage, predation, price, depending on markets becoming depressed, markets increase than people will retain animals, weather mostly, breakup of irrigated and non irrigated pastures, having workable land base and access

TABLE 1.3: Five Year Market Forecasts

	Name of Organization	Commodities	5 year prices	5 year demand	5 year output	comments 5	any factors affecting demand, production - 5 year
1	Washington State Farm Service Agency - Grant	all	increase	increase	increase		greater demand for increased savings from water management, greater demand to conserve more water, ag and farmer standpoint
2	USDA-NRCS-Washington State Office	non specific					
3	Washington State Potato Commission	potatoes	stable	stable	stable	Demand is going down, pop growth is going up.	changing demographics, baby boomers retiring, consumers aren't cooking as much, consumers are more health conscious, more nutrition awareness, prod-rising input cost, water availability, pest outbreaks, price - matching supply * demand
4	Woodward canyon	wine grapes	stable	increase	stable	it is unique to each individual winery, there will be new companies entering market	
5	Washington Association of Wheat Growers	wheat	decrease	increase	decrease	input price increase, output price decrease	2007 farm bill, WTO, fuel & fert, conservation programs
6	Washington Apple Commission	apples	stable		increase	hard to maintain prices in future	cost of energy, labor immigration issue & influence on labor availability
7	Alford Farms	pots & asp'rgs	stable	stable	stable	for the most part stable, but hard to predict, currency is weaker, this allows us to export, but he believes that will equilibrate over time	
8	Cattle Feeders	cattle, corn alfalfa, barley	increase	increase	increase	anticipating open more markets	outbreak of , borders closing BSE, FMD, ability to export, drought, climatic conditions, regulations
9	Columbia Snake River Irrigators Assoc.	all irrigated crops				stable slightly increasing	bio-fuels
10	Northwest Food Processor's Council	Process 39, fruits & veg. In Columbia basin, potatoes & sweet corn	stable	stable		represent different commodities, demand related to CRWMP, price determined by world market	water huge issue b/c it affects raw product availability & the economics of growing food, energy costs, the availability of trans rail *truck,, export market & global comp.

	Name of Organization	Commodities	5 year prices	5 year demand	5 year output	comments 5	any factors affecting demand, production - 5 year
11	Whitestone Reclamation District	tree fruits & alfalfa	stable	stable	stable		tree fruit - continued concentration of marketers, imports, and weather heat and moisture, alfalfa - mostly weather, plenty of demand and marketing no problem, fuel prices for both especially to get to market, further away from consumers,
12	Cattlemen's Association	cattle, wheat, hay, corn, potatoes	increase	increase	increase		animal health & food safety, leader in their industry, WA is in the for front
13	North Yakima Conservation District	All… Would like all $200 million					
14	Washington Cattleman's Association	cattlemen, cattle and livestock,	stable	increase	stable	peaks and valleys	environmental regulations on production, demand is much tougher (consumer preference), ability to market products competitive, limiting factors on production, cost of production fuel & fert increase people will have to cover those costs or reduce prod.

TABLE 1.4(a): Five Year Water Use Forecasts

	Name of Organization	Commodities	Mission wrt ag and water resource mg'mt	Water use type and function question	water use 5 year	total water use 5 year	factors affecting total water use
1	Washington State Farm Service Agency - Grant	all	purpose to help private land owners conserve soil and water. And be more productive	Irrigating and farm crops, majority of users use sprinkler, trying to help them conserve that use, or figure out other technologies to use & be more efficient	decrease	decrease	main area C Irrigation project, if funding available, better technology and water management could be in place. No incentive to use it unless funding is available to help them conserve,
2	USDA-NRCS-Washington State Office	non- specific	provides assistance to farmers and landowner, who want to improve… mission statement.. Helping people help the land… don't control land… help apply conservation practices	provide assistance to those who do use water, big impact on irrigation management, how it is handle to get it to the field, help once it gets to the field, help farmer with design and irrigation system and application, how farmer manages system, most of c			urban * domestic will increase dramatically, efficiency improve in irrigation, depends on success of Project… always going to see increased need & comp. either from ag or industrial or fish or to recharge aquifers, overall the future increased need for water
3	Washington State Potato Commission	potatoes	monitor the water situation, and preserve water for the farmers,	Production growing potatoes, & potato processing	stable	stable	funding for conservation projects,
4	Woodward canyon	wine grapes	Sustainable approach growing crops	irrigation of plants, used during production, rinsing barrels and washing things	decrease	increase	more wineries, a lot more awareness about conservation, Walla Walla wine allowance (conservation)
5	Washington Association of Wheat Growers	wheat	to keep them farming, provide food, 90% membership is dryland farming, some with deep wells or irrigate. Don't need irrigation to grow . How will CWM System affect western water law and current water rights?	small fraction of industry, dryland wheat farmers, 2.3 million acres in prod ~8% in irrigation, concerned about water rights because rural cities are on junior water rights,		stable	change of water rights, and water law, affecting the rural municipalities
6	Washington Apple Commission	apples	promotion of apples in the export market, water is essential	primarily, through some form of solid set irrigation system, trickle or micro sprinkler, or normal under over tree, … pumped irrigation cost… used for frost protection in spring, and irrigation of plant and climate control during summer time… modern methods	stable	stable	very little waste, irrigation delivery some work, but technology is very efficient… competition for water and water rights with urbanization and developments that may limit the usage… lack of addition reservoirs… snow pack
7	Alford Farms	potatoes & asparagus	use water to grow crops	irrigation of crops, a little bit of hydro cooling, maybe some prevention of erosion, but minimal to irrigation	decrease	stable	

TABLE 1.4(b): Five Year Water Use Forecasts (cont)

	Name of Organization	Commodities	Mission wrt ag and water resource mg'mt	Water use type and function question	Unit water use	Total water use	factors affecting total water use
8	Cattle Feeders	cattle, corn alfalfa, barley	mission is to impact positively the profitability of feed lots, inputs of feed stuff (cost), anything that affects the viability of those feed stuffs	feedlot - only for watering the cattle. Open air. Some sprinkling for dust control	stable	increase	change in regulation, water availability, livestock watering
9	Columbia Snake River Irrigators Assoc.	all irrigated crops	water management	through irrigation	decrease	stable	regulation
10	Northwest Food Processor's Council	Process 39, fruits & veg. In Columbia basin, potatoes & sweet corn	mission is to be a resource for the members to be more competitive in the global market place, primary interest is raw product availability, water to be predictable and dependable.	agricultural irrigation to grow raw products, processing plants use water to wash and process crops grown in region	decrease	stable	resolution of the CR salmon issue, how success the state is at implement new water projects
11	Whitestone Reclamation District	tree fruits and alfalfa	gather and store water when it's available and distributed to various farms	99% of the water used in their area is used through sprinkler irrigation, varies with the crop, tree fruit requires more water at different times, increasing in cherries, apples are consistent, demand for water in early spring for frost control, and cooling	stable	stable	political change, lot of talk about storage, housing not much difference in use, most household use should be the same as it is for farming, no big changes
12	Cattlemen's Association	cattle, wheat hay, corn, potatoes	can't find a better environmentalist than a rancher	primarily used for drinking and watering livestock, irrigated pastures, cooling water for feedlots	stable	stable	use about 2% water in Columbia river, activist judges in the legal system
13	North Yakima Conservation District	All… Would like all $200 million	providing technical & financial assistance for conservation and water is one of them, and meet the need of resource users (mostly farmers) - very much like other conservation districts. Help private landowners conserve water technically & financially.	Orchard, row crops, hay or pasture, top three in districts, fourth urban interface (yards and split irrigation districts)			steady to increasing - population, industry, competing needs and ag industry has it now and other interests will be competing
14	Washington Cattleman's Association	cattlemen, cattle and livestock,	to protect and preserve members property and water rights, and fight to ensure they are upheld, that individuals are able to utilize them, and that dept. of ecology follows their edict of the water right. Don't want water rights to change.	Stock watering purposed, ground and surface, secondary irrigation of pasture lands ground & surface water sources, secondary to produce crops hay corn barley to feed animals, processing facilities - groundwater, production cow,calf1) stock 2) irrigation,	increase	increase	hope to have a healthy industry that will grow… expand irrigation… per unit, per head, stock watering opinion with attorney general, overall to inability to obtain new water rights to get access to expand forage production

TABLE 1.5(a) Twenty Year Water Use Factors and Industry Concerns

	Name of Organization	factors affecting total water use	Water use per unit	Water use total use	factors total water use -- 20 years	decision makers	Industry concerns
1	WA State Farm Service Agency - Grant	main area C Irrigation project, if funding available, better technology and water management could be in place. No incentive to use it unless funding is available to help them conserve,			get funding then stable to decreasing	irrigation use - irrigators,	the state of our water use, goes back to the way the Columbia project is set up. A lot of waste because there is no incentive to conserve b/c of how it is allotted to each farmer, fees are a little goofy, pay for water whether See column comments 20
2	USDA-NRCS-Washington State Office	urban * domestic will increase dramatically, efficiency improve in irrigation, depends on success of Project… always going to see increased need & comp. either from ag or industrial or fish or to recharge aquifers, overall the future increased need for water			5 year factor - urbanization, suburbanization, significant changes in water use T&E species (water for salmon), issues on snake river dams, climate change, industrial use, isn't going to happen large expansion of irrigation for ag places,	Individual farmers on on-farm use based on crop and yield goals… cities impact water use from state… considerable amount of water use for T&E species… state stake in water use as do tribes… Bureau of Rec. has decision making authority, See comments	Official position, not much on CRWMP… ready and eager to help individual farmers and ranchers manage water available to them, ready to provide financial assistance to help conserve
3	WA State Potato Commission	funding for conservation projects,	Incr	Incr	would like to increase with continuing demand, … the whole endangered species act, one court case away from shutting down, wont know what water situation will be like	Prod - the farmers, Processors-the processors	Priority is to maintain what we have, need to look to the future, good to potato to newer ground, no water to develop new ground, potato prod will decrease due to pests in ground unless have new ground
4	Woodward canyon	more wineries, a lot more awareness about conservation, Walla Walla wine allowance (conservation)	Decr	Incr	education, more wineries, no new water rights,	vinyards "manager" winery "wine maker)	use it or lose it clause has been taken care of (if you have water right, you have to use it, or you will lose it." Farmers will spray dry fields. Very wasteful. If that has been care of, excess water rights should be spread "transferable".
5	WA Assoc. of Wheat Growers	change of water rights, and water law, affecting the rural municipalities		Stabl	change of water rights, and water law, affecting the rural municipalities	members, and growers	want to protect western water law
6	Washington Apple Commission	very little waste, irrigation delivery some work, but technology is very efficient… competition for water and water rights with urbanization and developments that may limit the usage… lack of addition reservoirs… snow pack	stable	stabl	small increase or decrease… if acreage remains stable… population and demand may contribute to increased	farms -farm operator, packing & storage facilities,	not able to stretch water on a short year.. Can't make water in legislation… need to look at increasing reservoir capacity where it makes the most sense… large influx of urbanization need to be address
7	Alford Farms		Decr	Decr	improved water delivery systems	department of ecology, (US bureau of reclamation), irrigation boards, water companies, municipalities	The biggest negative: inflexibility of the state government and water law (use or lose), more concern to conserve, conservancy board to be able to transfer" carrot and stick (a reason to conserve water) no incentive to conserve

TABLE 1.5(b) Twenty Year Water Use Factors and Industry Concerns (cont)

	Name of Organization	Commodities	factors affecting total water use	Water use per unit	Water use total use	factors total water 20 years	decision makers	Industry concerns
8	Cattle Feeders	cattle, corn alfalfa, barley	change in regulation, water availability, livestock watering	stable	stable	same as above	feed lot operations	
9	Columbia Snake River Irrigators Assoc.	all irrigated crops	Regulation	Decr	stable	to slight increase, efficiencies	state controls all permits	objective is to issue new water rights
10	Northwest Food Processor's Council	Process 39, fruits & veg. In Columbia basin, potatoes & sweet corn	resolution of the CR salmon issue, how success the state is at implement new water projects	Decr	stable	ability to deal with global comp, or success of CRWMP	How much to use and how to use 1) farm level - farm operator … grower, & processor, who has no control over grower, but can control amount used in plant.	absolute dependant on water supply, future of indust. Depend on how we decide to allocate water in the future, strong supports of CRWMP, "if off-stream storage and other aspects of the CRWMP are not implemented our industry will not thrive in the future,
11	Whitestone Reclamation District	tree fruits and alfalfa	political change, lot of talk about storage, housing not much difference in use, most household use should be the same as it is for farming, no big changes	stable	stable	technical advancements that may get more efficient water to the plant, and above	the board members set it here locally, some guidance from the bureau of rec., farmers last	storage, with the benefits of going elsewhere, concerned about that,
12	Cattlemen's Association	cattle, wheat hay, corn, potatoes	use about 2% water in Columbia river, activist judges in the legal system	stable	stable	changes in water law, if forced to make prod.	each individual/cattle owner, we were here first	not pleased with all aspects of CRWMP, don't acknowledge there is plenty of water in that river, how many fish do we need?, how much water does a fish need?
13	North Yakima Conservation District	All… Would like all $200 million	steady to increasing - population, industry, competing needs and ag industry has it now and other interests will be competing			continue to increase - competing factors, endangered species act, water quality regulation, ground water depletion, infrastructure failure, failure in storage reservoirs, carry over capacity was limited, technology and equipment to deliver water more efficiency	irrigation districts have a huge say, junior water right holders, Yakima nation, bureau of reclamation b/c of storage aspect	if I had money, I know what to take care of. Everyone will fight over very little money. Resources suffer and those how depend on the resources suffer. Rely on to work with private entities.
14	Washington Cattleman's Association	cattlemen, cattle and livestock,	hope to have a healthy industry that will grow… expand irrigation… per unit, per head, stock watering opinion with attorney general, overall to inability to obtain new water rights to get access to expand forage production	stable	stable	to increasing at a conservative rate, WA is cattle poor state in total number…	Membership is decision maker in stock water use surface & ground water… water right holders for farm or ranch for crop land irrigation… membership is responsible	hope that state of industry is quite well, want to see industry grow and prosper in the future, key that this legislation will work, have opportunity to secure water rights that are actually worth something, not just a piece of paper

6 Appendix 2 A: Tables and figures of NASS data

Commodity	Columbia Basin Revenue ($1000)	Percentage of Basin Total
Apples	973845	28.94
Potatoes	492307	14.63
Wheat	491765	14.61
Hay	330551	9.82
Cherries	136373	4.05
Grapes	133259	3.96
Pears	110495	3.28
Onions	110208	3.27
Hops	83288	2.47
Sweet Corn	63474	1.89
Barley	47259	1.40
Asparagus	44911	1.33
Corn for Grain	37772	1.12
Peppermint	26880	0.80
Corn for Silage	26520	0.79
Bluegrass Seed	17550	0.52
Lentils	17024	0.51
Alfalfa Seed	14280	0.42
Dry Peas	13452	0.40
Spearmint	13294	0.40
Peaches	12626	0.38
Dry Beans	11423	0.34
Green Peas	11040	0.33
Carrots	7857	0.23
Apricots	5323	0.16
Total	3232776	96.06

Table 2. Top 25 Columbia River Basin Crops by Revenue, 2002 data.

Crop	Time Trend Coefficient	t-value	p-value	95% Confidence Interval	
Alfalfa	-724.1053	-0.83	0.421	-2575.453	1127.242
Asparagus	-12297.21	-2.88	0.011	-21354.02	-3240.409
Barley	-1477693	-5.38	0	-2047148	-908238.8
Carrots	-5658.485	-2.16	0.063	-11701.95	384.9821
Grain corn	-38515.04	-0.3	0.77	-311454.6	234424.5
Silage corn	23737.83	5.31	0	14470.23	33005.43
Dry beans	-428.8538	-0.09	0.929	-10299.53	9441.82
Green peas	269.7317	0.43	0.671	-1053.048	1592.511
Hay	38069.92	7.29	0	27091.83	49048.02
Bluegrass	11037.2	7.34	0	7876.591	14197.81
Onions	544460.7	14.7	0	464471.6	624449.8
Peppermint	91650.88	4.94	0	52502.99	130798.8
Potatoes	2205141	10.85	0	1781235	2629047
Spearmint	-773.6842	-0.05	0.959	-31979.86	30432.49
Sweet corn	31031.41	9.03	0	23662.69	38400.13
Wheat	194757.2	0.23	0.817	-1539767	1929281
Grapes	6563.391	4.35	0	3437.771	9689.012
Hops	6.451739	0.03	0.979	-499.4923	512.3958
Dry peas	-14349.8	-0.98	0.34	-44924.57	16224.96
Lentils	5234.348	0.62	0.542	-12269.18	22737.88
Cherries	3.770549	4.14	0.001	1.785751	5.755348
Pears	5.748571	2.27	0.043	0.2282695	11.26887
Peaches	-0.0404396	-0.11	0.917	-0.8671201	0.7862409
Apricots	-0.1649451	-2.03	0.065	-0.3416108	0.0117207
Apples	16.81429	0.93	0.371	-22.64275	56.27132

Table 3. Results of 25 regressions of crops on a time trend and a constant. Note that estimates of constant parameters are not reported.

Figure 1. Counties in the Columbia River Basin

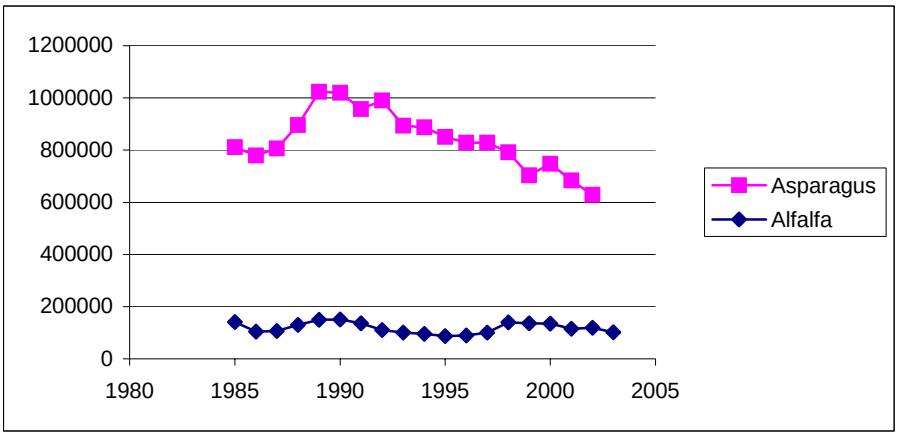

Figure 2. Production of asparagus (Cwt) and alfalfa (Cwt)

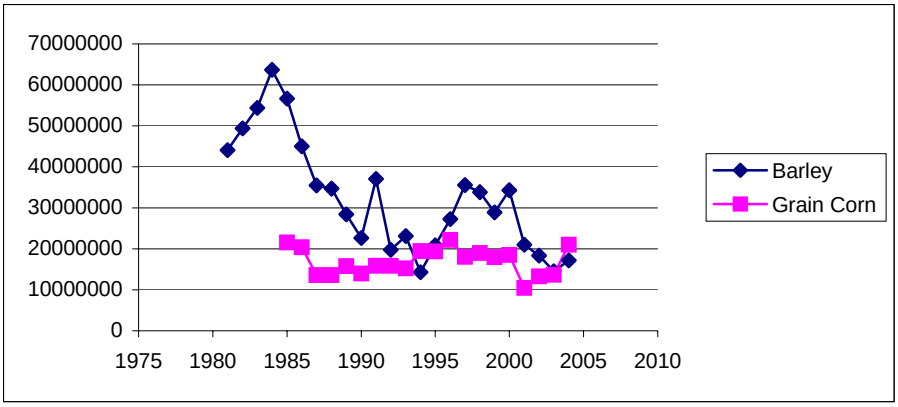

Figure 3. Barley and grain corn production (Bu).

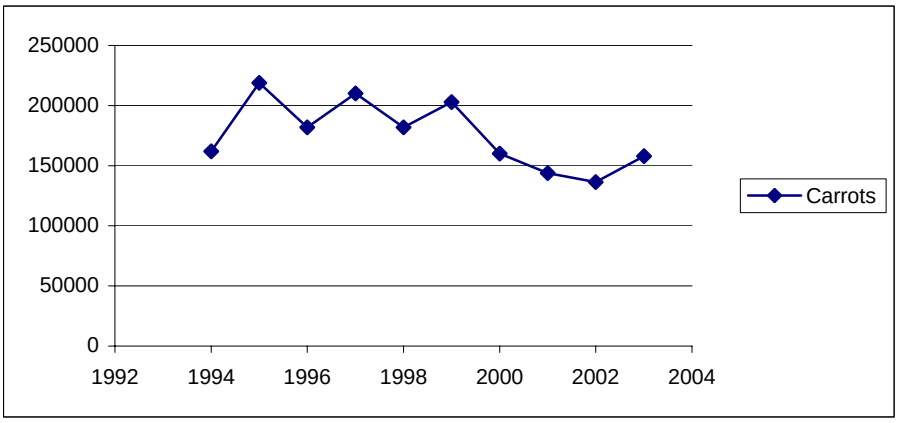

Figure 4. Carrot production (Cwt).

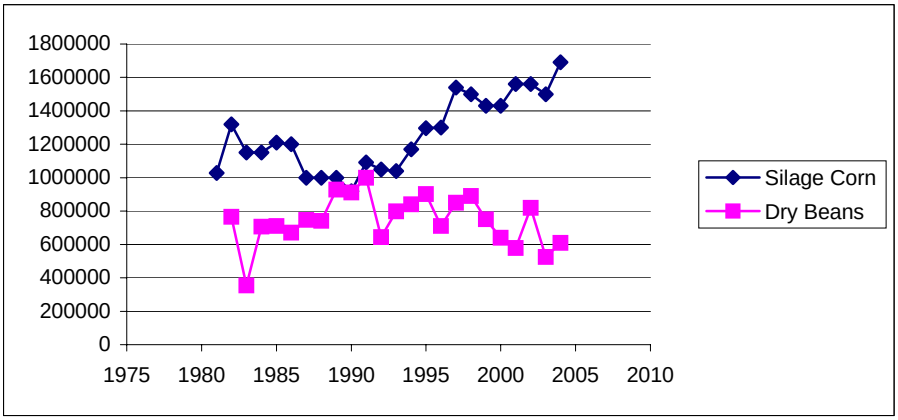

Figure 5. Silage corn (tons) and dry bean (Cwt) production.

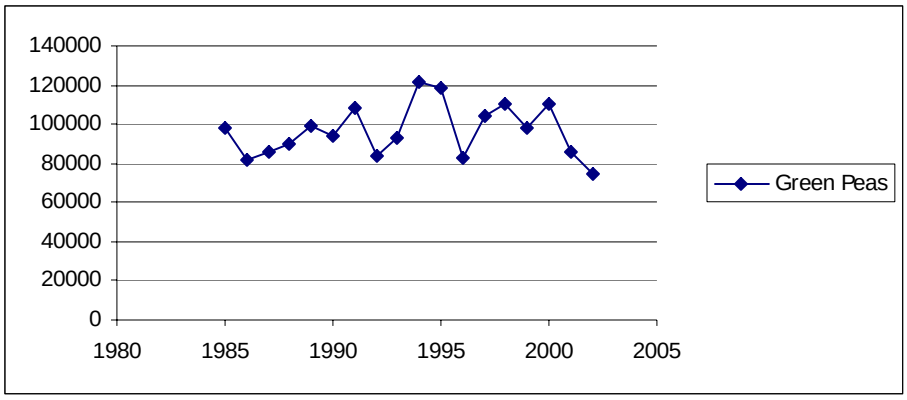

Figure 6. Green pea production (tons)

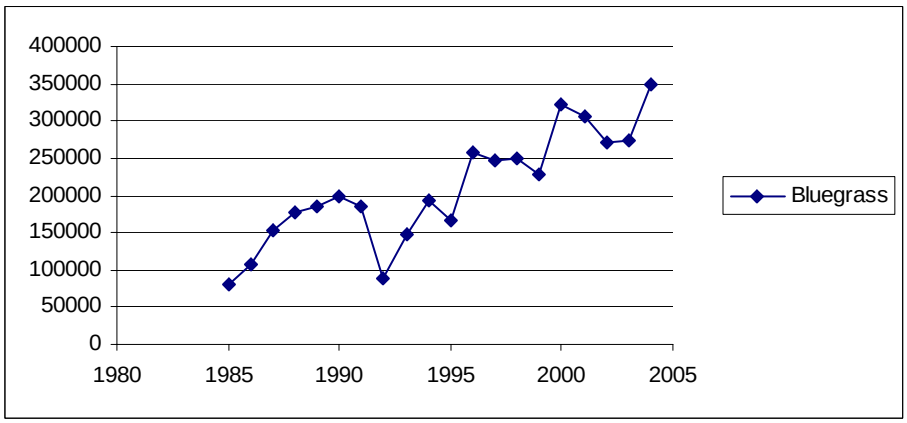

Figure 7. Bluegrass seed production (Cwt).

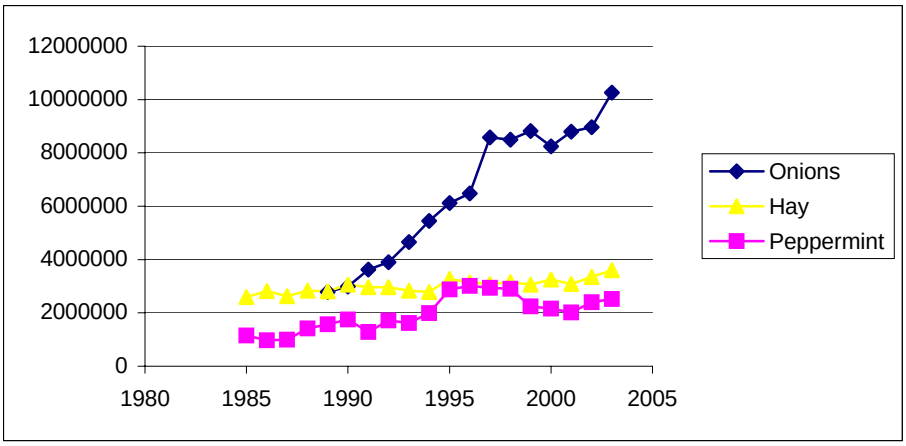

Figure 8. Onion (Cwt), hay (tons), and peppermint (Lbs) production.

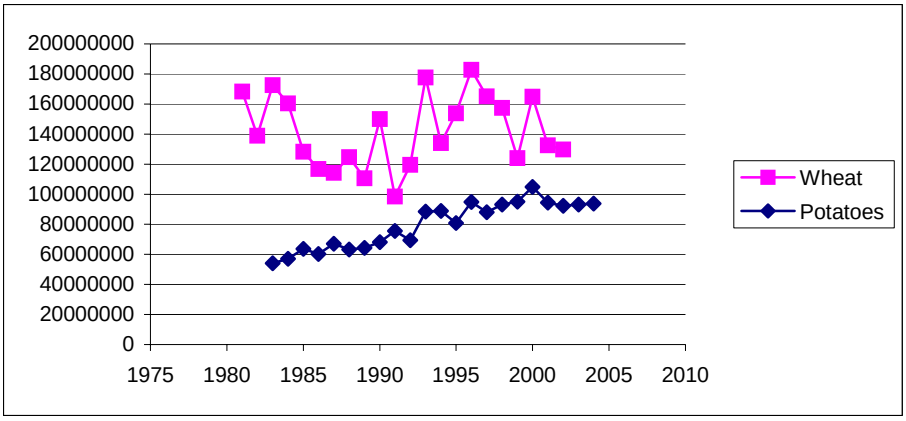

Figure 9. Wheat (Bu) and potato (Cwt) production.

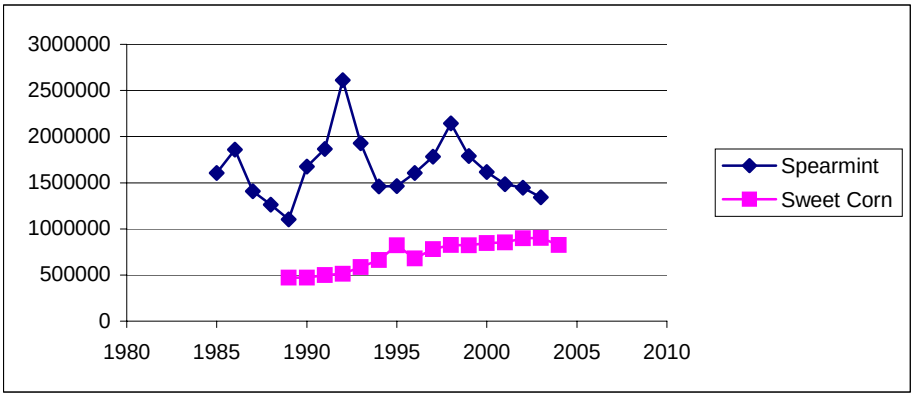

Figure 10. Spearmint (Lbs) and sweet corn (tons) production.

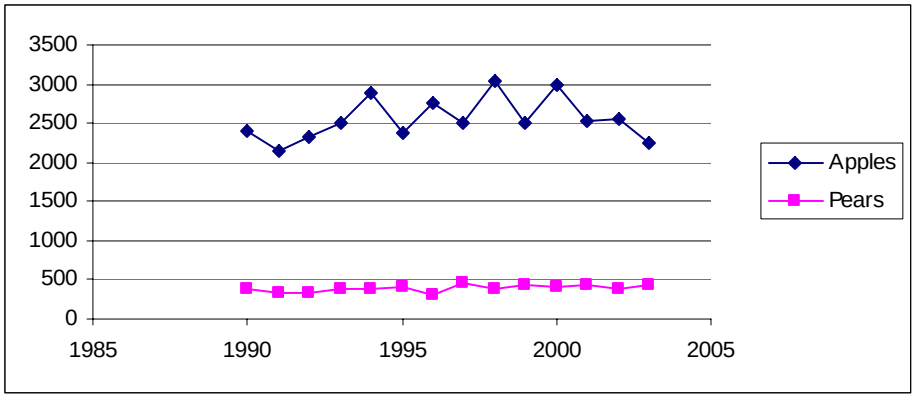

Figure 11. Apple and pear production (1000 tons).

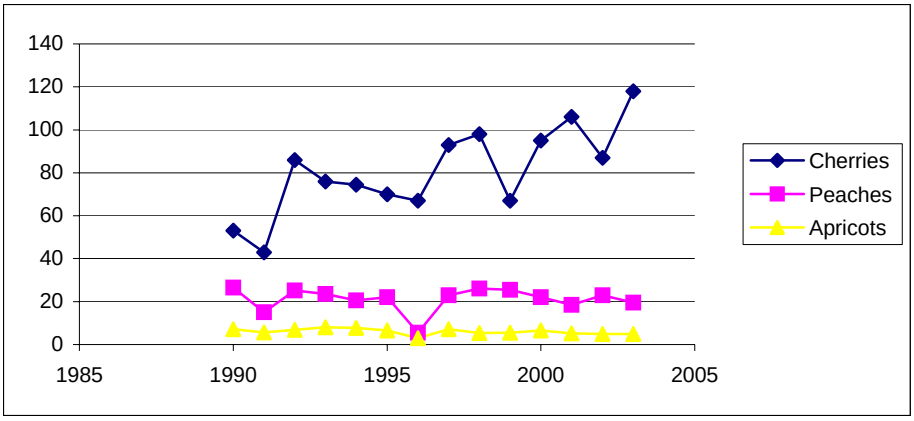

Figure 12. Cherry, peach and apricot production (1000 tons).

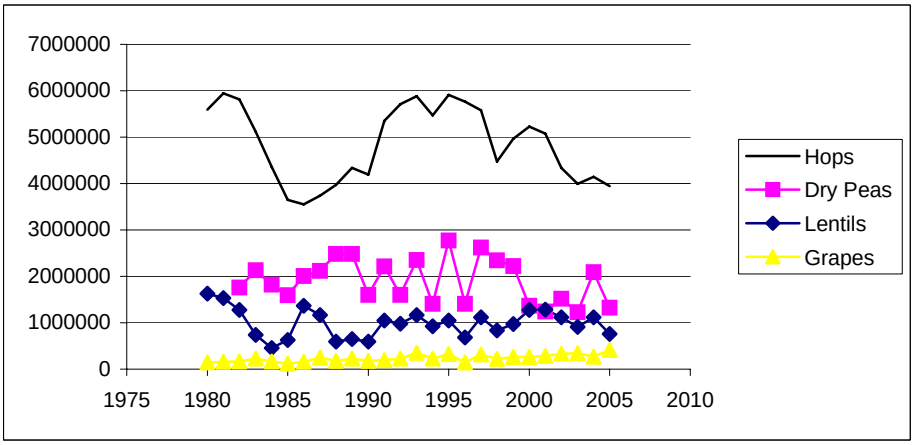

Figure 13. Hops (1000 Lbs), dry pea (Cwt), lentil (Cwt) and grape (tons) production.

7 Appendix 2 B: Vector Autoregression Results

See Excel Spreadsheets County1.xls –County77.xls, district1.xls—district4.xls, and stateforecasts.xls. Each file includes two worksheets.

One includes the data that were used in the VAR for that county/district/state, the 30-year forecasts and 95% confidence bounds for the forecasts. Forecasts have been appended to the original data in the worksheet. Upper and lower bounds of the forecasts are listed separately with the suffix "_UB" and "_LB", respectively. Note in no case were explicit non-negativity restrictions imposed on the regressions, so forecasts and confidence limits may be negative. The second worksheet includes a graph of the forecasts and confidence intervals. Stata code used to generate these results is available upon request.