Oregon's 100-Year Water Vision

Understanding the Current Condition and Future Needs for Water in Oregon

Water is perpetually moving. Starting as snow or rain at its source in the mountains, it flows into rivers, wetlands and the ground, supporting people, plants, fish and wildlife often on its way to the ocean. Sometimes there is an abundance of water, sometimes too little. As communities use water to grow food, get a glass of drinking water, generate electricity, make microchips, or sit along a river watching fish swim by—water is moving through both natural and built systems. Those systems need to be maintained, protected, and restored to achieve the goals of supporting health, economy, environment, and safety.

We know we need better, more integrated, and more accessible information to guide water planning, actions, and stewardship. This memo describes some of the important sets of information Oregon uses to better understand current and future conditions.

Figure 1. Oregon's Water System

Key Management Questions

In Oregon, a changing climate, underinvestment in aging infrastructure and natural systems, and rapidly shifting population dynamics, all place stress on Oregon's water. In the face of these challenges, it is important to plan for Oregon's water future. So which management questions should we be asking?

Addressing immediate and future water availability is critical. How much, when, and in which watersheds will water be available? Where is our water coming from, where is demand greatest, and how do we protect it such that it can meet a range of needs?

An evaluation of Oregon's water infrastructure also requires attention. How safe are our dams, tidegates, and levees? How can we prevent water loss from pipes and facilitate efficient irrigation? How can we enhance emergency preparedness for both large and small public water systems? What investments will be needed to modernize community drinking water, wastewater, and stormwater infrastructure?

Ultimately, planning and innovating for our communities—including those most vulnerable to water scarcity—will increase statewide resiliency. Which communities and ecosystems are at highest risk of experiencing water insecurity or infrastructure failure? How can innovative funding and management solutions be equitably distributed throughout the state?

As we attempt to address these big management questions, it's important to assess what information we have, and what information we need. For example, if we want to assess groundwater availability, we must have sufficient data and studies across the state. Do we have the data necessary, for ALL watersheds, to evaluate current and future projections of water availability? And how do we pay for these data and information needs? This document is intended to be dynamic and will be continuously revised based on the information and investment needs identified by stakeholders. The following is the state's attempt at providing an overview of an inventory of the availability of information about water quality and quantity, natural and built water systems, and innovative funding solutions.

Framework for a Water System

Figure 1 shows how the range of natural and built water systems can provide people, fish and wildlife with the water they need at the right time. Whether Oregonians manage water systems for irrigation, drinking water, energy, or fish and wildlife, there are basic elements common to each:

Water Quantity & Quality: Oregonians, fish, and wildlife need an adequate supply of water that is safe to use and available at the time it is needed for all of our ongoing essential uses. Understanding seasonal water availability and protecting source water areas is vital to ensure water that falls as snow or rain or is present as groundwater is available and usable. Gathering information on water quality, water availability, drinking water, agriculture, source protection, contaminated site cleanup, septic system inventory, and toxics control helps us identify current and potential gaps in water quality and water quantity.

Storage: Storage includes the dams, reservoirs, water storage tanks, groundwater storage, and healthy forests, rangelands and wetlands that store water and release it slowly for environmental, agriculture, and community uses. Strategies to reduce sedimentation into reservoirs (e.g., reducing fire or landslide risk) are

important to protect existing storage capacity.

Transport: Water transport systems allow the movement of water away from a source to where it is needed. These systems include irrigation ditches, drinking water pipes and intakes, wastewater pipes, and pump stations, and the maintenance required to prevent and repair leaks in or out of those systems. Water transport also means ensuring adequate flows and removing obstructions to natural systems so that fish and aquatic wildlife can move upstream and downstream and utilize habitat. Actions such as removing fish passage barriers, protecting water for instream flows, connecting floodplains and estuaries, updating tidegates, and providing the clean, cool water (or cold water refuges) that fish and wildlife need can all improve water transport for natural systems.

Treatment: Usable water must be clean. Water may be used several times after it first falls as snow or rain. Treatment includes the buffering and filtering actions of forests, streamside areas, wetlands, and stormwater facilities and the wastewater and drinking water treatment plants that use technology to ensure water meets safe standards under the Clean Water and Safe Drinking Water Acts. Treatment also includes maintenance of infrastructure and implementation of best practices that limit, reduce, or eliminate the discharge of pollutants to our water systems

Flood Water Management: The magnitude and impact of flood events can be managed and mitigated. Managing flooding includes providing space for rivers and coastal waters to move, through actions such as reconnecting floodplains and maintaining or increasing floodplain storage. Managing flood water also includes placing structures and infrastructure outside of high hazard areas when possible, and when not possible, building structures and infrastructure to withstand flooding. Levees, dikes, tide gates and dams, affect how floods play out on the ground. For example, moving dikes further away from water channels can increase flood protection and water storage while providing enhanced habitat for fish and wildlife and improving downstream water quality. Protecting and restoring floodplain wetlands can provide similar benefits.

Natural Systems for fish and wildlife: To meet the multiple water needs of the state while maintaining healthy ecosystems, we must understand fish and wildlife habitat needs, including proper flow and temperature of surface waters. Water transport also means adequate flows and removing obstructions to natural systems so that fish and aquatic wildlife can move upstream and downstream and utilize habitat. All Oregonians benefit from protecting the water needs of fish and wildlife, economic vitality, cultural values and enjoyment are tied to these ecological systems.

Water Use and Innovation: To make wise decisions about water, we need accurate, timely and complete information to know where, when, and how much water is used. We also know that technology can improve water efficiency, through actions such as irrigation modernization that produces water and energy savings, use of distributed wastewater treatment systems, and employing more closed-loop systems that use water several times.

Funding Capacity: Infrastructure throughout the state is aging. We lack the information to evaluate the ways in which the condition of the infrastructure may impact public health and safety, may contribute to inefficiencies and water loss, and may negatively impact habitat and conditions for fish and wildlife. Much of the drinking water, wastewater, and stormwater infrastructure built by previous generations has exceeded its useful life. In

order to bring agriculture into the 21st century in the most efficient manner possible, funding for modernization of irrigation equipment is not only needed but required. Without a coordinated effort to strategically finance water system projects, opportunities to leverage grants, loans, and other investments could result in reduced planning and implementation capacity. Furthermore, without baseline knowledge around on-going and future investments, including funding to support agencies and partners, we run the risk of disjointed and duplicated efforts.

I. Water Quantity & Quality

Why It Is Important

The amount of water we have and how water is being used are foundational to managing our water systems. Clean and available water is critical for our environment, industry and communities.

What We Know

Water quality and water quantity data is collected, analyzed and used by several agencies tasked with protecting and maintaining Oregon's water quality and quantity and to understand the state of landscape conditions that affect water quality (streamside vegetation, bare soil, etc.) There have been efforts amongst the state agencies to coordinate collection of stream data for flow, water quality, and other factors.

i. Water Quantity

The Oregon Water Resources Department (OWRD) maintains the Water Availability Reporting System, which calculates natural and expected stream flows, consumptive uses, and water available for new uses based on historical stream flows for many parts of the state. OWRD maintains the Groundwater Site Information System and has completed several groundwater basin studies; however, new data needs to be integrated into the Water Availability Database and more studies need to be completed so the state has a comprehensive understanding to guide decision making. Communities also need more information about water resources including quantity and quality in order to make decisions. The state has locations of water diversions (OWRD Points of Diversion); however, those locations are not always mapped for older water rights. We know where stream gages are located (Gaging Stations Database), and associated stream flows for those gages. OWRD tracks well construction and location (Oregon Water Resources Department Well Report Query); however, not all information has been digitized or verified for accuracy. OWRD also receives water use information from governmental entities, and others that are required to report water use.

In addition to OWRD, other state agencies track a range of factors affecting or related to water resources. The Oregon Department of Forestry (ODF) maintains information on water sources and locations for firefighting. The Department of Land Conservation and Development (DLCD) tracks information about current land use and population projections that can be used to project future water demands. The Institute for Natural Resources (INR) (co-located at OSU and PSU) has land cover data that can be used as a base layer to identify risk areas for source water protection.

ii. Water Quality

The Department of Environmental Quality (DEQ) assesses water quality and prepares reports detailing the condition of Oregon's waters relative to Oregon's standards. DEQ and the Oregon Health Authority (OHA) also know where water treatment facilities are (DEQ NPDES permit locations and OHA drinking water treatment plants).

Drinking water protection is implemented through a partnership between DEQ and OHA. The program addresses over 2500 public water systems in Oregon. More than 600,000 Oregonians get their drinking water from individual private water wells. OHA requires monitoring of municipal and community water systems. Groundwater serves as the water supply for over 70 percent of residents in Oregon[1], and about half are identified as highly sensitive groundwater management areas. DEQ provides ongoing monitoring and assessment of groundwater management areas that cover these public drinking water sources. Business Oregon partners with DEQ and OHA in the funding of drinking water source protection projects.

Forestlands supply abundant, clean water for Oregonians. Oregon communities have identified $298 million in source water protection investment need.[2] Fire protection, enforcement of the Forest Practices Act and other laws, active management of forest lands, and voluntary measures by forestland owners all contribute to the health and responsible stewardship of forestlands, which is the source for almost all water Oregonians use.

Gaps in What We Know

Although we know the rough locations of points of diversion and points of discharge, there is limited information about how much water is actually used (diverted) and consumed (evapotranspiration). We have little or no information about the safety of drinking water served by individual private wells or by water systems so small that they are below regulatory thresholds. OWRD has records of wells; however, there are gaps in this data. We need an accurate inventory of the location, and drinking water quality of small unregulated water systems. We need to know which communities have water supply vulnerabilities and require additional supply due to diminishing sources or increased demand.

There is missing information on which areas are covered by current drinking water source water protection plans, when those plans were last updated, and which source water protection activities are already occurring. We need to identify strategic investments required for source water protection.

For much of the state, particularly on agricultural lands, we need to understand streamside vegetation conditions, opportunities for improvement, and areas in need of restoration.

We also need to better understand, forecast or otherwise anticipate and plan for the likely spatial and temporal patterns associated with climate change. Where is sea-level rise going to impact coastal communities? How will changes in temperature reduce snowpack levels, timing of flows, and instream temperatures at the local scale? Where will changes in precipitation increase floods?

[1] There about 2,000 groundwater public drinking water sources (ASCE, 2010).
[2] EPA Drinking Water Infrastructure Needs Assessment (2015): https://www.epa.gov/dwsrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment

IWRS – Recommended Actions

Several recommended actions in the Integrated Water Resources Strategy (IWRS) address water quantity and quality information needs including:

- 1.A Conduct Additional Groundwater Investigations
- 1.B Improve Water Resource Data Collection and Monitoring
- 1.C Coordinate Inter-Agency Data Collection, Processing, and Use in Decision-Making
- 2.B Improve Water Use Measurement and Reporting
- 5.A Support Continued Basin Scale Climate Change Research
- 6.A Improve Integration of Water Information into Land Use Planning (and Vice Versa)
- 12.A Ensure the Safety of Oregon's Drinking Water

II. Storage

Why It Is Important

Water storage will continue to be essential in the face of a changing climate. The volume of water stored as snowpack is projected to decrease by 30% by mid-century and by 40–50% by late-century in the Pacific Northwest under low to high carbon emissions pathways (Mote et al., 2014). A well-maintained, safe and modern water storage infrastructure supports Oregon's economy, hydroelectric generation and is especially vital for those communities that rely on stored water for drinking water, agricultural and recreational needs.

What We Know

Across Oregon, about 1,200 reservoirs (that are 10 feet or more in height and store more than 9.2 acre-feet) are estimated to collectively store about 13,300,000 acre feet of water behind dams. Of those dams, approximately 950 are state regulated, and 234, including most of the largest dams, are federally regulated.

US EPA's 2015 survey of drinking water providers identified $1 billion in needed storage project investments in Oregon, and the League of Oregon Cities survey identified 73 communities with similar water needs.

There are over 200 (out of 351 total) communities in Oregon that serve less than 2000 people; of these communities, few have reservoir storage for more than 3 days.

Gaps in What We Know

While we know the total volume of water stored in snowpack will decrease, we do not yet know what that means for water availability in terms of water basins and timing of water runoff.

We do not know the rate of sediment loading going into most of these reservoirs, or the rate at which we are losing storage capacity. We do have information on streams subject to debris torrents on state and private forestlands (ODF), but have very limited direct information on how fast sediment is filling most reservoirs.

There is limited understanding of total groundwater storage capacity, current levels, and recharge capacity. There is limited understanding about where current land use and projected activity pose a risk

to groundwater recharge.

We have incomplete information on the forest structure, conditions, and locations most likely to retain snowpack as long as possible into the spring, which forested areas have already been treated and/or restored, and which areas are NEPA-ready and could be restored.

The state's inventory of potential dam storage sites includes very few off-channel sites. Off-channel sites have much less effect on fish and aquatic life, so could be the focus of future investigations.

We need more complete information on current natural storage locations (e.g., alpine meadows, wetlands, near-surface groundwater and natural groundwater recharge areas.

Most state-regulated, high-hazard dams still need to be assessed for seismic resiliency, structural integrity, and spillway capacity to pass flood flows. Evaluations also need to be done for the 146 state-regulated significant hazard dams. These assessments could result in more dams being classified as "poor" or "unsatisfactory." For the privately owned dams that are in poor or unsatisfactory condition, the OWRD does not have a good estimate of the cost to address critical safety improvements. Individual engineering assessments would need to be conducted.

IWRS Recommended Actions

Several recommended actions in the IWRS address water storage needs including:

- 5.B Assist with Climate Change Adaptation and Resiliency Strategies
- 7.C Ensure Public Safety/Dam Safety
- 10.B Improve Access to Built Storage
- 11.A Improve Watershed Health, Resiliency, and Capacity for Natural Storage.

III. Conveyance / Transport / Delivery

Why It Is Important

Water is moved via pipes, canals, pumps or streams and rivers downhill from point A to point B or uphill from Point B to Point A. Transporting water does not include strategies that source or store water, or that treat water. Transporting water includes the movement of drinking water, industrial water, wastewater, and irrigation water.

Water transport also includes water to support the movement of fish and wildlife in streams and rivers. Just as water needs to move downstream through a pipe without blockages to a treatment plant, fish need to be able to move upstream and downstream without barriers to upriver spawning grounds or downriver to the ocean.

What We Know

In Oregon, there are thousands of miles of pipes and canals, including pumps and drains that move water to serve almost 90,000 water rights and a population of over 4 million people. Many of these engineered transport systems of pipes and canals are several decades old, some upwards of 100-years old. US EPA's 2015 survey of drinking water providers identified $3.7 billion in needed distribution system investments in

Oregon over the next 20 years.

Streams need to have adequate water and freedom of movement to allow fish and other ecosystem functions to move and flow where needed. In Oregon, instream water rights allow for movement of fish, pollution abatement, and recreation. In addition, Oregon has identified 600 priority fish passage barriers out of 52,780 known artificial passage barriers.

A recent tide gate inventory identifies approximately 1,000 tide gates in the lower Columbia and along the coast. In Oregon, tide gates are commonly used to control water in tidally influenced areas along the coast and lower portions of the Columbia River Basin, but can also impact estuaries and prevent fish from migrating upstream.

Gaps in What We Know

Most of the information on water pipes and canals sit with local municipalities and special districts. They may know the location of many of these pipes and canals, but less information is available on their condition (e.g., water lost to leaks or gained from groundwater seeping in, frequency of service loss from failed pipes, or remaining life).

Tide gates serve a critical role in protecting Oregon's coastal communities, public infrastructure, and agricultural land. A state-wide inventory is still in the process of being finalized. Even with an inventory of tide gates, limited information is available about condition and function.

There are similar issues with Oregon's levees. While dikes and levee-like landscape features have been mapped comprehensively along the coast, and the lower Columbia River, the inventories did not assess construction methods or intent of these features, and do not contain information regarding feature condition

Oregon has instream water rights on some streams for recreation, pollution abatement, and maintenance for fish and wildlife and their habitats which vary by priority date and location. The state, however, does not know how effective the instream water rights system is in meeting the needs of fish and wildlife, or how fish and aquatic wildlife populations and their habitat will be altered by climate change. While Oregon has identified 52,780 known fish passage barriers, very little information is known about the condition of most barriers or the passability of these barriers for fish.

Larger public water systems typically have master plans and asset management plans to identify the location, age and condition of piping and to prioritize and plan for replacement. Less is known about smaller public water system needs. As of 2018, larger public water systems are required to include in Master Plan updates an assessment of risks and a mitigation plan related to a Cascadia-type earthquake. The costs for mitigating these risks is unknown but will be determined as plans are updated over time.

IWRS Recommended Actions

Several recommended actions in the IWRS address conveyance/transport/delivery needs including:

- 5.A Support Continued Basin-Scale Climate Change Research Efforts
- 5.B Assist with Climate Change Adaptation and Resiliency Strategies

- 5.5A Plan and Prepare for Drought Resiliency
- 7.A Develop and Upgrade Water and Wastewater Infrastructure
- 10.A Improve Water Use Efficiency and Water Conservation
- 11.D Protect and Restore Instream Habitat and Habitat Access for Fish and Wildlife

IV. Treatment

Why It Is Important

Water treatment ensures the water we use to drink, irrigate crops, and release back into streams is clean. Prior to 1970, water quality conditions were much worse than they are today. Wastewater and drinking water treatment facilities were extensively upgraded in the 1970s and 1980s dramatically improving water quality. Now we have better treatment technology available to meet current and future needs for water uses, protect human health, and ensure functioning ecosystems.

What We Know

There are 215 centralized wastewater treatment systems serving 3.6 million people.[3] There are 2,699 public drinking water systems[4] serving more than 3 million people. Seven Oregon municipalities are using both natural and built infrastructure to clean wastewater.

i. Wastewater Treatment

In a 2016 survey of member cities, the League of Oregon Cities projected a need of $7.6 billion to address municipal drinking water and wastewater infrastructure needs over the next 20 years. Oregon's Clean Water State Revolving Fund has financed over $1 billion over 30 years in loans to municipalities investing in wastewater and storm water improvements as well as irrigation districts for improving the transmission of water for agricultural uses. Costs can include capital construction and maintenance, transmission, storage, treatment, and distribution. These costs involve routine construction and maintenance, and do not include the billions of dollars' worth of seismic retrofits and emergency preparedness efforts, and infrastructure investments that Oregon needs to undertake in the coming years.

DEQ has information on the location of facilities covered under many NPDES permits, which includes industrial, municipal wastewater and municipal storm water for Oregon's largest communities. DEQ also has water quality information for all of Oregon's watersheds from various sources across the state.

As these investments are made, costs are passed on to ratepayers. In Oregon, 78 census tracts are at risk for rate affordability where sewer treatment costs exceed 2.5% of household income, and where there

[3] USEPA identifies 182 publicly-owned wastewater treatment plants (down from 215 in 2008).

[4] These are systems subject to the Safe Drinking Water Act (ASCE, 2010). 882 are community systems serving 3 million people. 346 are non-community systems serving schools or workplaces with independent water supply systems. 1,471 are transient non- community water systems (parks, campgrounds, restaurants). 921 are private very small water systems serving 4-14 homes. 600,000 people get drinking water from individual domestic wells (about 205,000 licensed wells + 150,000 unlicensed wells) not covered by state or federal drinking water standards.

is a cluster of households with income below $35,000.

ii. Septic System Treatment

In Oregon, 35% of the population (or about 1 million people) treat their wastewater via on-site septic systems (ASCE, 2010).

iii. Drinking Water Treatment

OHA has an inventory of the regulated public water systems in the state. While many ground water sources require no treatment to meet drinking water standards, public water systems served by surface water typically require disinfection and filtration. In addition, ground water sources that do not meet standards or that are under the influence of surface water also require treatment. Of the 3,400 public water systems in Oregon, 1,442 have some form of treatment system.

US EPA's 2015 survey of drinking water providers identified $1 billion in needed treatment system investments in Oregon over the next 20 years. OHA and Business Oregon partner to fund drinking water infrastructure projects through Oregon's Drinking Water State Revolving Fund.

iv. Natural Systems Treatment

Wetlands, riparian areas, floodplains, and other natural systems can also treat and clean water. There are several wastewater treatment facilities who have incorporated natural treatment systems into their facilities including Roseburg, Prineville, Albany, Ashland, Eugene, St. Helens, and Clean Water Services in Tualatin.

According to the Oregon Watershed Restoration Inventory, through restoration activities such as replanting riparian corridors, enhancing instream habitat and dam removals, Oregon has restored 7,172 miles of riparian forest areas that not only provide habitat, but also act as filters and natural treatment. Although extensive, the Inventory does not include conservation actions funded by USDA Farm Services Agency or Natural Resources Conservation Service. An example of a state program that supports riparian restoration is the joint state-federal Conservation Reserve Enhancement Program. Between 1999 and 2017, this program has enrolled over 39,000 acres in long-term agreements that protect and restore riparian areas.

DEQ invests in non-point pollution projects via its 319 program. The program distributes grant funds to NGOs and government agencies to conduct water pollution control projects that reduce nonpoint source contributions to Oregon waterbodies. Projects must be designed to achieve measurable water quality improvements. Funded projects are required to report back any measureable shifts in environmental improvement to DEQ.

The state's Coordinated Streamside Management initiative has identified 2,174 watersheds with agricultural activity. Of these, 1,018 watersheds were identified with water quality impairments. This initiative also identified 812 watersheds as priority for fish restoration. ODA completed Strategic Implementation Areas (SIAs) in 29 watersheds from 2013 to 2018 and will be adding approximately 30 watersheds in 2019. ODA evaluates landscape conditions in these areas and works with partners and producers to maintain and improve water quality. In addition, ODA is working with state agencies and local partners to design and implement monitoring plans in each SIA.

Gaps in What We Know

We do not have an up-to-date and complete inventory and assessment of the location and condition for municipal and non- municipal waste water, storm water, and drinking water treatment systems. Note: EPA has currently discontinued this inventory and the latest published report was in 2012. DEQ's data set on capital investments needs for publically-owned treatment works is out-of-date. The State does not have a complete inventory of the locations of private water treatment facilities, and their effect on water quality. We also need a complete inventory of streamside vegetation conditions, particularly along agricultural lands. This will help agencies and partners prioritize work and identify opportunities for uplift.

IWRS Recommended Actions

Several recommended actions in the IWRS address water treatment needs including:

- 7.A Develop and Upgrade Water and Wastewater Infrastructure
- 7.B Encourage Regional (Sub-Basin) Approaches to Water and Wastewater Systems
- 11.A Improve Watershed Health, Resiliency and Capacity for Natural Storage
- 12.A Ensure the Safety of Oregon's Drinking Water
- 13.E Invest in Implementation of Water Resources Projects

V. Flood Water Management and Coastal Impacts

Why Is It Important

Flooding is a known hazard, which occurs at various intervals and at various magnitudes throughout the state. Yet, while flooding can and does create hazards, periodic flooding also creates and maintains important habitat for fish and wildlife, enhances soil makeup that benefits plant growth, and provides a filter for pollutants. Over 2 million acres in Oregon are within the special flood hazard area mapped by the Federal Emergency Management Agency (FEMA). Long range Oregon weather forecasts predict more frequent occurrences of flood events, especially west of the Cascade Crest.

Flood water management includes: avoidance strategies to keep people and businesses out of harm's way; regulatory measures to ensure that what is built will withstand flood forces; and flood control infrastructure, to reduce the velocity and elevation of floodwaters so that, when floods occur, the human and economic impacts are reduced. For fish, flood water management means preserving access to slower moving water through access to floodplains and off-channel habitat when rivers are raging. Maintaining the storage and transport functions of natural floodplains decreases the need for manmade flood control structures and benefits fish and wildlife and their habitats.

What We Know

Climate change is predicted to increase the frequency of flood events. Oregon has 22 communities with FEMA-identified high risk flood hazard areas. Since 2006, Major Disaster Declarations for events that include flooding resulted in $185 million in uninsured damage to public infrastructure and emergency response cost to local governments. This figure represents only a portion of the real economic, cultural, and social costs of these events.

Some information is available to support flood water management. Oregon has completed a study to evaluate the susceptibility of rivers to channel migration based on generalized basin characteristics, but very few river specific studies have been conducted. State data identify the location of 2,000 miles of human created dikes and levees that affect or constrain the movement of water in estuaries and along the Columbia and Willamette Rivers. Federal data detail the location and condition of levees and floodwalls built specifically to protect communities. Yet both the state and federal data sets are incomplete. Dams also provide important flood management functions. Most dams operated by the Corps of Engineers are managed for flood control. Most other dams provide only limited flood protection. Unsafe dams can cause catastrophic flooding if they fail.

Along the coast and lower Columbia, there are approximately a thousand tide gates. Many protect lands from on-shore flooding and allow for agriculture, development and other types of land use in areas historically subject to tidal inundation. An inventory planned for completion in 2019 will improve our understanding of where tide gates are, their flood mitigation function, and their impact on habitat access. OWRD has an interactive web mapping tool to estimate the magnitude of peak discharges at various frequencies for rural, unregulated streams in Oregon. This tool can be used by scientists, engineers, and land managers to obtain information needed to make informed decisions about development and restorations efforts in or near watercourses. In addition, OWRD's Peak Flow Program can help to estimate the frequency of flood events within watersheds up to 500-year floods.

Oregon has additional data on Debris Torrent Prone Streams and High Landslide Hazard Locations. Like flooding, these hazards are associated with high levels of rainfall and snowmelt and can impact municipal water systems when debris and sediment enter waterways. Data also are available to support natural infrastructure solutions to floodwater management. DLCD and ODFW developed the Oregon ShoreZone Project to plan for the dynamic changes taking place along the coast (e.g., increasing storm frequency and coastal erosion). The Oregon Conservation Strategy identifies altered flood regimes as a Key Conservation Issue and outlines a series of goals and specific actions to address the issue. DSL also maintains data on removal fill permits for streams and wetlands.

In coastal areas, sea level rise and storm events will contribute to flooding. We know communities have key infrastructure at risk from sea level rise and coastal erosion. Oregon has created models that predict changes to the inland extent of tidal waters and a risk exposure analysis for infrastructure and other assets in estuaries has been completed. The potential effects of erosive wave action on the coastline has also been modeled.

Maps of land use, land cover, and zoning are available statewide. These data aid our understanding of how floods, and other hazards associated with severe rain events, might affect the built and natural landscape, and in turn, how the built environment influences flooding and other hazards.

Gaps in What We Know

There is no state agency that deals with flood mitigation/flood control and other technical aspects of flooding. DLCD coordinates the FEMA National Flood Insurance Program which provides minimal flood management. DOGAMI has mapped floodplains as part of risk map. But there is no agency that handles overall coordination of flooding issues or any other aspect of flood water management especially from a technical standpoint.

Uncertainty in precipitation information coupled with climate change and more extreme precipitation events has significant implications for the safety and resiliency of water resources infrastructure. The

design of dams, wastewater facilities, bridges, and culverts depends on accurate precipitation estimates for extreme events. The National Weather Service can update precipitation frequency estimates if it receives funding for such work. Oregon now relies mostly on information from 1973, with a very partial update completed in 2008. An analysis of precipitation frequency information with resulting maps and tables would provide designers and operators of water infrastructure with the most current and reliable precipitation frequency estimates to withstand floods.

While Oregon has over 600 stream gages, there is potential to improve spatial coverage in areas with little data or significant water management challenges. More stream gages are needed in Oregon to improve the accuracy of flood maps and tables across the state.

We need to update our data bases and maps to reflect improved topological data.

We do not have a statewide inventory of the location and condition of all levees and dikes that were built to protect developed areas and converted agricultural lands from flooding.

Information on coastal erosion rates has not been translated into a risk exposure assessment for public infrastructure.

To better understand the risks associated with channel migration we need more information about communities and infrastructure in areas with high susceptibility to this hazard.

IWRS Recommended Actions

Several recommended actions in the IWRS address flood water management and coastal impacts including:

- 5.5B Plan and Prepare for Flood Events
- 5.5C Plan and Prepare for a Cascadia Subduction Earthquake Event
- 7.A Develop and Upgrade Water and Wastewater Infrastructure
- 11.A Improve Watershed Health, Resiliency, and Capacity for Natural Storage

VI. Natural systems for fish and wildlife

Why It Is Important

Natural systems can provide many of the same functions for people that built infrastructure does—storing water, moving water, and cleaning water, and in some cases at a lower cost. In addition, natural systems also support the fish and wildlife that have thrived in Oregon since time immemorial—salmon that are part of culture and history, beaver that act as nature's engineers, and elk that rely on healthy streams and forests, among others. All Oregonians benefit from understanding and protecting the water needs of fish and wildlife as our cultural values, economic vitality, and enjoyment are tied to these ecological systems.

What We Know

As climate change causes increases in temperature and changes to precipitation patterns, we know that many fish and wildlife habitats will be impacted. For example, climate models suggest the frequency of extreme

winter precipitation may increase, which risks scouring fish eggs buried in the streambed and displacing juvenile fish. Rising air temperatures are also expected to cause earlier snowmelts, which will shift peak annual streamflow to earlier in the season and reduce the quantity of late season flows. This may cause a mismatch between the timing of flows that trigger fish movements and historic fish migrations. Combined with increased air temperatures, these changes also risk exposing native fish to lethal stream temperatures. As a result, cold-water refuges and healthy riparian habitats will continue to be critical to maintaining many salmonid and cold-water fish populations. Coupled with drought and increased fire risk there may be additional factors that challenge natural systems to support water quality, fish and wildlife, and human use of water. The Oregon Conservation Strategy identifies water quality and quantity as key conservation issues critical to support "at risk" species and their habitat needs. We know that currently there are streams that do not have adequate instream flows or water temperatures to support fish and wildlife during some parts of the year.

Another important strategy is maintaining forestland to ameliorate potential impacts from climate change. Oregon's Forestry Program supports the goal of protecting and improving the physical and biological quality of forest soil and water resources and conserving diverse native plant and animal populations and their habitats. Nationwide, the total area of private forestland has been gradually declining since the mid-20th century. In contrast, as of 2009, Oregon has maintained 98 percent of all nonfederal land and 98 percent of private land that was in forest, agricultural, and range land uses since 1974.

In addition to adequate instream flow, fish must to be able to make their way past artificial barriers to get where they need to go. In Oregon, we have 52,780 known fish passage barriers. ODFW has identified 600 of these as a high priority for removal. The estimated cost to remove these priority barriers, ranging from $10,000 to upwards in the millions, is highly variable based on type of structure, size, amount of fill, and the hydrological characteristics that determine the constraints of construction.

DLCD and ODFW also developed updated habitat maps of all estuaries in Oregon using the Coastal and Marine Ecological Classification Standard (CMECS). ODFW also maintains numerous data sets related to fish and wildlife and their habitats, including maps of Strategy Habitat, such as wetlands and estuaries, identified in the Oregon Conservation and Nearshore Strategies.

Gaps in What We Know

In order to address current and future water challenges it is critical to understand the needs and vulnerabilities of fish and wildlife species relative to stream habitat, temperature, and flow, now and in a future of climate change.

ODFW is taking a statewide approach to inventory species' needs and compare them against both current protections and those necessary under a future of climate change. For example, we do not have a statewide map identifying the location of cold-water resources or places that provide refuges for species when stream temperatures are elevated. The effectiveness and extent of current instream protections have not been evaluated across the state nor have they been done at a scale that can be used in local planning efforts. We don't know the Location and extent of aquatic and riparian invasive species that degrade water quality and habitat conditions. We also have not identified the highest priority habitats that will sustain species over time and the risk those habitats face with a changing climate. The ODFW and OWRD streamflow restoration priorities were developed 20 years ago, and our understanding of species distribution, species vulnerabilities relative to stream temperature, and flow has greatly progressed since then.

Oregon's reliance on hydroelectric generation requires a closer look at the impacts to natural systems. It may be beneficial to include a systematic inventory of hydroelectric generation plants by basin and stream, as they (may) affect water flows, timing of releases, and temperature in streams with cold-water fisheries. FERC relicensing of hydroelectric plants (often/almost always) triggers requirement to improve/add fish passage, it will be useful to know when various licenses are expiring. And finally, adding power to unpowered dam would similarly (almost certainly) triggers a requirement to improve fish screen on intake, and/or allow/improve fish passage, so it would be useful to have a cross-referencing inventory of unpowered dams where hydroelectric development is being seriously considered now or in the future.

Oregon is challenged to quantify how existing regulatory or non-regulatory programs contribute to overall function and maintenance of water quality and fish and wildlife resources. Oregon does not have specific data on how programs implemented by many state agencies may already contribute to improving and/or maintaining water quality and fish and wildlife.

Knowing more about how ecosystems, fish and wildlife interact and may benefit from improvements to the natural infrastructure is fundamental to this long-term vision.

IWRS Recommended Actions

Several recommended actions in the IWRS address natural systems for fish and wildlife information needs including:

- 3.A Determine Flows Needed (Quality and Quantity) to Support Instream Needs-Dependent Ecosystems
- 3.B Determine Needs of Groundwater
- 5.B Assist with Climate Change Adaptation and Resiliency Strategies
- 11.B Protect and Restore Instream Habitat and Habitat Access for Fish and Wildlife
- 11.C Prevent and Eradicate Invasive Species
- 11.D Protect and Restore Instream Habitat and Habitat Access for Fish and Wildlife
- 11.E Develop Additional Groundwater Protections

VII. Funding

Why It Is Important

For the last 50 years, we have collectively underinvested in our built and natural water infrastructure. For example, many of our dams, levees, and tidegates are aging, and we lack the information necessary to evaluate their safety. Without a coordinated effort to strategically finance water system projects, opportunities to leverage grants, loans, and other investments could result in reduced planning and implementation capacity. Furthermore, without baseline knowledge around on-going and future investments, we run the risk of disjointed and duplicated efforts.

What We Know

We know that in a 2016 survey of member cities, the League of Oregon Cities projected a need of $9 billion to address water and wastewater infrastructure, and $7.6 billion in water quality and water supply

infrastructure needs over the next 20 years. Many of these cost projections involve routine construction and maintenance, and do not include the billions of dollars needed for critical seismic retrofits and emergency preparedness.

We know that there is a variety of federal, state, local, and nonprofit funding opportunities to assist in the planning and implementation of water projects and studies. Water credits, grants, loans, and state revolving funds are just a few examples of the water project financing options available to municipalities, counties, special purpose districts, Native American Tribes, nonprofit corporations, and private citizens. Unfortunately, many communities are unaware of the funding opportunities or do not have the staffing to apply.

i. Federal

The USDA provides multiple planning and implementation grants for water and wastewater systems, built infrastructure repair and improvement, watershed projects and infrastructure upgrades, farmland energy efficiency improvement, agricultural conservation and innovation, and emergency mitigation. The USDA Rural Development offers grants and loans for rural areas.

The Natural Resources Conservation Service (within USDA) provides funding for on-farm water conservation efficiencies and irrigation system improvements for irrigation districts.

The Federal Emergency Management Administration (FEMA) also provides funds for pre-disaster emergency planning, primarily for climate resiliency and flood management projects.

The Bureau of Reclamation, US Economic Development Administration and the Department of Interior offer grants that focus on promoting community based, long-term economic development projects and improving economic stability in historically marginalized communities. In general, these grants are broad-based and require community widespread community support. The Bureau of Reclamation's WaterSMART program offers grants for small scale water efficiency projects, planning and marketing strategies, and allow for cost sharing opportunities. The EPA administers loans to be leveraged with the DEQ State Revolving Fund program that primarily support drinking water infrastructure projects. EPA also has funding available through their WIFI program for water and wastewater infrastructure through their WIIN Grants for small and disadvantaged communities and for brownfields to asses and implement site water quality clean-up actions.

The Department of Housing and Urban Development offers Community Development Block Grants for infrastructure.

ii. State

The Oregon Watershed Enhancement Board (OWEB), Department of State Lands (DSL), DEQ, and DLCD each offer a range of grants and loans for, surface and groundwater quality and infrastructure improvements, as well as restoration and watershed improvement and monitoring projects.

The Oregon Water Resources Department offers Feasibility Study Grants to investigate the feasibility of water conservation, reuse, and storage projects. Funding to develop water resources projects with economic, environmental, and community benefits is available through Water Project Grants and Loans. Planning has been supported through a pilot phase of Place-Based Planning grants.

DEQ's Clean Water State Revolving Fund provides loans and bonds for planning, designing and implementation of natural and built infrastructure projects. DSL also administers the Removal-Fill Mitigation fund, which provides revenue to facilitate wetland mitigation.

The Oregon Health Authority and the Infrastructure Finance Authority (Business Oregon) administer the Safe Drinking Water Revolving Loan fund for drinking water infrastructure and source protection projects. These agencies also provide Community Development Block grants and the Water Fund, to finance publically owned water system improvement projects.

ODFW offers both a cost-share program and tax credit to assist with installation of fish screening devices and passage facilities.

iii. Other Funding

Rural Community Assistance Corporation environmental infrastructure loans provide support for built infrastructure feasibility studies, and project pre-development, planning, and construction.

The League of Oregon Cities, Association of Oregon Counties, and Special Districts Association of Oregon each have funding mechanisms for their members.

The Energy Trust of Oregon (Pacific Power and Portland General Electric) and some BPA-served public utilities offer incentives for improvements in on-farm irrigation systems, irrigation pumps and controls. Energy Trust Funding and other energy incentive funding is available/has been used as part of total funding packages for irrigation delivery piping projects that add small hydroelectric facilities.

There may be other energy related incentives from utilities for energy efficiency for pumping and water treatment, and for anaerobic digestion biogas and other renewable energy projects at water treatment plants.

Private foundations have begun to offer funds to address community capacity and critical infrastructure needs in some areas.

Gaps in What We Know

With the increasing number of investments that need to be made, it is critical to leverage financing, planning, and implementation capacity to maximize the impact of each water project. In order to strategically implement water projects and investments, we must first identify where there are gaps in funding, in terms of geography, project type, implementation and technical capacity, and state of development (planning, design, implementation, and post-project monitoring. We must also identify where and how gaps may occur due to eligibility criteria. We need this information to help identify where critical investments need to be made in the near, intermediate, and long-term timeframe.

It is also important to address mechanisms for better data sharing amongst federal, state, local, and private entities, to help identify the needs more accurately and reduce disjointed and duplicated investments. The state is looking to work with our partners – federal and local agencies, Tribes, industry and conservation to help identify the current and foreseeable future challenges, opportunities, and strategies used to finance water projects. There is a critical need to identify innovative mechanisms that expand and maximize the

efficiencies of existing and future water funding opportunities.

IWRS Recommended Actions

Several recommended actions in the IWRS address funding needs including:

- 13.B Fund Water Resources Management Activities at State Agencies
- 13.C Invest in local or regional Water Planning Efforts
- 13.E Invest in Implementation of Water Resources Projects

Conclusion

This memo is intended to be a dynamic document that will be continuously revised based on stakeholder feedback. The information needs and initial investments outlined below give the State and local government together with industry and conservation partners the information they need to invest wisely in water systems both built and natural that reliably meet current and future needs.

Table 1. Identified data gaps and assessment needs: water quality and availability, storage, conveyance/transport, treatment, flood water management, and ecosystems, fish, and wildlife (funding TBD).

Data Gaps	Priority Timeframe
a) Ground Water basin studies and comprehensive view of groundwater	Near term
b) Information about how much water is used	Near term
c) Likely spatial and temporal patterns due to impacts of climate change (flow, temp, persistence of habitats)	Near term
d) Number and type of safety deficiencies associated with state regulated dams and the cost to address these issues	Near term
e) Water quantity in terms of changes to volume and timing of run-off for different basins due to climate change effects	Near term
f) Total groundwater storage capacity, current levels, and recharge capacity	Near term
g) Conditions of conveyance systems (e.g., pipes and canals)	Near term
h) Statewide Tidegate Inventory	Near term
i) Assessment of instream protection and instream demand	Near term
j) Assessment of supply vulnerabilities and future increased demand for drinking water, irrigation, and industrial water supply.	Near term
k) Inventory, location and assessment of condition for municipal and non- municipal waste water systems, including septic systems	Near term
l) Inventory, location and assessment of condition for municipal and non- municipal storm water systems.	Near term
m) Inventory, location and assessment of condition for municipal and non- municipal drinking water supply treatment systems.	Near term
n) Gaps in state inventories of dikes and levees (federal and non- federal entities)	Near term
o) Gaps in federal inventories of the location and condition of levees and floodwalls built specifically to protect communities	Near term

p) Inventory of species, flow, temperature and habitat needs	Near term
q) Update streamflow restoration priorities	Near term
r) Recognize which communities are experiencing water access disparities (using existing data)	Near term
s) Update water scarcity models	Near term
t) Stream flow and temperature data (robust system of stream gages)	Intermediate term
u) Drinking water source water protection plans - Inventory and status	Intermediate term
v) Inventory of current natural storage locations that considers forest structure, conditions, and locations most likely to retain snowpack and winter precipitation.	Intermediate term
w) Inventory of potential off-channel storage sites including ecological considerations	Intermediate term
x) Location and quality of drinking water supplied by private domestic wells or water systems. Private wells and small unregulated water systems.	Intermediate term
y) Locations for habitat improvements that could benefit water quality	Intermediate term
z) Location-specific studies on stream segments with high and medium susceptibility to channel migration identified	Intermediate term
aa) Updated flood maps that reflect better topological information	Intermediate term
bb) Coastal erosion rates and risk exposure assessment	Intermediate term
cc) High water mark data set	Intermediate term
dd) Locations of cold-water resources	Intermediate term
ee) Better understand water insecurity challenges faced by communities and households by using proven survey methods	Intermediate term
ff) Complete map of Oregon municipal water systems	Intermediate term
gg) Statewide water quality assessment	Long term
hh) NPDES permits that describe discharges that affect water quality	Long term
ii) Opportunities for restoration based on information about natural storage locations	Long term
jj) Reservoir Sediment loading	Long term
kk) Assessment of infrastructure hazards associated with channel migration	Long term
ll) Statewide mapping survey of points of diversion and water use	Long term
mm) Riparian vegetation conditions	Long term
nn) Precipitation Study	Long term