

LANDSCAPES IN TRANSITION: EXPLORING THE INTERSECTIONS BETWEEN
LAND USE PLANNING AND WATER MANAGEMENT IN HENRY'S FORK
WATERSHED, IDAHO

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ABSTRACT

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Lora H. Liegel

Watersheds throughout the arid western United States are experiencing rapid development. Urban, suburban, and resort developments are expanding onto previously irrigated agricultural lands, particularly in locations that also contain natural amenities such as mountains, rivers, and forests. This “landscape in transition” changes the way water is consumed and distributed and in some cases has led to tensions among water managers and users. The Henry’s Fork Watershed (HFW) in southeast Idaho is experiencing rapid development and is an area where ground and surface water are highly linked. While there is a large body of research that details the dynamic relationships between newer and longer-term residents in amenity rich locations, few studies have focused on how water management is affected by development processes. This study aimed to fill this gap by asking three questions: 1) How do changes in distribution and use of water due to development affect canal companies, 2) How are canal companies responding to these changes, and 3) How are land use planning policies taking water and environmental values into consideration? In-depth qualitative interviews revealed that

canal companies have been impacted differently by city and county land use planning policies, development trends, and newer residents' water management knowledge. Lack of communication among agricultural irrigators, development residents, and planning entities was a common theme. Examples of response to this landscape in transition included the creation of a development "checklist", watering schedules, and the construction of development irrigation infrastructure. Quantitative analyses strengthened this study by showing the quantity, type, and location of development sites on irrigated agricultural lands and characterized municipal water consumption trends. It was found that 5 % of all potentially irrigable acres have been subdivided since 1970, but that this land conversion can be as high as 14% at the county scale. This in-depth, regional study of water use issues generated an analytical framework for investigating the impacts of socioeconomic transformations and possibilities for better integrating land use planning and water management in other watersheds of the interior western United States.

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INTRODUCTION

Water management in the United States is an increasingly important issue. In the interior West, characterized by arid to semi-arid climates where irrigation is widespread, variable water supplies, complex water rights, and increased in-migration have created a challenging environment for water management. Irrigated agricultural lands in the western United States have given way to suburban, exurban, and resort developments, resulting in increased demand for water. At the same time, water is comparatively scarce. Because little precipitation falls during the summer, water supply is nearly completely dependent upon snowpack. In addition, increasingly variable climate means that water can be relatively abundant during peak snow years or extremely scarce during periods of drought. Furthermore, access to water in the West is overwhelmingly tied to historical water rights governed by the doctrine of prior appropriation. Together, these factors affect water supply and distribution and create challenges for resource governance under county and state regulations that separate decision-making about water from decisions about land use.

While land use planning often happens at a local or county level, water management decision-making frequently occurs at state and federal levels. The result can be miscommunication among land and water managers and incoherent sets of policy. Within the interior West, development has been gaining momentum for the past several decades. City and county planning regulations have allowed and encouraged this growth through zoning and ordinances. During the development approval process, water issues

related to demand, distribution, and quantity have often slipped through the cracks. State oversight can be lacking or ineffective at managing water at such a fine, localized, city or county scale. When landscapes are in transition, changing water distribution and use patterns can also impact long time and newer residents in a myriad of ways.

In this paper I explore how development patterns and land use decisions have affected longtime water management practices and created newer systems of use and distribution. Specifically, I examine how changes in water use and distribution affect canal companies¹ in the Henry's Fork Watershed (HFW) in southeast Idaho and western Wyoming. Although previous research has shown that amenity migration is affecting residential development (Gude et al. 2006) and ranching dynamics (Gosnell et al. 2006; Gosnell and Travis 2005), few studies have examined changing land use patterns and the potential impacts for water management and specifically, canal companies.

The HFW has lost irrigable lands to residential and commercial development. Over the last forty years, development patterns have ebbed and flowed in response to national and local economic trends. These patterns have varied depending on location. For example, there has been urban growth in and close to the City of Rexburg, largely

¹ Canal companies are organized groups of irrigators that are largely responsible for distributing and using surface water (from streams or rivers) for irrigated agriculture. A ditch rider is a member of a canal company who controls water flow levels by adjusting headgates at points of diversion or delivery. A canal company is usually managed by a few irrigators who serve as board members and fill positions such as Chairman, Secretary, Treasurer, President, and Vice President. Board members' responsibilities include managing finances, keeping track of records such as irrigation infrastructure maps and, helping resolve conflict among farmers. The majority of canal companies in HFW have storage water rights (from dams or reservoirs) with Fremont-Madison Irrigation District.

due to expanding populations and infrastructure for Brigham Young University-Idaho (BYU-I) and the Church of Jesus Christ of the Latter Day Saints (LDS). In Teton Valley, resorts and second homes extend into the scenic agricultural landscape. It was the aim of this research to investigate how development patterns affected canal company dynamics including shareholder numbers, ditch-rider responsibilities, and communication with development residents and land use planning entities.

This research was part of a larger study motivated initially by concerns that emerged from Henry's Fork Watershed Council² meetings during 2005-2006. The three primary concerns associated with a rapidly developing landscape included decreases in groundwater levels, potential changes in water consumption rates due to urbanization, and challenges to managing irrigation conveyance systems in an urbanizing landscape. A collaborative, interdisciplinary research approach was used to explore these issues. Partner organizations including Friends of the Teton River (FTR)³, Henry's Fork Foundation (HFF)⁴, and Fremont-Madison Irrigation District (FMID)⁵, all located within

² The Henry's Fork Watershed Council works with scientists, citizens, and agencies to resolve conflicts in order to better understand watershed perspectives and relationships. The HFWC was organized in 1994 and is a grassroots, community forum that uses a nonadversarial, consensus-based approach to restore, enhance, and maintain watershed resources for future generations (Henry's Fork Watershed Council 2011).

³ Friends of the Teton River helps implement community-based watershed protection and restoration by using their founding principles: sound science, collaborative relationships and community education. Located in Driggs, Idaho, FTR was founded in 2000 (Friends of the Teton River 2011).

⁴ The Henry's Fork Foundation located in Ashton, Idaho, works closely with area organizations, businesses and interest groups to ensure the sustainability of the Henry's Fork ecosystem: its land, water, wildlife, fisheries, and aesthetic qualities. HFF was founded in 1984 (Henry's Fork Foundation 2011).

the watershed, were crucial in establishing channels of trust and contributing to the research process.

⁵ The Fremont-Madison Irrigation District manages the distribution of storage water to canal companies in Fremont, Madison, and Teton counties, Idaho. FMID has played a critical role in encouraging developers to get proposed developments approved by canal companies.

LITERATURE REVIEW

What defines the “West?” For some, the word “West” may stir antiquated imagery of cowboys herding cattle across a limitless landscape. But what characteristics does the present West maintain? For the purpose of this research, the word “West” shall refer to the region of the United States west of and including the states of Montana, Wyoming, Colorado, and New Mexico. This study focuses on the “interior West,” characterized by arid to semi-arid climates where irrigation is widespread. Although some of the images of open space and cowboy hats hold true, it is undeniable that in many areas of the West a newer narrative has emerged—a West that is growing, more populous, and more developed than ever before. The interior West’s population as of 2006 was growing faster than any other region of the nation (Travis 2007). This transition has brought more people to previously sparsely populated areas, and with them, a growing and dynamic set of ideas, cultures, and ways of life.

There is an extensive body of literature that has addressed the transition from “Old West” to “New West” (Riebsame 2001; Hansen et al. 2002; Sheridan 2007; Robbins et al. 2009). In the West, jobs have mainly followed people, contrary to the common belief that migration is spurred by the prospect of employment (Vias 1999). Instead of improved earnings, people were lured by pristine natural landscapes and outdoor activities such as skiing, hiking, golfing, cycling, and fishing. These visitors, both seasonal and full-time residents are sometimes referred to as “amenity migrants” (Moss 2006). Idaho has not escaped this in-migration trend. In both the 1970s and 1990s, Idaho

was among the seven fastest growing states in the nation, and rural counties had a growth rate double the national average (Salant and Porter 2005). Yellowstone National Park, access to skiing, and an abundance of national forest lands are likely amenity attractants.

Amenity migration has created ecological and social challenges for the communities where its development and growth are persistent. The “Old West,” a landscape mainly dependent upon natural resource extraction such as logging, mining, or ranching, has opened to a “New West,” more reliant on a service sector economy stemming from tourism and recreation. Ecological changes have resulted from large swaths of land being carved out for development while social challenges have emerged from newer residents’ and older residents’ diverging viewpoints on politics, private property rights, and economics.

Walker (2003) described how the Old West was transformed, using the Sierra Foothills of California as an example. The pro-growth, long-time political establishment in Nevada County was caught by surprise when four environmentalist growth-control advocates were elected into county supervisor positions (Walker 2003). This situation created conflict among community members and was framed by Walker using a regional approach and six descriptive characteristics of a changing American West. Some of the most relevant characteristics that Walker discussed were the linkages between informal politics and formal political institutions at multiple scales. Quiet, yet pervasive changes occurred in county- and regional-level politics. Mundane processes such as drafting of General Plans or limits on parcel size became an arena for people to express what the Western landscape should look like (Walker 2003). Similar narratives of conflict within

regional politics have also emerged within the HFW. One sub-area of research that has also detailed an emerging New West was the investigation of land ownership changes among ranching lands.

A more detailed examination of amenity migration has spurred research that addresses the changing dynamics of ranching in the West (Gosnell and Travis 2005; Gosnell et al. 2006). Gosnell and Travis (2005) found that 54% of 400 acre or more ranching parcels were sold to “amenity buyers” and 62% of acres sold, went to out-of-state buyers in three Rocky Mountain counties. Ranching lands were significant because they represented the largest portion of privately owned open space. There has also been some research focused on how land ownership changes affect water resources (Gosnell et al. 2007). However, there should be more investigation of how new landowners use, view, and manage water resources. Changing the way water is used could significantly alter ground-surface water interactions and ultimately limit water availability within a particular region. Dominant forms of growth in the West have helped shape how water resources are viewed and used.

Land ownership changes in the West have been driven by dominant forms of growth including metro-zones, the exurbs, resort zones, and the gentrified range (Travis 2007). Sprawl is common and has been described as cookie-cutter developments, big-box, big-parking retail, and automobile dependent (Travis 2007). The federal government has helped enable these types of sprawl by granting money to cities and counties for development projects such as increased roadways that may not actually be needed. The production of growth and development are viewed as a means to community well being,

but water frequently does not make it to the forefront of the discussion. Some of the major barriers to the inclusion of water within land use planning and management have been a lack of integration between varying scales of government, including federal, state, and municipal.

Surprisingly, land and water are not as linked as one might intuitively presume. In the West, including Idaho, the prior appropriation doctrine governs water law and water property rights. Under prior appropriation, water rights are use-based, not land-based, meaning that as long as beneficial use can be demonstrated, water can be moved from one geographic place to another. A good, large-scale example would be Los Angeles' use of the Colorado River. Similarly at a smaller scale, irrigation water that originates from one diversion point on a creek or river can be transported through ditches or pipes and used on multiple parcels of farm land. Another complicating factor is that rights are "allocated by priority, not need or economic value" (Tarlock 2005). In times of drought, the burden of shortage among members of the same canal system need not be shared. As cities expand into rural lands, they have the possibility of purchasing high priority water rights because agricultural water rights are often the oldest.

There has been an increasing amount of literature centered on the need to incorporate discussions of wildlife, aquatic species, and abundant flow in water and land use planning (Morris 2000; Angelo 2001; Duncan 2002). The doctrine of prior appropriation is important because it can dictate how wildlife or instream flow are viewed, valued, and ultimately protected. Under the prior appropriation system, there is incentive to use every drop of water because it must be put to beneficial use (Neuman

1998; Tarlock 2000). In other words, the water law structure promotes a “use it or lose it” system.

The federal government can trump an individual’s water rights to protect animals or plants by invoking the Endangered Species Act (ESA), but the law only protects species that are at risk and only to the degree that a proposed water project would cause harm. Once a species is placed on the ESA list, farming irrigation practices that, for example, dewater critical habitat for endangered fish species can disrupt local economies and create conflict among community members (Doremus and Tarlock 2008). One way to avoid such a situation is for state, county, or city land use planning ordinances to take water into account. Stream buffers, lot size limitations, and wildlife overlays can work to protect at risk species at a finer geographic scale than more blanketing federal regulations. However, in order for this scenario to succeed, local land use planners and county commissioners must take initiative to include water in land use planning policy and not always defer to state and federal water management practices.

Each land-regulating body will set rules to reflect their values. No matter how non-partisan a group of county commissioners or government organization strives to be, decision-makers are influenced by their own land ethic, or the way they view and interpret the environment (Bosselman 1994; Freyfogle 1995; Freyfogle 2003). Although land use planning and water management have run relatively smoothly in Idaho throughout recent history, an increase of diverse perspectives and multiple land ethics, has created a more challenging environment.

Vertical disjunctions of what constitutes appropriate land and water use exist between federal, state, and local authorities, and horizontal gaps are apparent even among different decision makers within one organization (Tarlock and Lucero 2002). Arnold (2005) described such disassociations as the way different managers approach their position—land use planners tend to think spatially with maps and drawings while water-use planners think quantitatively and directionally with volume and flow. Arnold (2005) described this idea in more detail as three differing legal regulatory regimes: 1. water quality controls (largely federal), 2. water use (long-standing state water laws), and 3. land use controls (local government with federal/state regulatory overlays). The different regimes are at odds with each other with respect to how to channel growth, control impacts of growth, and facilitate growth.

One of the major fractures between water management and land use planning occurs because of the ways decision making power is distributed. States tend to pass land-use planning authority to local governments such as to cities and counties. Although the division of power and decision-making among many can be beneficial to meet specific, localized needs, an incongruent system of zoning and land use ordinances has been constructed. As a result, a county that favors unlimited growth may sit directly adjacent to another that favors preservation of open space. What is often lacking is a state or regional framework to integrate the many different planning strategies.

Gaps between water and land management can enable the creation of landscapes that support development projects, but lack adequate water supplies or value the ecological services that come from water resources. Because states delegate planning

authority to counties and cities, they will often compete with one another to try and attract growth because of the increased tax revenue it brings. However, this type of competition leaves little incentive to coordinate regional land use planning efforts (Arnold 2005). While a developer may have to get approval from a state authority concerning water resources, it is often up to cash-strapped, time-constrained, and understaffed municipalities or counties to keep track of localized water infrastructure and ecological needs. Without adequate institutional frameworks mandating state and local authority communication, the state could easily approve more projects than what a particular location can support. For example, Idaho Falls in southeast Idaho does not meter municipal water. Therefore, water consumption patterns regarding location or time of use are not readily available for land use planners.

Weatherby and Stapilus (2005) noted that fragmentation in policymaking characterizes Idaho's patchwork of local governments, and it is often unclear as to which entity is responsible for what service. Idaho legislation authorized counties and communities to establish ordinances and comprehensive plans in the 1950s (Weatherby and Stapilus 2005). The Local Planning Act of 1975 replaced previous legislation and mandated that all counties and cities provide a planning and zoning process (Teton County 2008). Although such a mandate existed, many counties did not begin organized zoning or ordinance development until the 1990s. Similarly, it is unclear how local governments should address water management issues. Typically, it is the responsibility of local municipalities to provide water and sewer infrastructure to their citizens. However, water quality and quantity issues are held by the Idaho Department of Water

Resources or other state level safety and regulatory authorities. Funding constraints and lack of communication between state and local government can create large gaps that fail to address land and water connections adequately.

As Dan Tarlock (2005) and Travis (2007) have noted, the West's harsh, dry, water-stressed climate continues to *attract* rather than repel growth. Arnold (2005) stated that "there is a need for a concept of "wet growth": integration of concerns about water quality and the availability of water supply into the density, form, pattern and location of land development." This definition of "wet growth" may be part of a broader "smart growth" agenda or may carve its own more defined path into the planning and regulatory fields. The potential of using a "wet growth" framework could mean growth that links multiple tiers of governance and brings water use and distribution to the forefront of land use planning. Taking into account how water resources affect development and vice versa also holds the possibility of creating communities that simultaneously meet ecological and social needs without sacrificing one for the other.

As the idea of wet growth emerges, more questions need to be asked, such as: what is happening to existing water sources and how will changes in water-use and distribution affect physical environments and human communities? Hanak and Browne (2006) discussed how adequacy laws in five western states have linked water supply to land use planning as a basis for development approval. Types of adequacy include: proving that a development project will have ample water supplies for a certain number of years, making a utility secure water rights, or demonstrating that groundwater overdraft will not occur (Hanak and Browne 2006). The challenge is to have strict

enough regulations that prevent water shortages and hamper developers from finding loopholes, while not passing costs to home buyers. Idaho does not appear to have any such adequacy laws in place regarding development. Researchers such as Hanak and Browne are calling for a multi-tiered approach at merging water management and land use planning. This includes considering a wide range of influences on water-use and distribution such as residential lot size, climate and geography, water knowledge⁶ and preferences, developer decisions, and governance gaps.

The field of watershed management has been one clear starting point at better incorporating land use planning and water management, but there is still room for more detailed analyses. Within the field of watershed management there are emerging sub-themes such as the role of collaboration (Lubell et al. 2002; Sabatier et al. 2005) the process of learning (Hamman and Drossman 2006), organizational structure of watershed institutions (Clark et al. 2005), and public participation in watershed councils (Griffin 1999). For the case of HFW the role and importance of the Henry's Fork Watershed Council (HFWC)⁷ has been documented (Johnson 1998; Weber 2003). The HFWC has

⁶ "Water knowledge" is the information that many long-term residents possess. This information pertains to knowing how much water crops or lawn need in order to grow for a certain period of time. Possessing "water knowledge" also means knowing the history of the irrigation-ditch system, how it is currently managed to be functional, the ways in which canal companies are organized, and where surface water originates.

⁷ The HFWC uses a Watershed Integrity Review and Evaluation (WIRE) criteria to assess watershed projects and programs (Henry's Fork Watershed Council 2011). HFWC accomplishments include annual State of the Watershed conferences, annual field trip tours, and participation with the 2010/2011 Henry's Fork Basin Study in cooperation with the U.S. Bureau of Reclamation (Kirk Johnson 1998; Henry's Fork Watershed Council 2011).

played a crucial role in bringing together multiple stakeholder groups, including agencies, citizens, state officials, irrigators, and canal company board members to be a part of the decision-making process regarding the watershed's resources.

There has been little in-depth research conducted on how water is distributed and used among irrigating water organizations responsible for transporting water from stream or river, and turning dry ground into fertile, irrigated, agriculture. One exception is the detail-rich, six-fold case study of irrigation *huertas* including Utah Valley in the United States (Maass and Anderson 1978). Maass and Anderson (1978) concluded that local control, exercised by individual farmers and as collective bodies, determined the procedures for distributing a limited water supply and resolving conflicts. An examination of larger scale water projects (Reisner 1986) shed light on the influences of federal water policy. What is needed is further investigation and expansion of Maass and Anderson's 1978 work, examining smaller scale irrigation schemes in the United States.

Although irrigating water organizations can be small, with only a handful of farmers, each group can be diverse in membership, and ecologically, economically, and socially influential. Organizations have the potential to recharge aquifers, increase riparian habitat, or control the way land use patterns spread across the landscape. An examination of the small scale Acequia irrigation systems in North America has led to insights revealing the importance of their infrastructure and the human dynamics that emerge from using irrigation water (Hicks and Peña 2003). As water flows across the landscape and into farmer's fields, ground-surface water interactions take place, potentially playing a large role in recharging local aquifers and supplying water to

support plant, animal, and human life. This is much the same case in southeast Idaho, where the majority of irrigation ditches are unlined and free of concrete. The farmers that run the systems are also important because they can have authority over local and regional politics and culture. Gaining insights into these human relationships has the potential to help researchers understand how irrigators, ranchers, farmers, and others involved with water management influence land use planning efforts.

The Acequia communities of northern New Mexico and southern Colorado are centered on a gravity fed irrigation system that relies on knowledge of local topography and geography that is passed from one generation to the next. Water is viewed as a communal resource, not an individual right, and the need for water to support aquatic plants and animals is also recognized. The Acequia system has roots in Roman, Spanish, Arabic, and Pueblo Indian culture (Guana 2005). Although the system has been in practice for hundreds of years, not all state authorities recognize the cultural law, which makes the system vulnerable. Guana framed vulnerability as increased scarcity and reduced water availability for diversion and consumptive uses. The article “Community Acequias in Colorado’s Rio Culebra Watershed: A Customary Commons in the Doctrine of Prior Appropriation” (Hicks and Peña 2003) and book titled, *Acequia, Culture, Water, Land, & Community in the Southwest* (Rivera 1998) were foundational in recognizing the importance of the Acequia communities.

Guana, Hicks and Peña, and Rivera used a lens of environmental justice to frame their research. They focused on how cultural laws intersect and butt against the doctrine of prior appropriation. However, issues of development and land conversion from

agriculture to other uses are not explicit themes. This thesis research aims to fill this gap, recognizing the social and ecological importance of HFW canal companies while also elucidating the effects of development and land use transformations.

A more recent study focusing on irrigated agricultural lands with an open ditch system was conducted by New Mexico State University. The project examined the link between surface and groundwater flow due to ditch seepage in Alcade, New Mexico. Project elements included research on surface-groundwater interactions, aquifer recharge, effects of Acequias on riparian vegetation, evapotranspiration, and restoration, long-term modeling, and climate variability and its effects on Acequia water flow (New Mexico State University Board of Regents 2008). From this research, an explicit exploration of land use changes and their effects on the Acequia system was undertaken (Ortiz et al. 2007). Ortiz et al. used geo-spatial analysis tools to examine land use changes from the 1960s to early 2000s. The potential impacts of development on regional water resources and related agricultural and economic activities were also documented. Ortiz et al.'s study lends itself well to this thesis research, providing a framework for how to better understand land transformation patterns and their effects on water resources and the communities that use them.

Lastly, in an example that is highly comparable to land use changes and impacts in the HFW, Aylward documented how irrigation districts have been influenced by development patterns in central Oregon (Aylward 2006). In participation with the Bureau of Reclamation and the Deschutes Water Alliance Water 2025 Grant, Aylward examined how rapid growth and development affected the upper Deschutes Basin. Fragmentation

and loss of irrigated agricultural lands were found to be impacts of increased urbanization. In relation to surface water, urbanization affected water district deliveries through right of way access, maintenance, and encroachments (Aylward 2006). An analysis of internal irrigation district dynamics also revealed that a “downward spiral” could occur when the value of district water rights fell through decreased demand and failure to pay assessments (Aylward 2006). Changing water rights could also potentially benefit irrigation districts and new users. These changes included: instream leasing, a temporary transfer of surface-water rights to instream use for modest payment; quitclaims, the relinquishing of water right title by landowner to an irrigation district, municipality, or Deschutes River Conservancy; exits, the removal of a water right from an irrigation district in return for payment; and, instream transfer, the permanent transfer of a water right to instream use for river restoration or groundwater mitigation (Aylward 2006).

Canal companies and the irrigators that comprise them are key players within the water management process in southeast Idaho, just as they are in the Acequia communities of New Mexico and Colorado, and the irrigation districts of Oregon. Each member is an individual farmer working to secure enough water for his/her parcel, a member of a collective group of irrigators, and citizen of a larger non-irrigating community. These relationships influence how water is used and distributed and also affect local governance by influencing politics and culture. Thus, understanding how canal companies are affected by development and what they do in response, can elucidate the ways in which land use planning and water management are, or are not integrated.

This study aimed to fill gaps in previous research by asking three questions: 1) How do changes in distribution and use of water due to development affect canal companies, 2) How are canal companies responding to these changes, and 3) How are land use planning policies taking water and environmental values into consideration?

SETTING

The HFW is part of the upper Snake River Basin and lies within eastern Idaho and western Wyoming (Figure 1). The watershed is 3,200 square miles in area and is surrounded by mountain ranges including the Tetons in the east, Centennial in the north and the Big Hole in the south (Figure 2). Elevations range from 4,500 feet in the southwest corner to 11,000 feet in the Teton Range. Most of the geological formations within the watershed were created between 4 million and 600,000 years ago as the Yellowstone hotspot moved northeastward through the region (Van Kirk and Benjamin 2000). Major water bodies include the Henry's North Fork of the Snake River, Island Park Reservoir, and Henry's Lake. The watershed contains more than 3,000 miles of rivers, streams, and canals (Henry's Fork Foundation 2010). This web of water resources supports a diverse natural environment including habitat for fish and wildlife and also attracts recreation and tourism through boating and world class fly-fishing activities.

Within the watershed, water is trapped as snowpack during winter months and melts throughout the summer when temperatures warm. The main source of the Henry's Fork of the Snake River originates as spring discharge in the northern area of Island Park Caldera (Benjamin 2000). To the east, Teton Valley receives the majority of its water from Wyoming. Unlike in the Midwest or Eastern Coastal regions, rainfall is not abundant during the agricultural growing season. Thus, surface water stored in reservoirs or flowing in streambeds is the major water source used. Although precipitation is nearly

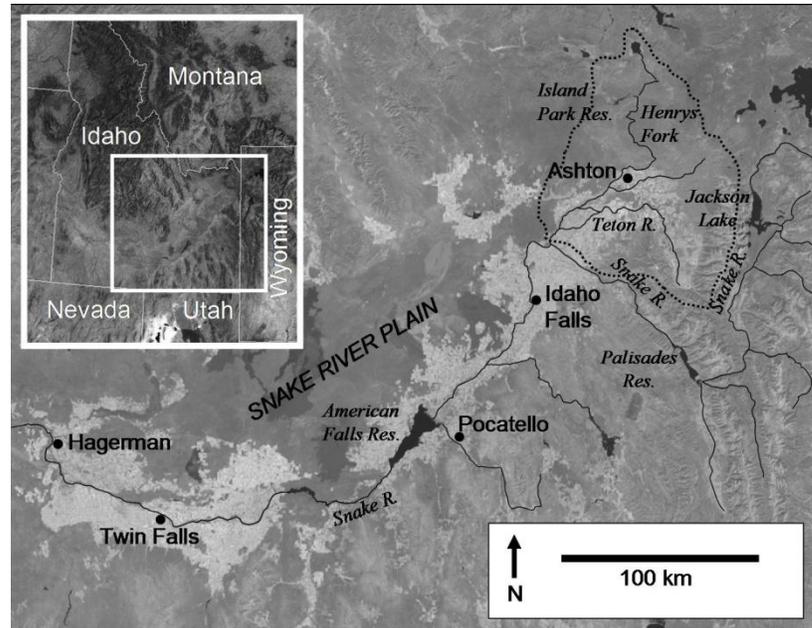


Figure 1: Henry's Fork Watershed situated in the Snake River Plain (Van Kirk 2008).

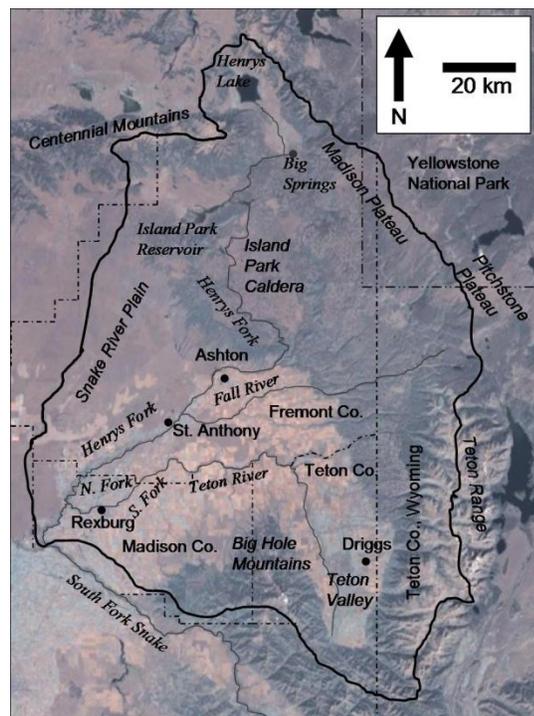


Figure 2: Henry's Fork Watershed (Van Kirk 2008).

uniformly distributed at lower elevations, the higher elevations are characterized by a large early-winter peak (Van Kirk and Benjamin 2000). The majority of the discharge within the region's waterways comes from snowfall at elevations above 6,000 feet. In drought years, a reduced snowpack reduces spring run-off, making less water available for downstream uses. Access to water rights, important even during normal years of precipitation, plays a critical role for irrigators in years of drought.

The climate in the HFW is arid to semi-arid except at higher elevations which are characterized by subfreezing winters and cool summers (Van Kirk and Benjamin 2000). Temperatures range from 5.3 °C at the lowest elevations to less than 1 °C at the highest elevations (Van Kirk and Benjamin 2000). Before agricultural cultivation, lower elevations were characterized by grassland and shrub steppes. Sagebrush (*Artemisia tridentate*), a once dominant species can still be seen in small patches throughout the watershed. Settlers cleared great swaths of sagebrush with horse-drawn cutters and rakes to prepare the land for agriculture (Fiege 1999).

An examination of key historical events can help explain some of the change in population growth and migration. One influential factor has been the Church of Jesus Christ of Latter Day Saints (LDS) also known as the Mormon Church. In the mid to late 1800s, LDS members moved northward from Utah and into Idaho to establish new farm settlements. This migration helped establish the initial irrigation systems in southern and eastern Idaho. The first water right was claimed at the lower end of the watershed near Rexburg and has a priority date of 1879.

Irrigated agriculture has been pervasive in southeastern Idaho since the late 1800s (Slaughter and Weiner 2007). Settlers from Utah, mostly LDS-church members were critical to establishing irrigation in the Snake River Valley (Fiege 1999). The prospect of successful farming through irrigation spurred dreams of prosperity and a better life. Although damming streams and diverting water into an extensive network of ditches was a difficult task, it eventually proved successful. As Fiege (1999) described, by “taming” and “capturing” nature, an “Irrigated Eden” was realized and produced. This Irrigated Eden was produced by small-scale labor efforts reinforced by Mormon “kinship and patriarchal religious order” (Fiege 1999). By pooling labor resources, relatives and neighbors who lived near each other were able to construct the simple but effective ditch system.

Throughout the late 1800s and early 20th century, the ditches moving water out of narrowly defined natural stream channels and into farmer’s fields raised groundwater levels, created new riparian and wetland environments, and extended wildlife habitat. These new environments were both troublesome and beneficial depending on perspective. For example, tourists and bird-watchers might value riparian habitat along canals, but that same habitat results from water diverted from streams that support fish.

Fiege also described how the boundary between what was domesticated or wild grew hazy (1999). For example, water seepage from irrigated agriculture has helped create wetlands and riparian areas along canals. Irrigators of the 1800s were not the first peoples to alter the landscape in a drastic way. Humans that first entered the Snake River

valley as many as 15,000 years ago changed the region's flora and fauna with their hunting practices and use of fire. Therefore, humans have played a large role in changing ecological processes a variety of times throughout history. Irrigators have altered the local landscape by: practicing initial flood irrigation methods, switching to sprinkler methods in the 1970s/1980s, and more recently converting irrigated agricultural lands to non-agricultural uses in the 1990s/2000s. While there has been little scholarly research focused in southeast Idaho, there has been some research describing the link between surface-groundwater interactions and elevated groundwater tables due to irrigated agriculture (Peck and Lovvorn 2001; Van Kirk and Burnett 2004; Peck et al. 2005; Fernald et al. 2007).

Although agriculture played a large role in the past, Idaho's economy has recently been diversifying. As regional economies have grown larger and mobility has increased, residential and commercial development has expanded around city centers and natural amenity-rich locations. In both the 1970s and 1990s, Idaho was among the seven fastest growing states in the nation (Salant and Porter 2005). Teton County doubled in population between 1990 and 2005 (Salant and Porter 2005). One clear reason for such in-migration has been natural amenities such as mountains, open space, rivers, scenic views and the recreational opportunities they support, including hiking, fishing, and skiing (Loomis 2006). More people have meant increased growth in the form of an expanding economy, including increases in manufacturing and construction, with a

collateral decrease in more traditional forms of employment such as mining, forestry and farming.

Although the total number of agricultural jobs in HFW has decreased from 1999 to 2009 (Jensen 2010), farming still plays a significant role in the region's economy. Irrigated agricultural land supports crops like wheat, barley, seed potatoes, hay and pasture. HFW agriculture is tied to other markets within the Eastern Snake River Plain. The loss of irrigated farmland due to development pressures will likely mean that the economy and culture will continue to change.

The three major counties in the watershed are Teton, Madison, and Fremont. The patterns of development vary across the watershed. For example, there is urban growth in and close to the City of Rexburg, largely due to expanding populations and infrastructure for Brigham Young University-Idaho (BYU-I) and the Mormon Church. In Teton Valley, growth associated with natural amenities has concentrated more at city fringes and extended into the rural landscape. A high percentage of federal and state lands in the watershed limits lands available for development. For example, 69% of Fremont County's total acreage is managed by federal or state government (Fremont County 2008).

The proportion of LDS members to the state population in Idaho is second only to Utah (Weatherby and Stapilus 2005). Cities like Rexburg have a Mormon population generally estimated at upwards of 90 percent (Weatherby and Stapilus 2005). Many descendents of Mormon families still live in the areas where they first settled and remain

prominent in these communities. The Henry's Fork region is generally politically and socially conservative, which influences discussions about water management and co-management strategies.

METHODS

This research has in part, emanated from meetings with stakeholders at the Henry's Fork Watershed Council during 2005 and 2006. Several meetings were devoted to socioeconomic change occurring in the watershed and its effects on traditional land and water uses. A need was recognized to address the rapidly developing landscape and the water management and conservation strategies appropriate for an urbanizing landscape. The three areas of concern at that time were: 1. Decreases in groundwater levels, 2. Potential changes in water use from urbanization, and 3. Challenges to managing irrigation conveyance systems in an urbanizing landscape. It was suspected that groundwater tables could be lowered if irrigated agricultural lands were converted to non-agricultural uses and/or the canals that transport irrigation water were removed from the landscape. Challenges to managing conveyance systems included an increase in new water users and housing developments. This research sought to help answer the three identified questions by exploring how canal companies were affected by development pressures, what they were doing in response to change, and examining how land use planning entities were or were not taking water and environmental concerns into account.

The four organizations that were involved with the United States Department of Agriculture (USDA) grant⁸ included the HFWC, HFF, FMID, and FTR. These four

⁸ The USDA grant ran from 2009-2011. Research objectives included: 1. development of quantitative models of ground and surface water flow pathways and 2. identification of economic, regulatory, and physical mechanisms that would encourage water conservation and facilitate efficient water management on developed lands. Extension objectives

organizations had worked with the Project Director, as well as local residents in the past. A collaborative approach with partner organizations and participants was employed. Partner organizations helped establish initial contacts and persons of interest for the interviewing process. An iterative approach was also employed by examining and reviewing the data multiple times throughout the study. Data were gathered through GIS analysis, review of plat maps, and qualitative interviews.

GIS Analysis

Using previous amenity migration and demographic research as a model, county level data sources and Geographic Information Systems (GIS)-based spatial analysis were used to examine changing patterns of development and water transfers in the HFW between 1970 and 2008. The GIS analysis was used to determine the total number of potentially irrigable acres within the watershed that had been taken out of agricultural production due to conversion and to determine the location of different types of development. Relevant data layers were gathered and developed with data from several sources (Table 1).

included: 1. distribution of educational materials on the watershed's hydrology and water conservation strategies and 2. working with the HFWC to create a strategy that would enhance ecological benefits and increase water availability for agriculture.

Table 1: GIS data layers and sources.

Data Layer	Source
County Boundaries	Idaho Tax Commission (2010)
Place of Use Water Rights	Idaho Department of Water Resources (2010)
Recommended Place of Use Water Rights	Idaho Department of Water Resources (2010)
Major Rivers	Friends of the Teton River (2010)
Henry's Fork Watershed Boundary	Idaho State University (2010)

Data about developments such as lot sizes and water infrastructure were obtained from county plat maps in Fremont, Madison, and Teton Counties. Plat maps were analyzed because they contained more detailed development information than the GIS layers. The county GIS layers included information on development names, location, and footprint size⁹. Although portions of Teton County, Wyoming and Yellowstone National Park fall within the Henry's Fork Watershed boundaries, they were not included in the analysis because these areas are not traditionally irrigated. Developments examined were platted between 1970 and 2008. Prior to 1970, the rate of land use conversion was relatively low.

Upon Idaho Department of Water Resources (IDWR) recommendation (Ciscell 2010), place-of-use water rights and Snake River Basin Adjudication, recommended place-of-use rights data were used to determine which current developments were sited on previously irrigated agricultural land (IDWR 2010). "Recommended" water rights

⁹ "Subdivision" from here on will refer to the land division process that a landowner initiates to plat his/her land and that is eventually approved or disapproved by a county or city. "Developments" shall refer to commercial, single-dwelling, multi-family dwellings or condos, and resorts, and the infrastructure they require such as roads, water/sewer, parking spaces, etc. Subdivision plats contain data on total acreage, lot size, and location.

were those that IDWR recommended be approved through the Snake River Basin Adjudication process. The adjudication was brought about by water users and began in 1987 to determine which water rights had legal standing and which did not (Shaw 1998). The two water rights data layers contained information regarding water right owner, priority date, decree date, water source, water right number, and water use code. From the place-of-use water rights layer, all water rights for which water use was defined as “irrigation,” “irrigation from storage,” or “irrigation storage” were queried. Querying for irrigation eliminated all other irrelevant data including water rights with uses labeled industrial, commercial, recreation, etc. “Stockwater” was deemed insignificant to hydrologic impacts and was not included under the “irrigation” umbrella.

The Idaho Tax Commission provided a shape file of all Idaho counties (Idaho Tax Commission 2010). Fremont, Madison, and Teton counties were selected from the whole state. A HFW layer was obtained from the Idaho State University Digital Mapping Laboratory. The HFW boundary is comprised of the outer bounds of three United States Geological Survey (USGS) hydrologic watershed units: Upper Henrys 17040202, Lower Henrys 17040203, and Teton 17040204. Friends of the Teton River provided two layers with Idaho Rivers and Streams. ArcGIS version 9.3. was used to analyze the data (ESRI 2010).

Determining Parcels Subdivided for Development on Potentially Irrigable Lands

All data layers were projected into the North American Datum 1983 (NAD83), State Plane, Idaho East, FIPS 1101 coordinate system. After querying for irrigation water-

use rights and recommended water rights in the place-of-use boundary rights layer, the layer was clipped to the three counties of interest. Each of the three development layers provided by each county was combined using a spatial join analysis, creating a single watershed land use conversion layer that contained Fremont, Madison, and Teton County developments and their accompanying footprint acreages.

Initially, it was expected that the IDWR water layers would be able to show which lands were previously irrigated with 100 percent accuracy. However, due to the complex nature of water management, an irrigation company can distribute water with multiple water rights to be used within a single designated place of use. A canal company can shift the water quantity derived from the water right's allowed maximum diversion rate to another location, as long as it remains within the company's designated place-of-use boundaries. Therefore, the IDWR data best showed *potentially* irrigable lands as defined by having a water right for which the "basis" was "decreed", "statutory claim," or "license." Similarly, where recommended water rights existed, lands were considered potentially irrigable because they will likely be approved by the Snake River Basin Adjudication process. Although an area of land that falls within an irrigation company's bounds could have never been irrigated, it is unlikely. The assumptions of the GIS analysis were discussed and confirmed with IDWR officials and local experts, including long-term irrigating farmers and ditch riders within the three counties.

An intersect analysis was performed with the spatially joined land use conversion layer and the water rights, place-of-use layer. The resulting layer contained all

developments that intersected or contained place-of-use water rights. An x-y tolerance of twenty feet was set to eliminate slivers at the edges of development polygons. The slivers would have contained water rights data that likely did not exist in reality. The slivers were probably a result of the two data layer boundaries slightly varying because they were created by different people. An intersect analysis was also performed with the recommended water rights place-of-use data layer and the spatially joined land use conversion layer. The x-y tolerance was also set to twenty feet. The only developments that intersected the recommended layer were those that did not have an associated water right in the water rights, place-of-use layer. If a development was already found to be on potentially irrigable land, there was no benefit to counting it a second time with the recommended layer. The results of the two intersect analyses verified which developments were on potentially irrigable lands.

Determining the Total Acreage of Potentially Irrigable Lands Taken Out of Production

The water rights place-of-use and recommended place-of-use layers were dissolved to determine the total number of acres they each occupied on the ground. In some areas, recommended place-of-use and water rights place-of-use overlapped. In other words, one piece of ground had the potential to be irrigated with a combination of recommended and already adjudicated water rights. Therefore, a union of the two water layers was performed to find out the total footprint or area where all potentially irrigable lands were located. All potentially irrigable lands within Fremont, Teton, and Madison

Counties were clipped to the HFW boundary. This eliminated irrigable lands that fell outside the watershed boundary.

The next step was to figure out how much potentially irrigable land has been taken out of production due to development. Using the select by attribute tool, all parcels that were platted for development before 1970 or after 2008 were eliminated from the water rights place-of-use and recommended place-of-use layers. Developments that fell outside watershed boundaries were also eliminated by clipping the development layer to the watershed boundary layer. All remaining subdivided parcels were dissolved and the total acreage was determined by creating a new field in the attribute table and using the calculate geometry tool.

Determining Total Acres of Irrigable Lands Taken Out of Production by County

To better understand land transformations at the county level, the total acreage of irrigable land taken out of production due to development was determined. First, the potentially irrigable land, as determined by the IDWR water rights place of use and recommended water rights layer was clipped to each of the three counties of interest. The layer of potentially irrigable land for each county was dissolved, and using the calculate geometry tool, the total area in acres was determined by county.

Next, the county development layers were added, one by one. After each county development layer was added, the select by attribute tool was used to remove all developments that fell outside the dates of interest, 1970-2008. An intersect analysis was performed in the same fashion as determining the total development acres on potentially

irrigable lands for the entire watershed. An x-y tolerance was again set to twenty feet to eliminate sliver polygons. After the intersect analysis, a new field was added to each county development layer and the calculate geometry tool was used to determine the total area acreage. In this way, the total acreage of developments on potentially irrigable lands was determined. Lastly, the percentage of developed acres on potentially irrigable lands was calculated using the total irrigable lands from each county.

Plat Map Data Collection

In order to gain detailed understanding of housing development characteristics, county and city plat maps from 1970-2008 were examined. Although plat maps varied by county and year, they usually contained information pertinent to development footprint in acres, lot sizes, date of approval, location in township and range, domestic water/sewer source, and whether the owner of the land held water rights. Similarly, the plat map might detail what was going to happen to the water rights (stay with the land, be removed completely, etc.). Plat maps were examined for Fremont, Madison, and Teton Counties. Development characteristics were analyzed by county and watershed level scales and lot size variations were assessed by county (Microsoft Excel 2007).

Four development types were classified: single-dwelling¹⁰, resort, apartment or condominium, and commercial. Single-dwelling developments were described as having

¹⁰ Water consumption data were collected for a sample of single-dwelling developments in Rexburg, St. Anthony, and Driggs. Information examined came from water meter records for the months of April-October, 2009. Although the specific data do not appear

one home per lot without major amenities such as a golf course, restaurant, lodge, or spa. Resorts included the previously listed amenities and a combination of single-dwelling homes and/or condominiums. Multi-family dwellings or condominiums were easily identifiable on plats because multiple “units” would be located on one lot and buildings were usually several stories tall. Lastly, commercial developments contained no livable units.

Interviews

Qualitative interviews with approximately 70 people were conducted from May-August during 2009 and 2010. Exploratory questions were asked in 2009. Participants were found initially through channels of trust already established by the Project Director and project partners. Using the snowball method (Biernacki and Waldorf 1981; Penrod et al. 2003; Owens 2005) other participants were identified. Interviews were semi-standardized (Berg 2009) and typically lasted between 30 minutes and 1.5 hours. Interview notes were typed, open-coded, and analyzed using coding frames (Berg 2009) to distill emerging themes (Appendix A, B, C).

Information collected from 2009 interviews was analyzed using a grounded theory approach (Berg 2009). Firstly, with the help of partner organizations, key players were identified and contacted within four major stakeholder groups:

in this thesis, they helped inform the research process, and a more detailed report will be compiled at a later date.

1. “traditional” water users including irrigators working on farms and ranches, 2. “development-oriented” water users including developers, property and resort managers and new residents, 3. “non-consumptive” users of fish, wildlife and scenic resources, including fishing guides and outfitters, anglers, and organizations representing their interests, and 4. planners and decision-makers including county and municipal planners as well as state and federal management agencies. In exploratory questions stakeholders were asked how they were being affected by increased development pressures, what their general perceptions of land use conversion were, and how water use and distribution have changed over time.

Information garnered from interviews was integrated with plat map data using content analysis techniques (Berg 2009). Major themes included: concerns about how much irrigated agricultural land was being converted and resulting dynamics of interactions with newer development residents, water-infrastructure and development types varying by county, LDS culture and community ties affecting local governance, and canal companies playing a major role in water-use, distribution, and management (Appendix C). Conversion rates and water infrastructure were important because of potential decreases in groundwater levels or changes to water rights. Interviews provided narratives of land ownership change and water use consumption while plat maps detailed water right transfers of individual developments and the locations where they occurred. Drawing from all themes, the overarching issue identified was a lack of integration between land use planning and water management.

Detailing canal companies' interaction with local government was one important way to assess how water management was integrated or not integrated into land use planning processes. Focusing on canal companies also helped fill a gap within amenity migration literature and expanded on wet growth research. This gap was addressed by examining how development pressures and land conversion affected water managers and water use, and resulting local politics and culture.

Focusing on the degree to which land use planning and water management have been integrated allowed for interview participant groups to be narrowed in 2010. Watershed stakeholder groups included: city/county staff or commissioners, ditch riders, irrigators, environmental organizations, golf-course managers/groundskeepers, landscapers, development residents, and IDWR staff (Appendix A). Between four and seven questions were asked of participants from each group. Although there were eight total participant groups interviewed, the majority of information for this thesis research came from ditch riders, irrigators, city/county staff, and environmental organizations. Representatives from ten canal companies were interviewed in total (Appendix B). The detail-rich qualitative interviews illuminated issues of water distribution and use, land conversion, and changing dynamics of canal company shareholder structure. Interviews also examined relationships between different groups of people including farmers and development residents, communication dynamics, and governance gaps.

Interviews were not tape-recorded or transcribed. Brief hand written notes were taken during the interview. The initial notes were then retyped with more detail using a

computer. Computer notes were typed within 24 hours of the interview. The detailed interview notes were then printed, open coded by hand, and analyzed using coding frames (Berg 2009) to distill emerging themes (Appendix C).

RESULTS

HFW has experienced significant land use and water use changes over the last forty years. Newer residents attracted by natural amenities and recreation opportunities have played a major role in influencing how landscape transitions take form. Newer residents attracted to urban amenities such as LDS related activities have also helped drive the varying forms of development. Newer residents influenced development by buying homes, starting businesses, or purchasing land, but also by living in the area and taking stances on political and cultural issues. Changes in Planning and Zoning (P&Z) committees and county commissioner positions, as well as new comprehensive plans, codes, and ordinances also reflected how land use planning processes have changed over time with the input of a changing citizenry.

Depending on watershed location, the degree to which land use planning processes take water into account varied. One reason for this was that different development pressures were apparent by county. For example, Teton County attracted amenity migrants due to its proximity to skiing, golfing, and national parks, while Madison County attracted residents pulled by urban amenities such as a university. How each county viewed and valued water resources in relation to development was apparent in land use comprehensive plans, codes, and ordinances. Similarly, land use planning processes took canal company concerns into account differently, largely depending on the importance placed on irrigated agriculture and its role in local economy and culture.

Canal companies were affected by development pressures differently because land conversion varied in form and location. For example, canal companies near Rexburg had the challenge of dealing with a quickly urbanizing landscape that meant more people living in close proximity to ditches. In contrast, canal companies in Fremont County interacted more with new residents that lived in rural areas where lot sizes were larger and more geographically dispersed. In Fremont County, many development sites were only minimally built-out, leaving canal companies to make decisions about how development sites and new residents would get to use surface water sources in the future. In Teton County, there were examples of developments using canal company water and passage of water rights to other irrigated agricultural areas instead of to converted parcels. What all three counties did have in common was a shift away from irrigated agriculture and increased dependence on tourism, recreation, or urban related activities. This shift was apparent in the number of irrigated agricultural acres subdivided for non-agricultural uses.

The number of irrigated agricultural acres platted for development was substantial. Conversion has taken 5.24% of all potentially irrigable lands out of production from 1970-2008 (Figure 3). There were 456,951 acres of potentially irrigable lands within the Henry's Fork Watershed (Table 2). This area represented lands irrigated by groundwater sources and surface water sources. A different analysis would need to be performed to find the total footprint of irrigated lands solely served by canal companies only using surface water sources. The total footprint of all developments in the watershed

on potentially irrigable lands was 23,941 acres. Results indicated that 59.46% of all acres platted were on potentially irrigable lands.

Water rights were transferred in a variety of ways, affecting water supply of newly built developments. When land was subdivided and water rights existed, they could be kept by the original owner, sold to the developer, transferred to another piece of property within the same canal company boundaries, or be taken away from the land completely if IDWR deemed they were not being adequately used. Depending on watershed location, different combinations of each were practiced. When canal companies or individuals did not sell water rights during land conversion, developments were excluded from gaining access to surface water sources. Developments without surface water rights then relied on individual or municipal wells for all of their irrigation needs. Thus, development was potentially putting more stress upon groundwater resources.

Table 2: Footprints of irrigable lands and the developments that fell within their boundaries.

Description	Area Acreages
Footprint of all development in the watershed	40,261
Footprint of development on potentially irrigable lands	23,941
All potentially irrigable lands within HF boundary	456,951
Description	Percent
Irrigable acres replaced by development	5.24
Percent of HF development on potentially irrigable acres, from total developed acres	59.46

Developments on Irrigable Lands, Henry's Fork Watershed

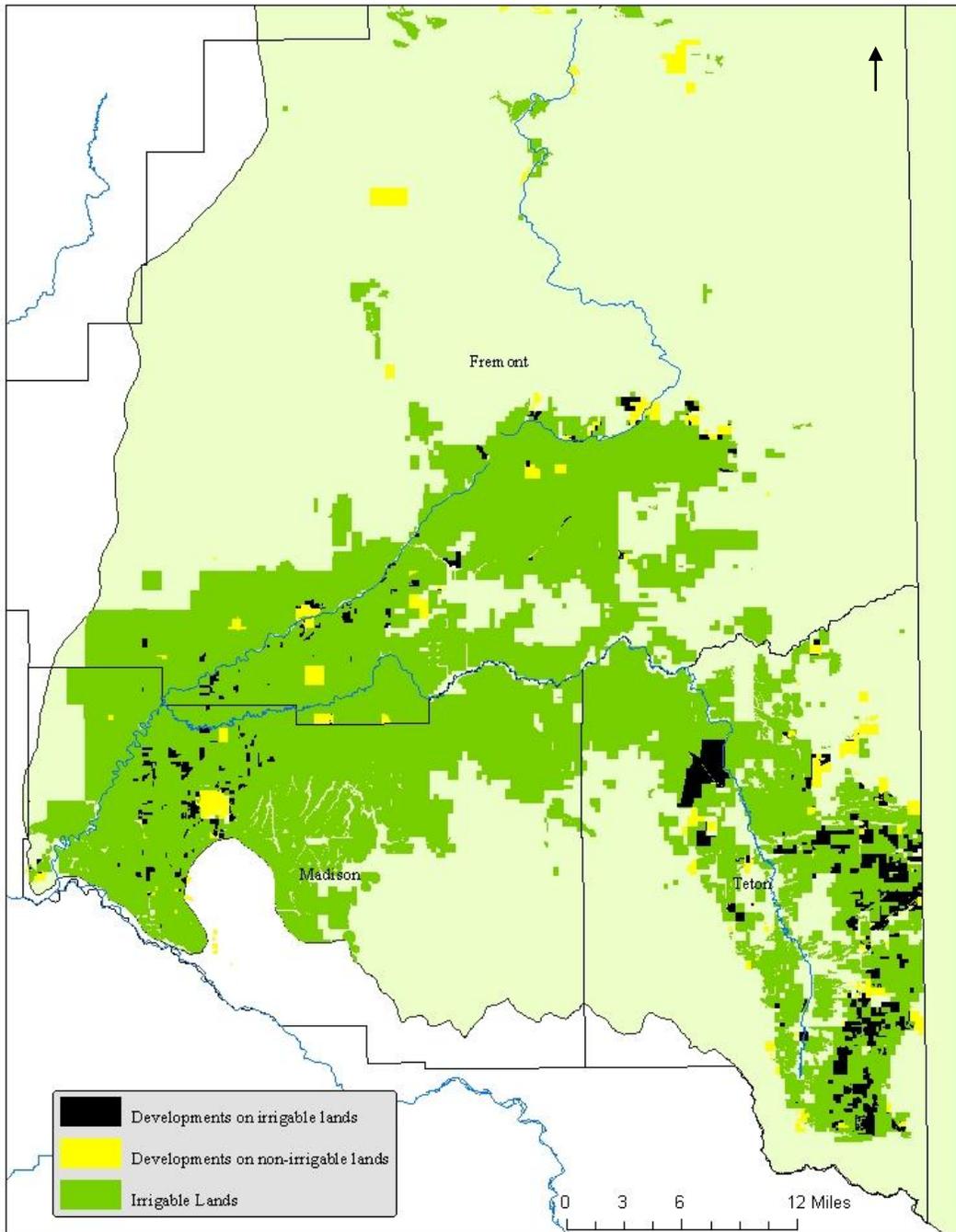


Figure 3: GIS Map. Coordinate System: NAD83_StatePlane_Idaho_East_FIPS_1101_Feet. Data Sources: Idaho State University, Teton, Madison, and Fremont Counties, IDWR, FTR, Idaho Tax Commission.

Table 3: Irrigable acres by county and total developments platted.

County	Acres of Irrigable Lands	Acres of Development on Irrigable Lands	Percent of Total Irrigable Acres	Total Developments on Irrigable Acres
Teton	118,720	16,781	14.13	338
Fremont	195,733	4,214	2.15	75
Madison	142,496	2,939	2.06	182

Teton County

Teton County, geographically located near Grand Teton and Yellowstone National Parks, and in close proximity to Jackson Hole, Wyoming, attracted many amenity migrants. Access to skiing, golfing, and recreation opportunities in federal forest lands also enticed people to buy land and become new home owners in Teton Valley. One canal company was able to get development residents to use surface water sources for landscaping purposes while other canal companies transferred water rights to other pieces of agricultural land. Changing community structure including politics and land rights regimes affected land use planning processes and the approval of developments.

Clearly, Teton County had the most acres converted at 16,781. This represented the largest total percentage of irrigable acres potentially taken out of production for one county at 14.13%. Teton County also had the most *resort* type developments which included proposed lodges, cabins, large swaths of open space such as golf courses, water-features such as ponds or lakes, or eating establishments such as restaurants on-site. Platted townhome developments were more common than multi-family dwellings. The

location of single-dwelling developments throughout the county varied as found from the GIS analysis. From the Excel plat-map spreadsheet and graphing, lot sizes for single-dwelling developments fluctuated with peaks at 0-1 acre, 2.1-3 acres, and also had a distribution of lots above five acres (Figure 4).

Plat-maps and qualitative interviews revealed information on development water-infrastructure and water transfers. Individual wells and septic systems were most common among single-dwelling developments. Teton County had the most platted communal well systems out of all three counties. Developments within city boundaries connected to municipal water and sewer systems. Although many plat maps beginning in the mid-1990s contained data regarding domestic water infrastructure, maps from prior dates often did not. After conducting on-the-ground interviews, it was concluded that almost all developments that were not within city boundaries had individual wells and septic systems for lots desiring a domestic water supply.

Beginning in the early 2000s, plat maps often revealed whether the owner of the subdivided land held water rights or if the lands were within a canal company's place of use boundaries. Within Teton County, the majority of water rights prior to the mid 1990s were transferred to different lands within the same irrigation company's boundaries if lands were subdivided. Although some developments surrounding the City of Driggs did retain water rights, the lands that have retained the most are near the City of Victor. Interviews revealed that the majority of water rights surrounding Victor were held by one company. This company converted much of its earthen lined canal system to pipe and

sprinkler in the early 1970s. Housing developments in or near Victor have been able to join to this piped irrigation infrastructure. The canal company was able to maintain its current water rights while new housing development residents got the benefit of low water rates for this surface water. In some Victor developments, access to surface water from May-September cost as little as \$10/month. Similarly, the City of Victor itself has accrued more water rights as land has converted from agriculture to urban uses.

Conversely, canal companies near Driggs or in more rural areas have converted from flood to sprinkler methods but have not converted canal systems to pipelines. Therefore, housing developments without a surface water supply use groundwater from wells for both indoor culinary and outdoor irrigation purposes.

Changes in Landownership and Private Property Regimes

Teton County has experienced a transformation over the past 40 years, beginning with the movement away from an economy based on irrigated agriculture, to one that is presently more diversified, including a reliance on tourism and recreation. Accelerating in the 1990s, farmland was subdivided and developments quickly appeared throughout the county. The rush to sell and subdivide land was continued until the national economy and housing market collapsed in the mid to late 2000s. Although changes occurring across the physical landscape are noticeable, another less overt shift happened with the influx and arrival of new residents. These new, growth-associated home owners, real estate agents, water brokers, and developers challenged existing notions of private property and water rights.

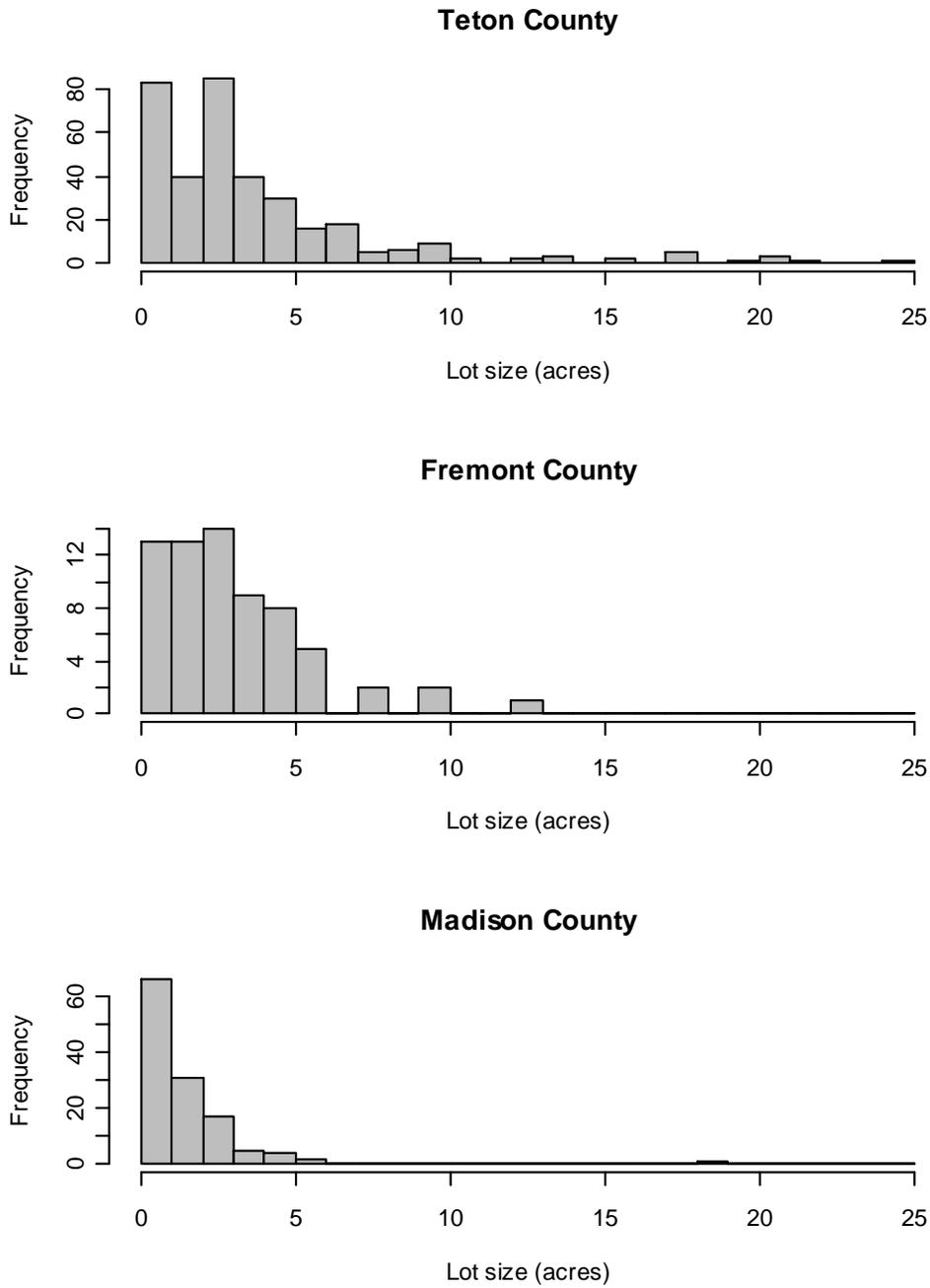


Figure 4: Distribution of lot sizes across the three counties.

The challenge of older, more traditional private property values largely came from new home owners and newer residents. Some saw a need to better control sprawl and growth, creating an engaging debate about natural amenities and land use planning. For although the scenic views and natural beauty of Teton County attracted many residents, without planning and regulation, these amenities were viewed to be under threat. Thus, questions were raised about what people could do with their land and water rights. The majority of older residents, including irrigators, believed in a property system that benefited the individual. If a farmer wanted to subdivide and sell a part or all of his land, he¹¹ should have been able to do so with relative ease. This view was supported by county commissioners and was demonstrated by the high number of housing developments they approved in the 1990s and early 2000s. However, as newer residents gained positions in land use planning and political arenas, a new way of interpreting property rights emerged.

The shift to a new property regime, one that included more regulation and zoning, or the inclusion of “smart growth principles” such as in Driggs, has not been an easy transition. One county staff member in political office described Teton County community members as “divided, insulated, and fearful of change.” One irrigator’s comments summed up the changes in land use planning policy when he stated that the regulations on farmland “are too restrictive, especially with the wildlife overlay.” The

¹¹ All irrigating farmers interviewed identified as male. The area’s historical ties to a patriarchal LDS founded society, helped explain a lack of female irrigators. Since the development boom, there appeared to be an increase in female landowners, but not irrigating farmers.

same irrigator expressed frustration by the process he must go through in order to give/sell his son a parcel of his farmland. He also mentioned the importance of economics when he stated that “a farmer subdivides because he needs money for retirement.” Thus, questions were raised about how government (county land use planning entities) meddles with family dynamics and personal economic choices. The mention of the wildlife overlay was also notable because it recognized that ecological integrity values have made their way into the planning process.

As one P&Z commissioner expressed, there has been increased awareness about the connections between development and water. When asked how often riparian habitat, water for fish, or other ecological concerns come up at meetings, he said “more often than they used to.” P&Z commissions now examine wildlife overlays, nitrogen pathogen studies, and riparian buffers before they approve or disapprove a proposed development. Local overlays and studies now in use go beyond minimum federal regulations such as the Clean Water Act or wetlands protection. A member of an environmental organization in the area mentioned that what allowed the inclusion of such ecological attributes in the planning process was “a change in administration...less Mormon male influence...and property rights getting broken down¹².” An employee of an organization promoting responsible development also mentioned the change in administration by saying “there is

¹² This interview, along with others, elucidated definitions of gender and male identity. Farmers in Teton Valley were almost exclusively male. Changing water management and land use practices decreased the number of irrigated agriculture acres, challenging traditional forms of economy, culture, and identity.

a lot of professional expertise and professional knowledge, when before, the county government was lead more by individual values.”

Throughout several interviews, people mentioned that “the good old boys” club mentality among city and county officials was eroding but still present. The good old boys club was described as male dominated, politically conservative, and LDS. A P&Z commissioner noted that the commission is “more progressive,” but that “a property rights agenda still permeates.” One area where this property rights agenda still permeated was with water. Several staff at environmental organizations expressed that although documents such as Comprehensive Plans mention the protection of wildlife or open space, “a basic framework for protecting water resources” was needed, including the ordinances to back-up that framework.

Although government regulation can appear transparent, clear, or fixed, personal land ethics and local politics are constantly interpreting or changing land use planning laws in large or small ways. Land use codes and ordinances in Teton County took water, wildlife, and other natural resources into consideration more than in the past. For example, agriculturally zoned county lands were incorporated into Driggs’ city limits to meet development requests. By incorporating more land into municipal boundaries, the city agreed to meet future demands for water and related water/sewer infrastructure. These land use decisions were made by P&Z commissioners who were tied to other community members and agendas in a multitude of ways. Teton County’s newest courthouse opened in 2009 and was constructed with funding from a private developer. In

exchange, the developer was deeded several parcels of county land (Valley Advocates for Responsible Development 2007). Some may argue that by accepting such a donation, the county will be obliged to meet certain demands by this private entity in the future. These demands could be related to land use codes, ordinances, or zoning. A cash strapped county was put in a hard position, working for the public good by building a new courthouse, but made tough economic choices that may lead to complication later. Ultimately, the line between private and public was blurred.

Difficulties Measuring Water Use and Lack of Water Management Knowledge

One of the dominant themes that emerged was a feeling among irrigators and ditch riders that development residents did not understand how water should be managed. Many irrigators expressed that they knew how much water should be applied to farmland in order to produce a successful crop. This knowledge in part came from being able to count how many nozzles existed on a wheel-line or pivot and then being able to move the line after a certain period of time. In essence, the agricultural watering system is based on rotation—water one piece of ground for X amount of time and then move on to the next. One piece of ground may only get watered once per week, but for 24 hours. One irrigator expressed that “most [new residents] do not understand the logistics of the system: so many nozzles on so many acres.” Once land is subdivided and houses are built, it becomes much harder to count the number of nozzles or places where water is being used.

Also in many instances, the system of watering rotation was stopped and replaced by development residents watering whenever and wherever they like. One irrigator discussed water usage by noting that “[new residents] water their grass too much...it only needs so much...it does not take more than hay or barley.” A ditch rider commented that “people want water all the time...it’s not on a rotation schedule [like farming].” Thus from an irrigator’s perspective, he had a harder time knowing how much water was being applied after lands were converted. With some frustration in his voice, one farmer and former ditch rider said “there is no way of knowing how many gallons [development residents] are using.” Similarly, this lack of water knowledge was transposed onto development residents. Many irrigators expressed concern that development residents had a lack of water knowledge and was encompassed by one irrigator’s perspective: “it’s hard to get new residents to understand the quantities it takes to water a piece of ground.”

Although development residents used a combination of well water, surface water, and/or municipal water, almost all residents expressed some degree of uncertainty about knowing how much water they consumed. One development resident stated that “there is no way that I could tell [how much surface water I use]” and another said, “I pretty much have no idea how much water I use.” Part of this uncertainty came from surface water and well water not being metered. The only metered water came from municipal sources and even then, residents could not easily recollect how much water they used per month.

It was important to know how much water a development used because surface water is a limited resource. As the summer progresses, more farmers need irrigation

water for crops which coincides with a decrease in snow melt into rivers and creeks. Thus, if a development uses too much water during a certain time, farmer's crops could have been at risk of damage. Although water rights with priority dates and the ditch rider help manage who should be getting water and how much, developments add a new stress to canal company dynamics. In the past, the ditch rider only dealt with a single or few irrigators, when now, the potential of multiple irrigators in the form of new home owners is quite common. The fact that new home owners did not know how much water they used also exacerbated the situation.

Lack of water knowledge among development residents translated to more than an annoyance among farmers, and in some instances expressed a more serious threat to a way of life. According to many farmers, many new home owners over-watered. If development residents used too much water and affected farmer's water needs, crops could suffer, and money could be lost. Lost revenue/profits could bring about other eventual losses such as a home, business, farm, or potentially a way of life. Therefore, resident's water knowledge meant more than knowing how much water was used, but when it was used, and how its use impacted local economy and culture.

One cultural aspect that was affected by development pressures was the loss of water management knowledge among farming families. Many of the irrigating farmers interviewed were at, or close to retirement age. This also included the majority of people involved with canal company board and ditch-rider positions. There did not appear to be enthusiasm from a younger cohort, willing to take on the responsibilities of maintaining

canals or ditch-rider routes in the near future. One irrigator interviewed had tears in his eyes when asked if his children would continue his family's farming legacy.

A lack of water knowledge also came in the form of knowing little about the canal companies that delivered the surface water to development sites. Two residents did not know whether their lots had shares of surface water or the canal company names which would have delivered the water to their housing development. One resident wanted to make the storage pond used for fire-safety "recreational so the kids can swim in it during the summer months." Such a comment expresses the convergence of differing needs and ways of valuing irrigation water. Whereas before, irrigation water was mainly used to irrigate crops, it is now also used for fire-safety and aesthetics.

Lack of Communication Among Local, State, and Federal Groups

As previously mentioned, the process that has occurred in the HFW is a *transition*. This process has been characterized by a lack of communication between many groups of people locally, as well as between municipal and county government, and state and federal entities. Lack of communication at the local level, between land use planners and canal companies was worst while the increase in developments was just beginning. Canal companies were largely unprepared for the impacts of development on water management. During the height of subdivision in Teton Valley, one ditch rider expressed his frustration stating that the "whole process was unclear" and that "developers were not telling canal companies about changes to canals or hook-ups."

Communication between canal companies and housing developments has improved since the first developments were platted, but what still lacked was one, clear, direct way of addressing concerns before they manifested into something greater. Although many organized housing developments had Home Owner's Association (HOA) presidents, they usually only communicated with canal company representatives when there was a problem. One HOA president stated that the ditch rider from the canal company providing his development's surface water was contacted not only by him, but also by many other residents when there was a problem with water delivery. The HOA president stated that the incident appeared to be "stressful" for the ditch rider. It was likely that the ditch rider was stressed because he was being contacted by so many people, all at the same time. When there was a water delivery problem with a piece of agricultural land in the past, the ditch rider only had to deal with one land owner, not ten, fifty, or even one hundred from a housing development.

Although canal companies could have communicated their needs through written documents or notices to housing developments, this was often not the case. Other than receiving a once per year notice of annual shareholder meetings, one development did not receive any other forms of communication. Another HOA president said he had "no communication" with the ditch rider or canal company, other than about paying dues. The same HOA president said "a person will come and open the fire-pond gate" but expressed uncertainty about who was actually performing the job. This example illustrated that even if there was supposedly one point of contact (HOA president)

representing all housing development residents, communication with the canal company could be lacking. Clearer communication could reduce the time it takes to fix water use or water timing issues and better express the needs of both developments and canal companies.

More residents on a single piece of ground has meant more nozzles or piping to allow irrigation of many lots at the same time. One irrigator noticed certain localized areas having reduced water pressure if too many people in one development used water at the same time. This can be particularly troublesome if there was a farmer down the line that needed substantial pressure and water to irrigate his crops. Communication about water scheduling/timing could have occurred between a development representative and the down-line farmer to ease tension and stress, but this did not frequently occur.

Internal dynamics of housing developments were also at play when discussing lack of communication. If build-out was high or many people were presently living in a development, it could be hard to organize water use and water scheduling. Organization by the housing development could ensure that not too much water is used and could take responsibility away from the ditch rider. Before development, a ditch-rider's responsibility ended at the headgate at the top of the property. If there were problems with water use or infrastructure, it was up to the landowner to fix the issue. A lack of water knowledge among newer home owners has prompted the ditch rider or other canal company members to manage water use and infrastructure issues on the newly owned properties. One resident stated that the water-use process "is so informal, no one talks to

anyone” and that “it’s hard to organize 21 households.” In this example, the development resident knew he had surface water rights. However, during the initial phases of subdivision of lands and transferring of water rights, the process of transferring water rights was unclear. One development resident noted that some of his neighbors were initially told water rights existed with the purchase of land but later expressed that the developer had sold them already. He stated that “the whole [water rights transfer process] has been very unclear.” Similarly, a different resident stated that when she purchased her land “the water was not clear in the original deed” and mentioned having to go out of her way to secure water rights with the canal company.

It was clear that lack of communication was persistent among farming irrigators and housing development residents, but land use planners and related commissions also play roles in the water management process. Asking land use planners how water and other ecological values were taken into consideration was an approach used to elicit the degree to which land use planning entities communicated with canal companies. Although one P&Z commissioner said that communication with canal companies “is very good,” other participants suggested that a lack of communication prevailed.

Echoing a ditch-rider’s sentiments, some land use P&Z commissioners admitted that during the height of development in Teton Valley, the organizational link between water and land was weak. One planning and zoning commissioner stated that “canal companies didn’t know what was going on.” Canal company board members and particularly ditch riders were not explicitly made aware of land use changes occurring

within company boundaries. As a result, ditch rider's jobs were made more difficult by not knowing land was under new ownership. Also, ditch riders had to deal with developers' canal and easement alterations. One outcome was the creation of a development checklist to let canal companies know of future land use changes. Fremont-Madison Irrigation District created a checklist that was distributed to each county. The checklist was intended to be given by the county to each developer prior to subdivision and asked about whether water rights were present, ensured that agricultural lands and ditch easements were protected, and requested that an HOA be in charge of canal company water shares (Appendix D). If the developer decided to affect irrigation and/or drainage in any way, a license agreement had to be submitted to FMID, not the county.

Not surprisingly, developers emerged as key players within the land conversion process. The county and cities appeared to designate notification of land use change responsibility to developers. One city P&Z commissioner said his commission "rarely" communicated with canal companies and expressed that it was a developer's responsibility to communicate with them instead. In other words, instead of the county directly notifying a canal company that parcelization was occurring, the developer was made responsible by having to get a canal company's signature. A canal company's signature was just another among many such as an engineer's or surveyor's approval. However, it was unclear when Teton County canal companies began being included in the checklist process as a whole. One City Administrator stated that developers have been required to get signature approval from a canal company "for a long time" while one

county P&Z commissioner noted that the signature requirement or practice only “began in 2007/2008.”

Even though the checklist process has helped canal companies gain knowledge about land use changes, and as a result, potential water management changes, it did not appear that there was a clear flow of information between developers and canal companies. For example, a developer was not required to get a particular canal company representative’s signature, such as the Board President or ditch rider. A simple signature from any canal company member seemed to satisfy county or city planning officials. Therefore, whoever represented the canal company with a checklist signature was left with the responsibility of notifying other irrigators or the ditch rider of land use changes. There did not appear to be one designated way of how to spread land use change information from one irrigator to the next, thus creating a lack of communication.

Fremont County

Changes to county commissioner and P&Z positions held the potential of creating a land use planning structure that protects natural amenities including the waterways and agricultural lands that encompass the county. However, a shift in reliance on an irrigated agricultural supported economy and turn toward recreation and tourism created challenges for canal companies to get recognition and support in land use codes and ordinances.

In Fremont County, 4,214 irrigated agricultural acres were converted (Table 3) which represent 2.15% of all irrigable acres within the county. From on-the-ground

observation and interviewing, much of the subdivided acreage has not been built out as of summer, 2010. The developments that did have houses or buildings were built within or near the towns of St Anthony, Chester, and Ashton. The acres converted in rural areas tended to be larger, with more lots and larger lot sizes. Also in rural areas, some farmers sold off the corners of a square piece of land where a center-pivot could not deliver irrigation water, thus creating more parcels for residential units. In other words, land owners sold off 1-5 acre parcels because it was more profitable than laying “hand-line” to grow crops in these corner parcels. “Hand-line” is a system of irrigation pipes connected by hand, as opposed to “center-pivots” which deliver water from one central location and do not need much manual attention to operate. Lot size distribution ranged from small to large, with the most single-dwelling lots being below 3 acres (Figure 4).

Unlike Teton County, developers did not install irrigation pipe to distribute water to each lot. Instead, if water rights were sold with the land, it was up to the new land owners to figure out a way to receive surface water. If a new land owner’s lot was directly next to a canal, he or she could use a small pump to take surface water or use the same gravity fed system as before. However, if the lot was not adjacent to a canal but had water rights, the new owner was likely to not use the water due to the potential expenses accrued from construction of a water distribution system. Therefore, when a land owner who held water rights did subdivide, water rights were usually retained by the original owner and/or transferred to another location within the same canal company boundaries.

Water rights applied to land already in irrigated agriculture gave land owners a few more water shares to use in times of drought.

Culinary water was provided by individual wells outside city limits. Individual sewer systems have also been installed in rural areas. Within city limits, developments joined existing municipal water/sewer infrastructure. There were no clear examples of developments having a community water system which would have included all lots having one to two wells from which to draw water. Not all plat maps in Fremont County contained information regarding where culinary water was to originate, either well or municipal sources. This lack of information may have hidden a few developments with community systems.

At a Turning Point

Fremont County is at a turning point. Decision-makers have the power to influence development processes in a similar way to Teton County, a place with many sprawling developments dotting the landscape, or they can continue to protect Fremont County's natural amenities while meeting the demands for growth in a sustainable manner. County commissioners were the most influential and powerful decision-makers within local land use planning. P&Z commissioners followed closely behind. Land use planning entities had the ability to affect where future development occurred, what kind of development was built, and whether canal companies were or were not involved in the platting process. The current trajectory of Fremont County is in the direction of approval

of more development and growth while moving away from an agriculturally dominated economy.

Developments were ultimately approved because of the perceived benefits that came from selling and subdividing property. The benefits for an individual landowner included the ability to pass land to a family member, acquire more money for retirement, or make a quick dollar. However, as one P&Z commissioner offered, the county commissioners also operated on the assumption that if land was developed, more people would move to the area and an increased tax base would translate to increased county revenue. One employee of a land trust working within the watershed echoed this sentiment when he said “the motivation [for development] comes from a perceived increased tax revenue.” An employee of the Nature Conservancy noted that “home building is a quick economy” because “the house only gets built once.” His suggestion was that the protection of the recreation economy, which would include rivers, streams, and other natural resources, could bring more long-term benefits to the local job market.

The majority of canal companies in Fremont County were only slightly affected by development issues compared to those in Teton and Madison counties which have experienced more rampant sprawl and urban-related impacts. For example, there were city and county-approved developments, but many were only partially built out. Thus, the canals that meander through subdivided lands were largely unaffected. However, as time goes on and there is an increase in the number of housing development residents, there will likely be more issues with canal easements, misuse of ditches, or increased surface

water usage. Instead of waiting for problems to arise, local government decision-makers and canal company members have the potential to work proactively to decrease future tensions. As one member of an irrigation district mentioned, “canal companies should be vigilant” and execute their legal power to protect their water rights in the face of increased development. There was a sense among many non-irrigators that irrigators need to get more involved in the development process. However, even as local government decision-makers were working on a new Fremont County draft of the development code, an ideal time for canal company representatives to give their input, a canal company president said that “the new development code does not pertain to us” and “[the county] has a handle on it.”

Decision-Makers

County commissioners have a lot of power because they can approve or disapprove developments. Commissioners in such a position of power are supposed to be working for the public good. However, insider politics and personal agendas have been heavily imbedded within the land use planning process. Unlike in Teton County, where this is beginning to change, Fremont County is still ruled by a private property rights agenda. One farmer and member of a smart-growth oriented organization went as far as saying “[the commissioners] don’t give a damn...they have their own agenda.” This agenda included upholding private property rights and allowing farmers to sell large swaths of land for development. One P&Z commissioner mentioned a development application that several members of the P&Z did not approve because they felt the road

infrastructure was not safe or adequate. The county commissioners overstepped the P&Z decision and passed the development anyway.

P&Z commissioners and county commissioners were closely integrated throughout the planning process. The make-up of the P&Z committee was influenced by the county commissioners' vision of increased development and growth. One farmer said that "they took over," referring to the county commissioners taking over the P&Z committee. Another farmer expressed that the P&Z had been "stacked" with people who propagate county commissioners' agendas. This sort of "stacking" was allowed because P&Z members were not voted in by the public, but appointed by county commissioners. Allowing county commissioners to appoint P&Z commissioners saved time and money by not having a slew of local elections. Appointing commissioners does not inherently create conflict, but when spot zoning or specific variances are permitted, an abuse of the government system can occur. This abuse of the system was reflected in the word choice "stacking." One P&Z member mentioned how just a few years ago the P&Z make-up was different than it currently is, alluding to the unstable nature of the committee. The changing committees represented the unstable community environment. As with P&Z committee members, ordinances and zoning can also change rapidly.

The fact that the P&Z commission can change quickly may make it unstable, but the ability to bring in new members can create opportunities to protect and enhance ecological integrity. For example, a recent addition to the P&Z committee was a member of HFF. The commissioner stated how important it was to research and analyze how

current and future development will affect water resources. With regard to canal companies, he explained that “irrigators are asleep at the wheel” if they do not see connections between increased housing developments and water issues. Although irrigators tend to be solely concerned with water rights, they will have to become increasingly aware of the problems associated with canals meandering through developments. By being a P&Z member, this commissioner was hoping to influence farmers, fellow commissioners, and county commissioners to think more proactively about the future. The commissioner stated that county commissioners believed that “there is not a problem until something really bad happens.” HFF was concerned with the potential for development to decrease irrigation return flow, wetland area, stream flow, and wildlife habitat. From the commissioner’s experience, planning staff related that they “did not want to become another Teton County,” but the appropriate legal steps were lacking to prevent this from occurring.

Linking County Vision to Ordinances and Zoning

Within Fremont County there was a gap between the Comprehensive Plan’s vision and the codes and ordinances that were supposed to carry out that vision. One P&Z commissioner mentioned that he felt the guidelines in the Comprehensive Plan were “strong” in terms of trying to protect the county’s natural amenities like open space and wildlife, but that the codes and zoning “have not been able to back it up.” As of summer 2010, the county development code was under review and it was unclear what direction it was going. One county planner indicated that the goal of the review was to make

development standards “more predictable.” As one P&Z commissioner and long-time farmer noted, the past code tried to keep development only on unproductive soil. However, where that line was drawn between unproductive and productive “was really subjective.” The move away from requirements revolving largely around agricultural lands further demonstrates the county’s push toward a more diversified economy. This economy includes dependence on tourism and recreation opportunities. However, if P&Z codes and regulations do not protect natural amenities such as water resources, they could come under threat of pollution, degradation, or loss, just as they have been in Teton County.

There were clear gaps in governance when it came to decide who should be setting standards for how development should consider water management. When asked what criteria were important when approving a development, one county planner said “public health, waste water, and fire safety.” Water supply and well management responsibility were largely delegated to IDWR officials. Although the latest development code under review may have new standards regarding well placement, canal companies did not emerge as top priorities of concern. However, the ground and surface water sources that canal companies use are highly interconnected. Surface water that farmers divert makes its way through a series of open ditches and onto farmer’s fields. Much of the water within those canals seeps back into the ground and recharges the local aquifer. As more developments are approved by the P&Z committee and county commissioners, the likelihood of more domestic wells being constructed and used will increase. As one

member of a smart-growth oriented organization said, wells are like “straws in the ground.” He also asked the question, if farmers do not begin selling surface water rights to residents in new developments, how do they (the newcomers) expect to water their lot if it is over half acre, the IDWR maximum for an individual well? As for the location of where wells can be drilled, one P&Z member said that they can be put in “pretty much anywhere.” This spoke to the issue of long term problems of groundwater overdraft.

Fremont County has a strong comprehensive plan detailing how natural resources should be protected. However, the comprehensive plan is like a long vision statement, not a regulatory document. Ordinances and codes are needed to turn the vision into legal requirements. A member of HFF was instrumental in bringing ecological concerns into the 2008 comprehensive plan. The three topic areas that were added were: fish and wildlife, water, and recreation. Under the water category of the comprehensive plan, the vision was quite clear in protecting water resources and even mentioned canal companies:

The county should develop language in its development code to require water resource management agency consultation processes, including county checklists, where applicable, to be completed by developers prior to scheduling applications for a public hearing. Water resource management agencies may include applicable State and Federal agencies as well as irrigation districts, and canal companies. This process should ensure that a given development will not cause undue harm to existing water rights, water resources, or natural resources dependent upon water or encroach on canal easements.

One way to ensure that canal companies and their interests are protected during the development process is to use the above mentioned checklist. Although Fremont County has begun to use the FMID checklist, the relationship between county planning

officials and canal company representatives was still lacking. One county planner stated that “our relationship [with canal companies] is dysfunctional” and alluded to mistrust. The planner went as far as saying that some P&Z commissioners are “vehemently opposed” to the canal companies having any say in the development approval process. The mistrust, lack of communication, and selective approval of specific developments demonstrated that the planning process continued to uphold a private property rights agenda. The private property valued by decision-makers was land rights, while water rights took a back seat in the local planning protection process. The commissioner from HFF also noted that there is strong “anti-government sentiment.” Anti-government sentiment was reflected by a lack of interest to work with state or federal agencies described by the commissioner as “honest brokers.”

“Honest brokers” were defined as “objective managers,” such as employees of Fish and Game. The idea of bringing honest brokers to the development process was to allow them to make decisions concerning wildlife and habitat on a proposed development site. The fear for HFF is that if honest brokers are not involved, they will become “non-participants,” and decisions related to ecological integrity will be left to developers working to make financial profits. One way to involve federal or state oversight would be to add them to the checklist process, helping ensure that migratory patterns were not affected, stream buffers were adequate, and local waterways were not polluted or degraded. However, as a member of a land trust said, “the county is leery to participate with NGOs or [state or federal] agencies.”

Canal Companies Deal with Housing Developments, New Residents, and “Town Schedules”

The persisting private property rights agenda and mistrust dominant in the local planning process, as well as the delegation of water management responsibility to IDWR, has left canal companies with few resources to curb potential arising conflict due to development. The 2008 FMID checklist was mentioned several times by canal company representatives as a beneficial way to decrease development impacts on canal companies. However, the document may not be adequate at addressing the already-subdivided, smaller, scattered parcels prevalent in Fremont County. These parcels did not look like typical large-scale developments, but were the corners of land that farmers sold because it was easier and more profitable than irrigating. Ditch riders were largely left with the responsibility of managing the impacts of residential units on canal companies.

Organizing new canal company members has been difficult for two ditch riders in Fremont County. The first ditch rider near St Anthony summed up his experience eloquently by stating “new move-ins want water on their Town Schedule,” a Saturday, not when it makes sense for everyone. Watering on Saturday would be easiest for new residents because it is not part of the Monday-Friday “work week” or on Sunday, when many have LDS church activities. He went on to say that newer residents only wanted a small amount of water, such as half a share, which was harder to move throughout the canal system. To compound matters, there was a lack of communication between newer residents using a shared canal. Without organization, it was harder to maintain the overall ditch system. Prior to development, only one farmer with tens of acres and several water

shares used the ditch, so there was more incentive to perform repair and maintenance tasks.

The development of lands caused an increase in canal company shareholders near St. Anthony. However, this increase in shareholders did not mean automatic water usage. Some new shareholders did not understand that even if they do not use surface water they must pay for it through dues and assessments. A lack of interest in using water may have arisen from water access difficulties. No water distribution systems were required to be built by the canal company or the county after development approval. Although the ditch rider did not notice any kind of direct communication between developers and canal companies, communication with FMID was good. FMID was called the “Mother Hen” because it has looked out for canal company interests.

A second ditch rider from a canal company near the town of Ashton also had to deal with an increase in shareholders. Communication with newer residents was described as “fairly good.” The ditch rider had to take time to organize lot owners that only wanted to use a small amount of water at a time. What worked best was to get residents to water during the evening hours when pivots were off. Thus, farming irrigators using many shares took precedence over smaller land owners using only a few. He stated that “a ditch rider is a glamorous name for babysitter” when describing organization and communication with farmers and residents. New residents were characterized as not having a good understanding of what one share of water meant or how much land it could irrigate.

One concern the Ashton ditch rider had with future development pertained to easement obstruction, saying that “canals are an attractive nuisance.” Canals were attractive but also a nuisance because some development residents enjoyed the aesthetics of running water but did not understand that ditches could be dangerous or that they were integral for sustaining irrigated agriculture. One document that could help protect the functionality of ditches was the FMID checklist. The checklist was mentioned positively because it held the potential of defending easements and water rights in the future. Another instance of development preparedness that worked well was the annual water meeting that IDWR held for ditch riders. At the meeting, representatives from an Idaho Falls canal company warned smaller companies within HFW to “get ready” for development impacts.

Madison County

Madison County faced development pressures from an increasingly urbanizing landscape. Urbanization brought new residents closer to ditches. Canal companies faced the challenges of maintaining an irrigation system in the face of an increasing population that lacked water knowledge about water management. Although the City of Rexburg worked with canal companies to mitigate damage to the irrigation system, assistance from the city usually came after harmful impacts had already occurred. Local county and land use planning entities expressed little interest in stepping up to bridge the water knowledge gap between newer development residents and irrigating agricultural water users.

Madison County had the least subdivided acres at 2,939 (Table 3). The majority of the developments were platted in or near the City of Rexburg. Lot sizes were smaller than in Teton or Fremont Counties and were usually between 0-1 acres (Figure 4). Unlike Teton County, there were few resort developments. In Madison County, resort developments included equestrian facilities. Therefore, the majority of small lot size developments, less than one acre, were for single dwellings or multi-family dwellings located within or near Rexburg. Larger lot size developments with 1-3 acre lots were in rural areas.

Water rights were rarely transferred with the land during the development process. In most cases, water rights were maintained by the original owner and used on a different piece of land within the same canal company boundaries. In rural areas where water rights did get sold with the subdivided land, new owners often had to investigate and inquire in depth with the developer about water right details. In other words, it was not explicitly clear whether new lot owners had water rights or not after the land was purchased. As in Fremont County, if subdivided land was adjacent to a canal, it was much easier to receive surface water. Developers did not usually put in irrigation systems to bring surface water to each lot. The few examples of newly constructed irrigation infrastructure were in new developments on the outskirts of Rexburg.

Developments built within Rexburg city limits were connected to the city municipal water and sewer lines. Rexburg water is supplied by six wells located throughout the city. Developments that were not within city limits withdrew water from

individual domestic home wells. Well water was used for indoor and outdoor irrigation purposes. Few rurally located housing developments had communal well systems.

Canal Companies Face an Urbanizing Landscape Including an Increase in New Developments, New Residents, and Lack of Water Knowledge

One of the biggest differences that separates Madison County from Teton and Fremont Counties is the arrival of development which is more *urban*. Whereas Teton and Fremont Counties have experienced development at urban fringes and within rural bounds, the City of Rexburg has spurred and promoted development that supports a city. Such types of development include single-dwelling houses for families, multi-family dwellings to serve a university student population, and commercial buildings to sell goods and services. Although most surface water rights did not remain with lands that were subdivided, the canals still exist to serve remaining irrigating agricultural users. As a result, canal companies have faced several challenges to maintaining ditches amidst a growing population of urbanites.

Many irrigators expressed that since the arrival of housing development residents, liability issues were of great concern. If a canal company builds a fence along a ditch to keep people out, and someone falls into the water, the company as a whole could be at fault. Conversely, one irrigator mentioned that his canal company asked him to sign an agreement stating that any damage caused by a newly installed screen (to keep sticks and debris away from his intake pump) would be his fault alone, not the company's. This was a change in practice from the past when a canal company would intercede to protect

an individual irrigator's rights. Without canal company support, the irrigator would alone face significant monetary implications if sued by a new landowner. One of the irrigator's biggest fears was that the screen would become clogged and water would back up so much that flooding would occur. Flooding of house basements has been a common result of building homes within a canal company's service district boundaries. Flooding was caused by debris getting stuck in ditches or groundwater levels being elevated enough to fill crawl spaces/basements. What was notable was that when flooding occurred in the past, it was not as big of a concern as it is presently. The difference is that instead of only having one farmer's 20 acre field to deal with, there are now 20 homes that could suffer damage.

Madison County irrigators echoed many of the same sentiments as did irrigators in Teton County including lack of water knowledge among new residents and the harm it created for canal companies. In Teton County, new residents did not have a clear idea about how much water they consumptively use. In Madison County, lack of water knowledge in and around Rexburg translated to canal company ditch misuse. As a result, development residents' actions caused harm or stress to canal company dynamics. Among ditch riders and irrigators, a common problem was development residents inappropriately using the ditches as trash receptacles. Multiple irrigators noted that grass clippings, branches, oil, or even larger debris such as furniture were thrown into canals. One ditch rider expressed his frustration when describing how development residents think their trash will just float away and how seemingly harmless grass clippings can clog

irrigation water intakes. A different ditch rider described how some residents shoveled or pushed snow into canals. If enough snow accumulates, initial spring ditch flows could be altered and stalled, thus changing when surface water reaches farmers' fields.

Furthermore, trash or snow within the canal system can disrupt ditch maintenance.

Maintaining Sub-Irrigation as a *System*

There were enough irrigators in Madison County still practicing sub-irrigation methods¹³ to affect shallow ground-surface water interactions. If several farmers sub-irrigate, groundwater levels could be raised, which helps provide and maintain water in a crop's root zone throughout the growing season. Sprinkler irrigation techniques provide enough water to meet plant needs as well, but less water is maintained beneath the surface at any one time. As more lands are converted, sub-irrigation methods have become harder to sustain.

In the majority of housing developments that were partially or fully built out, sprinkler irrigation methods were used. If sub-irrigation techniques had been practiced pre-development, those same techniques were no longer in use. The houses, roads, small lot sizes, and lack of irrigation infrastructure made it too difficult to spread large amounts of water over the land through sub-irrigation practices. The more acres that get taken out

¹³ Sub-irrigation refers to raising the local water table to crop root level. Water is routed through ditches that border the perimeter of a farm field, thus raising the groundwater level in the field via seepage into the center of the field from these border ditches. Sub-irrigation is practiced where land is flat, such as near Rexburg and in some parts of Teton Valley, but not in Fremont County, where land is hilly. Flood irrigation generally refers to watering a field with a sheet of water spread across the ground. Water is diverted onto the field by placing a small dam across a ditch at the edge of the field.

of sub-irrigation the harder it becomes for remaining sub-irrigators to raise groundwater levels. Thus, irrigation functions best when it is a contiguous system—the more farmers that sub-irrigate, the easier it is for all farmers to sub-irrigate by collectively raising the local water table. As lands become fragmented and converted, it gets increasingly more difficult to maintain the system. The majority of new residents did not understand the complexities of this system.

Lack of canal maintenance by development residents was a common complaint among irrigators and ditch riders. If one stretch of canal was overgrown by grass, bushes, or was otherwise unmaintained, it created problems for other irrigators down the line. Too much organic matter in ditches decreased surface flow and caused flooding. Conversely, if development residents “cleaned” or scraped the ditches in excess amounts, in the words of an irrigator, the “seal could be broken,” and too much water seeped through the ground. Therefore, the knowledge needed to keep a network of canals in good working order is complex.

Although there has been some informal water knowledge transfer from farmer to development resident, no formal process exists. One canal company president echoed other irrigators when he said “there needs to be more education [about how the canal company works].” Presently, the most organized way a new resident might get education about canal company dynamics is via a HOA representative. However, this research found that no HOAs distributed a detailed description of canal systems to new residents. By receiving little to no formal information, it was unlikely that residents understood that

it was the canal company's responsibility to maintain ditches only to a certain point (usually a headgate). After the headgate, it was the individual land owner's responsibility to maintain the remaining ditch. Before development, one or two farmers might have maintained several hundred feet of ditch. However, now that same ditch could be a shared responsibility among several different lot owners. If no one told the new lot owner how the canal should be maintained, and/or the lot owner did not inquire, it was likely that ditches were unkempt or poorly managed.

At the same time, newer residents were often overly interested in the land adjacent to ditches, creating tension with irrigators about easements. As one irrigator stated, "new residents want grass and trees right up to the canal." Other residents were described as wanting fences near ditches, which obstructed maintenance. In the bylaws of all canal companies interviewed, there was a clause that stated that an area of 10-30 feet on each side of a ditch was canal company property. This area was required to maintain and clean ditches. Canal company board members and/or ditch riders now have to devote more time in dealing with development residents that obstruct these easements.

Some farmers in Madison County expressed frustration over the difficulties they face with regards to land conversion. One canal company president and irrigator articulated that farming culture is further pushed toward sprinkler methods by increased development. When asked how the canal company is responding to land conversion processes, he said "we're not changing." On the surface, the farmer was clearly meaning that he had no desire to change his irrigation practices or techniques. At another level, his

words along with feelings expressed later in the conversation, also implied a rich sense of pride and history about farming and a way of life. Farmers have not only been facing changing irrigation methods, but also the threat of losing associated knowledge and relationships as new houses and people replace agricultural lands.

One long-time ditch rider noted several ground-surface water interaction changes due to increased development. For the ditch rider, it was now easier to get water to a down-line irrigator because there was more water moving throughout the irrigation canal system. More water was available because developments in his call area were using less water than irrigated agriculture. However, he also noted that with fewer irrigating farmers, the shallow water table has been reduced, thus making “the crops burn up easier.” The crops burning or dying was a sign that local groundwater levels were not being maintained at the plant root zone. The same ditch rider also said that “there is always somebody who wants to switch from flood to sprinkler,” making it harder for other farmers to practice sub-irrigation methods. Lastly, this 33-year long ditch rider noticed that drain ditches in the area used to be full of water every spring, but recently very little water has been seen. The ditch rider’s thoughts were that an increased number of individual wells could be reducing local groundwater levels.

Even though there are currently more permanent development residents living on lands that were once maintained primarily by a few farmers, an increase in population does not mean an increase in surface water users or water use. Discussing water rights transfers with members of Madison County canal companies elucidated shareholder

dynamics. Farmers indicated that the best ways to maintain canal company finances as well as ground-water recharge abilities was to maintain or increase shareholder numbers. However, the potential to increase shareholder numbers was affected by three factors: whether the developer put in a surface water distribution system to each lot, whether newer residents wanted to use surface water sources, and whether developers retained water rights for the purpose of trying to sell them for a higher price in the future.

When irrigated agricultural land conversion accelerated in the 1990s/2000s, some irrigators sold their water rights with the land, but developers rarely built a water distribution system to each lot. Without a distribution system, new housing developments did not gain access to surface water sources. Without access to surface sources, development residents did not want to pay for assessments even though they were required to as mandated by canal company bylaws. Fewer shareholders paying assessments lead to a decrease in expected revenue and less money for operation and maintenance of the irrigation system. A member of one canal company located near Rexburg stated that they would prefer if developments put in irrigation distribution systems so that assessments were paid and water was used on-site to help maintain surface-groundwater interactions.

Having surface water available at each lot because a distribution system was constructed did not guarantee that residents used the water. One ditch rider mentioned that new residents tried to sell their water rights back to the canal company because “they don’t want to pay assessments.” If the canal company were to accept all requests to buy

back water rights, there would be a decrease in total shareholders, which would mean less revenue from paid dues. Respondents from three out of four canal companies interviewed identified a decrease in total shareholder numbers as a concern because of the resulting income loss. One irrigator called shareholders that choose not to pay “delinquent payers” and noted that both new residents and older residents can fit into this category. The difference was that older residents tended to have many shares translating to more money being owed, compared with a single development resident who likely had only one share, and a much smaller debt.

A decrease in shareholder numbers due to lack of access to surface water, or by non-use, affected water distribution as a whole. For example, the fragmentation of a 20-acre irrigated agricultural parcel into 20 or more individual parcels decreased the amount of water each person used to half a share or less. From a ditch rider’s perspective, it was harder to get water from point A to point B if there was little water in the entire ditch system. As one ditch rider explained “any one person needs more than just one share.” If one development resident wanted to use just half a share of water, it could take more than one share to move that half share to the user due to canal seepage, flow rate, topography, and other factors. Also associated with a decrease in share size were the attitudes of new users. One irrigator described how newer residents wanted only a half or quarter share of water, but did not want to pay full price for it. With this particular canal company, the minimum share unit was one full share. It was hard for newer residents to understand that they must pay full price for water because of the quantities associated with moving water

throughout the entire ditch system. When asked whether canal companies would be willing to raise the price of water shares for developments, the resounding answer was “no.” Even though there was a decrease in shareholder numbers and a lack of interest in surface water use, canal companies did not describe mechanisms that would deal with declining revenues.

Moving water throughout the entire irrigation system required water users. During some land conversions, an irrigator sold water rights to a developer, but the developer did not sell water rights to individual lot owners. In this case, one canal company mentioned that this helped cover expenses because the developers were paying dues for large number of shares. However, few or no shares were actually being utilized in the new development. Thus, less water was applied where it once was, potentially affecting local surface-groundwater interactions. A developer could also lease shares to another farmer within the same canal company, but water would be used in a different location than before land conversion. When asked why developers did not sell water rights, one irrigator said that this was done in order to potentially make more money in the future. The implication was that water rights would become more valuable with time. This scenario would require water user groups willing to buy surface water rights, whether development residents, other farmers, or municipalities.

Development location was an important factor influencing whether shareholder numbers increased or decreased during land conversion processes. There was “a big increase in shareholder numbers” outside Rexburg city limits. Development lots that

tended to use surface water were usually three-acre parcels or larger. In contrast, within or very close to Rexburg city limits, lot sizes tended to be less than 1.5 acres. There was an increase in shareholder numbers because more people wanted to use water and were able to do so with relative ease. Larger lots tended to have horse pasture that needed irrigation water during warm, dry, months. With current canal company infrastructure, including the use of sub-irrigation, it was easier to distribute surface water if lots were large. Ditch size and associated water flow created for the original irrigation system were intended to water large parcels of agricultural land. Distributing surface water to home lots less than one acre, without alteration of the distribution system, and fragmented by development roads and houses, proved challenging.

Lack of Communication Between Farmers, Development Residents, and Land Use Planners

As in Teton County, lack of communication among farmers, development residents, and land use planners was prevalent. In more urban parts of Madison County, communication issues were related to the increase in population density. In rural areas where new residents used surface water sources there were increasing numbers of users on a single watering system. One ditch rider said that “neighborhood feuds” were emerging because more lot owners had to coordinate water use. Farmers suggested that “there needs to be more coordination” among individual lot owners, and all irrigators “have to act as a community.” Communication gaps between development residents and canal companies boiled down to new residents’ lack of understanding of the water

distribution system. The majority of irrigator and canal company ditch-rider sentiment was expressed by one farmer who said “subdivision residents have no idea what they are doing.” As one canal company president stated, “there needs to be education” about how the canal company works. It was unclear however who would provide this “education.” Canal company board members, ditch riders, and irrigators were often busy working on the farm and were also employed by another full or part-time job in the city. For example, one ditch rider who maintained more than one company’s ditches also worked as the county tax assessor. Therefore, under the existing structure, there were limited opportunities to discuss how the irrigation system worked with development residents. Local county and land-use planning entities expressed little interest in stepping up to bridge the water knowledge gap between newer development residents and agricultural water users.

Water management was not a top priority for the Madison County P&Z Commission. City and county land use issues were tied strongly to urban related issues such as growth due to BYU-I and the LDS Temple. Water use and distribution issues had gone largely unnoticed or had not been recognized as a major concern. Even though canal company boundaries crisscrossed much of Madison County’s landscape, there had been little communication between county planning authorities and canal companies. As one irrigator put it, “there needs to be more communication...we need to have a dialogue.”

When three P&Z Commission representatives were asked if they communicate with irrigators or canal companies, their responses were “not very much,” “we really

don't talk to them," and "there is not a lot of communication." The general consensus was that it was IDWR's responsibility to deal with water issues. Representatives noted that when the county did try to discuss issues like set-backs or easements, canal companies were "unresponsive and unwilling" to give exact figures. There was an implied responsibility placed on developers by the county to communicate with canal companies about potential harm from development projects. However, irrigators said that "there is rarely any communication with developers" and "we never hear from developers."

As in Teton County, Madison County relied on the developer to be a point of contact with canal companies. Before county officials would authorize parcel subdivision, the developer had to get a signature from a canal company representative. This process was supposed to let canal companies know of future land use changes, ditch movement, culvert construction, etc. FMID played a key role in encouraging Madison County to adopt the checklist system, which included getting a developer signature. However, the FMID checklist was created in 2008, and it was unclear how effective it would become in the future due to county apathy. Although canal companies were not at the forefront of land use planning, well concerns surfaced as one issue of water management.

One P&Z commissioner said that most of the water concerns they received were related to wells. IDWR regulations allow residents to irrigate one-half acre from an individual well. Therefore, residents that irrigated more than a half acre using an

individual well were out of compliance. The P&Z commissioner gave an example of a question a resident might ask: “what do you want me to do with the remaining 1.5 acres of a 2 acre lot, let it go to weeds?” The P&Z commissioner recommended the resident “buy some land with surface water rights.” In other words, the P&Z commissioner felt that it was up to newer residents to learn about and understand water use practices on their own—it was not the county’s responsibility.

If Madison County does not take a more proactive approach to include water in land use planning processes, canal companies could further suffer losses to their irrigation system. These losses might include continued fluctuation in shareholder numbers, decreases in revenue, and ultimately the loss of total acreage of irrigated agricultural land within canal company boundaries. As more people move to the Rexburg area, it will become increasingly more important for official shareholders as well as new residents living adjacent to farmland to understand the irrigation system so they do not further damage ditches and water flow. Although full responsibility cannot be placed on county or city land use planning ordinances or codes, or even developers, local government could work more *with* canal companies and subdividers to pass water knowledge to developments residents. A collaborative approach could similarly benefit canal companies in Fremont and Teton Counties as well. Increased inclusion of “honest brokers” such as state and federal agencies into the processes that help form local comprehensive plans, ordinances, and codes, could also work to better integrate land use planning with water management.

DISCUSSION

While previous research has investigated social consequences of demographic change (Smith and Krannich 2000; Nelson 2001; Jones et al. 2003; Saint Onge et al. 2007), few studies have examined how amenity migration affects water management. Specifically, development and resulting impacts on community-based irrigation systems have only recently been studied (Aylward 2006; Ortiz et al. 2007). This project aimed to contribute to this emerging field by asking three questions in the Henry's Fork Watershed: 1) How do changes in distribution and use of water due to development affect canal companies, 2) How are canal companies responding to these changes, and 3) How are land use planning policies taking water and environmental values into consideration? Investigating land use planning policy added to "wet growth" literature (Tarlock and Lucero 2002; Arnold 2005; Hanak 2007; Hanak and Chen 2007) by examining the degree to which local governments addressed water in their planning efforts including comprehensive plans, codes, and ordinances. Describing the communication levels between local, state, and federal planning and water management entities also identified gaps in integrated governance.

How Canal Companies Have Been Affected by Changes in Distribution and Use

Canal companies in HFW have dealt with both urban and rural demographic changes as development replaces irrigated agriculture. Just as Aylward (2006) showed,

urbanization affected surface water deliveries through right of way access, maintenance, and encroachments. Near Rexburg, irrigators confronted urbanites using ditches as places for trash or snow from streetways and driveways. In Teton County, fragmented irrigated lands made it more difficult for ditch riders to coordinate water use among multiple user groups (farms, resorts, home owners, cities). Fremont County is at a crossroad because there are platted developments with few to no houses, making the impacts of large-scale development on canal companies uncertain. Irrigators will have to decide whether to retain or sell water rights to developments as homes become occupied and the potential demand for surface water rises. If surface water rights are not sold to new landowners, groundwater withdrawals will be further increased to irrigate outdoor spaces such as lawns and yards.

One of the most important facts to note is that all culinary water in the HFW comes from groundwater. With every new resident, wells provide the culinary water source. The impact is an increase in groundwater withdrawals for in-home use and outdoor irrigation. Although the development boom has slowed in recent years, it is likely that more houses will dot the landscape as the economy regains momentum. As more irrigated agricultural lands are converted to non-agricultural uses, irrigators will be forced to make more decisions about where to send surface water: to another location, to the same subdivided parcel, or even leave it as instream flow. Such decisions will affect ground-surface water interactions as described by other literature focused on community

irrigation systems (Peck and Lovvorn 2001; Van Kirk and Burnett 2004; Peck et al. 2005; Fernald et al. 2007).

Many subdivided parcels that did have access to surface water in rural areas tended to want only small amounts, creating water distribution challenges for ditch riders. When shareholders desired only small amounts of water or did not pay for their full assessment, monetary stress was placed upon the canal company. This was similar to what Aylward (2006) described as a “downward spiral” that can occur when the value of district water rights fall through decreased demand and non-payment of assessments. Another factor affecting water use in development was access. Although some residents wanted to use surface water, without a built-in distribution system, there were difficulties transporting and using the water on-site. This is because the original canal systems were constructed to irrigate large blocks of land, not quarter-acre or two-acre parcels.

Succession of canal company positions and knowledge also emerged as concerns resulting from development pressures. As more development creeps into the watershed, non-farm job opportunities will likely attract irrigating farmers’ sons and daughters. Examples of families passing water knowledge from one generation to the next will likely become fewer. Lack of water knowledge transfer through succession could create one more barrier to maintaining the canals and irrigation infrastructure as a cohesive system. There has been much literature focused on the benefits of partnering farmers, younger generations, and organizations such as land trusts for the purpose of conserving agricultural and ranching lands (Morrisette 2001; Johnson 2008; Brunson and Huntsinger

2008), from which HFW stakeholders including environmental organizations and land use planning entities could draw insights.

How Canal Companies Have Responded to Change

There were specific examples of irrigators and ditch riders communicating with new residents or local government officials. However, rather than being proactive, most communication occurred after harm had already been inflicted upon the ditch system. For example, communication occurred when an individual using surface water created a home pond, resulting in the flooding of a farmer's field, or when county bridges were built over canals, thus making canal operation and maintenance more difficult. In rural areas where there was an increase in shareholder numbers with home residences, two ditch riders discussed the importance of moving to a watering schedule. The impetus was to prevent insufficient water flow to priority, irrigating farmers. Ditch riders recognized the need to organize new user groups and made the time to do so. Increased interactions between user groups worked to dismantle new resident's propensity for desiring water use on a "town schedule" while developing more understanding for the intricacies of irrigated agricultural water management. Moving to a scheduling system could become increasingly helpful as more user groups are added to the shareholder roster.

For canal companies located in rural areas, increased shareholder rosters did not necessarily increase revenue or maintain water use. Access, ability to use, and price were all factors in whether development residents used surface water. Non-payment from home residents owning one-to three-acre lot parcels was apparent. However, non-

payment also occurred among farmers as well. The difference was that members with a great number of shares owed more money than a shareholder with only one or half a share. When development lot owners did want to use surface water, they often wanted a small amount, creating challenges for ditch riders to move water from point A to point B.

Developments closer to or within cities tended to use surface water more frequently than those in rural areas. Again, lot size and irrigation infrastructure affected the ability of residents to use surface water. Developments near town had smaller lots, usually less than one acre, more lots closer together, and were more likely to have pipes that brought water from ditches to each home. Canal companies that had experienced decreases in the number of shareholders were unwilling to increase share prices for development residents. Even though a home-owner's burden to pay a single share was less than a farmer that paid for tens of shares, all canal company members interviewed appeared uneasy when asked if share prices could be raised for development users. A multi-tiered payment approach, one that would designate different prices for different user groups, had not been seriously considered. Ultimately, canal companies lacked mechanisms to make shareholders pay full price for water.

Although most successful responses to development challenges usually occurred after difficulties had already arisen (such as the creation of an irrigation schedule due to frustrations over moving small amounts of water), there was one example of proactive response. The attendance of water management meetings held by IDWR was mentioned by several irrigators and ditch riders. During one such meeting in 2006/2007, an FMID

representative got the idea for the checklist that was eventually printed and finalized in 2008. At the 2006/2007 meeting, canal companies in larger cities warned that development pressures affected their irrigation systems. The main message was to protect canal companies, easements, and water rights before major damage was inflicted. Although canal companies had “a lot of legal authority,” they needed to figure out more strategies to use it if they wanted to protect and preserve ditches, rights, and cultural values that encompassed irrigation management. FMID, taking the lead, was an excellent resource to provide the checklist model and possibly other future methods of preparedness, because canal companies were often small, comprised of members that worked multiple jobs, or lacked the time or financial means to stave off development pressures. However, if board members and other irrigators had taken more individual responsibility for being prepared, facing the many challenges that existed could have been made easier.

How Land Use Planning Policies Can Take Water and Environmental Values into Consideration

City and county codes and ordinances can play a major role in helping protect canal companies and farming culture. Although the development checklist was one way to prevent friction, another simple way could be to provide water management information to new landowners and development residents. Requiring that new residents receive information about how surface water is used or what the ditch rider’s responsibilities are could benefit canal companies greatly. Such a requirement could

come in the form of a city or county development code. A brochure or pamphlet given to new home and lot owners could help fill in the gap of missing water knowledge that many irrigators expressed new residents were lacking. Environmental organizations, land use planning entities, farmers, concerned citizens, recreationists, or other watershed stakeholders could all be a part of drafting such a brochure. However, it would be imperative that long-time irrigator and ditch-rider knowledge be captured sooner rather than later, as traditional irrigated agriculture water management information succession was already under threat from development pressures. HOA Presidents could be one group to assume responsibility for distributing materials to new home/lot owners. The HOA could distribute information about water shares, where the water comes from, or how much water residents can use.

While all three counties expressed visions of water protection in comprehensive plans, canal company rights were rarely addressed or safeguarded by regulatory documents, codes, or ordinances. Water regulation remained with the state, in the IDWR. If local governments were to assume more responsibility, it is possible that regulatory schemes could better meet specific county or regional needs than often general overarching state guidelines. More local control could also help bridge the “governance gap” that was created when various levels of government failed to adequately address land use and water management decisions (Bates Van de Wetering 2007).

Well regulation is one issue that counties often deferred to IDWR. However, Fremont and Madison counties were reviewing guidelines for wells within their

development codes as of summer 2010. A development code that could help curb groundwater withdrawal could be a requirement that lots over half acre in size hold water rights or shares with a canal company. Although home lots with individual wells should have already been irrigating less than half acre lots according to IDWR guidelines, many home development lot owners were out of compliance. Thus, enforcement of well regulation would begin at development approval, prior to homes actually being built. One challenge of placing sole enforcement responsibility on IDWR was that it lacked the time and resources to adequately oversee the hundreds of individual wells that were approved by local authorities through the platting process.

Although it was not an explicitly required part of any county policy, the FMID development checklist was a clear starting point for integrating canal company water management issues into the development approval process. At the very least, developers had to get approval from a canal company member for a proposed development project. The aim was to avoid unnecessary harm to ditches or surface-water use. Most counties began adding such a step in 2007/2008, so more time was needed to determine the full strength of its potential capabilities. Similarly, although developers had to contact at least one canal company representative to approve a development proposal, canal companies had no mechanism for sharing such information among their members. While an acknowledgment of surface water within guiding and regulatory documents had begun, local governments could solidify who (ditch rider, board president, etc.) within a canal company should be notified of submitted development plats, how a canal company could

prove that harm would be done to the irrigation system if a project were to be approved, and how grievances could be handled and damages remediated, if harm were to be proved after subdivision and subsequent development.

As more agricultural land is converted and developments are platted, cities or counties could require developers to install irrigation infrastructure to increase the number of points of delivery and extend water from ditches to home lots. Although it is not a city ordinance, the majority of developments within the City of Victor have been constructed with irrigation systems, making access to surface water easier. If such a requirement were to be established, there could be a potential for increased conflict among multiple stakeholder groups. The more water that developments use, the less water available to other water user groups or those that serve their interests such as irrigators or environmental organizations. Part of the tension during the landscape in transition process was not knowing exactly how much surface water developments use. Installing irrigation infrastructure to home lots could be an opportunity to meter surface water, helping clarify questions surrounding quantity usage.

Landscapes in Transition

The result of an increase in development was the creation of “landscapes in transition.” An increasing shift away from irrigated agriculture has created both challenges and opportunities for canal companies. There was increased awareness among farming irrigators of land use changes and the local government policies that affect their irrigation systems. Several possibilities emerged for how canal company members could

take action in the future, especially if there is resurgence in the national economy, and development pressures ensue. Innovations such as the checklist, watering schedules, and IDWR-sponsored water management meetings may be able to protect irrigation systems. Institutional tools including policy reform could create deeper integration of land use planning with water management by ensuring that multiple stakeholder needs are met and that HFW historical, cultural, ecological, and hydrological processes are maintained and valued.

CONCLUSIONS

The irrigation system in HFW has created an agricultural and cultural landscape, supporting the regional economy. Farming in a semi-arid region has required high volumes of water creating an “Irrigated Eden” (Fiege 1999). It has been argued that lining ditches or moving away from flood irrigation to sprinkler methods could be more efficient because less water is consumptively used. However, such simple arguments do not take into account that irrigation in this region works as a *system*. The ditches that spread across the landscape have significant effects on ground-surface water interactions. Maintaining the irrigation system as it has been for the past 130 years, could continue providing ecological, hydrological, and societal benefits. Land use planning could further protect benefits of the irrigation system by integrating water management considerations into decisions, particularly before and during land conversion processes.

Had there been more time, a more thorough examination of LDS culture and its influences on politics and economy in the region could have been helpful. For example, LDS religion was traditionally patriarchal and gender roles and identities may have influenced ideas of land ownership, private property rights, and government decision-making. These narratives emerged in interviews, but given the limited resources allotted for a Master’s thesis, detailed follow-up questions regarding such matters were not feasible at the time. Similarly, lack of integration between land use planning and water management was a large and complex topic. Focusing on how canal companies were affected by lack of integration grounded the study in a manageable manner. Other

limitations included missing information and variability among county plat maps and varying degrees of participation among interviewees. Although most stakeholders were willing to discuss water and land use management issues, some refused or side-stepped the interview process, due to the sometimes heated and contentious nature of water management issues in the area. It was important to maintain availability, but not apply too much pressure, as there were channels of trust and communication to be respected.

Land conversions and subsequent development have altered the watershed, producing “landscapes in transition.” Irrigated farmland has been converted to residential, commercial, and resort-type developments. This development has supported a growing population of amenity migrants and urban residents, among already existing groups, such as irrigators and long-time LDS families. This research has investigated the effects of these shifting physical and cultural landscapes on water management by documenting types of conversion at the county scale and recording canal company responses. It is likely that this trend will continue, prompting the need for more research in the future.

The exact quantity of water that ditches lose and subsequently contribute to groundwater recharge should be studied. Two other Master’s theses that emanate from this USDA Project are hoping to provide such figures. A better understanding of the hydrologic regime, timing, and seasonality, could indicate the ecological benefits and disadvantages that might exist if the irrigation system were to be preserved or destroyed. Tying such hydrologic scenarios to results from this research could create a holistic model for studying the impacts of development pressures on an irrigated, semi-arid

landscape. As previously mentioned, all municipal water consumed in this region comes from groundwater sources. Continuing to convey surface water through ditches could help maintain local aquifer levels needed for societal and wildlife habitat uses.

Compounding potential conflict over water management practices are large-scale processes such as global climate change. Within the interior West, studying ground-surface water interactions will likely become increasingly more important as arid and semi-arid climates are further stressed by changing weather patterns, snow pack, and rainfall. Research that investigates how irrigated agriculture impacts regional or national ecosystems, at varying scales of time, could be beneficial. The Comprehensive Aquifer Management Plan (CAMP) is designed to provide necessary information to the Idaho Water Resource Board and IDWR to develop plans for managing ground and surface water resources into the future (Idaho Water Resource Board 2011). There is a specific CAMP for the Eastern Snake Plain Aquifer in which much of the HFW is located. Regional plans such as this one are beneficial for bringing stakeholders together from multiple levels of governance while examining long-term water management strategies.

Although IDWR and other water managers have been largely responsible for regulating water use and distribution, it is clear from previous “wet growth” literature that land use planning processes can greatly impact water management (Tarlock and Lucero 2002; Arnold 2005; Hanak 2007; Hanak and Chen 2007) and from this research, that irrigation systems can be affected as well. City and county governments have the ability to pass ordinances and codes that affect how land is subdivided, taking lot size, well

regulation, and surface water into consideration. If local land use planners worked in conjunction with IDWR to craft policies requiring developers to install surface water distribution systems in developments, fewer groundwater sources would be tapped, and surface water rights would remain in use. Benefits might include less stress on local aquifers and the continued maintenance of an irrigation *system* that relies on earthen canals and groundwater recharge. However, instream flow would not be strengthened and possible conflicts about water consumption among varying user groups might still exist. Thus, the examination of how land use planning and water management bodies can become more integrated to meet the needs of multiple stakeholder groups is critical during the land conversion process in eastern Idaho as well as in other western watersheds.

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APPENDIX A

RESEARCH QUESTIONS BY STAKEHOLDER GROUP

Commissioners, City/County Staff, Planning and Zoning:

1. Does the city/county try to communicate with irrigators or canal companies?
2. What are the major changes that have occurred to land use planning processes over the past 30 years? Why have those changes occurred?
3. How do zoning and land use ordinances or permits take water supply into consideration, if at all?
4. In what legal ways can you involve water in land use planning? Building codes, stream buffers, agricultural zones, developer checklist, etc?
5. How often does riparian habitat, water for fish, or other ecological concerns come up at meetings or through public input?
6. Have there been any major changes to the Comprehensive Plans to include water issue or environmental concerns?
7. What do you consider when thinking about approving a subdivision? Location, size, affects on environment, type (resort, multi-unit, single-family), access to transportation, monetary costs (snow removal, road maintenance)?
8. Is there sufficient water to meets the needs of increasing urban uses? How does surface irrigation water play into this?

Ditch Rider:

1. Have you had to change the way you distribute water over the past 30 years? How have development and new subdivisions affected water management?
2. Do you know which subdivisions receive surface irrigation water? If so, how do these subdivisions receiving water affect the overall canal system? Are the subdivision or lot sizes an issue?
3. Are there any general topics that have caused friction between your canal company and subdivisions? Are there any instances where your canal company and a subdivision have come to an agreement or the experience was positive?
4. Has your canal company been approached by the city, county, or other entity such as FMID to try to coordinate surface water use between agricultural users and new residential users?
5. How have the shareholders changed in terms of quantity, type, or majority?
6. Do subdivisions use more, less, or the same amount of water as agriculture? Differences in timing or quantity of distribution?
7. How are finances mobilized to make repairs to canals among shareholders? Have prices increased?

8. How are canal companies adapting to changes in the landscape and water management?

IDWR Staff:

1. How have your duties changed, if at all, since there have been an increased number of subdivisions?
2. How much do you work with the city or county to coordinate surface irrigation water use?

Irrigators:

1. Have you had to change the way you irrigate due to increased housing developments or other subdivision types?
2. How has your experience been with newer residents? In particular, how have you dealt with issues of water use and distribution?
3. How is your overall canal system affected by subdivision development?
4. Has the city or county contacted you or your canal company to discuss land use issues such as zoning, ordinances, increased communication, etc?
5. How is your land affected by subdivisions that are slated to be developed but are not completely built out? Such as issues with fallow land?
6. What has worked well during the subdivision process?

Environmental Organizations:

1. How does your organization view water, water-use, and distribution?
2. What are some major concerns or issues with water and development? Examples might be: residential water use, agricultural interests, increased flow for fish, the spread of weeds, or changing dynamics within city/county employees.
3. Have you tried to work with the city, county, or other land use planning body to raise awareness about your concerns?
4. How have county commissioners or other authorities dealt with increased subdivisions? Have there been any major changes within the planning process over recent years?
5. What ordinances or zoning laws have aided or harmed environmental concerns? Were you a part of this planning and zoning process? Was the planning commission receptive to your cause?
6. In what ways could land use and water use be better connected? Examples might be: different zoning laws or ordinances, outreach to hard to reach communities of interest, increased public input, monthly dinners, etc.

Golf course managers/grounds keepers:

1. How much water does your open space and golf course use? When is it watered? Beginning and end of watering season?

2. Do you communicate with canal companies or ditch riders? In what ways and how has this experience gone?
3. Have there been any major issues or concerns that canal companies have approached you with, such as weeds, too little/too much water use, increased noise or problems with road access?
4. Before the subdivision was platted, were there any environmental or water concerns that you had to take care of? Any kind of “check list”?

Landscapers:

1. Do your jobs mainly use surface irrigation water, city water, or both? Is there any difference to you in terms of ease or difficulty to work with?
2. Are you ever approached by canal companies or irrigators to discuss plant types, water use, or other issues?
3. Do your clients ask about water use and plant species?
4. Do you ever think about how your landscaping job affects surrounding farms or areas?

Newer/Development Residents:

1. Do you know how much water you use? How do you know this, meter, estimate, previous experience?
2. Do you ever interact with canal companies or ditch riders? What has your experience with them been?
3. Do you use surface irrigation water? Do you know where it comes from (which company/creek)? Is it easy or difficult to use, problems with water filters?
4. If you use surface irrigation water, how does it get to your house? When do you use it/seasonality? Does HOA personnel turn on a valve, do you, does ditch rider

APPENDIX B

CANAL COMPANIES INTERVIEWED BY COUNTY

Teton County:

1. Trail Creek Sprinkler Irrigation Company
2. Fox Creek Canal Company
3. Grand Teton Canal Company LTD (informal interview only)

Madison County:

1. Rexburg Irrigation Company
2. Salem-Union Canal Company LTD
3. Teton Island Feeder Canal Company
4. Salem Irrigation Canal Company

Fremont County:

1. Farmer's Own Canal Company
2. Marysville Canal Company
3. Southeast Idaho Canal Company

Water District (serving Fremont, Madison, and Teton Counties):

1. Fremont-Madison Irrigation District (storage water only)

APPENDIX C

INTERVIEW CODES FROM DISTILLED THEMES, AUGUST, 2010

1. Private property rights
2. Distribution of power
3. Lack of interest in land use planning
4. Agriculture is on its way out
5. Infrastructure, ability to water development lots
6. Canal companies and newer resident's interactions... easements, garbage, etc
7. Water not a dominate player
8. Need for incentives, penalties
9. Lack of water use knowledge
10. Lack of communication, need for improvement
11. Multiple positions/positionality
12. Checklist, adaptation
13. Lack of concern for wildlife
14. Internal canal company dynamics, administration, and functioning being altered
15. Difficulty mobilizing residents to work together
16. Canal company succession issues

APPENDIX D

FREMONT-MADISON IRRIGATION DISTRICT CHECKLIST

FREMONT- MADISON IRRIGATION DISTRICT

P.O. BOX 15
ST. ANTHONY, IDAHO 83445
PHONE: 208-624-3381 FAX: 208-624-3990
EMAIL: fmid@ida.net

FREMONT-MADISON IRRIGATION DISTRICT DEVELOPMENT CHECKLIST

The following information must be submitted to the Fremont-Madison Irrigation District and/or the Administrator of the Fremont County Planning and Building Department prior to, or with, the submission of any Class II permit application being submitted to the Fremont County Planning and Building Administrator.

- Provide copies of decreed or licensed water rights for the property.
- Provide evidence to assure that no water rights have been severed from the property or if water rights have been severed, a description of which water rights remain.
- If the water rights are represented by shares and/or storage water, provide evidence that the canal company and/or irrigation district shares and/or storage water are valid.
- Provide evidence that the irrigated acres for the property are described in the decree or license.
- Provide evidence that the legal descriptions of the points of diversion are for the property.
- Investigate and file a report with the District on the reliability of the water rights and how often they are satisfied.
- Provide written certification that a site visit has been done with irrigation district and canal company officials.
- Organize a Home Owners Association or other legal entity for ownership of shares in the canal company and/or Fremont-Madison storage water. Draft documentation must be submitted to the Fremont-Madison Irrigation District and the Administrator of the Fremont County Planning and Building Department with the submission of any Class II permit application. Final documentation must be submitted to the Fremont-Madison Irrigation District and the Administrator of the Fremont County Planning and Building Department with the submission of the Final Plat application and recorded simultaneously with the Final Plat.
- Easement/right-of-way site development agreement signed or a statement from canal company and irrigation district that one is not required.
- Provide evidence of compliance with Idaho Code Section 67-6537 or have a mitigation plan approved by the Idaho Department of Water Resources to drill new well(s) for irrigation purposes.

(This form last revised February 2008)