Growth, Urbanization and Land Use Change: Impacts on Agriculture and Irrigation Districts in Central Oregon

DWA Final Report

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Deschutes Water Alliance

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FOREWORD

BACKGROUND

The upper Deschutes Basin comprises about 4,500 square miles of watershed between the highland areas to the east, south and west, and Lake Billy Chinook to the north. The Central Oregon area, located within the upper basin, is experiencing rapid growth and changes in both lifestyle and land uses. Along with these changes, long-recognized water resources issues have become more important and a number of others have developed.

More effective use of water resources to broaden the benefits of water use in connection with irrigation, stream flow restoration, protection of scenic waterway flows and water quality improvements has long been an important resource management issue in the upper basin. Other developing issues include need for safe, reliable water supply for future basin needs, urbanization of irrigated lands and impacts on agriculture, and needs to protect flows for fishery, recreation and other instream uses.

The significance of basin water issues has increased considerably over the last few years. The rapid growth and subsequent water needs that the region is experiencing present an opportunity to study these issues in more detail given changing values and availability of funding. Consequently, water usage and availability are now a major topic in discussions among basin water suppliers and planners. Due to increased dialogue and awareness relative to water issues, regional urban water suppliers, irrigation districts and other private, government and individual water users now recognize their interdependency in the use, management and protection of Deschutes Basin water resources. This recognition and related dialogue enjoined the major water suppliers in a common vision that commits energy and resources in a collaborative effort to respond to basin water issues.

Water supply, water quality, flow depletion and irrigation district urbanization issues in the upper Deschutes Basin establish the framework for need for the Deschutes Water Alliance. Mutually beneficial opportunities exist for municipalities and flow restoration interests to obtain needed water supply and for irrigation districts to resolve urbanization and conservation issues. Some of the key management considerations involved with these opportunities include:

- Full appropriation of surface waters
- Declaration of groundwater restrictions and related mitigation requirements
- Dependency of municipal water providers on groundwater for future needs
- Diversion of substantial river flows by irrigation districts
- 303(d) listings for water quality parameters and need for TMDLs throughout the Deschutes and Crooked subbasins.
- Protection of scenic waterway flows in the lower reaches of the Deschutes and Crooked Rivers

- Potential Endangered Species Act issues
- Re-Introduction of anadromous fish species in the Deschutes and Crooked Rivers
- Rapid growth, urbanization and land-use change in the Basin

Organization

The Deschutes Water Alliance (DWA) was formed by four major basin partners to develop and implement integrated water resources management programs in the upper Deschutes Basin. The partners include**:**

- Deschutes Basin Board of Control (DBBC): represents seven irrigation districts in the Basin including BOR's Deschutes Project (North Unit Irrigation District) and Ochoco Projects formed under ORS 190.125.
- Central Oregon Cities' Organization (COCO): which is comprised of cities in the Basin and affiliated drinking water districts and private companies providing potable water supply.
- Deschutes River Conservancy (DRC):
- Confederated Tribes of Warm Springs (CTWS)

Goals and objectives

The DWA is investing in managing the water resources of the Deschutes Basin in a unified way to provide:

- Reliable and safe water supply for the region's future municipal and agriculture needs and sustained economic viability considering growth, urbanization and related effects on water resources;
- Financial stability for the Basin's irrigation districts and their patrons;
- Protection of the fishery, wildlife, existing water rights, recreational and aesthetic values of the Deschutes River along with stream flow and water quality improvements;
- Focus on maintaining the resource and land base in the Basin, consistent with acknowledged comprehensive land use plans; and
- An institutional framework that supports the orderly development of local water markets to protect participants and create an "even playing field" for water transactions.

These considerations are key elements to be incorporated into development of the integrated water resources management and restoration program.

Approach

Mutually beneficial opportunities exist to boost water supply for agriculture, municipal needs and stream flow for fish, wildlife and water quality improvements. Mutually beneficial

opportunities also exist through integrated planning for irrigation districts to resolve urbanization issues. In order to develop a framework and program to achieve these objectives, the DWA is implementing five planning studies under a Water 2025 Program grant to generate facts and background information necessary for program formulation. The planning study results will be synthesized into a Water Supply, Demand and Water Reallocation document with project scenarios, five-year implementation benchmarks and 20-year timeframe. The five planning studies are as follows:

- Irrigation District Water Conservation Cost Analysis and Prioritization-an evaluation and prioritization of opportunities to save water through piping and lining of canals, laterals and ditches, as well as through on-farm conservation technologies.
- Growth, Urbanization and Land Use Change: Impacts on Agriculture and Irrigation Districts in Central Oregon. (Title in Water 2025 Grant was *Impacts of Urbanization on Irrigable Lands*) -an inventory of amounts, patterns and rates of district water rights becoming surplus due to urbanization or other changes in land use patterns in Central Oregon and corresponding impact on district assessments.
- Reservoir Management (Title in Water 2025 Grant was *Reservoir Optimization Study and Water Quality*)- a rapid assessment of potential gains from optimization of existing reservoirs and their potential impact on improving flow and quality, with terms of reference for more formal and rigorous assessment.
- Future Groundwater Demand in the Deschutes Basin (Title in Water 2025 Grant was *Municipal Water Demand*)-an assessment of the water supply needs, quantity and timeline of the Basin's regional urban suppliers.
- Instream Flow in the Deschutes Basin: Monitoring, Status and Restoration Needs (Title in Water 2025 Grant was *Measurement, Monitoring and Evaluations* Systems)- assessment of instream flow needs for fish, wildlife and recreation; measurement, monitoring and evaluation systems; and the suitability and completeness of existing flow measurement sites and the existing Water Quality and Monitoring Plan for the Upper Deschutes Basin. Also includes a funding and implementation action plan.

EXECUTIVE SUMMARY

Background

With the decline of the timber industry in the 1980s, irrigated agriculture was left as the dominant the force in the productive rural economy in Central Oregon, with farms and ranches spread throughout the tri-county area. However, for the past decade or more Central Oregon populations have been growing rapidly, both inside incorporated areas and in the rural county areas. Consumptive, lifestyle (or 'hobby') farms have now taken their place alongside production agriculture on rural lands. These changes pose challenges for municipalities, counties and landowners particularly in terms of how government policy, regulations, taxes and services will adapt to an evolving land economy in the region.

In Central Oregon, changes in land use will also directly affect water use and management. This paper examines how growth impacts irrigated agriculture and identifies the social, economic and environmental issues arising. A primary focus of the paper is to understand the risk to irrigated agriculture and the irrigation districts that serve irrigators. Of particular concern is the fragmentation of farms, the loss of district acreage and the resulting operational and financial impacts on district deliveries and assessments. Recent institutional innovation has provided a number of local strategies for coping with this transition, with the formation of a pilot Central Oregon Water Bank a promising mechanism for the permanent reallocation of water rights.

The paper pulls together existing information on land, water, agriculture and growth in order to both characterize the current situation and examine the future potential impacts of growth on agriculture. In this manner, the paper serves to inform the DWA long-range planning scenarios by providing data and projections on the changing demand for surface irrigation water in the upper Deschutes Basin, particularly with regard to irrigation districts. The reduction in demand for surface irrigation water also represents a potential supply of surface water to meet new demands in the Basin. Surface water rights may be transferred to instream use to meet flow restoration needs and to meet new groundwater demand through the Deschutes Groundwater Mitigation Program. These rights also may be available to replace junior rights where there is demand for a more reliable supply.

Agriculture and Irrigation in Central Oregon: Conditions

US Department of Agriculture census data from 2002 confirms that Central Oregon is the home of the family farm with over 92% of owners living on the farm. However, 60% of farm operators also work at least part-time off the farm, with 40% effectively working full-time off the farm. Agriculture makes up around 10% of county income in Crook and Jefferson County and only 1% in Deschutes County. Much of irrigated land in Deschutes County is dedicated to pasture and hay, including for dairy. Jefferson County is home to larger farms in and around the Madras area, with irrigation largely for the purposes of growing crops such as alfalfa, potatoes and seed crops. Crook County produces proportionately more of its agricultural revenue from livestock, particularly cattle, and has smaller irrigated parcels near Prineville and very large ranches with irrigated areas in the valley bottoms throughout the remainder of the County. Returns to agriculture are well below the state average at $8/acre in Crook County, $4/acre in

Jefferson County and -$51/acre in Deschutes County (see Table ES-1). USDA census data on non-farm income suggests that for about half of the farms in Central Oregon, farming is more a lifestyle choice than a commercial activity that sustains livelihoods. This is consistent with the observation that Deschutes County is largely home to lifestyle or hobby farming, and that Crook County may be headed in that direction.

Table ES-1. Key Indicators for Agriculture and Irrigation in Central Oregon, 2002

	Crook County	Deschutes County	Jefferson County	Central Oregon	Oregon
Land Area ('000 acres)	1,914	1,955	1,114	5,015	61,437
Land Area in Farms ('000 acres)	937	138	701	1,777	17,080
Median Farm Size	66	21	160	na	39
Acres in Production per Inhabitant	46	35	1.1	11	4.8
Agricultural share of County Income	9%	1%	13%	3%	
Average per acre Net Cash Farm Income	$8	-$51	$4	$2	$36
Average Value of Land and Buildings per acre	$531	$5,172	$561	$859	$1,202
Total number of farms	685	1,632	428	2,745	40,033
Number of farms with irrigation	501	1,425	311	2,237	17,776
% of Farmland Irrigated	8%	32%	8%	10%	11%
Irrigated Land (acres)	77,861	44,436	56,954	179,251	1,907,627
for crops	49%	51%	89%	63%	74%
for pasture	51%	49%	11%	37%	26%

Source: USDA/NASS 2002 census

Agriculture and Irrigation in Central Oregon: Trends

Recent USDA census data highlights trends from 1997 to 2002 for agriculture in Central Oregon (see Table ES-2). The trend in overall farmed acreage is down slightly at a 3% decrease overall for Central Oregon, consistent with state-wide numbers. This masks considerable variation as Crook and Deschutes counties saw small increases while Jefferson County saw a substantial 12% decrease. Average farm size decreased by 9% during the period, with Crook and Jefferson County moving rapidly towards the smaller farm sizes found in Deschutes County. Irrigated acreage expanded in all three counties, perhaps reflecting a consolidation to farming irrigated acres in Central Oregon to 2002 or the good water years experienced in the late 1990s. Farms with irrigation also experienced a decline in average farm size (by 12% for Central Oregon as a whole). Generally, there appears to be a consolidation in the numbers of farms with irrigation in three counties consisting of an increase for very large farms, a decrease in mid-size farms and an increase in small farms. In Crook and Deschutes counties the number of farms with irrigation in the 1 to 49 acre class size saw increases of 20% or more. On farms of less than 1,000 acres in Jefferson County a decline of 11% in total acreage irrigated was reported during the period. The majority of the increase in irrigated area for the period, occurred on the very large farms, suggesting a marginal scaling up of irrigated production on large farms due to good water years.

The profitability of farming continues to worsen across Central Oregon. Total gross sales fell by 3% while expenses rose by 13%. Sales from crops fell across the board with Crook County recording a 28% decrease over the five-year period. Livestock sales rose by a corresponding percentage in Crook County, but fell back significantly in Jefferson County. In Deschutes County farm expenses increased by 15% as sales dropped by 8%. Despite these negative trends, it is worth noting that farming in Deschutes County is 4 to 6 times as intensive in terms of expenditure per acre as in the other two counties. This reflects the nature of hobby farming as a consumptive, high expenditure and low revenue activity.

While agricultural operations are on average yielding little in the way of financial returns, the rapid growth and development experienced by Central Oregon over the last decade provides other economic benefits to farmers. The market value of land and buildings held by Central Oregon farmers increased 32% during the 1997 to 2002 period. This means that farmers have an additional $370 million stored in these assets. This probably reflects new investment and price appreciation. As farms are subdivided and gentrified (in Deschutes and Crook counties) investments in homes and buildings are made. However, the rapid rise in the price of land in Central Oregon is probably the main factor underpinning this growth in asset values. The financial benefits of farming in Central Oregon are therefore not in farm operations but in owning a farm.

Table ES-2. Key Trends for Agriculture and Irrigation in Central Oregon, 1997 to 2002

Changes in:	Crook County	Deschutes County	Jefferson County	Central Oregon	Oregon
Farmed Acreage	4%	5%	-12%	-3%	-3%
Average Farm Size	-10%	-1%	-6%	-9%	-3%
Irrigated Acreage	11%	4%	5%	7%	-3%
# of Farms with Irrigation of 1 to 9 aces	43%	22%	-6%	24%	
# of Farms with Irrigation of 100 to 219 acres	-13%	-26%	-20%	-21%	
Gross Sales – Crops	-23%	-16%	-5%	-11%	1%
Gross Sales – Livestock, etc	28%	0%	-21%	9%	17%
Gross Sales – Total	6%	-8%	-8%	-3%	5%
Farm Production Expenses	13%	15%	12%	13%	21%
Value of Land and Buildings	49%	29%	18%	32%	15%

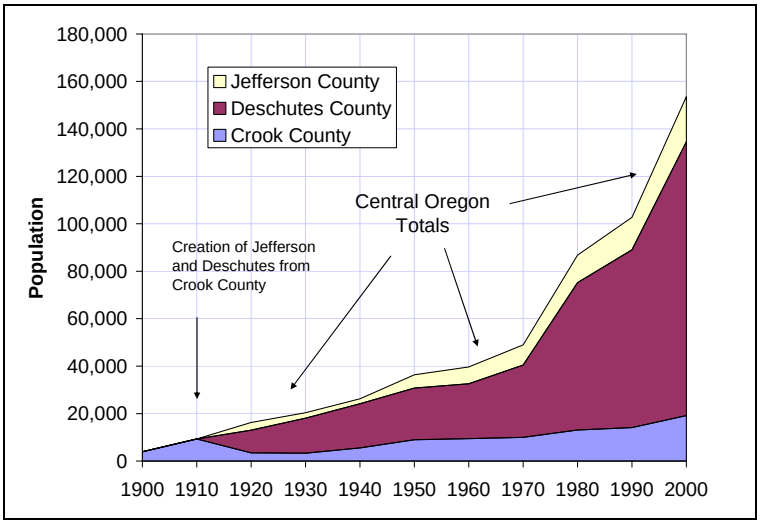
Source: USDA/NASS 2002 census

Growth and Urbanization

Central Oregon has gone through periods of explosive growth, notably in the 1970s and from 1990 onwards. Averaged over the last century Central Oregon's population has grown at a rate of 44% every decade. In comparison Oregon's rate was 24% and for the country as a whole it was 14%. Figure ES-1 shows that the bulk of the population gain in Central Oregon has been in Deschutes County. During the 1990s the population of Deschutes County increased by 50% from 75,000 to 115,000. Since 2000, Central Oregon continues to grow rapidly, recording a 20%

increase in population in the last five years. Of this increase 27,000 comes in incorporated areas and 5,000 in unincorporated areas. For Bend and Redmond, the two largest population centers, growth rates have oscillated between 4 and 11%. Official population forecasts suggest these rates will slow to 2% inside of 5 years; however, these projected rates are founded more on bureaucratic caution than market data. Based on the last 15 years experience, current trends and continued development opportunities suggest that it is likely that rates of growth in both urban and rural areas will not slow down but continue apace.

Figure ES-1. Central Oregon Counties Population, 1910 to 2000



Source: University of Portland, Population Research Center

Impacts on Demand for Surface Water Irrigation

The paper focuses on the effects of growth and urbanization on the 9 irrigation districts in Central Oregon that provide water to a major portion of the region's irrigated lands (150,000 of the 180,000 irrigated acres) (Table ES-3). Examination of the impacts resulting from land use and demographic change suggest the following:

- Fragmentation of irrigated acreages continues, particularly as urban areas expand into the irrigation districts that often surround or border existing urban areas
- Loss of irrigable land and delivering water within urban areas will be continued challenges for districts as irrigated acreage within urban areas is developed
- Population growth and the changing mix of the landowner base in irrigation districts, as well as land speculation in advance of urban area expansion and Measure 37 claims, will result in a growing trend of non-use by district patrons, with the potential for temporary or permanent reallocation of water through instream leasing of water rights
- The resulting surplus water presents a potential threat to irrigation districts and their patrons, in terms of a devaluation in the going price of water rights and a decline in the assessment base that maintains the operations of the districts

Table ES-3 District Water Right Acreages, Customers and Farm Size

District	Point of Diversion	Irrigation	Total	Customers[1]	Average Farm Size (acres)[1]
Swalley	Deschutes River at Bend	4,351	4,561	755	6
COID	Deschutes River at Bend	43,747	44,784	4,497	10
Lone Pine	Deschutes River at Bend	2,369	2,369	20	120
Arnold	Deschutes River above Bend	3,976	4,384	792	6
North Unit	Deschutes River at Bend and Crooked River above Smith Rock	58,868	58,868	850	69
Walker Basin	Little Deschutes above La Pine	1,534	1,534	10	153
Tumalo	Tumalo Creek and Middle Deschutes at Bend	7,367	7,381	632	12
Three Sisters	Whychus Creek above Sisters	7,568	7,651	129	59
Ochoco	Ochoco Creek and Crooked River above Prineville, McKay Creek below Prineville	20,150	20,332	745	27
Totals		149,924	151,878	8,897	17

Notes: [1]Estimates only for some districts

Quantitative analysis of the overlap between urban areas and irrigation district water rights shows that some 5,000 to 9,000 acres is already within current urban areas in Central Oregon (see Table ES-4 for the regional breakdown). This number may rise as the City of Bend considers a long overdue expansion in the next year. The rate at which these acres will be developed is impossible to forecast with accuracy, however, if growth rates continue on their current trajectory much of the water on these lands could be surplus by 2025. A significant portion of this water is already being leased and acquired by new users as described further below. In the rural areas, additional water is surplus to irrigation demand as evidenced by the continued growth of the DRC Leasing Program and the year-to-year renewal of many of the leases. Based on current figures, and available information on temporary trading in other basins, 4,000 acres is a reasonable but conservative estimate for additional water (beyond the urbanized water) that will be surplus to needs. A total decline in irrigation demand of from 9,000 to 13,000 acres may therefore be projected. For the upper basin that represents from 5% to 7% of irrigated land that farm operators and landowners are likely to make available for reallocation on a temporary or permanent basis to assist in meeting new demand for instream flows and groundwater. Absent mechanisms for seeing that this surplus water is marketed to these non-traditional demands, the value of irrigation district water rights could decline precipitously with consequent risk to the district assessment base and solvency of district operations.

Table ES-4. Summary of Irrigable Lands at Risk to Urbanization

Urban Area	UGB (acres)	URA (acres)	Totals (acres)	% of All Urban Area Totals
Redmond	2,904	2,595	4,112	45%
Bend	1,632	1,272	2,904	32%
Prineville	1,571	-	1,571	17%
Madras	536	-	536	6%
Totals	5,256	3,867	9,123	100%

Coping Strategies for Irrigation Districts

Reallocation strategies pursued by irrigation districts and their partners to cope with the changing context of irrigation and water resource management in Central Oregon include:

- Instream Leasing: the temporary transfer of irrigation surface water rights to instream use in return for a modest leasing payment (including the use of leased water to back new groundwater permits through the DRC's groundwater mitigation bank)
- Quitclaims: the conveyance of interest and title in water right by the landowner to the host irrigation district, or to a municipality or the DRC.
- Exits: the removal of a water right from the assessment base of an irrigation district in return for payment of an exit fee covering existing debt and future O&M charges (usually associated with transfer of ownership through a quitclaim or an instream transfer)
- Instream Transfer: the permanent transfer of an irrigation surface water right to instream use either for the purposes of river restoration or groundwater mitigation

A summary of activity in each of these categories is provided in Table ES-5. These strategies, whether pursued individually or as a progressive suite of tools, provide a means for districts to release the internal pressure on district acreage and finances brought by growth, urbanization and land use change. A pilot Central Oregon Water Bank operated cooperatively by COID, Swalley and the DRC aims to bring these strategies into a single coordinated banking effort. Enabling new sources of demand for water rights to enter traditional irrigation water right markets supports water right values and provides financial security for irrigation districts.

Table ES-5. Water Rights Reallocation from Irrigation Districts

(all figures in irrigation water right acres)	Leasing	Quitclaims	Exits from Districts	Instream Transfers
COID	2095	519	114	131
Swalley	473	174	181	21
Other Districts	2142	-	-	-
Grand Total	4,710	693	295	153

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Acronyms & Abbreviations

AF or ac-ft	acre-foot, amount of water one foot high covering one acre
cfs	cubic feet per second
COID	Central Oregon Irrigation District
OWRD	Oregon Water Resources Department
UGB	Urban Growth Boundary
URA/UAR	Urban Reserve Area / Urban Area Reserve

1. Introduction

With the decline of the timber industry in the 1980s, irrigated agriculture was left as the dominant the force in the productive rural economy in Central Oregon, with farms and ranches spread throughout the tri-county area. However, for the past decade or more Central Oregon populations have been growing rapidly, both inside incorporated areas and in the rural county areas. Consumptive, lifestyle (or 'hobby') farms have now taken their place alongside production agriculture on rural lands. These changes pose challenges for municipalities, counties and landowners particularly in terms of how government policy, regulations, taxes and services will adapt to an evolving land economy in the region.

In Central Oregon, changes in land use will also directly affect water use and management. This paper examines how growth impacts irrigated agriculture and identifies the social, economic and environmental issues arising. A primary focus of the paper is to understand the risk to irrigated agriculture and the irrigation districts that serve irrigators. Of particular concern is the fragmentation of farms, the loss of district acreage and the resulting operational and financial impacts on district deliveries and assessments. Recent institutional innovation has provided a number of local strategies for coping with this transition, with the formation of a pilot Central Oregon Water Bank a promising mechanism for the permanent reallocation of water rights.

The paper pulls together existing information on land, water, agriculture and growth in order to both characterize the current situation and examine the future potential impacts of growth on agriculture. In this manner, the paper serves to inform the DWA long-range planning scenarios by providing data and projections on the changing demand for surface irrigation water in the upper Deschutes Basin, particularly with regard to irrigation districts. The reduction in demand for surface irrigation water also represents a potential supply of surface water to meet new demands in the Basin. Surface water rights may be transferred to instream use to meet flow restoration needs and to meet new groundwater demand through the Deschutes Groundwater Mitigation Program.

The paper begins by providing an overview of land resources in the Deschutes Basin and a summary of the socio-economics of agriculture in Central Oregon. Agricultural census data and other sources are then used to examine irrigation's contribution to agriculture in Central Oregon and to characterize the irrigation economy in the tri-county area. As irrigation districts form the vast majority of irrigated agriculture in Central Oregon the next section provides detail on these district's water rights, customers, acreages and assessments. Further detail on district delivery systems is provided in the companion DWA Issues Paper *Irrigation District Water Efficiency Cost Analysis and Prioritization*. Finally, the nature and extent of population growth and urbanization in Central Oregon is review based on historical data and current growth forecasts.

Analysis of the impacts of growth and urbanization on irrigated agriculture and irrigation districts is then taken up, examining the impacts on irrigated land in detail and summarizing other impacts on district delivery system, water demand and water resources management more broadly. Strategies employed by districts to respond to these changes and challenges are identified and discussed, including the potential of exit fee policies for securing the district

assessment base in the face of rapid growth and declining demand for surface water irrigation. The major issues surrounding response to growth and its impacts on irrigated agriculture are then summarized in the concluding section.

2. Land and Agriculture

2.1 Central Oregon and the Deschutes Basin

The Deschutes Basin is the second largest river basin in Oregon (behind the Willamette) covering 10,700 square miles (see Figure 1). The counties of Crook, Deschutes, Jefferson, Sherman and Wasco make up a majority of the Basin. Central Oregon – defined in this paper as Crook, Deschutes and Jefferson counties – total over 5 million acres, or 73% of the Basin (see Table 1). For the Basin as a whole just 40% of the land area is in private hands, with the remainder under public or tribal control. The Confederated Tribes of the Warm Springs Reservation hold 641,000 acres or 7% of the Basin.

As of 2004, the population of Central Oregon totaled 176,000, 57% of which live in incorporated areas. Deschutes County, with the cities of Bend (65,210), Redmond (18,100) and Sisters (1,490) has a much larger urban population at 63%, than Crook (42%) or Jefferson (35%) counties. Deschutes County has a population density of 38 persons per square mile, slightly higher than the average for Oregon, while Jefferson (10 p/mi^2) and Crook (6 p/mi^2) are sparsely populated.

Table 1. Land Area and Population, 2004

	Population					Land		
	Total	Urban		Rural		Total	Public and Tribal	Urban
	#	#	%	#	%	Acres	%	%
Administrative Units - Counties								
Crook	20,650	8,640	42%	12,010	58%	1,914,231		
Deschutes	135,450	84,800	63%	50,650	37%	1,955,191		
Jefferson	20,250	7,070	35%	13,180	65%	1,146,235		
Subtotal - Central Oregon (3 counties)	176,350	100,510	57%	75,840	43%	5,015,656		
Wasco	23,900	13,970	58%	9,930	42%	1,533,433		
Sherman	1,900	1,140	60%	760	40%	531,838		
Subtotal - Five counties	202,150	115,620	57%	86,530	43%	7,080,927		
Drainage Unit - Watershed								
Deschutes Basin						6,847,968	59%	
Upper Deschutes Basin								
Groundwater Unit - Aquifer								
Groundwater Study Area						2,879,987	66%	
Oregon	3,582,600	2,434,922	68%	1,147,678	32%	61,437,792		

Source: Oregon Population Research Center, Gannett et al (2001)

Figure 1. Deschutes Basin and Central Oregon

Land available for private uses in Central Oregon is limited due to large expanses of public (federal and state) and tribal lands. Still, 1.77 million acres or just over a third of Central Oregon land area was dedicated to farming and ranching according to the 2002 National Agricultural Census. The Census defines farms as operations with over $1,000 in gross income from farming.

The proportion of farm area that is irrigated is roughly one-tenth of the total, reflecting the predominance of dryland ranching as a land use in Crook and Jefferson counties. In these two counties over 80% of the land area in farming comes from the 92 ranches and farms that are over 2,000 acres in size. There exists considerable variability between counties in terms of the extent of agriculture (see Table 2). Deschutes County has only 138,000 acres in farming or 7% of its land area. Jefferson and Crook counties have a much larger agricultural base with 61% and 49% of their area, respectively, in farming. Large acreage ranches in Crook and Jefferson County lead to large average farm sizes of 1,400 acres and 1,600 acres, respectively, in these counties. These figures reflect the large size of ranches rather than that of irrigated farms. Deschutes County's average farm size is considerably smaller at 85 acres, with a median farm size of just 21 acres. The smaller size of agricultural parcels in Deschutes County has its origins in fragmentation and subdivision that took place in the 1960s before Oregon's strict land use planning system was implemented in 1973.

Table 2. Agriculture in Central Oregon, 1997-2002

		Crook	Deschutes	Jefferson	Central Oregon	as % of Oregon	Oregon
Number of Farms	2002	685	1,632	428	2,745	7%	40,033
	1997	596	1,523	456	2,575	6%	39,975
change in %		15%	7%	-6%	7%		0%
Land in farms (acres)	2002	937,628	138,226	701,440	1,777,294	10%	17,080,422
	1997	904,794	131,734	793,525	1,830,053	10%	17,658,213
change in %		4%	5%	-12%	-3%		-3%
as % of County Area		49%	7%	61%	35%		28%
as % of Private Land		to be added					
Median Farm Size	2002	66	21	160			39
Average Farm Size	2002	1,369	85	1,639	647	152%	427
	1997	1,518	86	1,740	711	161%	442
change in %		-10%	-1%	-6%	-9%		-3%

Source: NASS Census 2002

Table 2 reveals a trend towards a reduction in average farm size in all counties, but for different reasons. In Crook and Deschutes counties farm acreage has grown by a small percentage but is outpaced by the growth in number of farms. In Crook County the large (15%) increase in number of farms most likely results from the break up of larger farms (despite some growth in overall acreage). In Jefferson County a decrease in farmed acres (90,000) during the five year period dominates the decrease in number of farms leading to a reduction in average farm size.

For Central Oregon as a whole there are 11 acres in agricultural production per inhabitant. In Deschutes County this falls to 1.1 acre per person. In Crook and Jefferson there are 46 and 35 acres per inhabitant, respectively. For Oregon as a whole the number is 5 acres per inhabitant.

The differences between Deschutes and the other two counties are therefore evident with Crook and Jefferson being counties where agricultural plays a more important role in resource use.

2.2 Socio-Economics of Agriculture in Central Oregon

2.2.1 Type of farms/operators

Farms in Central Oregon are predominantly owned by individuals or families, and over 92% of owners live on the farm with little variation between the counties in this regard. Consistent with Oregon as a whole, the average age of farm operators is in the mid to early fifties and is steadily increasing. In Deschutes and Jefferson County the number of farmers of less than 45 years of age in each county decreased by 32% and 17% respectively from 1997 to 2002. Crook County saw a small increase (6%) in number of farmers under 45 years of age but a much larger increase (43%) in farmers in their 60s. Three-fifths (60%) of farmers in Central Oregon also work at least part-time off the farm, with 40% working over 200 days a year off the farm. Just 48% of farmers list farming as their primary occupation in Deschutes County. Even in Jefferson County, only 60% of farmers have farming as their primary occupation. With slightly lower proportions in Jefferson County, about 20% of farm operators in Central Oregon are women.

The data suggests that for about half of farms in Central Oregon, farming is not an economic activity that underpins livelihoods, but rather a lifestyle choice. Living on a farm and having farming as a secondary economic activity appears to be the motivation. This is particularly true for Deschutes County where a shift from commercial farming towards lifestyle or hobby farming is largely complete. Crook County and to a lesser extent Jefferson County show the beginning signs of such a transition.

2.2.2 Farm Returns

While agriculture is a dominant land use in Central Oregon, it continues to struggle economically. Despite having 10% of Oregon's agricultural land, Central Oregon is responsible for just 3% of the market value of agricultural products sold (or $94 million in 2002). With farm production expenses roughly the same as for other areas in the state, the NASS Census calculates a net cash farm income for the region of $3.5 million, just 1% of the total for the state. Returns to operator labor, land and capital are negative in Deschutes County and positive in Crook and Jefferson County. For Oregon as a whole the net cash farm income per acre of land is $36. In Crook and Jefferson net income is positive at $8/acre and $4/acre respectively, while in Deschutes County there is a net loss of $51 per acre (Table 3). This is indicative of the difficulty in making farming a productive, financially-rewarding activity in Crook and Jefferson counties. In the case of Deschutes County, the lack of profitability reveals that farming is often a consumptive, as opposed to productive, activity – which is consistent with the prevalence of lifestyle farming, as noted earlier.

Table 3. Farm Economics in Central Oregon, 2002

Item	Unit	Crook	Deschutes	Jefferson	Central Oregon	as % of Oregon	Oregon
Market value of agricultural products sold							
Crops	$000	10,115	8,955	34,426	53,496	2%	2,194,911
Livestock	$000	22,758	12,028	6,359	41,145	4%	1,000,586
Total	$000	32,873	20,983	40,785	94,641	3%	3,195,497
as % of county income		9%	1%	13%	3%		
Total farm production expenses	$000	30,335	27,406	38,083	95,824	3%	2,786,838
Net cash farm income of operation (see text)	$000	7,850	(7,084)	2,773	3,539	1%	607,092
Average per farm	$	11,411	(4,351)	6,479	1,289	9%	15,156
Average per acre	$	8	(51)	4	2	6%	36

Source: NASS Census 2002

2.2.3 Agriculture and the Economy

While agricultural operations are on average yielding little in the way of financial returns, the rapid growth and development experienced by Central Oregon over the last decade provides other economic benefits to farmers. As shown in Table 4, the market value of land and buildings held by Central Oregonian farmers increased 32% during the 1997 to 2002 period. This means that farmers have an additional $370 million stored in these assets. The extent to which this is a result of new investment or price appreciation cannot be determined from the figures. In all likelihood both factors are responsible. As farms are subdivided and gentrified (in Deschutes and Crook counties) investments in homes and buildings are made. However, the rapid rise in the price of land in Central Oregon is probably the main factor underpinning this growth in asset values. The financial benefits of farming in Central Oregon are therefore not in farm operations but in owning a farm.

Table 4. Market Value of Land and Buildings, 1997-2002

Item	Unit	Crook	Deschutes	Jefferson	Central Oregon	as % of Oregon	Oregon
Estimated market value of land and buildings							
In 2002	$000	481,328	689,394	355,295	1,526,017	7%	20,383,264
In 1997	$000	323,016	532,811	301,384	1,157,211	7%	17,744,663
Change	%	49%	29%	18%	32%	214%	15%
2002 Average per farm	$	699,605	423,461	830,129	555,926	109%	508,882
Average per acre	$	531	5,172	561	859	71%	1,202

With 7% of its land area devoted to farming, agriculture in Deschutes County accounts for about 1% of total county income. Agriculture is much more important in Crook and Jefferson counties where 9% and 13% of county income, respectively, is derived from farming. A regional economic modeling effort confirms the importance of agriculture to these two counties in another way; they are estimated to have 11% of their workforce related to agriculture (Sorte and Campbell 2004a and 2004b).

It is important to recognize that the economic effects of lifestyle farming are poorly represented by income figures. As a consumptive activity, for example a small horse farm's economic

impact will be felt through investment in buildings and other farm infrastructure (including fences and irrigation equipment), as well as in the expenditure on the horses, including purchase of the horse, veterinary services, tack and other gear. For example, in Deschutes County total farm production expenses apportioned across all farmed acres leads to a per acre cost of $198. The figure in Crook County is $32/acre and in Jefferson $54/acre. The intensification of economic production on farms in Deschutes County is therefore 4 to 6 times that in the other counties. The difference between Crook and Jefferson counties probably reflects the difference between the higher intensity inputs required for farming (Jefferson) as opposed to ranching (Crook).

3. Irrigated Agriculture in Central Oregon

3.1 Irrigation and Agriculture

The NASS census suggests that there are 2,237 farms in Central Oregon that have irrigation (see Table 5). The total irrigated area is almost 180,000 acres or 15% of the total land area of these farms. In Deschutes County, the large number of small farms results in a higher proportion of farm land that is irrigated (40%). In Crook and Deschutes counties half of irrigated acreage is devoted to pastureland, while in Jefferson County 89% of irrigated land is devoted to crops.

Central Oregon makes up about 10% of Oregon's irrigated acreage (Table 5). Contrary to state-wide trends from 1997 to 2002, which saw a 3% dip in irrigated land, all three Central Oregon counties saw an increase in irrigated land during this period. Total irrigated land reported under the Census went up by 7% or 12,000 acres. The majority of this was on very large holdings of 1,000 acres or more. Given that few if any additional groundwater permits were approved during this period and the majority of rivers in the upper basin are closed to further development of surface waters, this variance must be ascribed to an increase in use of existing rights and permits, given climatic conditions. A number of good water years at the end of the 1990s may have resulting in increase in irrigated acreage on these large farms. Or with 2002 being a dry year, it may reflect an increase in the use of supplemental irrigation (largely from groundwater or the Crooked River) by the larger farms that year.

Table 5. Irrigated Agriculture in Central Oregon, 2002

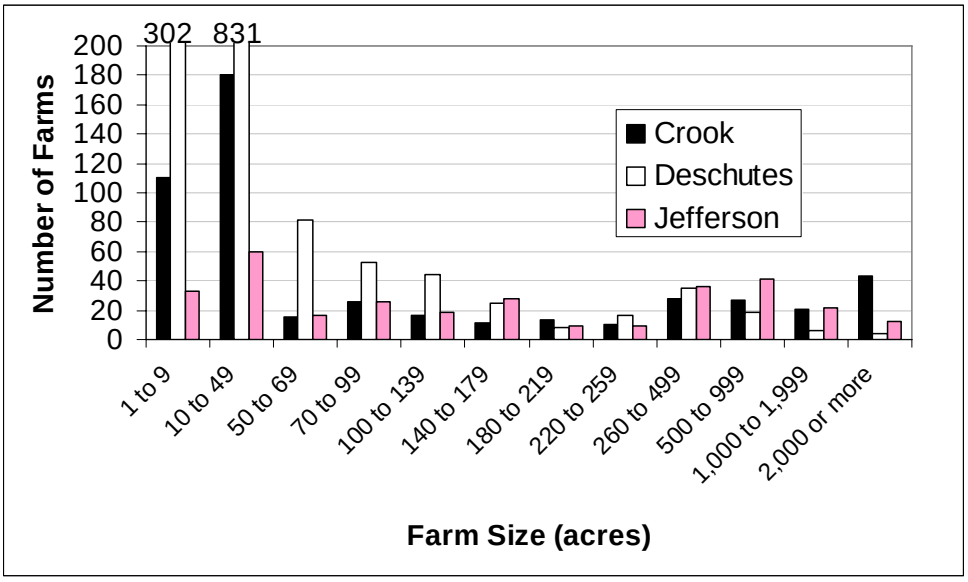
		Crook	Deschutes	Jefferson	Central Oregon	as % of Oregon	Oregon
Farms with Irrigation	#	501	1,425	311	2,237	13%	17,776
Land on these Farms	acres	758,915	110,721	307,123	1,176,759	11%	10,773,708
Non-Irrigated Land	acres	681,054	66,285	250,169	997,508	11%	8,866,081
Irrigated Land	acres	77,861	44,436	56,954	179,251	9%	1,907,627
as % of total land on farm		10%	40%	19%	15%		18%
change 1997 to 2002		11%	4%	5%	7%		-3%
Cropland	acres	38,482	22,724	50,874	112,080	8%	1,415,826
Pastureland	acres	39,379	21,712	6,080	67,171	14%	491,801
Pastureland (% of irr land)		51%	49%	11%	37%		26%

Source: NASS Census 2002

3.2 Farms, Farm Size and Irrigated Acreage

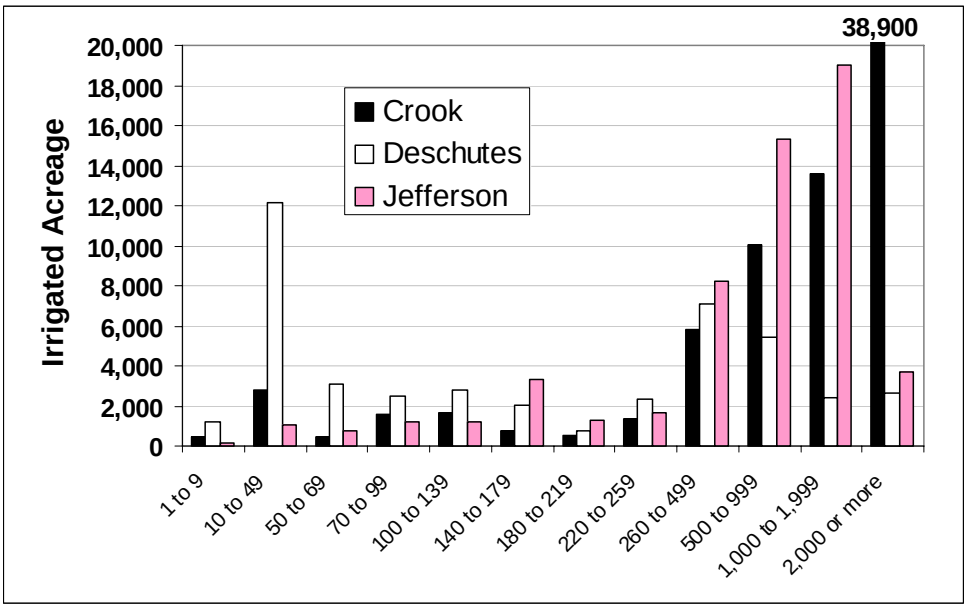
Patterns in size distribution of farms with irrigation are largely similar to those for agriculture as a whole when viewed county by county (see Figure 2 and Figure 3). Deschutes County has over 1,100 farms less than 50 acres in size. Almost one-third of total irrigated acreage in the County occurs on farms between 10 and 50 acres. Crook County also has a large number of smaller farms, but also has 40 that exceed 2,000 acres. The majority of irrigated acres (88%) in Crook County are on ranches that are more than 260 acres in size. Jefferson County exhibits a more modest variation with a larger number of farms in the less than 50 acre size range and in the 260 to 2,000 acre range. Three-quarters of total irrigated acreage in Jefferson County is on farms of between 260 and 2,000 acres. This reflects the prevalence of cropland on irrigated acres in Jefferson County, ranching in Crook County and smaller hobby farms in Deschutes County.

Figure 2. Farm Size Distribution for Irrigated Agriculture, 2002



Source: NASS Census 2002

Figure 3. Total Irrigated Acreage by Farm Size (acres), 2002



Source: NASS Census 2002

When compared with data from 1997, the 2002 data confirm the process of fragmentation of farms with irrigated acreage in Deschutes County (see Table 6). The number of farms and acreage on farms from less than 100 acres in size has increased dramatically; largely it appears from the breakup of farms between 100 and 220 acres. An increase in the number of farms of between 220 to 999 acres in size in Deschutes County masks the fragmentation of larger farms within this category and an increase in farms of less than 500 acres in size. A similar process is observed in Crook County with the increase in farms less than 50 acres in size, and the source of these acres from farms from 50 to 220 acres in size. In Jefferson County decreases in farm numbers and farm acreage are observed across all farm sizes. The exception is farms greater than 1,000 acres. This reflects a reduction in farms over 2,000 acres and a corresponding increase in farms between 1000 and 2000 acres. This, despite an increase in 2,000 acres of irrigated land in Jefferson County during the period.

Table 6. Change in Number of Farms with Irrigation and Irrigated Acreage by Size of Farm for Farms with Irrigation, 1997 to 2002

Farm Size	Crook County	Deschutes County	Jefferson County	Central Oregon
Change in Number of Farms of size (in acres)				
1 to 9	43%	22%	-6%	24%
10 to 49	23%	18%	-5%	18%
50 to 99	-2%	10%	0%	5%
100 to 219	-2%	-8%	-14%	-9%
220 to 999	20%	13%	-4%	7%
1000 and up	-19%	11%	-19%	-17%
Change in Total Irrigated Acreage within size category (in acres)				
1 to 9	46%	NA	-20%	268%
10 to 49	9%	15%	-18%	11%
50 to 99	-3%	5%	-18%	-2%
100 to 219	-13%	-26%	-20%	-21%
220 to 999	0%	26%	-15%	-3%
1000 and up	17%	NA	73%	34%

Source: NASS Census 2002

3.3 Water Rights

In Oregon all waters of the state are owned by the public, with the Oregon Water Resources Department serving as caretaker of the public's interest. A water right gives an individual the right to use water in a specified way, but not actual ownership of the physical water. Nonetheless, a water right creates a property interest for the owner of a perfected water right.

In Oregon, a permit or water right certificate is needed to use water in most cases. A prospective water user must first apply to the Department for a permit to use water. If the Department grants a permit, the applicant constructs a water system and begins using water. The applicant then hires a certified water rights examiner who verifies the water is being used according to the permit. If the water is being used within the terms of the permit, a water right certificate is issued.

A water right certificate gives its holder a perfected water right. A water right is made up of several elements or components. The elements of a water right in Oregon are:

- character of use (purpose or type of use such as irrigation or municipal)
- point of diversion/appropriation (where the water is taken from the source stream/location of the well)
- place of use
- priority date
- quantity (expressed as rate and duty)
- season of use.

These elements define both the outer limits of allowable water use and the property interest owned by the water right holder. In addition, water use is restricted by the requirement that it not be wasted. If water is not being used according to the terms of the certificate, is wasted, or is not used for a period of five consecutive years (abandonment), all or a portion of the water right is subject to forfeiture and cancellation.

3.4 Irrigation Water Rights

Irrigation rights in Oregon are subject to appurtenancy, that is, water goes with the land. Water rights for irrigation must therefore specify the lands on which the water will be applied. Beyond this universal requirement, irrigation water rights come in different shapes and sizes:

- Surface water and groundwater rights
- Natural flow and storage rights
- Primary and supplemental rights (i.e. primary being initial source and supplemental sources being those used when the primary is not available)
- Rights held by landowners in special districts (e.g. irrigation districts) and rights held by landowners outside of special districts

The latter distinction is a central one in water rights and water resources management in Central Oregon, since the bulk of water rights are appurtenant to land located within irrigation district boundaries and held as part of a district water right certificate. In addition, the majority of storage rights are held by these irrigation districts. Individual water rights (those held outside districts) for irrigation are therefore typically held as primary surface water rights, though there are some primary groundwater rights and some rights with supplemental groundwater rights. In some cases individuals will hold storage rights though these are largely limited to rights in the Paulina Creek system and to rights held in the lower Crooked River to storage from Prineville Reservoir.

3.5 Irrigated Acreage

An overview of the water rights for the nine irrigation districts considered here is presented in the next section. Taken as a group these districts provide water for about 150,000 acres. As total irrigation water rights in the upper basin are typically reported to be on the order of 160,000 (Gorman pers. com 2006) this suggests that these districts account for about 94% of the irrigation rights in the upper basin. However, the NASS Census cited earlier reports on 180,000 acres in irrigated farms in Central Oregon. The discrepancy is probably increased since not all district irrigated acres reported here would qualify as farms for the NASS Census – given urban encroachment. The distinction between lands irrigated with groundwater as opposed to surface water rights may account for some of the difference, but it remains likely that total irrigated acres are higher than reported.

Estimates of significant quantities of individual water rights used for irrigation as organized by reach include:

- Upper Deschutes: reportedly only 30 acres of irrigation rights

- Little Deschutes: little irrigation apart from Walker Basin Cooperative
- Paulina Creek: several ranches of approximately 500 acres total
- Whychus Creek: 10 cfs of senior rights and 72 cfs of junior rights servicing about 4,000 acres
- Indian Ford Creek: a number of large ranches of around 1,000 acres in total
- Tumalo Creek: no appreciable irrigation rights apart from Tumalo Irrigation District
- Lower Bridge area of the lower Middle Deschutes and Dry Canyon: a few large farms, some using primary groundwater rights of several thousand acres
- Metolius River and its tributaries: a few scattered diversions, largely for non-farm use
- Lower Crooked River between Smith Rock and Prineville: a significant number of large and smaller farms covering several thousand acres
- Ochoco Creek above Ochoco Reservoir – a number of ranches of hundreds acres
- North Fork of the Crooked River – a number of ranches of hundreds of acres
- South Fork of the Crooked River – numerous ranches, including several thousand acres of irrigation on Summit Prairie
- Bear Creek above Prineville – a few large ranches of around one thousand acres

It is also the case that of these individual rights a significant portion may be junior and therefore not actively irrigated year in and year out.

4. Irrigation Districts

Irrigation districts in Oregon are organized as Special Districts under ORS Chapter 545. They are thus public corporations under Oregon Law, with prescribed rules for purpose, boards, elections, staffing, charges, etc. The districts are created for the purpose of delivering water to their patrons. As such they are effectively non-profit water user associations.

In addition to irrigation uses, these districts also supply a number of other uses, including municipal, industrial, and pond maintenance. The most significant non-irrigation right is a municipal right held by the city of Redmond in the Central Oregon Irrigation District of about 800 acre equivalents. However, by and large the districts exist for the purposes of irrigation.

4.1 Water Rights

The nine irrigation districts are spread across Central Oregon, although there is a clustering of diversion points at Bend for the districts using water from the Middle Deschutes (see Table 7). Swalley Irrigation District (Swalley), Central Oregon Irrigation District (COID), Arnold Irrigation District (Arnold), North Unit Irrigation District (North Unit) and Crook County Improvement District #1 (Lone Pine) all take water exclusively from the Deschutes River at Bend (see Figure 1).

Tumalo Irrigation District (Tumalo), Three Sisters Irrigation District (Three Sisters) and the La Pine Cooperative Water Association (Walker Basin) are the sole districts on Tumalo Creek, Whychus Creek and the Little Deschutes respectively. Tumalo also takes live flow from the Deschutes, as well as stored water from Crescent Lake delivered via the Little Deschutes and the

Deschutes. Ochoco Irrigation District is a federal project that is the major user of water from the Crooked River and is located in Crook County. A number of smaller districts, including the People's Irrigation District, divert water below Prineville on the Crooked River. The majority of North Unit lands are 'Deschutes Lands' but the district also serves its 'Crooked River Lands' pumping water up from Crooked River above Smith Rock. North Unit thus takes Deschutes and Crooked water, but it is located in Jefferson County. Lone Pine has Deschutes water but is located largely in Crook County (although it also has a small amount of land crossing into Jefferson and Deschutes County).

The majority of COID lands are in Deschutes and Crook counties. Swalley, Tumalo, Arnold, and Three Sisters are wholly located within Deschutes County. Walker Basin is largely in Deschutes County but its point of diversion and some of the lands are in Klamath County.

Table 7. Irrigation Districts

District	Point of Diversion	Lands in County
Swalley Irrigation District*	Deschutes River at Bend	Deschutes
Central Oregon Irrigation District (COID)*	Deschutes River at Bend	Deschutes, Crook, Jefferson
Crook County Improvement District #1 (Lone Pine)	Deschutes River at Bend	Crook, Jefferson, Deschutes
Arnold Irrigation District	Deschutes River above Bend	Deschutes
North Unit Irrigation District	Deschutes River at Bend and Crooked River above Smith Rock	Jefferson
La Pine Cooperative Water Association (Walker Basin)	Little Deschutes above La Pine	Deschutes, Klamath
Tumalo Irrigation District	Tumalo Creek and Middle Deschutes at Bend	Deschutes
Three Sisters Irrigation District*	Whychus Creek above Sisters	Deschutes
Ochoco Irrigation District	Ochoco Creek and Crooked River above Prineville, McKay Creek below Prineville	Crook

Notes: Diversions related to district main canals only. *These districts serve some lands that divert directly from the river.

The nine districts all have primary water rights from surface waters (see Table 8). These rights come with priority dates. Swalley, COID, Lone Pine, Tumalo and Walker Basin generally have senior surface water rights, i.e. rights that are typically filled each year. Most of the districts that do not have senior rights have storage rights that assure the district a reasonable supply of water in all but the driest of years. There are two exceptions to this rule. The first is Three Sisters, which has no winter storage facility and has a considerable amount of its rights that are either junior or only partially filled on a regular basis (see Appendix C in the companion DWA Issues Paper *Instream Flows in the Deschutes Basin* for a detailed explanation of water availability and water rights in Whychus Creek). Many of the farmers in Three Sisters rely on groundwater as a supplemental source in the summer months. The second exception is North Unit, where the Crooked River Lands have a junior surface water right.

Tumalo is in a class all its own with a bewildering array of surface water rights and access to rather unreliable storage in Crescent Lake. Rather than attempt to regulate individual users the

district treats all users equally. This ensures that all users obtain water throughout the season, with dry year shortages shared equally.

Table 8. District Primary and Supplemental Water Rights

	Primary Surface Water Right(s)			Supplemental Right(s)			
District	Certificate Number(s)	Source	Priority Date(s)	Permit or Certificate Number(s)	Storage Facility	Source	Priority Date
Swalley[1]	74145	Deschutes	1899	No supplemental rights			
COID[1]	76358	Deschutes	1900, 1907	76714	Crane Prairie	Upper Deschutes	1913
Lone Pine[1]	72197	Deschutes	1900	76714	Crane Prairie	Upper Deschutes	1913
				Some farmers also have groundwater supplemental rights			
Arnold[1]	74197	Deschutes	1905	76714	Crane Prairie	Upper Deschutes	1913
North Unit	72279, 72280	Deschutes[2]	1913	51230, 51229	Wickiup, Haystack	Upper Deschutes	1913 & 1955
				72281, 72282	n/a surface water supp.	Crooked River	1955
	72283, 72284, 47284	Crooked	1968, 1982	No supplementals			
Walker Basin	72196, 68721	Little Deschutes	1897, 1900,1902, 1907	No supplemental rights			
Tumalo	74146, 74147, 76106	Tumalo Creek	1900, 1905, 1907, 1913, 1961	74148, 74149 & 76520	Cresecent Res.	Crescent Creek	1905, 1911 & 1961
				74149	n/a – surface water supp.	Deschutes R	1905
Three Sisters	74135	Whychus	1869,1885, 1887, 1889, 1893, 1895, 1899, 1900, 1901, 1903, 1904	The district and some farmers have groundwater supplemental rights			
Ochoco	68394 (55974), 76576	Ochoco, McKay, Lytle, Dry, Johnson Creeks	1916, 1917, 1986	S-68342, S-5426, 55973, 57162, R-528, R-2223, 25591	Prineville & Ochoco Res.	Crooked River, Ochoco Creek	1914

Notes: [1]According to the Deschutes County Court Decree of March 24th, 1933. [2]North Unit's Deschutes Lands also have a supplemental right to live flow from the Crooked River

4.2 Season, Rate and Duty

The irrigation season in Central Oregon is generally from April 1st to November 1st (see Table 9). Under the Deschutes Decrees, the Districts diverting water from the Deschutes have their seasons divided into five intervals for rate purposes. Two, symmetrical ramp up and ramp down seasons surround the main season from May 15th to September 15th. Three Sisters is the only district without any season specified on the certificate. Ochoco and the North Unit Crooked River Lands do not have specific dates for their Crooked River rights but they are limited to diverting water during 'the irrigation season,' which is set at February 1 to December 1.

Diversion rates for the districts vary significantly. The Deschutes Decree districts receive generous maximum rates due to high transmission losses. Arnold, pulling water out of the Deschutes above Bend near the Newberry lava flow has the highest rate at just over 1 cfs for every 20 acres. Swalley, COID and Tumalo have slightly higher rates at roughly 1/32. North Unit and Walker Basin are at 1/40 and Three Sisters at 1/50. Over in the Crooked, with less permeable geology, Ochoco has just a 1/80 diversion rate.

When applied to the total acre equivalents within each district, the full legal diversion capability of each district and the districts in each reach can be calculated. In some cases, the district certificate specifies a limit short of the maximum suggested by the per acre rate and the number of acres. In total, these districts have legal rights to divert just over 3,600 cfs. This is equal to 83% of the total outflow of water from the upper basin as calculated in the companion DWA Issues Paper *Instream Flows in the Deschutes Basin*. These high rates of diversion, in comparison to available water mean that at the key points of diversion for these districts the rivers are overappropriated. As a result, Whychus Creek at Sisters, the Middle Deschutes at Bend, the Crooked River above Smith Rock and Tumalo Creek below the Tumalo diversion have historically been severely depleted or run dry.

The duty (annual volume) of water that can be applied to an acre of irrigated ground is also specified in the district water rights, in accordance with the relevant decrees. The duties vary in a predictable fashion depending on expected transmission losses and, thus, the diversion rates reviewed above. Whereas typical irrigation duties would be in the 3 to 4 acre-feet/acre range, duties in the Deschutes are much higher (see Table 10). Arnold's duty exceeds 15 ac-ft/acre and most of the other Deschutes districts have duties just under 10 ac-ft/acre.

Table 9. District Primary Water Rights, Priority Dates and Seasons

District	Irrigation Season			Rates at Point of Diversion (cfs/acre)			Total Rate Limit at Point of Diversion (cfs)		
	Season 1	Season 2	Season 3 (max rate)	Season 1	Season 2	Season 3 (max rate)	Season 1	Season 2	Season 3 (max rate)
Swalley	Apr 1-May 1; Oct 1-Nov 1	May 1-May 15; Sept 15-Oct 1	May 15-Sept 15	1/83	1/62	2/67	55	74	125
COID	Apr 1-May 1; Oct 1-Nov 1	May 1-May 15; Sept 15-Oct 1	May 15-Sept 15	1/80	1/60	3/97	560	746	1,382
Lone Pine[1]	Apr 1-May 1; Oct 1-Nov 1	May 1-May 15; Sept 15-Oct 1	May 15-Sept 15	1/137 0.01123	1/109 0.01411	1/86.6 0.1077	27	33	29.1 42
Arnold	Apr 1-May 1; Oct 1-Nov 1	May 1-May 15; Sept 15-Oct 1	May 15-Sept 15	1/51	1/39	5/104	86	112	150
North Unit			Apr 1-Nov 1			1/40			1,101
Deschutes River									
Crooked River			Feb 1 – Dec 1			1/40			200
Walker Basin		Apr 1-May 23; Aug 20-Nov 1	May 23-Aug 20		1/80	1/40		19	38
Tumalo[2]	Apr 1-May 1; Oct 1-Nov 1	May 1-May 15; Sept 15-Oct 1	May 15-Sept 15	1/80	1/60	3/97	94	121	214
Three Sisters			no season			1/50			153
Ochoco			Feb 1 – Dec 1			1/80			211

Notes:[1]Lone Pine rates on the top row are rates at the Crooked River, rates at the point of diversion in Bend on the second row account for a 35% decreed transmission loss to the Crooked River. [2]Tumalo has 790.60 acres of 1961 rights that were limited to a rate of 1/70 and a duty of 2.5 ac-ft/acre

Table 10. Duties, Transmission Loss and Instream Leases

	Legal 'Paper' Rights at Point of Diversion		Decreed Transmission Loss	Allowed Duty for Instream Leases
	At Point of Diversion (ac-ft/acre)	Total Annual Potential Diversion (ac-ft)[1]	% loss	(ac-ft/acre)
Swalley	9.58	41,523	43%	5.46 decreed
COID	9.91	443,807	45%	5.53 decreed
Lone Pine	6.46	15,307	35%	4.20 decreed
Arnold	15.42	53,685	65%	5.40 decreed
North Unit	5.25	262,762	n/a	2.0 allocation
	4.00	35,271	n/a	1.0 allocation
Walker Basin	4.00	6,136	n/a	4.0 certificate
Tumalo	9.91	73,293	45%	5.53 decreed
Three Sisters	No duty limit	64,952	n/a	Yearly Allocation
Ochoco	4.00	81,327	n/a	Yearly Allocation
Totals[2]	7.10	1,078,064		

Notes: [1]Minimum value depending on rates, duty limit and any total rate limitations on the certificate; Three Sisters is calculated at full rate for the standard 214 irrigation season although legally there is no season for these rights. [2]Total paper duty at point of diversion is a weighted average across all district acres,

The Deschutes districts have a further anomaly in their decreed rights. The decree of March 24th 1933 specifies the percent transmission loss in each district. In their certificates issued following district remapping in the late 1990s Arnold, Swalley, and COID contain the language that the rate and duty for lands irrigated directly from the river (i.e. not from a district main canal) will be less the amount of transmission loss specified in the Decree. For the purposes of instream leases and transfers to direct river point of diversions OWRD reduces the rate and duty allowed by the transmission loss in these Districts. This is also current practice on leases from Lone Pine and Tumalo. Instream transfers from COID have also been subject to the deduction of transmission loss. Table 10 clarifies the duties and total duty permitted these rights as well as the lease duty currently allowed by districts or OWRD on these water rights.

4.3 Acreages and Customers

As reported earlier, these nine districts account for almost 150,000 acres of water right. The district-by-district figures are presented in Table 11. North Unit and COID are by far the dominant districts in terms of size accounting for two-thirds of total acreage. Ochoco is a respectable third in size at 20,000 acres followed by Tumalo and Three Sisters at just under 8,000 acres. Swalley and Arnold are of a similar size at around 4,000 acres and Lone Pine and Walker Basin are the smallest districts at around 2,000 acres. Interestingly it is these two smaller districts that have by far the largest average farm size, with over an 80 acre average in Walker Basin and over 100 acres in Lone Pine. No other district comes close. North Unit has the next highest average farm size followed closely by Three Sisters, in the 60 to 70 acre range. Ochoco follows at just under 30 acres and the rest of the districts range from 6 to 12 acres in average

farm size. The average for all the districts comes to just 17 acres, reflecting the large number of small farms in COID.

Table 11. District Water Right Acreages, Customers and Farm Size

District	Irrigation	Municipal	Industrial	Other	Total	Customers[1]	Average Farm Size (acres)[1]
Swalley	4,351	-	24	186	4,561	755	6
COID	43,747	789	87	161	44,784	4,497	10
Lone Pine	2,369	-	-	-	2,369	20	120
Arnold	3,976	348	23	37	4,384	792	6
North Unit	58,868	-	-	-	58,868	850	69
Walker Basin	1,534	-	-	-	1,534	18	85
Tumalo	7,367	-	4	11	7,381	632	12
Three Sisters	7,568	-	5	79	7,651	129	59
Ochoco	20,150	-	182	-	20,332	745	27
Totals	149,924	1,137	334	483	151,878	8,897	17

Note: Acreage equivalent figures are from the water right certificates. Since the 1990s purchases and transfers may have modified these numbers, particularly in Swalley and COID. [1]Customer numbers and hence average farm size are indicative only and will be updated to 2006 account numbers as part of the review process with districts.

As will be discussed below the major explanatory factor for the differences in average farm size is proximity to urban areas. Lone Pine and Walker Basin are the only two Districts located in rural areas at a reasonable distance from incorporated areas. All the rest of the districts are either adjacent to or at least partially subsumed within urban areas.

4.4 Water Distribution

The water delivery system for the districts is extensive with close to 300 miles of main canals and over 360 miles of laterals (see Table 12). The delivery system is discussed in much greater detail in the respective companion DWA Issues Paper and is not dwelt on here. Suffice it to say that for those districts encroached upon by urban areas the maintenance, operational and safety & liability issues associated with these canals and laterals are significant, as discussed further below.

Table 12. District Delivery Systems

District	Canals (miles)	Laterals (miles)
Swalley	11.60	16.80
COID	76.50	129.70
Lone Pine	40.10	5.40
Arnold	15.50	24.50
North Unit	65.00	83.90
Walker Basin		
Tumalo	35.70	26.30
Three Sisters	20.90	39.50
Ochoco	33.90	37.50
Totals	299.20	363.60

Source: BOR (1997)

Note: Figures for Walker Basin yet to be obtained

4.5 District Budgets and Staffing

Staffing typically makes up the major portion of irrigation district budgets. Staffing is itself determined by extent of the operational complexity of the district during the irrigation season and maintenance tasks in the off-season. Increasingly, as the district patron base has shifted from farmers to lifestyle farmers, as the turnover in the patron base has increased, as in-migrants have arrived with little previous experience with irrigation, as developers have purchased farmlands and developed subdivisions, and as efforts to restore the river through conservation, leasing and transfers were initiated, the front office and water rights management tasks have grown rapidly as well. Staffing level at each of the districts is reported in Table 13 along with the latest annual operating budgets.

Table 13. District Budget and Staffing

			District Staffing				
District	Operating Budget 2005 actual	Annual Operating Budget 2006	Total	Manager	Office	Watermaster & Patrolman	Engineering, & Maintenance.
Swalley		$486,208	4.0	1.00	1.00	2.0	
COID	$2.1 m	$2,131,000	23.00	1.00	5.00+	11.00	6.00
Lone Pine*			-	-	-	0.5	-
Arnold*			4.00	1.00	1.00	2.00	-
North Unit*							
Walker Basin			-	-	-	-	-
Tumalo*			6.00	1.00	2.00	2.00	1.00
Three Sisters*			2.50	0.50	1.00	1.00	-
Ochoco*							

Source: Irrigation Districts

Note: *Estimates only where available, Districts to be consulted for correct figures as part of the review process with districts.

4.6 District Assessments

In order to cover operating costs and to pay back capital expenses incurred, irrigation districts levy annual assessments on their patrons. Previous reviews of assessments were included in BOR (1997) and Newton Consultants and DRC (2003). Information from these reviews is compiled along with current assessment information provided by Swalley Irrigation District for the seven districts that make up the Deschutes Basin Board of Control. Additional information was gathered from individual districts and efforts will be made to review this information with each district to assess its veracity. The analysis below is thus based on three samples of assessments. The first comes from charges current at the time of the BOR (1997) report – assumed to be 1996 as the report was published in April of 1997 (the water year for the charges listed was not specified). The second and third come from 2003 and 2006 water year assessment rates.

As described by BOR (1997) districts in Central Oregon can be separated out as to whether they charge based on the amount of water consumed or whether they charge a flat fee irrespective of the amount of water used. Historically, North Unit and Three Sisters have used the former approach of volumetric charges. Three Sisters patrons pay the same price for each acre of water they receive in a season. North Unit uses a tiered block tariff system wherein a fixed rate is charged to all farms for the first 2 acre feet delivered. Farmers have the option of acquiring additional water but the per acre foot charge rises for the third acre foot and rises again for any water used in excess of 3 acre feet.

For districts charging by the acre there is considerable variance between districts in how rates are determined. A flat per acre fee is often (though not always) combined with a per account fee. This has the effect, discussed further below, that the amount paid per acre of water rights on an account will vary within a district based on the number of acres being irrigated on the account. Swalley, COID, Lone Pine, Arnold, Tumalo and Ochoco all employ an acreage charge approach. The assessment rates for the districts over the three periods used in this analysis are provided in Table 14.

Table 14. Irrigation District Assessments, circa 1996, 2003, 2006

Irrigation District	Year	Fees and Charges			Water
		Base / Delivery Charge	Charge Per Acre	Other Charges	Allocation [6] (ac-ft/ac)
Swalley	1996	$ 242.00	$ 14.13		
	2003	$ 307.12	$ 16.98		
	2006	$ 375.00	$ 20.50		
COID	1996	$ 200.00	$ 17.50		
	2003	$ 275.00	$ 23.00		
	2006	$ 275.00	$ 23.00		
Lone Pine	1996	-	$ 18.50		
	2003	-	$ 21.00		
	2006	-	$ 27.00		
Arnold	1996	$ 303.10	$ 43.00	lot fees	
	2003	$ 319.06	$ 53.53	$34.06 per lot	
	2006	$ 364.02	$ 67.18	$42.04 per lot	
North Unit[1,2]	1996	$ 3.13	$ 25.85	see Note[3]	2.00
	2003	$ 1.00	$ 29.00	see Note[4]	2.00
	2006	$ 50.00	$ 47.43	see Note[5]	2.00
Walker Basin	1996	TBD			
	2003				
	2006				
Tumalo	1996	$ 250.00	$ 25.00		
	2003	$ 315.00	$ 32.00	15.00	3.00
	2006	$ 375.00	$ 40.00		
Three Sisters[1]	1996	$ 250.00	-	$7.50/ac-ft	3.00
	2003	$ 250.00	-	$7.50/ac-ft	3.00
	2006	$ 300.00	-	$7.50/ac-ft	3.00
Ochoco	1996	$ 65.00	$ 20.24		
	2003	$ 65.00	$ 27.40		3.00
	2006	$ 105.00	$ 51.00		

Sources: BOR (1997); Deschutes Basin Board of Control; Crook County Improvement District No. 1.

Notes: [1]Volumetric charging; [2]For North Unit Deschutes Lands; [3]1996 charges: $25.85 for first 2 ac-ft/acre; $15.52 per ac-ft in excess of 2 ac-ft; $18.10 per ac-ft in excess of 3 ac-ft; [4]2003 charges: $1.99 and $11.24 Excess Water $17.40 for first ac-ft, Then $20.30 for all additional ac-ft; [5]2006 charges: $50 base fee; $14.51 per acre for bond payment; $32.92 for first 2 ac-ft/acre; amounts above 2 ac-ft/acre to be obtained. [6]Allocation of water used to calculate per acre water usage in other tables.

The assessment cost paid by patrons in 2006 (for a range of account sizes) is provided in Table 15. For smaller acreage accounts both Lone Pine and North Unit have the lowest charges – this is likely to due to their having few if any accounts in this range. Their assessments are oriented towards larger farmers that make up the bulk of their districts. Districts with larger numbers of smaller hobby or 'lifestyle' farmers tend to have proportionately higher charges the smaller the acreage on the account. Arnold and Tumalo have the highest charges for farms at 10 acres or

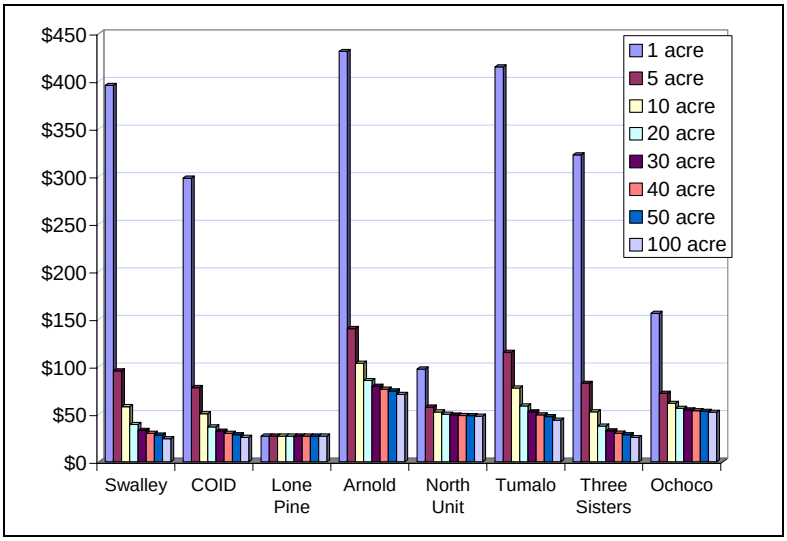
less. Swalley has a higher base charge than COID but a lower per acre charge so that the costs of irrigating one acre in Swalley are $100/yr higher than in COID, but irrigating a 40 acre parcel in both districts costs exactly the same. Three Sisters assessments are reasonable in comparison to the others – at the 3 ac-ft allocation used to calculate these costs.

Table 15. Cost of Irrigating District Acreage, 2006

	Total Annual Water Charges for Accounts of Different Sizes (in acres)							
Irrigation District	1	5	10	20	30	40	50	100
Swalley	$ 396	$ 478	$ 580	$ 785	$ 990	$ 1,195	$ 1,400	$ 2,425
COID	$ 298	$ 390	$ 505	$ 735	$ 965	$ 1,195	$ 1,425	$ 2,575
Lone Pine	$ 27	$ 135	$ 270	$ 540	$ 810	$ 1,080	$ 1,350	$ 2,700
Arnold	$ 431	$ 700	$ 1,036	$ 1,708	$ 2,379	$ 3,051	$ 3,723	$ 7,082
North Unit	$ 97	$ 287	$ 524	$ 999	$ 1,473	$ 1,947	$ 2,422	$ 4,793
Tumalo	$ 415	$ 575	$ 775	$ 1,175	$ 1,575	$ 1,975	$ 2,375	$ 4,375
Three Sisters	$ 323	$ 413	$ 525	$ 750	$ 975	$ 1,200	$ 1,425	$ 2,550
Ochoco	$ 156	$ 360	$ 615	$ 1,125	$ 1,635	$ 2,145	$ 2,655	$ 5,205

Ochoco's pricing structure is different from that observed in other districts. The cost of irrigating small acreages is low in comparison with other districts and the cost of irrigating large acreages is high in comparison with other districts. In Figure 4 this difference is easily viewed as the per acre cost of irrigating one acre in Ochoco (the first bar) is considerably less than in the other districts, while at the other end of the spectrum, the per acre costs of irrigation 100 acres in Ochoco is higher than in many of the other districts. Generally speaking it can be observed that the districts with smaller average account sizes (see Table 11) tend to have a larger degree of differential pricing in terms of customer account size, while those with higher average account sizes (e.g. Lone Pine, North Unit, Ochoco) tend to have lower differential (flatter curves across account sizes in the figure). The exception is Three Sisters which despite having 59 acre average account size has a differential pricing structure similar to that of Swalley or Arnold (with 6 acre average sizes). One purpose of this review is to raise questions about the pricing policy issue. To what extent is it justified for farmers of different sizes to pay varying amounts for water – and what are the implications for the reallocation of this water? We return to this issue in later sections.

Figure 4. Per Acre Cost of Irrigating District Acreage across Different Account Sizes, 2006



Raising assessment rates, as with price hikes in any 'public' service is a source of concern for district management and patrons alike. Reviewing the pricing data obtained allows an examination of whether and to what extent assessments have increased over time – and provides information on how the costs of providing services to patrons have changed across the districts in Central Oregon.

Comparison of the assessment rates shows that rates have generally been rising over the last ten years. Table 16 presents these 'nominal' increases in assessments from 1996 to 2006 for the average account size class for each district. Using data on the consumer price index the figures are then adjusted to account for general price inflation. These 'real' figures show that generally speaking irrigation district assessments have increased faster than inflation. However, this is not to say that prices rise in a regular fashion. In real terms there were real price decreases over a number of the periods analyzed for a number of districts. For example, real prices fell from 1996 to 2003 in North Unit (by around -5%) and then rose severely from 2003 to 2006 (by 52%). In this case the price rise largely reflects increased power costs as the district's low-price power contract ended and expenses incurred under Reclamation's Safety of Dams program for work at Wickiup dam.

Table 16. Assessment Increases

	1996 - 2006	
District	Nominal Increase	Real Increase
Swalley	52%	18%
COID	35%	5%
Lone Pine	46%	13%
Arnold	37%	6%
North Unit	87%	45%
Walker Basin	na	
Tumalo	55%	20%
Three Sisters	4%	-19%
Ochoco	143%	89%

Interestingly, Three Sisters assessments have actually fallen by 20% in real term while both COID and Arnold have seen price rises that barely exceed the general rate of inflation at 5% and 6% respectively. Swalley rates have risen by 18%, whereas rates have increased considerably (by 89%) in Ochoco irrigation district.

Thus, in general it can be concluded that the cost of providing water to district patrons in Central Oregon has increased at a substantial rate above inflation. Absent a full analysis of district finances over this time frame anecdotal evidence suggest that these increases stem mainly from four sources. First, district O&M expenses are often made up in large part by personnel expenses. As Special Districts under Oregon Law, the irrigation districts have been hard hit in recent years by increasing costs of benefit packages, particularly pension costs under the PERS system and insurance costs (districts typically provide comprehensive health, dental and vision packages to their employees). Second, districts that pump large amounts of water (for example North Unit and Ochoco) have been hit by higher energy prices. Third, urbanization, the accompanying reduction of farm size and the complexity of delivering water and satisfying urban patrons has led to an increase in administrative and operational costs. The other source of increased cost has to do with construction expenses to ensure safety of dams, provide enhanced water supply through conservation measures and requirements to install new fish screens on diversions. For example, North Unit patrons are currently paying off a 20-year bond that was used to finance a major canal lining project to shore up water reliability in the district.

5. Population Growth and Urbanization in Central Oregon

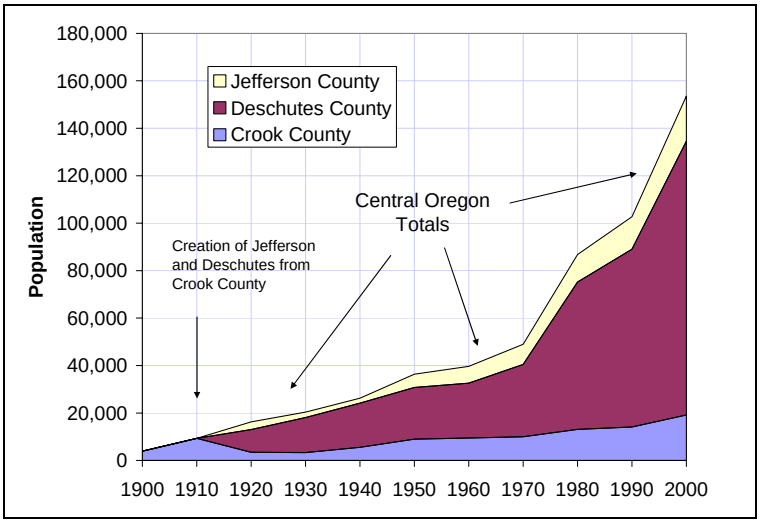
Over the last century and a half a number of different driving forces have led to the settlement of Central Oregon and substantial modification of land cover and land use in the region. Productive activities, particularly timber, ranching and agriculture, drove settlement from 1860 through 1980. Beginning in the 1960s, consumptive activities like recreation, tourism, and lifestyle farming, along with a growing population of mobile retirees contributed to population growth and a growing service industry. In one way or another population changes have largely driven

land and water use in Central Oregon. A brief overview of historical trends in population growth rates is presented as baseline information.

5.1 Population Trends

The West is the fastest growing region in the United States for a variety of reasons, not least of which are its environmental amenities, and Bend was recently identified as the sixth fastest growing metropolitan area in the nation. Deschutes County is the fastest growing county in Oregon, but Crook and Jefferson are not far behind, Flattening out Central Oregon's population growth over the last century reveals a growth rate of 44% every decade. In comparison, Oregon's rate was 24% and for the US as a whole it was 14%. Figure 5 shows that the bulk of the population gain in Central Oregon has been in Deschutes County. Over the last eighty years the corresponding growth rate for Deschutes County has been 54% per decade. However, charting out these increases by decade shows that Central Oregon grew quickly but steadily through 1970. Growth from 1970 to 1980 exploded, slowed from 1980 to 1990 and then took off again through 2000. Deschutes County doubled its population from 30,000 to 60,000 between 1970 and 1980 and from 1990 to 2000 the population increased by another 50% from 75,000 to 115,000.

Figure 5. Central Oregon Counties Population, 1910 to 2000

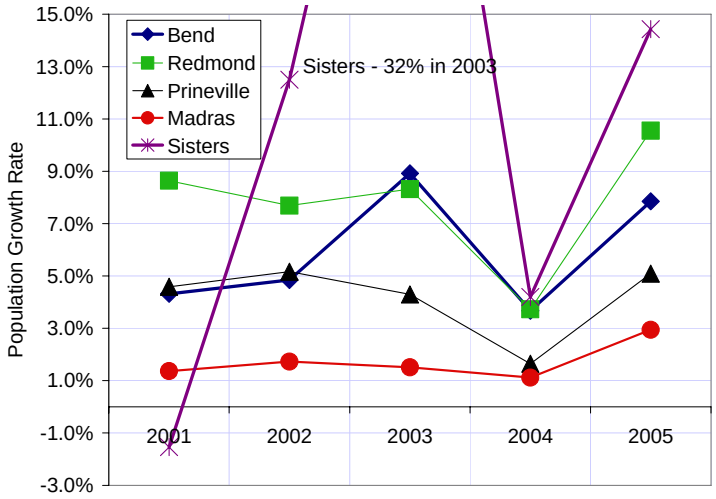


Source: Population Research Center

In February of 2006 Portland State University's Population Research Center released its certified numbers for 2005. These figures show that Central Oregon continues to grow rapidly, recording a 20% increase in population in the last five years (PRC 2006). Of this increase, 27,000 comes in incorporated areas and 5,000 in unincorporated areas. Clearly the balance of the push in raw numbers is in the urban areas, as expected. Growth rates over the last five years for the major urban centers in Central Oregon are shown in Figure 6. For Bend and Redmond, the two largest centers, these rates have oscillated between 4 and 11% with Redmond at an average of 8% per year and Bend at 6% per year. Madras and Prineville have seen lower rates, with Prineville averaging 4 to 5% and Madras from 1 to 3%. Sisters has seen huge swings, including a 32% increase in 2003. Culver (not shown) saw little growth during the period, at least until 2005

when the population increased by 25%. Such large swings are typically due to annexation of additional areas into the incorporated areas.

Figure 6. Year-on-year Population Growth in Urban Centers, 2001 to 2005



While most of the West is seeing increasing exurbanization – migration to rural unincorporated areas – Oregon's strict land use planning system puts a significant constraint on this trend. In Oregon, population growth is largely constrained by Urban Growth Boundaries (UGBs). The effect of population growth in Oregon has thus been rapid infill of lands within UGBs. As cities in Oregon are expected to maintain a 20-year supply of buildable land within their UGBs, rapid population growth shortens the time frame for consideration of UGB expansion for these cities. Depending on the location of irrigated lands and the direction of UGB expansion there are corresponding impacts on irrigable land as it is brought within UGBs. This is a process with which Central Oregonians are increasingly familiar as the growth continues. The recent passage of Measure 37, which creates a mechanism for more development in unincorporated areas, may have a significant impact on growth patterns, exurbanization, and land use in Central Oregon, but it is too soon to know the exact dimensions of the Measure 37 effect.

The impacts of urbanization on irrigable lands is clear, as infill occurs formerly irrigated land is developed and the irrigation water rights are removed. The impacts of population growth and demographic change in rural unincorporated areas on irrigated lands are less clear. As noted above, an increase in absolute numbers of 5,000 in rural areas occurred over the last five years. In the previous ten years (1990 to 2000) population grew in unincorporated areas by another 8,500 people. These are large numbers, particularly when it is recalled that these are net increases that include the impact of urban expansion into rural lands, thus switching some existing residents from rural to city dwellers. Perhaps as important a driving force as the sheer numbers is the demographic change that occurs with such large net in-migration.

Demographic data on this influx is not widely available, however, anecdotal observation and results from research carried out by developers sheds some light on this phenomenon, particularly in Deschutes County. There is at least the suggestion that many in-migrants to Central Oregon unincorporated areas arrive from the Willamette Valley, Puget Sound and the

Bay Area with plans to 'country-up'. Acquisition of land with water to run cattle, grow pasture or alfalfa, or raise horses (or other more exotic animals) is often the plan. At least a significant portion of such folk discover in short order that the farm life is not quite so idyllic, in fact it can be quite hard work – moving hand line, mucking out stalls, visiting feed stores, veterinarians, etc. After a couple of years a proportion of these migrants 'retire' to the city and dedicate themselves more fully to recreational, cultural and other quality of life pursuits. Managers of irrigation districts in Deschutes County, where lifestyle farmers predominate, estimate that there is a turnover of 20% in the district's patron base each year. Under these circumstances there is continuing decline in demand for irrigation water in these rural areas as discussed in greater detail later in this report.

5.2 Population Forecasts

The companion DWA Issues Paper *Municipal Water Supply Report* provides estimates of future urban population growth and corresponding expansions in UGBs. This information is not repeated here. Suffice it to say that the growth of urban areas is expected to continue for the foreseeable future. Accompanying these increases will no doubt be continuing influx to rural areas in Central Oregon. Quite a number of new destination resorts are moving from design to reality in Deschutes County, with additional prospects in Crook County, and several Measure 37 claims are being considered.

6. Impacts of Growth and Urbanization

Net in-migration and population growth in urban and rural areas, along with the associated demographic changes in the makeup of the rural population, are generally regarded as the proximate causes for the following phenomena:

- fragmentation and loss of irrigable land
- impairment of water delivery by irrigation districts
- reduced demand for irrigation water

These in turn contribute to concern regarding the loss of the district assessment base and the future financial solvency of irrigation districts. In this section the impacts on land and water use of population growth, urban expansion and changing rural demographics on irrigable land, irrigation district management and the demand for water resources are examined in detail, including case studies of how these processes have unfolded in local irrigation districts.

6.1 Impacts on Irrigable land

Two primary impacts on irrigable land come from the trend towards fragmentation (or partitioning) of rural lands under population pressures and the inexorable expansion of UGBs to accommodate increasing urban populations.

6.1.1 Fragmentation

No systematic examination of long-term historical data on the process of fragmentation of irrigated lands is available. Reclamation's 1997 report contained no information on numbers of accounts held in the seven local irrigation districts included in the reconnaissance study. However, recall that in Section 4.2 data from the NASS Census showed a clear trend in fragmentation of larger farms in Crook and Deschutes County over the 1997 to 2002 time period (see Table 6).

Fragmentation can have a number of different causes. In urban areas, lands subsumed within a UGB are subject to new zoning designations that allow the partitioning of lands previously zoned for Exclusive Farm Use (EFU). As described further below the movement from farm to subdivision has a number of phases and typically occurs over a significant period of time. The partitioning of the land and division into smaller taxlots for the purpose of residential construction is simply part of this process.

In peri-urban areas, expectations regarding UGB expansion can drive speculation and land purchase. This does not necessarily lead to fragmentation of the property; however, where the opportunities are there for partitioning there is clear financial incentive for landowners to try to partition in advance of sale in order to maximize their land value. In addition, lands brought into an Urban Reserve Area (URA) are clearly slated for eventual development and may be subject to zoning changes which further increase the likelihood of gradual partitioning of larger acreages.

In rural areas, the influx of buyers seeking a hobby farming or country lifestyle can also lead to fragmentation. With farming not the principal occupation of landowners, opportunities to partition and increase the land value by, for example, splitting a taxlot in two and having two (instead of one) home site on a property will be exploited. As discussed earlier the financial returns to irrigated land use in Deschutes County largely comes from increasing land values rather than operations. Partitioning a rural property that has a view and a comfortable rural ambiance is the surest way to increase property value given the rapid influx to the area. The passage of Measure 37 is likely to make this easier to do – at least for long-time property holders in the area.

Irregardless of the forces and trends over time that have led to the fragmentation of agricultural lands, an analysis of the current status of account size and acreages demonstrates the degree to which irrigated lands are fragmented. In order to explore the degree of this fragmentation customer accounts (for the 2004 water year) were analyzed in Central Oregon Irrigation District (COID). The results are presented below.

6.1.2 COID Case Study of Fragmentation

COID is located in Deschutes, Crook and Jefferson Counties. The Pilot Butte Canal which diverts water at the northern end of Bend parallels Highway 97 providing water to a swathe of land stretching north from Bend to Redmond and then to Terrebonne and the Crooked River. The Central Oregon (or CO) Canal diverts water at the southern end of Bend, crosses through Bend's east side and then proceeds to water land to the northeast, including large tracts of land

near Alfalfa and Powell Butte in Crook County. Both canals are, thus, subject to the effects of urbanization.

Overall some 22% of COID accounts are within the Bend or Redmond UGBs. Average size for accounts in Bend is 1.2 acres and for Redmond 3.8. At the time the analysis was conducted some 2,247 irrigated acres were located within city UGBs. One reason for the much smaller average account size in Bend is that COID water is used by Avion Water Company on the east side of Bend as part of dual pipe systems. Residential customers have both domestic and irrigation water accounts with Avion. The result is large numbers of small district customers that are typically watering small lawns with irrigation water. Outside the UGB the average COID account has a size of 11.3 acres. All told COID has an average farm size of just over 9 acres.

Table 17. Urban and Rural Accounts in COID

	Accounts	as % of Total	Acreage	as % of total	Average Size
Bend	598	13%	717	2%	1.20
Redmond	404	9%	1,530	3%	3.79
Non-UGB	3,695	79%	41,728	95%	11.29
Total	4,697		43,975		9.36

Source: COID

Finer resolution analysis is provided in Table 18 which breaks the account and acreage down by the five divisions that make up COID. The rural extent of the CO Canal delivery area, that is Alfalfa and Powell Butte, have the largest acreages, with Powell Butte averaging almost 40 acres per account. The North Redmond and Terrebonne division averages 10 acres per account mirroring COID as a whole. The two divisions that overlap with Bend and Redmond have non-UGB average sizes of from 4.5 acres for Bend to 8.2 acres for Redmond. The data supports the contention that proximity to an urban area is correlated with small farm size.

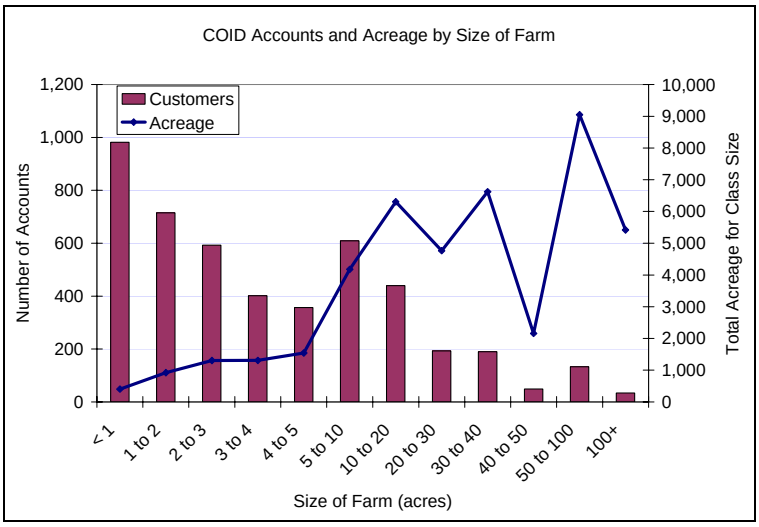
Table 18. COID Accounts and Acreage by Division

	Accounts	Acreage	Average Size
Division 1: North Redmond and Terrebonne	965	9,994	10.36
Division 2: Redmond	1,139	7,565	6.64
Redmond UGB	404	1,530	3.79
Non-UGB	735	6,035	8.21
Division 3: Bend	1,907	6,691	3.51
Bend UGB	598	717	1.20
Non-UGB	1,309	5,973	4.56
Division 4: Alfalfa	337	5,972	17.72
Division 5: Powell Butte	349	13,754	39.41
Total	4,697	43,975	9.36

Source: COID

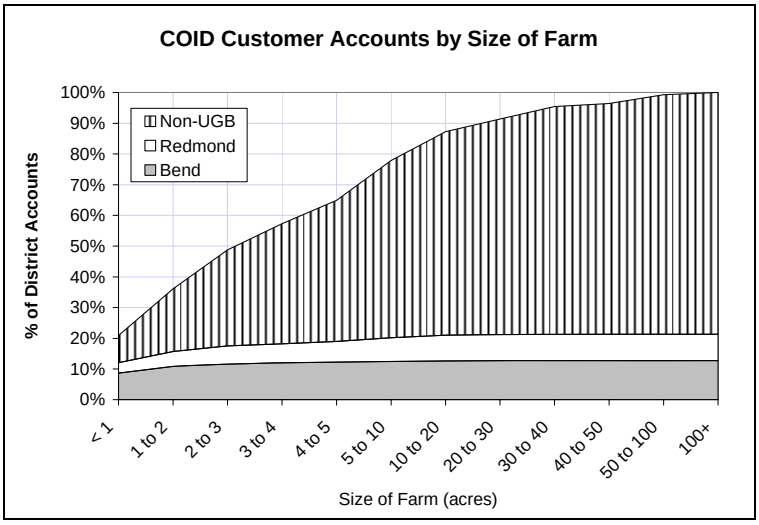
The fragmentation of district lands leads to a high proportion of accounts being of small size and a high proportion of total acreage coming from (the few) larger farms (see Figure 7). Figure 8 and Figure 9 provide another view on this data. For example, Figure 8 reveals that half of all COID customer accounts are less than 3 acres in size and Figure 9 shows that 80% of district acreage occurs on farms greater than 10 acres in size. Finally, Figure 10 demonstrates the importance of small, lifestyle farms to COID. Farms outside the UGB that are less than 10 acres make up 58% of total accounts (but only 19% of the acreage). The importance of these figures lies with the structure of district assessments (as explained earlier). With per account fees of $275 and per acre charges of $23/acre the financial importance of this large number of small farms to the district finances is considerable. Modeling district assessments on the basis of the account data suggests that farms less than 10 acres – or around 20% of the district lands – provide over 50% of the district assessments. Under future paths for the district and water resources in the Basin, the implications of this pattern of charging on district finances is explored later in the section on Exit Fees (Section 7).

Figure 7. COID Accounts and Acreage by Size of Farm



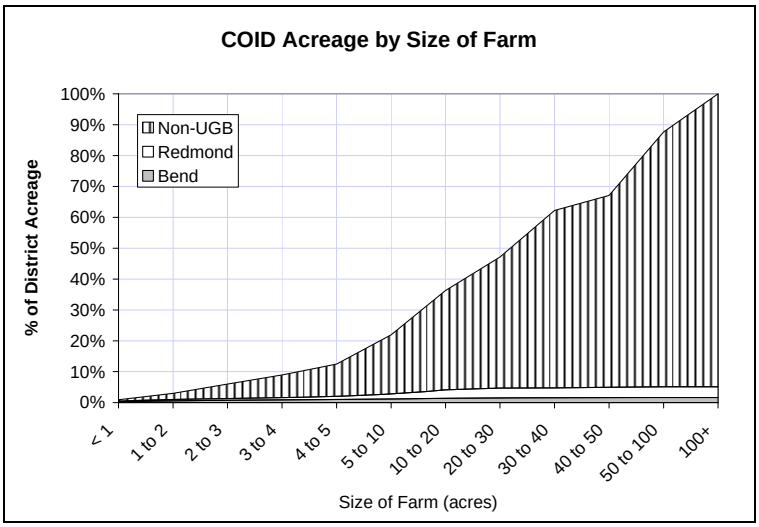
Source: COID

Figure 8. COID Customer Accounts by Size of Farm



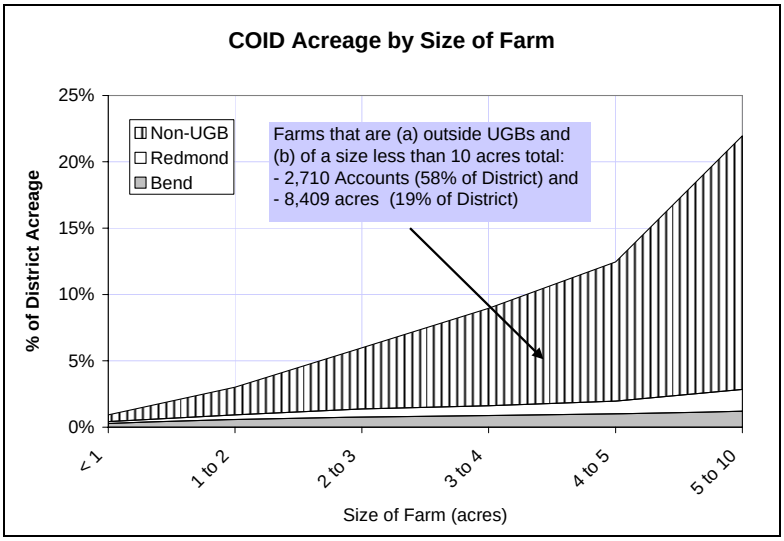
Source: COID

Figure 9. COID Acreage by Size of Farm and Urban/Rural Location



Source: COID

Figure 10. Contribution of Small Acreages to District Acreage and Accounts



Source: COID

6.1.3 Loss of Irrigable Land to Urbanization

As part of the work undertaken for the companion paper on Municipal Water Supply, growth and urbanization patterns were evaluated to estimate the acreage of irrigated lands within irrigation districts that would be urbanized over the 20-year planning horizons. While the intent was to estimate amounts of surface water rights potentially available over time for meeting mitigation obligations of the municipal suppliers, the information is equally useful in examining potential impacts on irrigable land of urbanization. Projecting growth rates out 20 years is a substantial undertaking. Projecting such rates and the pattern of urban expansion out any further would be an even more speculative endeavor. Because Oregon land use regulations require cities to have 20 years of buildable land inside their UGBs, the following analysis uses current boundaries of UGBs and Urban Reserve Areas (URAs) to guide the analysis of which irrigable lands may be at risk over this time frame.

Information on current UGB and URA boundaries was correlated with maps of district water right acres by GeoSpatial Solutions. In addition, the area currently being investigated by the City of Bend for future expansion through its Residential Lands Study was also included in this overlay analysis. This latter area is in effect a large box around the current URA and, thus, probably far overstates the area that might be included in a new UGB or URA. Nevertheless, it provides an indication of what areas may be at risk going forward.

The results show that a substantial amount of water rights in several irrigation districts are also within these boundaries (see Table 19). Note that the figures from the 2004 COID analysis of UGB acres above (as undertaken by COID) closely resemble those from this 2006 analysis. Each irrigation district is reviewed in turn below, followed by a discussion of the overall potential for impact on irrigable lands by urban area.

Table 19. Potential Acreage of Urban Development on Irrigated Land within Irrigation Districts, as of February, 2006

	Urban area	Land inside UGB	Land Inside URA	Subtotal Acres	% of District
Swalley	Bend – current	342.8	558.9	901.7	20.6
	Bend – study area			274.6	6.3
subtotal				1,176.3	26.9
COID	Bend – current	737.6	532.6	1,270.2	2.9
	Bend – study area			1,887.7	4.3
	Redmond	1517	2595.3	4,112.3	9.4
subtotals				7,270.2	16.5
Lone Pine	n/a	-	-	-	-
Arnold	Bend – current	549.8	48.9	598.6	15.3
	Bend – study area			1,970.2	50.4
subtotals				2,568.8	65.8
North Unit	Madras	536		536.0	0.9
Walker Basin	n/a				
Tumalo	Bend – current	2.0	131.3	133.3	1.8
	Bend – study area			10.4	
subtotals				143.7	1.9
Three Sisters	Sisters	-	-	-	-
Ochoco	Prineville	1,571	-	1,571	7.8%

Source: GeoSpatial Solutions

Note: Study area refers to the Bend Residential Lands Study which is taking a comprehensive look at future areas for URA/UGB expansion – only a portion of these lands will be included in the next Bend UGB expansion, expected in 2006.

Swalley Irrigation District has the largest percentage of its land lying with the URA with fully 20% of its district at risk. Another 6% of district lands lie in the Bend Residential Lands Study Area. Existing indications are that the next expansion of the Bend UGB will take in a section of Swalley to the North of the existing UGB (the section between the Deschutes River on the west and Highway 20 on the east down to the intersection of Highway 20 and the Deschutes River) that includes land irrigated by the Rogers and Riley laterals. Additional rights to the Northeast along the Kotzmann lateral may also be affected. In this case, however, a project to pipe the lateral and the continued need that Bend Parks and Recreation will have for irrigation water at the Bend Pine Nursery site may limit the acres that would be converted through development. Swalley rights are the most senior on the Deschutes and therefore are very attractive for flow restoration and groundwater mitigation. Further analysis of the Swalley situation is included in the case study below.

The Arnold Irrigation District (Arnold) is located in the south and southeast areas of Bend. Approximately 15% of the district lies within the current URA. An additional 50% of district lands lie within the Bend Residential Lands Study Area. The outcome of the Bend expansion in terms of which lands are brought into the URA and UGB will be critical to the district. Presently, the district maintains that it has customers ready and waiting for irrigation water.

Accordingly, the district reports that as irrigated lands within the district are urbanized, the water is readily transferred to other areas within the district. Urbanization is therefore not presently viewed by the district as a high-priority issue. Arnold water rights are also relatively junior and rely on stored water, and thus are less attractive for flow restoration and have yet to be tested for their value in generation groundwater mitigation credits. This said, there is evidence that surplus rights are being acquired by Avion Water Company and the amount of water being leased is increasing each year. Given the high losses in the Arnold system it is also debatable how much further out the water may be delivered without lowering its reliability further.

COID is the next most affected district with 12.3% of its district lying within the current URAs of Bend and Redmond, with both cities looking at additional expansion currently. In absolute terms COID also represents the district with the most land at risk – some 5,400 acres in the current URAs. Another 1,900 acres is in the Bend Residential Lands Study Area. In the Bend area, COID has a relationship with Avion Water Company for the delivery of a few hundred acres of water rights. These contracts are for irrigation water delivered through dual-pipe systems and, thus, are not subject to the same risk as COID's regular irrigated lands. These areas are already urbanized. However, as costs of delivering surface water to these patrons increases, at some point it may be less expensive to simply serve these customers' irrigation needs (for lawn) with Avion's regular quasi-municipal groundwater sources. COID water rights are senior rights and are attractive for both restoration and groundwater mitigation. A number of transfers for groundwater mitigation have successfully been carried out with COID water rights and they have all received the full amount of mitigation credits (1.8 credits/acre).

Lower risk levels are experienced in Ochoco and North Unit where 5% and 1% of district lands are within the URAs of Prineville and Madras respectively. Both districts are federal projects under the Bureau of Reclamation and rely on federal storage projects for reliable delivery of water to their patrons. For both of these districts any change in the use of these water rights to instream use (for restoration or groundwater mitigation) would be subject to change in authorized use and contract provisions with Reclamation. Although no efforts have been made to date to file for mitigation credits on these water rights it is unlikely that they would qualify for full credits without the ability to lease or transfer the storage associated with these rights, as otherwise the district primary flow rights are junior. Discussions with OWRD suggest that these rights would fail to qualify even for temporary mitigation credits through a lease – where the requirement is for water to be available at least half the time in order to earn credits – without the storage being leased instream as well.

Three Sisters, Lone Pine and Walker basin have no lands within urban boundaries. The risk facing district lands in these districts is more likely to be the filing of Measure 37 claims for rural subdivisions or filing for destination resort status. Three Sisters is already facing one or more of these situations, with other landowners considering such options for capitalizing on the value of their land.

In sum, the analysis of district lands suggests that 9,000 acres are already inside URAs and some 5,000 of this is already within UGBs (Table 20). With an urban area expansion in process in Redmond and one under consideration in Bend, the UGB numbers probably reflect conservative estimates of the land that will be urbanized in the next 20 years. If growth rates continue at current rates, even the URA figures may prove insufficient to provide buildable land for fast-

growing Central Oregon cities. In Bend alone, some 4,000 additional acres of irrigated lands is included in the Residential Lands Study Area. While there is no decision as to whether any of these lands will end up in the expanded area the Study Area does represent the long-run profile of continuing growth in and expansion of the City of Bend.

Table 20. Summary of Irrigable Lands at Risk to Urbanization

Urban Area	UGB (acres)	URA (acres)	Totals (acres)	% of All Urban Area Totals
Redmond	2,904	2,595	4,112	45%
Bend	1,632	1,272	2,904	32%
Prineville	1,571	-	1,571	17%
Madras	536	-	536	6%
Totals	5,256	3,867	9,123	100%

Given that not all land inside an urban boundary is necessarily converted and the water removed a rough approximation would be that the amount of urbanized land will range between the UGB and URA numbers (i.e. between 5,200 and 9,100). The water on this land would be surplus to needs of the appurtenant land and available for redistribution.

6.2 Impacts on Irrigation Deliveries

Improvements in district conveyance systems are reviewed in more detail in the companion DWA Issues Paper *Irrigation District Water Efficiency Cost Analysis and Prioritization.* Here it is useful just to note that urbanization may impact on deliveries either directly or indirectly. Direct impacts include hindrances and problems that occur as growth and development in an urban area proceed. They can be O&M issues such as:

- Right-of-way access – as subdivisions and new roadways are built districts may experience difficulties with access to ditch roads and district facilities, unless necessary easements are in place to ensure connections to public roads
- Maintenance – maintenance activities such as cleaning laterals and canals during the off-season can be more difficult as access for equipment and maneuverability of this equipment is hampered by the built environment
- Encroachments – lack of understanding or uncertainty of applicable district easements may lead to builders encroaching upon district ditch roads and other district facilities

In addition, urbanization increases districts' liability and risk to public safety related to district facilities, particularly large, open canals coursing through heavily populated or trafficked urban areas.

Indirect impacts occur as a result of the fragmentation of district lands or the loss of lands. Of primary concern here is impact on the ability to deliver water to patrons. As urban infill occurs the continuity of a delivery system is likely to be impacted given that the pattern of infill typically is not planned with the water delivery system in mind. In addition, servicing a new

type of urban customer base may increase the cost of 'delivering' water. Typical situations include:

- A significant user at the tail end of a lateral develops their property, and this user's water served as the 'carry' water for other users higher up in the system – the district must then either cease delivery to the remaining users or increase the flow per acre sent down the lateral.
- A parcel partitions or subdivides and the new owners wish to continue receiving a portion of the former water rights – deliveries to urban, micro-accounts can be a complicated and time-consuming activity for already stretched district personnel.
- As acreage is gradually developed in formerly agricultural areas, fulfilling the customer service expectation of new, urban users may be challenging for district personnel oriented towards the needs of farmers.
- Developers wishing to maximize buildable land will wish to pipe laterals traversing their land (whether they were or will continue to be irrigated) and reduce easements, adding to the office, legal and management burden faced by a district.

6.3 Impacts on Demand for Irrigation Water

Other things being equal the impact of the urbanization trends described above on irrigation districts and their patrons will be to lessen the extent of demand for irrigable land, promote the fragmentation of district lands and hence reduce the demand for irrigation water. Population growth and rapid development also affect water demand in rural areas. In addition low and declining net farm income and the settlement of non-farming immigrants on farmlands accelerate the decline in demand for irrigable land.

As described later in this paper the Leasing Program developed by the Deschutes River Conservancy and local irrigation districts has led to increasing quantities of water being leased instream as lands are fallowed. Water within urban boundaries accounted for 2,200 of 5,500 acres leased in the upper basin in 2005. Projections for 2006 suggest the total acreage increasing to 6,500 acres of which roughly two-thirds or 4,200 acres will be leased from acreages in rural areas. While this amount may increase or decrease over time, the current trend is for a steady year-on-year increase (as discussed further below, see Figure 11). Given that there are 160,000 or so irrigated acres in the upper basin it is not unreasonable to expect a small percentage to be available for temporary transfer each year. Studies from other markets suggest a 2 to 3% trade in temporary water is not uncommon (Aylward et al. 2005). For this reason a conservative estimate would be that over time a total of 4,000 acres per year will be fallowed year-in-year-out in rural areas, with the exact acreages leased varying somewhat each year. This water is therefore, available for leasing and temporary reallocation. Thus, in addition to the 5,000 to 9,000 acres that have left or will leave agricultural production in the next 20 years, there is an additional 4,000 acres or so of rural water that may be regarded as surplus to irrigation demand and available on an ongoing basis.

It is also important to emphasize that urbanization and the associated lining or piping of canals and conversion from alfalfa to lawn, and from flood to sprinkler irrigation will all also tend to reduce the per acre demand for irrigation water. These efficiency gains are treated in the

companion DWA Issues Paper *Irrigation District Water Efficiency Cost Analysis and Prioritization.*

6.4 Impacts on Price of Irrigation Water and the District Assessment Base

As documented earlier the value of a farm and the associated water right in Deschutes County – with some of the same trends emerging in Crook and Jefferson County – increasingly revolves around the consumptive amenity and recreational value associated with the property as much as it does the productive opportunity of farming. This may explain the conundrum of increasing farm property values at the same time as net farm income falls. The impact on the demand for irrigation water is gradual and may be difficult to identify but the economics are clear. If irrigation water rights are only available for use on irrigated acres and the demand for irrigated acres falls, the value of an irrigation water right will fall. The Swalley case study presented below demonstrates this vividly.

The consequence of a downward spiral in the value of district water rights for an irrigation district is also clear. Normally, there is an internal market within a district for the sale and transfer of water rights from one user to another. While the market may be limited in volume, if a user wishes to dispose of their right, for whatever reason there is a price for an acre of water right that can be easily ascertained. Given that the volume in these internal markets is limited it may not take much 'surplus' water on the market to depress price – even to the point where users will simply give them back to the district.

When this happens the financial impacts on the irrigation district take on a downward spiral as well. If the district takes back water rights that it cannot sell back onto land, then the assessment that would have been paid by a patron is in effect the responsibility of the district. However, the only funds available to the district for O&M purposes are (by definition) the assessments of other patrons. Other revenue sources include capital provisions, real estate sales, or other asset sales. The district is then left in the awkward position of either not paying the assessment or, in effect, paying its own assessments with the assessments paid by other patrons. Either way it is construed, the net effect is to shrink the patron base which is available to pay assessments needed to run the district. If a district ends up taking donated water rights it is then put in the position of increasing assessment rates for the remaining customers.

The only alternative is to lower district expenditures, but as discussed above there are all sorts of reasons why the job of running an irrigation district gets increasingly involved as urbanization proceeds. Thus, costs are unlikely to decrease. Absent any other source of demand for the water rights then, assessments will rise as urbanization proceeds. Increasing assessments just serve to make farming less profitable and increase the incentive for district patrons to donate more water back to the district – and so on. The picture is then a bleak one for districts that experience this set of impacts.

In much of the West however, there are other, new demands – particularly those of growing municipalities and river restoration – on water traditionally used by irrigators. In Central Oregon both are present. As documented in the companion DWA Issues Paper *Municipal Water Supply Report* the growing populations that spur urbanization and land use change themselves require water – a need that in Central Oregon will be met through tapping the regional aquifer. In

addition, rural subdivisions present in destination resorts provide another new demand on groundwater resources. Through the State's Groundwater Mitigation Program new permits for municipal and industrial (and quasi-municipal) users will require groundwater mitigation. These mitigation needs are being met through conversion of irrigation water rights to an instream use (both temporarily through leases and permanently through transfers). The companion DWA Issues Paper *Instream Flows in the Deschutes Basin* also documents the current demand for building instream flows back to minimal levels to sustain fish and wildlife, provide recreational opportunities and improve water quality.

Alongside these two proven demands is the possibility for urbanizing districts with surplus water rights to move some of these rights to districts with junior water rights, thereby securing a more reliable supply for the junior districts. As described earlier there are not many irrigation districts in Central Oregon that do not have some form of urbanization and land use change ongoing in their district. Thus trade between districts is likely to be a zero sum game where a senior right replaces or supplements a junior water right, rather than a senior right finding new lands for irrigation. Ultimately this does not alter the reduction in district lands as the current junior water right will either be canceled or transferred off the land before the senior right may be exercised. This option may therefore provide support for the value of water rights in senior, urbanizing districts but it does not solve the assessment problem – unless the farmer receiving the senior right is willing to pay the assessment on both the junior and senior right.

Thus, the solution to the downward spiral in the value of district water rights, the reduction in the assessment base and the subsequent rise in assessments really has only one solution in Central Oregon and that is to allow district patrons (and the district holding surplus rights) to access the restoration and M&I demand. After presentation of case study data from Swalley Irrigation District on this pattern of decline the paper turns to the ways that districts in Central Oregon have found to take proactive approaches to deal with the risks to district operations and solvency brought on by the growth and development occurring in the region.

6.5 Swalley Case Study

This case study attempts to portray the changes that occur over time as urbanization and land use change proceed in an irrigation district in a peri-urban locale. Knowing that a certain number of farms or acres are located within an urban boundary might imply that in the long run the acres will be converted to residential, commercial or industrial use but provides little information about to what extent this will occur and at what rate over time. Urbanization is not a new phenomenon in Central Oregon and, therefore, these issues are empirical, rather than theoretical. In an effort to explore how urbanization and land use change affect an irrigation district over time the following case study of Swalley Irrigation District is presented.

The study examines impacts of urbanization and land use change in Swalley Irrigation District on district lands and water rights, and to a lesser extent on the delivery system. The study was undertaken by Geospatial Solutions and the Deschutes River Conservancy, with the support of the district. Data on water rights transfers, leases and quitclaims was compiled from 1996 through 2005. Layers for the relevant boundaries were also collected for each year and the water rights information was coded as to whether the water rights involved were located within the city boundaries, the UGB, the URA or the county. Information on delivery systems and turnouts was

also compiled and analyzed in terms of spatial change as well as improvements (particularly piping of laterals and ditches).

Water that is made surplus to needs through urbanization and land use change shows up in a number of different ways. First, is water that is transferred off irrigated lands to new lands. This 'transfer off water' may find a new home on land, but this is irrespective of the fact that it was put into the transfer water market by a landowner no longer needing it (at the current market price). Second, is water that is quitclaimed from a landowner to a third party. In 1996 the first water rights displaced by urbanization in Swalley were quitclaimed to the irrigation district. A quitclaim deed transfers the grantor's interest and title in the water right to a third party, in this case the irrigation district. The water right remains appurtenant to the developed land but the new water right holder – in this case the district – may lease the water instream to maintain the beneficial use of the water right.

The third indication of surplus water is water that remains with the landowner but is leased instream. A right that is leased instream one year and then not leased in subsequent years may simply be an indication of a water right user fallowing their land for a year. Water leased each year would be more conclusive evidence of surplus water. Available data on each of these types of surplus water is presented below and summarized in Table 21 and Table 23, including where the lands are located.

The analysis of transfers and quitclaims suggests the following findings for the 1996 to 2004 time period:

- Gross permanent water transferred off district lands of 447 acres during the nine year period, of which 51% came from lands that were in the UGB or URA at the time
- Net off water of 175 acres, 21 acres of which went to an instream transfer and 154 acres that were quitclaimed to the district and subsequently sold to the City of Bend
- Transfers and quitclaims were entered into by landowners during the same years from 1996 to 2002
- Through 2002, 273 acres were transferred to new lands, the vast majority of which (87%) was outside the urban area
- From 2003 on, demand for water on new lands evaporated and the 'off' water went 100% to quitclaims

The net effect of this changing supply and demand equilibrium within the district was that by 2002 patrons were donating their water rights to the district in return for getting out from under assessments for water that they were not using (at that time the DRC was not paying for leased water). The internal market in water rights had imploded under the strain of excess supply and a lack of demand. With no other source of demand for water rights the value of landowners property interest in the water fell to zero.

The analysis of trends in leasing within the district suggests the following findings:

- Leasing in 2005 and a 21 acre instream transfer completed in 2001 led to almost 500 acres of Swalley water rights protected instream in 2005 – some 11% of the district

- Apart from the leasing of quitclaimed water, leasing grew quickly in response to the incentive offered by the DRC in 2002 and subsequent years of a payment of approximately $40/acre/year – though the growth rate has dropped off in the last couple of years
- Of the non-quitclaim water leased in 2005 only 6% is from within the UGB, with a further 54% (largely one property) from within the URA, and the remaining 120 acres being rural land in the county outside the URA

Considering the net 'off' water as the sum of the permanent 'off' water and the leases it appears that a net of 357 acres of urban water are already 'off' land. Given the movement of water from urban to county lands, there is a net of 'off' water from land in rural areas of 98 acres. Thus, as expected, urbanization is causing the loss of both UGB and URA irrigated acres, with the UGB acres tending to move permanently while the URA acres are leased pending final disposition of the land (i.e. inclusion in the UGB). Finally, the total 'off' water from rural lands is considerable, at 207 acres of transfer water and 120 of leased water. While much of this water was initially accommodated on new lands in the district only time will tell to what extent this water will be demanded by rural landowners in the future. Indeed, initial reports from 2005 and 2006 suggests that there remains demand from small hobby farmers for adding additional acres of water rights to their properties, though at a diminished rate from earlier periods.

Table 21. Transfers and Quitclaim of Water Rights 'Off' Land in Swalley Irrigation District, 1996-2004

	Transfer Water: Off of Land					Quitclaims (QCs) Off					Total Off Water: Transfers and Quitclaims				
	UGB	URA	Urban Subtotal	Non-Urban	Total	UGB	URA	Urban Subtotal	Non-Urban	Total	UGB	URA	Urban Subtotal	Non-Urban	Total
1996	7.9	-	7.9	6.7	14.6					12.0	7.9	-	7.9	6.7	26.6
1997	2.0	-	2.0	9.4	11.4					1.4	2.0	-	2.0	9.4	12.8
1998	15.7	-	15.7	1.7	17.4					0.5	15.7	-	15.7	1.7	17.9
1999	26.1	-	26.1	16.8	42.9					21.0	26.1	-	26.1	16.8	63.9
2000	14.0	-	14.0	29.1	43.0					17.3	14.0	-	14.0	29.1	60.4
2001	9.2	-	9.2	22.4	31.6					11.0	9.2	-	9.2	22.4	42.6
2002	12.3	0.3	12.5	120.8	133.3					11.0	12.3	0.3	12.5	120.8	144.2
2003	-	-	-	-	-					41.9	-	-	-	-	41.9
2004	-	-	-	-	-					37.6	-	-	-	-	37.6
Totals	87.1	0.3	87.3	206.9	294.2	-	-	145.5	8.1	153.6	87.1	0.3	232.9	215.0	447.8

Notes: Quitclaim numbers are preliminary only, pending further analysis and correlation of year of quitclaim with spatial location. A 21 acre instream transfer accounts for missing water in 2000

Table 22. Transfer of Water Rights 'On' Land and Net Permanent 'Off' Water in Swalley Irrigation District 1996-2004

	Transfers On					Net Off Water: Xfers & QCs					
	UGB	URA	Urban Subtotal	Non-Urban	Total	UGB	URA	Urban Subtotal	Non-Urban	Total	Running Total
1996	4.4	-	4.4	10.2	14.6	3.5	-	3.5	(3.5)	12.0	12.0
1997		-	-	11.4	11.4	2.0	-	2.0	(2.0)	1.4	13.4
1998	7.5	5.2	12.7	4.7	17.4	8.2	(5.2)	3.0	(3.0)	0.5	13.9
1999	8.5	2.0	10.5	32.4	42.9	17.6	(2.0)	15.6	(15.6)	21.0	34.8
2000	1.0	-	1.0	21.0	22.0	13.0	-	13.0	8.1	38.3	73.2
2001	1.2	-	1.2	30.4	31.6	8.0	-	8.0	(8.0)	11.0	84.2
2002	5.8	-	5.8	127.5	133.3	6.5	0.3	6.8	(6.8)	11.0	95.1
2003	-	-	-	-	-	-	-	-	-	41.9	137.1
2004	-	-	-	-	-	-	-	-	-	37.6	174.6
Totals	28.3	7.2	35.5	237.7	273.2	58.8	(7.0)	197.3	(22.7)	174.6	

Notes: A 21 acre instream transfer accounts for missing water transfer 'off' water in 2000.

Table 23. Instream Water Leases in Swalley Irrigation District, 1996-2005

	Leased Water	QC Leases	Non-QuitClaim Leases					
	Total	Total	UGB	URA	Urban Subtotal	Non-Urban	Total	Growth
1996	12.0	12					-	
1997	13.4	13.35					-	
1998	1.9	1.85					-	
1999	38.1	14.35					23.7	
2000	115.8	31.44					84.4	256%
2001	206.0	42.44					163.5	94%
2002	184.8	53.44					131.4	-20%
2003	318.9	91.75	-	149.5	149.5	77.7	227.2	73%
2004	422.9	141.61	9.4	151.5	160.9	120.3	281.2	24%
2005	472.7	141.61	17.2	151.9	159.7	120.3	280.0	0%

7. Strategies for Coping with Declining Irrigation Demand

The threat of declining demand for irrigated acreage and the potential impacts on district deliveries and finances is one that irrigation district boards and managers throughout the West have gradually become aware of over time. A number of responses have been formulated by districts in an effort to confront the potential threat. Included in these are efforts to protect the ability of the district to deliver water to remaining customers in urban areas, as well as efforts to find other services for sustaining district finances such as creating groundwater patrons and developing small hydropower projects. At the same time a number of opportunities to use this situation to proactively engage in stream flow restoration have been developed by the Deschutes River Conservancy in collaboration with the Districts. These responses, strategies and mechanisms are described briefly below.

7.1 Water Leasing

Perhaps the earliest response was that of protecting the water right through instream leasing. Instream leasing provides a voluntary means to aid the restoration and protection of stream flow while meeting water right holders' need to beneficially use their water right once every five years. Oregon's leasing program is operated under the authority of ORS 537.348 and OAR Chapter 690, Division 077. In addition, under the State's Deschutes Basin Groundwater Mitigation Program (OAR Chapter 690, Division 521) instream leases may be used to create mitigation credits (see Box 1).

Water right holders may place their water instream temporarily through various types of leasing mechanisms, including the following:

- Standard Lease involving one water right, typically one or five years with an opt out provision
- Pooled Landowner Lease involving more than one water right; one or five years
- Split season Lease allowing for water right to be used for two uses during one season

Leasing in the upper basin began in 1996 when Swalley leased the first of the water rights that were conveyed to the district. In 1998 the DRC began operations and slowly began encouraging districts to take advantage of the opportunity provided by leasing, first on a donation basis and then ultimately through paying for leases.

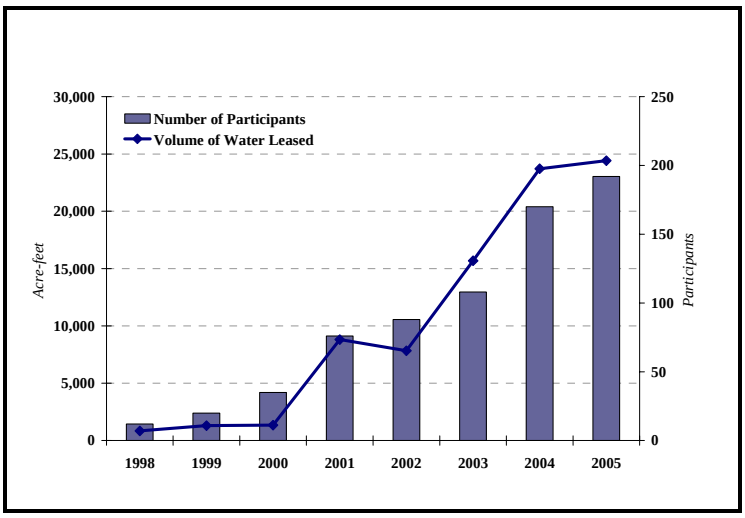
Leasing of district water rights in the upper Deschutes Basin is a partnership between districts and the DRC. Each district and the DRC have a memorandum of agreement specifying the roles and responsibilities of each party. Landowners contact the district representative in charge of leasing or the DRC directly, depending on the arrangement with the district. Once the paperwork has been submitted to the Oregon Water Resources Department (OWRD), and the Department has issued a Final Order for the lease, the water is legally protected instream. In the

case of five year opt out leases the lessor must notify OWRD 30 days before the start of the irrigation season if he or she wishes to cancel the lease.

The DRC typically leases water instream year by year using either one year pooled leases or the five year individual lease (with an annual opt out clause for the landowner). Leased water is either donated by water rights holders or paid for by the Deschutes River Conservancy (DRC). Public entities generally donate their water instream, and some private water rights holders choose to donate their water instream. When the DRC pays to lease water from acreage the per acre price will vary depending on the period of maturity of the lease and the source of the water. Generally, an effort is made to set the price for leases from private landowners at $7 per acre-foot. This is a modest payment by standards of the Pacific Northwest, reflecting the low net income from farming in the area and the lack of alternative lessees for this water. The Columbia Basin Water Transaction Program and its participating qualified entities lease water in the Columbia Basin for prices ranging from $30/acre-foot/year up to $100/acre-foot/year (see www.cbwtp.org). The DRC's Leasing Program, which covers both district and individual water right holder leases, is funded by Reclamation, Bonneville Power, groundwater mitigation credit buyers and other sources.

Since 1998, the Leasing Program has grown in both acres leased and number of participants leasing (see Figure 11). In 2005, the Program included more participants and leased more water instream than in any previous year, despite drought conditions in much of the Basin. The Program leased a total of 24,400 acre feet of water (up 3% on 2004). Program expenditure on leases was $131,000 for a slight increase in cost-effectiveness (to $5.39 per acre foot). The Program leased 89 cfs of water rights, including up to 66 cfs of instream flow in the middle Deschutes, 9.1 cfs in Whychus Creek, 9.9 cfs in Tumalo Creek, and 5.5 cfs in the Crooked River. The Program expanded into Walker Basin for the first time in 2006, where it leased almost 10 cfs in the Little Deschutes and middle Deschutes. The 2006 water year also marked an increase in coordination between the leasing and mitigation banking programs, a trend that is expected to continue in future years.

Figure 11. Leasing trends, 1998-2005



Source: Deschutes River Conservancy

The growth of the Leasing Program can be further broken out by acres in each irrigation district and as a percent of total acres in each district (see Figure 12 and Figure 13). The rate of change varies considerably from district to district. Interest in leasing in North Unit peaked in 2001 when the price paid was $40/acre (not per acre foot). Once the payment was tied to water protected instream the price fell to $14/acre (for Deschutes lands) and $7/acre (for Crooked River lands) and interest in the program from North Unit farmers evaporated.

Figure 12. Leasing Participation (in acres) by Irrigation District, 2001 - 2005

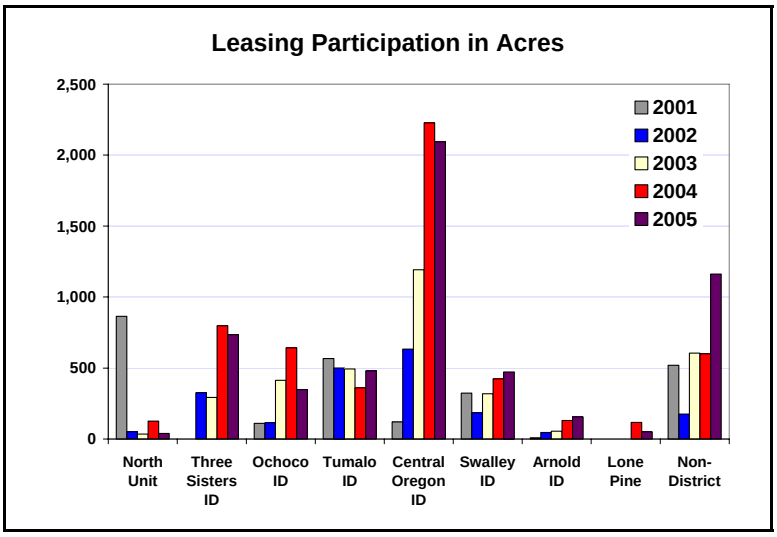
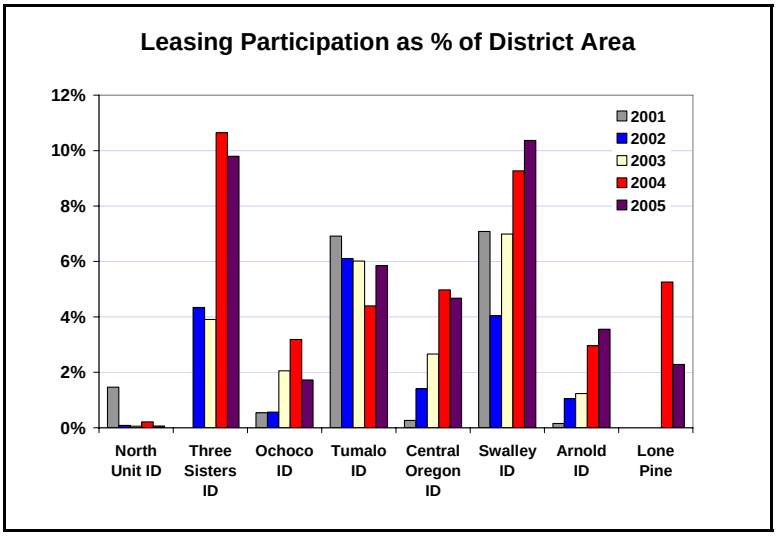


Figure 13. Leasing Participation as Percent of Irrigation District Area, 2001 - 2005



In the urbanizing districts, and particularly in COID, Swalley and Arnold interest in the program is strong and growing. Between 4% and 10% of the acreage in these districts is currently leased. Somewhat surprisingly, in Three Sisters Irrigation District growth has been strong and on a percentage basis is as high as any other district (at around 10%). This may be due to

development pressures in the sought after Sisters area and the district's history as a water short district. Tumalo Irrigation District has kept its numbers relatively constant at 6% of the district but submits new pooled leases on an annual basis. As opposed to some of the other districts Tumalo rotates the opportunity to lease through its patron base.

As stated earlier, in most districts the DRC offers $7 per acre-foot for leased water. The average cost of leased water has fluctuated since the programs inception, moving between a low of $4.60/ac-ft and a high of $6.82/ac-ft. The average cost of water in 2005 was $5.39/ac-ft. The variation is largely due to the variation in water that is donated to the program, although there is some annual variation in prices paid on non-district leases, for example. The price paid for leasing is, by and large, below market value. It is even below the assessment cost paid by the patron on a per unit volume basis. Table 24 shows that only in Lone Pine does $7/ac-ft cover the assessment when the cost of water delivery is spread across the water that is typically made available on-farm (and for lease). Arnold and North Unit have the highest per acre-foot costs, perhaps explaining their low participation in the leasing program. COID and Three Sisters have low per acre-foot costs that are just in excess of the leasing price. Of course, as noted above, actual assessment charges vary tremendously within districts – but this analysis demonstrates that on average the price paid for leasing is below even the cost of delivery to the patron. Raising the price paid for leased water would therefore be likely to increase the participation in the program by landowners looking to improve their bottom line.

Table 24. Cost to District Patrons of Water Delivery

Irrigation District	Water for Lease	Average Size	Annual Assessment	
			Charge Per Acre	Charge per Ac-Ft
Swalley	5.46	6	$ 83	$ 15
COID	5.53	9	$ 54	$ 10
Lone Pine	4.20	120	$ 27	$ 6
Arnold	5.40	6	$ 128	$ 24
North Unit	2.00	69	$ 48	$ 24
Tumalo	5.53	12	$ 71	$ 13
Three Sisters	3.00	59	$ 28	$ 9
Ochoco	3.00	27	$ 55	$ 18

Note: Actual annual assessment charges per acre will vary with the size of the account. Here the average size of accounts is used in calculating the per acre charge.

The Leasing Program clearly provides important instream benefits, but the program can be of consequence for landowners as well. Protection of the water right is often cited as a major benefit of leasing for landowners. Leasing does protect the water right; however, technically-speaking leasing would only be required one out of every five years for this purpose. The five year opt out lease used in many districts provides a convenient way to enroll such water rights in the program and keep them there – with the benefit of receiving annual leasing payments each year.

Nevertheless, for landowners leasing small acreages or portions of an acre the leasing program is unlikely to prove a major factor in financial decision-making. Due to the structure of assessments in most districts a payment of $40 for a one acre lease is relatively insignificant

compared to annual assessment costs of $300 to $400 per acre (see Table 15). Of course given the low or negative returns to farming in some areas, particularly in Deschutes County, leasing small acreages instream allows the landowner to avoid losing more money through farming than they may lose by leasing the water. For larger leases the situation reverses as generally-speaking leases of 10 acres or more allow the landowner to break even on assessments or even make money on the water right.

Regardless of the exact motives the end result of leasing is to protect the landowner's option to use the water right in the future and also provide the landowner with some financial compensation which can be used to offset the district assessment. Leasing therefore does help irrigation districts keep water appurtenant to land in the district and helps landowners continue to pay assessments. From a reallocation perspective, however, leasing in an urban area merely creates an incentive for landowners not to address the pending question of the final disposition of a water right that has no long-term future use on the appurtenant lands.

7.2 Deschutes Basin Groundwater Mitigation Program and Mitigation Bank

A brief introduction to the Deschutes Basin Groundwater Mitigation Program and the DRC's Groundwater Mitigation Bank are provided here as it is an integral part of the response to new groundwater demand in the Basin. A more complete explanation of the Program is provided in the companion DWA Issues Paper *Instream Flows in the Deschutes Basin.*

The Water Resources Commission adopted groundwater mitigation rules for the Deschutes Groundwater Study Area (a large portion of the upper basin) in September of 2002 and the Deschutes River Conservancy received the first charter for a DRC Groundwater Mitigation Bank in February of 2003. Groundwater mitigation banking involves the brokering of temporary mitigation credits generated through instream leases. Credits are brokered to groundwater permit applicants who are required to provide mitigation for the impact on surface flows of their proposed new groundwater withdrawal. Credits are temporary and must be renewed annually.

Under the Mitigation Program applicants for new groundwater permits are informed of their mitigation obligation by the Oregon Water Resources Department during the first phase of the groundwater permit application process and they must provide mitigation before their permit can be issued. They can provide one of two types of mitigation:

- Permanent credits - Permanent credits are generated through a permanent instream transfer, water right cancellation, artificial groundwater recharge project or allocation of conserved water. These typically involve a transfer and are therefore covered in the transfer section.

- Temporary credits - Temporary credits may only be acquired from a chartered mitigation Bank and are created by an instream lease or a time limited transfer. These credits must be renewed annually or replaced by permanent credits during the life the permit/water right.

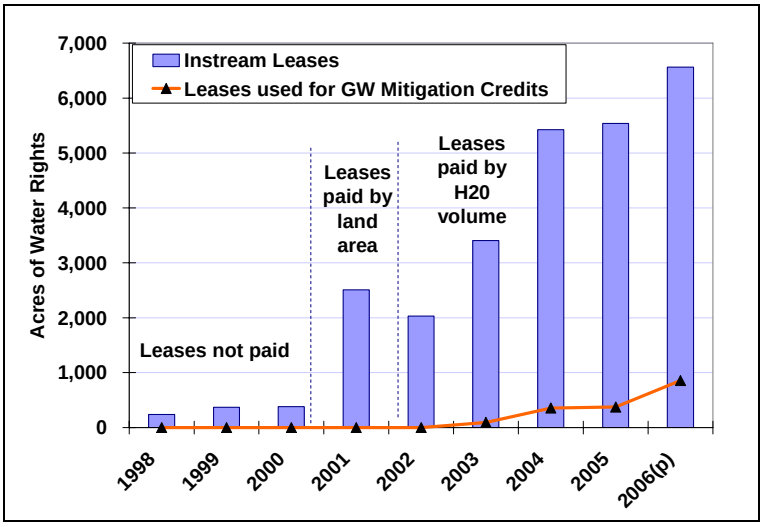
A mitigation credit is a means of accounting for water that is consumptively used and is measured volumetrically (in acre-feet). For example, if a groundwater applicant wishes to irrigate one acre of land with a total seasonal volume of three acre-feet, OWRD has chosen as a reference point that 1.8 acre-feet is evapotranspired by the plants. In this case, the applicants'

mitigation obligation would be 1.8 mitigation credits. In addition mitigation credits are accrued and consumed in specific Zones of Impact, or sub-basins in which groundwater withdrawal has shown a localized effect on aquifer levels.

The DRC's Groundwater Mitigation Bank is intricately linked with the DRC Leasing Program as the latter is the source of temporary credits. In return, the Bank provides the Leasing Program with a renewable source of market-based financing. The Leasing Program submits leases as mitigation projects in all five Zones of Impact where applicants with mitigation obligations exist. Once a groundwater applicant contracts with the Bank for temporary credits, the Bank submits documentary evidence of mitigation for their application, and OWRD issues their permit.

The Bank therefore provides financing for the Leasing Program, but also provides liquidity to the developing market for groundwater mitigation. As such it helps to smooth out a program that in its early years saw little if any supply of permanent credits. The Bank, thus, helps to alleviate market pressure, reduce market speculation and provides an efficient and low-cost alternative for groundwater applicants with an immediate need for water. As shown in Figure 14 the Bank to date has used only a small proportion of available leases for the purpose of mitigation. In other words the Leasing Program remains by and large a restoration effort.

Figure 14. Relationship between the DRC Leasing Program and the Groundwater Mitigation Bank



7.3 Infrastructure Improvements to Protect Deliveries

With fragmentation and loss of irrigated area on ditches, districts have had to develop policies that protect the district's ability to deliver water, while constraining the growth in expenditure – including capital expenditure. Fortunately, for developers that plan and plat subdivisions on land formerly irrigated the expense of piping or otherwise accommodating deliveries is not an onerous burden. Benefits also accrue to the developer as ditches are piped and covered, leading to opportunities to reduce easement sizes and eliminate bridging costs. Thus, many districts place the burden of ensuring that other users on a ditch may continue to access their water on the developer that is leaving the ditch.

An inevitable tipping point may be eventually reached where the additional effort and expenditure in piping a lateral or canal is not warranted, taken on the whole, by the few acres that remain to be serviced. At some point the district may declare the remaining acres to be unserviceable. However, where the process is gradual and developers are required to pipe there may be little financial incentive to halt this process until well past any optimum level of economic effort in saving the ditch. Assessment and calculation of the marginal value of maintaining a ditch versus the marginal benefit of retiring it would be useful in improving decision-making.

There are also cases where urbanized ditches are not piped or where portions remain un-piped and the end result is the need to send much more water down the ditch than is typically allocated for transmission loss. These high loss areas may become targets for conservation projects and for conserved water that can be protected instream. In a number of irrigation districts that divert water at Bend and are subject to the Deschutes Decree, OWRD does not consider transmission loss as protectable instream on a transfer, rather that portion of the water right is effectively cancelled (Paul 2006). In other words as acreage on a ditch is retired and transferred to instream use (whether for restoration or mitigation) and eventually the urbanized ditch is itself retired, the only way to ensure that the transmission loss is protected instream is to actively pipe these urbanizing laterals. In this case, the administrative process governing rules promotes a financial investment at odds with what makes economic sense.

The relationship between urbanizing land and district delivery systems is therefore a complex one and simplistic rules about the disposition of transmission loss on transfers or district policy on determining responsibility for preservation of deliveries may lead to misallocation of economic resources.

7.4 New Revenue Sources: Groundwater Patrons and Small Hydropower

Another alternative for irrigation districts under threat from declining acreage and assessment base is to broaden the scope of their operations to provide other services for which they can charge fees or earn revenue. The districts' business is delivering water so other uses and services that can be derived from water are potential opportunities for districts.

COID, for example, has developed a Groundwater patron policy. Under this policy, the district will coapply on a new groundwater right in or adjacent to the district boundaries. The district then can assist, as necessary, in providing the new patron with the groundwater mitigation credits necessary to obtain the new permit and develop the groundwater right. COID will undertake to use water rights acquired through the Reserve Program of the Central Oregon Water Bank to meet the needs of applicants who demonstrate a bona fide need for the groundwater. The district then manages the right for the new patron, taking care of OWRD reporting requirements and other tasks. In return the new patron undertakes to pay the assessment levied by the district. In this case no exit fee is paid, so in effect the district loses a patron as the surface water right is transferred but gains a new patron (of equal acreage) once the new groundwater patron is up and running. In this manner the district may offset any impacts on the assessment base of a decline in demand for surface water use. To date COID has had few applicants of this type.

A second source of revenue is to pipe canals or laterals and attach small hydropower facilities in order to generate power from the flow through the pipe. As of yet no projects of this kind have been constructed, however, COID, Swalley and Three Sisters Irrigation District all have plans to include hydropower on their main canal piping projects. Depending on the cost of the pipe, the head generated and flow rates these projects can be quite profitable as add-ons to pipe. However, the ability to generate power does depend in the first place on the investment in pipe, so that there is a case to be made that that the hydropower projects should assist in financing the piping projects. This in turn, lowers the effective cost of piping and lowers the cost of conserved water obtained from such projects. Once any repayments for pipe are made, however, there will be revenue for the district to employ – either in a capital fund or to cover operational costs.

7.5 Marketing Water to non-Irrigation Sources of Demand

The most direct method of confronting a decline in demand for irrigation acreage is to support the price of water in the district and the financial solvency of the district by enabling out-of-district demand for water rights to enter the internal district market. This may occur in a passive or active mode. The district may simply establish the rules by which outside buyers may acquire district water rights for transfer out of the district or the district may itself – or in partnership with other organizations – actively participate in buying available water and reselling it to non-district users.

In either case the mechanism to enable contracts for the exchange of appurtenant water that is used in Central Oregon is a quitclaim deed. A district policy that governs the transfer of water out of the district is called an 'Exit Policy' and the compensation the district obtains to balance its assessment is called an 'Exit Fee.' These are each explained, followed by a brief description of the active role COID and Swalley have chosen to play in the permanent reallocation of water through the Central Oregon Water Bank.

7.5.1 Quitclaims

A quitclaim for a water right is a recorded deed that legally releases a landowner from all rights, title and interest in a water right which is appurtenant to his or her land (OWRD 2006). In recent years irrigation districts in the Deschutes have used quitclaims to accommodate the effects of urbanization, allowing the district to temporarily 'park' the water. Landowners that convey rights to the district or other parties through the district quitclaim process are then no longer responsible for district assessments and liabilities. For example, the Swalley Irrigation District, Central Oregon Irrigation District, the City of Redmond, the City of Bend and the DRC have used quitclaims in COID and Swalley in order to acquire title to water rights, to be held within the district until the future 'home' of the water is identified and the water is transferred to its new use.

In the case of the cities and the DRC, each of whom hold water in COID, the water stays on the District certificate and the City and DRC pay all assessments as a patron. In Swalley, the City of Bend has chosen to negotiate an exit fee from the District and will continue to hold the water on the certificate until it needs to acquire mitigation credits. Typically, the water is leased instream pending resolution of the final destination of the water right. Increasingly the leased water is leased for temporary groundwater mitigation credits. The advantage of leasing district-owned

quitclaimed water for mitigation is that it allows the district or the city to receive a leasing payment when the mitigation credits are assigned and used. In this fashion the Mitigation Program and the DRC Groundwater Mitigation Bank enables public entities holding water for long-term reallocation to do so in a manner that does not endanger the district assessment base.

The use of the quitclaim began in the late 1990s in Swalley Irrigation District and was adopted by COID in 2002. At present almost 693 acres are held in quitclaim accounts in the two irrigation districts, with the cities the largest holders of these water rights (see Table 25).

Table 25. Quitclaimed water held in Central Oregon and Swalley Irrigation District

District	Holder	Acres
COID	City of Redmond	162
	City of Bend	27
	COID	244
	Other	84
	DRC	2
Subtotal COID		519
Swalley	City of Bend	156
	Swalley	14
	DRC	4
Subtotal Swalley		174
Grand Total		693

Source: Central Oregon Irrigation District and Swalley Irrigation District

Notes: Numbers current as of April 29, 2006.

7.5.2 Exit Policies and Instream Transfers

An irrigation 'Exit Policy' is a policy created by an irrigation district to govern the transfer of a district water right off the district certificate. This typically includes not just the transfer of the water right through the OWRD transfer process, but also the release of the landowner (or quitclaim holder) from being subject to the district's powers of assessment. In 2003 a transfer was filed in which a landowner attempted to transfer a water right instream without the consent of the district. The 'end run,' as it was called, met the requirements of current statute and administrative rule which do not require district consent on a transfer out of the district. However, this does not absolve the landowner of responsibility – as an owner of lands included in a special district and subject to the charges of the district – for the assessment. In a related example from Grants Pass Irrigation District, a number of district landowners canceled their rights through the relevant OWRD process, but were not exempt from paying assessments and, ultimately, exit fees.

Exit policies represent the formal creation by irrigation district boards of a window through which external demand may enter the district market (and remove water rights from the district). As stated earlier, the benefits of such a policy are the avoidance of the death spiral wherein the price of water rights and the amount of district assessments recovered from patrons both fall precipitously. It can also prevent costly efforts to deal with end runs around the district by patrons – where the district offers no alternative but the use or lease of a surplus water right.

An exit policy may help a district maintain financial solvency in the face of a drop in demand for the district's services and the assets it delivers. At the same time, irrigation districts may be concerned that creation of such a window may lead either to extremely high prices for water rights or the exit of too many water rights. The latter of course is a worst case scenario for a district and perhaps more clearly understood and feared than the death spiral scenario.

An exit policy may therefore choose to exercise quantity or price controls in order to control the manner in which outside demand filters through into the district. The district may limit the amount of water that can pass through the exit window during a given time period. The district may also set an exit fee – effectively a price for exiting water from the district. Exit fees may be a way for districts to replace lost assessments and stay financially 'whole' in the process. The fee is added on top of the cost of purchasing the water from a willing seller. It raises the costs of acquisition for the user that wishes to remove it from the district, while not affecting the costs of transferring water within the district. Exit fees are discussed further in the next section.

The first exit policy in Central Oregon was approved by the COID Board of Directors in 2004 at which point the district chose to set a limit of 200 acres exiting the district in a year. No effort was made to set the terms on which water could be bought or sold by entities wishing to exit water from the district. The district did however place an exit fee on the exit of any water right. Subsequent exit policies enacted by Swalley and Lone Pine have been variants of this approach. Swalley has set an exit fee but no explicit cap. All exits require Swalley Board approval. Lone Pine has set an exit fee and, presumably, exit will require board approval, although this was not explicit – perhaps the willingness to pay the exit fee is sufficient.

To date the impact of these exit policies have been limited (see Table 26) as just over 250 acres have been exited from local irrigation districts. Note that in the case of Swalley Irrigation District the City of Bend and the DRC have exited water by means of payment of exit fees but have not undertaken a corresponding transfer. However, the District has consented to the eventual transfer of the water and on the basis of the exit fee payment released the grantees on the quitclaims from further assessments associated with these water rights. In other words the assessment base for COID and Swalley contains fewer acres – however the exit fees paid in effect replace these annual assessments. The exit fees therefore help to sustain the financial health of the irrigation districts. The amount of water actually transferred off of district water right certificates is less than the amount of exited acres. To date only about 130 acres of instream transfer have been final ordered.

Table 26. Instream Transfers and Exits of water from Central Oregon and Swalley Irrigation District

District and Transfer #	Exit Fees Paid	Year Approved	Principal (Agent)	Acres	Mitigation or Restoration
COID					
T-9603	No[1]	2004	Mt. Bachelor Village (DRC)	18	Mitigation
T-9883	Yes	2005	DRC	31	Restoration
T-9824	Yes	2005	Various (Creative Water Solutions)	83	Mitigation
Swalley					
T-8519	Yes	2001	Eagle Crest (Swalley Irrigation District)	21	Restoration[2]
	Yes	2005	City of Bend	156	[3]
	Yes	2005	DRC	4	Restoration[4]
Grand Total				258	

Source: Central Oregon Irrigation District and Swalley Irrigation District

Notes: [1]Applicant chose to continue paying assessments under agreement with the district (as a precursor of a groundwater patron) [2]Not for groundwater mitigation but a transfer to meet Department of State Lands mitigation requirements. [3]The intent is to use the transfer to obtain mitigation credits but no transfer has been filed. [4]Water rights donated to the DRC for river restoration thus the transfer will be for restoration.

7.5.3 Exit Fees: Economic and Legal Considerations

The conceptual basis for exit fees rests on an economic argument about the nature of toll or club goods. There are many types of club goods (Cornes and Sandler 1986). In simple terms, an irrigation district is a club where members share the fixed cost of providing a shared service. In joining the club or district, members purchase an interest in real property – the water right. This purchase also enrolls them in the district through the purchase of land included in the district. The landowner therefore not only acquires the asset but takes on a responsibility as a patron of the district to share in the continued costs of maintaining the delivery system and providing water to all patrons.

When a member of a club that shares the fixed cost of providing a good, and perhaps past capital costs of building the club, decides of their own free will to leave the club the question comes of what is their obligation to the club (as they leave). Clearly, once they leave the fixed costs will be shared between fewer members and the mere act of leaving the club makes other club members worse off. In the extreme case, if enough members leave the club is unable to provide the shared good and it must be dissolved – thereby leaving all remaining members worse off in terms of access to the shared good. This goes to the origins of the club as a response to the market failure inherent in the production of a good where the costs of provision to any one member exceed the benefits.

The concept of exit fees therefore rests on firm economic foundations in that there is a claim on the departing member on behalf of remaining members. Debt incurred for prior capital investments would clearly need to be fully paid off by the departing member. Remaining members would have some claim regarding future O&M costs, at least over a reasonable period for the club to transition to a new costs structure. The costs of future undefined or non-specified

capital investments would however not be included in any exit fees as the departing member would not have any say in the investment nor enjoy any of the benefits.

Ideally, the rules of the club are established and regulated and, as necessary, new members would sign a contract that sets forth the agreed terms of departure. Whether this is the case is in some dispute, evidence by considerable debate within Oregon regarding the issue of 'who owns the water.' The obvious point to make is that the State owns the water (Bastach 1998). Much as described above with clubs, the Oregon Water Resources Congress (the State Association of Irrigation Districts) regards district patrons as entering into a trust relationship with the district. The district agrees to deliver the water and manage and construct the delivery system and the patron agrees to participate as a member in district governance, beneficially use the water and pay the assessments levied by the district.

Oregon Statute and Administrative Rules do not clearly resolve the issue of who owns a water right. Current statute and rule do not require a district patron to notify their district or to obtain the consent of the district in a transfer of water from their land (OWRD 2005). While this might suggest that the landowner is in control of the disposition of the water right it is interesting to note that in order to undertake a temporary instream lease the landowner must have the district as the second lessor, implicitly providing the district with veto power over the temporary disposition of the water right.

This paper outlines the current statutes and rules governing transfer transactions as a way of setting forth the risks and returns that exist for the landowner, the district and third parties in 'moving' water – and assesses how current exit fee formulas reflect these realities.

It is clear that if a district either cannot or chooses not to deliver water to a patron on a district distribution system the patron will not have the ability to irrigate. Districts do have the power to lien the landowner's property and there are rules that govern the conditions under which districts may confiscate a water right. Typically, liens are filed in cases of failure to pay assessments and/or failure to make beneficial use of the water (ORS 540.572). So, irrigation districts do have a degree of de facto control over the exercising of the water right, through their control over delivery of water to the landowner's system or turnout. However, just as clear is that the appurtenancy requirement means it is the patron who has the right to water his/her property and that the patron is in de facto control of the water once it is delivered to the turnout as long as it is used in accord with the State authorized certificate's designated place of use, type of use, rate, and duty. The district then has control over delivery, the landowner has control over usage and the landowner is bound to the district because in the absence of delivery there can be no use.

At the same time, current statute and rule permit the patron to file a transfer out of the district without district consent. The landowner does therefore appear to have dejure control over the water right. This does not imply that filing of such a transfer would not be objected to and protested by a district. Thus it is clear that in a transfer application both the district and the landowner bear risk arising out of the lack of clear de facto control by either party. The district bears the risk that the landowner may leave the district without access to future assessments and the landowner the risk that the district will subject the landowner to delays and costs in attempting to transfer the water out of the district. On the basis of this analysis it is clear that there is shared risk and therefore it is an unlikely outcome that the exit fee associated with a

patron leaving the district should be set at zero – or that the patron should be bound to pay the district assessment in perpetuity regardless of any plans to ever use the water right in the district.

Unfortunately, these absolute bounds do not provide practical guidance on how to set exit fees. As a result the bulk of the discussion surrounding fees revolves around the question of what level of compensation is appropriate.

7.6 Exit Fees in Practice

There is limited experience with exit fees in this context. It is reported that the State of Montana had established exit fees equal to one-half of the present value of assessments over 20 years (Cleary, pers. com 2004). In response to a series of voluntary cancellations by patrons, the Grants Pass Irrigation District established exit fees of $700/acre for the exclusion of irrigated lands from the district – where the water rights had become unusable due to development. As described above, the extent of exit fees depends on the cost structure of the district that remains following the exit. In Idaho, the Bell Rapids Irrigation District sold all of its 25,000 acres to the State of Idaho (for $24 million), which will now lease the water for instream flow to the federal government for salmon and steelhead recovery. Little to no exit fee is required in this case as there is no continued obligation to deliver water - the farmers simply themselves recoup the majority of the funds paid for forgoing the use of their water rights.

In Central Oregon, three districts have set exit fees: COID, Swalley and Lone Pine. COID adopted a formula wherein a per acre exit fee is established and then applied to the amount of acres being exited. The per acre exit fee is set based on the current value of district debt and assessments. Debt is allocated to assessment acres and then added to the asset value that must be invested today in order to yield a yearly payment that is equal to one acre's proportionate share of current assessments. The assessment per acre fee varies with the type of interest rate selected and its current value. The fees are therefore calculated as follows:

Exit Fee = Total Debt / Number of district acres + (Total District Annual O&M / Number of District Acres) / Interest rate

This formula was also adopted by Swalley. COID initially chose the 20-year Treasury Bill rate but later switched to the 10-year rate as the 20-year has been discontinued by the U.S. Treasury (SJ). Based on 2005 exit fee levels and recognizing that they will vary from year to year the COID fee was slightly over $1,000 an acre and the Swalley fee was just over $2,000 an acre. The significant variance between the two figures is based on the differing circumstances of the districts, Swalley has only 10% of the acreage assessed by COID and therefore the assessments are more heavily weighted per customer or acre in a smaller district.

Finally, in early 2006, the Lone Pine Board simply selected a $500/acre exit fee without regard to a formula. In the table below these existing fees are compared with present value calculations. The latter consist of using the interest rate (chosen to be equal to the 10-year T-Bill for simplicity sake) to discount a stream of assessment payments made over the time horizon specified. In all three cases the exit fees exceed the equivalent discounted stream of assessment payments over 40 years (at the 4.5% interest rate).

Table 27. Exit Fee Comparison

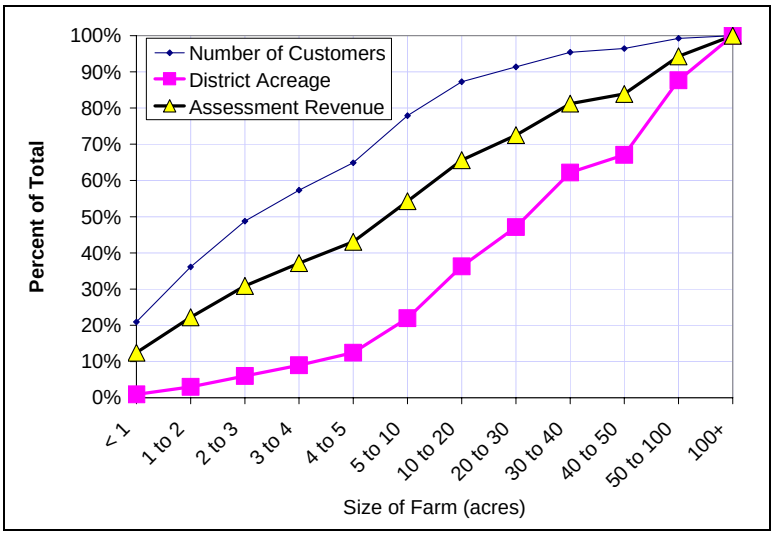
Irrigation District	Average Size Category (acres)	Assessment Fees and Charges			Present Value over given years			Existing Fees ($/acre)
		Base / Delivery Charge	Charge Per Acre	Annual Assessment ($/acre)	10 yrs	20 yrs	40 yrs	
Swalley	6	$ 375.00	$ 20.50	$ 83.00	$657	$1,080	$1,527	$ 2,000
COID	9	$ 275.00	$ 23.00	$ 53.56	$424	$697	$986	$ 1,100
Lone Pine	125	$ -	$ 23.00	$ 23.00	$182	$299	$423	$ 500

The formula chosen enables the assessment to be paid in perpetuity. Returning to the earlier theoretical discussion it appears that those exiting the districts are paying close to the full potential cost of doing so. The rationale for this may well be that there are significant demands for the permanent reallocation of water rights and very little of such reallocation underway. In a sense then the district fees are set very much as would be expected in an oligopolistic market, that is a market with a few sellers – and one where demand exceeds supply.

A particular uncertainty in this case is the lack of knowledge of what size of water right will exit. As discussed earlier, the skewed size distribution (many small water right holders and few large water right holders) and the structure of assessments (large account fees and low per acre charges) mean that irrigation districts are largely financed by small acreages. The formula developed by COID relies on spreading the O&M cost across all acres. As a result, if only small acreages exit the district, the district will not recoup as much of the lost assessment as if large acreages exit the district.

Using the information from the COID case study presented earlier and the basis for assessment charges it is possible to construct an assessment revenue forecast by account size class for the district. The cumulative totals by size class can then be plotted against similar cumulative totals for numbers of customers and district acreage (see Figure 15). What the analysis shows is that there are a large number of accounts that account for a small amount of district acreage, but a much larger share of assessment revenues. Further, the smaller acreages are more likely to be in or near an urban area and therefore more at risk of purchase or exit. The risk to the district is then that small acreages will exit and in doing so pay what is an exit fee averaged across the district, while leaving a more than proportionate shortfall in assessment revenue.

Figure 15. Comparison of COID Customer Numbers, Acreage and Assessment Revenue by Account Size Class



For example, in the 1 to 2 acre size class there are 99 accounts that total 131 acres. If all of these acres exited the district the total amount of exit fees collected would be approximately $131,000. However, the current annual assessment revenues from these 99 accounts are $31,000. Calculated along the lines shown above the exit fees that would be received by COID in this example represent the present value of only 5 years of assessments (at 4.5%). In other words, in order to receive a more 'fair' exit fee payment on these acres an even higher exit fee would need to be charged.

This suggests a number of conclusions with respect to exit fees and assessments more generally. First, given the current revenue structure of many of the districts there may be a need to develop a differential exit fee. A differential fee is one that varies with the size of the water right that is being exited. When larger water rights are exited from the district the fees actually net districts corresponding net gains (as opposed to the losses when smaller acreages leave). For example, the exit of an 80 acre farm from COID would provide the district $80,000 in exit fees. Then annual assessment foregone by the district in this case is $2,115. The $80,000 is equivalent to paying double the present value of the $2,115 as paid in perpetuity. Differential exit pricing may therefore be called for given the skewed nature of district accounts and the structure of assessments.

Second, the obvious conclusion is that such differential pricing would have its limits. Any 'fair' exit fee calculated for smaller acreages would be prohibitively high. Just as small acreages currently pay very high per acre-foot costs for water so would a buyer attempting to exit such acreages end up facing a very large bill to remove the water. Given that the transaction costs involved in purchasing and transferring a water right are non-trivial this just makes moving small acreage water rights an even more tenuous economic proposition.

Part of the uncertainty also revolves around the cost side. The concept of an exit fee as owed to a district upon a patron's departure as presented earlier assumes that costs of providing water are fixed. In the long-run, of course, all costs are variable. Taking a longer view may therefore be

helpful, just as developing a better understanding of the cost structure of a district will be important in really understanding exit fees.

8. Conclusions

The paper has made an effort to describe and analyze the current conditions and future trends in irrigated agriculture in the upper Deschutes Basin – where population growth, urbanization and land use change are having an important impact on the demand for irrigation water – and therefore also an important impact on the potential supply of irrigation water rights to meet new, non-traditional uses of water.

The positive conclusion is that development pressures do not by themselves have to lead to a water 'crisis' in the Basin. Development over the last decade has been matched by a declining interest in and demand for the delivery of irrigation water for agricultural purposes. A number of irrigation districts are responding to the trends in the irrigation sector, as well as broader societal demands for water, and are working with new legal and market tools in order to find a way to free up surplus agricultural water to meet other needs. Further assessment of the balance of supply and demand of water and water rights over the longer term is addressed in the last of the companion DWA Issues Paper *Scenarios for Long-Range Integrated Water Resource Management in the Deschutes*.

In this respect, the use of market-based approaches exercised within a strong collaborative institutional framework that is driven by the public good and with a long-range vision and a transparent plan will be essential to ensure success. The Central Oregon Water Bank that is being pioneered by COID, Swalley and the DRC as a mechanism to meet agricultural, groundwater and instream needs is an example of this cooperative, voluntary approach. While the cost and timeliness of undertaking leasing and transfer applications with the State could be improved, particularly as volume increases, so far efforts to transfer water rights from their traditional use to instream and groundwater mitigation uses have been largely successful in their implementation.

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