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AN ABSTRACT OF THE CAPSTONE PROJECT OF

Meagan Atkinson for the degree of Master of Natural Resources presented on September 8, 2014

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Oregon possesses a diversity of natural resources from the dense rain-soaked forests of the Coastal and Cascade ranges to the deep, fertile soils of the Willamette Valley to the arid and semi-arid Snake River Basin. In the Willamette Valley, water resources sustain agriculture, municipalities, hydropower, fish and wildlife, flood control, and allow for greater economic opportunity. However, with increasing concerns over climate change, population growth, and water use, water abundance is an ongoing concern. There is a need for policy tools to deal with Willamette Valley water use and management issues made more complex by limited scientific knowledge and public value uncertainty. Understanding the role that geographic, socio-demographic and psychological factors may play in influencing policy preferences is vital to minimizing controversy and managing water resources effectively. Using a mail survey of 1,402 landowners, this study examined attitudes toward prospective water allocation policies across three locations in the Willamette Valley to determine how geography, perceptions about water, environmental beliefs, and socio-demographic characteristics may influence the acceptability of these policy measures. Analysis revealed strong linkages between social proximity to resource-based industry, such as agriculture, environmental beliefs, and attitudes toward specific policy initiatives. Socio-demographic characteristics such as tenure, gender, age, education, and income as well as social psychological variables such as environmental worldview and water management-specific environmental beliefs were also related to water policy preferences. Similarities and differences in attitudes toward policy among respondents revealed widespread opinions about the acceptability and theoretical implications of prospective policy initiatives.

Attitudes Toward Water Allocation Policy in the Willamette Valley, Oregon

by
Meagan Atkinson

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I understand that my capstone project will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Meagan Atkinson, Author

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Chapter 1. Introduction

> *There is no substitute for clean and abundant water. Every living thing depends upon clean and abundant water to meet basic needs. Oregon's economic vitality, environmental integrity, and cultural identity depend upon it. Water is Oregon's most precious natural resource. (Oregon Water Resources Department, 2012)*

The history of water management in the western United States is one guided by politics and replete with conflict (Reisner, 1993). The westward movement of American population gained momentum in the 1800s encouraged by extensive federally funded infrastructure expansion projects. These projects included construction of road and rail networks, granting western lands in exchange for military service, and large-scale hydrologic manipulation and reclamation that included river dam and diversion projects to support burgeoning populations and a prevailing agrarian lifestyle (Reisner, 1993). Exploration and resettlement in Oregon transformed the landscape and gave rise to a populace with diverse values and priorities leading to prolonged conflicts over water and shaping water management policy (Consensus Building Institute, 2012).

Oregon's Water Code was established in 1909 to grant landowners a degree of security provided their water use was deemed "beneficial" (Oregon Water Resources Department, 2012). This system of water rights stipulates that all water in Oregon belongs to the public and that allocation is assigned by the state through a permitting system primarily based on the concept of prior appropriation (Bastasch, 2006; Oregon Water Resources Department, 2012). Prior appropriation doctrine ("first in time, first in right") mandates that users with the earliest obtained (oldest date of priority) water right on a given stream are the last to be shut off in times of low streamflows (Institute for Water and Watersheds, 2012). Therefore all "senior" water right holders downstream can demand the full quantity of water from the source stipulated in their water right until all rights are fulfilled or no excess water remains. Oregon's water code does not favor any single type of water use out of the broad spectrum of "beneficial" uses unless users with identical dates of priority are in conflict. In this case, the law specifies that domestic use and livestock watering have preference over all other uses (Institute for Water and Watersheds, 2012). About 80% of water rights authorize surface water use with the remaining 20% of water rights authorize groundwater use (Oregon Water Resources Department, 2012). In much of Oregon, groundwater interacts directly with surface water and, where appropriate, these connected sources are managed as one in the form of conjunctive management (Oregon Water Resources Department, 2012).

1.1 Water challenges

Oregon's water resources sustain agriculture, municipalities, hydropower, fish and wildlife, flood control, and allow for greater economic opportunity. In 2010, annual out-of-stream consumptive demands for agricultural, municipal, industrial, and domestic well users in the Willamette Valley were estimated at about 2.5 million acre-feet of water diverted from surface or groundwater sources (Oregon Water Resources Department & HDR Engineering, 2008). The Willamette River Basin region represents the highest annual in-stream demands in the state with an estimated 11 million acre-feet of water sustaining aquatic ecosystems as well as supporting fishing, recreation, energy production, and transportation industries (Oregon Water Resources Department & HDR Engineering, 2008; Oregon Water Resources Department, 2012).

While Oregon is commonly perceived as a water-rich state, the average statewide precipitation is only about 28 inches per year; roughly the same as Texas. Precipitation is not evenly distributed across the state and is largely determined by barrier effects from the centrally located Cascade Range. Some arid regions of eastern Oregon can receive as little as eight inches annually, while coastal areas can accumulate 200 inches annually (PRISM Climate Group, 2012). Generally higher precipitation amounts during winter months lead to higher streamflows in winter and spring followed by much lower summer base flows. Annually, an estimated 100 million acre-feet of water originating from groundwater, rainfall, and snow accumulation in higher elevations fills lakes, rivers, and streams and recharges groundwater aquifers (Oregon Water Resources Department, 2012).

Climate scientists predict that the quality and quantity of water in Oregon will be significantly impacted by a number of observed and projected climate changes, including warmer, wetter winters and hotter, drier summers (Bastasch, 2006; Mote *et al.*, 2014; Oregon Water Resources Department & U.S. Bureau of Reclamation, 2013). Mean annual temperature increases are predicted to significantly reduce the percentage of precipitation that falls as snow, thereby diminishing springtime snowpack by an estimated 60%, resulting in shifts in the timing of melting snowpack and runoff, and reducing summer streamflows by 20% to 50% (Oregon Water Resources Department, 2012; Oregon Water Resources Department & U.S. Bureau of Reclamation, 2013). As a result, it is likely that drought incidence will increase during summer months, and water availability will be strongly dependent on natural and constructed storage systems since snowmelt constitutes up to 80% of the volume of the Willamette River (Oregon Water Resources Department, 2012; Oregon Water Resources Department & U.S. Bureau of Reclamation, 2013). At the same time, increased frequency and severity of precipitation events will likely intensify flood concerns, especially in communities with a history of chronic flooding. Shifts in precipitation and temperature are also likely to impact the diversity and resilience of wetland, forest, and aquatic ecosystems (Mote *et al.*, 2014).

Many surface water resources in the Willamette Valley are either fully or over-allocated in summer months (Figure 1.1) and water quantity concerns are often directly linked to water quality issues (Bastasch, 2006; Hulse *et al.*, 2002; Oregon Water Resources Department, 2012). Twelve groundwater areas are no longer capable of supporting future uses or are limited to essential public safety needs (Figure 1.2), and more than 46% of stream and river miles are considered to be severely biologically impaired (Hubbard, 2013; Oregon Water Resources Department, 2012; Oregon Water Resources Department & U.S. Bureau of Reclamation, 2013).

By 2050, in-stream and out-of-stream water demands in the Willamette Valley are projected to increase 18% and population is expected to nearly double in size, placing additional pressure on already limited resources (Hulse *et al.*, 2002). In addition, clashing priorities of different user groups contribute to the complexity of the water allocation resource dilemma in Oregon, and often these issues culminate in contentious conflicts such as those observed in the Klamath Basin in recent years.

1.2 Water permitting process and policy issues

Recognizing the need for an integrated strategy to address these current and future challenges, the state of Oregon collaborated with stakeholders, water management organizations, and the public to construct Oregon's Integrated Water Resources Strategy (IWRS). The IWRS, adopted in August 2012, focused on understanding current water resource conditions, in-stream versus out-of-stream needs, projected changes in water resource needs and demands, and comprehensive water resource management looking into the future (Oregon Water Resources Department, 2012). The conventional top-down "command-and-control" regulatory approach has historically revealed how deeply public values of individual and property rights are held, and has rarely been sufficient on its own in the past (Baker *et al.*, 2004). Therefore the IWRS sought to explore current water resource conditions and demands, projected changes in availability and demand, and to provide a number of "bottom-up" recommendations to inform decisions individuals and communities make every day about how and to what extent they will use land and water which then impacts the type and extent of environmental effects.

The IWRS recommended a number of water re-use and conservation programs and practices for household to state-level energy efficiency applications. One such suggestion addressed improving irrigation efficiency for agricultural users, the primary diversionary water users in Oregon (Oregon Water Resources Department, 2012). As Oregon water law currently stands, saved water from efficient practices cannot be applied to uses outside of those specified in a water right. Oregon's Allocation of Conserved Water Program enables water right holders to use some of the conserved water while the remainder goes toward permanent in-stream protection (Oregon Water Resources Department, 2012). Incentivized water conservation policy such as increasing irrigation efficiency or reducing diversions likely would economically benefit agricultural users as well as the general public, but the "use it or lose it" fear of forfeited water rights with current Oregon water law tends to sway these users toward less conservation-minded use over improved irrigation technologies (Schaible, 2000). The IWRS suggested that public outreach be conducted to spread awareness about conservation programs in order to resolve misconceptions and expand participation (Oregon Water Resources Department, 2012).

The existing permitting process in Oregon requires the public to navigate a complex web of interagency coordination. While water rights can be purchased, leased, or transferred for approved conversion to in-stream use, this occurs infrequently and water rights generally tend to be limited to the original use specified (Baker *et al.*, 2004; Hulse *et al.*, 2002; Oregon Water Resources Department, 2012). As a result, the system may not allot water rights to new demands even though existing water rights uses may no longer be relevant. Despite the fact that in-stream rights (e.g., maintaining flows for fish and wildlife or hydropower) represent the principal share of water rights, other uses tend to have earlier priority dates and therefore highest precedence (Hulse *et al.*, 2002). Future water management strategies will likely involve reallocation of water from agriculture to other uses, possibly through water markets and incentivized conservation-based or regulatory policies (Bjornlund *et al.*, 2013; Schaible, 2000). Establishing water markets would enable landowners with water rights to transfer or lease their right to use water to another user (individual or organization) and to keep the profit (Institute for Water and Watersheds, 2012). Water quality markets function similarly but focus more on mitigation credits that can be sold to users (typically industrial users with compromising ecological issues). As of April 2012, eight water market-related initiatives were reportedly underway within the Willamette River Basin (Institute for Water and Watersheds, 2012).

Oregon currently makes use of water storage to supplement surface water resources, especially during the summer months. Built storage methods include above ground reservoirs and below ground aquifer storage, recovery, and artificial recharge

(Oregon Water Resources Department, 2012). Future IWRS recommendations include identifying and developing new above ground and below ground storage sites, expanding aquifer recharge and recovery programs, and improving access to storage such as by reallocating uncontracted federally stored water in the Willamette River Basin to agricultural, municipal, biological, and recreational needs (Oregon Water Resources Department, 2012).

1.3 Water availability and scarcity

Understanding public attitudes toward water management practices and policy initiatives is vital for future water management in the Willamette River Basin. Some research has explored Oregonians' opinions toward water issues (Oregon Water Resources Department, 2012), water resource knowledge and civil society (Hubbard, 2013), and environmental concern related to water issues (Wolters, 2012). Although it is commonly recognized that water management should focus on identifying watershed-level issues and challenges specific to the basin (Wolters, 2012), few studies have explored attitudes towards specific policy preferences for addressing water scarcity concerns and none specifically within the regional context of the Willamette Valley.

Generally, water scarcity is understood as the lack of access to adequate quantities of water for human and environmental uses. Despite considerable multi-disciplinary concentration in the literature in recent years (Bastasch, 2006; Hulse *et al.*, 2002; Jaeger *et al.*, 2013), there has been no broad consensus on a specific and measurable definition for water scarcity. In the Oregon Water Handbook, Bastasch (2006) defined water availability as "the potential of a water body to sustain additional use after considering existing water uses and water conditions". Bastasch suggested that water availability could be measured and "expressed as the unappropriated flow in excess of the amount likely to be present 80% of the time, after accounting for out-of-stream and instream water rights" (Bastasch, 2006). Studies have shown that the 'illusion of plenty' or 'myth of abundance' (Jaeger *et al.*, 2013) of water in Oregon can influence risk perception and even awareness of solutions. Historically, water managers have favored "hard" path or infrastructural methods of supply-side management to address water management issues (Wutich *et al.*, 2013). Recently, however, water resource issues including scarcity concerns have emphasized the need to reduce demands by employing "soft" path water management solutions. These solutions involve using a range of water policies and conservation approaches to improve efficiency of water use thereby reducing pressures on water supply (Wutich *et al.*, 2013). In the Willamette Valley, understanding water scarcity in terms of contributing human or environmental factors as well as public attitudes provides the basis for policy or infrastructural decisions to address potential consequences of limited water availability now and into the future (Jaeger *et al.*, 2013; Wutich *et al.*, 2013).

1.4 Project objectives

Regional consequences of climate change, mounting pressures from population growth and associated increases in water demand, rising awareness of the need for species and habitat protection, and growing recreational demands will only amplify the existing strain on Oregon's water resources (Baker *et al.*, 2004; Bastasch, 2006; Mote *et al.*, 2014; Oregon Water Resources Department, 2012). Consequently stakeholders must be actively engaged in the process of developing and implementing solutions in order to facilitate community-based participatory, collaborative, multi-pronged forms of governance (Baker *et al.*, 2004; Oregon Water Resources Department, 2012). Therefore before an integrated water system response such as the IWRS can be effectively implemented, a greater understanding of people's attitudes toward water resources, management, and policy in the Willamette River Basin and the factors that form these attitudes must be reached.

The central research question for this study is "What water distribution policies do Willamette Valley residents prefer in times of limited water availability?" The research presented in this paper seeks to answer this question by investigating public support for potential water policy and the role potentially driving factors may play in influencing policy preferences. The objectives of this study are to explore Willamette

Valley residents' attitudes toward water regulation and potential allocation policy measures based on several factors: (1) respondent geography, (2) perceptions about water, (3) environmental beliefs, and (4) socio-demographic characteristics.

1.5 Background

In 2010, Oregon State University, the University of Oregon, and Portland State University launched a five-year Willamette Water 2100 (WW2100) collaborative project, funded by the National Science Foundation, to develop a modeling framework on a decadal to centennial timescale. The project uses the *Envision* integrated geographic and temporal data modeling platform developed at OSU in which hydrologic, economic, and human systems interact synergistically (Willamette Water 2100, 2014). Willamette Water 2100 is comprised of a supervisory committee and six research groups with specific concentrations, including Climate, Ecohydrology, Hydrology, Economics/Law, Envision/Ecology, and Broader Impacts teams. In addition, the WW2100 Project teams are working together with a variety of public and private stakeholders focused on water stewardship and management in the Willamette River Basin. A primary project objective is to evaluate how climate change, population growth, and economic growth will alter the availability and use of water in the Willamette Valley.

The Willamette Valley is delineated by the Willamette River Basin (Figure 1.3), a 3rd field watershed designated by the U.S. Geological Survey as Hydrologic Unit Code (HUC) 170900. The basin is comprised of twelve 4th field sub-basins as defined by hydrologic pattern (Figure 1.4). The Willamette River Basin covers an area of more than 29,000 square kilometers (about 11,200 square miles) that drain into the Willamette River making it the largest watershed in the state (Hulse *et al.*, 2002). Nestled between the Coastal and Cascade Ranges in northwest Oregon, the Willamette River travels roughly 200 miles from its headwaters at the confluence of the Coast Fork and Middle Fork Willamette rivers near Eugene to the confluence with the Columbia River at Kelley Point in Portland (Hulse *et al.*, 2002). In terms of discharge, the Willamette River is 13th largest in the conterminous United States but the largest in terms of discharge per square mile drainage area (Uhrich & Wentz, 1999). The Willamette Valley contains more than 11,000 miles of streams and rivers including numerous channels, tributaries, and islands (Figure 1.5). Formed by millions of years of constructional volcanism, oceanic tectonic shift, glaciation, and outbreak flooding, the physical topography (Figure 1.6), relatively mild climate (Figure 1.7), and significant human influence on the landscape have combined to give rise to the unique environmental conditions in the Willamette Valley (Uhrich & Wentz, 1999). Distinguished by its fertile soils and diverse ecological habitats, the Willamette Valley covers only about 12% of Oregon's land area but is home to about 70% of the state's population, and produces approximately 31% of state timber harvest and 45% of the market value of state agricultural products (Hulse *et al.*, 2002; Oregon Department of Environmental Quality, 2014). This region also provides critical habitat for several species listed under the Endangered Species Act, is the richest in native fish in the state, and the Willamette River and its reservoirs contribute significantly to the recreational economy of the Basin (Oregon Water Resources Department & U.S. Bureau of Reclamation, 2013).

One part of the Willamette Water 2100 project includes exploring possible geographic relationships related to perspectives on water use and management and identifying characteristics that allow for projection of landowner behaviors in response to future water availability. These characteristics combined with attitudes toward policy alternatives will be used to verify human behavior components of the *Envision* model and guide development of alternative scenarios.

Chapter 2. Literature Review

2.1 Factors affecting water policy preferences

Researchers have identified a range of factors associated with pro-environmental attitudes that may influence environmental behaviors and support for environmental policies (Corral-Verdugo *et al.*, 2003; Dunlap & Jones, 2002; Huddart-Kennedy *et al.*, 2009b; Kollmuss & Agyeman, 2002; Larson & Santelmann, 2007; Larson *et al.*, 2011a; Larson *et al.*, 2011b; Scott & Willits, 1994; Thorvaldson *et al.*, 2010; Wolters, 2013). Past literature has suggested that key factors may include cognitive judgments (Dunlap & Jones, 2002; Larson *et al.*, 2011b; Salvaggio *et al.*, 2013; Thorvaldson *et al.*, 2010), conative judgments (Corral-Verdugo *et al.*, 2003; Larson *et al.*, 2011a; Larson *et al.*, 2011b), affective judgments (Dunlap *et al.*, 2000; Dunlap, 2008; Huddart-Kennedy *et al.*, 2009b; Salvaggio *et al.*, 2013; Wolters, 2013), as well as demographic characteristics such as age, sex, education, socio-economic status or income, and place of residence (Hubbard, 2013; Huddart-Kennedy *et al.*, 2009b; Salka, 2001; Salvaggio *et al.*, 2013; Sharp & Adua, 2009; Wolters, 2012).

Some authors have argued that in searching for links between socio-demography, social psychological constructs (e.g., attitudes, values, and beliefs) and behavior, research on attitudes should focus on correspondingly specific behaviors (Fishbein & Ajzen, 1975). However both are important for evaluating preferences since general and specific attitudes reflect a variety of values, beliefs, and possibly behaviors, and narrowly focused analysis could result in seemingly significant relationships that are no longer applicable to the broader objectives (Kollmuss & Agyeman, 2002; Larson & Santelmann, 2007). Because the association between these constructs and behavior is tentative, halting analysis at the level of attitudinal expression of preference (Figure 2.1) may provide valuable insight into decisions to support or oppose water policy measures (Dunlap & Jones, 2002; Russenberger *et al.*, 2011; Stern *et al.*, 1999).

2.1.1 Why study public opinion on water policy?

Public support has long been acknowledged as one of the most important resources for social movements (Stern *et al.*, 1999) and by extension, policy development. A crucial step in developing viable water policy solutions is to understand the social and economic context in which they are introduced since such measures have often met with opposition in the past (Bjornlund *et al.*, 2013; Russenberger *et al.*, 2011). There is a consensus within the literature that values play a significant role in how people perceive and respond to new policies (Huddart-Kennedy *et al.*, 2009b). For water policy initiatives to be socially and politically feasible, they must gain broad acceptance with sufficient public support to smooth the way for effective implementation of integrated water management strategies (Bjornlund *et al.*, 2013; Salvaggio *et al.*, 2013; Vugteveen *et al.*, 2010). Therefore, understanding public opinion and the factors that influence policy preferences may help to minimize controversy and reduce the need for social and political conflict mitigation as the IWRS moves closer to implementation (Bjornlund *et al.*, 2013; Dunlap *et al.*, 2000; Hubbard, 2013; Larson & Santelmann, 2007; Russenberger *et al.*, 2011; Thorvaldson *et al.*, 2010).

2.1.2 Defining values

Rokeach's (1968) study of the association of basic values with beliefs and attitudes was fundamental to all subsequent empirical research on values. Beliefs are commonly understood within the literature as simple conscious or unconscious, central or peripheral perceptions about the world (Figure 2.1). According to Rokeach (1968), values are a limited number of enduring, core beliefs within one's total belief system that control a person's behavior or determine whether some end-state of existence is worth attaining (Figure 2.1). In effect, values are an individual's principle beliefs concerning desirable end states or behaviors that guide decisions and influence other cognitions such as attitudes (Dietz *et al.*, 2005; Huddart-Kennedy *et al.*, 2009b; Rokeach, 1968). Attitudes describe positive or negative evaluations of specific objects or situations (Figure 2.1), and along with beliefs, are more numerous than values (Dietz *et al.*, 2005; Rokeach, 1968).

Further research substantiated the link between values, beliefs, and attitudes (Fishbein & Ajzen, 1975) and was expanded to include study of behavior and concern about the environment. Although conceptually based in values, concern is distinct in that the environment is deemed important and that it may be at risk (Stern *et al.*, 1999). A person can have multiple values organized into a weighted hierarchical system but these values can be contradictory to one another, thus generating internal conflict (Rokeach, 1968). As such, values never correlate perfectly with behavior because a person may be required to violate one value in order to act upon another (Huddart-Kennedy *et al.*, 2009a). This is especially applicable to water management which often involves balancing multiple objectives and choosing among diverse policy approaches, and where compromise is frequently required.

2.1.3 Values, beliefs, attitudes and environmentalism

In the 1960s and 1970s, environmental problems began to emerge as major policy issues. Evidence pointed to fundamental shifts in social views of both the relationship between humans and the environment as well as in human responsibility for their environment. Rising environmentalism challenged the conceptualization by Pirages and Ehrlich (1974) of the dominant social paradigm (DSP) worldview defined by support for laissez-faire government, individual and property rights, belief in science and technology, and unrestricted economic growth (Dunlap & Van Liere, 1978; Dunlap, 2008). In response, Dunlap and Van Liere (1978) proposed a New Environmental Paradigm (NEP) worldview focused on the importance of maintaining the balance of nature, the existence of ecological limits to growth for humans, and humanity's right to rule over the rest of nature (Dunlap & Van Liere, 1978; Dunlap, 2008). The original 12-item scale, as well as a shortened 6-item version, was constructed to measure general environmental beliefs, using standard 4-point Likert-type responses. After several major and minor revisions, the revised 15-item New Ecological Paradigm (NEP) scale emerged. In addition to the original facets of the balance of nature, limits of growth, and anti-anthropocentrism, Dunlap *et al.* (2000) added dimensions on human exemptionalism from ecological constraints and the potential for catastrophic ecological changes. Revisions also included removing outmoded wording, adding a fifth "undecided" Likert response to reduce item non-response, and correcting earlier methodological artifacts that might have contributed to ambiguity regarding dimensionality of the scale (Dunlap *et al.*, 2000).

Criticisms of the NEP scale, albeit the original unrevised NEP scale, contended that it is restricted by its simplistic and outdated wording (Lalonde & Jackson, 2002). Further, detractors argue that the unrevised scale has been made obsolete by significant changes in attitudes, social conditions, and scientific understanding of human-environmental relations since the original scale was published in 1978, and the resulting shift from the prevailing anthropocentric worldview to an increasingly more biocentric worldview (Lalonde & Jackson, 2002). However, these criticisms were based exclusively on surveys of politically active and highly educated experts rather than on samples of the broader public and these criticisms apply only to the admittedly outdated original NEP scale; consequently they are arguably irrelevant to the revised NEP scale (Dunlap *et al.*, 2000; Dunlap, 2008).

The revised NEP survey-based metric measures degrees of endorsement (from low to high) of "primitive beliefs" relating to human-ecological relations and therefore should be conceptualized as general ecological worldviews (Dunlap, 2008). Ecological worldviews are general ideas that reflect basic truths about human-environment relations (Corral-Verdugo *et al.*, 2003; Dietz *et al.*, 2005; Dunlap *et al.*, 2000). The NEP scale has been used extensively in research on worldviews and their link between cognitive perceptions, conative attitudes, affective concern, and behavior (Arcury *et al.*, 1986; Hubbard, 2013; Larson *et al.*, 2011b; Slimak & Dietz, 2006; Stern *et al.*, 1999; Wolters, 2012). However, Dunlap *et al.* (2000) and others (Larson *et al.*, 2011a; Larson *et al.*, 2011b) have acknowledged the unfortunate oversight in the conception of the NEP measure whereby the authors disregarded extant literature exploring social-psychological work on values, beliefs, and attitudes (e.g., Rokeach, 1968). This resulted in the widespread use of the measure as endorsement of a range of constructs including attitudes, concern, values/beliefs, and related constructs. These concepts inherently contain an element of ambiguity, but inconsistent use of the constructs over time has contributed to some difficulty interpreting findings across studies (Dunlap *et al.*, 2000; Larson *et al.*, 2011a; Larson *et al.*, 2011b).

Another point of contention within the literature is whether the NEP scale is a one-dimensional or multi-dimensional measure. Dunlap *et al.* (2000) argued that there are three distinct dimensions but also stipulated that the actual number of dimensions may vary by sample. Therefore they have suggested that the decision to treat the NEP scale as a single variable or multiple variables should not be pre-determined, but rather researchers should base the requisite number of dimensions on sample-specific factor analysis of the scale (Dunlap *et al.*, 2000).

More recent literature has incorporated several models of theory derived from research by Rokeach (1968) and others, environmental value/belief constructs including the revised NEP measure, altruistic values constructs, and environmental concern in order to evaluate the relationship between values/beliefs and decisions about the environment. Stern *et al.* (1999) theorized that values influence personal environmental worldviews which, in turn, influence concern both that something valued is under threat and that actions undertaken by the individual can diminish the threat. The basic determinants of environmental concern were conceptualized as egoistic values, motivated by self-interest, humanistic values focused on the larger community (and possibly the whole of humanity), and biospheric values extending to all other species and their ecosystems (Dietz *et al.*, 2005; Stern & Dietz, 1994). Egoistic and humanistic values corresponded to anthropocentric environmental beliefs while biospheric values were consistent with biocentric environmental beliefs. Environmental belief and policy research has suggested that the degree to which individuals express anthropocentric or biocentric values impacts their attitudes toward water management practices and policy (Corral-Verdugo *et al.*, 2003). Stern *et al.* (1999) posited that values, especially those related to human and environmental concern, had the greatest influence on personal worldviews and therefore on attitudinal policy preferences (Dunlap & Van Liere, 1978; Dunlap *et al.*, 2000;

Dunlap, 2008; Rokeach, 1968; Slimak & Dietz, 2006). These correlative altruistic values have been described as the most stable determinants of environmentalism because these values/beliefs (e.g., worldviews) are steadfast and resistant to change. However, critical environmental experience can accelerate changes in environmental worldview, and value/belief changes are likely to have the greatest impact on environmental decisions (Arcury, 1990; Dietz *et al.*, 2005; Larson *et al.*, 2011b). As a result, the literature has commonly assumed that values are causally prior to other social psychological constructs but despite substantial evidence of a robust association between values and other constructs such as beliefs, attitudes, and norms, causal order cannot be determined (Dietz *et al.*, 2005).

In order to more thoroughly evaluate relationships between these constructs, some authors have integrated these constructs with a tri-partite approach by including cognitive, conative, and affective human-ecological judgments as a multidimensional construct measuring environmental attitudes (Dunlap & Jones, 2002; Larson *et al.*, 2011a; Salvaggio *et al.*, 2013). This method addressed the criticisms that the NEP scale has multiple themes and reflects more general environmental beliefs by evaluating more specific cognitive, affective, and conative judgments that may shape environmental attitudes potentially linked to policy preferences (Corral-Verdugo *et al.*, 2003; Larson *et al.*, 2011b). Cognitive perceptions of human understanding in water use and management consist of knowledge, beliefs, and personal norms related to water issues, such as water scarcity, potential causes, and solutions (Dunlap & Jones, 2002; Larson *et al.*, 2011b; Salvaggio *et al.*, 2013). Conative attitudes reflect dispositions and intentions toward action, and can be conceptualized as support for specific water policies (Dunlap & Jones, 2002; Larson *et al.*, 2011b). In order to measure public support for specific policy measures, preferences are indicated by ranking or rating possible outcomes from a decision thereby allowing the researcher to obtain aggregated group choices with greater utility for policy than individual preference orderings (Dietz *et al.*, 2005). Affective concern, or environmental concern, reflects emotional attachment to issues, and can be used to explore commitment and degree of support for water policies since higher perception of risk has been associated with more ecologically-friendly decisions (Slimak & Dietz, 2006; Wolters, 2013). While the tri-partite model has merit, it is potentially limited by multiple possible explanations for suggested correlations and by the small number of NEP items typically used in assessing environmental beliefs.

2.1.4 Rural-urban differences

Many authors have studied the potential influence of place of residence (rural versus urban) on environmental values/beliefs and policy preferences (Bjornlund *et al.*, 2013; Huddart-Kennedy *et al.*, 2009b; Salka, 2001; Wolters, 2013) to determine if there are significant differences, however findings are mixed. Distinctions between rural and urban populations in previous literature include variations in environmental attitudes, beliefs, and concern. These potential differences warrant more comprehensive investigation due to frequent conflicts between urban and rural populations.

The "differential-exposure" theory has suggested that urban residents would be more likely to align with more pro-environmental attitudes, and to support environmental protection because they are theoretically exposed to a greater level of environmental degradation than rural residents (Tremblay & Dunlap, 1978). Individuals with higher incomes and higher levels of education, typically found in urban areas, tend to express more pro-environmental values/beliefs and consequently, findings of widespread value agreement amongst rural and urban respondents have suggested the issue may be one of socio-demography rather than rural-urban differences (Salka, 2001).

Alternatively, the "extractive-commodity" theory posited that rural residents are more likely to support resource extraction industries over environmental protection since these entities are often at odds (Salka, 2001). Normative influences have been shown to interact with environmental values and beliefs to indirectly influence attitudes and possibly determine behavior by means of behavioral intent (Kollmuss & Agyeman, 2002; Stern *et al.*, 1999). For example, social and cultural ties to agriculture (e.g., economic or other participation in activities linked to the irrigation industry), or other connections related to social proximity (e.g., friendship, socialization, involvement in stakeholder groups), have been linked to environmental concern and more utilitarian values orientations (Sharp & Adua, 2009). Rural residents including rural agriculturalists and non-farmers may share a common culture due to physical proximity, and consequently have been found to oppose policies threatening the livelihoods of those in resource-based industries (Salka, 2001; Sharp & Adua, 2009). More recent studies of place of residence have determined that rural residents exhibited higher environmental concern for natural resource conservation issues and therefore may participate in more pro-environmental stewardship behaviors than urban residents (Huddart-Kennedy *et al.*, 2009b).

Due to diversification of rural economies in recent years, and since only people with close social interactions with farmers were more likely to hold utilitarian values, contrary to earlier literature, environmental concern in rural areas may not be as homogenous as previously believed (Huddart-Kennedy *et al.*, 2009b; Sharp & Adua, 2009). Other authors have found evidence of this narrowing gap between rural and urban residents stemming from increased availability of community environmental services in rural areas and greater movement between urban and rural areas (Huddart-Kennedy *et al.*, 2009b).

Many authors have found that rural and urban communities may not have such diverging environmental values/beliefs, once socio-demography is controlled for, with differences observed only in terms of policy implementation (Bjornlund *et al.*, 2013; Huddart-Kennedy *et al.*, 2009b; Pritchett *et al.*, 2009; Wolters, 2012). Huddart-Kennedy *et al.* (2009b) suggested that opportunity and place of socialization may factor more significantly into environmental beliefs, concern, and policy support based on growing evidence of values transfer from movement between the populations. As a result, differences between rural and urban residents in the literature may be overstated or explained by factors other than place of residence (Bjornlund *et al.*, 2013; Huddart-Kennedy *et al.*, 2009b; Salka, 2001). Recent research has further suggested that rural and urban communities are simply too complex to generalize findings only by place of residence without factoring in the diversity found in these populations such as socio-demographic characteristics (Wolters, 2013).

2.1.5 Socio-demographic characteristics

Socio-demographic and socio-economic variables such as age, tenure, sex, education, or income may influence values, environmental beliefs, and attitudes toward water management practices and policy (Figure 2.1). Although young people generally tend to have less policy knowledge (Hubbard, 2013), some studies have shown that younger individuals showed more concern for the environment (Arcury, 1990; Corral-Verdugo *et al.*, 2003; Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Jones & Dunlap, 1992). Dietz *et al.* (1998) found more specifically that most younger respondents expressed the strongest pro-environmental attitudes but the remainder expressed the least pro-environmental attitudes, with little moderation. Conversely, other studies have found a direct association between age and environmental attitudes (Larson *et al.*, 2011b; Sharp & Adua, 2009) or that older respondents were more likely to support water conservation regulation or policies (Larson *et al.*, 2011b). Salka (2001) argued that age was a weak predictor of support for environmental policies within Oregon in general, most likely because population age tended to be relatively homogeneous across counties.

Few studies have researched the association between tenure and attitudes toward policy, however Larson *et al.* (2011b) found that long term residents tended to be accustomed to extant water usage and regulation and therefore were more strongly opposed to proposed water-use restrictions. The literature is mixed in terms of how gender influences environmental attitudes and by extension, support for environmental policies. In past literature, women were generally found to have more environmental concern (Arcury, 1990; Salvaggio *et al.*, 2013; Sharp & Adua, 2009; Wolters, 2012) but findings were often mixed (Larson *et al.*, 2011a). Other studies reported that men were more environmentally concerned, or observed no relationship between sex and environmental attitudes (Larson *et al.*, 2011a; Larson *et al.*, 2011b). One explanation for these conflicting findings is the complexity of environmental beliefs, concern, and attitudes constructs (Dunlap & Jones, 2002). Additionally, few studies have focused specifically on topics of water scarcity or specific water policy initiatives, so focusing study topics on more specific water problems at larger scales may produce more useful findings (Larson *et al.*, 2011a). Generally, both men and women have preferred voluntary actions to economic or regulatory measures, and while men tend to show more economic support, women were more likely to support resource protection goals (Larson & Santelmann, 2007; Larson *et al.*, 2011a). Therefore, since women tend to be the primary water users and decision makers in the household, this sub-population may be key for evaluating policy alternatives (Larson *et al.*, 2011a).

Past literature has shown linkages between level of education and measures of environmental policy support including environmental attitudes (Arcury, 1990; Bjornlund *et al.*, 2013; Corral-Verdugo *et al.*, 2003; Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Jones & Dunlap, 1992; Larson *et al.*, 2011b; Salvaggio *et al.*, 2013; Stern & Dietz, 1994) and environmental concern (Arcury, 1990; Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Jones & Dunlap, 1992; Larson *et al.*, 2011b; Salvaggio *et al.*, 2013; Slimak & Dietz, 2006; Stern & Dietz, 1994; Stern *et al.*, 1999; Wolters, 2012). However findings are mixed in terms of the direction of association, and while some authors have found education to be positively correlated to environmental attitudes (Arcury, 1990; Salvaggio *et al.*, 2013; Slimak & Dietz, 2006), other authors have found education to be inversely correlated with environmental attitudes or concern (Sharp & Adua, 2009). For example, Larson *et al.* (2011b) found that individuals with higher levels of education showed lower conative attitudinal support for policies incorporating water pricing mechanisms. Similarly, while some studies have shown a positive correlation between income and environmental attitudes (Arcury, 1990; Salvaggio *et al.*, 2013; Thorvaldson *et al.*, 2010), other research suggests that income is less influential (Jones & Dunlap, 1992; Salka, 2001) or negatively correlated with environmental attitudes (Dunlap *et al.*, 2000). Despite these mixed findings related to environmental attitudes, income may influence environmental concern and thus may be a useful indicator of policy preference. Although lower incomes have been linked to greater environmental concern (Larson *et al.*, 2011b), those with higher incomes have been correlated to increased public willingness to pay for environmental protection (Salka, 2001) probably due to disproportionate impacts among disparate incomes.

Although not measured by this study, previous literature has suggested that individuals with more liberal political ideology tend to be less supportive of the status quo and particularly adverse toward the priorities embodied by the anthropocentric environmental beliefs of the dominant social paradigm worldview (Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Larson *et al.*, 2011b; Salka, 2001). Ideology may therefore be associated with more pro-environmental worldviews, but may not necessarily link to more specific environmental problems (Larson *et al.*, 2011b). In terms of environmental policy support, sociopolitical factors appear to be only one aspect of influence for individuals (Larson & Santelmann, 2007).

With existing challenges from over-allocated surface water supply in the Willamette Valley, rising pressures from climate change, population growth, and increasing water usage (Oregon Water Resources Department, 2012) future water management and policy calls for collaboration among bodies of governance, policy makers, and the diverse collection of water users in the Willamette Valley. Cooperative policy development may minimize controversy and encourage acceptance with sufficient public support to smooth implementation. As such, exploring potential influence of respondent geography, environmental beliefs, perceptions about water, and socio-demography may help to cultivate an understanding of the social and economic context of the Willamette Valley. This study evaluated policy preferences as well as potentially formative factors such as environmental worldview beliefs measured by the NEP, beliefs specifically related to water management objectives, perceptions about water, and socio-demographic characteristics.

Chapter 3. Research and Methods

The survey area focused on three geographic locations in the Willamette Valley: Lower Valley (portions of Washington and Yamhill Counties), Middle Valley (Marion County), and Upper Valley (Lane County). The county represents a fundamental unit of analysis since counties play key roles both as stand-alone policy-making authorities and as intermediaries between state and local governments typically responsible for implementation of environmental policy (Salka, 2001). The scope of water use and management policy has increasingly shifted toward watershed-level water resource management in recent years (Figure 1.2). These three locations were chosen because, according to the U.S. Census Bureau, although these locations vary significantly both in population totals and densities (Table 3.1), they represent the three major population centers in the state: Portland, Salem, and Eugene (Hulse *et al.*, 2002).

Following landmark land use laws enacted as part of an integrated statewide land-use planning program in the early 1970s, each urban area in Oregon was required to establish an urban growth area or boundary (UGB) to control urban expansion onto farm and forest lands (Hulse *et al.*, 2002). For this study, the rural-urban place of residence classification was derived from the position of selected tax lots relative to urban growth boundaries (UGBs). To determine whether a tax lot lay inside or outside of a UGB, the tax lot data was superimposed over Department of Land Conservation and Development UGB data (Development, 2012) and assigned the appropriate value (a more detailed explanation of the selection criteria can be found in Figure 3.1). This stratum included respondents residing inside the UGB ("urban") and those residing outside the UGB ("rural"), analogous with many definitions of place of residence found in the literature (Bjornlund *et al.*, 2013; Hubbard, 2013; Salka, 2001; Sharp & Adua, 2009; Wolters, 2012).

As a result of Oregon's regulated growth using UGBs, the Willamette Valley has grown into a blend of urban sprawl, agriculture, and forestlands (Figure 3.2). Due largely to the fertile soils and long growing season, the valley floor of the Willamette

River Basin represents a major agricultural region in Oregon. Land use in the foothills and higher elevations is primarily centered on the timber industry. Often, however, these farm and forested lands are intermixed with rural and urban development. In all, about 70% of the Willamette Valley is forestland, 22% is used for agriculture, 6% for urban centers, and less than 4% for rural residential use (Hulse *et al.*, 2002; Oregon Water Resources Department & U.S. Bureau of Reclamation, 2013). For this study, the land use stratum was comprised of selected tax lots coded by property classification to denote different land uses including farm and forest ("agriculturalist") landowners and "residential" landowners.

3.1 Research design

The data collection tool for this study was the Water in the Willamette Valley mail survey conducted in Spring-Summer of 2013. The survey instrument consisted of a broad set of questions developed from stakeholder focus group material and similarly focused previously conducted studies. Specifically, the survey was designed to evaluate the following:

- perceptions about water use, availability, and scarcity;
- attitudes toward water allocation, conservation, and prospective policy measures;
- management goals for property, conservation behavior, and prospective future land use and ownership;
- priorities for habitation and concerns about impacts to future quality of life;
- general environmental worldview beliefs and beliefs specifically related to water management objectives;
- cognitive processes and sources for information gathering about water;
- participation in water-related activities and organizations;
- socio-demographic characteristics.

The survey required that respondents be Willamette Valley residents 18 years of age or older. Using a modified version of the "Tailored Design Method" devised by

Dillman (2002) to achieve desired response rates and reduce coverage, sampling, non-response, and measurement error, a total of three mailings were disseminated. The first mailing consisted of the questionnaire accompanied by a cover letter stating the survey's purpose, summarizing the researchers' intention for the survey data, and informing respondents of the right to opt out of participation. In addition, a business reply mailer with postage was provided for returning the survey. The two subsequent mailings included a reminder post card thanking respondents for their participation followed by a second mailing of the questionnaire to individuals that had not yet returned the survey.

For this study, respondents were stratified by geographic location, place of residence, and land use type. From the selected population, 1,600 lots were randomly chosen from each of three geographic locations for a total sample size of 4,800 landowners. Sample size was based on a 95% confidence interval and an assumed 25% response rate. The Institutional Review Board (IRB #4722) at Oregon State University granted permission for use of human subjects.

Survey questions analyzed for this study focused on perceptions about the role and availability of water in the Willamette Valley, conceptualization of place-based identity, environmental worldview and water management-specific beliefs, acceptability of water policy alternatives, and belief in water regulation (Table 3.2). Information was also collected on socio-demographic characteristics (Table 3.2). The process by which variables were constructed is outlined below with variable names (as specified in Table 3.2) indicated in parentheses.

3.2 Dependent variables

3.2.1 Prospective water policy preferences

Respondents were asked to indicate the degree of acceptability of thirteen policy statements describing methods of allocating water among competing uses in times of limited water availability. Responses to each statement were coded using a 4-point Likert-type scale indicating level of acceptability (4 = high, 3 = moderate, 2 =

low, 1 = none). Principal components analysis with varimax orthogonal rotation (Fabrigar *et al.*, 1999) was used to assess internal consistency and, where appropriate, reduce the number of statements so that only items that factored together were included in scale scores. Cronbach's alpha (α) was used to test for the internal reliability of each commonly factored component group (Cortina, 1993). As a result, three component group variables (*Equity*, *Reallocation*, and *Storage*) were constructed. Three statements did not factor together reliably (α=0.256) and so three individual statement variables (*CurrentLaw*, *SellExcess*, and *DistPayMore*) were constructed.

Four items were used to construct a scale score for *Equity*: (a) The method that makes the most economic sense regardless of priority, (b) Users must share any excess water beyond what they need, (c) All potential users have equal access to water that is available, and (d) Those who use more water pay more for its use. The *Equity* scale (*n*=1,186) ranged from 4 to 16, with a higher score on the scale indicating a higher level of policy support. According to Table 3.3 the mean ($\pm$SD) *Equity* policy support score for the sample was 11.0 (2.8) with 17% of total variance explained. Cronbach's alpha (α) for the scale was 0.615, suggesting that the scale has internal consistency and is a reliable measure of water policy support for the component statements.

Four items were used to construct a scale score for *Reallocation*: (a) Give water not used by agriculture to municipal use, (b) Give water not used by agriculture to biological use, (c) Give water not used by agriculture to recreational use, and (d) Allow the state to decide allocation methods for water. The *Reallocation* scale (*n*=1,216) ranged from 4 to 16 and demonstrated suitable internal consistency (α=0.599). The average ($\pm$SD) *Reallocation* scale score for the sample was 9.8 (2.5) with 14% of total variance explained (Table 3.3).

Two items were used to construct a scale score for *Storage*: (a) Store enough water in reservoirs to account for all potential users, and (b) Build more facilities for water storage and replenishment. The *Storage* scale (*n*=1,242) ranged from 2 to 8 and demonstrated suitable internal consistency (α=0.628). The average ($\pm$SD) scale score for the sample was 6.3 (1.5) with 13% of total variance explained (Table 3.3).

Three individual statement variables were considered separately during analysis including: (a) Current Oregon water law i.e., "first in line, first in right" (*CurrentLaw*, *n*=1,224), (b) Users may sell any excess water beyond what they need (*SellExcess*, *n*=1,251), and (c) Users farther from the water source pay more for its use (*DistPayMore*, *n*=1,249). Each of these individual policy variable scales ranged from 1 to 4. According to Table 3.3 the mean (±SD) scale score for the sample for *CurrentLaw* was 2.9 (0.9), for *SellExcess* was 2.4 (1.0), and for *DistPayMore* was 2.5 (0.9).

3.2.2 Belief in water regulation

Belief in regulation relating to water use and management (*Regulation*) was assessed by asking participants, "Do you believe that at least some regulation should exist related to water use and management" (yes = 2, unsure = 1, no = 0).

3.3 Independent variables

The primary independent variables included geographic strata, perceptions about water, general environmental worldview, specific environmental beliefs about water management, and socio-demography.

3.3.1 Residential characteristics

In order to target a variety of landowners for the survey, a stratified random sample was selected using county tax lot data. The geographic location stratum was coded by county for each of the selected tax lots (1 = Lane County, 2 = Marion County, and 3 = Washington/Yamhill Counties). The rural-urban place of residence classification included residents outside the UGB ("rural" = 0) and inside the UGB ("urban" = 1). The land use type stratum was comprised of farm and forest landowners ("agriculturalist" coded as 0) and "residential" landowners (coded as 1).

3.3.2 Socio-demographic characteristics

Socio-demographic information for the sample was also collected from the survey (Table 3.2). *Identity* described how a respondent best characterized their place-based identity from more to less localized conceptualization (United States resident = 4, Pacific Northwest resident = 3, Oregon resident = 2, Willamette Valley resident = 1, Other = 5). Additional space beside ‘Other’ was provided for respondents to write in an answer although qualitative analysis of those responses was outside the scope of this study. Household size (*Hhsize*) was defined as the integer value of the number of individuals living in respondents’ household at the time of the survey. *Children* indicated the presence (1 = yes) or absence (0 = no) of individuals less than 18 years of age living in the household. *Tenure* was the integer value of respondents’ time (in years) at the current residence. For respondent gender (*Sex*), binomial responses were used (1 = female, 0 = male). Respondent age (*Age*) was derived from the integer value of the respondents’ year of birth subtracted from 2013 to obtain the respondents’ age in years. For highest level of formal education completed (*Education*), respondents were asked to select from the following seven categories (coded sequentially 1 through 7, from lowest to highest level of education): (a) Less than high school, (b) High school or equivalent (e.g., GED), (c) Vocational or trade school, (d) Some college, (e) College degree (2-year or certificate), (f) College degree (Bachelor’s), and (g) Graduate or professional degree. For gross household income (*Income*), respondents were asked to select from a range of incomes grouped into $25,000 increments (five groups total, coded sequentially 1 through 5, from least to greatest income) from a low of less than $25,000 to a high of $100,000 or more.

Nearly all respondents were homeowners (99%), most likely because landowners were the target audience for the survey. Also, more than 90% of respondents identified their race or ethnicity as White or Caucasian. Due to their homogeneity across Willamette Valley respondents, these variables were omitted from the final analysis and results.

3.3.3 Perceptions about water

To determine how far into the future individuals considered the role of water (*H2ORole*), respondents were asked, “How far into the future do you think about the role of water in your life?” Responses were coded by the indicated extent (today = 1, this week = 2, this month = 3, this year = 4, five to ten years = 5, my lifetime = 6, I think about future generations = 7, I don’t think about it at all = 9).

Perceptions about water availability in the Willamette Valley were determined by asking respondents, “To what degree do you believe the Willamette Valley has enough water to meet the needs of people, plants, and animals in each of the following time periods”: (a) Currently (*AvailNow*), (b) 10 years into the future (*Avail10Yr*), (c) 50 years into the future (*Avail50Yr*), and (d) 100 years into the future (*Avail100Yr*). Responses to each statement were measured on a 5-point Likert scale (5 = strongly agree, 4 = agree, 3 = unsure, 2 = disagree, 1 = strongly disagree).

3.3.4 Environmental beliefs

General environmental worldview beliefs were assessed by asking respondents to indicate strength of agreement with ten of the fifteen revised New Ecological Paradigm (NEP) statements (Dunlap *et al.*, 2000). Five items were eliminated from the survey based on space and time limitations, as well as for outmoded or confusing wording as determined from feedback from a workshop conducted by the Willamette Water 2100 project group in spring 2013. The remaining ten NEP items covered four of the five dimensions, including balance of nature (three items), limits to growth (one item), anti-anthropocentrism (three items), and the likelihood of eco-crisis (three items). Responses for each item were measured using a 5-point Likert-type scale indicating level of endorsement for each statement (5 = strongly agree, 4 = agree, 3 = unsure, 2 = disagree, 1 = strongly disagree).

Due to the removal of items and dimensional ambiguity of the NEP measure within the literature (Dunlap *et al.*, 2000), the surveyed NEP items were factor-analyzed using principal components analysis with varimax rotation to create orthogonal dimensions with eigenvalues greater than 1. As a result, two environmental worldview scale variables were constructed (*DSP, NEP*).

Four items were used to construct a scale score for *DSP*: (a) Humans have the right to modify the natural environment to suit their needs, (b) Humans were meant to rule over the rest of nature, (c) The so-called ecological crisis facing humans has been greatly exaggerated, and (d) The balance of nature is strong enough to cope with impacts of modern industrial nations. The *DSP* scale (n=1,331; α=0.809) ranged from 4 to 20, with a higher score on the scale indicating higher endorsement of the anthropocentric perspective of natural resources typically embodied by the traditional dominant social paradigm (Dunlap *et al.*, 2000). According to Table 3.4 the mean ($\pm$SD) *DSP* scale score for the sample was 11.1 (4.5) with 35% of total variance explained, and the Cronbach's alpha value suggested that the *DSP* scale had internal consistency and therefore was a reliable measure of endorsement for the component environmental belief statements.

Six items were used to construct a scale score for *NEP*: (a) If things continue on their present course, we will soon experience a major ecological catastrophe, (b) We are approaching the limit of the number of people the earth can support, (c) The balance of nature is very delicate and easily upset, (d) When humans interfere with nature it often produces disastrous consequences, (e) Plants and animals have as much right as humans to exist, and (f) Humans are severely abusing the environment. The *NEP* scale (n=1,330; α=0.872) ranged from 6 to 30 with a higher score on the scale signifying higher endorsement of the pro-environmental NEP. According to Table 3.4 the average ($\pm$SD) *NEP* scale score for the sample was 20.4 (6.4) with 28% of total variance explained, and the *NEP* scale was shown to be internally consistent.

Environmental beliefs specifically related to water use and management were assessed by asking respondents to indicate strength of agreement with four water management statements. Responses for each item were measured using a 5-point Likert-type scale indicating level of endorsement for each statement (5 = strongly agree, 4 = agree, 3 = unsure, 2 = disagree, 1 = strongly disagree). Two variables

(*Utilitarian*, *Ecological*) were constructed using principal components analysis with varimax rotation.

Two items were used to construct a scale score for *Utilitarian*: (a) Humans should manage water resources so that *only* humans benefit, and (b) Water resources exist primarily to be used by humans. The *Utilitarian* scale (n=1,329; α=0.803) ranged from 2 to 10 with a higher score indicating stronger belief that water management should be focused exclusively on humanistic concerns. According to Table 3.4 the average ($\pm$SD) *Utilitarian* scale score for the sample was 3.6 (2.0) with 42% of total variance explained.

Two items were used to construct a scale score for *Ecological*: (a) Water resources should be managed for their own sake rather than simply to meet the needs of humans, and (b) We should focus on doing what is best for other species that depend on water instead of what is best for humans. The *Ecological* scale (n=1,317; α=0.610) ranged from 2 to 10 with a higher score indicating stronger belief that water management should focus on biocentric concerns as much or more than humanistic concerns. According to Table 3.4 the average ($\pm$SD) *Ecological* scale score for the sample was 6.1 (2.2) with 36% of total variance explained.

3.4 Statistical Analysis

All statistical analyses were run using IBM SPSS Statistics 21 (SPSS, Inc.). Principal components factor analysis with varimax rotation was used for data reduction. Cronbach's alpha (α) was used as the test for reliability with alpha values defined at the 95% confidence interval. One-way ANOVA, chi-square, and Pearson's r were used to compare sample means and test bivariate relationships (Sokal & Rohlf, 1995). To assess the strength of relationships between variables, effect size (Gliner *et al.*, 2001) was calculated where appropriate.

Chapter 4. Results

A response rate of 32.5% was achieved. Survey participants were evenly distributed across Lane (31%, n=437), Marion (35%, n=491), and Washington/Yamhill (34%, n=474) Counties. Respondents were comprised of with 832 (59%) rural and 570 (41%) urban residents, and 883 agriculturalists owning farm or forest property (63%) and 519 residential landowners (37%; Figure 4.1).

A non-response follow-up (n=383, 15.3%) was performed to assess demographic differences between original survey respondents and non-respondents. Approximately 75% of non-respondents were over the age of 52 compared to an average age of about 64 for respondents in the original survey. Over half of non-respondents (55%) reported having an unspecified college degree while a slightly smaller percentage of respondents (47%) reported at least a Bachelor's degree. The percentage of non-respondent women (49%) was slightly higher than that of respondents (40%). Non-respondents had a higher proportion of both urban residents (43%) and residential landowners (46%) than respondents in the original survey (41% and 37%, respectively). Findings from the non-response survey indicated that the most common reasons for not completing the original survey were that non-respondents did not like answering surveys (35%), they thought the survey looked too long and/or complicated (36%), or they do not have time to answer surveys (26%).

4.1 Sample characteristics across geographic strata

Generally, survey respondents characterized their conception of place-based identity as Oregon residents foremost (34%), and then as Willamette Valley residents (24%), U.S. residents (23%), or Pacific Northwest residents (13%). Location, place of residence, and land use were not significantly associated to *Identity*. Female respondents (F=5.485, df=1, p=0.019, Eta=0.065) as well as those with longer tenure (r=–0.063, p=0.022) were more likely to have more localized characterizations of identity (e.g., Willamette Valley residents).

For respondents stratified by location, Lane County had smaller households on average and had fewer households with children (Table 4.1). Washington/Yamhill County households were larger on average and had more households with children (Table 4.1). Although females comprised less than half of respondents in all three locations, Washington/Yamhill Counties contained the highest percentages of women, while Marion County contained the lowest proportion of female respondents (Table 4.1). Average age was similar for both Lane and Marion County while Washington/Yamhill respondents tended to be younger (Table 4.1). Overall, about 47% of survey respondents reported at least a Bachelor's degree. Washington/Yamhill respondents were more likely to have higher levels of education whereas Marion County respondents were more likely to have lower levels of formal education (Table 4.1). Sixty-nine percent of respondent households earned $50,000 or more in gross annual income. Among the three locations, Washington/Yamhill households reported higher household incomes while Lane County respondents reported lower incomes (Table 4.1).

For respondents stratified by rurality, average tenure, age, and gross annual household incomes were higher for rural residents while the proportion of female respondents was higher for urban residents (Table 4.2). For respondents stratified by land use, agriculturalist landowners tended to be older on average, and reported longer tenure, higher levels of education, and higher household incomes than residential landowners (Table 4.2). Residential landowners had more households with children and higher proportions of women (Table 4.2).

4.2 Perceptions about water

Respondents across all geographic strata most commonly thought about the role of water for future generations or at least within their lifetime (Table 4.3 and Table 4.4) although strata were not significantly associated with *H2ORole*. Older respondents (r=0.088, p=0.002) as well as those with smaller households (r=–0.059, p=0.035), and those with less localized characterization of identity (r=0.055, p=0.049) were more likely to consider the role of water further into the future.

Overall, the majority of survey participants (90%) believed that the Willamette Valley has enough water to meet the needs of people, plants, and animals now. This number fell to 72% of respondents perceiving water availability in 10 years, 31% perceiving water availability in 50 years, and only 19% of respondents perceived sufficient water in the Willamette Valley in 100 years. Washington/Yamhill respondents were generally less likely to perceive water availability over all time periods, especially in 50 years time, relative to Lane and Marion Counties (Table 4.3). Respondents with more localized characterizations of place-based identity (e.g., Willamette Valley residents) were more likely to believe that water is currently available to meet Willamette Valley needs ($r=-0.071$, $p=0.014$) but less likely to perceive sufficient water availability in 100 years ($r=0.073$, $p=0.011$). Respondents with higher household incomes were more likely to believe the Willamette Valley has enough water to meet needs now ($r=0.078$, $p=0.010$) and 10 years into the future ($r=0.098$, $p=0.001$). Respondents with higher levels of formal education were more likely to perceive water availability now ($r=0.058$, $p=0.043$). Respondents in larger households as well as those with children were more likely to perceive water availability in 10 years ($r=0.089$, $p=0.002$ and $F=6.358$, $df=1$, $p=0.012$, $Eta=0.072$, respectively), in 50 years ($r=0.118$, $p<0.001$ and $F=5.496$, $df=1$, $p=0.019$, $Eta=0.067$, respectively) and in 100 years ($r=0.135$, $p<0.001$ and $F=6.790$, $df=1$, $p=0.009$, $Eta=0.074$, respectively). Similarly, male respondents were more likely to believe sufficient water would be available now ($F=11.375$, $df=1$, $p=0.001$, $Eta=0.097$), in 10 years ($F=18.565$, $df=1$, $p<0.001$, $Eta=0.123$), in 50 years ($F=11.046$, $df=1$, $p=0.001$, $Eta=0.094$), and in 100 years ($F=18.030$, $df=1$, $p<0.001$, $Eta=0.120$).

4.3 Environmental beliefs

Residential landowners had higher *NEP* scale scores than agriculturalist landowners (Table 4.5). Although not significant, urban residents generally had higher *NEP* scale scores whereas rural residents had higher *DSP* scale scores (Table 4.5). Also, Marion County respondents generally had higher *DSP* scale scores and lower *NEP* scale scores than either Lane or Washington/Yamhill Counties (Table 4.5).

Respondents who considered the role of water further into the future were more likely to have lower *DSP* scale scores and higher *NEP* scale scores (Table 4.5). Conversely, individuals that believed the Willamette Valley has sufficient water availability across all time scales were more likely to have higher *DSP* scale scores whereas those that perceived insufficient water availability across all time periods were more likely to have higher *NEP* scale scores (Table 4.5). Male respondents as well as those with larger households, longer tenure, and those with lower levels of education were more likely to endorse the DSP worldview (Table 4.5). Female respondents as well as those with smaller households, more localized identity, and those with lower incomes were more likely to endorse the NEP worldview (Table 4.5).

Agriculturalist landowners had higher *Utilitarian* scale scores than residential landowners (Table 4.5). Individuals that perceived sufficient water availability across all time scales were more likely to have higher *Utilitarian* scale scores whereas those that perceived insufficient water availability across all time periods were more likely to have higher *Ecological* scale scores (Table 4.5). Male respondents as well as those with larger households, longer tenure, older respondents, and those with lower levels of education were more likely to have utilitarian environmental beliefs about water management. Female respondents as well as those with smaller households and lower incomes were more likely to have pro-ecological environmental beliefs about water management.

4.4 Attitudes toward water allocation policy

Overall, survey respondents supported at least some regulation regarding water use and management (Table 4.6 and Table 4.7). Water regulation was supported in varying degrees across the geographic strata, and was significantly linked to all three strata (Figure 4.2). Washington/Yamhill respondents showed the strongest belief in water regulation relative to Lane and Marion Counties (Table 4.6). Urban residents and residential landowners indicated stronger beliefs in water regulation compared to rural residents and agriculturist landowners (Table 4.7).

The thirteen policy statements were factored together into *Equity*, *Reallocation*, and *Storage* component variables and *CurrentLaw*, *SellExcess*, and *DistPayMore* individual statement variables (Figure 4.3). Lane County respondents were more likely to support *Reallocation* policies than Washington/Yamhill or Marion County respondents (Table 4.6). Conversely, Marion County respondents were more likely to support *CurrentLaw* policy than Washington/Yamhill or Lane County respondents (Table 4.6). Urban residents were more likely to support *Equity* policies relative to rural residents (Table 4.7). Residential landowners were more likely to support *Equity* and *Reallocation* policies whereas agriculturalist landowners were more likely to support *CurrentLaw* policy (Table 4.7).

4.4.1 Socio-demography and policy support

Male respondents as well as those with higher levels of education were more likely to support water regulation (Table 4.8). Female respondents as well as those with smaller households, lower levels of education, and those with lower household incomes were more likely to support *Equity* policies (Table 4.8). Respondents with lower levels of education and those with lower incomes were more likely to support *Storage* policies (Table 4.8). Male respondents as well as those with longer tenure, older respondents, and those with lower levels of education were more likely to support *CurrentLaw* policies (Table 4.8). Younger respondents were more likely to support *SellExcess* policies (Table 4.8). Male respondents were more likely to support *DistPayMore* policies (Table 4.8).

4.4.2 Perceptions about water and policy support

Respondents who believed in sufficient water availability in the Willamette Valley to meet the needs of all people, plants, and animals now (F=3.866, df=4, p=0.004, Eta=0.114) and 10 years into the future (F=3.068, df=4, p=0.016, Eta=0.101), but who did not perceive water availability in 50 years (F=14.962, df=4, p<0.001, Eta=0.218) or in 100 years (F=19.220, df=4, p<0.001, Eta=0.245) were more likely to support at least some regulation related to water use and management. An association also emerged between respondents that perceived water availability in the Willamette Valley across all time periods and those indicating uncertainty about (rather than supporting or opposing) water regulation.

Respondents that considered the role of water in their lives further into the future were less likely to support *SellExcess* policy. Those with less localized conceptualization of identity (e.g., characterized as Oregon or U.S. residents) were more likely to support both *Equity* and *Reallocation* policies (Table 4.8). Respondents that believed in water regulation were more likely to support *Equity*, *Reallocation*, and *DistPayMore* policies but less likely to support *CurrentLaw* and *SellExcess* policies (Table 4.8). Respondents indicating uncertainty about water regulation were more likely to support *CurrentLaw* but comparable in lack of support for *SellExcess* policies to those not believing water regulation should exist.

4.4.3 Environmental beliefs and worldviews and policy support

Respondents that endorsed the DSP worldview as well as those with utilitarian environmental beliefs related to water use and management were less likely to support water regulation (Table 4.8). Conversely, those that endorsed the NEP worldview and those with pro-environmental beliefs related to water use and management were more likely to support regulation (Table 4.8). Respondents with higher *DSP* scale scores were less likely to support *Equity* and *Reallocation* policies but more likely to support *Storage*, *CurrentLaw*, and *SellExcess* policies (Table 4.8). Similarly, those with utilitarian environmental beliefs were less likely to support *Equity* and *Reallocation* policies but more likely to support *Storage*, *CurrentLaw*, and *SellExcess* policies (Table 4.8). Conversely, respondents with higher *NEP* scale scores were more likely to support *Equity*, *Reallocation*, and *DistPayMore* policies but less likely to support *CurrentLaw* and *SellExcess* policies (Table 4.8). In addition, respondents with pro-environmental beliefs were more likely to support *Equity*, *Reallocation*, and *DistPayMore* policies but less likely to support *Storage*, *CurrentLaw*, and *SellExcess* policies (Table 4.8).

Chapter 5. Discussion

Understanding attitudes toward water management practices and policy initiatives will be crucial for developing viable policy solutions to address water issues in the Willamette River Basin. Some Oregon-specific research has explored water issues (Oregon Water Resources Department, 2012), water resource knowledge and civil society (Hubbard, 2013), and environmental concern related to water issues (Wolters, 2012). Although it is commonly recognized that water management should focus on identifying watershed-level issues and challenges specific to the basin (Wolters, 2012), few studies have explored attitudes towards specific policy measures for addressing water scarcity concerns, and none have focused on the regional context of the Willamette Valley. This study evaluated attitudes toward water regulation and potential water distribution policies in the Willamette Valley based on geography, perceptions about water, environmental beliefs, and socio-demographic characteristics.

Results suggested that there are more similarities than differences in attitudes toward water regulation and policy preferences among the three geographic strata. Across the Willamette Valley, respondents generally believed in at least some regulation related to water use and management. Yet, some prospective water policies were more acceptable to respondents than others across the geographic strata.

5.1 Policy support across the landscape

Willamette Valley residents generally supported existing “first in time, first in right” prior appropriation-based water allocation policy. However, higher support for the *CurrentLaw* policy among agriculturalist landowners as well as respondents in Marion County (Figure 4.4) may have resulted from social proximity to or involvement with agriculture, a finding that is consistent with past studies (Salka, 2001; Sharp & Adua, 2009). Whether higher support from these sub-populations reflected satisfaction with the status quo, unease about new policy in general, or uncertainty about the specific policy initiatives proposed in the survey is beyond the scope this study. However, agriculturalists as well as locations with higher proportions of agriculturalist landowners (e.g., Marion County) may consider the status quo more acceptable than alternate water policy initiatives which they may perceive as threatening to farm and timber industries (Salka, 2001; Sharp & Adua, 2009). Notably, there was no difference between urban and rural acceptability of *CurrentLaw* (Figure 4.4). This is consistent with previous findings related to the social proximity theory (Tremblay & Dunlap, 1978) which posited that only those with close social interactions with agriculturalists share value agreement (Sharp & Adua, 2009) and, therefore, physical proximity (e.g., rurality) may not be as strong of an indicator for policy support as social proximity.

Like Sharp and Adua (2009), our results suggested similarity in policy support among those with closer social rather than physical proximity. Higher support of *Equity* policies by both urban residents and residential landowners suggested that although these populations generally consider current water policy (*CurrentLaw*) moderately acceptable, they were more willing to support alternative policy initiatives than rural residents or agriculturalist landowners. This was not unusual since the policy statements contained by the *Equity* policy variable ("regardless of priority", "must share", "all equal access", "use more pay more") would likely be more beneficial for urban residents and residential landowners compared to rural residents or agriculturalist landowners. In the same way, higher support for *Reallocation* policies was observed among Lane County respondents and residential landowners. While considerable variation in acceptability existed among the locations and between residential and agriculturalist landowners, support for *Reallocation* policies by rurality was comparatively homogeneous, and revealed moderate support for *Reallocation* policies regardless of rurality. This may substantiate social relationships among the landowner types as more influential for policy support than physical proximity reflected by rurality. This also may suggest that policies permitting the transfer of unused allotments of water to other municipal, biological, or recreational uses may be politically divisive between the different socially proximate groups (Bjornlund *et al.*, 2013; Oregon Water Resources Department, 2012). Higher support for *Equity* and/or

Reallocation relative to *CurrentLaw* among urban residents and residential landowners may be evidence that these stakeholders are more aware of the complexity of watershed issues and the need for new methods of distributing water in the Willamette Valley (Bjornlund *et al.*, 2013). Alternatively, these stakeholders may have the luxury of supporting alternative pro-environmental water policies over extant water policy with few perceived impacts to their own lifestyle (Bjornlund *et al.*, 2013).

Some policy measures, including *Storage*, *SellExcess*, or *DistPayMore* policies, were not linked to any geographic strata. In particular, *SellExcess* was only associated with younger respondents and those less likely to consider the role of water further into the future. This may corroborate findings by Bjornlund *et al.* (2013) whereby respondents with utilitarian or undecided environmental beliefs showed higher support for expropriation compared to transfers from agricultural to ecological needs with compensation. These sub-populations may view idle allocations of water held speculatively unfavorably and further, that respondents including irrigators may support attempts to extract water from agricultural users without compensation (Bjornlund *et al.*, 2013). However, this policy objective would likely be politically problematic and difficult to implement as it could significantly impact agricultural communities.

5.2 Policy support, environmental beliefs, and socio-demography

Several socio-demographic patterns emerged in both environmental beliefs and attitudes toward water regulation and support for particular policies. Respondents with more localized place-based identities (e.g., identifying as Willamette Valley residents) tended to endorse the NEP worldview, likely because they conceptualized their identity analogously with watershed-level water management. In the same way, respondents with more localized characterizations of place-based identity were more likely to support *Equity* and *Reallocation* policies. These findings contradicted the hyperopia effect in which individuals exhibited greater concern for broader scale national or global environmental issues (Larson *et al.*, 2011a; Larson *et al.*, 2011b). Localized place-based identity may therefore be linked to social proximity, whereby individuals would be more likely to support and benefit from resource protection (Larson & Santelmann, 2007). Similarly, results supported previous findings relating sex and place-based identity where women tended to express greater concern about local environmental problems (Larson *et al.*, 2011b).

Also consistent with past literature, female respondents were more likely than males to express pro-environmental worldviews and beliefs related to water management (Larson *et al.*, 2011a; Salvaggio *et al.*, 2013). Additionally, findings corroborated other studies that found heightened environmental concern in women (Larson *et al.*, 2011a; Sharp & Adua, 2009). Female respondents were more likely to support more pro-environmental policies (i.e., *Equity*), whereas male respondents were more likely to support existing water policy or policy measures similar to the extant water permitting process (i.e., *SellExcess*). However, men showed stronger belief that there should be water regulation which suggested that influence of gender on attitudes toward water regulation and policy may be mixed (Larson *et al.*, 2011a; Salvaggio *et al.*, 2013).

Respondents with larger households were more likely to endorse the traditional DSP worldview and to have utilitarian beliefs about water management, whereas smaller households were more likely to endorse the NEP worldview and have pro-environmental water management beliefs. However, households with children were not linked to either general worldviews or water management-specific environmental beliefs. Although smaller households were more likely to support *SellExcess* policy, there was generally little distinction among the other policy variables with either *HhSize* or *Children*. These findings counter previous research suggesting that larger households, especially those with children, may be more conservation-oriented (Morzillo *et al.*, 2007).

Older respondents were more likely to believe in utilitarian water management consistent with past literature (Corral-Verdugo *et al.*, 2003). Some research has suggested that younger individuals were more likely to endorse the NEP worldview (Arcury, 1990; Dunlap *et al.*, 2000; Jones & Dunlap, 1992), but this study found no linkage between age and environmental worldview. Both older respondents and those with longer residential tenure were more likely to support existing water policy, which contrasted previous literature that found older individuals showed greater support for pro-environmental regulation and policy (Larson *et al.*, 2011b; Sharp & Adua, 2009) or that suggested age may be a weak indicator of policy support, especially in Oregon (Salka, 2001). These results also substantiated previous findings where those with longer tenure may be acclimatized to existing levels of regulation and current policy and therefore were more likely to support the status quo (Larson *et al.*, 2011b).

Some authors have theorized that higher educated individuals were more capable of comprehending the ecological perspective implicit in the NEP due to higher exposure to information about environmental issues (Dunlap *et al.*, 2000; Jones & Dunlap, 1992). Rather than linking higher education to endorsement of the NEP as was found in past literature (Arcury, 1990; Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Jones & Dunlap, 1992; Salvaggio *et al.*, 2013), our findings showed the converse, where lower levels of formal education were associated with endorsement of the DSP worldview and utilitarian water management beliefs. These results countered other research showing lower levels of education correlated to greater environmental concern (Sharp & Adua, 2009; Slimak & Dietz, 2006). Respondents with lower levels of education were less likely to believe in regulation but were more likely to support a variety of policies ranging from *CurrentLaw* to *Storage* to *Equity* policies. This variation in policy support runs counter to past literature suggesting a link between higher education and higher support for water conservation (Salvaggio *et al.*, 2013).

Consistent with previous research (Corral-Verdugo *et al.*, 2003; Dunlap *et al.*, 2000; Jones & Dunlap, 1992), lower income was associated with pro-environmental worldviews and pro-environmental water management beliefs. Lower incomes were also linked to support for *Equity* and *Storage* but not to *CurrentLaw*. These findings may corroborate past literature that found lower income respondents tended to consume less water than more affluent respondents, possibly because they were regularly affected by water scarcity and were therefore more aware of water issues (Corral-Verdugo *et al.*, 2003). Other authors have found that higher income translated into higher support for environmental policies, especially in terms of willingness to pay (Thorvaldson *et al.*, 2010). Overall, the inconsistency in linkages and the direction of association between education or income and attitudes toward water management and policy in the past literature illustrate the complexity of water resource issues among socio-demographically diverse populations.

5.3 Environmental beliefs across the landscape

Results revealed a number of relationships with environmental worldviews and environmental beliefs specifically related to water management objectives. Associations revealed between perceptions about water and environmental beliefs were consistent with previous research, such that pro-environmental beliefs are associated with greater affective perceptions of environmental concern (Arcury, 1990; Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Jones & Dunlap, 1992; Larson *et al.*, 2011b; Salvaggio *et al.*, 2013; Slimak & Dietz, 2006; Stern & Dietz, 1994; Stern *et al.*, 1999; Wolters, 2012). Location and place of residence were not significantly linked to general or specific environmental beliefs which may suggest that there are more similarities than differences in beliefs among geographic locations and rural-urban place of residence (Huddart-Kennedy *et al.*, 2009b; Salka, 2001; Sharp & Adua, 2009). Alternatively, this lack of association may reflect values agreement stemming from the moderately pro-environmental proclivity generally observed in Oregon (Wolters, 2013) and from preliminary analysis across Willamette Valley respondents in this study. While residential landowners were correlated to endorsement of the NEP and agriculturalist landowners were linked with utilitarian beliefs in water management, no relationship existed between landowner types and either the *DSP* or the *Ecological* variables. These results deviate from other findings contending that both rurality and dependence on resource-related industries correlates to utilitarian, anthropocentric environmental beliefs (Salka, 2001). Instead, these findings further substantiate the argument that rurality may be less influential on environmental beliefs and concern than the social relationships found within resource-related industry (Sharp & Adua, 2009).

The four survey statements targeting water-specific beliefs were split antithetically resulting in two component variables that endorsed mutually exclusive beliefs about water management. *Utilitarian* articulated purely humanistic water use and management objectives, whereas *Ecological* focused purely on biocentric objectives (Stern *et al.*, 1999). Since no association was found between any geographic strata and the *Ecological* variable, respondents ostensibly believed that water management should be focused primarily on human needs rather than managing water resources solely for other species or for the water resources in their own right. Some authors have argued that internal conflict can arise when contradictory beliefs exist within one's hierarchical system of beliefs (Huddart-Kennedy *et al.*, 2009b; Rokeach, 1968). Dietz *et al.* (2005) further suggested that survey questions may not provide a decision context that allows for reflection and may pressure individuals to respond without consulting their full range of personal values. In addition, Bjornlund *et al.* (2013) found that because such beliefs statements necessarily need to be brief, there is a risk that conflicting interpretations may occur among respondents. In this way, these statements may have compelled an "either/or" decision when, in reality, water management often involves integrating human and ecological considerations. These findings represent an additional layer of complexity when applied to water policy development. Even though these belief statements only allowed respondents to express the extremes of the spectrum, if given a policy choice, the majority of Willamette Valley residents may choose human needs over ecological concerns. Future policy initiatives should therefore avoid setting human- and ecological-focused water management objectives in opposition to each other.

5.4 Policy support and environmental beliefs

A fundamental assumption for this study was that environmental beliefs influenced water regulation and policy preferences. Higher support for water regulation and lower support for *CurrentLaw* among respondents with stronger pro-environmental beliefs was consistent with considerable previous research linking biocentric environmental worldviews and beliefs with pro-environmental conative attitudinal judgments (Arcury, 1990; Bjornlund *et al.*, 2013; Corral-Verdugo *et al.*, 2003; Dietz *et al.*, 1998; Dunlap *et al.*, 2000; Dunlap & Jones, 2002; Larson *et al.*, 2011b; Russenberger *et al.*, 2011; Salvaggio *et al.*, 2013; Stern & Dietz, 1994). Notably, almost twice as many respondents indicated uncertainty rather than opposition to the existence of water regulation. Higher support for *Equity* and *Reallocation* policies among respondents with pro-environmental worldviews and water-related beliefs was consistent with past research correlating pro-environmental values and beliefs with support for policies that benefited the environment (Bjornlund *et al.*, 2013; Salvaggio *et al.*, 2013). Lower support for *Equity* and *Reallocation* policies among respondents with utilitarian worldviews and beliefs about water management may be evidence of an exaggerated perception of risk from changing extant water use and management practices (Hubbard, 2013). Because agriculturalist landowners tended to exhibit utilitarian water management beliefs, this sub-population may perceive *Equity* and *Reallocation* policies as threatening to farm and forest industries, further substantiating the values/beliefs agreement found among socially proximate populations (Sharp & Adua, 2009). Hubbard (2013) found that this heightened or inaccurate risk perception could originate from limited knowledge perpetuating misconceptions and assumptions, and could influence preference toward unsatisfactory or deficient water policy. Although knowledge does not necessarily correlate with pro-environmental behaviors (Kollmuss & Agyeman, 2002), improving public awareness of water issues in the Willamette Valley as well as clearly communicating aspects of potential water policy initiatives that may be contentious may lessen opposition among these populations (Hubbard, 2013).

Higher support for *Storage* policies among respondents endorsing the DSP worldview and those with utilitarian water-related beliefs may reflect these respondents' willingness to confront water availability challenges while avoiding policies that would involve more significant changes to existing water permitting and policy (Sharp & Adua, 2009). These potentially controversial changes may include policy initiatives within *Equity* and *Reallocation* which could be unacceptable to some populations due to concern about impacts to resource-related industry (e.g., irrigators).

Lower acceptability for *Storage* policies among respondents with pro-ecological water management beliefs may be due to negative ecological consequences from creating reservoirs, including disrupting streamflow (e.g., damming) and impacting habitats (Stoutenborough & Vedlitz, 2013).

Higher support for *SellExcess* policy among respondents with utilitarian worldviews and water-related beliefs but lower support among those with pro-environmental worldviews and water-related beliefs reflected the divergence between utilitarian and protectionist beliefs about human-ecological interactions. Further, this revealed the complexity of environmental values/beliefs across geographic strata and supported the argument that respondents with utilitarian worldviews and beliefs about water management viewed idle allocations of water that are held speculatively unfavorably (Bjornlund *et al.*, 2013). Therefore, environmental beliefs explained *SellExcess* policy preference among respondents to a greater degree than geographic strata.

Findings revealed lower support for *SellExcess* but higher support for *DistPayMore* among respondents that believed at least some water regulation should exist in the Willamette Valley. These relationships paralleled those of *SellExcess* and *DistPayMore* with environmental beliefs and showed possible linkages between belief in regulation and pro-environmental beliefs. Higher support for *DistPayMore* policy among respondents with pro-environmental worldviews and water-related beliefs may further corroborate past literature theorizing that these stakeholders supported pro-environmental policy since they did not perceive negative impacts to their lifestyle from expressing pro-environmental values (Bjornlund *et al.*, 2013). However, Thorvaldson *et al.* (2010) found that support for conceptual environmental outcomes does not necessarily translate to support for specific policy initiatives and strong views do not necessarily equate to willingness to pay (Thorvaldson *et al.*, 2010). While these results contradicted this, if implementation of the *DistPayMore* policy measure were to impact these respondents acceptability of the measure may be reduced.

5.4 Variation in support for specific water allocation methods

Some variation in policy support was observed between the six policy variables and their constituent policy statements. One example of this is found in the *Storage* variable. Acceptability for the variable ranged from 46% to 51% across the three geographic strata. However, acceptability for the two individual *Storage* statements (“Store enough water in reservoirs for all potential users” and “Build more facilities for water storage and replenishment”) ranged from 74% to 84% across geographic strata. The *Storage* variable was not significantly associated with any geographic strata and was only linked to lower levels of education and income. This disparity may be explained by somewhat inconsistent support for *Storage* across the independent variables despite moderate internal consistency (r=0.628). This inconsistency could indicate limited knowledge about water storage among Willamette Valley respondents. Both built and natural water storage systems are currently implemented in Oregon and play a key role in meeting water needs (Oregon Water Resources Department, 2012). While methodological advancements and expansion continue to be considered for future water planning and management (Oregon Water Resources Department, 2012), implementation of storage initiatives alone would likely not be sufficient to resolve water concerns, especially in the face of growing pressures. As a result, future water management will likely necessitate implementation of policy including a combination of management practices. Inconsistency in support for the *Storage* policy may therefore result from perception of *Storage* as a lateral policy move or from concerns that the necessary infrastructural expansions in storage capacity could impact both ecological systems and recreational users (Oregon Water Resources Department, 2012; Stoutenborough & Vedlitz, 2013).

Variation was also noted in the perceived acceptability between the thirteen policy statements. Within the *Equity* component variable, policy measures requiring that users using more water pay more for its use and mandatory sharing of any excess water beyond what they need were among the most acceptable policy statements, especially among Lane and Washington/Yamhill respondents, urban residents, and residential landowners (Figure 4.5). Although *Equity* was moderately acceptable to respondents across geographic strata, Marion County respondents, rural residents, and agriculturalist landowners were less supportive of the "equal access to available water for all users" policy statement than other respondents. While respondents in all three locations equally showed moderate support for the "economic sense regardless of priority" policy statement, higher support was observed among both urban residents and residential landowners compared to their rural and agriculturalist counterparts. These geographic relationships correspond to those observed for *CurrentLaw* wherein both rural residents and agriculturalist landowners may have perceived that disregarding priority could threaten resource-based industries (Figure 4.4). Another explanation for these relationships could be the inherent ambiguity in which water use and management practices constituted the "most economic sense". Both *DistPayMore* and *SellExcess* were among the least acceptable policy statements across all geographic strata. The disparity in acceptability between the statement mandating sharing of excess water (contained within the *Equity* variable) and the statement allowing the sale of excess water (*SellExcess*) may explain why the policy statement comprising the *SellExcess* variable ("can sell excess water beyond their needs") did not factor together into the *Equity* component variable along with the "must share excess water beyond what they need" statement in spite of their outward similarity.

Attitudes toward the *Reallocation* variable and component statements seemed to support the hypothesis that Willamette Valley residents are generally critical of unallocated water held speculatively (Bjornlund *et al.*, 2013). Transferring idle allotments of water from agricultural to biological use (e.g., to maintain suitable stream temperature for fish) was among the most acceptable policy statements across all geographic strata suggesting that Willamette Valley respondents are generally supportive of efforts to protect ecological systems (Figure 4.6). Respondents' willingness to protect biological uses could corroborate that inconsistency in support for *Storage* was due in part to potential impacts to ecological systems. Alternatively, reallocating water not used by agriculture to recreational use was among the least acceptable policy statements across all geographic strata in spite of the overlap between biological and recreational management objectives. While low acceptability suggested that shifting water allocation to recreational purposes may be politically contentious, it may have resulted from respondents' limited knowledge of this terminology and thus unaware of what was meant by a "recreational use". The "transfer to biological use" policy statement incorporated an example to clarify what was meant by a "biological use". However, no such example was given with the recreational allocation statement, so it is possible that respondents were unfamiliar. As with the environmental beliefs statements, the policy statements necessarily needed to be concise but this brevity may have allowed conflicting interpretations to occur among respondents. Reallocating unused water allotments from agricultural to municipal uses was similarly supported among respondents in all three locations (Figure 4.6). However higher acceptability was found among urban residents and residential landowners relative to rural or agriculturalist respondents. These relationships are logical since agriculturalist landowners would be less likely to benefit from water transfers away from agriculture. Additionally, rural residents are more likely to live outside public water systems and therefore would be less likely to benefit and more likely to be impacted by these reallocations.

Contrary to past literature surveying Canadian (Bjornlund *et al.*, 2013) and Texan residents (Stoutenborough & Vedlitz, 2013), Willamette Valley respondents across all geographic strata were least likely to accept the *Reallocation* policy statement authorizing state intervention in water allocation (Figure 4.6). However, Stoutenborough and Vedlitz (2013) found that individuals supported government efforts to manage water resources during drought and implementation of plans to reduce the impact of future droughts, but only if those efforts did not impact agriculture. Further, participants supported government intervention with the caveat that the government would comprehensively explain why specific management practices were necessary and steps for future implementation (Stoutenborough & Vedlitz, 2013). Willamette Valley respondents may therefore relax their opposition to government intervention if they felt governing bodies were openly communicating about potential management plans and policies, especially regarding how specific stakeholder concerns were being addressed (Morzillo *et al.*, 2007).

Chapter 6. Conclusion

The purpose of this study was to develop a more comprehensive understanding of the factors affecting attitudes toward prospective water policies in the Willamette Valley. This study also aimed to supplement extant literature and gain further insight into the values, beliefs, and attitudes of Oregon residents in general, and represents some of the first empirical research to explore the influence of these constructs on water policy preferences within the regional context of the Willamette Valley.

There were more similarities than differences in attitudes toward water regulation, prospective water policies, perceptions about water, and environmental beliefs. Localized place-based characterization of identity (e.g., as Willamette Valley residents) also translated into social proximity whereby pro-environmental beliefs and policy support were conceptualized corresponding to watershed-level identity. Future research into the influence of social proximity could incorporate analysis of the Water in the Willamette Valley survey questions relating to land management goals, future land use and ownership, priorities for habitation, affective concerns about impacts to quality of life, cognitive processes and sources for gathering information about water issues, and participation in water-related activities and organizations. This could also allow for more a more informed approach to future interactions with stakeholders and encourage truly participative policy making with positive water management outcomes for the range of values among Willamette Valley residents.

Policy support was shown to be linked to both environmental worldview and beliefs related to water management. In many ways, environmental beliefs were more explanatory for policy support than socio-demography, geographic location or rurality, and at times, even socially proximate landowner groups. In spite of the socio-demographic diversity observed across the geographic strata, social constructs such as age, education or income were less consistently linked to policy support than environmental beliefs. The environmental values/beliefs of stakeholders in the Willamette Valley may therefore be most influential on water policy preferences, especially since these core beliefs are slowest to change but also likely to have the greatest impact on decisions when they do change.

Future research could explore the range of environmental beliefs in two ways. First, the environmental worldview statements could be adjusted so that all five dimensions—balance of nature, limits to growth, human domination over nature, human exemptionalism, and the likelihood for potentially catastrophic environmental changes—were equally represented (Dunlap *et al.*, 2000). As it stands, this survey question had three statements each assessing balance of nature, human domination over nature, and potential for eco-crisis, and one statement assessing limits to growth. Assessing beliefs related to the idea that humans are exempt from the constraints of nature could be especially useful since water resource management often involves integrating human and ecological considerations. In the same way, a more comprehensive assessment of beliefs related to limits to growth could reveal the extent to which Willamette Valley residents could be willing to prioritize ecological protection. Qualitatively, a number of responses to the worldview survey question (including comments handwritten on the survey) were defensive in nature, possibly due to a conflict between social norms and concern for the viability of their communities, especially those dependent on resource-based industry. Second, the survey question assessing respondents' humanistic or ecocentric beliefs related to water management objectives could be expanded to include a broader range of statements. This would allow researchers to explore more of the breadth of respondents' water-specific beliefs rather than limiting expression to degrees of agreement with the two value extremes on the humanistic to biocentric spectrum.

Some prospective policy initiatives were more widely accepted or opposed across the Willamette Valley. Low support for some potential policy measures could be explained by fear-based perception of risk, which may or may not be accurate. Management implementation could be inhibited by erroneous risk perception sometimes related to low levels of knowledge about policy initiatives (Hubbard, 2013). This may not be an issue some future policy development and implementation such as Oregon's Integrated Water Resources Strategy and Willamette Water 2100 project outcomes since they focus on community-based water management planning and development and emphasize broad scale collaboration and considerable public outreach.

Findings for this study should be considered in the context of the study's limitations. First, the results reported were derived from only a single data collection. Future research should continue to further explore the dimensions that were revealed in this study. This study used established survey protocol (the Tailored Design Method), but respondents to mail surveys tend to be more educated and have higher incomes than the general public (Dillman *et al.*, 2002). Second, the vast majority of respondents in this study were homeowners and so analysis eliminated homeownership from the list of socio-demographic variables. Future work could compare findings from this study with research targeting renters to more accurately consider all Willamette Valley residents' policy preferences. Race was also eliminated as a socio-demographic variable since respondents were mostly White or Caucasian ethnicity. Due to the ethnic homogeneity in the Willamette Valley, racial divergence among stakeholders may or may not be a factor for future water policy initiatives. However, further study could reveal if ethnic and racial influence on policy preferences is an issue among minority populations in the Willamette Valley albeit on a much smaller scale than previous study areas. Finally, this study was conducted using a stratified random sample which may be criticized for restricting generalizability to the entire Willamette Valley including the areas that were not sampled for the study. However, this method allowed for considerable amounts of data capture and concentrated place-based examination focused on locations with existing water concerns. Using geographic strata also allowed for the analysis of place of residence and socially proximate land use types in relation to environmental beliefs and policy preference.

The outcomes of this study, therefore, represent the initial efforts to understand the extent to which the regional context of the Willamette Valley influences attitudes toward water policy. Further study of the influence of social and geographic factors on water policy preferences may assist in filling the gaps between policy making and implementation. Ultimately, developing a broader understanding of the values, beliefs, and attitudes relating to water in the Willamette Valley will contribute to the literature base while informing decisions about watershed-level management of water resources and promoting public acceptance of future water policy initiatives in the basin.

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Table 3.1: Willamette Valley, Oregon, 2010 population characteristics[a]

Geographic Area	Population (Total)	Land Area (mi^2)	Density per square mile of land area	
			Population	Housing units
Oregon	3,831,074	95,988.01	39.9	17.5
Lane County (Upper Willamette)	351,715	4,553.12	77.2	34.3
Marion County (Middle Willamette)	315,335	1,182.33	266.7	102.3
Washington County (Lower Willamette)	529,710	724.23	731.4	293.3
Yamhill County (Lower Willamette)	99,193	715.86	138.6	51.6

[a] Source: U.S. Census. (2008-2012). American Community Survey. Retrieved from: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none.

Table 3.2: Survey questions used to construct variables for identifying respondents' perceptions about water in the Willamette Valley (*), attitudes toward prospective water policies (‡) and water regulation (‡‡), general environmental worldview beliefs (^), specific environmental beliefs about water management (^^), and socio-demographic characteristics (§)

Survey question	Variable
How far into the future do you think about the role of water in your life?	*H2ORole*[*]
To what degree do you believe that the Willamette Valley has enough water to meet the needs of people, plants, and animals in each of the following time periods?	*AvailNow* *Avail10Yr* *Avail50Yr* *Avail100Yr*[*]
Please indicate, in your opinion, the acceptability of each of the following ways of distributing water among competing uses *at times of limited water availability*.	*Equity* *Reallocation* *Storage* *CurrentLaw* *SellExcess* *DistPayMore*[‡]
Do you believe that at least some regulation should exist related to water use and management?	*Regulation*[‡‡]
To what extent do you agree or disagree with each statement [about general environmental worldview beliefs][a]?	*DSP* *NEP*^
To what extent do you agree or disagree with each statement [about specific environmental beliefs related to water management][a]?	*Utilitarian* *Ecological*^^
Which of the following [about place-based conception of identity] <u>best</u> describes how you characterize yourself?	*Identity*[§]
How many individuals live in your household?	*HhSize*[§]
How many individuals in your household are less than 18 years old?	*Children*[§]
Approximately how long [in years and months] have you lived at your current address?	*Tenure*[§]
Are you female or male?	*Sex*[§]
In what year were you born?	*Age*[§]
What is the highest level of formal education that you have completed?	*Education*[§]
What was your gross household income (before taxes) in 2012?	*Income*[§]

[a] Additional information in brackets added for clarity of question relative to each variable

Table 3.3: Descriptive results for scales and scale items for measuring acceptability of prospective water policy variables

Please indicate the acceptability[a] of each of the following:	High	Moderate	Low	None	*M (SD)*[b]
Equity (n=1186; α=0.615, Percent of Total Variance Explained=17%, Range=4-16):					*11.0 (2.8)*
The method that makes the most economic sense, regardless of priority (0.621)[c]		33	37	13	2.6 (0.9)
Users must share any excess water beyond what they need (0.539)	44	33	16	7	3.1 (0.9)
All potential users have equal access to water that is available (0.668)	22		31	19	2.5 (1.0)
Those who use more water pay more for its use (0.664) 18	42	33	17	9	3.1 (1.0)
Reallocation (n=1216; α=0.599, Percent of Total Variance Explained=14%, Range=4-16):	28				*9.8 (2.5)*
Give water not used by agriculture to municipal use (0.504)	23	44	26	7	2.8 (0.9)
Give water not used by agriculture to biological use (e.g., more water in streams to maintain appropriate water temperature for fish) (0.728)	34		20	7	3.0 (0.9)
Give water not used by agriculture to recreational use (0.799)	9	24	47	20	2.2 (0.9)
Allow the state to decide allocation methods for water (0.433)	6 40	22	35	38	1.9 (0.9)
Storage (n=1242; r=0.628, Percent of Total Variance Explained=13%, Range=2-8):					*6.3 (1.5)*
Store enough water in reservoirs to account for all potential users (0.834)	44	37	16	3	3.2 (0.8)
Build more facilities for water storage and replenishment (0.769)	42	36	18	4	3.2 (0.8)
CurrentLaw (n=1224, Range=1-4):					*2.9 (0.9)*
Current Oregon water law ("first in line, first in right")	29	39	27	5	2.9 (0.9)
SellExcess (n=1251, Range=1-4):					*2.4 (1.0)*
Users can sell any excess water beyond what they need	16	27	34	24	2.4 (1.0)
DistPayMore (n=1249, Range=1-4):					*2.5 (0.9)*
Users farther from the water source pay more for its use	13	36	38	13	2.5 (0.9)

[a] Question wording: Please indicate, in your opinion, the acceptability of each of the following ways of distributing water among competing uses at times of limited water availability (Please circle ONE number for each item)

[b] Scale values (High = 4 to None = 1) were used to calculate mean and standard deviation values

[c] Factor loading scores indicating corrected item-total correlation shown in parentheses

Table 3.4: Descriptive results of scales and scale items for measuring environmental beliefs

Do you agree or disagree[a] that:	Strongly agree	Agree	Unsure	Disagree	Strongly disagree	*M (SD)*[b]
DSP (n=1331; α=0.809; Range=4-20; Percent of Total Variance Explained=35%):						*11.1 (4.5)*
Humans have the right to modify the natural environment to suit their needs (0.801)[c]	16	35	12	21	16	3.2 (1.3)
Humans were meant to rule over the rest of nature (0.832)	17	20	15	15	33	2.7 (1.5)
The so-called ecological crisis facing humans has been greatly exaggerated (0.653)	19	24	11	18	28	2.9 (1.5)
The balance of nature is strong enough to cope with impacts of modern industrial nations (0.661)	6	19	13	27	34	2.4 (1.3)
NEP (n=1330; α=0.872; Range=6-30; Percent of Total Variance Explained=28%):						*20.4 (6.4)*
If things continue on their present course, we will soon experience a major ecological catastrophe (0.760)	18	29	16	18	18	3.1 (1.4)
We are approaching the limit of the number of people the earth can support (0.734)	22	25	17	17	18	3.2 (1.4)
The balance of nature is very delicate and easily upset (0.787)	23	33	15	18	10	3.4 (1.3)
When humans interfere with nature it often produces disastrous consequences (0.785)	28	35	15	14	8	3.6 (1.2)
Plants and animals have as much right as humans to exist (0.534)	33	25	13	15	14	3.5 (1.4)
Humans are severely abusing the environment (0.730)	34	32	12	12	12	3.6 (1.4)
Utilitarian (n=1329; α=0.803; Range=2-10; Percent of Total Variance Explained=42%):						*3.6 (2.0)*
Humans should manage water resources so that *only* humans benefit (0.919)	2	5	11	23	60	1.7 (1.0)
Water resources exist primarily to be used by humans (0.894)	4	10	13	21	52	1.9 (1.2)
Ecological (n=1317; α=0.610; Range=2-10; Percent of Total Variance Explained=36%):						*6.1 (2.2)*
Water resources should be managed for their own sake rather than simply to meet the needs of humans (0.813)	26	32	19	14	10	3.5 (1.3)
We should focus on doing what is best for other species that depend on water instead of what is best for humans (0.864)	8	16	27	23	26	2.6 (1.3)

[a] Question wording: To what extent do you agree or disagree with each statement (Please circle ONE number for each item)

[b] Scale values (strongly agree = 5 to strongly disagree = 1) were used to calculate mean and standard deviation values

[c] Factor loading scores indicating corrected item-total correlation shown in parentheses

Table 4.1: Descriptive results of independent variables stratified by location

Variable name (Description)	Lane County (*n*=437) *n*		Marion County (*n*=491) *n*		Washington/Yamhill County (*n*=474) *n*	
DSP (mean DSP score±SD)[a]	*420*	10.9 (4.4)	*458*	11.8 (4.5)	*453*	10.7 (4.5)
NEP (mean NEP score±SD)[a]	*420*	21.1 (6.3)	*459*	19.4 (6.5)	*453*	20.8 (6.2)
Utilitarian (mean scale score±SD)[a]	*418*	3.4 (1.9)	*466*	3.9 (2.1)	*453*	3.4 (1.8)
Ecological (mean scale score±SD)[a]	*418*	6.3 (2.2)	*466*	5.7 (2.2)	*453*	6.2 (2.1)
Identity (% of respondents)[b]	*406*		*460*		*455*	
United States resident		23		25		20
Pacific Northwest resident		13		9		18
Oregon resident		36		29		37
Willamette Valley resident		22		32		19
HhSize (mean number of individuals in household±SD)[c]*	*414*	2.3 (1.1)	*461*	2.4 (1.2)	*456*	2.5 (1.3)
Children (% of households with children)*	*413*	15	*463*	18	*453*	23
Tenure (mean number of years at current residence±SD)	*414*	22.9 (15.5)	*464*	26.6 (18.0)	*456*	21.4 (15.8)
Sex (% of respondents who were female)*	*413*	41	*461*	33	*451*	45
Age (mean age in years±SD)*	*399*	64.8 (12.5)	*451*	64.7 (13.6)	*444*	61.4 (13.5)
Education (% of respondents at each level)[b,]*	*411*		*459*		*455*	
Less than high school		1		3		1
High school or equivalent (e.g., GED)		15		21		12
Vocational or trade school		6		6		2
Some college		21		20		19
College degree (2-year or certificate)		14		10		11
College degree (Bachelor's)		24		23		28
Graduate or professional degree		20		17		28
Income (% of respondents within each income bracket)[b,]*	*381*		*415*		*400*	
Less than $25,000		13		7		6
$25,000 to $49,999		31		22		16
$50,000 to $74,999		23		24		22
$75,000 to $99,999		11		20		21
$100,000 or more		22		28		35

[a] Possible scale ranges were 4-20 for *DSP*, 6-30 for *NEP*, 2-10 for *Utilitarian*, and 2-10 for *Ecological*
[b] May not sum to 100% due to rounding
[c] $P < 0.05$ indicated by an asterisk (*)

Table 4.2: Descriptive results of independent variables stratified by rural-urban place of residence and land use classification

Variable name (description)	*n*	Rural (*n=832*)	*n*	Urban (*n=570*)	*n*	Agriculturalist (*n=883*)	*n*	Residential (*n=519*)
DSP (mean DSP scale score±SD)[a]	*794*	11.2 (4.6)	*537*	11.0 (4.4)	*844*	11.3 (4.6)	*487*	10.9 (4.4)
NEP (mean NEP scale score±SD)[a,b]^	*795*	20.2 (6.5)	*537*	20.6 (6.1)	*845*	20.0 (6.5)	*487*	21.0 (6.1)
Utilitarian (mean scale score±SD)[a]^	792	3.7 (2.0)	545	3.4 (1.9)	*838*	3.7 (2.0)	*489*	3.4 (1.9)
Ecological (mean scale score±SD)[a]	*791*	6.0 (2.2)	*546*	6.1 (2.1)	*837*	6.0 (2.2)	*490*	6.2 (2.2)
Identity (% of respondents)[c]	*784*		*537*		*833*		*488*	
United States resident		23		23		22		24
Pacific Northwest resident		12		16		12		15
Oregon resident		35		33		34		35
Willamette Valley resident		25		24		26		21
HhSize (mean number of individuals in household±SD)	*789*	2.4 (1.2)	*542*	2.4 (1.2)	*839*	2.4 (1.2)	*492*	2.5 (1.2)
Children (% of households with children)[c]^	*789*	18	*540*	20	*838*	17	*491*	23
Tenure (mean number of years at current residence±SD)*^	*791*	25.7 (16.7)	*544*	20.6 (16.2)	*842*	27.3 (17.4)	*493*	17.3 (13.2)
Sex (% of respondents who were female)*^	*784*	37	*541*	44	*837*	36	*488*	47
Age (mean age in years±SD)*^	*767*	64.7 (12.5)	*527*	62.1 (14.3)	*815*	65.3 (12.2)	*479*	60.8 (14.6)
Education (% of respondents at each level)[c]^	*787*		*538*		*834*		*491*	
Less than high school		2		1		2		1
High school or equivalent (e.g., GED)		16		17		16		17
Vocational or trade school		5		5		5		5
Some college		18		22		18		22
College degree (2-year or certificate)		11		13		9		15
College degree (Bachelor's)		25		25		26		23
Graduate or professional degree		24		18		25		17
Income (% of respondents within income bracket)[c]*^	*702*		*494*		*743*		*453*	
Less than $25,000		8		9		7		21
$25,000 to $49,999		22		24		20		16
$50,000 to $74,999		21		26		22		25
$75,000 to $99,999		18		18		19		28
$100,000 or more		31		24		32		11

[a] Possible scale ranges were 4-20 for *Anti-NEP*, 6-30 for *Pro-NEP*, 2-10 for *Utilitarian*, and 2-10 for *Ecological*

[b] $P < 0.05$ indicated by an asterisk (*) for Rural or Urban and by a caret (^) for Agricultural or Residential

[c] May not sum to 100% due to rounding

Table 4.3: Perceptions about water in the Willamette Valley stratified by location

Variable name (description)	Lane County (*n*=437)		Marion County (*n*=491)		Washington/Yamhill County (*n*=474)	
	n		*n*		*n*	
H2ORole (% of respondents at each level)[a,b]	*426*		*475*		*461*	
Today		2.8		2.3		2.4
This week		0.5		0.4		0.7
This month		0.5		0.2		0.9
This year		3.3		2.9		1.5
Five to ten years		3.5		5.7		7.6
My lifetime		25.1		28.2		22.3
I think about future generations		58.2		51.8		59.7
I don't think about it at all		6.1		8.4		5.0
AvailNow (% of respondents perceiving sufficient water now)[c]	*401*	92	*438*	91	*419*	89
Avail10Yr (% of respondents perceiving sufficient water in 10 years)[c]	*403*	73	*437*	73	*424*	68
Avail50Yr (% of respondents perceiving sufficient water in 50 years)[c,d]*	*408*	34	*442*	33	*434*	26
Avail100Yr (% of respondents perceiving sufficient water in 100 years)[c]	*406*	18	*455*	24	*433*	15

[a] May not sum to 100% due to rounding

[b] Question wording: How far into the future do you think about the role of water in your life (Please check one)

[c] Question wording: To what degree do you believe that the Willamette Valley has enough water to meet the needs of people, plants, and animals in each of the following time periods (Please circle ONE number for each item)

[d] $P < 0.05$ indicated by an asterisk (*)

Table 4.4: Perceptions about water in the Willamette Valley stratified by rural-urban place of residence and land use classification

Variable name (description)	Rural (*n=832*) *n*		Urban (*n=570*) *n*		Agriculturalist (*n=883*) *n*		Residential (*n=519*) *n*	
H2ORole (% of respondents at each level)[a,b]	*803*		*559*		*854*		*508*	
Today		1.9		3.4		1.8		3.7
This week		0.6		0.4		0.6		0.4
This month		0.4		0.7		0.2		1.0
This year		2.6		2.5		2.1		3.3
Five to ten years		6.5		4.5		6.6		4.1
My lifetime		25.2		25.4		26.7		22.8
I think about future generations		58.2		54		57.5		54.7
I don't think about it at all		4.7		9.1		4.6		9.8
AvailNow (% of respondents perceiving sufficient water now)[c]	*746*	91	*512*	90	*794*	91	*464*	90
Avail10Yr (% of respondents perceiving sufficient water in 10 years)[c]	*744*	72	*520*	71	*792*	73	*472*	70
Avail50Yr (% of respondents perceiving sufficient water in 50 years)[c]	*765*	31	*519*	31	*809*	30	*475*	32
Avail100Yr (% of respondents perceiving sufficient water in 100 years)[c]	*765*	20	*529*	18	*816*	20	*478*	17

[a] May not sum to 100% due to rounding

[b] Question wording: How far into the future do you think about the role of water in your life (Please check one)

[c] Question wording: To what degree do you believe that the Willamette Valley has enough water to meet the needs of people, plants, and animals in each of the following time periods (Please circle ONE number for each item)

Table 4.5: Relationships between environmental beliefs and geographic strata, perceptions about water in the Willamette Valley, belief in water regulation, and socio-demographic characteristics

Variable name	Environmental Worldviews		Water Management Environmental Beliefs	
	DSP	*NEP*	*Utilitarian*	*Ecological*
Location	–0.020[a]	–0.021	0.005	–0.023
Rural-urban classification	–0.016	0.028	–0.052	0.019
Land use type	–0.034	0.078[b]*	–0.068*	0.043
H2ORole	–0.074*	0.084*	–0.036	0.030
AvailNow	0.194*	–0.201*	0.091*	–0.111*
Avail10Yr	0.288*	–0.296*	0.153*	–0.171*
Avail50Yr	0.354*	–0.367*	–0.227*	–0.225*
Avail100Yr	0.350*	–0.362*	0.208*	–0.172*
Regulation	–0.225*	0.231*	–0.214*	0.160*
Identity	0.011	–0.068*	–0.001	0.011
HhSize	0.066*	–0.091*	0.059*	–0.050*
Children	‡	‡	‡	‡
Tenure	0.062*	0.012	0.084*	0.000
Sex	‡*	‡*	‡*	‡*
Age	0.016	0.041	0.060*	0.005
Education	–0.098*	–0.010	–0.078*	–0.031
Income	0.019	–0.141*	0.013	–0.098*

[a] Test Statistic = Pearson correlation coefficient (*r*) unless otherwise noted (‡).

[b] $P < 0.05$ indicated by an asterisk (*).

‡ Test Statistic = ANOVA; For *DSP*, Children (*F*=0.331, *df*=1), Sex (*F*=51.337, *df*=1, *p*<0.001, *Eta*=0.196). For *NEP*, Children (*F*=2.528, *df*=1), Sex (*F*=64.004, *df*=1, *p*<0.001, *Eta*=0.218). For *Utilitarian*, Children (*F*=0.179, *df*=1), Sex (*F*=25.910, *df*=1, *p*<0.001, *Eta*=0.140). For *Ecological*, Children (*F*=0.275, *df*=1), Sex (*F*=15.689, *df*=1, *p*<0.001, *Eta*=0.109).

Table 4.6: Water allocation policy preferences and belief in water regulation stratified by location

Variable name (description)	Lane County (*n*=437)		Marion County (*n*=491)		Washington/Yamhill County (*n*=474)	
	n		*n*		*n*	
Equity (mean score±SD)[a]	*404*	11.3 (2.9)	*436*	10.8 (2.7)	*438*	11.1 (2.7)
Reallocation (mean score±SD)[a,b]*	*405*	10.1 (2.7)	*436*	9.5 (2.5)	*435*	9.8 (2.4)
Storage (mean score±SD)[a]	*401*	6.2 (1.5)	*439*	6.3 (1.5)	*433*	6.4 (1.5)
CurrentLaw (mean score±SD)[a,]*	*388*	2.8 (0.9)	*418*	3.0 (0.8)	*418*	2.9 (0.9)
SellExcess (mean score±SD)[a]	*391*	2.3 (1.0)	*428*	2.3 (1.0)	*432*	2.5 (1.0)
DistPayMore (mean score±SD)[a]	*396*	2.5 (0.9)	*424*	2.5 (0.9)	*429*	2.5 (0.9)
Regulation (% of respondents)*	*407*	75	*452*	74	*439*	83

[a] Possible scale ranges were 4-16 for *Equity*, 4-16 for *Reallocation*, 2-8 for *Storage*, 1-4 for *CurrentLaw*, 1-4 for *SellExcess*, 1-4 for *DistPayMore*

[b] $P < 0.05$ indicated by an asterisk (*)

Table 4.7: Water allocation policy preferences and belief in water regulation stratified by rural-urban place of residence and land use classification

Variable name (description)	Rural (*n=832*)		Urban (*n=570*)		Agriculturalist (*n=883*)		Residential (*n=519*)	
	n		*n*		*n*		*n*	
Equity (mean score±SD)[a,b]*^	*761*	10.7 (2.8)	*517*	11.5 (2.7)	*802*	10.6 (2.7)	*476*	11.8 (2.7)
Reallocation (mean score±SD)[a,^]	*759*	9.7 (2.6)	*517*	10.1 (2.4)	*799*	9.6 (2.5)	*477*	10.2 (2.5)
Storage (mean score±SD)[a]	*756*	6.3 (1.5)	*517*	6.3 (1.5)	*798*	6.3 (1.5)	*475*	6.3 (1.5)
CurrentLaw (mean score±SD)[a,^]	*735*	3.0 (0.9)	*489*	2.8 (0.9)	*774*	3.0 (0.9)	*450*	2.7 (0.9)
SellExcess (mean score±SD)[a]	*747*	2.4 (1.0)	*504*	2.3 (1.0)	*790*	2.4 (1.0)	*461*	2.3 (1.0)
DistPayMore (mean score±SD)[a]	*740*	2.5 (0.9)	*509*	2.5 (0.9)	*782*	2.5 (0.9)	*467*	2.5 (0.9)
Regulation (% of respondents)*^	*770*	78	*486*	81	*811*	78	*486*	81

[a] Possible scale ranges were 4-16 for *Equity*, 4-16 for *Reallocation*, 2-8 for *Storage*, 1-4 for *CurrentLaw*, 1-4 for *SellExcess*, 1-4 for *DistPayMore*

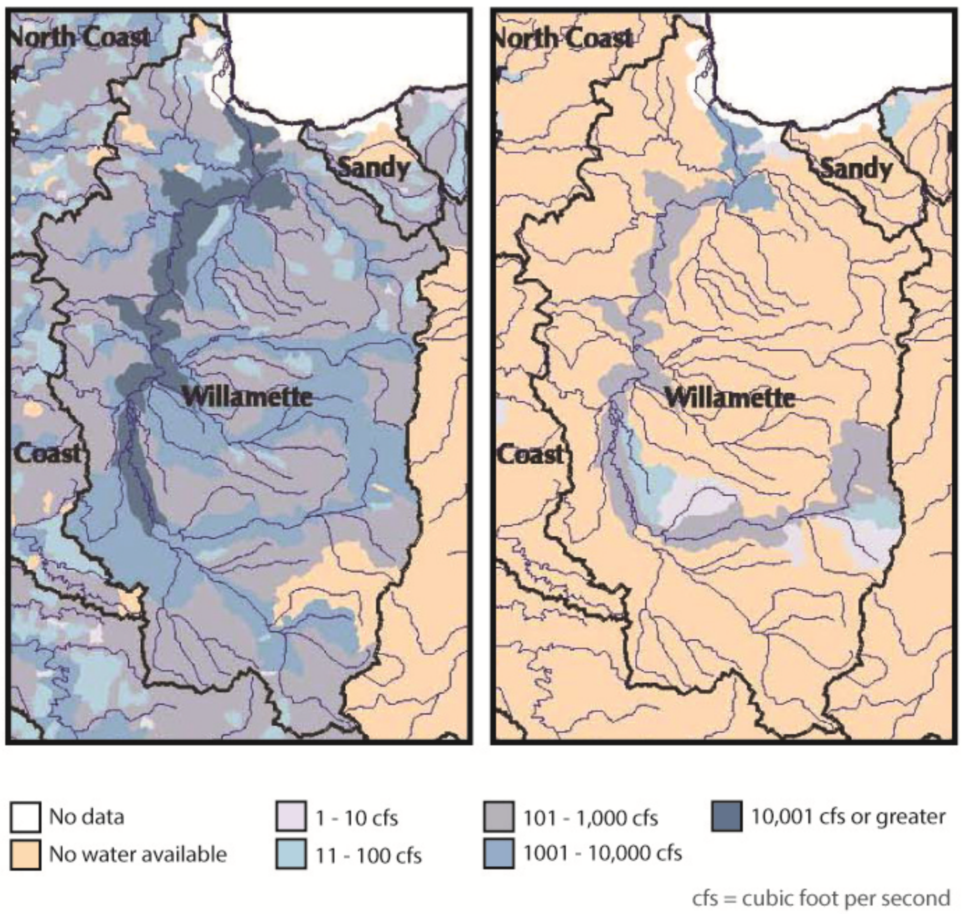
[b] $P < 0.05$ indicated by an asterisk (*) for place of residence (rural or urban) and by a caret (^) for land use classification (agricultural or residential)

Table 4.8: Relationships between acceptability of water policy variables and belief in water regulation and geographic strata, perceptions about water, environmental beliefs, and socio-demographic characteristics

Strata/Variables	*Equity*	*Reallocation*	*Storage*	*CurrentLaw*	*SellExcess*	*DistPayMore*	*Regulation*
Location	‡[a]	‡[b]*	‡	‡*	‡	‡	‡*
Rural/Urban	‡*	‡	‡	‡	‡	‡	‡*
Agriculturist/Residential	‡*	*	‡	‡*	‡	‡	‡*
H2ORole	0.000	0.025	–0.010	–0.025	–0.064*	–0.006	0.018
Regulation	‡*	*	‡	‡*	*	*	N/A
Anti-NEP	–0.224*	–0.261*	0.120*	0.275*	0.138*	–0.043	–0.225*
Pro-NEP	0.301‡*	0.326*	–0.031	–0.216*	–0.088*	0.108*	0.231*
Utilitarian	–0.167*	–0.174*	0.127*	0.179*	0.137*	–0.007	–0.214*
Ecological	0.245‡*	0.251*	–0.061*	–0.188*	–0.122*	0.076*	0.160*
Identity	–0.061*	–0.068*	0.008	–0.034‡	–0.002‡	0.001	–0.025
HhSize	–0.079*	–0.008	–0.026	–0.043	0.047	–0.035	–0.048
Children	‡	‡	‡	‡	‡	‡	‡
Tenure	–0.052	–0.041	0.035	0.183*	–0.010	0.011	–0.014
Sex	‡*	‡	‡	‡*	‡	‡*	*
Age	–0.035	–0.014	0.031	0.120*	–0.066*	–0.008	0.036
Education	–0.088*	0.013	–0.098*	–0.101*	0.041	0.032	0.164*
Income	–0.134*	–0.058	–0.062*	–0.019	0.053	0.049	0.048

[a] Test Statistic = Pearson correlation coefficient (*r*) unless otherwise noted (‡).
[b] *P* < 0.05 indicated by an asterisk (*). ‡
‡ Test Statistic = Chi-square; For *Equity*, Location (χ^2=36.446, *df*=28), Rural/Urban (χ^2=42.093, *df*=14, *p*<0.001, *V*=0.181), Agriculturalist/Residential (χ^2=78.638, *df*=14, *p*<0.001, *V*=0.248), *Regulation* (χ^2=120.597, *df*=28, *p*<0.001, *V*=0.220), *Children* (χ^2=17.560, *df*=14), and *Sex* (χ^2=38.875, *df*=14, *p*<0.001, *V*=0.178). For *Reallocation*, Location (χ^2=44.909, *df*=30, *p*=0.039, *V*=0.133), Rural/Urban (χ^2=18.522, *df*=15), Agriculturalist/Residential (χ^2=28.862, *df*=15, *p*=0.017, *V*=0.150), *Regulation* (χ^2=92.751, *df*=30, *p*<0.001, *V*=0.193), *Children* (χ^2=7.247, *df*=15), and *Sex* (χ^2=23.659, *df*=15). For *Storage*, Location (χ^2=13.779, *df*=14), Rural/Urban (χ^2=4.994, *df*=7), Agriculturalist/Residential (χ^2=5.102, *df*=7), *Regulation* (χ^2=22.566, *df*=14), *Children* (χ^2=8.166, *df*=7), and *Sex* (χ^2=12.854, *df*=7). For *CurrentLaw*, Location (χ^2=15.768, *df*=6, *p*=0.015, *V*=0.080), Rural/Urban (χ^2=7.656, *df*=3), Agriculturalist/Residential (χ^2=40.499, *df*=3, *p*<0.001, *V*=0.182), *Regulation* (χ^2=21.210, *df*=6, *p*=0.002, *V*=0.094), *Children* (χ^2=5.135, *df*=3), and *Sex* (χ^2=34.029, *df*=3, *p*<0.001, *V*=0.170). For *SellExcess*, Location (χ^2=11.034, *df*=6), Rural/Urban (χ^2=2.653, *df*=3), Agriculturalist/Residential (χ^2=3.233, *df*=3), *Regulation* (χ^2=21.766, *df*=6, *p*=0.001, *V*=0.095), *Children* (χ^2=6.392, *df*=3), and *Sex* (χ^2=5.201, *df*=3). For *DistPayMore*, Location (χ^2=2.437, *df*=6), Rural/Urban (χ^2=1.490, *df*=3), Agriculturalist/Residential (χ^2=0.290, *df*=3), *Regulation* (χ^2=33.723, *df*=6, *p*<0.001, *V*=0.118), *Children* (χ^2=0.898, *df*=3), and *Sex* (χ^2=16.087, *df*=3, *p*=0.001, *V*=0.116). For *Regulation*, Location (χ^2=12.733, *df*=4, *p*=0.013, *V*=0.070), Rural/Urban (χ^2=8.847, *df*=2, *p*=0.012, *V*=0.083), Agriculturalist/Residential (χ^2=8.986, *df*=2, *p*=0.011, *V*=0.083), *Children* (χ^2=4.712, *df*=2), and *Sex* (χ^2=7.850, *df*=2, *p*=0.020, *V*=0.079).

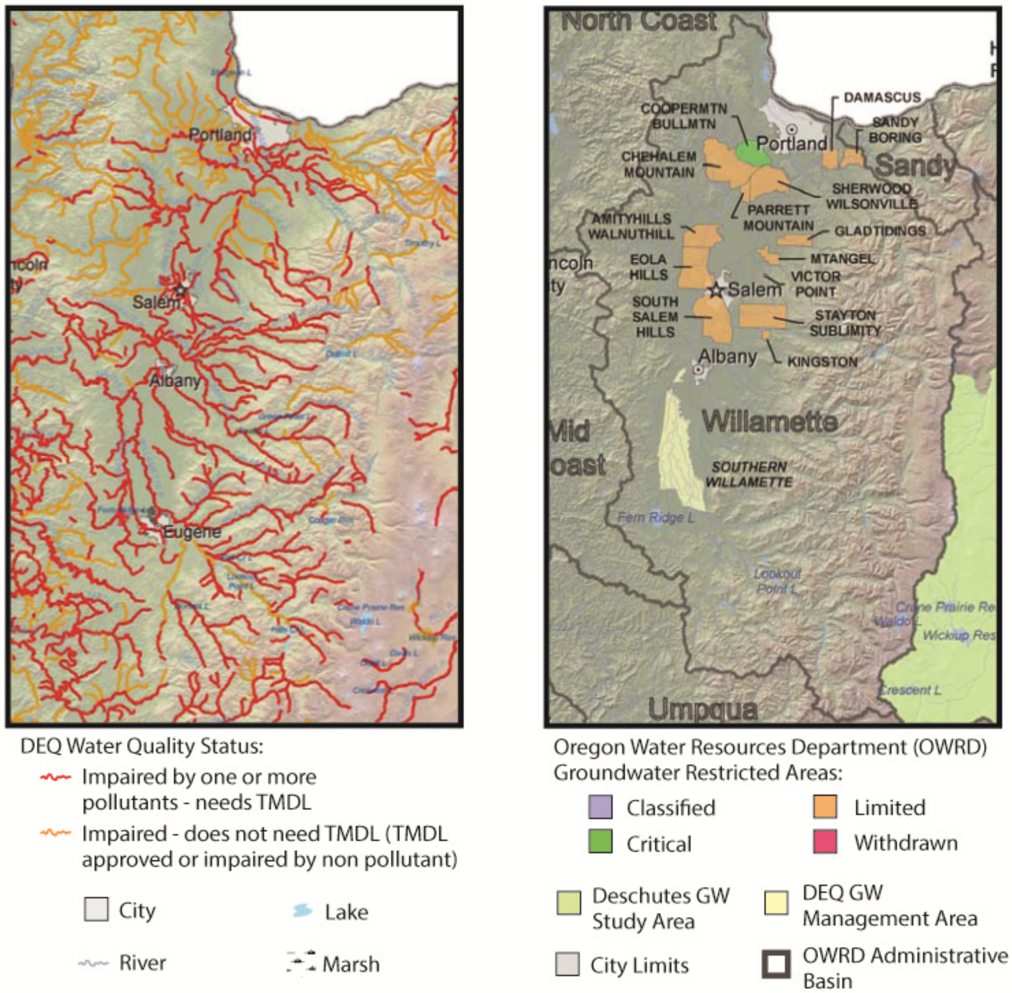
Figure 1.1: January and August available streamflow in the Willamette River Basin (adapted from January and August Available Streamflow [in Oregon] figures, Oregon Water Resources Department, 2012)



(a) January Available Streamflow (estimated at 50% exceedence)

(b) August Available Streamflow (estimated at 80% exceedence)

Figure 1.2: Impaired waterways in the Willamette River Basin (adapted from Impaired Streams and Lakes figure and Groundwater Management Areas figure, Oregon Water Resources Department, 2012)



(a) Water Quality Impaired Lakes and Streams

(b) Groundwater Management Areas

Figure 1.3: Overview of the Willamette Valley, Oregon

Figure 1.4: Watershed-level water resource management in the Willamette Valley

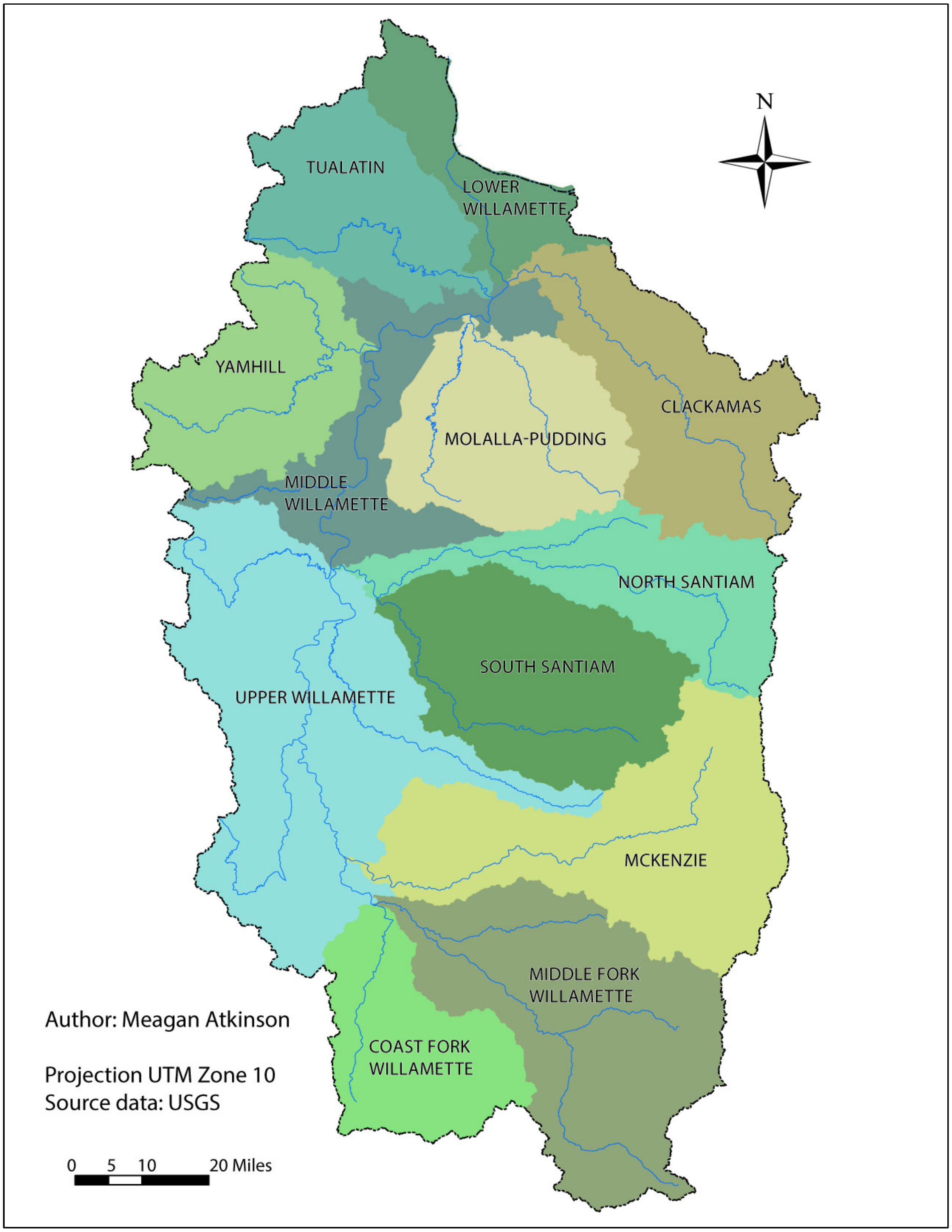


Figure 1.5: Hydrography of the Willamette River Basin

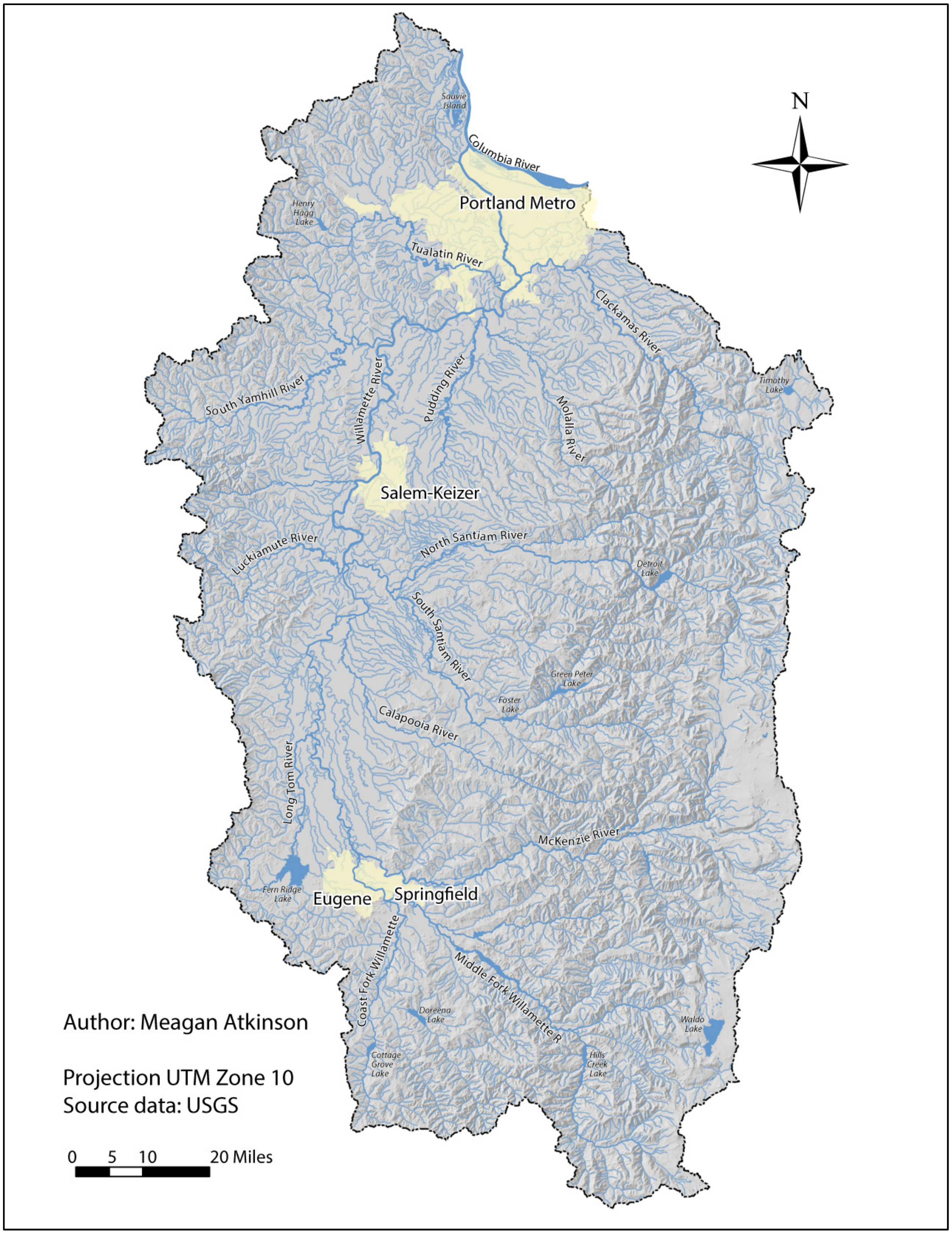


Figure 1.6: Elevation and elevation profiles of the Willamette River Basin

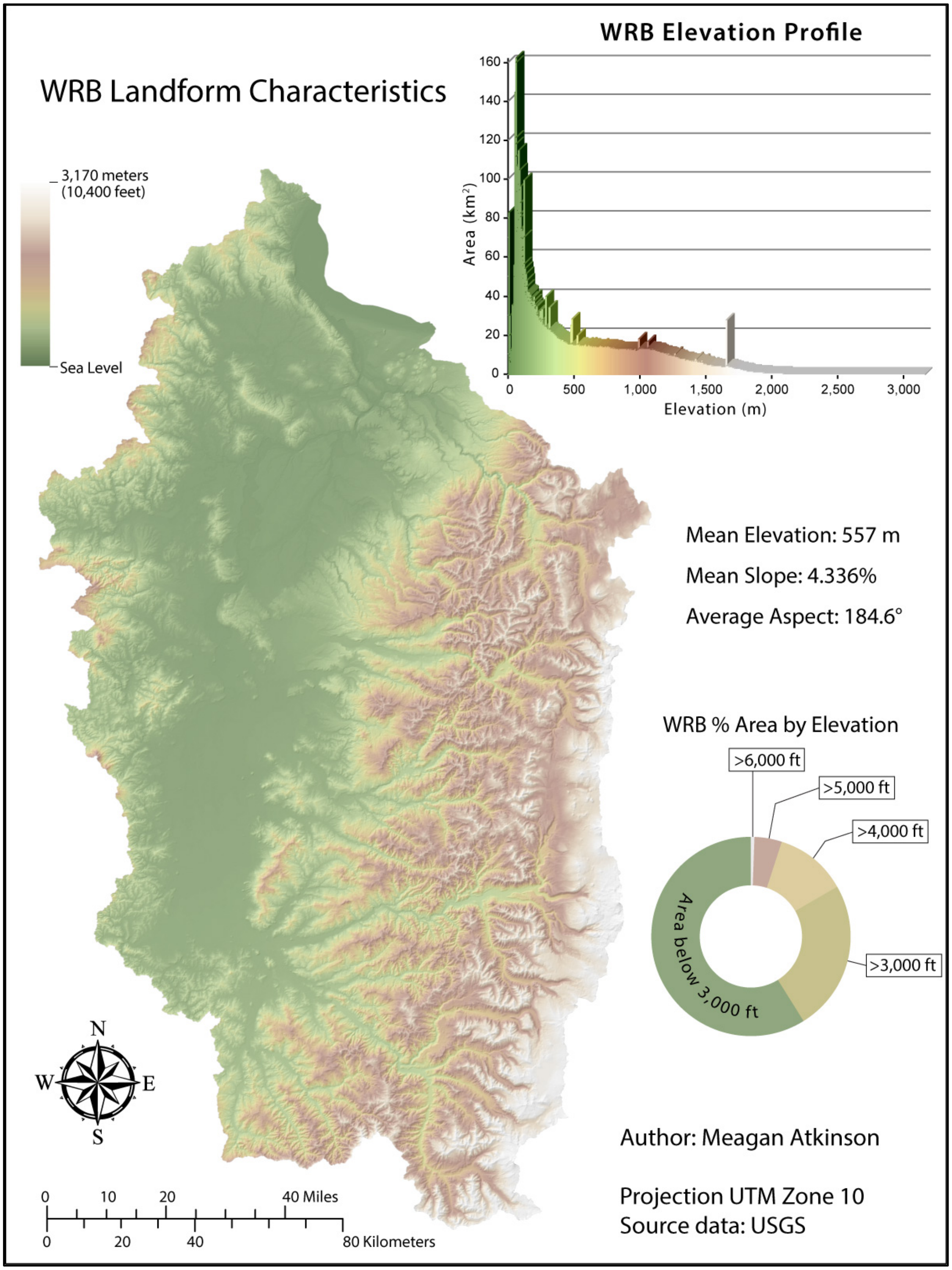
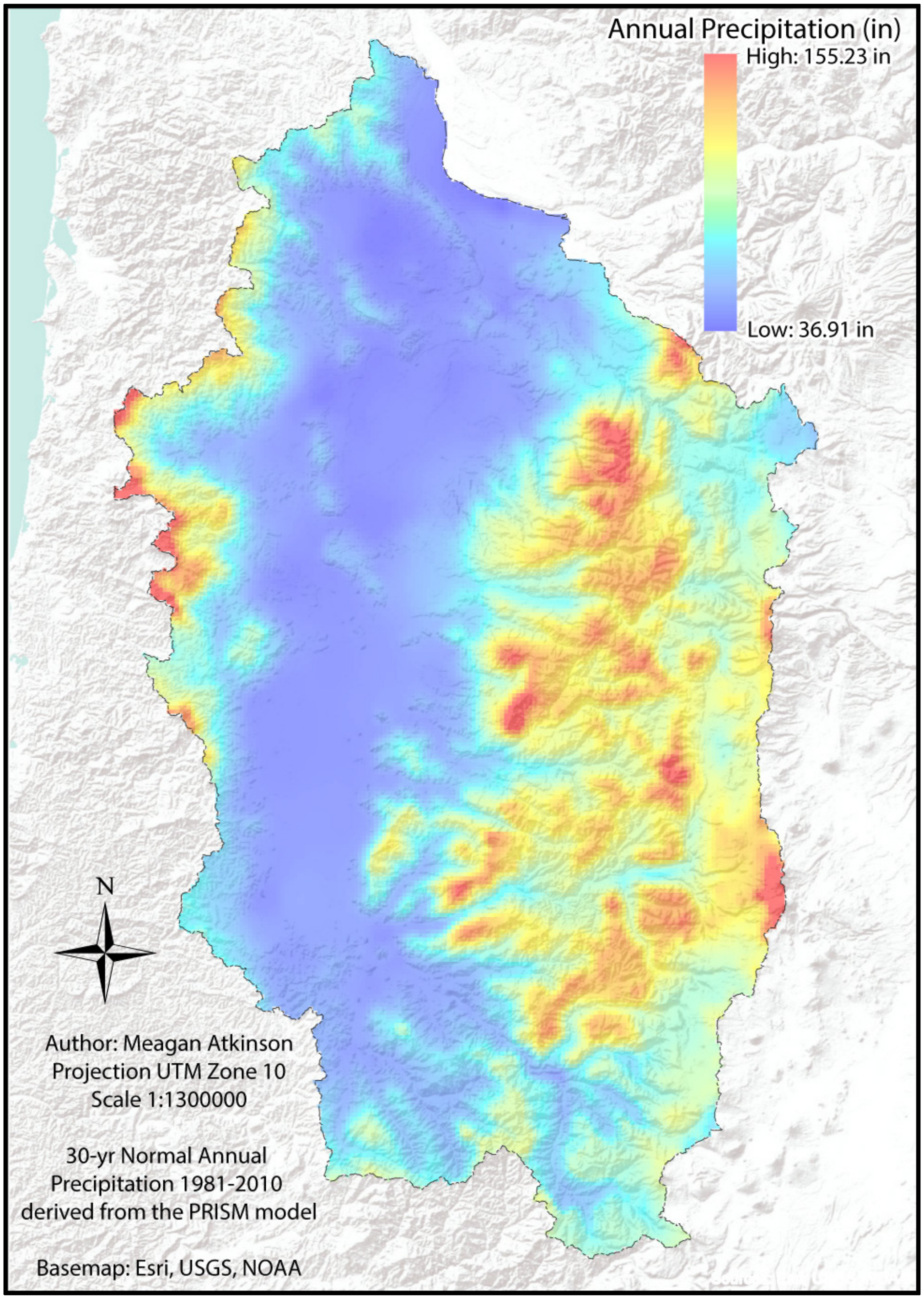
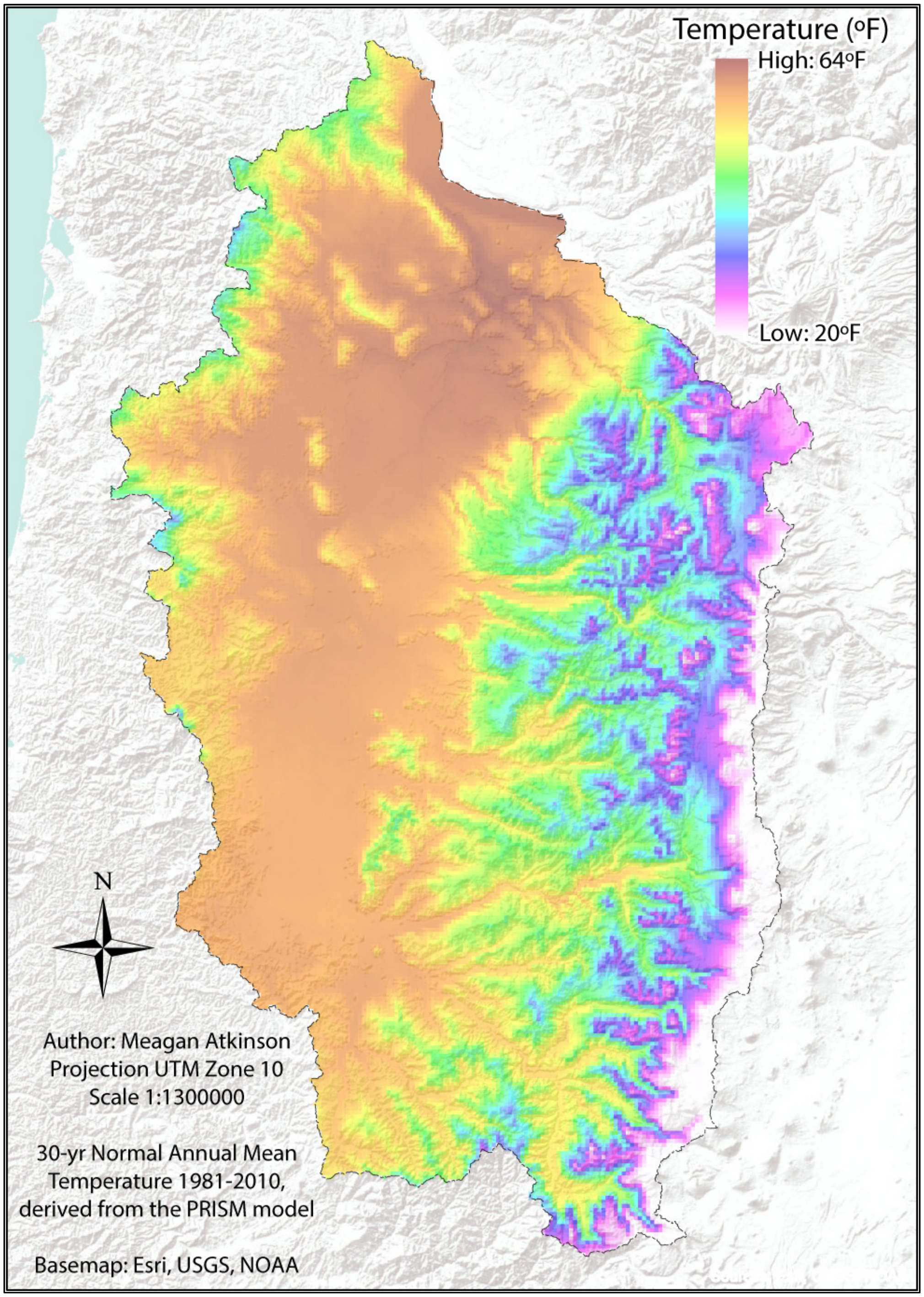


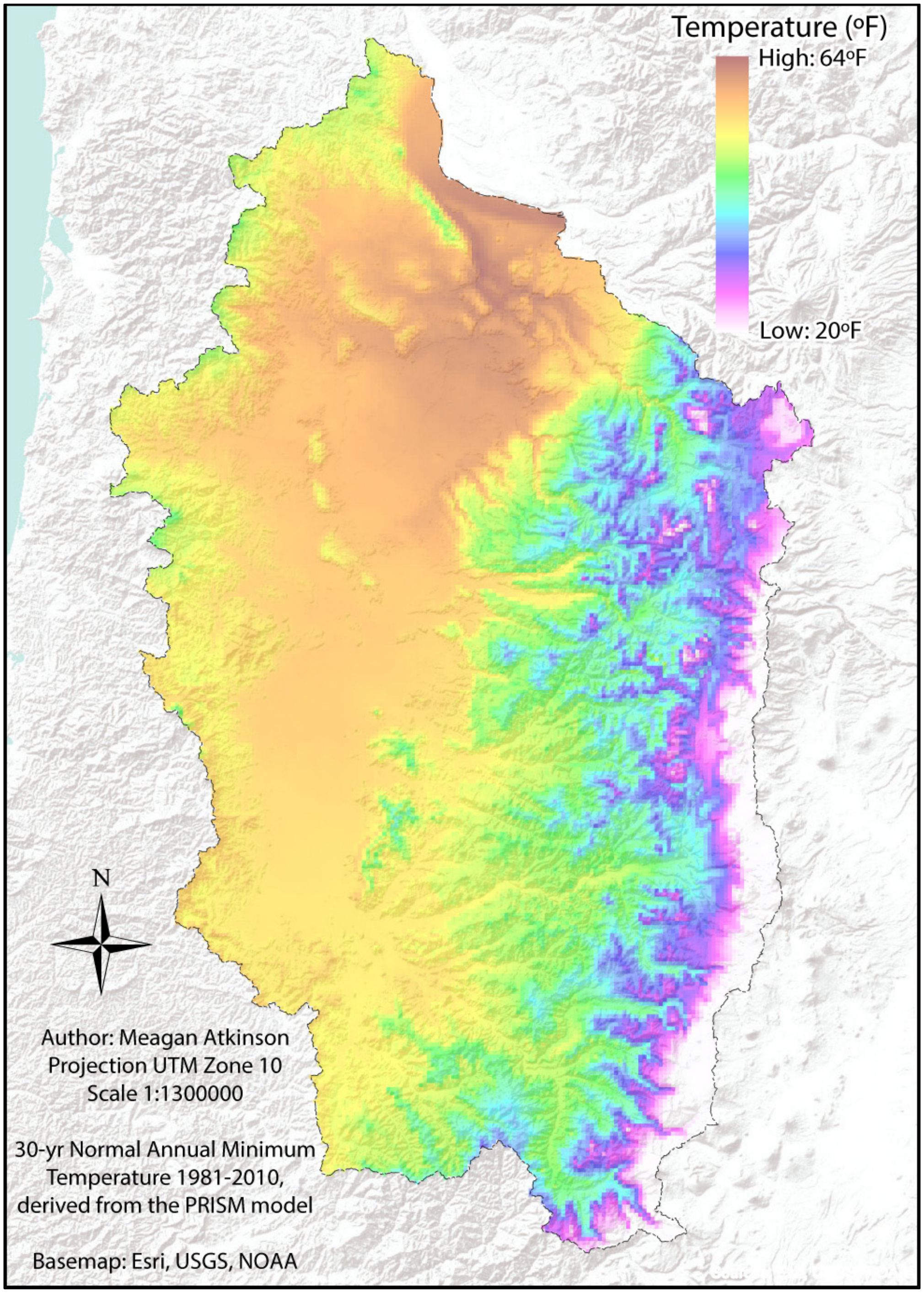
Figure 1.7: Willamette River Basin climate characteristics, including 30-yr normal annual (a) precipitation, (b) mean temperature, (c) minimum temperature, and (d) maximum temperature



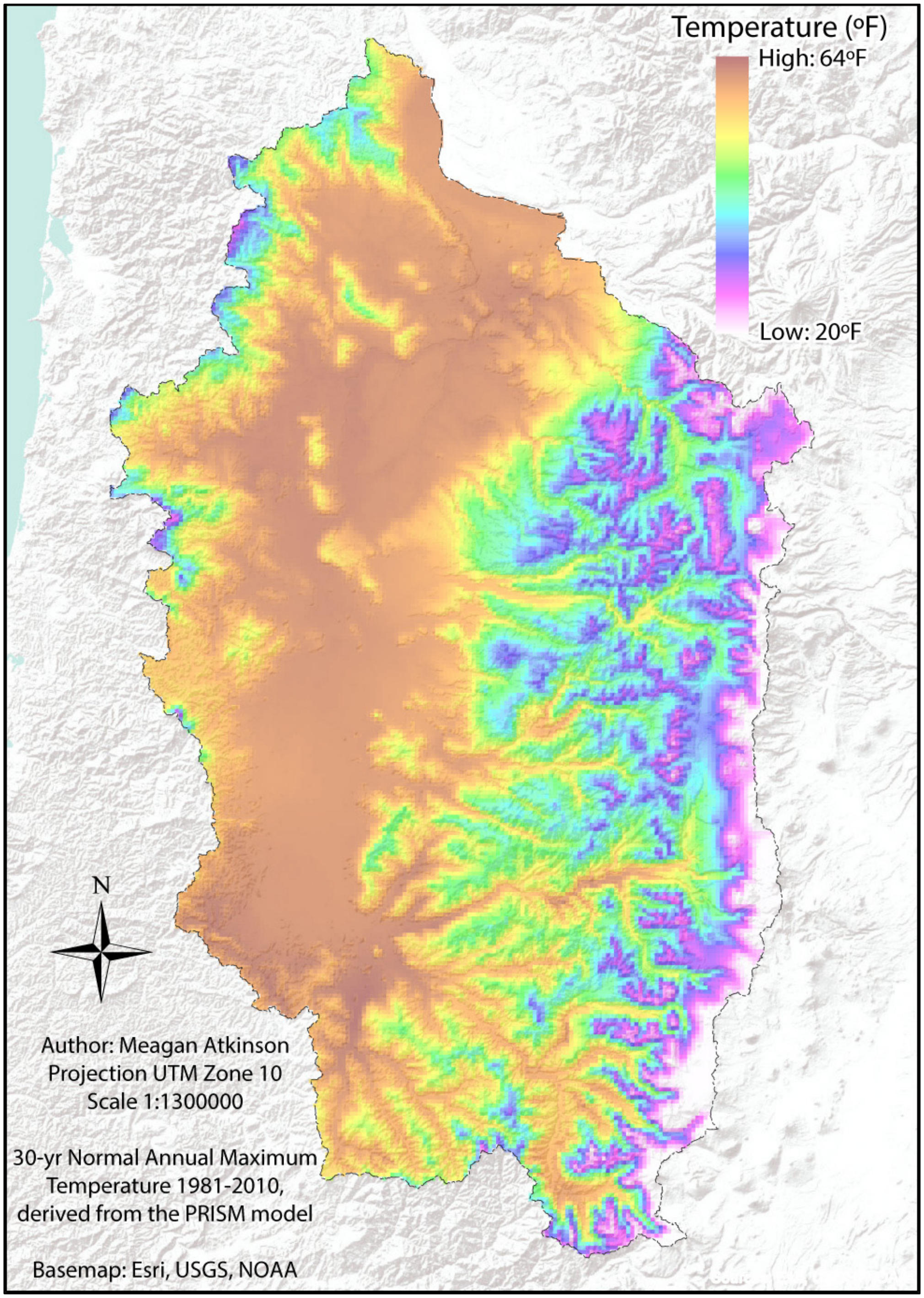
(a) 30-yr annual normal precipitation



(b) 30-yr normal annual mean temperature



(c) 30-yr normal annual minimum temperature



(d) 30-yr annual normal maximum temperature

Figure 2.1: Adapted conceptual interaction of factors potentially influencing attitudes toward water management and allocation policy (Dietz *et al.*, 2005; Larson *et al.*, 2011b; Russenberger *et al.*, 2011; Slimak & Dietz, 2006; Stern *et al.*, 1999)

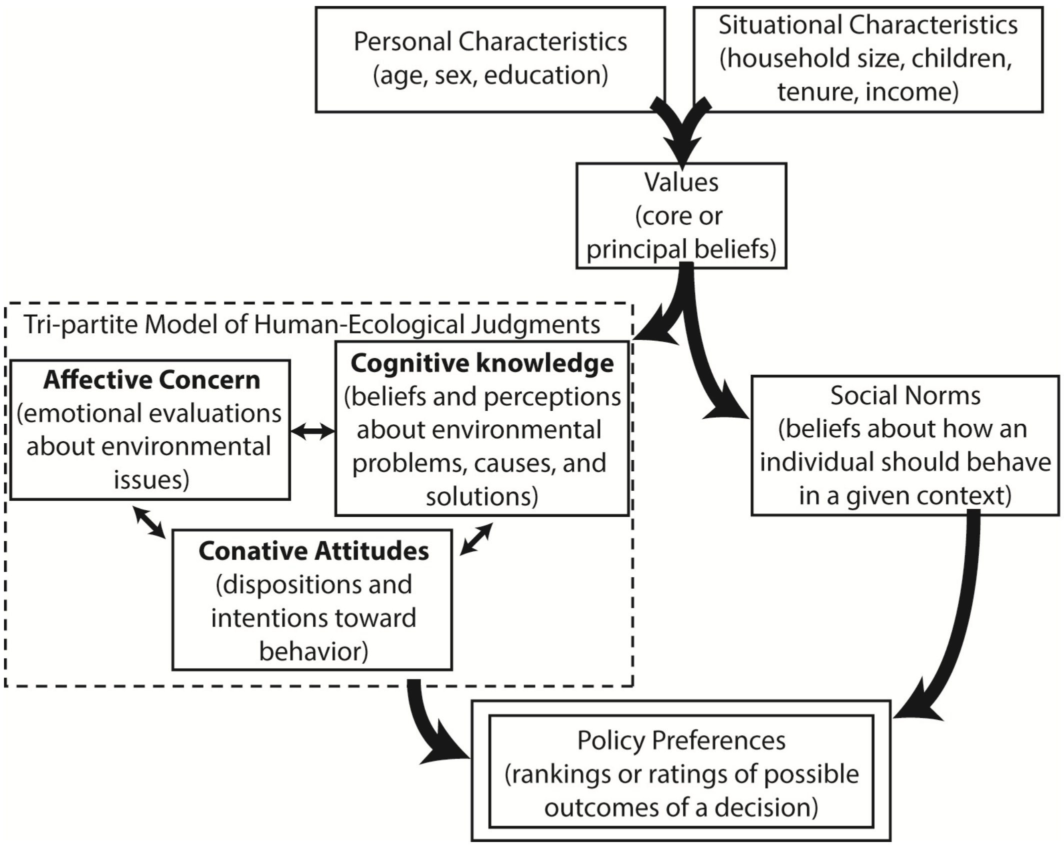


Figure 3.1: Survey tax lot selection criteria for geographic strata

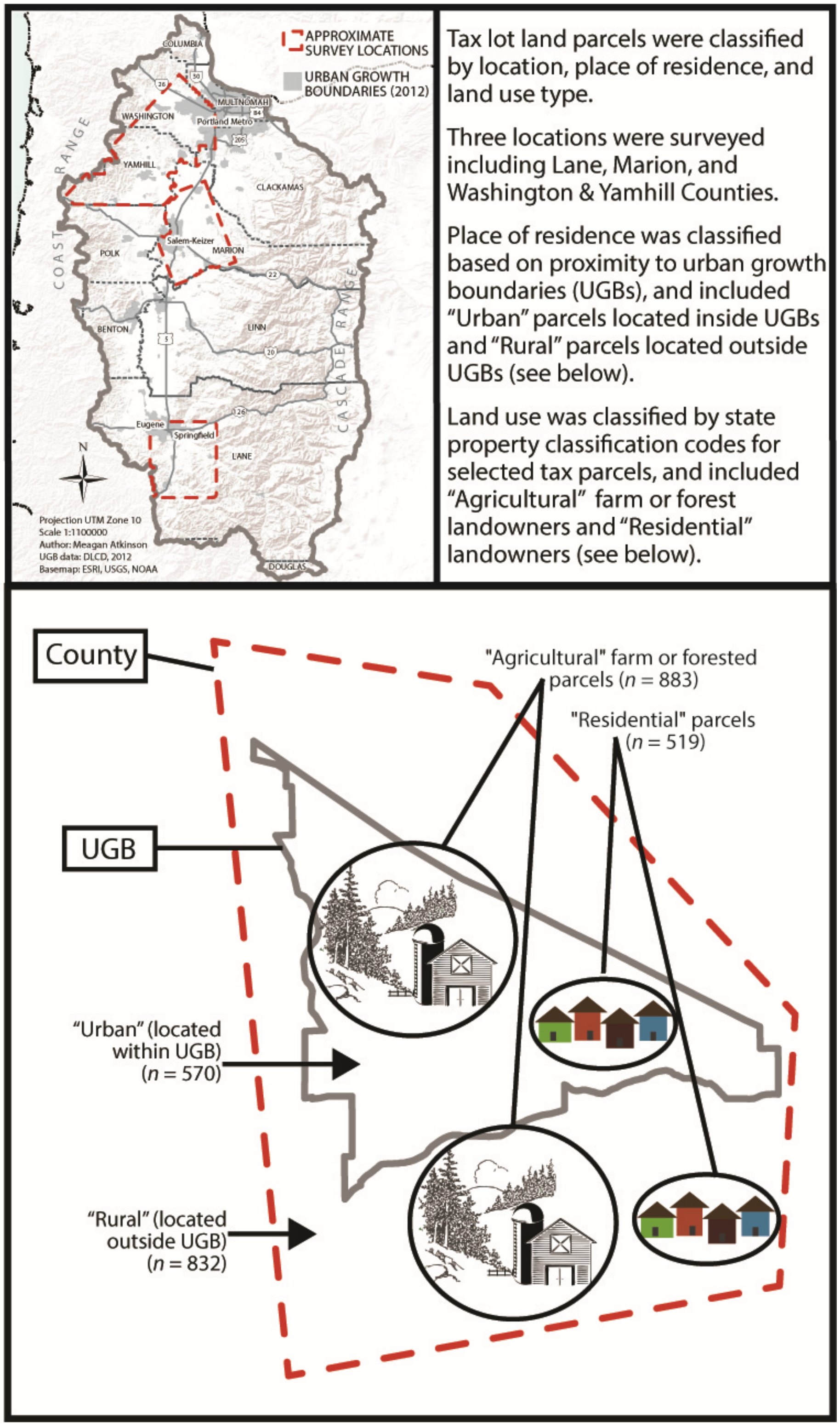


Figure 3.2: Land use in the Willamette River Basin

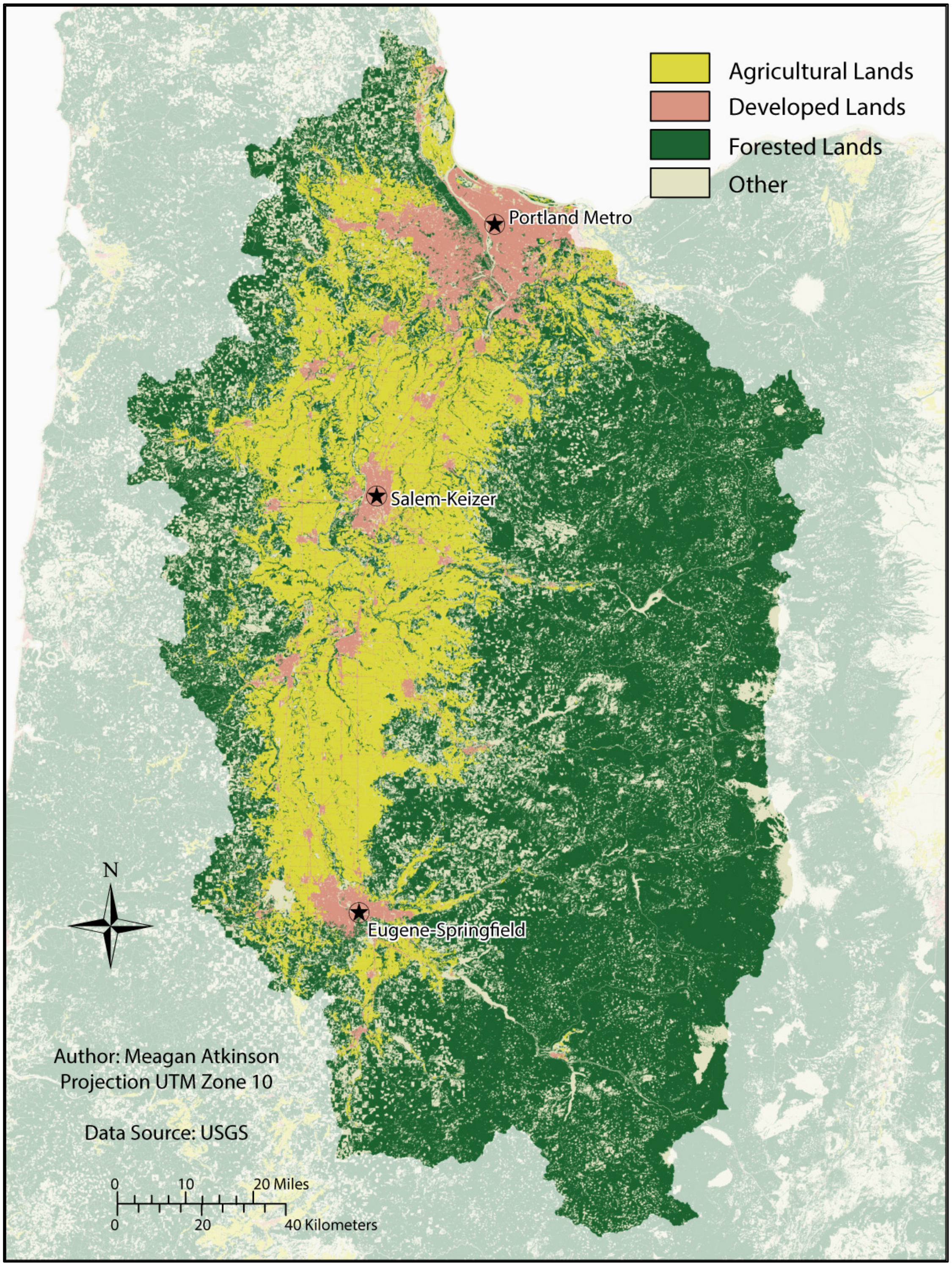


Figure 4.1: Distribution of rural-urban and land use classifications by geographic location

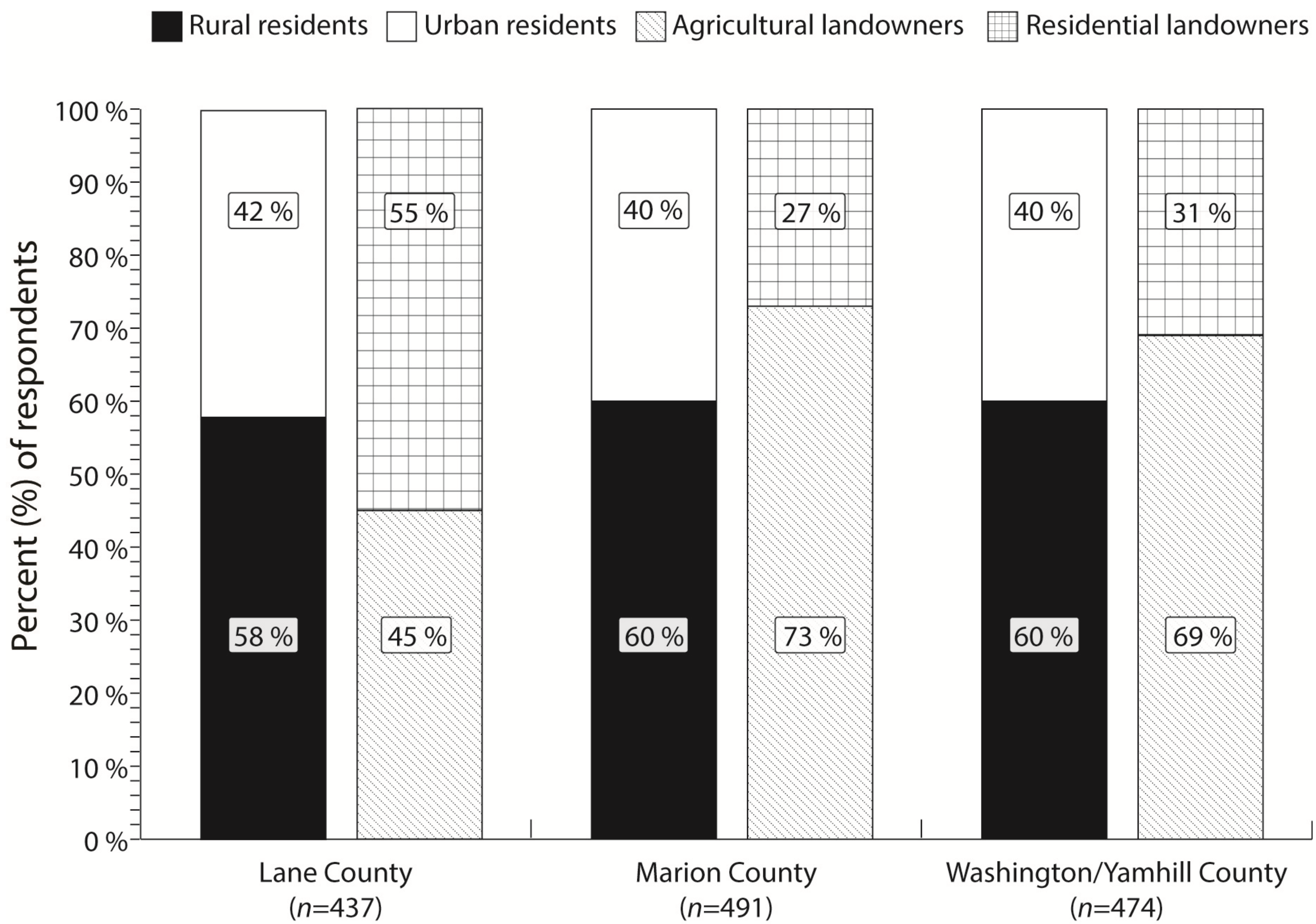
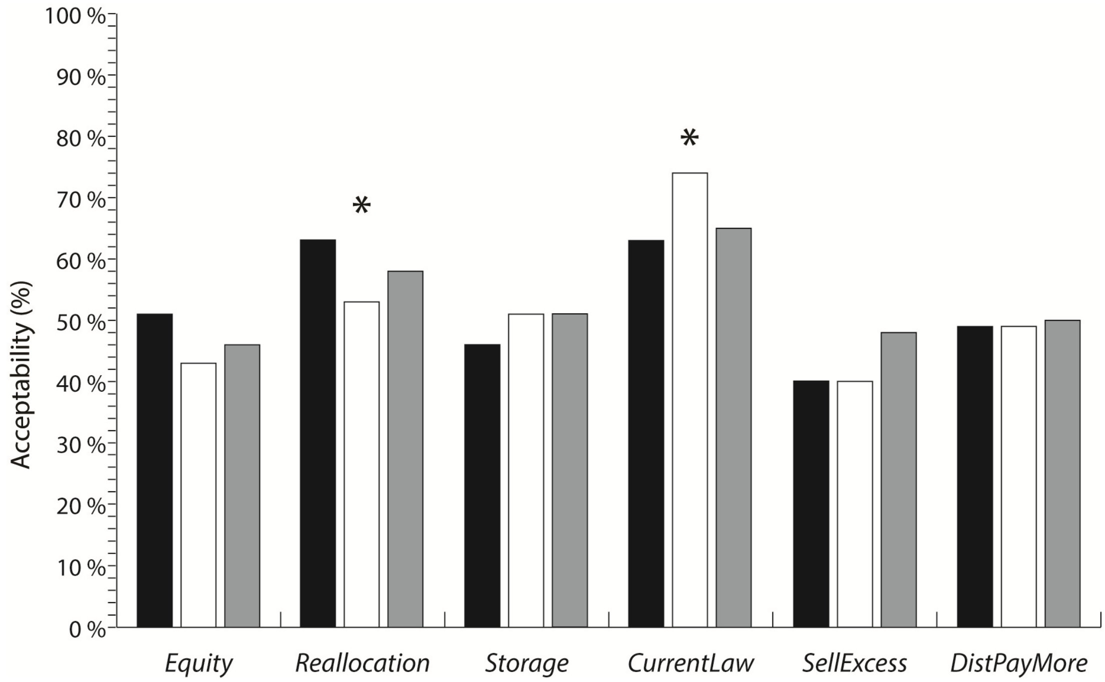
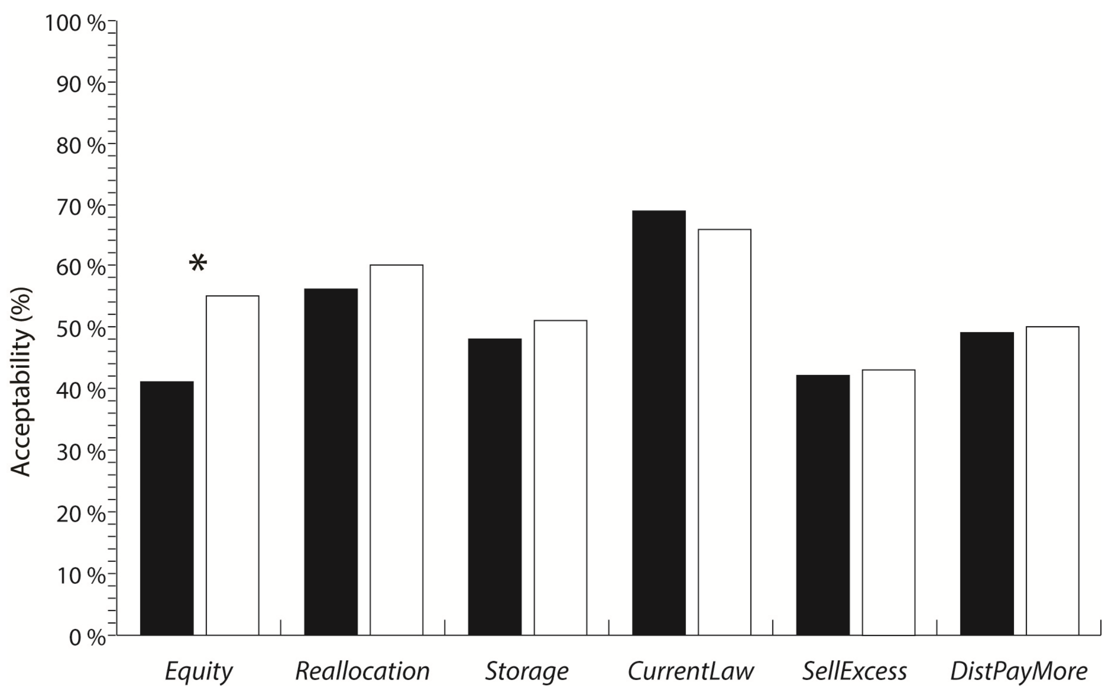


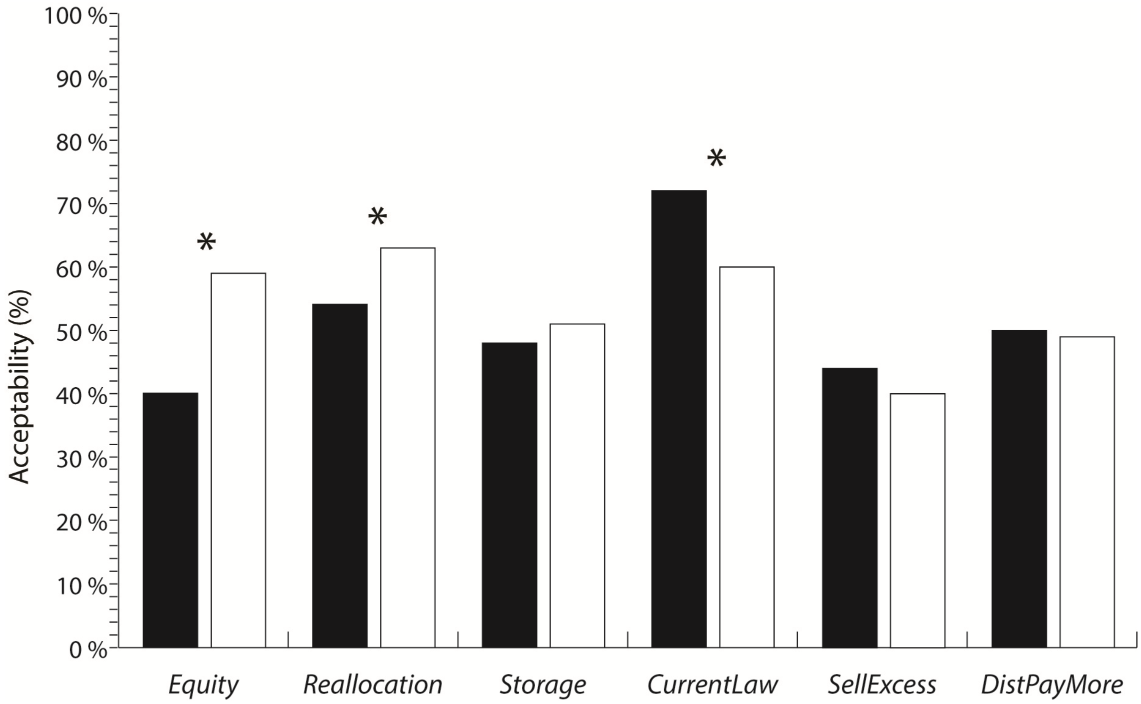
Figure 4.2: Acceptability (percent) of water policy variables by (a) Location, (b) Place of residence, and (c) Land use type, where $P < 0.05$ indicated by an asterisk (*)



(a) Lane County (black bars; *n*=437); Marion County (white bars; *n*=491); Washington/Yamhill County (gray bars; *n*=474)

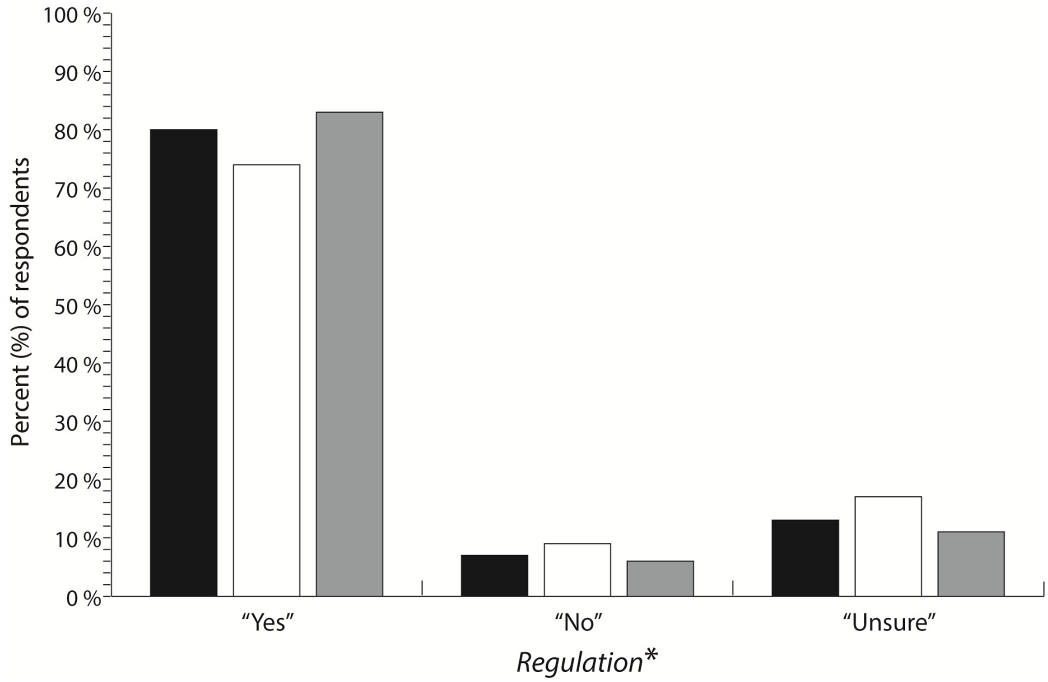


(b) Rural residents located outside the Urban Growth Boundary (black bars; *n*=832); Urban residents located inside the Urban Growth Boundary (white bars; *n*=570)

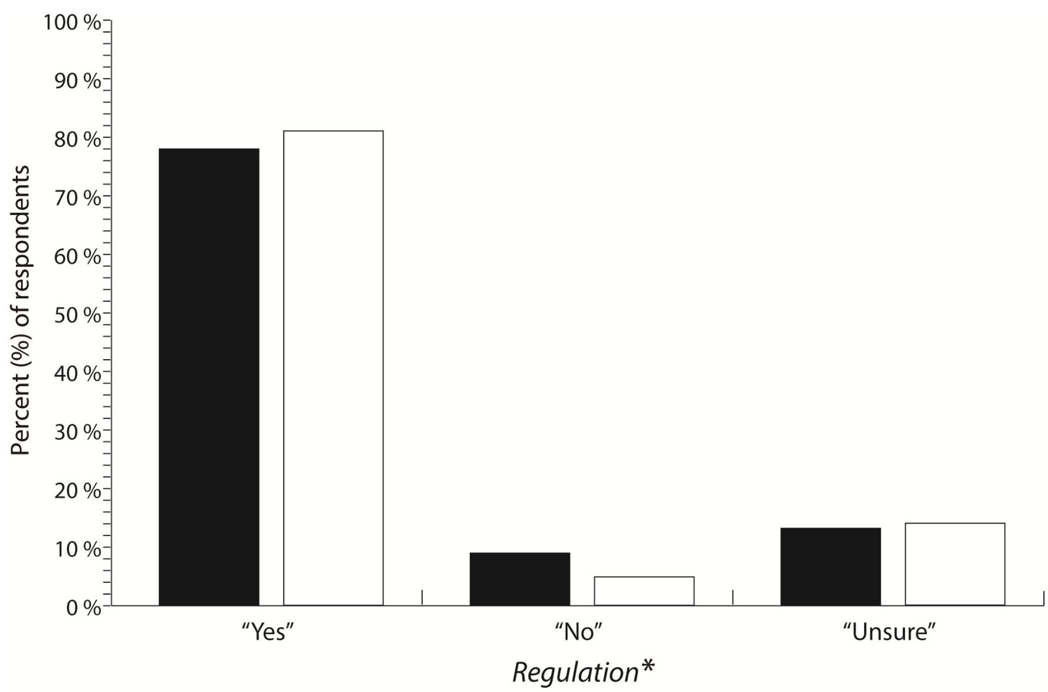


(c) Farm and forest, or agriculturalist landowners (black bars; *n*=883);
Residential landowners (white bars; *n*=519)

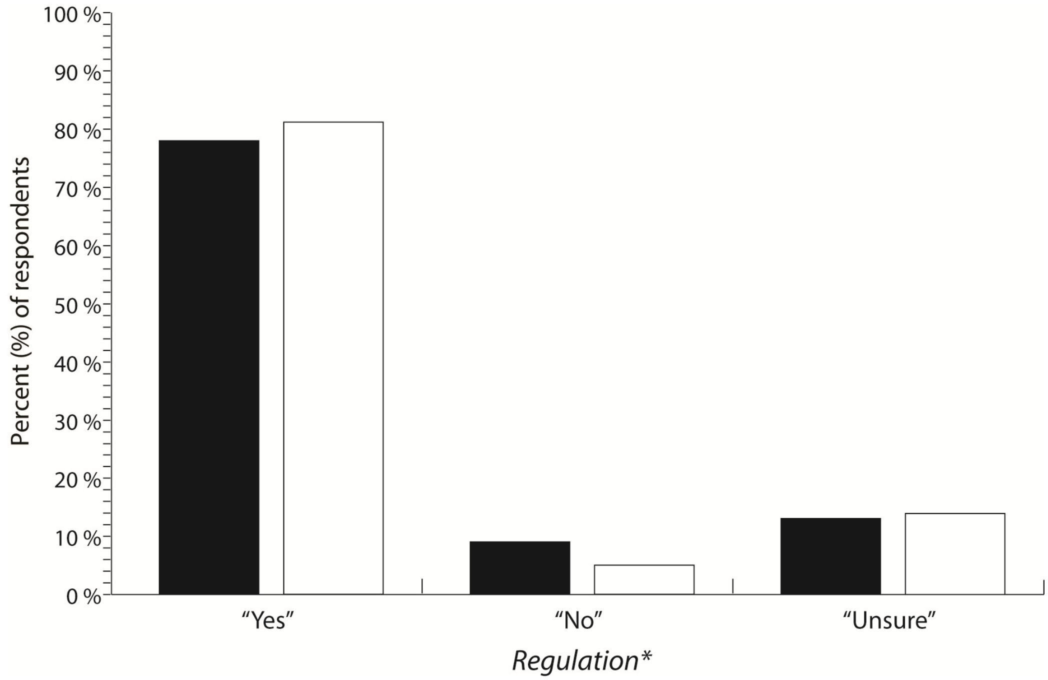
Figure 4.3: Frequency (percent) of support for water regulation by (a) Location, (b) Place of residence, and (c) Land use type, where $P < 0.05$ indicated by an asterisk (*)



(a) Lane County (black cars; *n*=408); Marion County (white bars; *n*=452); Washington/Yamhill County (gray bars; *n*=439)



(b) Rural residents located outside the Urban Growth Boundary (black bars; *n*=771); Urban residents located inside the Urban Growth Boundary (white bars; *n*=528)



(c) Farm and forest, or agriculturalist landowners (black bars; *n*=813);
Residential landowners (white bars; *n*=486)

Figure 4.4: Acceptability (percent) of support for one *CurrentLaw* water policy component statement stratified geographically, where $P < 0.05$ for *CurrentLaw* indicated by an asterisk (*)

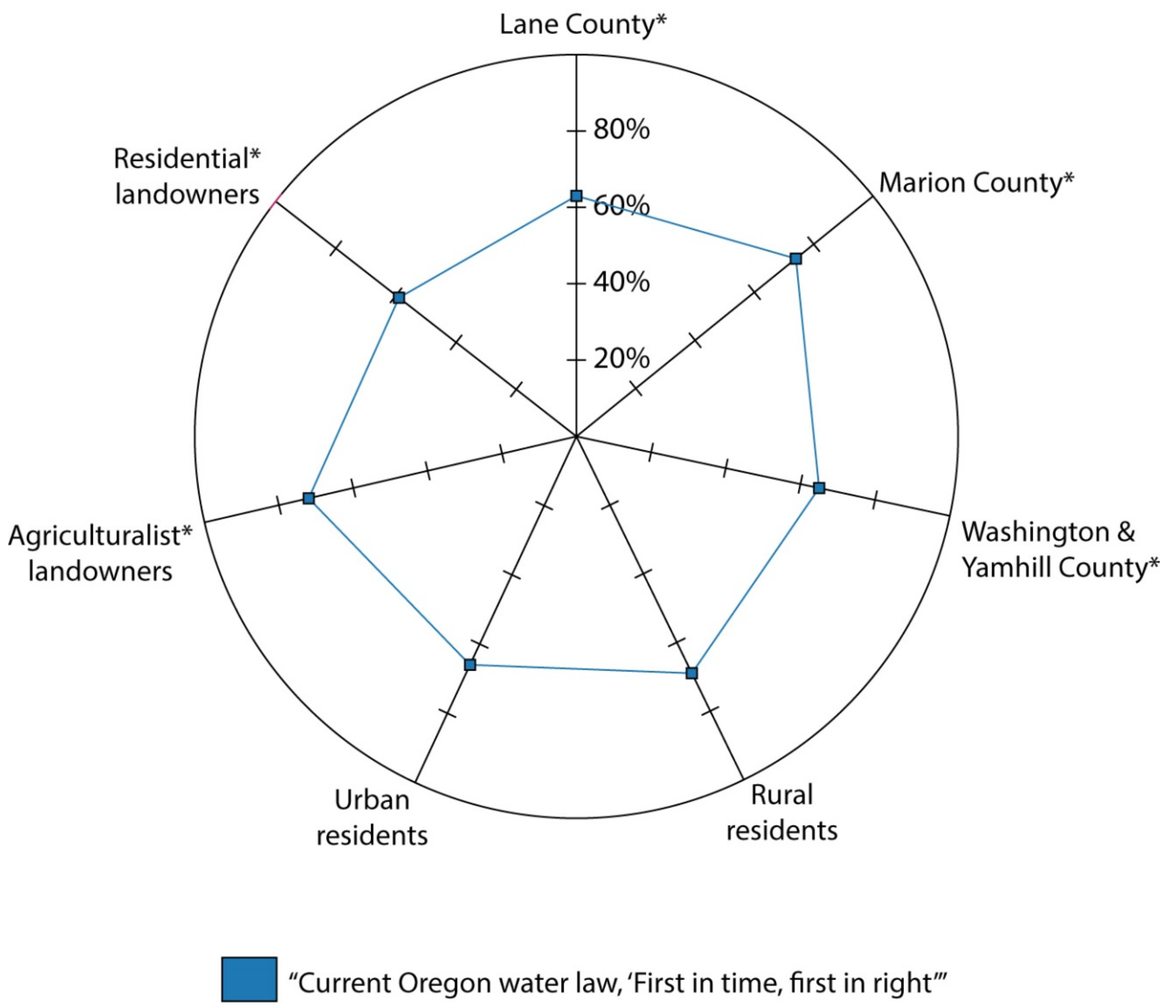


Figure 4.5: Acceptability (percent) of support for four *Equity* water policy component statements stratified geographically, where $P < 0.05$ for *Equity* variable indicated by an asterisk (*)

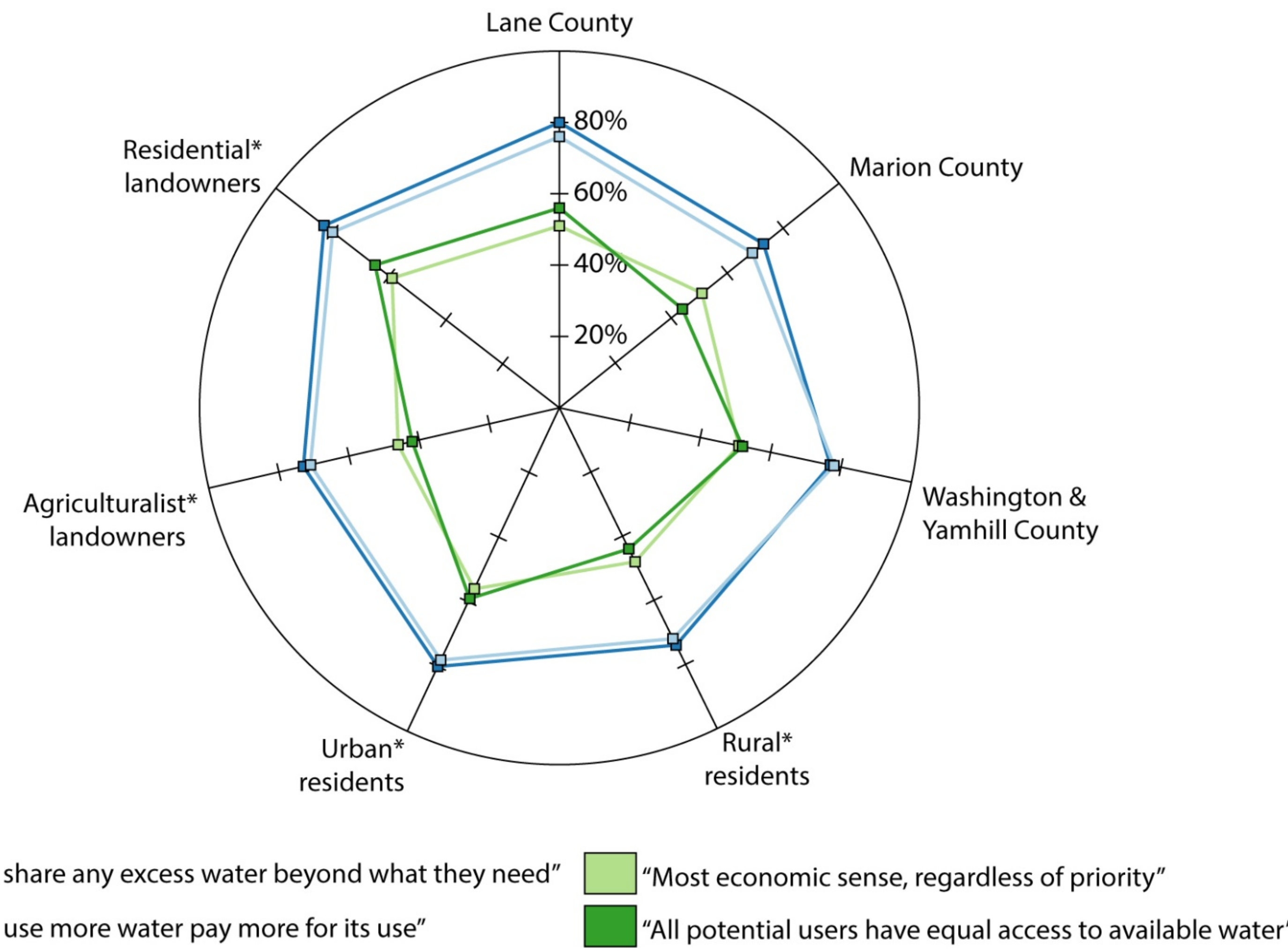


Figure 4.6: Acceptability (percent) of support for four *Reallocation* water policy component statements stratified geographically, where $P < 0.05$ for *Reallocation* indicated by an asterisk (*)