The Water Report

Water Rights, Water Quality & Water Solutions in the West

In This Issue

Business Case for Water ___1

Potable Reuse Communications _____16

Water Briefs _____ 23

Calendar _____ 27

Upcoming Stories

EPA CWA 401 Rule

The Great Salt Lake

Texas v. NM

& More!

THE BUSINESS CASE FOR INVESTING IN WATER IN OREGON

A STATEWIDE ASSESSMENT OF THE ECONOMIC VALUE OF WATER

by Davíd Pilz J.D. and Sarah Kruse, Ph.D., AMP Insights (Portland, OR)

Introduction

Oregon released a 100-year Water Vision report (Vision) in 2020, at the heart of which was ensuring sufficient water for Oregon's people, economy, and environment now and for future generations. The report also promoted strategic investment in infrastructure and ecosystems to support resilient communities, vibrant local economies, and a healthy environment. Following the release of the Vision — and to further the goals of the Vision — in 2021, the Oregon Legislature appropriated funds for the Oregon Water Resources Department (OWRD) to contract for a statewide business case assessment to examine the economic value of water to Oregon.

AMP Insights, along with One Water Econ and Robert Raucher, Ph.D. (Raucher LLC), were awarded the contract for developing the business case assessment in the spring of 2023; the report was completed on June 30, 2023. This article summarizes the full report: *The Business Case for Investing in Water in Oregon* (the Business Case). The authors would like to acknowledge the work of our collaborators on this project — One Water Econ and Raucher LLC — who contributed substantial research and writing to the effort along with deep expertise and help with the overall approach and conceptual strategy of the work.

Background

Beginning with Indigenous cultures since time immemorial, Oregon's land, people, and environment have always been deeply connected to water. The objective of the Business Case is to highlight the critical value of water to Oregon and clearly articulate the case for making and sustaining investments to protect and manage Oregon's water assets.

Applying a business case perspective provides an objective approach for assessing the beneficial returns that potential water investments might generate and how those benefits are likely to be distributed across Oregon's people, regions, economic sectors, and ecosystems. The goal is to identify options with high returns on investment while recognizing that many returns are not monetary. The Business Case is in large part based on economic considerations but is not constrained by that frame of reference. Compelling reasons to invest in water in Oregon are diverse and include many non-monetary benefits such as spiritual and aesthetic values for water.

The Business Case begins with the risks Oregon faces in maintaining and equitably distributing access to clean, abundant, reliable water supplies as well as the opportunities and benefits of doing so. In Oregon, climate- and human-related stressors manifest in numerous ways. First, most of Oregon's streams and rivers are fully or over-appropriated, and groundwater is not a viable alternative for new water uses in many parts of the state. Another growing water stress for the state is impairment of water quality. A recent study estimated that over 80% of assessed river and stream miles in Oregon were impaired for aquatic life and almost 60% were impaired for recreational uses such as swimming (Environmental Integrity Project 2022).

The Water Report
(ISSN 1946-116X)
is published monthly by
Sky Island Insights LLC

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Email
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Website
www.TheWaterReport.com

Subscription Rates
$299 per year
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Aside from physical stressors related to climate and hydrology, historic and persistent inequities in access to clean, plentiful water and influence over water decision-making also have implications for Oregon's water future. Oregon's Tribes, rural populations, lower-income populations, and populations of color are often exposed to greater water risks, including: lack of access to water and culturally/spiritually important aquatic species that rely on water; unsafe drinking water; and a lack of affordable domestic water supply.

While risk is one part of the business case for water in Oregon, another part is the benefits and opportunities that investing in water affords. Water provides an array of essential and highly valuable services to Oregon's natural and human communities (Figure 1).

Figure 1. Examples of Use Benefits Derived from Water Resources

Oregon's Water Use Context

After describing the drivers for articulating the Business Case, the report describes the various uses and economic values associated with water resources across Oregon. To streamline the Business Case analysis, the project team divided the state into seven regions made up of county groupings (Figure 2). County groupings were used rather than watershed delineations due to the limited timeframe the project team had to complete the report.

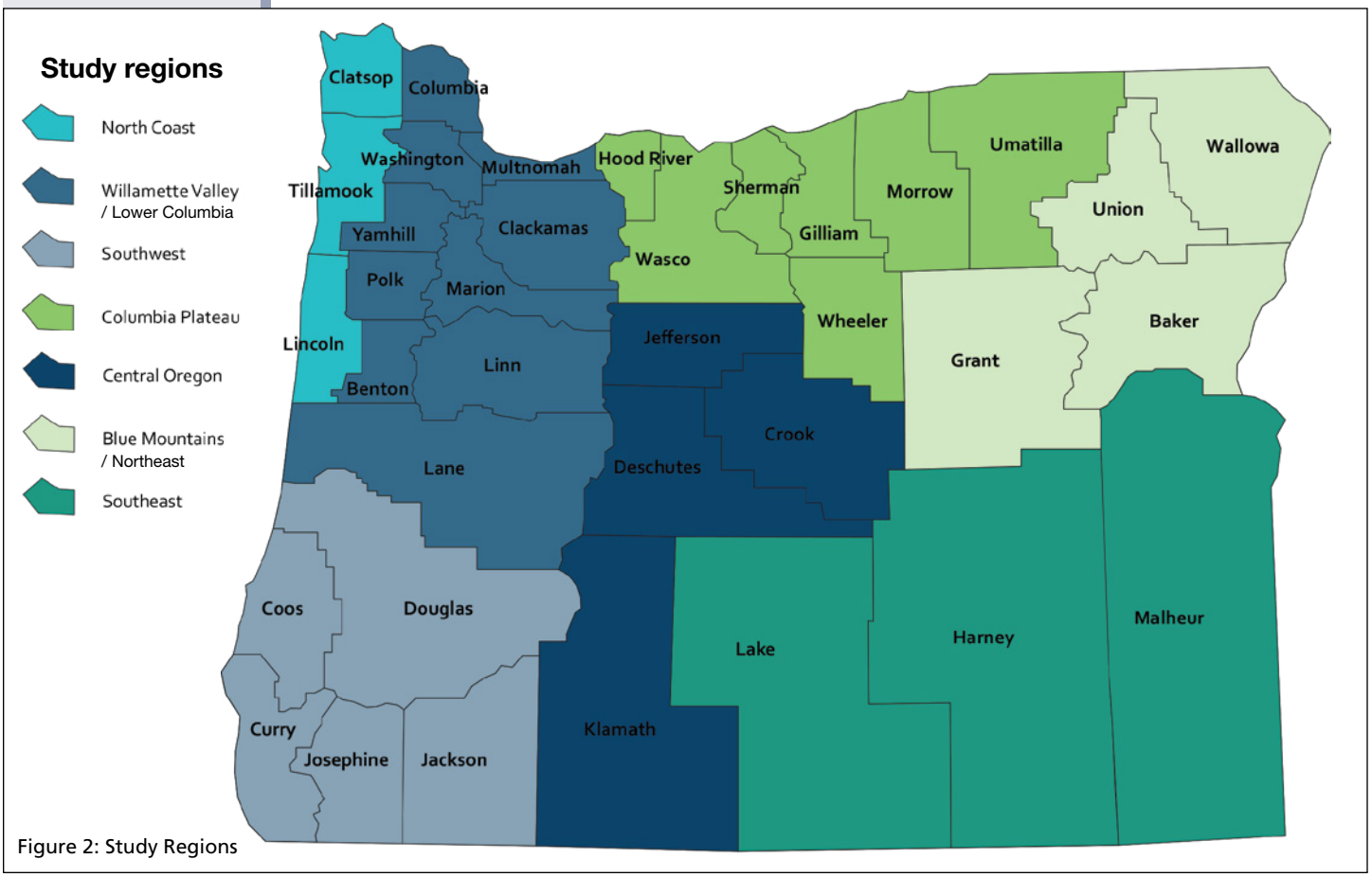

Figure 2: Study Regions

Business Case

Across the state, approximately 78% of total water withdrawals are from surface water sources, while 22% come from groundwater; of the water withdrawn, 78% is used for irrigation (USGS 2023). The balance of water use between irrigation and other uses varies across different regions of the state; in many coastal regions and valleys on the west side of the Cascade Mountains, irrigation is a significant water use sector but to a lesser magnitude than in the drier portion of the state east of the Cascades.

Economic Output

From the data analyzed in the report, a conservative estimate is that businesses that depend on water for production and output in Oregon (including agriculture) contribute approximately half (48%) of the state's total economic output and close to half (44%) of its employment. This estimate is conservative due to differences in how output in these sectors is calculated and differences in available data sources. In addition, to avoid risk of double counting some sectors, the estimate does not include economic contributions from recreation, commercial fishing, hydroelectric power generation, or thermoelectric power generation. The following sub-sections of the Business Case discuss key water-related sectors using both statewide and regional data.

AGRICULTURE

Irrigation Crops

Irrigated agriculture accounts for approximately 80% of the total water use in Oregon (USGS 2020; NOAA 2022). Across the state, 45% of harvested cropland is irrigated, totaling more than 1.3 **m**illion (M) acres (USDA NASS 2017). An additional 338,900 acres of pastureland is also irrigated, although this makes up a very small percentage of the 10.5M total acres of pastureland across the state.

According to the most recent National Agricultural Statistics Service (NASS) Census of Agriculture (CoA), conducted in 2017, forage crops make up the largest percentage of irrigated acreage at 55% and vegetables, grains, and field and grass seed together account for an additional 27%. The makeup of irrigated acreage varies across regions (Figure 3). The Willamette Valley/Lower Columbia and the Columbia Plateau regions both contain a more varied crop mix and are home to many of Oregon's specialty and high-value crops, including orchards (grapes and fruits), vegetables, and field and grass seed. The Willamette Valley/Lower Columbia region is also home to much of the state's irrigated hops, mint, and berry acreage. The Southwest region, while containing substantially fewer irrigated acres overall, also grows berries and orchard crops. In the other regions of the state, irrigated acreage is largely dominated by forage, hay, and grain crops.

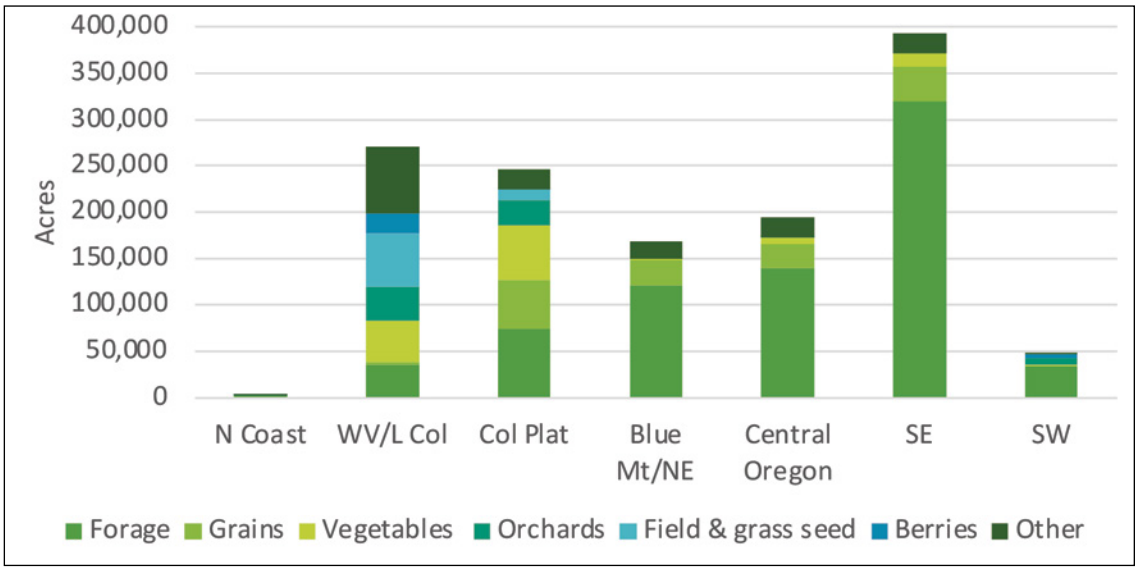

Figure 3. Irrigated Acres by Crop Type and Study Region Source: USDA NASS 2017.

Economic Contributions

NASS CoA data on the value and irrigation of various crops throughout the state was used to estimate the direct value of irrigated agriculture as a percentage of total cropped agricultural production. IMPLAN was then used to modeling the overall economic contribution of irrigated agriculture to Oregon's economy. IMPLAN is a modeling software that quantifies the direct economic activity associated with different sectors in terms of economic output (e.g., total sales), employment, value added (or **g**ross **d**omestic **p**roduct (GDP)), and labor income. It also estimates the economic activity generated by the purchase of intermediate inputs from different sectors (indirect effects) and by spending from individuals employed in affected sectors (induced effects). Table 1 shows the total economic contribution of irrigated agriculture across the state, including direct, indirect, and induced effects.

Business Case

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct	42,964	$1,494	$1,682	$3,763
Indirect	12,621	$787	$1,041	$1,792
Induced	10,259	$622	$1,077	$1,813
Total - Irrigated Ag	65,844	$2,903	$3,800	$7,368
Irrigated Ag as a % of State Total	2.6%	1.6%	1.4%	1.5%

Table 1. Economic Contribution of Irrigated Agriculture to Oregon's Economy

Source: IMPLAN. Value Added is equivalent to GDP. It includes labor income, taxes and subsidies, and other property income.

Ag Impact

On its own, irrigated agriculture accounts for a relatively small percentage of the state's GDP, equivalent to Value Added in IMPLAN, and total economic output. However, the role of irrigated agriculture in supporting food security for Oregon's residents cannot be understated. According to data from the IMPLAN model, fruits grown in Oregon meet 34% of total demand from businesses and residents in the state, while vegetable and nut production meet 57% and 48% of total demand, respectively. Irrigated agriculture has important forward linkages too, supporting many other industries throughout the state, including wineries and associated tourism activities, breweries, cattle ranching and farming, dairy cattle and milk production, and fruit farms and related specialty products for which Oregon is famous.

Industry Output

WATER-DEPENDENT INDUSTRIES

Water-dependent industries such as manufacturing, health care, and wineries rely heavily on water for key aspects of production. In Oregon, manufacturing is by far the largest economic contributor and employer, with an annual economic output of $89 billion, accounting for 18% of the total state output and 62% of output from only water-dependent industries. Health care services such as hospitals, physicians' offices, and nursing homes contribute $39 billion to the state's economy annually (or approximately 8% and 21% of total output and water-dependent industries output, respectively). Manufacturing and health care services collectively employ over 400,000 people, making up about 16% of the state's total workforce.

Beyond direct economic contribution, water-dependent businesses create additional economic activity in the form of indirect and induced spending. Together, these industries support $221 billion in economic output (46% of the state's total) and $111 billion in total value added (40% of the state's total), supporting just over 1 million jobs (41% of the state's total).

Use Values

FRESHWATER-RELATED RECREATION AND TOURISM

Oregon's diverse geography and ecology create opportunities for a range of outdoor recreation activities including hiking, boating, swimming, fishing, camping, skiing. The state's clean and abundant water sources — including its lakes, rivers, and streams — underpin the values and economic activity associated with many outdoor recreational activities. The inherent value that individuals place on outdoor recreational activities can be difficult to measure, however. Economists have developed non-market valuation techniques to estimate the value of recreational experiences across a range of activities. These studies yield what economists refer to as direct use values, which reflect the maximum amount that individuals would be willing to pay to participate in a recreational activity. The net economic value of a recreation activity equals maximum willingness-to-pay minus any costs incurred to participate. Applying this methodology to a statewide survey of participation in outdoor recreational activities, Rosenberger (2018) estimated that in 2017, Oregonians participated in 1.4 billion outdoor recreation activity days, with a total net economic value of $63 billion.

Direct Revenues

COMMERCIAL SALMON FISHING

The coastal waters off Oregon's shores support vibrant fisheries and fishing communities. Among the iconic commercial fisheries are six runs of anadromous salmonids: Coho, Chinook, Chum, Pink, and Sockeye salmon and steelhead trout. In 2021, Oregon's fishing fleet landed close to 1.8M pounds of salmon, producing more than $6 million in revenue (NOAA Fisheries 2021). Salmon fishing accounted for just over 3% of direct revenues (or ex-vessel sales) from onshore landings along the coast in 2021. Based on data from the IMPLAN model, the salmon fishery supported an estimated 151 direct jobs and over $5 million in labor income (including proprietor income). The employment and labor incomes were

Business Case

estimated based on industry patterns for the commercial fishing sector. The direct economic activity associated with salmon fishing — $24 million — is concentrated in the coastal regions of the state, and in particular, the North Coast region, which is responsible for 89% of total onshore landings across its five ports (ECONorthwest 2019).

Energy

HYDROPOWER

Oregon's rivers provide the state with an immense amount of hydropower. Oregon is the second-largest producer of hydroelectric power in the United States after Washington. In recent years, approximately half of Oregon's electricity generation has come from over 100 hydroelectric facilities located within the state or on its shared borders with Washington and Idaho. This energy has two primary economic signatures; first, and most importantly, it powers homes, businesses, and industries across the state, contributing to statewide and regional economic productivity. Second, hydropower is an industry, with revenues and employment levels that also contribute to the state's economic well-being. The hydropower industry in Oregon employs approximately 1,500 people across the state (Oregon Department of Energy 2022).

Gas Fired Facilities

THERMOELECTRIC POWER GENERATION

Compared to the number of hydroelectric generating facilities, Oregon has relatively few thermoelectric generation stations. There are 13 natural gas–fired facilities, several with multiple generating units, located within the state (Northwest Power and Conservation Council (NPCC) 2023). These plants rely on consistent supplies of fresh water for cooling and steam generation. Water withdrawals from rivers, as well as discharges of heated water by these facilities, can have adverse effects on aquatic fish and habitat (Mehaffey, Neale, and Horvath 2017). Despite their small numbers, thermoelectric generating facilities produced approximately 20M **m**ega**w**att **h**ours (MWh) in 2020, or about 30% of the electricity generated within the state. Oregon power producers also exported approximately 7.5M MWh of natural gas–generated electricity in 2020 (Oregon Department of Energy 2022). In addition, the state's thermoelectric facilities are important contributors to the state and regional economies. In 2022, natural gas–fired power plants directly employed nearly 500 Oregonians, with most of these positions concentrated in the Willamette Valley/Lower Columbia and Plateau regions.

Small v. Large Water Providers

POTABLE WATER SUPPLY

Understanding water use by households and businesses for drinking water and sanitation purposes, as well as the water systems that provide these services, was critical to making the Business Case. Very small public water systems (i.e., those providing water to fewer than 500 people) serve 12%–16% of the population in all regions. The Willamette Valley/Lower Columbia region leans on large and very large systems (i.e., those providing water to over 10,000 and over 100,000 people, respectively) to serve water to 86% of the population. Most of the population in the Blue Mountains/NE, Columbia Plateau, North Coast, and Southeast regions get their water from systems that serve under 10,000 people (EPA 2023).

Relative dependence on public water systems vs. domestic self-suppliers varies across the state. Self-supply is most often from groundwater. The Willamette Valley/Lower Columbia region, with its large population and large and very large water systems is one of the least dependent on domestic self-supply (12%), along with the North Coast region (9%). On the other end of the spectrum, regions such as the Southeast (38%), Blue Mountains/NE (28%), and Southwest (28%) are more dependent on domestic self-supply and, thus, groundwater (USGS 2018).

Additional Benefits

OTHER WATER VALUES

In addition to the sectors described above, there are numerous other benefits of water that either 1) do not fall neatly into a single industry sector (e.g., golf courses, navigation, and transport); 2) represent only a portion of an industry sector (e.g., freshwater aquaculture); or 3) require non-market valuation approaches to estimate (e.g., spiritual, aesthetic and symbolic values, and ecological function values). While not discussed in additional detail here, these benefits are covered in the full report.

Water and Oregon Tribes

Frontline Communities

After presenting the baseline value of water for Oregon as a whole, the Business Case shifts to a discussion of the value of water specifically to Oregon's Indigenous people. The borders of modern-day Oregon are home to nine federally recognized Tribes as well as several Tribes that are not recognized by the US government. Water takes on a special importance for the Indigenous people who live in Oregon because of the implications water has for their culture and their spiritual, economic, and subsistence

Business Case

needs. Tribal communities are also often frontline communities in Oregon, meaning that they experience impacts from degradation of water resources first and worst. It is impossible to make the business case for investing in water in Oregon without recognizing Tribal sovereignty and the imperative of co-managing water resources that sovereignty implies.

Water Relationship

Water is an essential and integrated part of life for Oregon Tribes and has been forever — it is deeply woven into Tribal culture, spirituality, society, identity, and the nourishment of homelands. Broadly speaking, the relationship between Oregon's Indigenous people and water goes beyond viewing water as a resource for human use. It is rooted in stewardship, community, and reverence. Additionally, the culture, health, and well-being of many Indigenous communities in Oregon are integrally tied to salmon; therefore, declining salmon populations directly endanger the health and vitality of these communities.

In September 2021, Oregon's nine federally recognized Tribes signed a joint letter to then-Governor Kate Brown that articulated the extent and importance of Tribal connections to water in Oregon. In their words:

> "Water is sacred. Water is life. Water is the heartbeat of our culture. Our understanding of these truths is based upon a legacy of survival and reliance on our Oregon oceans, rivers, and lakes... Our tribes and their fisheries lived together before Oregon existed. Our ancestors understood that they had to live in a balanced relationship with oceans, rivers, creeks, lakes, springs, marshes, and the flora and fauna that depend upon them. There was, and is, no other way to survive." (The Nine Sovereign Tribes of Oregon 2021)

Connection

The Oregon Tribes also detailed how deep their connection is, and has always been, with steelhead, salmon, lamprey, suckers, and other species:

> "*The extinction of these vital fisheries would equate to the genocide of our people* and the end of our irreplaceable lifeways — because these resources form essential parts of who we are" [emphasis added]. (The Nine Sovereign Tribes of Oregon 2021)

Subsistence

Indigenous communities living in Oregon face the same water-related risks as all Oregonians, but due to the relationship of Tribal history, culture, and health with water resources and aquatic species, these risks take on special urgency. The Fourth National Climate Assessment (Reidmiller et al. 2018) noted that a changing climate "threatens these delicately balanced subsistence networks by, for example, changing the patterns of seasonal timing and availability of culturally important species in traditional hunting, gathering, and fishing areas" (Jantarasami et al. 2018). With this in mind, the Business Case discusses the approaches of two Oregon tribes — the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Confederated Tribes of the Warm Springs (CTWS) — to valuing and managing water and aquatic species. CTUIR's approach is highlighted here.

CTUIR FIRST FOODS

CTUIR explains their view and connection to water on their website, describing that:

> "Water was created first, life and land were created next, land promised to take care of all life, all life promised to take care of the land. Across generations of the CTUIR, Indigenous people promised to... protect the land and have the responsibility to care for her. Water represents an integral link in a world view where water is sacred and extremely important in preserving precious balance. Water is the origin of and essential for the survival of all life." (CTUIR n.d.)

First Foods

In the CTUIR creation belief, the Creator spoke to the foods, asking, "Who will take care of the Indian people?" Salmon stepped forward first with a promise of care, followed by other fish. Then deer, cous (a type of root), and huckleberry stepped forward. Each of these "First Foods" are grouped with other ecologically related foods, and the order in which they stepped forward forms the basis of the ceremonial and ritualistic serving order of meals (Jones et al. 2008).

Robust Watershed

For CTUIR, the long-term protection of water relies on an ecologically healthy and robust watershed, beginning with the Umatilla River that runs through the Tribe's reservation. From the perspective of the river, a dynamic and healthy watershed is rooted in ecological processes and patterns that support enduring production and utilization of First Foods by the CTUIR community (Endress, Quaempts, and Steinmetz 2019). Reliable availability of First Foods — beginning with water and salmon — contributes to the continuation of Tribal ceremonies, knowledge, and traditions that support the physical, mental, spiritual, and relational health of Tribal members. On the other hand, a degraded river leads to loss and decreasing

Business Case

production and availability of First Foods. A reduction in practices around First Foods is linked to a wider and more severe array of health issues for Tribal and community members (Jones et al. 2008).

Therefore, the CTUIR Department of Natural Resources established a mission focused on caring for the minimum ecological products necessary to nourish CTUIR subsistence and cultural needs (Endress, Quaempts, and Steinmetz 2019). The mission has a long-term goal of restoring a network of related foods to continue community expressions of First Foods traditions, provide a diverse table setting of native foods for the Tribal community, and restore First Foods for their respectful use now and into the future (Jones et al. 2008).

Tribal Water Rights in Oregon

After discussing Tribal approaches to water management, the Business Case briefly discusses the status of tribal water rights in Oregon; specifically, the report summarizes the status of water rights for the CTUIR, CTWS, and the Klamath Tribes.

CTUIR WATER RIGHTS

Losses

Between 1906 and 1927 the Bureau of Reclamation (Reclamation) built the Umatilla Basin Project — a series of reservoirs and canal systems — to help provide water for irrigation in and around the towns of Pendleton, Hermiston, and the Port of Morrow (Guaio 2012). The project, combined with increased water use by irrigation and industry in the area, decimated the Umatilla River's Chinook and Coho salmon runs. By 1926, experts observed that the two fish had been extirpated from the river (Guaio 2012). Speaking of this loss, and others, Antone Minthorn, a CTUIR member, noted:

> "The CTUIR lost a tremendous amount of resources and culture from the time of Lewis and Clark in 1804 and the 1855 Treaty signing, but we can never go backward to make things right. That is done. It is over. The only way we are going to recover what we have lost of our original reservation promise is to move forward using the sovereign powers we have retained. We have to learn how to use our sovereign powers to rebuild our nation and take our place in this world." (Minthorn 2006)

Water Exchange

CTUIR applied this same approach to their water rights in the Umatilla Basin, working with area irrigation districts, the State of Oregon, and the federal government in the 1980s and 1990s to develop what are now called the Umatilla Basin Project Phases I and II. These projects were a massive investment in instream flow restoration and irrigation infrastructure to allow for reintroduction of salmon in the Umatilla River. They involve two water exchanges whereby farms that formerly diverted from (and, thus, dewatered) the Umatilla River for irrigation are provided with water pumped from the nearby Columbia River in exchange for letting water flow in the Umatilla to its confluence with the Columbia (Pagel 2016). The result of the exchanges has been a successful restoration of a productive salmon fishery in the Umatilla River (Pagel 2016). Despite the success of these projects, CTUIR does not yet have settled water rights.

Unsettled Rights

In 2011, the federal government appointed a team to negotiate with CTUIR, Oregon, and others to settle CTUIR's water rights in the basin. CTUIR is entitled to reserved water rights sufficient to fulfill the purposes of their reservation including reserved rights to support fish populations (CTUIR 2020). The negotiations are ongoing as of the writing of this article (September 2023).

CTWS WATER RIGHTS

Negotiations

The Warm Springs Tribes settled their water rights in the mid-1990s. CTWS had several advantages in negotiating their water rights settlement compared to many other Tribes in the western US. For example, all of the rivers that begin on the reservation also end within the reservation's boundaries; other aspects, such as CTWS's location, geography, hydrology, and land ownership, also made negotiating their water rights less likely to conflict with other water users in the watershed (Guaio 2012).

Cooperative Management

The CTWS along with the State of Oregon and the US government agreed to a settlement of the Tribe's water rights in 1997 (Brunoe, Newton, and Seales 2023). An important focus of the agreement was cooperative management of the Deschutes River and its tributaries for long-term protection of fisheries. A unique facet of the CTWS water rights settlement is that the Tribe agreed that, while the priority date for their reserved water rights would be the earliest in the basin, existing state water rights with a priority prior to January 15, 1991 would not be curtailed to satisfy the Tribal reserved right (Guaio 2012). The Tribe also negotiated the ability to be the sole administrators of their reserved rights on the reservation and to have authority over state water rights on the reservation (Guaio 2012).

Business Case

US v. Adair

Adjudication

Investment Analysis

Goals & Approach

Beneficial Outcomes

TRIBES WATER RIGHTS

The story of the Klamath Tribes' water rights began with an 1864 treaty in which the Tribes gave up their interest in their 22-million-acre homeland to the US government but reserved "the exclusive right of taking fish in the streams and lakes (of the Reservation)..." (Sudbury 2004). More than 100 years later, in 1979, after many of the fish populations on which the Klamath Tribes traditionally depend were in steep decline, a federal District Court in Oregon ruled that the Klamath Tribes' treaty guaranteed an implied right to protect their hunting and fishing rights with a priority date of time immemorial (*United States v. Adair* 1979).

After almost four decades and numerous additional court cases, in 2013 the Klamath Tribes were finally able to enforce their water rights to protect fish in Klamath Basin rivers and streams (Sudbury 2004). The Klamath Tribes hold instream water rights in the Williamson, Sycan, Sprague, and Wood Rivers along with the Klamath Marsh and 140 springs located in the former Klamath Reservation (Native American Rights Fund n.d.). As of this writing (September 2023), the Klamath Tribes' water rights are moving through the final stages of the state adjudication process — a court-led process for finalizing all valid water right claims in a watershed or basin.

Business Case Examples

The next element of the Business Case is a series of regional case studies. Case studies were used to analyze a diverse range of types of investments across each region of the state. Case studies involved specific past or planned investments as well as a general characterization of the value of instream flow in the Southwestern region. These analyses use a combination of quantitative economic analysis and qualitative discussion to weigh costs and benefits of specific investments. Lessons drawn from these case studies provide the platform through which the Business Case demonstrates potential returns — both economic and non-economic — from investing in Oregon's water assets. An example case study from the Business Case, located in the Blue Mountains/Northeast region, is presented here.

BLUE MOUNTAINS/NORTHEAST REGIONAL CASE STUDY: ON-FARM CONSERVATION AND ENVIRONMENTAL WATER TRANSACTIONS IN THE LOSTINE RIVER WATERSHED

The Lostine River begins in the high mountains of the Eagle Cap Wilderness and flows into the Wallowa River near the town of Lostine (Figure 4). The Wallowa River is a tributary of the Grande Ronde River, itself a tributary of the Snake River. The wide valley into which the Lostine River flows is part of the ancestral homelands of the Nez Perce Tribe and the CTUIR. Though Wallowa County is not part of either Tribe's current reservation, both Tribes reserved the right to hunt and fish there (among other lands) as part of treaties signed in the mid-1800s.

This case study describes two types of investments to increase instream flow in the Lostine River while also helping maintain agricultural viability: **e**nvironmental **w**ater **t**ransactions (EWTs); and irrigation infrastructure modernization on family farms. In turn, these investments support and increase the resiliency of a vital Tribal fishery and recovery of Chinook salmon — listed under the Endangered Species Act (ESA) — and reintroduced Coho salmon populations. Given that many of the beneficial outcomes of these investments are non-market or non-use in nature, the case study provides a quantified business case example only for investments in irrigation efficiency upgrades as this particular investment also provides monetizable on-farm benefits.

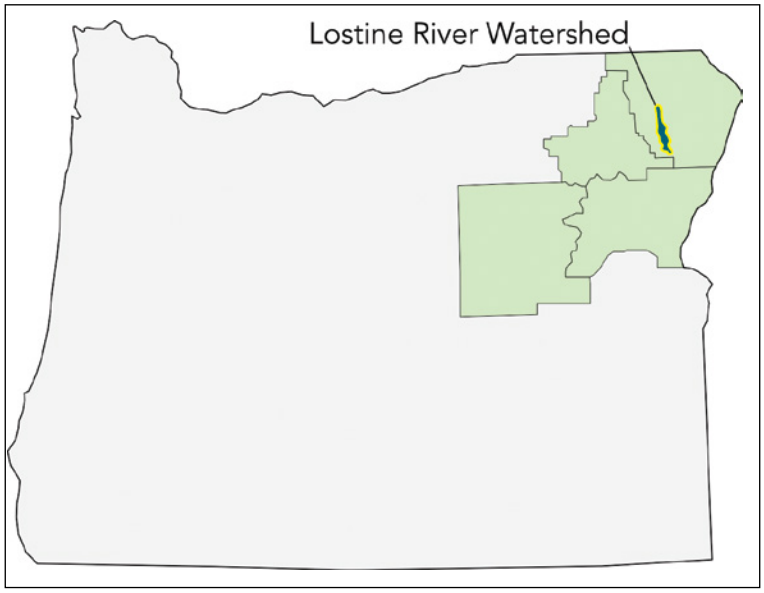

Figure 4: Map of Lostine River Watershed Location

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Seasonal Demands

Dewatering

Minimum Flows

Compensation

CHALLENGE

The Lostine River provides critical spawning and rearing habitat for spring and fall Snake River Chinook salmon (listed as threatened under ESA), recently reintroduced Coho salmon, steelhead, and bull trout. Salmon hold deep cultural importance for the Nez Perce and CTUIR and have been a primary source of food supply since time immemorial. Chinook salmon exhibit a unique migration pattern on the Lostine. The fish return in two pulses, with the second pulse of returning fish occurring in late August and lasting through the end of September. This migration of Chinook salmon coincides with low late-summer stream flow in the Lostine River. The period is also a time of year when local farms and ranches rely most heavily on the river for water for irrigated agriculture.

Since the late 1800s, water from the Lostine River has been used to irrigate farms growing mostly hay and alfalfa as well as small grains. Diversions from the river can completely dewater the river just above the town of Lostine, making upstream passage to the Lostine River's ideal spawning habitat difficult or impossible for returning adult salmon. Low flows, coupled with changing ocean conditions, the presence of dams on the Snake and Columbia Rivers, and other alterations on the Lostine River, resulted in the disappearance of Coho salmon from the river and severely impacted the spring Chinook salmon population (NOAA 2020). The Nez Perce and the state of Oregon manage a hatchery supplementation program for Chinook salmon on the river, and recently worked with CTUIR to successfully reintroduce Coho salmon.

Water in the Lostine River is in high demand for both farms and fish and has significant economic and cultural value. The challenge for the region is keeping the agricultural heritage and economy of the region whole while better providing for the needs of ESA-listed Chinook salmon, reintroduced Coho salmon, and the cultural and sustaining role these species play for the region's Indigenous Tribes.

INVESTMENTS

While the business case is quantified only for the on-farm irrigation infrastructure modernization investments, investments in EWTs are also described in detail to provide a point of comparison for assessing cost-effectiveness of public investments.

Environmental Water Transactions

Starting in 2005, a unique, voluntary, and cooperative effort was started by the Oregon Water Trust — working with local partners including the Nez Perce — to increase instream flows in the Lostine River during the late summer through an innovative environmental water transaction. Funded by the Columbia Basin Water Transactions Program with money from Bonneville Power Administration, the Oregon Water Trust initiated an agreement with approximately one hundred local landowners organized into five irrigation companies. The agreement provides a minimum flow in the Lostine River of 15 **c**ubic **f**eet per **s**econd (cfs) from mid-August through September. This was accomplished by the five irrigation companies reducing and otherwise managing their diversions to ensure that at least 15 cfs and up to 20 cfs stayed in the river through a reach that was once dry.

The terms of the agreement evolved over time, but for several years settled on a payment of $164,000 per year if the minimum flow was met during the defined late-summer period. A lump sum payment was made each year by the Oregon Water Trust — later The Freshwater Trust and then Trout Unlimited — to the irrigation ditch companies in proportion to the number of participating acres within each company. Payments were then made to individual landowners by the ditch companies on a per-acre basis. Approximately 4,000 acres were enrolled each year. This innovative and successful long-term agreement laid the groundwork for subsequent investments to further increase instream flow in the Lostine River, thereby ensuring that Chinook salmon, and now Coho salmon, can reach their spawning grounds in the late summer.

Irrigation Infrastructure Modernization

Building on the success of the Lostine River minimum flow agreement, in 2016, the Wolfe Ranch — a multi-generational family farm that diverts and uses water from the Lostine River — worked with The Freshwater Trust and other partners to upgrade to center pivot irrigation on several parcels of land. This project was followed by two additional, similar projects. The benefits of these investments are increased on-farm productivity and increased instream flow in the Lostine River to support fish.

ANALYSIS

The business case illustration focuses on the economic costs and benefits of investing in on-farm irrigation infrastructure modernization. The benefits of environmental water transactions are discussed qualitatively but are not directly quantified.

Business Case

Costs

No-Action Alternative

The no-action alternative is for farms to continue their current on-farm irrigation practices with no upgrades. While this no-action alternative does not have an investment cost, there are economic costs associated with not investing. The costs of not investing include inability to realize the benefits the investment: additional water permanently conserved instream, increased hay yields (and associated revenue), and increased value for irrigated acreage. The cost then, is the lost opportunity for greater productivity, revenue, and property value.

Project Examples

Irrigation Infrastructure Modernization

To date, investments have been made in three irrigation efficiency projects on farms that divert water for irrigation from the Lostine River:

1. In 2016, the Wolfe Family Farm Water Conservation Project was funded by OWRD to improve on-farm irrigation efficiency and increase instream flows in the Lostine River. A total of 16 center pivots and nearly 30,000 feet of mainline pipes were installed on 872 acres that had previously been flood-irrigated. This resulted in 1,166 **a**cre-**f**eet (AF) of conserved water. The project also freed up 102.3 acres for conversion to wildlife habitat and dryland farming; water rights from these lands were permanently transferred instream, resulting in an additional 460 AF (2.5 cfs) restored to the river in May through July and 102.3 AF (0.8 cfs) restored to the river in August and September. In total, the project cost just over $2.5M (The Freshwater Trust 2018).
2. In 2020, the Johnston Lane Conservation Project was funded by OWRD to improve on-farm irrigation efficiency and increase instream flows in the Lostine River. Five center pivots were installed, converting 277 acres of formerly flood-irrigated land. Through the project, 353.4 AF (1.94 cfs) were restored to the Lostine River from May through July. In addition, the landowners permanently transferred water rights associated with corners of their fields not accessible by center pivots, to instream flow for an additional 77.55 AF (0.36 cfs) restored instream from May through July and 0.12 cfs in August and September. In total, the project cost just over $930,000 (The Freshwater Trust 2020).

Instream Transfers

3. In 2021, the Fitzpatrick Conservation Project was funded by OWRD with a two-part goal of improving the efficiency of on-farm irrigation infrastructure and permanently transferring water savings instream. More specifically, the project will pipe 3,100 feet of irrigation ditch and replace flood irrigation with center pivot irrigation on 127 acres owned by the Rocking M Cattle Company. All water conserved as part of the irrigation infrastructure modernization will be permanently protected instream, resulting in improved flow and aquatic habitat. The project is projected to saved 207 AF of (senior priority) water that will be protected at a rate of 1.13 cfs from May to July in the Lostine River. At the time the OWRD grant proposal was submitted, the estimated total cost for the project was just over $763,000 (in 2022 dollars) (Trout Unlimited 2021).

Total costs for all three projects was just over $4.2M, with at least 25% of costs covered by match funding and/or in-kind contributions from the landowners.

Additional Benefits

Land under these projects converted from flood to pivot irrigation is expected to be more productive, with hay yields increasing from 1.5 to 3 tons per acre depending on the farm (each farm reported different increases in their funding proposals). Additionally, hay quality can be improved because of better moisture management. Finally, the new efficient irrigation infrastructure is also expected to increase the value of the irrigated land itself — by as much as 5%–20% (Trout Unlimited 2021; The Freshwater Trust 2020; 2018).

Increased Yield

Using price data from the 2022 Oregon Annual Statistical Bulletin, the impact of increased yield on farm revenues was estimated using the following assumptions for two scenarios: (1) Low Hay Price: Price: $215/ton; Pivot system life span: 19 years and (2) High Hay Price: Price: $255/ton; Pivot system life span: 27.5 years.

These are conservative estimates; the price data may underestimate true conditions for some of the farms described here in certain years. Based on these assumptions and the expected yield increase for each farm, total on-farm benefits for all three projects is estimated to be over $500,000 per year even under the low scenario and as high as $630,000 under the high scenario (Table 2).

Project	Acres	Increased Yield (tons/acre)	Scenario	
			Low	High
Fitzpatrick	127	2.5	$68,260	$80,960
Wolfe Family Farm	872	2	$374,960	$444,720
Johnston Lane	277	1.5	$89,330	$105,950
		Total	$532,550	$631,630

Table 2. Estimated Annual On-Farm Benefits

Business Case

Value

Assuming a 19-year lifespan for center pivot irrigation infrastructure, the estimated **n**et **p**resent **v**alue (NPV) of these direct benefits are $7.6M for the low scenario and $9.0M for the high scenario, both of which are greater than the investment cost of the project. Assuming a longer lifespan of 27 years for the irrigation infrastructure, the estimated NPV of direct benefits ranges from $9.9M to $11.7M. The increased value of the land itself would only be realized if the land were sold. However, based on 2022 irrigated land prices for the state of Oregon (i.e., $6,350 per acre), a 10% increase in value would be worth an over $800,000 increase across all three farms (USDA, NASS 2022).

As highlighted in Figure 5, there are also numerous benefits that are not easily monetizable, including perhaps most importantly, the cultural and subsistence values of the Lostine River and its salmon runs to the local Tribes. In the Pacific Northwest, salmon is also an iconic species and popular for both recreational and commercial fishing.

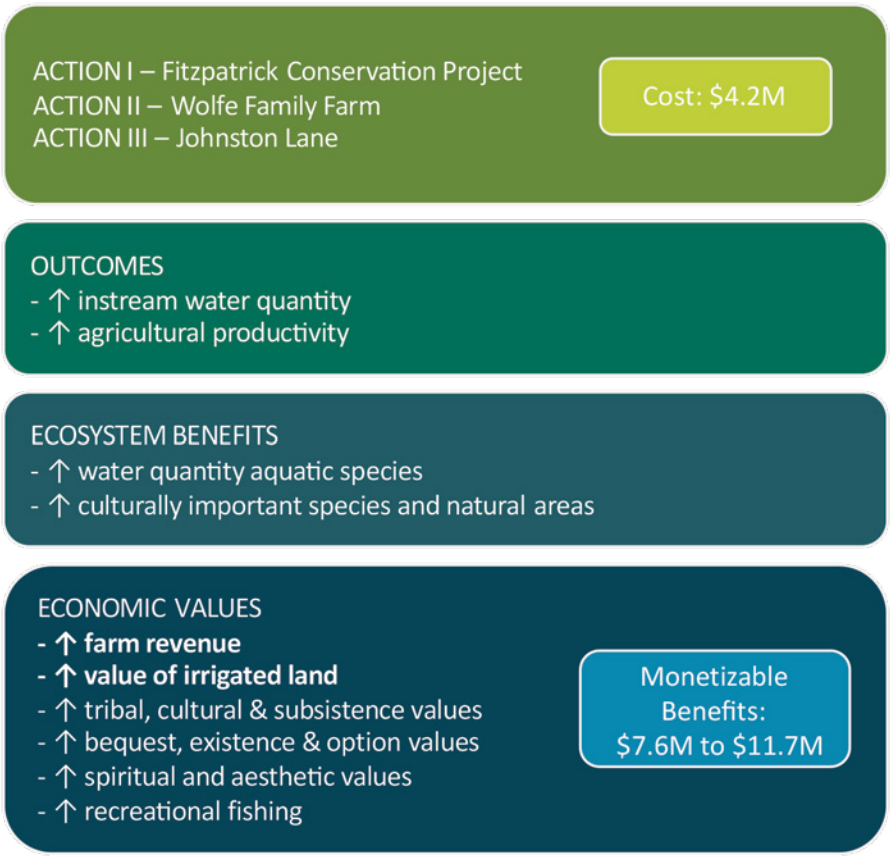

Figure 5. Lostine Summary

LCOW Metric

COST-EFFECTIVENESS

In a multicriteria project evaluation process, economic data can be used to evaluate economic feasibility of available alternatives to inform water-related investments, alongside other criteria. Economic feasibility can be measured a variety of ways, however, making it difficult or impossible to compare alternatives in an effective and useful way.

The **l**evelized **c**ost **o**f **w**ater (LCOW) metric is the most robust approach to estimate cost-effectiveness across projects with differing lifespans and cost/benefit streams and is straightforward to apply in practice. LCOW is calculated as the discounted NPV of costs less any monetizable benefits, divided by the NPV water benefits (for the Business Case, acre-feet was the physical unit chosen). Using a 3% discount rate and a conservative 19-year lifespan for center pivots, the LCOW for each project was calculated (Table 3).

Project	Cost ($2022M)	Water Conserved (AF/year)	LCOW ($/AF)
Fitzpatrick	0.8	207	$257
Wolfe Family Farm	2.5	1,167	$152
Johnston Lane	0.9	431	$151

Table 3. Project Comparison

Business Case

BENEFITS OF ENVIRONMENTAL WATER TRANSACTIONS

The benefits of the Lostine Minimum Flow Agreement are improved conditions for ESA-listed Chinook salmon and recently reintroduced Coho salmon, along with other aquatic species such as steelhead. These fish are of immense cultural importance to the Nez Perce Tribe and CTUIR and are a key part of both Tribes' traditional diets and practices. The Tribes, along with ODFW, have invested heavily in hatchery augmentation of Chinook and reintroduction of Coho; these investments are partially secured by instream flows from EWTs.

Private Liability

Supporting ESA-listed Chinook salmon by implementing EWTs alongside other conservation actions can help avoid private liability under the ESA. While not likely, individual liability — including fines and other punitive remedies — can be levied under the ESA for so-called "take of listed species." In an extreme scenario where low flows persist and seriously jeopardize listed Chinook, diversion and irrigation from the Lostine River could be curtailed, resulting in devastating economic impacts for the local community from crop losses and property devaluation. While unlikely, the history of successfully restoring flows through the Lostine Minimum Flow Agreement provides a layer of informal protection against this worst-case outcome.

Finally, the Lostine's fish species are important to the region's non-Tribal residents. Many area farmers recall being able to see and fish for abundant salmon in the Lostine and want their children and visitors to have the same experience.

Discussion

The Lostine River does double duty as a vital water source for area farms and as habitat for fish species that have, culturally and literally, sustained both the Nez Perce and Umatilla Tribes since time immemorial. For much of the 19th and 20th centuries, diversions from the river decimated Chinook and Coho salmon populations, effectively extirpating Coho and coming close to the same for Chinook. The community upset the status quo in 2005 by agreeing to an innovative water use agreement to try to reset the balance between fish and farms. The success of this EWT led to more water in the Lostine during critical times of year but also catalyzed additional investment in on-farm efficiency upgrades.

Key takeaways from this case study include:

Irrigation Upgrades

- In the right conditions, investments in irrigation infrastructure modernization make economic sense simply in the context of farm profitability — suggesting that this might be a prudent investment even if farmers were to pursue it on their own. These results suggest that even if the farmer pays the full cost, over the lifespan of the upgraded irrigation system the resulting increase in yield (and profitability) could outweigh the initial cost of installation. This finding suggests that farmers in similar situations should consider upgrading their irrigation infrastructure even if their only motivation is financial. State support, however, may be necessary to lower the barriers to entry presented by the large upfront costs for these projects.
- Farmers may not be aware that efficiency upgrades can result in improved yield and profitability. Therefore, outreach and technical information may be useful.

Farmer Assistance

- Farmers may not have the upfront capital to cover the cost of upgrades, which this case study showed can be substantial. Assistance in covering costs (even partially) and/or providing low- or no-interest loans may be beneficial.
- Farming communities value rivers for more than irrigation water. Close to one hundred individual landowners signed the original Lostine Minimum Flow Agreement, demonstrating that they were willing to try something different. Memories of a river full of Chinook salmon inspired not only the area's Indigenous people, but also many in the farming and ranching community.
- Environmental Water Transactions are innovation catalysts. Engaging with farms and communities on innovative, voluntary agreements to restore instream flow inspires creativity; when people see positive results from giving back to the river, their willingness to consider innovation increases.

Case Study Insights

In addition to the Lostine case study excerpted above, the Business Case presented seven other cases (Table 4). The dominant theme that emerged from the investments analyzed in the report's case studies is that they increase resiliency and flexibility, enhancing Oregon's ability to withstand or recover from shocks and challenges, both predictable and unpredictable.

Business Case

Region	Case Study	Water Use Sector(s)	Investment Focus
North Coast	Addressing Flooding, Diminished Critical Habitat and Other Impacts of Declining Watershed Health	Municipal, Aquatic Species/Habitat	Floodplain restoration and upland forest restoration
Willamette Valley/Lower Columbia	Investing in Water Reuse for Supply Diversification and Reliability to Support Households, Businesses, Agriculture and the Environment	Municipal, Aquatic Species/Habitat, Wetland Restoration	Using highly purified wastewater for various fit-for-purpose irrigation uses
Columbia Plateau	Farmer's Irrigation District Reservoir Expansion Project	Agriculture, Aquatic Species/Habitat	Expanding existing reservoir storage
	Nitrate Contamination in Groundwater-Sourced Drinking Water	Individual Domestic Use, Municipal, Agriculture	Immediate treatment technology and long-term best management practices; water justice
Blue Mountains/Northeast	Investing in Conservation and Environmental Water Transactions to Support Farms Culturally and Ecologically Important Chinook Salmon	Agriculture, Aquatic Species/Habitat	On-farm water conservation and environmental water transactions
Southeast	Groundwater Overdraft and Threats to the Local Economy and Environment	Agriculture, Individual Domestic, Wildlife, Wildlife Viewing	Payments to retire groundwater rights
Central	Addressing Impacts to Agriculture and Aquatic Species from Long-Term Drought Through Conservation and Innovative Governance	Agriculture, Aquatic Species/Habitat	Piping large irrigation canals and developing innovative governance approaches (water banking)
Southwest	Characterizing the Value of Water for Recreation on the Rogue River	Recreation	River restoration actions to address water quality, quantity and instream barriers

Table 4: Summary of Case Studies from the Business Case

Important high-level observations from the cases include:

Climate Impacts

- Aridification may be the new normal for much of Oregon east of the Cascades, underlining the importance of aggressive conservation and flexible innovations in governance to weather unpredictable future changes.
- Too much water (flooding), not just drought, will stress public water systems and watersheds as the climate changes.
- Wildfires impact watersheds in many ways that can harm water quality and reduce the landscape's ability to store water in soils. Limiting wildfire risk is critical to limiting risks to both human and natural communities that depend on forested watersheds.

Co-Benefits

- Whole-watershed and nature-based approaches are effective and leverage investment by generating co-benefits.
- Modernizing infrastructure across the landscape, from diversions and canals to farm fields to dams, supports a range of productive economic water uses.
- In many places in Oregon, agriculture can benefit from testing more heat- and drought-tolerant crops and cropping patterns — including dryland agriculture — to keep agriculture viable despite growing water scarcity.
- Even partial solutions to some of Oregon's water supply challenges are likely to be expensive.
- Groundwater is one of the most difficult resources to manage because it is hidden, and some impacts

Business Case

Vulnerability

Collaboration

Key Lessons

of groundwater pumping don't manifest immediately or in the places they are expected.

- Frontline communities are especially vulnerable. Due to language and other barriers, some members of these communities may not know a problem exists, while those who are aware may not have the resources, time, or capacity to access information and assistance.
- Indigenous Tribes face similar water risks to all Oregonians but with enhanced urgency and import because of their especially deep cultural and spiritual ties to water and fish species that rely on water.
- Many uses of water have lagging impacts or impacts that compound over time. It is critical to identify these types of potential impacts and design approaches for managing them now rather than waiting for their full impact to appear years later. For example, groundwater pumping can impact surface water long after a pump is turned on.
- Collaboration is powerful; trust built over time between collaborators increases resiliency by reducing conflict and providing a basis for the level of commitment that is required to tackle future challenges.

The Business Case further distills these observations into five guideposts that support investing to increase resiliency and flexibility with the urgency that Oregon's current and future water-related challenges merit:

1. Invest in whole-watershed and nature-based approaches for a range of benefits including avoided future costs of potential negative impacts from climate change.
2. Fund innovative governance and policy adaptations to increase the flexibility of water management and capitalize on collaboration and creativity.
3. Focus on modernizing infrastructure across the landscape in ways that help address specific risks such as flooding, stormwater management, reduced summer baseflow, shrinking glaciers, and fish passage.
4. Enhance water justice by authentically engaging frontline communities in policy and power and targeting investment so that benefits are distributed equitably to these and other communities.
5. Recognize and invest to support Tribal economic, spiritual, and cultural values for water and fish and engage with Tribes as sovereign co-managers of the resource.

Conclusions

The Business Case that emerged from the project team's intense three-month effort is straightforward. Water provides countless benefits — economic and non-economic — and defines Oregon's sense of place; it has been this way since the ancestors of Oregon's Indigenous people first called the land home. But these benefits are at risk; Oregon faces significant threats to its environment, economy, and way of life from current and future water-related risks and challenges. Oregonians have demonstrated that they have many of the required strategies and tools at hand as well as the expertise and motivation to develop new approaches when necessary. Wielding the tools and deploying the strategies, however, requires major investment — not just once but for the foreseeable future. The necessary investment cannot be underestimated and requires determination, commitment, and engagement across all sectors, agencies, communities, and levels of government and power. Importantly, it also requires inclusion of frontline communities that have been traditionally left out of decision-making and power over water, including Tribes, low-income communities, rural communities, and communities of color. If the aim of a Business Case assessment is to answer the question of whether investment is wise, the answer to whether Oregon should invest in its water resources is an emphatic "Yes." At its core, the Business Case for investing in water is that Oregon simply is not Oregon without clean, abundant water.

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