



DEPARTMENT OF  
**ECOLOGY**  
State of Washington



# **Washington State Drought Contingency Plan**

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# Washington State Drought Contingency Plan

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by:

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Department of Commerce

Department of Ecology

Department of Fish and Wildlife

Department of Health

Office of Washington State Climatologist

Washington Military Department, Emergency Management Division

Washington State Conservation Commission

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Water Resources Program  
Washington State Department of Ecology  
Olympia, Washington





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# Acronyms

| <b>Acronym</b> | <b>Definition</b>   |
|----------------|---|
| DNR            | Washington Department of Natural Resources                          |
| EMD            | Washington State Military Department, Emergency Management Division |
| ENSO           | El Niño-Southern Oscillation  |
| EPA            | Environmental Protection Agency                                     |
| EWEC           | Executive Water Emergency Committee                                 |
| FERC           | Federal Energy Regulatory Commission                                |
| FSA            | Farm Service Agency   |
| HPA            | Hydraulic Project Approval  |
| MOA            | Memorandum of Agreement   |
| NDMC           | National Drought Mitigation Center                                  |
| NIDIS          | National Integrated Drought Information System                      |
| NMME           | National Multi-Model Ensemble                                       |
| NOAA           | National Oceanic and Atmospheric Administration                     |
| NRCS           | Natural Resources Conservation Service                              |
| OFM            | Office of Financial Management                                      |
| PDSI           | Palmer Drought Severity Index                                       |
| PUD            | Public Utility District   |
| RCP            | Representative Concentration Pathway                                |
| RCW            | Revised Code of Washington  |
| SPI            | Standardized Precipitation Index                                    |
| SWE            | Snow Water Equivalent   |
| USDA           | U.S. Department of Agriculture                                      |
| USGS           | United States Geological Survey                                     |
| UW             | University of Washington  |
| WAC            | Washington Administrative Code                                      |
| WDFW           | Washington Department of Fish and Wildlife                          |
| WRIA           | Water Resource Inventory Areas                                      |



| <b>Acronym</b> | <b>Definition</b>                             |
|----------------|---|
| WSAC           | Water Supply Advisory Committee               |
| WSDA           | Washington Department of Agriculture          |
| YRBWEP         | Yakima River Basin, Water Enhancement Program |

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# Executive Summary

This plan was completed with the support of a Federal WaterSMART Drought Response Program grant from the Bureau of Reclamation. This grant award enabled the Department of Ecology to convene a Drought Contingency Planning Task Force, and to contract with HDR, Inc., for facilitation and strategic services.

The year 2015 was the most extreme drought Washington had experienced in recent decades. Record warm winter temperatures caused a record low snowpack, or snow drought. Reduced snow-water storage and a very dry spring and early summer resulted in extremely low stream flows in many watersheds across the state.

The drought proved to be a learning experience for water managers and water users statewide. Much of that new understanding is reflected in this revised Washington State Drought Contingency Plan (DCP). This plan replaces Washington State's existing Drought Contingency Plan, published in 1992.

## Background

The Background section introduces the current drought framework and the development of this plan by the DCP Task Force. This section recommends various actions to improve the state response framework.

In Washington State, drought is defined in statute RCW 43.83B as conditions in which water supply is anticipated to be less than 75 percent of normal and there is anticipated hardship to water users and uses.

Washington's current drought response framework emphasizes emergency response and provides a discrete set of tools for addressing water supply shortage emergencies. Those tools include emergency water right permitting, emergency water right transfers, and – if funding is made available – grants and loans to public entities for emergency infrastructure needs.

A key recommendation is to provide more certainty regarding the availability of drought funding to improve the timeliness of drought response and the state's ability to communicate with and provide relief to water users experiencing hardship.

The plan also makes recommendations for streamlining the disbursement of money to state agencies responsible for drought response. These options include the pre-staging of spending agreements and contracts, and working with the Legislature to enable direct appropriations to agencies, rather than routing the money through Ecology.

Anticipating drought conditions depends on the availability of skillful forecasts of precipitation and temperature conditions in the coming weeks and months. While there are continuing advances in hydro-meteorological forecasting systems, considerable uncertainty in long-range forecasts is likely to remain in the years ahead. Thus, more value can be gained from emphasizing drought preparation and the streamlining of drought response.

## **Operations and Administration**

The Operations and Administration section discusses the challenge of making resources available for drought relief in time for water managers to benefit. Irrigators have largely committed to planting and growing by the time water supply forecasts are clarified for the coming spring and summer. If the State intends to make alternatives available for growers, those options must be quick to implement. The plan recommends that the Legislature provide year-to-year drought contingency funding for drought actions.

The DCP Task Force proposes that Washington State move to a two-stage drought system, Advisory and Emergency. The current drought framework stipulates that the state may issue a drought emergency declaration. The task force believes that also using Drought Advisories would provide a valuable tool for communicating to the public when conditions are below normal but not yet at a level where the risk of hardship is high.

Advisory and Emergency stages are summarized as follows:

- Stage 1 – Advisory Conditions: The long-term forecast indicates drought of any level of severity may occur, or the short-term forecast indicates minor drought conditions may occur in at least some area of the state.
- Stage 2 – Emergency (issue Declaration) Conditions: The short-term forecast indicates a high probability that drought conditions meeting the statutory definition will occur in some portion of the state, or drought conditions have materialized in some area of the state (at any level of severity, minor to severe).

The plan recommends that the state periodically update the drought plan in conjunction with the state's natural hazard mitigation planning process.

## **Actions**

This section describes resiliency and response actions that can reduce the impacts of drought on water users and the environment. Resiliency actions include projects and ongoing programs that mitigate the impacts of future droughts (e.g., irrigation efficiency, water system planning). Response actions are those that occur during drought emergencies (e.g., emergency water right permits, emergency grants and loans, and fish rescue).

## **Drought Monitoring and Forecasting**

Washington State's formal definition of drought is based on water supply. However, consideration of multiple drought indicators (tools using precipitation, temperature, streamflow, and/or snowpack, and so on) can provide complementary information and a more comprehensive perspective on the state of the system. This chapter, located in the appendix, provides an overview of some of the most relevant drought indicators in the region. It also identifies which stage of drought (i.e., onset, existing, or the end) each indicator is most suitable.

Most of the drought indicators described use multiple variables in their definition, but there are several stand-alone variables that are useful for assessing drought conditions. The state's Water

Supply Availability Committee (WSAC) already uses many of these to monitor drought monthly. For example, the average temperature departure from normal, percent of normal precipitation, and streamflow percentiles are commonly assessed and can be determined for multiple time scales.

Current mountain snowpack conditions in the form of snow-water equivalent (SWE) are also useful during the winter months. Derived quantities, such as the percentage of normal for that time of year or the percentage of peak snowpack, can be used to assess statewide conditions. Another example is stream temperatures in the spring and summer months, when high temperatures can indicate unfavorable conditions for certain species of fish. These indicators are relatively easy to understand and communicate to others, and are accessible. On the other hand, more sophisticated indicators may have the potential to identify a developing drought sooner, which would put the state in a better position to respond quickly and proactively.

## **Vulnerability**

This appendix chapter summarizes previous research on Washington State's vulnerability to drought and supplements it with information gained during the 2015 drought. Additionally, it discusses how vulnerability of key sectors is the result of the interaction of several key factors: exposure, sensitivity, and adaptive capacity.

The sectors that rank the highest for vulnerability to drought are irrigators with junior water rights and fisheries. Most municipal drinking water systems are highly resilient to drought impacts. Smaller water systems, which are more likely to depend on single sources, shallow wells, or both, are more vulnerable, but data regarding how small water systems managed during recent droughts is not formally tracked. Energy is highly resilient due to regional coordination and trading of power. In the recreation sector, ski resorts reported massive drops in ski visitors in the winter of 2014-2015. Whitewater boaters also reported a large drop in the number of days that rivers were runnable.

Following the 2015 drought, the Washington Department of Agriculture (WSDA) provided an estimate of the cost of drought impacts to agriculture. WSDA concluded that the estimated economic loss due to the 2015 drought reached between \$633 and \$773 million.

This chapter also summarizes the number and location of emergency drought permits issued in 2001, 2005, and 2015. There is a declining trend in the number of temporary emergency drought authorizations issued during drought years. Most permits have been issued in the Yakima Basin and in other agricultural basins east of the Cascades, where there is significant irrigation using surface water supplies. In 2015, there were a few drought permits issued west of the Cascades, more than during previous droughts.

In 2015, the Department of Ecology reviewed the impacts of the drought on groundwater conditions. Major findings include:

- The data indicate little impact of the drought on groundwater levels.

- The time lag between a drought's occurrence and corresponding water level responses (particularly in deep basaltic wells) makes it difficult to discern cause-and-effect relationships.
- It is often difficult to detect short-term, drought-related trends due to widespread regional groundwater declines.

# Purpose of the Plan

This Washington State Drought Contingency Plan has been prepared to guide those state agencies responsible for planning and responding to drought conditions in the state of Washington. The Department of Ecology (Ecology), as the state lead agency for drought response, holds emergency powers during a declared drought to take expedited actions to address drought-related water supply shortages. These actions include emergency water right permitting and disbursing funding to other agencies and governments to mitigate the impacts of drought conditions on water users in the agriculture, public health, environment, and energy sectors. Ecology's goal with this plan is to improve the state's ability to effectively respond to drought in a timely manner, but also to reduce the vulnerability of water users to drought in the long run.

## Intended Plan Audience

This plan's intended audience is primarily staff at Washington State agencies who are responsible for forecasting and monitoring drought conditions, and planning and implementing drought response actions. Other water managers, water users, researchers, and members of the public who seek to understand the state drought framework and drought processes should also find this document informative.

# Background

When droughts occur, they can disrupt economic activities, compromise public health, and harm natural resources. The State of Washington has an interest in reducing these impacts to protect the public welfare. Based on relevant statutes and the State's responsibilities for managing water resources, Ecology takes a lead role in drought response. Several other state agencies collaborate closely with Ecology to carry out their missions under the stresses imposed by droughts.

This Washington State Drought Contingency Plan (drought plan) provides a framework for coordinating state agency activities to prepare for and respond to droughts. It replaces the previous Drought Contingency Plan adopted in 1992 and a draft update that was prepared in 2005. It is aimed specifically at the activities of state government. Many local agencies and organizations have their own drought contingency plans or emergency response plans. This drought plan does not override or replace those local plans.

Washington State's framework for emergency drought response provides a discrete set of tools for addressing water shortages and alleviating hardships. These tools include emergency water rights permitting, potential supplemental funds for state agencies to carry out drought response actions, and potential funding for grants and loans to public entities experiencing drought-caused hardship. These tools have been effective in instances where water supply shortages can be addressed through emergency water right permitting actions, or financial aid can support emergency infrastructure with immediate benefits.

The existing framework has a few significant challenges, however:

- Imbalances between water supply and demand are usually more complex than can be resolved within an emergency framework. Washington State seeks to resolve water supply challenges using an integrated water management strategy. An integrated strategy entails working collaboratively with diverse groups of water users to find solutions that serve multiple objectives. The time required for these processes to yield results exceeds emergency response timeframes.
- The lack of dependable drought response funding makes it difficult to plan and publicize the scale and scope of the state's drought response.
- How funding is routed to Ecology and other agencies can cause delays in drought response. Money routed to Ecology to disburse to other agencies is delayed by contracting and other administrative requirements.
- Awarding emergency grants only to those projects that provide benefit in the current drought emergency limits the number of projects which can be approved. Design work, bidding of contracts, scheduling work, and permitting make it difficult to complete projects before drought conditions improve as the water year concludes.
- Establishing emergency water right leasing in the context of a drought year has had mixed success. It has worked well with split-season leases, in which farmers forgo a late-season cutting of hay. This provides more time to plan and finalize agreements. But when the expectation is for a participating farmer to forgo an entire season's crop, unveiling a leasing program in early spring is too late.
- Waiting until a drought year to lease water means paying a premium for water. In 2015, the going rate for water in the Yakima Basin was roughly twice what it was in 2005, the previous drought year.
- In the Yakima Basin, official water supply forecasts are not available until early March. This challenges the ability to roll out drought response measures in the Yakima Basin in time for irrigators to incorporate them into their own planning. Obtaining probabilistic water supply forecasts earlier in the season would provide more lead time for response measures such as water right leasing and emergency wells.
- The existing drought response framework requires that drought conditions be anticipated. While there is high skill in forecasting near-term weather patterns, there is much less confidence in longer-term forecasts. This is especially true in rain-dominant watersheds, which do not benefit from the predictive power of snowpack conditions.

Within the scope of this plan, the following measures to improve drought mitigation should be prioritized. These measures also emphasize the improvement of the emergency drought response framework:

- Maintain and expand the capacity to pursue integrated water management strategies to resolve major water supply imbalances, such as those that occur in heavily agricultural



areas like the Yakima and Walla Walla Basins. This should be a priority for the state as, in the long run, continued investment in this strategy is likely to yield more enduring solutions for these and other areas of the state.

- Obtain support for year-to-year drought contingency funding. Build certainty into funding structure.
- Obtain authorization and funding support for long-term, dry-year-option water right leases.
- Simplify and streamline the distribution of drought funding to state agencies, to enable more timely support of their respective sectors.
- Eliminate the need for emergency rulemaking during drought years. This process delays the release of funding, and emergency rules expire after 120 days. This will require a more stable definition of drought funding priorities in statute, which would allow Ecology to draft a permanent funding rule.
- Provide grants and loans to support longer-term projects that minimize drought vulnerability, including the preparation of local drought contingency plans. The state should have a goal of creating a WaterSMART program at the state level, just as the Department of the Interior has done at the Federal level.
- Improve the drought declaration system to include Advisory and Emergency phases. This would provide a more formal communication structure for conditions in which the potential for hardship is low or not known and allow Ecology to initiate the mobilization of resources.
- Washington State statute defines drought as a water supply deficit (below 75 percent of normal). Climate change is expected to re-define what is normal, so re-evaluating other metrics would be appropriate in the future.
- Washington's drought metric largely hinges on water supply forecasts and does not lend itself well to watersheds for which water supply forecasts are not available.
- Continuing advances in the science and operations of hydro-meteorological forecasting would support earlier identification of potential drought conditions. Formal recognition and financial support of an Office of Washington State Climatologist in state statute would ensure that there is a credible and expert source of climate and weather information for state and local decision-makers and for agencies working on drought and related issues.

## **Statutory Basis for State Drought Response**

For purposes of guiding the state's actions, the state Legislature defined drought conditions in RCW 43.83B.400 as follows:

*“... ‘drought condition’ means that the water supply for a geographical area or for a significant portion of a geographical area is below seventy-five percent of normal and the water shortage is likely to create undue hardships for various water uses and users.”*

Ecology further defines how this definition is applied in rule at WAC 173-166-050. On an ongoing basis, Ecology convenes a Water Supply Advisory Committee (WSAC) to coordinate data and make judgments as to whether a drought is likely to occur or has begun.

Recommendations from WSAC are communicated to the Emergency Water Executive Committee (EWEC) composed of agency directors. EWEC may recommend that the Governor instruct Ecology to issue a formal drought declaration. Once a drought declaration has been issued, Ecology and other agencies have the authority to disburse any drought funding made available by the Legislature, and to activate certain emergency procedures designed to alleviate the effects of drought on water users and natural resources.

This drought plan update uses the legal foundations in the Revised Code of Washington (RCW) and the Washington Administrative Code (WAC) and the established process of drought declaration as the basis for drought response actions. In addition, this drought plan update outlines methods to better prepare for droughts in advance.

## **Federal Grant for Drought Plan Update**

The Federal government provided a grant to support this drought plan update. The grant is administered by the Department of the Interior, Bureau of Reclamation (Reclamation), through its WaterSMART program, Agreement No. R15AC00082.

Reclamation has issued a guidance document titled Drought Response Program Framework, WaterSMART Program (Reclamation 2015). The guidance document recommends that drought contingency plans address these topics:

- Drought Monitoring
- Vulnerability Assessment
- Mitigation Actions
- Response Actions
- Operational and Administrative Framework
- Plan Update Process

This drought plan update addresses each of these topics. In addition, based on prior experience with droughts in Washington State, this drought plan update includes a section on communications leading up to and during a declared drought emergency.

## **Process for Preparing the Drought Plan Update**

To prepare this drought plan update, Ecology convened a task force comprising these Washington State agencies that engage in drought response:

- Department of Ecology (Ecology)
- Department of Health (Health)
- Department of Fish and Wildlife (WDFW)
- Department of Agriculture (WSDA)
- Department of Commerce (Commerce)
- Military Department, Emergency Management Division (EMD)
- Washington Conservation Commission (WCC)
- University of Washington, Office of State Climatologist (OWSC)

Ecology led monthly meetings of the Task Force for a 16-month period, assisted by a contracted facilitator. The Task Force reviewed the State's statutes and code requirements, prior drought contingency plans, drought plans prepared by other states, reports to the Washington State Legislature describing drought effects and response activities in 2001, 2005, and 2015, and a range of scientific information pertaining to drought occurrence in the Pacific Northwest. The OWSC provided technical input and convened a separate group of experts to review drought forecasting capabilities and methods.

The Task Force also met with representatives of three interest groups that tend to be greatly affected by droughts: municipal drinking water purveyors, agriculture, and tribal governments. In addition, Ecology organized an Advisory Committee with representatives of these same interest groups. Advisory Committee members participated in many of the Task Force meetings over the course of the project, and commented on a draft of the updated drought plan.

Using the information and recommendations gathered from this process, Ecology led the preparation of this drought plan update. Where appropriate, individual subsections were authored by staff of the agencies whose responsibilities are described.

## **Geographic and Climatological Setting of Planning Area**

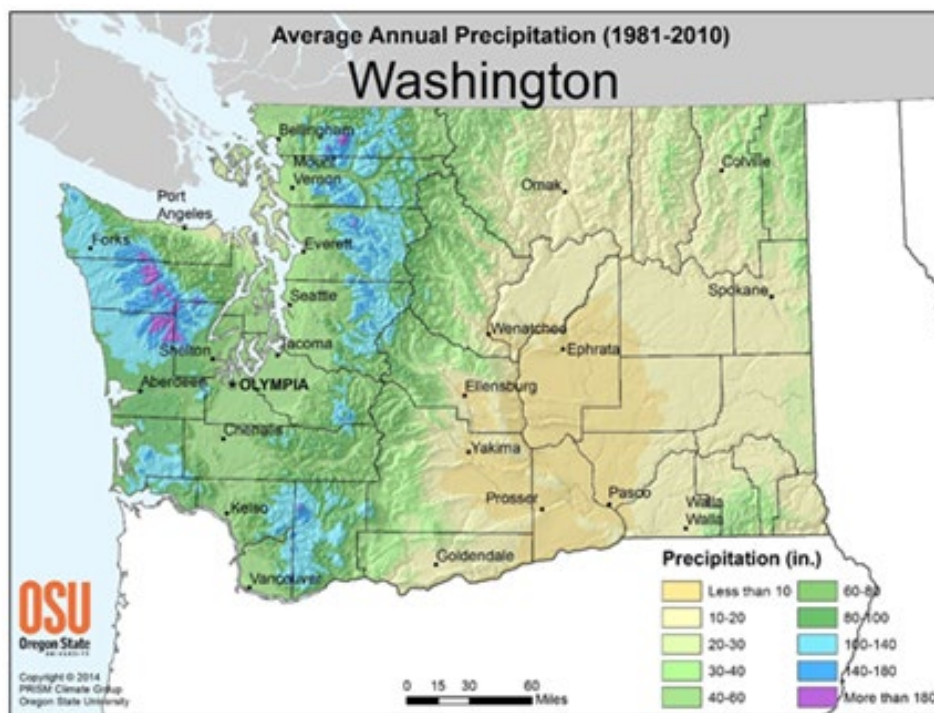
The state is divided topographically and climatologically by the Cascade Mountain Range, which prevents moist ocean air from reaching the eastern two-thirds of the state (Western Region Climate Center, n.d.). West of the Cascades, Washington State's climate is dominated by marine influences and is mild year-round. East of the Cascades, the climate is affected by both marine and continental influences, and subject to significantly greater annual swings in temperature. The east side is drier year-round, warmer in the summer, and cooler in the winter.

Differences in precipitation can be dramatic. Forks, on the west side of the Olympic Peninsula, averages 119 inches of rain annually, while Prosser, in Benton County, receives an average of less than 9 inches.

Temperature regimes vary from the west to the east side as well. West of the Cascades, the average January maximum temperature ranges from 40° F in the lower elevations to 30° F at the 5,500-foot elevation. Minimum temperatures range from 30° F in the lower elevations to 20° F in the higher elevations. On the east slope of the Cascades, the average January maximum temperature varies from 25° to 35° F and the minimum temperature from 15° to 25°.

The crest of the Cascades divides the state hydrologically, as well. The warmer, wetter conditions on the west side mean that winter snows are more transient and confined to higher elevations. To the west, multiple watersheds discharge directly to Puget Sound, the Strait of Juan de Fuca, the Pacific Ocean, and to the Columbia River. West of the Cascades at lower elevations, the geology consists largely of unconsolidated glacial deposits containing extensive groundwater aquifers. These aquifers recharge quickly in response to fall-winter precipitation.

East of the Cascades, every river within Washington drains to the Columbia River. The Columbia Plateau is largely characterized by extensive layers of Columbia River basalts. Beyond alluvial areas adjacent to rivers, groundwater is often scarce and found at greater depths. These aquifers receive less annual recharge from precipitation, and thus are more vulnerable to years of heavy pumping, during which the volume of withdrawal exceeds the volume of recharge. Much of the Columbia Basin is already experiencing significant declines in groundwater levels.



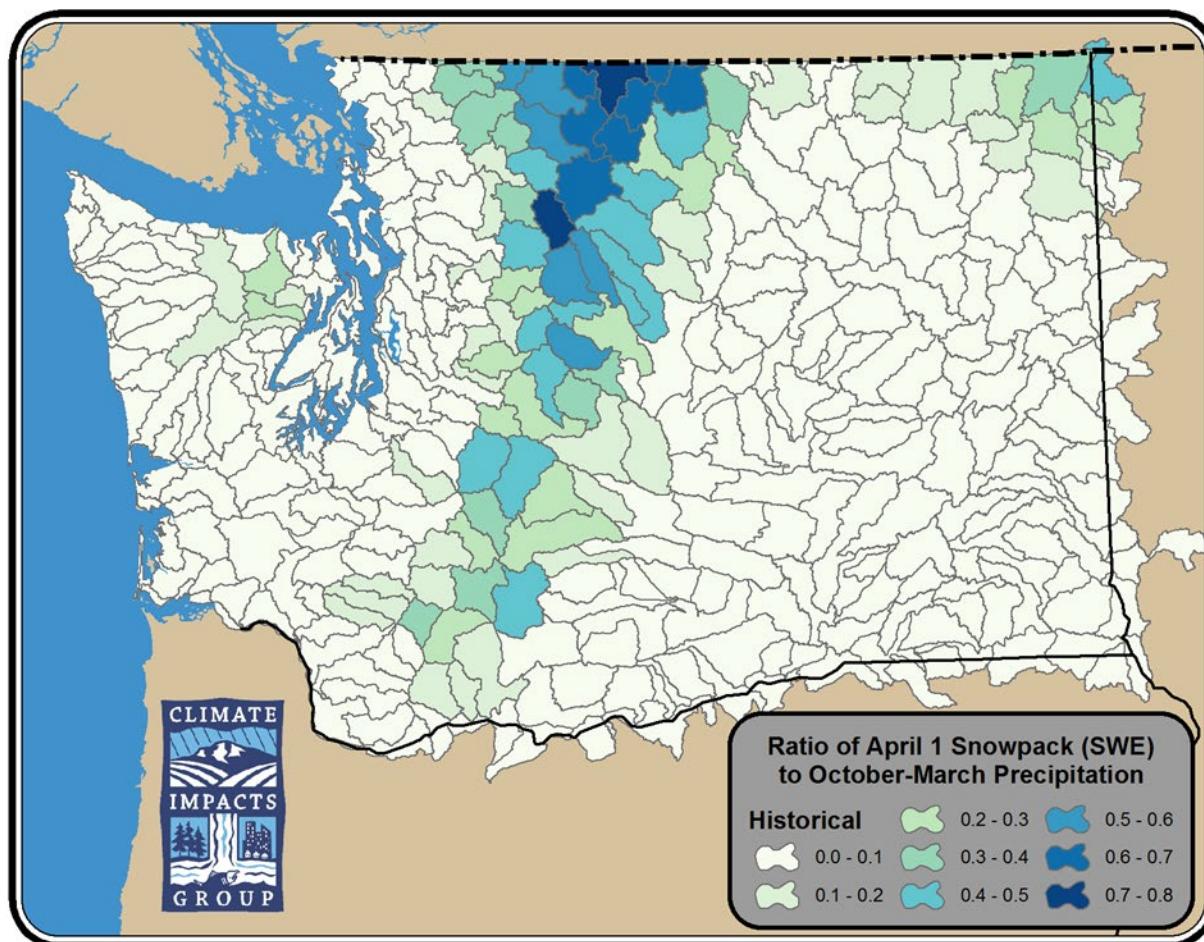
**Figure 1. Average annual precipitation for Washington (1981-2010) (PRISM Climate Group, Oregon State University, copyright 2014).**

## **Snow- Versus Rain-dominant Watersheds**

Washington's watersheds can be classified according to their ratio of precipitation in the form of snow versus rain. This information informs their exposure and sensitivity to drought conditions, as driven by above-normal temperatures, below-normal precipitation, or some combination of both. Watersheds that normally receive substantial snowpack are likely to be more sensitive to warm winters than other watersheds.

Snow-dominant watersheds are areas in which the ratio of April 1 snowpack (snow-water equivalent, SWE) to October-through-March total precipitation is high (above 40 percent). In other words, at least 40 percent of the precipitation that falls during those 6 months remains stored in snowpack on April 1. In rain-dominant watersheds, less than 10 percent of their October-through-March precipitation is stored as snow, while the range is 10 to 40 percent for mixed-rain-and-snow basins. In warmer-than-normal years, precipitation falls more as rain than snow as the freezing level rises. Because precipitation is not retained at higher elevations in the form of snow, more runoff is prone to occur during the winter months, rather than during the spring and early summer snowmelt.

Runoff volumes and timing are affected by a complex interplay of meteorological and hydrologic factors, including precipitation, soil moisture, snowpack, and groundwater influences. Appendix C displays sequences of monthly average runoff patterns during prior years of statewide drought. These patterns demonstrate that in drought years, the changes in normal runoff patterns can vary seasonally and geographically across the state. These differences can be attributed to the interaction of specific watershed characteristics (e.g., snow and soil moisture conditions) and the distribution and location of precipitation, which occurs prior to and during the runoff period.



**Figure 2. Ratio of April 1 snowpack to October-through-March precipitation.**

## Defining Normal Water Supply

Because Washington State defines drought as a percentage of normal water supply, it is necessary to define normal water supply. The definition of normal water supply is found at WAC 173-166-030 (6):

*Normal water supply is: “...the median amount of water available to a geographical area relative to the most recent thirty-year base period used to define climate normals. The determination of drought conditions will consider seasonal water supply forecasts, other relevant hydro-meteorological factors (e.g., precipitation, snowpack, soil moisture, streamflow, and aquifer levels) and also may consider extreme departures from normal over sub-seasonal timeframes.”*

Seasonal water supply forecasts are provided from the National Weather Service’s Northwest River Forecast Center (NWRFC) and the Natural Resource Conservation Service (NRCS) and are described in more detail in the Drought Monitoring and Forecasting chapter. The lists below describe the available seasonal forecasting periods provided each as of 2017.

### National Weather Service

- April through September
- April through July
- January through September
- January through July
- October through September
- Month by Month
- 10-Day and 120-Day
- Minimum Flow
- Columbia River Low Stage

### Natural Resources Conservation Service

- April through September (available January through May)
- April through July (available January through May)

April-through-September water supply forecasts are generally most critical for drought forecasting, as this is when higher water demand associated with irrigation coincides with low precipitation and high temperatures. Outside of the April-through-September forecast period, the fall period is important to water managers who need fall rains to replenish depleted reservoirs. In such circumstances, shorter-term forecasts (Month by Month, 10-Day and 120-Day) are relevant. As noted in the Drought Monitoring and Forecasting chapter, however, there has been less skill demonstrated for sub-seasonal and seasonal forecasts during the fall months. This means attempts to predict water supply conditions more than several weeks in advance are likely to be characterized by high levels of uncertainty.

The NWRFC and NRCS use the World Meteorological Organization base period for determining the 30-year average water supply conditions, currently 1981 to 2010. Due to climate change, runoff is expected to shift from the spring-summer seasons to the fall-winter seasons. Consequently, normal runoff for the April-through-September runoff period is likely to decline, and normal runoff for the October-through-September runoff period is likely to increase. In turn, the 75 percent of normal drought threshold will be met at a lower forecasted volume than currently for the April-through-September period.

### **Consideration of other water supply indicators**

Ecology's administrative rule expressly provides that a determination of drought conditions may include precipitation, streamflow, snowpack, and other hydrological and meteorological factors. The use of a broader suite of criteria, in addition to water supply forecasts, has been incorporated into the advisory stage triggers for this Drought Plan update, and can also be considered at the emergency phase. See Appendix A - Drought Monitoring and Forecasting.

Given Washington's water supply-focused definition of drought conditions, these broader criteria are most pertinent to watersheds lacking official streamflow forecasts. In the past, WSAC has considered available water supply forecasts as a proxy indicator for nearby watersheds lacking official forecast values. Information regarding major sources of water supply (e.g., groundwater, surface water, the status of surface water storage) can help decision-makers assess whether water users are at risk of hardship. Over time, the number of watersheds lacking predictive water supply information will decline as new tools, like the National Water Model, which provides comprehensive coverage, become suitable for operational purposes. See Appendix A -Drought Monitoring and Forecasting.

Precipitation deficits may also contribute to water supply shortage, but forecasting precipitation with consistent skill is difficult. A precipitation deficit that develops late in the water year is probably less troubling than one which develops earlier. The sooner the deficit develops, the more time there is for impacts to accumulate at a time when the imbalance between water supply and demand are at their highest.

### **Groundwater as water supply indicator**

Groundwater level information can indicate whether aquifers are experiencing long-term declines or failing to rebound from years of heavy well pumping. Ecology has a well monitoring network consisting of approximately 420 water level measuring wells, but very few of them have been measured long enough or consistently enough to provide a good understanding of baseline normal conditions. This limitation will be solved over time, provided the state continues to devote resources to measuring these wells.

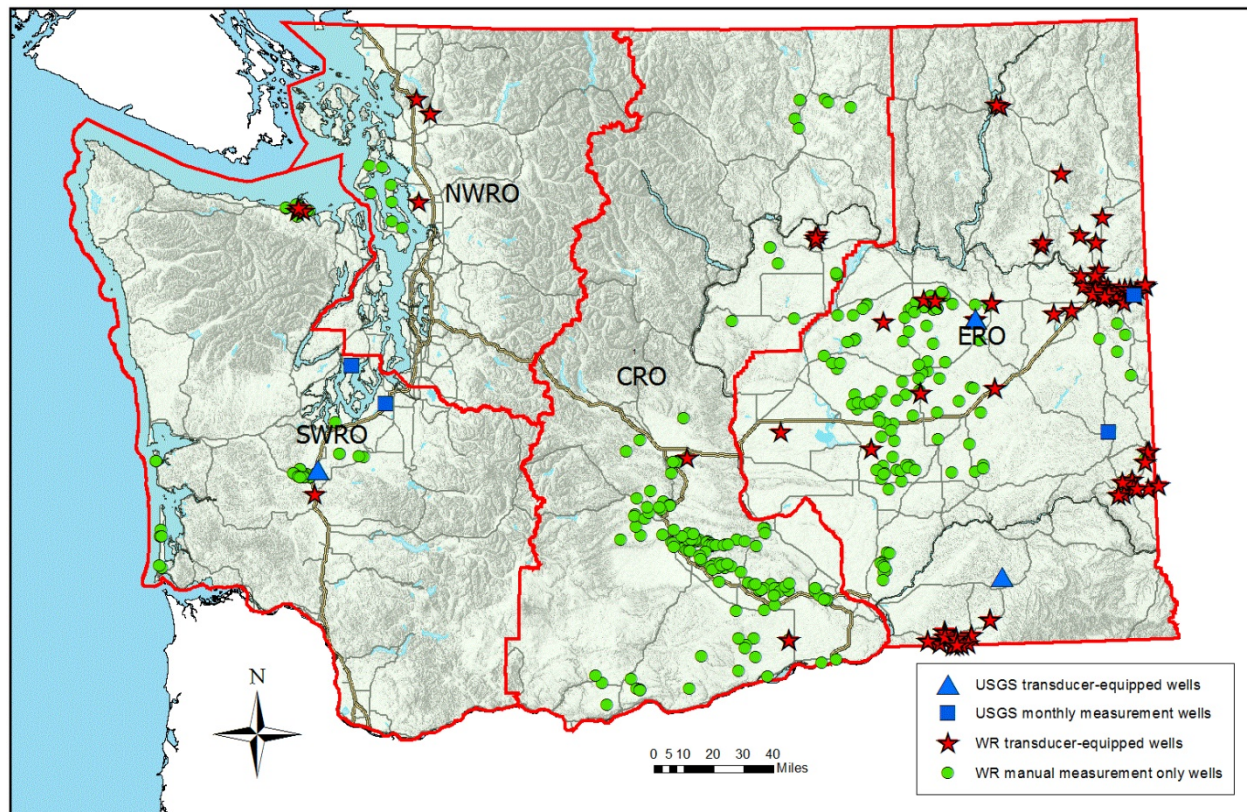
There are wells in key areas where year-to-year changes in groundwater levels have been documented because of higher pumping levels in drought years (the Yakima Basin and within the Columbia Basin Irrigation Project). In the past several years, Ecology consolidated its groundwater data to a central database (the Environmental Information Management System) to support easier queries and visualization of trends.



The United States Geological Survey (USGS) also conducts groundwater monitoring in Washington, and makes the data available through the National Water Information System (<http://waterdata.usgs.gov/nwis/gw>). Most of these data have been collected through groundwater studies. Ecology has taken over operation of those monitoring circuits (e.g., Island County, Yakima County, the Dungeness watershed, and the original Odessa subarea).

A small subset of groundwater-level monitoring conducted by the USGS in Washington is associated with the national USGS Climate Response Network, which is used to monitor the effects of droughts and other climate variability exclusive of human influences. Nationwide, this network includes about 130 wells, which includes three transducer-equipped, real-time, and four monthly measured wells in Washington (see Figure 3 below).

In addition to the above initiatives, the USGS has established a National Ground-Water Monitoring Network (NGWMN), aimed at providing access to data from major and principal aquifers nationwide over a network interface called the Data Portal. The NGWMN Data Portal provides access to groundwater data from multiple, dispersed, primarily state-maintained databases in a web-based mapping application.



**Figure 3. Well monitoring locations in Department of Ecology administrative regions.**

### **Consideration of artificial storage where natural water supply conditions are below 75 percent of normal**

River forecasts model the seasonal volume of natural flow to be measured at any point in a watershed. They may not factor in the existence of artificial storage in a watershed that is



available to satisfy water demands for drinking water, irrigation, etc. Reservoirs compensate for the lack of natural runoff during the spring and summer and may mitigate the risk of hardship to water users and uses. These water uses include not only the direct water users of stored waters, but potentially other uses downstream of the reservoir through managed releases of water to benefit fishery populations. The extent to which storage may compensate for the lack of natural runoff should be considered in the evaluation of hardship potential for a given geographic area.

## History of Drought in Washington State

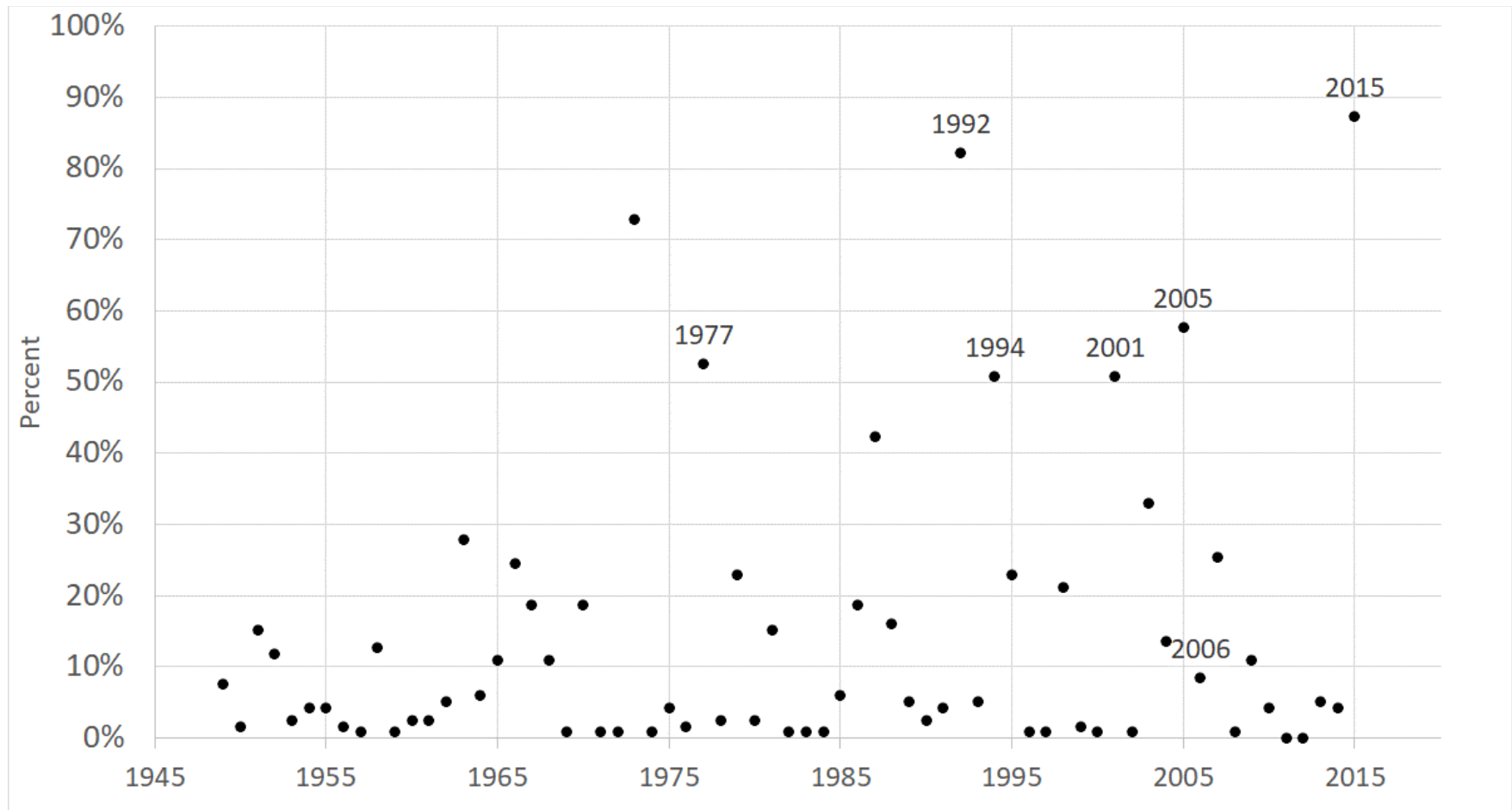
The hydrologic trigger used in Washington State's definition of drought (less than 75 percent of normal water supply) is itself a statistical measure which may be used to describe the frequency of drought.

Both the National Weather Service and Natural Resources Conservation Service use the average or median values for a 30-year base period (1981-2010)<sup>1</sup> for forecasting water supply conditions. Seventy-five percent of median is equal to the 37.5 percentile ( $0.75 * 0.50$ ). This suggests that the hydrologic threshold of Washington's state drought criteria would be expected to be met roughly 37 percent of the time, or every 3 to 4 years at any given river forecast point. However, because normal is calculated for a specific 30-year period, rather than the entire period of record, this expectation is not met. A review of the entire 1949-2016 record shows streamflows observed during the April-through-September period fell below 75 percent of normal about 13 percent of the time at the Northwest River Forecast Center's 118 streamflow stations.

Another way to gain perspective on the frequency of drought (as defined in statute) is to identify the number of years during which the state has declared drought up to 2016. This sample size is small and only includes very recent history. Washington's drought declaration framework was established by the Legislature in 1989. Since 1990, Washington State has declared statewide drought in 3 years – 2001, 2005, and 2015 – and watershed-specific droughts in 1992, 1994, and 2006. Thus, drought has been declared for at least some portion of the state about 1 out of every 4 years. Drought declarations covering the entire state have been characterized by forecasts of a large percentage (about 48 to 87 percent) of river stations that have less than 75 percent of normal water supply.

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<sup>1</sup> The 30-year base period used to establish climate normal is updated every decade, in accordance with agreements between the World Meteorological Organization and nations of the world.



**Figure 4. Percent of river stations below 75 percent of normal; labels indicate years where drought was declared for at least some portion of the state (1942 - 2015) (Based on data provided by the Northwest River Forecast Center).**

## Three Types of Drought

Bumbaco and Mote (2010) used the water years (October through September) of 2001, 2003, and 2005 to illustrate three distinct types of recent drought in Washington State:

- 1) Low winter precipitation
- 2) Dry summer
- 3) Warm winter temperatures

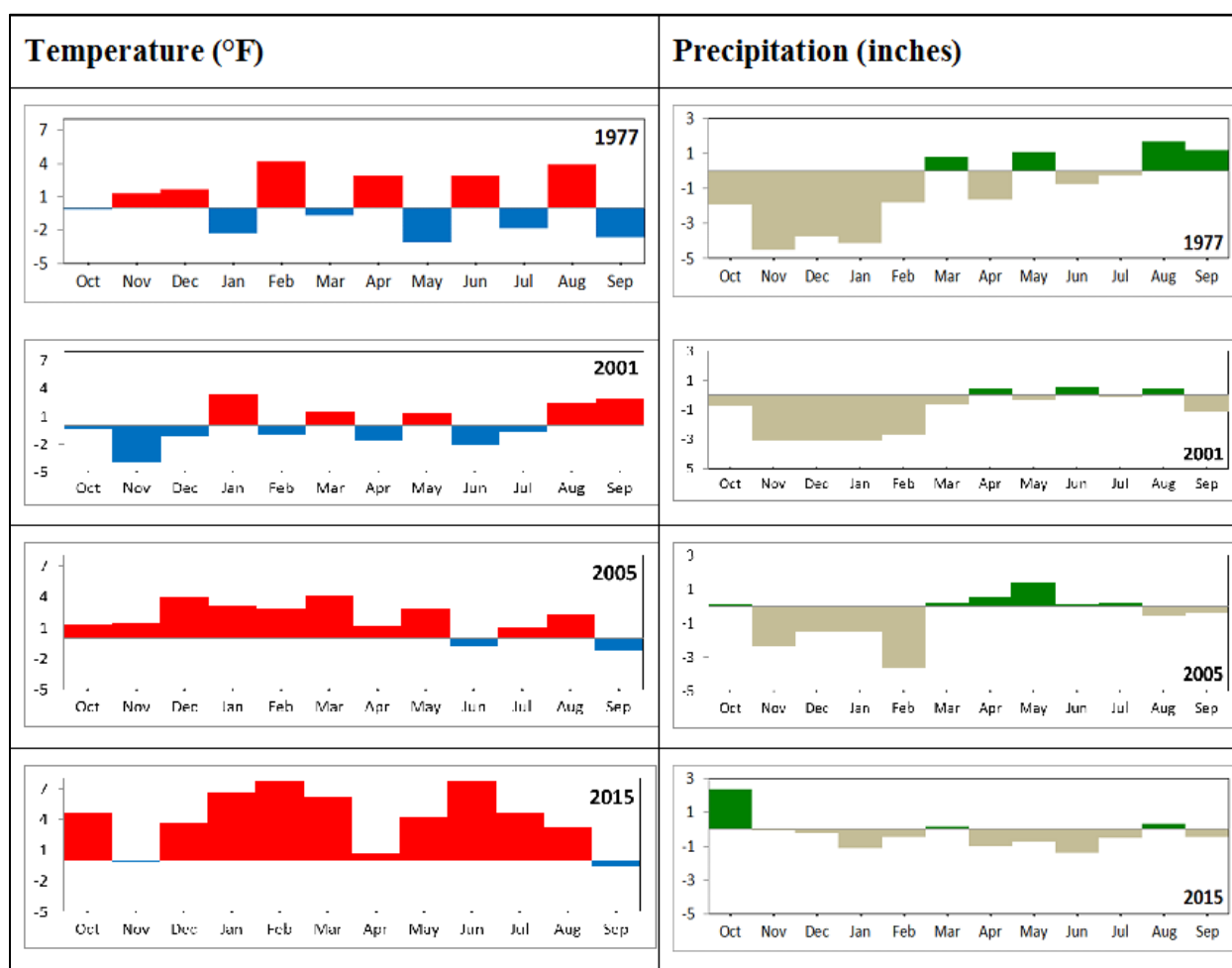
The first, in 2001, had low winter snowpack caused by low winter precipitation, and most of the impacts occurred in the spring and summer. In addition to the generally low streamflow in the winter (December through February), the snowmelt-dominated streams in the state (mostly in eastern Washington) experienced streamflows during summer (June through September) that ranked among the five lowest in 55 years.

The second type of drought, the dry summer drought, occurred in Washington in the summer of 2003 as a result of the second warmest and second driest (as of July 2010) July-through-August period for Washington and Oregon combined. Even though summers are typically dry in the region, there were record or near-record low flows during the June-through-September period for streams that are not snowmelt-dominated. The fire season was also particularly bad in Oregon and British Columbia, but Washington was mostly spared.

The last type of drought, and the one that is particularly relevant to 2015, was the drought of 2005. Warm winter temperatures decreased the snowpack, leading to both winter and summer drought. Precipitation in the Washington Cascades was between 70 and 80 percent of normal during the winter, but due to the higher-than-normal temperatures, snowpack was only 20 percent of normal for much of the winter. Late-winter storms were accompanied by such warm temperatures that snow water content declined even at the highest elevations monitored.

A graphic depicting the statewide monthly temperature and precipitation anomalies (departures from normal) for the years 1977, 2001, 2005, and 2015 is included below (Figure 5).

Note the extremely warm temperatures that played a key role in the 2015 drought. This caused the near-normal precipitation to fall as rain rather than snow in the mountains. This also occurred to some extent in 2005, when a few intervals of warm, wet weather associated with atmospheric rivers depleted snowpack (Bumbaco and Mote 2010), while the rest of the season had periods of lesser precipitation and near-normal temperatures. Other droughts in (1977 and 2001) were largely driven by a lack of winter precipitation, rather than extreme temperatures.



**Figure 5. Washington State temperature and precipitation anomalies for water years 1977, 2001, 2005, and 2015 (Graphic courtesy of Karin Bumbaco, Office of Washington State Climatologist).**

## Prehistorical Evidence for Drought

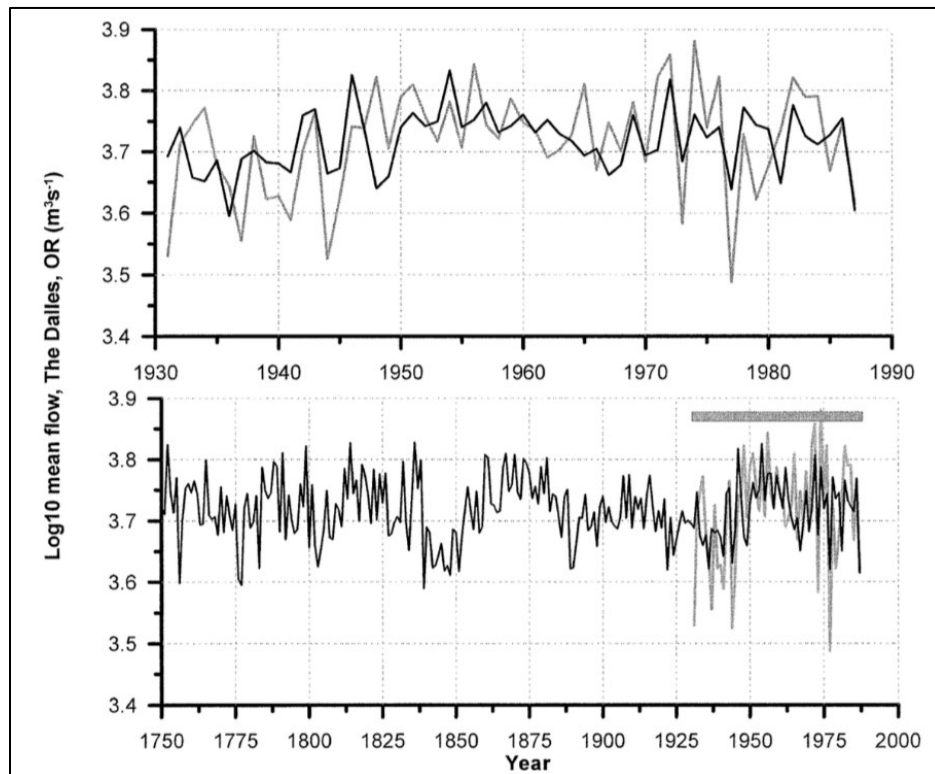
The Pacific Northwest, like much of the western United States, experiences periodic droughts. Drought is often difficult to define, as no single definition fully represents the different types of drought that can impact different sectors. Drought is typically separated into categories such as meteorological, hydrologic, agricultural, and socioeconomic, depending on the drought impacts experienced (Wilhite and Glantz 1985). Impacts have long been recognized as an important defining factor in drought. The historical record of drought is examined here based on a few different drought definitions.

Long records of drought can be reconstructed using tree rings of tree species that are sensitive to different climate parameters. Gedalof et al. (2004) created a historical record (1750-1987) of hydrologic drought for the entire Columbia River Basin (including parts of Washington, Oregon, Idaho, Montana, and British Columbia) using tree rings throughout the Pacific Northwest. This information was used to reconstruct mean water year flows for the Columbia River at The Dalles, Oregon. Notable findings emerged from this reconstruction of a historical record for

drought (Figure 6). Specifically, several multi-year hydrologic droughts were identified on the Columbia River, including the worst in the record (1840s-1855) and the second-worst (1930s).

The most recent period in the reconstruction (1950-1987) was anomalous compared to the rest of the record in that no multi-year droughts were observed, suggesting that more-severe droughts than what have occurred in the second half of the 20<sup>th</sup> century are possible in the region. Other prolonged drought periods occurred in the 1890s and 1770s, with shorter intervals of low flows on the Columbia River in 1775, 1805, and 1925.

An updated reconstruction of Columbia River streamflow at The Dalles has been produced by Littell et al. (2016). This recent effort features updated tree-ring chronologies and a more complete account of seasonal effects on the hydrological variability of the Columbia River. Its key finding is that the droughts that occurred from the 1500s through the early 1900s were of comparable duration and magnitude as droughts during the observational record. In particular, Littell et al. (2016) suggest that low flows in the 1840s were not as severe as indicated by previous reconstructions. They also discuss how climate model projections of streamflows indicate the potential for increased hydrological variability in future decades.



**Figure 6. Reconstructed mean water year flow of the Columbia River at The Dalles, Oregon, from Pacific Northwest tree rings.<sup>2</sup>**

<sup>2</sup> The gray bar represents the period in which observations (gray trace) were compared to the reconstruction (black trace). A closer look at the comparison period is shown in the top plot (from Gedalof et al. 2004). Note that the reconstructed flow underestimates the magnitude of the low-flow events.

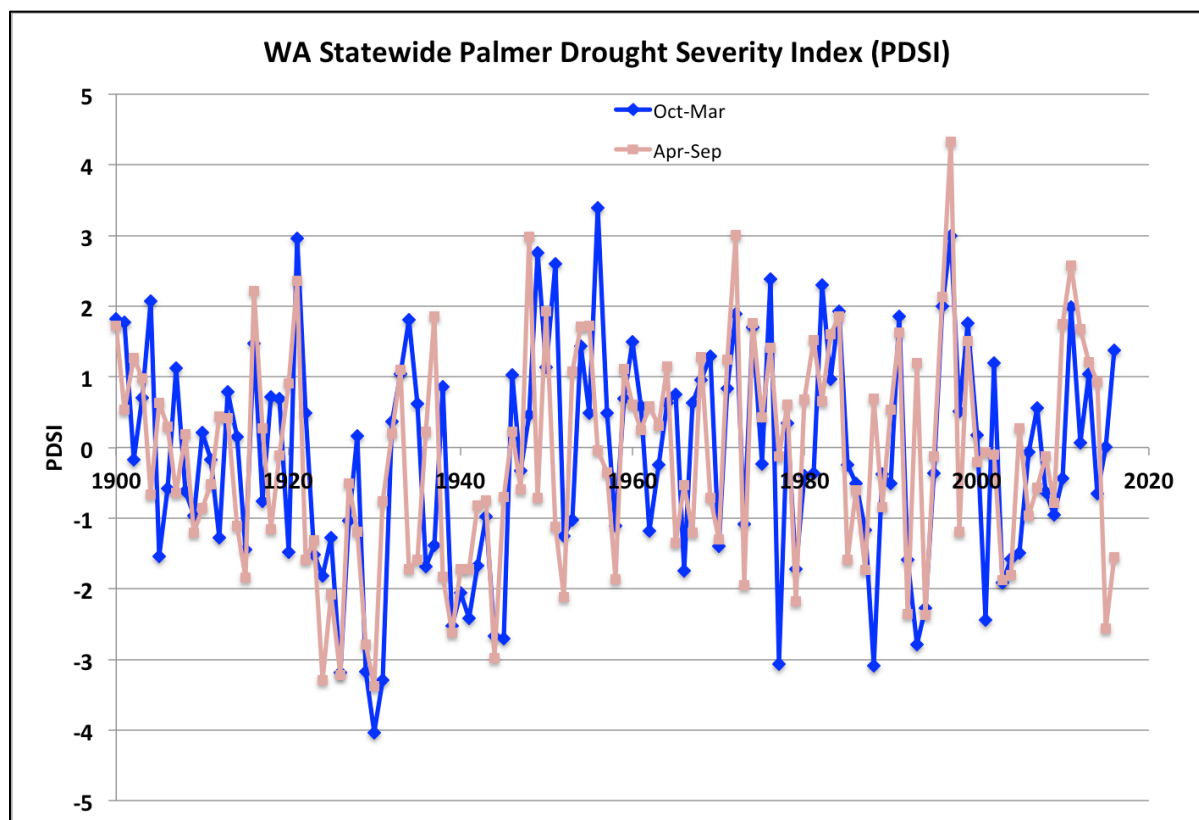
## Twentieth Century Indicators

There are sufficient precipitation and temperature observations to assess the character of past Washington State droughts since about the beginning of the 20th century. Here, the focus is on the seasonality, spatial variability, and duration of drought.

### Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) provides monthly records back to the end of the 19<sup>th</sup> century for each of the state's 10 climate divisions, and for the state as a whole. The PDSI includes the effects of temperature and precipitation, but not snowpack. This limits its applicability for characterizing drought in Washington but represents a reasonable index for the present purposes. A more complete description of the PDSI is included in the Drought Monitoring and Forecasting Appendix A.

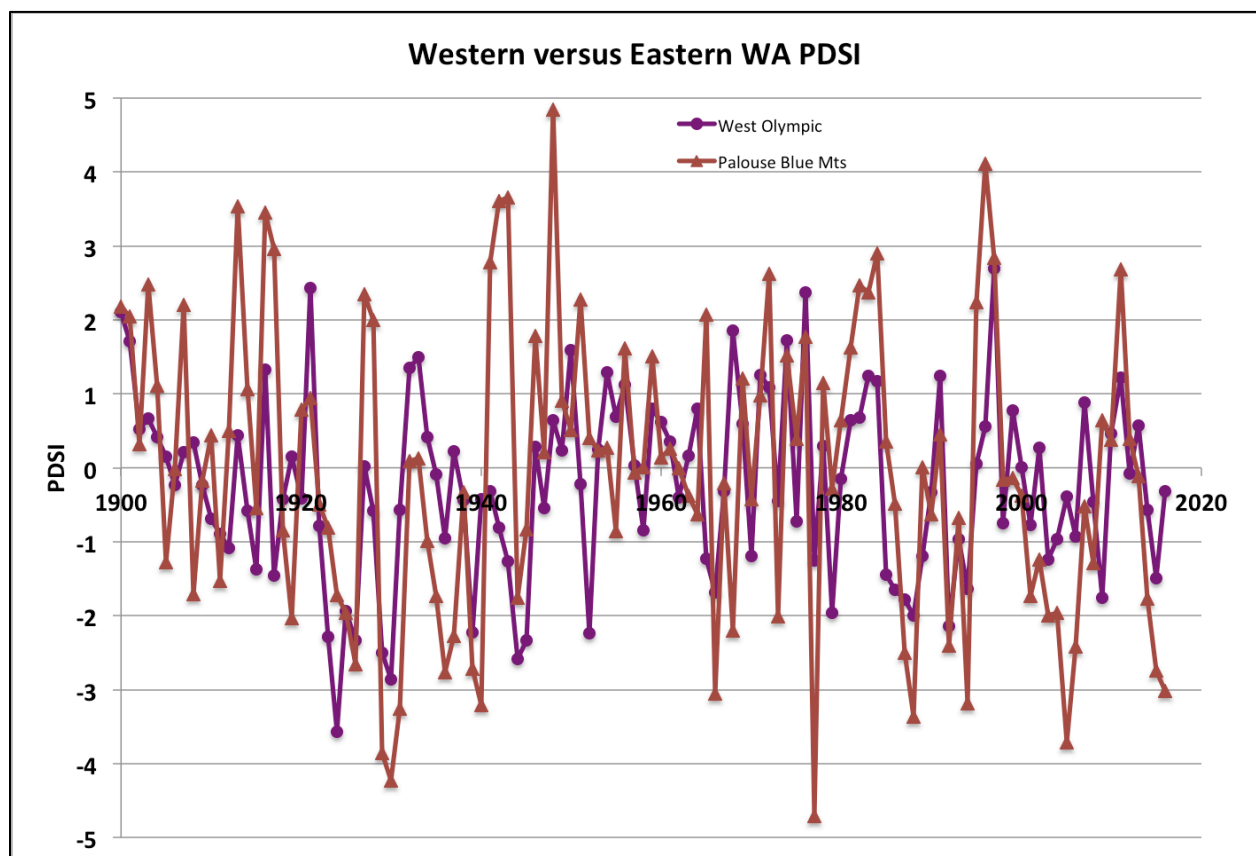
Time series of the PDSI for Washington State as a whole are plotted in Figure 7 for the years of 1900 through 2016, separately considering the wetter first half of the water year of October through March and the drier second half of April through September. These time series reveal an extended period from the early 1920s to the 1940s, when the PDSI was generally negative during both the wet and dry portions of the year, interrupted by a period of wetter conditions in the late 1930s.



**Figure 7. Time series of Palmer Drought Severity Index (PDSI) for Washington State 1900 to 2016 for October through March (blue line) and April through September (pink line).**

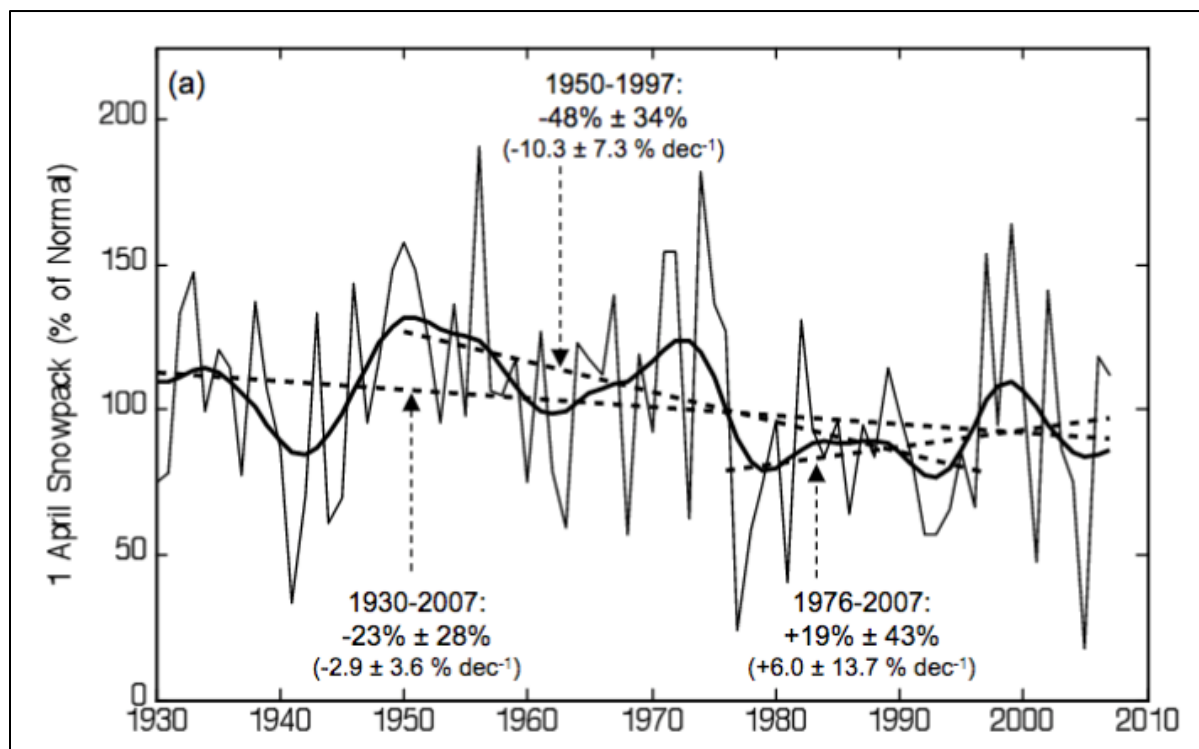
As mentioned above, the period from the middle 1940s to the present (2016) has been characterized by mostly year-to-year fluctuations. For example, the years of 2003 through 2005 comprise the only 3-year period with three consecutive values of wet season PDSI of about -1.5 or less. The two time series also indicate that low PDSI wet seasons tend to be followed by low PDSI dry seasons, and vice versa, with some exceptions. The linear correlation coefficient between the two series is about 0.52. The implication is that poor conditions at the end of the first half of the water year are unlikely to be alleviated until the following wet season.

The PDSI record has also been used to explore spatial variations in drought across Washington State. An example is shown in Figure 8, in the form of water year (October through September) averages of the PDSI for the West Olympic and Palouse/Blue Mountains climate divisions, located in the northwest and southeast corners of the state, respectively. These series positively correspond with one another, with a linear correlation coefficient of about 0.51. The PDSI for the Palouse/Blue Mountains climate division is more variable and hence more prone to extreme droughts by this measure; relatively large variability in the PDSI was found for other climate divisions east of the Cascade Mountains crest (not shown). As suggested by Figure 8, typically the spatial footprints of droughts in Washington State are large enough to encompass most, if not all, of the state.



**Figure 8. Time series of PDSI for the water years 1900 to 2016 for the West Olympic climate division (purple line) and the Palouse/Blue Mountains climate division (burgundy line) of Washington State.**

A long record (1930 to 2007) of snowpack for the western slope of the Cascade Mountains was produced by Stoelinga et al. (2009). Their series is based on a water balance using measurements of streamflows, precipitation, and temperature. The method for the last two-thirds of the record was checked against direct snowpack observations. The time series of estimated April 1 SWE from their analysis is shown in Figure 9. This time series indicates particularly low SWE for the winters of 1940-41, 1976-77, and 2004-05. The latter two events resulted in water supply issues for Washington and appear more anomalous in terms of the April 1 SWE of Figure 9 than in the PDSI of Figure 7. On the other hand, the temporal character of the snowpack record estimated by Stoelinga et al. (2009) is consistent with that of the PDSI, in that each record indicates that a substantial drought of multi-year duration has not occurred in Washington for many decades.



**Figure 9. The April 1 water-balance snowpack (percent of 1961 through 1990, thin solid line); smoothed version (heavy solid line); trend lines over the periods indicated (heavy dashed lines), with trend values (total percent change and percent per decade) and 95 percent confidence intervals listed.<sup>3</sup>**

### Historical Streamflows during the Growing Season

The following is a brief review of historical streamflows during the growing season, specifically, the mean flows during the months of May through August for the years of 1930 through 2016, as shown in Figure 10 for three unregulated rivers representing different regions of the state: the

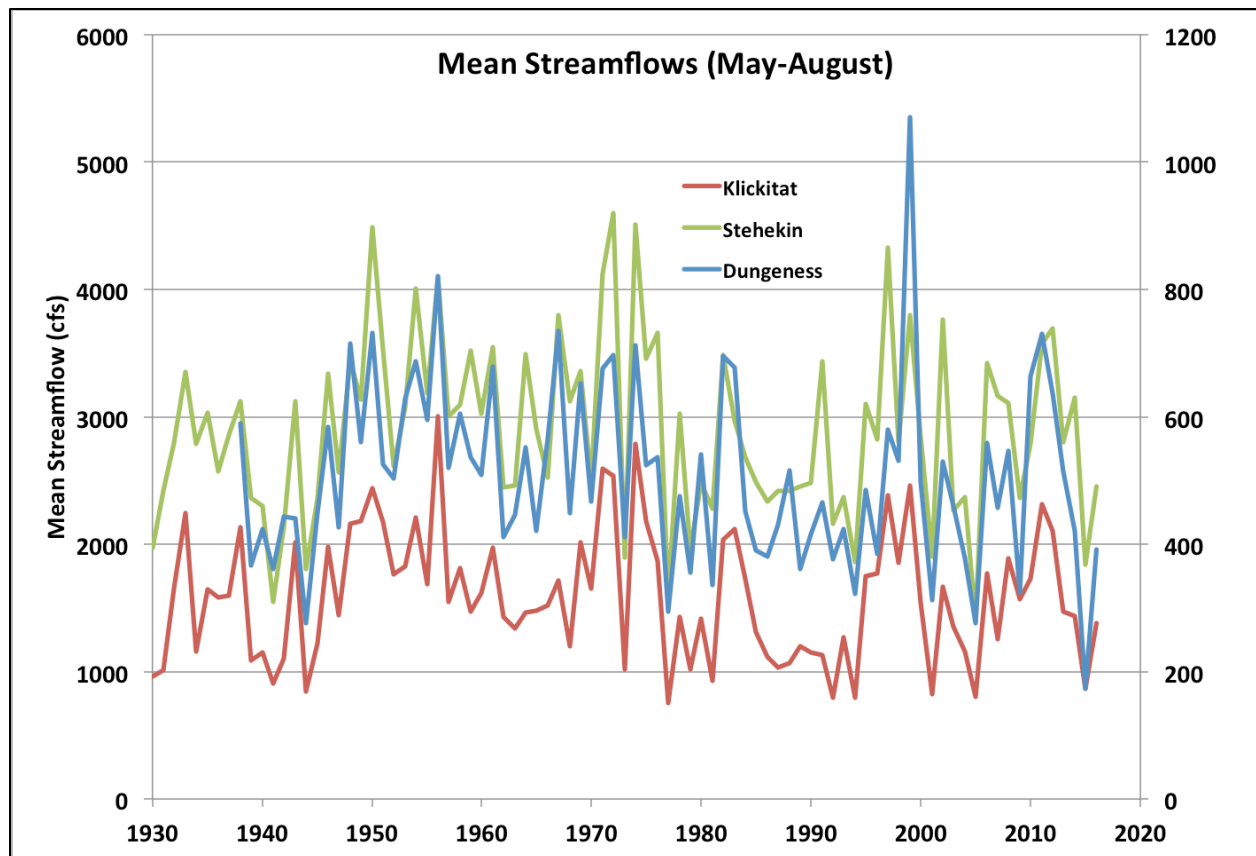
<sup>3</sup> Reproduced from Stoelinga et al. 2009.



Dungeness River near Sequim (USGS #1204800), the Klickitat River near Pitt (USGS #14113000), and the Stehekin River near Stehekin (USGS #12451000). These time series are generally consistent with the results presented above.

While past dry and wet periods have had different manifestations, in broad terms, there appears to be a correspondence among the streamflow variations in the various portions of Washington State. A similar result was suggested by the PDSI example illustrated in Figure 8.

The period of the late 1940s through middle 1970s included mostly higher streamflows, as would be expected, given the mostly positive values of PDSI and above-normal snowpack in those years. There appears to be somewhat less year-to-year variability in the streamflows than the other two measures, as exemplified by the mostly lower flows that prevailed from the late 1970s until the mid-1990s. It is possible that the groundwater contribution serves to smooth out shorter-term fluctuations in streamflows, but a thorough analysis of this factor is beyond the scope of the present piece.



**Figure 10. Mean streamflows May through August for the Klickitat (red line, left axis), Stehekin (green line, left axis), and Dungeness (blue line, right axis) in cubic feet per second for the years 1930 to 2016.**

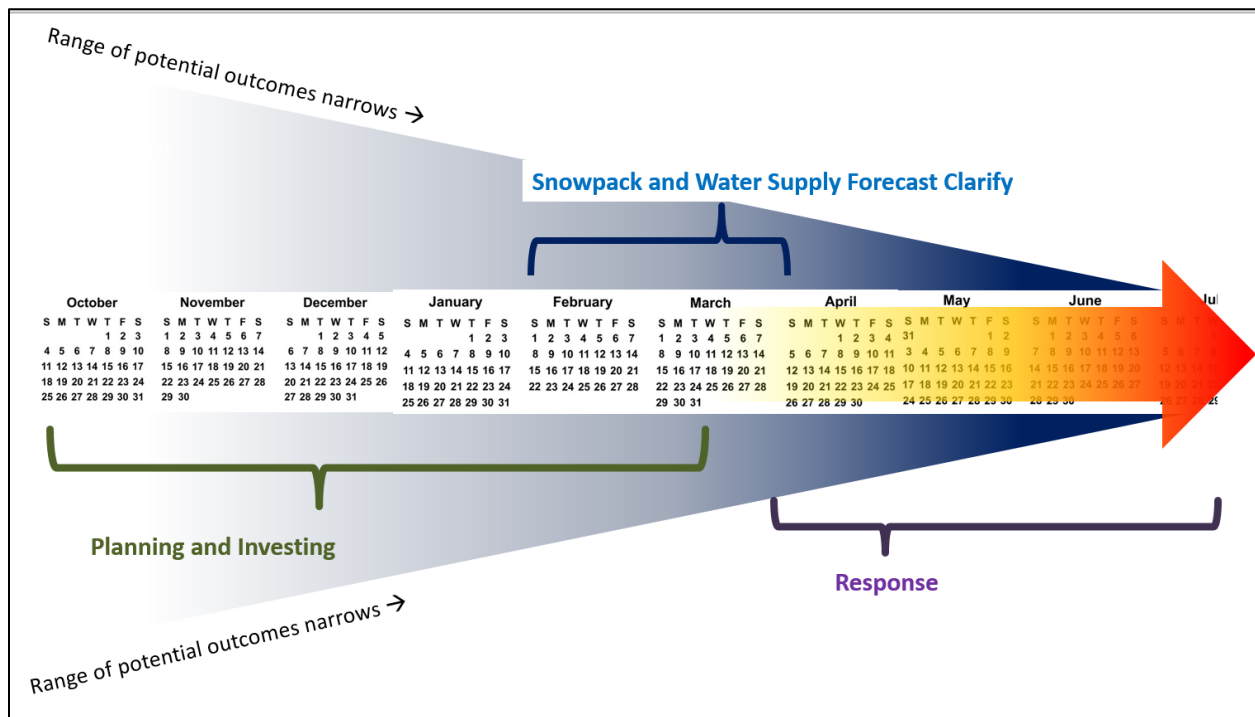
# Operations and Administration

The State of Washington serves a dual role in assisting its citizens in coping with future droughts. State agencies, as resource managers, are responsible for monitoring and forecasting anticipated drought conditions. When conditions reach the statutory threshold and a drought is declared, Ecology is authorized to expedite emergency water right permitting actions.

Additionally, to the extent that funding and staff resources allow, the state will also assist local communities through emergency and non-emergency programs, when local capabilities and resources are inadequate to deal with the drought event.

## Challenge of Timely Response

Drought is often described as a slow-moving disaster but, in fact, conditions can develop rapidly, challenging a government's ability to respond in a timely manner. Figure 11 illustrates the challenge associated with planning and responding to drought conditions.



**Figure 11. Forecasting certainty in relation to water supply planning and drought response**

Droughts can develop at any time of year, but given the strong (wet/dry) seasonality of Washington's climate and the importance of snowpack and winter precipitation in shaping water supply conditions, it is logical to frame this challenge in the context of a water year.

At the beginning of a new water year (October), there are many potential water supply outcomes for the next year's critical water supply season, ranging from much-above to much-below normal. Large, hemispheric climatic influences such as El Niño or La Niña may shape, but do

not necessarily determine, the outcomes. During the fall months, water supply forecasts for the next spring and summer largely depend on climatology (i.e., what has happened historically) to generate a range of potential outcomes. As the end of the calendar year nears, the spread of potential hydrologic outcomes for the following summer is still quite broad. The snowpack may start out slow but then accumulate more consistently. Or, it may start out strong but then stall and fall below normal. As winter moves toward spring, the probabilities of various water supply outcomes begin to narrow, as actual (measured) snowpack and precipitation conditions begin to constrain the outcomes of water supply models.

By March, it is possible to predict summer (April through September) seasonal water supply conditions with significant skill. However, this timing also creates challenges for responding in a timely manner, if conditions point toward drought. By early March, many agricultural growers have already committed to a plan for the summer. Fields may already be planted, which means that certain actions, like leasing water rights, may be difficult. For other sectors, there may be more time to react, but obtaining funding and mobilizing resources can take weeks or months.

There are two major ways to improve the timeliness of state response. One is to gain lead time through enhancements in forecasting and the prediction of drought conditions. The other is to improve the state's ability to react to drought.

An earlier warning provides more lead time to prepare for anticipated conditions. As is discussed in the Monitoring and Forecasting appendix (Appendix A), forecasting skill is continually improving, though enormous technical challenges remain. For at least the next decade, it is unlikely that forecasting improvements will significantly expand the lead time for decision-making.

Thus, the more promising strategy is for the state to become more agile in how it responds to drought conditions. There are multiple aspects to this strategy:

- Adopting a Two-Stage Drought Framework, including an option for a Drought Advisory to provide an early warning potential drought conditions to water users of.
- Mitigating drought impacts so that the probability of emergency hardship is reduced.
- Assuring that there is a stable, dependable source of drought contingency funding.
- Adopting practices that reduce the time and effort required to mobilize and deploy state resources.

## **A Two-Stage Drought Framework**

With the plan revision, the state is committing to use a Two-Stage Drought Framework: Advisory and Emergency. As depicted in the graphic below, these two stages are triggered by different criteria within a recurring process of monitoring and forecasting to determine whether water supply conditions meet hydrologic or hardship triggers. When the hydrologic criteria are met for a geographic area (e.g., a specific watershed, region, or the entire state), a drought

advisory may be issued. When both the hydrologic criteria and the hardship criteria are met, a formal drought declaration emergency may be issued.

## Stages and Triggers

The Advisory Stage provides a framework for communicating about water supply conditions that do not exceed Washington's statutory threshold for drought, but which nonetheless indicate cause for caution, the need for preparation, and the mobilization of resources. The Emergency Stage is only reached when the statutory threshold for drought conditions is met.

This staged approach emulates some other forms of progressive messaging (e.g., the advisory/watch/warning system used by the National Weather Service and the four-stage water shortage response framework used by municipalities to manage water demand via increasing levels of water use reduction (advisory through rationing)). A few other states also use multiple drought stages. Some of them include as many as five distinct stages, which are triggered by various drought indices and precipitation percentiles. The Advisory trigger in this plan is purposely broad and general, in terms of environmental metrics considered. This is to provide more flexibility in shaping our messaging to the public. A summary of the drought stages and triggers is provided below, followed by a detailed description of advisory stage goals and actions.

### Stage 1 – Advisory

**Conditions:** Long-term forecast indicates drought of any level of severity may occur, or short-term forecast indicates minor drought conditions may occur in at least some area of the state.

#### Triggers:

- *Water supply trigger:* Consideration of the following factors suggest a strong likelihood of reduced water supply, that careful management of water supply and demand is advisable, and that concerns should be conveyed to natural resource managers, water users, and the public:
  - Below-normal snowpack;
  - Below-normal river forecasts;
  - Below-average reservoir refill or carry-over from the previous year;
  - Depleted soil moisture or groundwater;
  - Extended precipitation deficit (e.g., the Standardized Precipitation Index is -1 or below); and/or
  - Forecasts of high temperature or low precipitation for an extended period.
- *Hardship trigger:* There is a potential for hardships to water users and uses in the affected area due to drought conditions.

**Response:** Heightened awareness, increased preparation. Communicate existing monitored conditions and forecasted short-term climate outlooks (1 to 3 months). Coordinate communication with local water managers and affected governments (state, local, tribal). Water users who anticipate hardships would be informed they can petition Ecology for assistance with drought preparedness/response actions. State agencies may begin mobilizing resources, communicating with the Legislature and Office of Financial Management (OFM) on potential funding needs, and preparing for drought response actions.

## **Stage 2 – Emergency (issue Declaration)**

**Conditions:** Short-term forecast indicates high probability that drought conditions meeting the statutory definition will occur at least in some areas of the state; or drought conditions have actually materialized in at least some area of the state (at any level of severity – minor to severe).

### **Triggers:**

- *Water supply trigger:* Forecasted seasonal runoff is likely to be less than 75 percent of normal and/or other water supply indicators, as summarized above, have deteriorated to more extreme levels.
- *Hardship trigger:* There is high confidence of existing or imminent hardships to water users in the affected area due to the drought conditions.

**Response:** Issue Drought Declaration for affected areas. Communicate existing monitored conditions and forecasted short-term climate outlooks (1 to 3 months). Coordinate communication with local water managers and affected governments (state, local, tribal). Activate state systems for response actions defined in the state’s Drought Contingency Plan. (Note: Water users would need to provide evidence of imminent or demonstrated hardship when requesting permits or funding for specific actions under the emergency drought provisions of state law.) Seek emergency funding as needed from the Legislature and coordinate with OFM.

## **Drought Advisory Actions**

Under the two-stage approach, a formal Drought Advisory triggers actions in three major areas:

1. Communicating Advisory status to both external and internal audiences.
2. Mobilizing resources internally in preparation for a formal declaration of drought emergency.
3. More intensive monitoring of water supply conditions and forecasts, including reports of existing or pending impacts.

### **Communication**

Under an advisory phase, the state response emphasizes communication to water users in affected areas. Key audiences are both internal and external to state agency organizations. Ecology has the lead responsibility for media outreach and broad messaging, while individual

agencies are responsible for communicating with their specific sectors at a more detailed level and establishing an effective two-way flow of information between the state and stakeholders.

Execution of the communication strategy would follow the guidance of the drought communication plan, which is included at Appendix G. Table 1 below summarizes the key actions.

Note that communication actions also are included for times when there is neither an Advisory nor Emergency in effect. Communication during this time is geared toward keeping the public informed on water supply conditions and summarizing the discussion of the WSAC. These are described as Water Supply Updates.

**Table 1. Drought communication actions**

|  | <b>Actions</b>   | <b>Communications</b>   |
|--|--|---|
| Water supply updates (year-round)          | <ul style="list-style-type: none"> <li>• Ecology regularly convenes the WSAC to review conditions and anticipate potential problems</li> <li>• Ecology continues its drought mitigation efforts</li> </ul>   | <ul style="list-style-type: none"> <li>• Ecology updates its website, blog, and social media based on WSAC findings</li> <li>• Other state agencies are involved in communications, as necessary</li> <li>• Highlight successful projects or plans that increase drought resilience (e.g., Office of Columbia River work)</li> </ul>  |
| Stage 1 – Advisory (regional or statewide) | <ul style="list-style-type: none"> <li>• Ecology issues an advisory for the affected area(s)</li> <li>• Involved state agencies have heightened awareness and increased preparation</li> <li>• Involved agencies may begin mobilizing resources and preparing for drought response actions</li> <li>• Ecology invites water users who anticipate hardships to petition for assistance with drought preparedness/ response actions</li> </ul> | <ul style="list-style-type: none"> <li>• Ecology convenes the drought communication coordination team</li> <li>• Ecology leads the effort to communicate about existing conditions and forecasted climate outlooks</li> <li>• Coordinate communication with major water managers and affected governments (county, city, and tribal)</li> <li>• Drought Advisories may also be used at the back end to communicate when drought conditions are improving from emergency conditions, but have not yet reached full recovery</li> <li>• Tone: Concerned but not panicked; clear and conversational</li> </ul> |

|   | <b>Actions</b>   | <b>Communications</b>   |
|---|--|---|
| Stage 2 –<br>Emergency<br>declaration<br>(regional or<br>statewide) | <ul style="list-style-type: none"> <li>• Ecology issues a drought declaration for the affected area(s)</li> <li>• Ecology activates systems for response as defined in the state’s drought contingency plan</li> <li>• Involved agencies mobilize resources</li> </ul> | <ul style="list-style-type: none"> <li>• The drought communication coordination team (Ecology convenes this group, if advisory step is skipped) highlights information about relief efforts and how affected people can access resources</li> <li>• Ecology continues communicating about existing conditions and forecasted climate outlooks; state agencies support</li> <li>• Team coordinates communication with major water managers and affected governments (county, city and tribal)</li> <li>• Tone: Calm, direct, and empathetic</li> </ul> |

## **Mobilization of Resources**

### *Applications for emergency water right permits*

At the Drought Advisory stage, Ecology will prepare to accept applications for emergency drought permits. Historically, holders of proratable irrigation rights in the Yakima Basin have filed most of these applications. Fewer application have been filed in other areas of the state.

In a drought advisory phase, Ecology should begin refreshing application templates and drafting decision documents (e.g., formal declaration language). Some basins may require special preparatory work and public outreach. In the Yakima Basin, for example, the regional staff should begin to assess the number of water rights holders who may be interested in using emergency drought wells. In the past, the region has scheduled workshops to explain the requirements for operating an emergency drought well. In 2015, applicants for emergency wells were issued their permits at workshop completion. Irrigators benefit from having certainty over the use of their well as soon as possible.

In other locations, emergency water right applications are processed as they are received. Because drought permit applications have a short, 15-day decision timeline, it is prudent for Ecology staff to encourage water users to consult with Ecology before submitting their application. Ecology staff can offer recommendations for how to proceed and identify any information needs to ensure they will be able to process the application promptly.

### *Assessment of funding adequacy*

Depending on future drought funding structures, state agencies may or may not have contingency funding available at the time an advisory is declared. Agency staff will need to assess whether to make an additional funding request to the Legislature and Governor’s Office. Options for

funding emergency drought work by drawing on accounts for other purposes will need to be evaluated. Reviewing the expenditures of past drought emergencies, including reviewing previous inter-agency agreements and work plans, will be useful in gauging needs in the current year.

### ***Review and refresh existing agreements***

Existing MOAs/MOUs between Ecology and other agencies or organizations should be reviewed and refreshed. Contacts for implementing the agreements should be identified, and consultation amongst the involved agencies or other parties should be initiated. Any additional costs required to implement the agreement should be identified, if not already described in the agreement itself.

### ***Planning for temporary reassignment of staff duties***

If the state transitions to an Emergency Stage drought declaration, then agencies' staff will need to be assigned to carry out state response actions. The Advisory Stage provides a short time period for agency managers to assess potential staffing needs, identify appropriate personnel to carry them out, and make arrangements for backfilling their normal duties. Since this may affect each agency's ability to provide normal services to the public, the effects of reallocating staff need to be communicated to existing applicants and affected staff.

### ***Identifying most vulnerable public water systems***

The Department of Health (Health) is responsible for querying its database to identify those systems which are likely to be most vulnerable to drought conditions. Once these systems have been identified, Health would be responsible to contact them to provide a status report on state drought response, potential future developments, and to determine if any systems require technical or other assistance.

## **Monitoring Drought Conditions**

In an Advisory Stage, water managers are faced with the question: Are conditions getting worse? The following actions should be taken to monitor the situation closely and determine quickly whether water supplies are below 75 percent of normal:

- River forecasts are updated daily and should be reviewed daily.
- Recent precipitation and temperature trends (e.g., weekly to monthly) should be reviewed to see if anomalies are worsening or abating.
- Near-term (8 to 14 days or 3 to 4 weeks) and seasonal forecasts should be reviewed to assess whether conditions are likely to change for the better or worse.

During drought advisories, the frequency of Water Supply Availability Committee meetings should increase as well. Bi-weekly or even weekly discussions may be more suitable.



# Drought Declaration Process

The following steps are taken to assess the need for a drought declaration, determine the severity and the scope of the declaration, and acquire and distribute resources to those water users affected by the declaration:

1. Forecasting and monitoring the water supply
2. Determining what constitutes hardship for potentially affected water users
3. Identifying the geographic area covered by the determination
4. Drafting and publishing the drought order
5. Addressing Petitions for Declaration

These steps are discussed in greater depth below. A discussion of issues to consider during drought planning and response follows the description of the drought declaration process.

## Drought Declaration Process

### Forecasting and Monitoring the Water Supply

The WSAC is responsible for assessing whether water supply is likely to be below 75 percent of normal for any area of the state. WSAC is chaired by Ecology and consists primarily of State and Federal agencies with expertise in water supply forecasting, drought monitoring, and climate:

- Department of Ecology (chair)
- Office of Washington State Climatologist
- U.S. Geological Survey
- National Weather Service
- Natural Resources Conservation Service
- U.S. Bureau of Reclamation
- U.S. Army Corps of Engineers (optional)
- Bonneville Power Administration (optional)

Representatives of major water utilities (e.g., Seattle, Tacoma, Everett, and Puget Sound Energy) are invited to provide updates of their respective water system status, as well.

Ecology convenes WSAC over the course of the year, as needed, based on Ecology's monitoring of conditions and forecasts. Meetings are scheduled more frequently (e.g., every 4 to 6 weeks) in winter months than during the summer and fall. This reflects the state emphasis on forecasting water supply conditions as the current water year's snowpack takes shape. These meetings are open to the public. The discussion is summarized in meeting minutes provided on Ecology's website.

Meetings are held less frequently during the summer. By late spring, after snowpack has peaked and snowmelt is underway, there is high confidence regarding the probability of water supply

conditions over the next several months, though precipitation and temperature still need to be monitored. The window for mounting a timely response to drought narrows as the end of each water year approaches in the fall, when water demand drops due to the moderating influences of shorter, cooler days and the end of irrigation season.

Relevant drought and water supply indicators are described in the Drought Monitoring and Forecasting chapter. Generally, WSAC meetings should address the following topics:

- Recent trends and anomalies in regional temperature and precipitation
- Ocean conditions; probabilities for the development El Niño or La Niña conditions, either of which can affect northwest weather in the coming months
- Seasonal water supply forecasts (National Oceanic and Atmospheric Administration (NOAA) and National Resources Conservation Service (NRCS))
- Long term temperature and precipitation forecasts or other models (e.g., National Multi-Model Ensemble (NMME))
- Mountain snowpack and precipitation status
- Status of major water supply projects (e.g., storage status, special forecasts)
- Current streamflow and groundwater conditions (e.g., percent of rivers above or below normal)
- Water supply impacts
- Other indicators of drought conditions

Water supply forecasts are the most critical indicator. When a forecast is less than 75 percent of normal, WSAC needs to evaluate whether that forecast is likely to hold, or whether it is premature to act. If the forecast is likely to hold, then WSAC must evaluate whether to recommend that the EWEC convene to evaluate the potential for hardship because of that water supply shortage.

### *Requirements for consensus*

WSAC recommendations are reached via facilitated group discussions of water supply forecasts and other relevant information. When there is a lack of consensus, Ecology will determine whether to forward the recommendation to EWEC or to continue monitoring and reconvene later.

### **Determination of Hardship**

When considering a drought declaration, hardships and vulnerabilities experienced during previous drought years suggest where impacts are likely to occur in the future. This provides a sufficient basis to affirm the potential for hardship.

Where there is no evidence of past hardship, EWEC must consider whether anticipated conditions merit the declaration of an emergency, or whether a drought advisory would be more appropriate. Ecology can use a drought advisory to solicit more information from water users and invite them to petition for a full drought declaration if they are at risk of hardship.

When Ecology has declared a drought emergency within a geographic area, water users may be eligible for emergency drought permits and financial assistance. Any user with a previously authorized water use may apply for an emergency drought permit. Financial assistance in the form of grants and loans is limited to public entities. At this stage, the burden for documenting hardship falls upon the applicant. Neither the state legislature nor Ecology has formally defined the term *hardship*. However, the entity seeking a permit or assistance should be able to demonstrate that the ongoing or anticipated water shortage is likely to cause a severe economic injury, a public health emergency, or severe environmental harm.

Avoided hardship can be economic, environmental, and social:

- Authorizing the use of emergency wells where a grower would suffer severe economic losses otherwise, resulting from a loss of orchard trees.
- Funding new wells for a small community dependent on springs that were drying up during drought.
- Funding work crews responsible for removing stream blockages to salmon migration.
- Authorizing emergency water transfers between water right holders to enable junior water right holders to replace lost water supplies.

### *Evaluating Hardship and Impacts: The Executive Water Emergency Committee*

Assessing whether water supply deficits are likely to cause undue hardships to water uses or users is the responsibility of EWEC. EWEC is chaired by the Governor's Office, assesses information provided by the WSAC, and determines whether water users within water-short areas will likely experience hardships.

EWEC is an executive-level committee, which is convened on an ad hoc basis, at the recommendation of the WSAC. Past participation on the committee has included representatives from the following agencies:

- Governor's Office (chair)
- Washington State Conservation Commission (WCC)
- Washington Department of Agriculture (WSDA)
- Washington Department of Commerce (Commerce)
- Washington Department of Ecology (Ecology)
- Washington Department of Fish and Wildlife (WDFW)
- Washington Department of Health (Health)
- Washington Department of Natural Resources (DNR)
- Washington State Military Department, Emergency Management Division (EMD)

Evaluating the potential for hardship requires that EWEC have some understanding of past drought-related impacts. Sources of this information include:

- Information regarding drought impacts from previous droughts (e.g., vulnerability assessments, economic studies, impact assessments).

- Staff assessments of risk
- Petitions or requests from water users

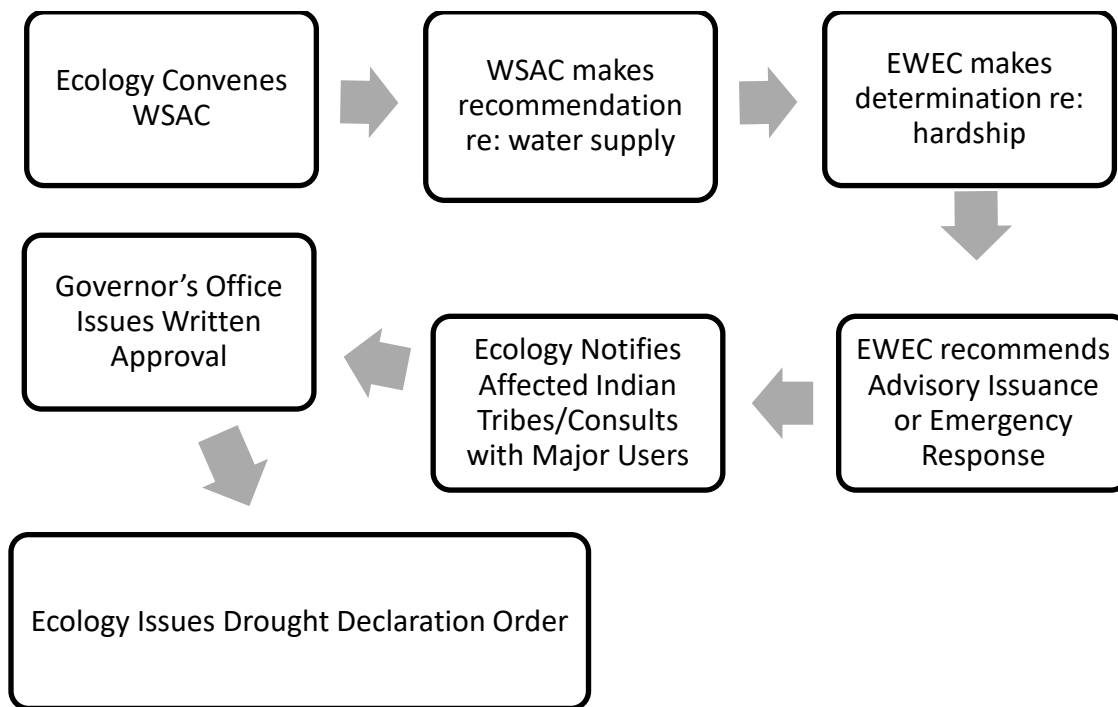
As executive sessions, EWEC meetings are not open to the public. Each agency is expected to speak to impacts that affect their respective sector of responsibility. Staff-level employees are expected to have briefed their respective directors prior to the meeting. Discussion is facilitated by either the Governor's Office or Ecology.

If EWEC recommends that any part of the state be declared as drought and the Governor's Office concurs, the Governor's Office must formally request Ecology to issue an Order and Determination of Drought (See example memo in Appendix H).

As noted above, WSAC recommendations regarding water supply shortages are communicated to EWEC, which is charged with making a final recommendation whether to declare a Drought Advisory or Emergency Declaration.

Before issuing an Emergency Declaration, the state must also notify affected tribes in affected drought areas. This notification is important for providing a point of contact to tribes and informing them of the type of drought response actions that are likely to occur in areas where they have interests.

Pursuant to this plan, the state will also communicate with major water users who may be affected by a Drought Advisory or Emergency Declaration. In particular, large municipalities have expressed a desire for Ecology to coordinate drought communication with them so that they can manage their own communications with their own users. This process is illustrated in Figure 12.



**Figure 12. Schematic for Drought Declaration (Advisory or Emergency)**

### **Identification of Geographic Area Covered by Drought Declaration**

A drought emergency or advisory may be issued for a specific geographic area, which is an area within the State of Washington that can be described either by natural or political boundaries and can be identified specifically in an order declaring a drought emergency. The state has broad discretion to define drought areas.

Examples of specific geographical areas include, but are not limited to:

- The State of Washington
- Counties
- Water resource inventory areas (WRIAs), as defined in Chapter 173-500 WAC
- Individual sub-basins that constitute only a portion of a WRIA but whose boundaries can be topographically described
- Groundwater management areas and subareas as defined in WAC 173-100
- Designated sole source aquifers
- Combinations of the above areas

When identifying the boundaries of the drought declaration, the State must evaluate how broadly or narrowly to define the area. Decision-makers must take into account water-supply forecasts and conditions, and they must also evaluate the potential for hardship. The goal is to avoid both omitting those who are affected by drought conditions and including water users who aren't affected. In practice, the State has used WRIA boundaries, which define watershed areas for

administering water rights and water resources-related rules (e.g., the priority water rights system and instream flow regulations). as discussed below, advisory or declaration areas can be expanded in response to petition, new information, or evolving conditions by WSAC and EWEC. To ensure that the public is sufficiently informed about drought conditions, it may be helpful to include the names of affected counties and cities in drought orders and advisories, and to create maps with clearly delineated boundaries. This can help the public understand who is affected by the drought declaration.

When defining an area for either Advisory or Emergency status, the state will also describe the types of uses most likely to be affected by drought conditions, as illustrated in the two examples on the following pages.

## **Drafting and Publication of Drought Order**

Drought Orders must comply with the requirements specified at WAC 173-166-060(2):

*"The order declaring drought conditions for a geographical area or part of a geographical area must contain the following elements:*

- (a) A description of the geographical area or part of a geographical area which is being so designated.*
- (b) The facts leading to the issuance of the order.*
- (c) The statutory authority upon which the order is being issued.*
- (d) The commencement date and termination date of the order. The termination date may be no later than one calendar year from the date the order is issued.*
- (e) Brief descriptions of the actions which are possible under the order.*
- (f) Provisions for the termination of withdrawals if essential minimum flows are jeopardized."*

An example is provided in Appendix H.

## **Petitions for Declaration**

WAC 173-166 provides that petitions to declare areas for drought may be submitted to Ecology. Petitions must be submitted by letter and contain information describing the nature of relief, the area that is being requested for designation, and the facts underlying the petition.

EXAMPLE 1: Hydrologic conditions indicate drought in central Washington

A Stage X drought is declared for parts of Chelan, Douglas, Grant, Kittitas, Yakima, and Benton counties. This stage means: \_\_\_\_\_.

River basins affected within those counties are the Wenatchee, Entiat, Chelan, Lower Yakima, Upper Yakima, Naches, and Alkali-Squilchuck. (WRIAs 27, 38, 39, 40, 45, 46, 47).

Affected areas:

The affected water users and natural resources may include farms that rely on surface water sources; communities drawing from surface water sources; communities and homeowners drawing from shallow wells in unconfined aquifers; and fish in each of the affected basins including tributary streams.

Farms in the Yakima River Basin that receive water from the Bureau of Reclamation should consult with their irrigation district managers. As of the current date, Reclamation has indicated Total Water Supply Available of \_\_\_ percent. The TWSA forecast will be confirmed or updated by Reclamation, at least monthly.

Customers of public water systems in the affected area should look for communications from their local water utility to determine whether shortages are expected.

Unaffected Areas:

Farms and communities receiving water from the Columbia River and Lake Roosevelt are not expected to experience shortages this year if current weather trends continue.

Because information regarding anticipated drought impacts is imperfect, the state should actively publicize the opportunity for petitions in communications regarding drought advisories or declarations. Petitions can bring new information to the attention of state officials.

Upon receiving a petition for a drought declaration, Ecology has 15 days to provide a decision to the applicant as to whether the petition will be acted upon. Prior to deciding, Ecology must consult with WSAC and staff members of EWEC agencies. A decision to issue or expand an Emergency Drought declaration may only be made after a formal recommendation of EWEC to the Governor's Office.

EXAMPLE 2: Hydrologic conditions indicate drought in northwest corner of state

A Stage X drought is declared for parts of Whatcom, Skagit, and Snohomish counties. This stage means: \_\_\_\_\_.

River basins affected within those counties are the Nooksack, Lower Skagit/Samish, Upper Skagit, and Stillaguamish basins (WRIAs 1, 3, 4, and 5).

Affected Areas:

The affected water users and natural resources may include farms relying on natural rainfall for a large portion of their water needs; communities drawing from surface water sources; communities and homeowners drawing from shallow wells in unconfined aquifers; and fish in each of the affected basins, especially in smaller creeks.

Customers of other public water systems in the affected area should look for communications from their local water utility to determine whether shortages are expected.

Unaffected Areas:

The City of Bellingham lies in the affected area but is not expected to experience shortages this year if current weather trends continue.

The City of Everett and communities receiving water from Everett's regional water supply system lie outside the affected area of Snohomish County, and are not currently expected to experience shortages this year. This unaffected area includes Arlington, Lynnwood, Marysville, the Alderwood Water and Wastewater District, and other communities in the southern half of Snohomish County.

## Issues to Consider throughout Drought Declaration Process

Drought response efforts can be affected by several issues, including preparation and planning; funding sources; coordination with other agencies at the Federal, State and local levels; the timing and duration of drought declarations, and monitoring of drought impacts during a declaration.

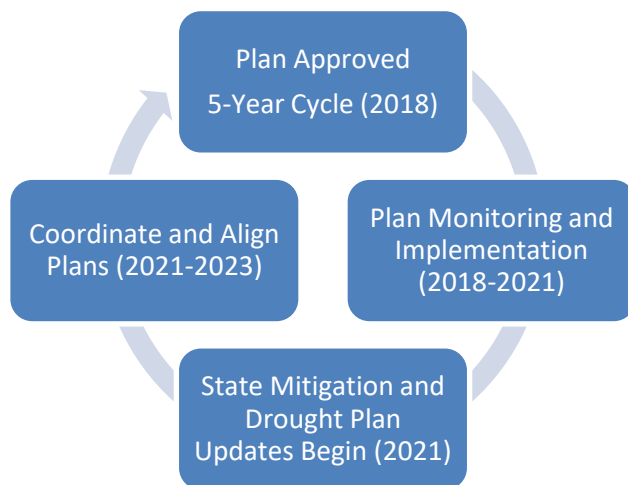
### Plan Update and Maintenance

In addition to the Drought Contingency Plan, which is developed and maintained by Ecology, Washington maintains a State Enhanced Hazard Mitigation Plan (SEHMP) through its Emergency Management Division (EMD). Both plans contain a drought hazard overview and state-level mitigation actions that can be implemented to reduce risk and minimize impacts of drought. The Drought Contingency Plan contributes to the SEHMP through the drought mitigation strategies and drought hazard vulnerability and risk assessment. The SEHMP, in turn, guides local jurisdiction mitigation planning best practices, encouraging the use of data and methods from the Drought Contingency Plan.



The SEHMP is updated every 5 years, with the current update scheduled for completion in summer 2018. In order to ensure consistency between plans and leverage the best available science, the Drought Contingency Plan will be updated every 5 years, in the 2 years preceding the SEHMP update. Thus, the next update will be completed by 2023.

EMD will begin the mitigation plan update process 2 years prior to the SEHMP's expiration (approximately in 2021) and will use the state's mitigation plan review and monitoring steering committee (currently the Hazard Mitigation Workgroup). Ecology will also initiate updating of the Drought Contingency Plan. Appropriate Ecology staff will participate as members of the Hazard Mitigation Workgroup and other relevant committees to facilitate ongoing dialogue and enhance identification of proactive mitigation measures that can be implemented at a state level.



**Figure 13. Schematic depicting the State Emergency Hazard Management Plan update cycle.**

Additionally, at Ecology's request, EMD will provide copies of local jurisdiction mitigation plans that capture locally identified mitigation strategies to reduce the impacts of drought, for possible action or incorporation into the Drought Contingency Plan.

## **Training and Exercises**

Widespread moderate to severe drought conditions that would necessitate implementation of the Drought Contingency Plan generally do not occur on an annual basis.

To maximize awareness and familiarity of the Drought Contingency Plan, a training and exercise regimen is necessary to ensure that inter-agency staff and the organizations they represent can develop and retain an understanding of the plan and its actions in advance of drought incidents. This will ensure that the state is able to effectively implement the plan during a drought emergency.

### ***Training***

Ecology's Water Resources Program, in collaboration with key stakeholders, will offer a Drought Contingency Plan overview and refresher training for organizations identified within the plan on an annual basis. This training will occur during late winter/early spring months in advance of drier summer and fall months in which drought plan implementation is most likely to occur.

### ***Exercises***

Exercises play a vital role in any emergency planning process by enabling plan stakeholders to test and validate planning assumptions and identified actions, and detect additional capabilities in order to ascertain both capability gaps and areas for improvement.

Periodic exercises of the Drought Contingency Plan will ensure the capabilities and actions outlined in the plan are able to be effectively accomplished. Support for plan exercises will be provided by the Washington Emergency Management Division's (EMD) Exercise and Training Section, which specializes in exercise development.

Drought Contingency Plan exercises will occur on a bi-annual basis. Six months in advance of a scheduled exercise, Ecology will work with EMD training staff to begin the exercise planning process. Biennial (once every two years) discussion-based exercises may include, but are not limited to: seminars, workshops, and/or tabletop exercises. Exercise outcomes will be captured through a corrective action program and used to address capability gaps, as well as update the current Drought Contingency Plan.

## **Coordination with Other Agencies**

### **Pre-Agreements**

Front-line responders to natural disasters such as fires, floods, and earthquakes understand the importance of pre-staging critical tools and supplies where they can be deployed quickly. This same principle can be applied to executing administrative requirements necessary to support drought resiliency and response activities identified in the Drought Planning and Response Actions chapter. Reducing response time can compensate for the inherent uncertainty in the forecasting of drought conditions.

- Interagency agreements, work plans, budgets, and scopes of work should be available prior to the onset of drought. This will speed the disbursement of money from Ecology to other agencies and organizations needing drought response funding.
- The Washington Water/Wastewater Agency Response Network allows water and wastewater systems to receive rapid mutual aid and assistance from other systems in an emergency. Utilities sign the network's standard agreement, which then allows them to share resources with any other system in Washington that has also signed the agreement. Mutual aid agreements between water users can specify that participating systems will make equipment and other resources available in the event of a water supply emergency. See Appendix E.
- Some water right transfers may be recurrent in drought years. To the extent the participants require State authorization to proceed with the transfer, parties should work with Ecology to obtain prior approval for measures that can proceed on the basis of simple notification to Ecology.

### **State Agency Coordination during Drought Emergencies**

State agencies will coordinate during drought emergencies to ensure that drought relief can be provided in an efficient, expeditious manner. EWEC will identify staff employees from each agency to staff an inter-agency coordination committee, which can agree upon a meeting schedule and protocol appropriate to the scale and severity of the drought.

The key objective of the committee is to ensure a continuous and timely information flow among state agencies to ensure each agency is aware of actions that other agencies are taking. Areas of coordination are likely to include:

- Funding
- Communication
- Permitting
- Monitoring of impacts
- Implementation of interagency agreements

EWEC membership includes DNR and the EMD, which play central roles in state wildfire response. EWEC does not have a role in planning and responding to state wildfire. It is important for DNR and EMD to take part in EWEC for three reasons:

1. To ensure that the state has an effective communication strategy, given that both fire and water supply are drought issues in the public's mind. During the 2015 drought, DNR officials were present during media events to announce drought declarations. Even though the basis of the declaration is water supply, many reporters asked questions regarding the wildfire risk for the coming summer.
2. To ensure that connections are being made between managers and staff from both agencies regarding communication of drought conditions.

3. To determine whether wildfire and water resource agencies need to coordinate more closely, given current circumstances.

State agency responsibilities with respect to drought planning and response can be distinguished from the role of other levels of government. A key distinction is that the state is not a water supply provider or purveyor, as is the case in some other states (e.g., California). Washington State does not own or operate water supply projects. Other than regulation of junior water rights, the state does not have the authority to restrict water demand in times of drought in order to extend supplies. Rather, the state's role includes a range of regulatory, coordination, and support roles.

The state may restrict the water use of local governments only insofar as it is necessary to protect the seniority of other water rights or to stop the waste of water. Thus, Washington can be distinguished from California and other states in which water resource regulators have required cities to reduce their water demand by certain percentages. Washington State has municipal water efficiency standards, but these standards apply uniformly to municipal water supplies, irrespective of drought periods.

## **Funding for Drought Response**

### **Contingency funding**

A predictable and timely source of funding is necessary to support drought resiliency and response actions. While droughts do not occur every year, they are likely to occur in some part of the state every decade, and are expected to become more frequent as the climate changes. When droughts do occur, a stable source of contingency funds is needed to initiate extraordinary actions (e.g., emergency water leases, hiring temporary staff, supporting emergency infrastructure).

If contingency funding is not available, the scope of state agency response will be limited to core actions such as issuing emergency drought permits and regulating water users, when necessary, to enforce the water right priority scheme. The emphasis will be on regulation, not relief.

The state will work to secure a continuing source of funding for drought resiliency actions, which can be available prior to an actual drought emergency. This will allow a more systematic, transparent review of proposed remedies to drought vulnerabilities, with a goal of providing a permanent solution to a water supply imbalance. Efforts underway in the Columbia Basin, including the Yakima Basin, are examples of this approach. The Department of Ecology's 2018-19 Legislative Strategy prioritizes the establishment of a continuing drought and climate change resiliency fund.

### **Direct agency appropriations**

The way funding is provided to state agencies in drought emergencies can also be structured in a way to facilitate a more expedient response. Historically, the Legislature has appropriated drought funds to Ecology, which has been responsible for subsequently disbursing the funds to other state agencies via interagency agreements and contracts. Contracting and finalizing

agreements can consume significant blocks of time (multiple weeks), resulting in delayed response.

An alternative, streamlined approach may be for the Legislature to provide direct appropriations to each agency to support extraordinary drought-related costs. Direct appropriations could eliminate the need for interagency agreements and contracts, thereby shortening response time. Direct appropriations of contingency funds would additionally improve deployment of money and resources to address hardship. Ecology will recommend this concept to the Legislature and the Office of Financial Management.

In Washington State's budget process, state agencies develop budget requests in consultation with the Office of Financial Management, for inclusion in the Governor's Budget Request to the Legislature. The timing for the process occurs in the fall, long before the water supply picture of the new water year is clear.

### **Ad hoc supplementary funding requests**

If contingency funding is not available, then state agencies must be prepared in the event of a formal Drought Advisory or Emergency to advocate for an ad hoc supplementary funding request. The success of this strategy will depend on the progress and dynamics of ongoing budget discussions in the Legislature. If the Legislature is not in session, then agencies must consider whether to reallocate money dedicated for other purposes to emergency drought response. However, if emergency drought relief differs significantly from the authorized purpose, shifting money from one account to another may not be supported.

### **Estimating funding needs**

Expenditures during previous drought emergencies (of which there have been three statewide and several watershed-specific) can be used to approximate funding needs, although changes in conditions, inflation, and the geographic scope of the drought need to be considered. A further caveat is that past expenditures also reflect how much money was allocated, not necessarily only how much may have been needed.

Costs for non-grant and grant expenditures should be estimated separately. Non-grant expenditures represent agency costs (i.e., salaries, office space, and equipment) and spending on specific projects (e.g., emergency water right leasing). These costs should be described and approximated in agency agreements such that they can be refreshed easily in times of pending drought (See Importance of Pre-agreements section).

Grant expenditures represent money allocated via a formal grant application process. That amount can be capped, but the number and costs represented by individual applications will vary from drought to drought.

### **Emergency grants and loans**

Ecology has been responsible for allocating grants and loans for emergency drought relief in past droughts. In each instance, Ecology has drafted an emergency rule to define the application process and specific eligibility criteria for grant awards. The rule is adopted pursuant to the state

Administrative Procedures Act and the agency also prepares a rule adoption plan as part of its own internal rule making processes. Emergency rules are limited in duration to 120 days. Because they are limited, an emergency drought grant program may only cover a limited extent of a drought emergency.

Ecology is responsible for all aspects of the emergency rule process, including:

- Drafting and publishing the rule.
- Developing application forms and processing applications.
- Managing grant and loan contracts.

## **Timing of Drought Declarations**

A drought declaration can be issued at any time of year, but historically, all forecasts have been issued in the spring months. Early in the water year (October through December), water supply forecasts for the coming April-through-September season still have a wide range of possible outcomes. Because snowpack is a major component of water supply conditions over much of the state, spring brings much more clarity on water supply.

Judgment must be exercised regarding the risk of acting versus not acting, and choosing between an advisory and an emergency declaration. Delaying action will foreclose some options for response as the water year continues. When risks to vulnerable users in the absence of state action are high, it may be prudent to move forward with a drought advisory or declaration.

Drought declarations are not open-ended. They may only be issued for up to a 1-year time period (RCW43.83B.405 (2)). The duration may be extended up to 1 additional year with written consent of the Governor.

Past practice has been to set the expiration date to a time that corresponds with the end of the calendar year (December 31). This timeline allows water managers to wait until the new water year is well underway before announcing that the drought is over.

## **Monitoring of Impacts**

Monitoring of impacts during drought is important for assessing whether resources may need to be directed, and whether mitigation and response measures are effective. Over time, the continuous documentation of impacts creates a record, which can be correlated to physical and hydrologic conditions. This record can illustrate whether impacts are changing as climate changes evolve (see the discussion on the Time of Emergence concept in the Planning for Climate Change section below) and can improve the ability to predict the likelihood of drought-caused hardship. These data can also inform water managers whether impacts are getting worse, particularly as climate change alters seasonal water availability, or whether vulnerabilities are being reduced as water users adopt resiliency measures.

Washington State has supported work to formally assess impacts and vulnerabilities in past droughts, and will continue to do so. Documenting drought experiences in post-drought reports

to the Legislature has proven valuable, as it supports information retention and encourages agencies to formally evaluate the impacts to their respective sectors.

In future droughts, agency staff will encourage the public to report impacts to the Drought Impact Reporter, which is maintained by the National Drought Mitigation Center (NDMC). Information captured by the impact reporter resides in a database with the ability to run queries by location and time. As of this writing, the NDMC is developing enhancements to improve the ease of data collection and visualizations of drought impact data. An experimental version tailored to the Pacific Northwest is now available.

## **Drought Planning and Response Actions**

This chapter discusses resources and methods to improve the state's resiliency before a drought, which can also be described as mitigation, and actions to reduce adverse effects during drought. Sectors identified as potentially vulnerable to drought are targeted individually. Multi-sector actions benefit more than one high-risk sector. These sectors include:

- Agriculture
- Energy
- Fish and wildlife
- Groundwater
- Public water supplies
- Recreation

This plan focuses on state mitigation and response on those impacts which are directly related to water supply, consistent with Washington's legislative definition of drought. It does not address non-water supply-related impacts.

## **Multi-Sector Resiliency Actions**

### **Water Management**

The essential framework of *first in time, first in right*, which has been in place since the late 1800s in Washington State, still determines who gets water in drought years. Junior water users – both instream and out-of-stream – are most at risk of not receiving their full water supply in drought years. The consequences of losing access to a water supply in water-short years can be severe to users, communities, and the environment. Over the decades, the Washington State Legislature has supported various initiatives to improve water supply reliability for all users. A comprehensive listing of such measures is beyond the scope of this plan, but a few especially relevant actions are discussed below.

### **Columbia River Water Supply**

Ecology's Office of the Columbia River is charged with seeking out new water supplies for both instream and out-of-stream purposes. Created following the 2006 passage of the Columbia River

Water Management Act (Chapter 90.90 RCW), the Office of the Columbia River is tasked with six directives:

- Find sources of water supply for pending water right applications (RCW 90.90.020(3)(b)).
- Develop water sources for new municipal, domestic, industrial, and irrigation water needs within the Columbia River Basin (RCW 90.90.020(3)(d)).
- Issue supply and demand reports (RCW 90.90.040(3)).
- Secure alternatives to groundwater for agricultural users in the Odessa subarea aquifer (RCW 90.90.020(3)(a)).
- Find a new, uninterruptible supply of water for the holders of interruptible water rights on the Columbia River mainstem (RCW 90.90.020(3)(c)).
- Develop water supplies for instream and out-of-stream uses (RCW 90.90.020(1)(a)(ii)).

The same legislation set up the Columbia River Basin Development Account and provided \$200 million in funding. As of January 1, 2016, the Office of the Columbia River has added almost 376,000 acre-feet of water to eastern Washington's water supply at a cost of \$506 per acre-foot. Another 320,000 acre-feet of water will be made available in the near-term. More water supply is under long-term development tied to future demand projections.

### **Lake Roosevelt Incremental Storage Releases**

The Lake Roosevelt Incremental Storage Releases Project is based upon an agreement among the State and Federal government and affected Indian Tribes. It enables Reclamation to release more water to provide for drought relief, municipal and industrial supply, replacement of groundwater use in the Odessa Subarea, and enhanced streamflows for fish, using Reclamation's Grand Coulee Dam storage right (6.4 million acre-feet). In drought years, 132,500 acre-feet would be released to serve the above uses, provide another 50,000 acre-feet for stream flows, and supply water to interruptible water right holders on the Columbia River Mainstem.

### **Yakima Integrated Plan**

The Yakima Integrated Plan is a nationally significant watershed enhancement proposal for the Yakima Basin which, when completed, will substantially reduce drought vulnerability in the Yakima Basin. Details and supporting documentation for the plan are available from Reclamation and Ecology websites<sup>4</sup>. The plan includes seven elements:

- Fish passage at existing dams
- Structural and operational changes
- Surface water storage
- Groundwater storage
- Habitat protection and enhancement

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<sup>4</sup> Information about the Yakima Integrated Plan can be found on Ecology's website at <https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-supply-projects-EW/Yakima-River-Basin-projects/Yakima-integrated-plan> and on Reclamation's website at <https://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/>.



- Enhanced water conservation
- Market-based reallocation

The total cost of all actions in the plan is estimated to be approximately \$4 billion. Funding is subject to further review and authorizations at the Federal, state, and local levels. If funded, the actions would be carried out over a period of approximately 15 to 20 years in distinct phases. Additional storage and efficiency measures would ensure that junior irrigation districts receive at least 70 percent of their normal water supply, even in drought years.

### *Support for local drought contingency plans*

Local governments may prepare their own drought contingency plans. Support for local drought planning is made available by both state (via the State Conservation Commission) and Federal funding (Reclamation's WaterSMART Drought Response Program). Local entities that plan for drought are better positioned to cope with drought impacts, and better able to prioritize and seek state support of drought mitigation and response investments.

### *Water storage*

To address long-term water demands and the impacts of climate change, the state should evaluate opportunities for new water storage. Additional storage may take the form of:

- Large new reservoirs
- Smaller off-channel storage reservoirs
- Enhancing storage at existing reservoirs
- Aquifer storage
- Adopting development standards which preserve and enhance the infiltration of surface runoff into groundwater supplies

This analysis is already underway in the Columbia Basin, under the leadership of the Office of Columbia River, in cooperation with Federal, state, and local governments and major water users. Replicating this approach on the west side of the Cascades is a large public policy question that is beyond the scope of this plan, doing so would provide more financial and analytical support for water supply resiliency projects in west-side watersheds.

## **Technical assistance**

### **Washington State Conservation Commission and Conservation Districts**

The Washington State Conservation Commission (SCC) is the coordinating state agency for all 45 conservation districts in Washington State. Together, the SCC and conservation districts provide voluntary, incentive-based programs that support private landowner efforts to implement conservation on their property.

The SCC was created by the legislature in 1939 (RCW 89.08.070) to support conservation districts through financial and technical assistance; administrative and operational oversight; program coordination; and promotion of district activities and services.

Conservation districts<sup>5</sup> offer direct technical assistance to landowners and land operators. Districts offer a range of voluntary services, including assistance with irrigation water management, irrigation efficiency, fish barrier removals, erosion control, habitat restoration, manure management, wildfire prevention/mitigation, stormwater management, forest plans, noxious weed control, livestock stream crossings, and more. This information mitigates the impacts of drought through improved soil moisture retention and reduced water demand.

## **Technical Resources for Engineering Efficiency**

Ecology's Technical Resources for Engineering Efficiency team consists of Ecology scientists and engineers with expertise in industrial processes and pollution prevention. The team provides a free service to Washington businesses and organizations. Through research, process modeling, benchmarking best practices, and engineering analysis, the team determines the potential cost savings of reducing resource use and waste, including water waste. The team documents the opportunities and potential benefits in a report, which they present to the client.

## **Funding Programs**

### **Irrigation Efficiencies Grant Program**

Ecology works in collaboration with the State Conservation Commission to enable irrigators to meet water demand while using less water, leaving more water in-stream for the benefit of fish. The Irrigation Efficiencies Grant Program targets over-appropriated tributaries in the 16 Salmon Critical Basins and other basins where conflicts between instream and out-of-stream needs can be mitigated with a reduction in the demand for irrigation water diversion. As of December 2016, the program has enhanced streamflow in targeted tributaries by a cumulative total of 65 cubic feet per second, with 16,130 acre-feet of saved water.

### **WaterSMART Program**

WaterSMART is the Department of the Interior's sustainable water initiative that uses the best available science to improve water conservation and help water resource managers identify strategies to narrow the gap between supply and demand.

Programs within WaterSMART include:

- Through the Drought Response Program, Reclamation provides financial assistance to states, tribes, irrigation and water districts and other local entities for the development of drought contingency plans, and implementation of Drought Resiliency Projects, including infrastructure improvements to increase flexibility during drought.
- WaterSMART Grants provides financial assistance to construct infrastructure improvements to conserve water and increase efficiency, increase the production of

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<sup>5</sup> See map: <http://scc.wa.gov/conservation-district-map/>

hydropower, and improve water management to mitigate the risk of conflicts over water and increase water supply reliability in the western United States.

- The Cooperative Watershed Management Program provides funding for watershed groups to encourage diverse stakeholders to form local groups to address their water management needs.

## **Multi-Sector Response Actions**

### **Financial Assistance – Grants and Loans**

The State Legislature historically has appropriated money for the distribution of grants and loans during drought emergencies. These appropriations may be provisioned to ensure that money is distributed equitably across various sectors, prioritizes certain sectors, or establishes eligibility criteria.

### **Water Management**

The State Legislature has defined the primary goal of emergency drought response as: “To provide emergency powers to the Department of Ecology to enable it to take actions, in a timely and expeditious manner, that are designed to alleviate hardships and reduce burdens on various water users and uses arising from drought conditions.” To accomplish this goal, Ecology is empowered to authorize emergency withdrawals and water right transfers and, when funded, to provide emergency grants and loans.

#### *Water right curtailment and enforcement actions*

Enforcement of the water right priority system is a major workload during low-water and drought years. Ecology’s regional offices proceed to curtail after first giving affected water users notification that curtailment is likely. This notification is followed up by more formal requests to cease withdrawals and diversions and, if necessary, formal orders to do so. In some basins, where curtailment is tied to enforcement of an instream flow rule, Ecology provides a toll-free hotline for users to call in each day to determine whether they may divert water that day, or whether regulation is still in effect.

#### *Expedited water right permitting*

Under an emergency drought declaration, Ecology is authorized to issue emergency drought permits to water right holders if their water supply is likely to be below 75 percent of normal and they are at risk of experiencing hardship. Emergency drought permits may only be issued for a previously established use within a geographic area declared to be in drought. Not all water users and uses will suffer hardship in a drought-declared watershed. Thus, a determination that the applicant’s water supply is below 75 percent of normal and that he or she anticipates or already experiences hardship must be made before an application is approved. Emergency drought permits must also be issued in conformance with the criteria specified in WAC 173-166.

Applicants might request an alternate point of groundwater withdrawal or surface water diversion to compensate for loss of surface water supply, or temporary transfers of a water right to another user.

### *Yakima Basin Water Transfer Working Group*

Speed, certainty, and convenience are important factors for drought-year water right transfers. In the Yakima Basin, the Water Transfer Working Group is a voluntary team of agencies and water users that meet to provide technical review of proposed water right transfers in the Yakima Basin. The Water Transfer Working Group uses a predetermined set of rules tailored to the Yakima River Basin that are intended to protect other water rights to the Yakima River and tributary streams. Prospective water users submit water right transfer proposals to the group for their review, and the process guides applicants to those types of water right changes and transfers that more expeditiously gain approval from the state.

### *Leasing of Water Rights*

To reduce the impact of low instream flows on fishery populations, Ecology may temporarily lease water from irrigators if funding is available. Leasing activity is focused on streams where there is a high fishery value and where senior water rights are available that would not be subject to curtailment.

Water right leasing in the past has shown that efforts are more effective at addressing drought conditions if invitations for leasing are made well before the leasing period. For example, in 2015, late-summer leases in the Dungeness Basin – which allowed irrigators time to consider their options – were more successful than earlier-season leasing attempts in the Yakima Basin.

Competition for water is greater during drought years. High water prices limit the volume of water that can be successfully purchased using state funds.

Executing a single-season leasing program requires several actions:

- 1) Determination of the State's willingness and ability to pay
- 2) Identifying basins for leasing activity
- 3) Determining which entity should take the lead in reaching out to individual irrigators
- 4) Holding public workshops to educate users about leasing opportunities
- 5) Publishing a notice of invitation to bid
- 6) Review of bid offers to determine if the water rights meets the State's suitability criteria
- 7) Additional rounds of invitation to bid, if necessary
- 8) Negotiating and drafting lease contracts
- 9) Ensuring that lessees remain in compliance with the terms of the lease (e.g., by forgoing irrigation)

Leasing may be more effective where water users have had time to become familiar with how leasing works, as well as develop trust with the non-governmental organizations who typically facilitate such transactions.

## Education

When drought is declared, state agencies may schedule community workshops to inform and educate community members about expected drought impacts and opportunities to obtain financial or permitting assistance from the State (see communications plan in Appendix G).

## Prioritization of Resiliency and Response Actions

Table 2 summarizes vulnerabilities and resiliency and response actions. This information is organized according to whether the actions applies across multiple sectors or whether it applies to a particular high-risk sector. The table also indicates whether the action is mandatory (i.e., required by statute or rule) or contingent upon additional funding (currently, there are no permanent drought contingency funds). The table also indicates whether the action occurs in the Advisory or Emergency Phase (or both), and whether the action is ongoing (not limited to drought events). A “P” indicates that the action is considered to provide high value in reducing the drought vulnerability of the sector. Actions that are effective in reducing drought vulnerability are also likely to be effective in reducing vulnerability to the effects of climate change. In a drought event for which sufficient drought response funds are not available, legislatively prescribed mandatory actions will be prioritized, even to the exclusion of other actions that may also provide high value in reducing drought vulnerability.

**Table 2. Multi-sector drought actions**

| Action  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
|---|---------------------|----------|-----------|----------------------------------|
| Financial Assistance (Grants and Loans)         | CP                  |          | X         |                                  |
| Water Right Curtailment and Enforcement Actions | MP                  | X        | X         | X                                |
| Expedited Water Right Permitting                | MP                  |          | X         |                                  |
| Yakima Basin Water Transfer Working Group       | P                   | X        | X         | X                                |
| Leasing of Water Rights                         | PC                  |          | X         |                                  |
| Education                                       | C                   |          |           |                                  |

### Prioritization Codes:

M = Mandated in times of Drought Emergency

C = Contingent on supplemental drought Funding

P = Considered High Value for Reducing Vulnerability to Drought Conditions

## *Prioritization in High-risk Sectors*

### **Agriculture**

The agricultural sector is subject to the following vulnerabilities:

- A large portion of the state's agricultural production is in the Yakima Valley, where irrigation is necessary for nearly all crops and post-1905 water rights are proratable in low water years.
- Areas where farmers rely on rain to water crops or support foraging have little or no recourse when the rain doesn't come. If forced to purchase feed to support livestock, they must also pay premium prices, as demand is high.
- Fruit trees, particularly apples, need reliable water supplies, or the tree itself is lost, as well as the year's crop. This results in costs from the removal of dead trees, purchase and planting of new trees, and years of lost revenue waiting for new trees to mature and bear fruit.
- Potatoes are a high-water -demand crop and a top producer of agricultural profits in four counties.
- Berries with inadequate water produce fewer and smaller fruit with reduced quality. Many farmers during the 2015 drought experienced reduced production, of lesser quality, with higher expense.
- Nursery stock growers may be challenged to keep plants healthy, while the market for the plants falls dramatically
- Growers also report higher costs for pest and weed control.

The following are actions that can assist those in the agricultural sector in improving drought resiliency.

#### **Ongoing resiliency actions:**

- The Washington State Conservation Commission is the leading entity for supporting the adoption of farm-related irrigation efficiency tools.
- Environmental Quality Incentives Program (EQIP) (Landowner): The Natural Resources Conservation Service (NRCS) provides conservation assistance to participating farm operations on an annual basis. Several different programs can assist farm operations with installing water-efficient irrigation methods for crops or Firewise-friendly irrigated hedgerows.
- Irrigation Water Management Plans: As an approved Technical Service Provider for NRCS, a conservation district could assist irrigators develop Irrigation Water Management Plans as a component of EQIP contracts.

## Response actions:

- Livestock Forage Program (Federal program): Producers who own or lease grazing land in a county rated by the U.S. Drought Monitor as having severe drought (D2) conditions for eight consecutive weeks during the normal grazing period are eligible to receive assistance equal to one monthly payment. Increasing drought intensity on the drought monitor triggers eligibility for additional payments. An eligibility tool for qualifying is available through <http://droughtmonitor.unl.edu/fsa/Home.aspx>.
- Emergency Loan Program (Federal program): This program provides emergency loans to assist producers in recovering from production losses due to drought. These funds can be used to repair or restore property, payment of some production losses, and refinance debts. Producers become eligible for emergency loans when they operate in a county declared a disaster area or a contiguous county and have suffered at least a 30 percent loss in production.
- Tree Assistance Program (Federal program): This program aids orchardists and nursery tree growers to replant or rehabilitate trees, bushes, or vines lost from drought. Commercially produced crops are eligible for this program, except for trees used for pulp or timber. Trees must have suffered at least 15 percent mortality to become eligible. Losses must be visually observed by an FSA agent and cannot be preventable by reasonable and available means. Producers must replace the trees, bushes, or vines within one year from application approval.

## Energy

The energy sector is subject to the following vulnerabilities:

- Reduced volume of streamflow and reservoir storage due to drought reduces hydropower generation.
- Ordered spill rates for fish flows can have a large impact on the water available for power generation.

Table 3 shows the resiliency and response actions that can assist the energy sector in preparing for and adapting to drought.

**Table 3. Resiliency and response actions for the energy sector. Lead Agency – Department of Commerce**

| Actions   | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
|---|---------------------|----------|-----------|----------------------------------|
| <b>Resiliency Actions</b>   |                     |          |           |                                  |
| The Pacific Northwest power system mitigates drought risk by assuming that every year is a drought year, for resource planning purposes. RCW 19.280 requires all state electric utilities to maintain plans that forecast future load, identify resource options, and detail power costs and resource management. | P                   |          |           | X                                |
| The Pacific Northwest Coordination Agreement provides the framework for managing the region's hydropower resources.   | P                   |          |           | X                                |
| The Northwest Power Pool Reserve Sharing Program establishes requirements for maintaining operating reserves and providing reserves to other participants in the power pool (Northwest Power Planning Council Reserve Sharing Program, 2017).   | P                   |          |           | X                                |
| Standards for determining adequate capacity for long-term planning are a matter of common practice (Pacific Northwest Utilities Coordinating Committee, 2010).  | P                   |          |           | X                                |
| The regional power council has a resource adequacy standard. Although it is not binding on individual utilities, most utilities consider it to be a useful guideline that provides a floor for their own reliability standards (Northwest Planning and Conservation Council, 2011).                               | P                   |          |           | X                                |



| Response Actions  |                     |          |           |                                  |
|---|---------------------|----------|-----------|----------------------------------|
| Actions   | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Governor may declare an Energy Supply Alert or an Energy Emergency, which convenes the Joint Committee on Energy Supply and Energy Conservation | P                   |          | X         |                                  |

## Fisheries

### *Fish in Nature*

Fish inhabiting rivers, streams, and lakes in the region are subject to the following vulnerabilities:

- Low flows expose physical blockages to migration and can strand migrants in dewatered stream segments.
- Low flows or reservoir levels shrink habitat, causing crowding, low dissolved oxygen, disease, less food available, and higher mortality of juvenile and adult fish.
- High stream temperatures, due to low flow and/or higher air temperatures, can kill fish and create thermal blockages, which upstream migrants will not pass.
- Low flows reduce riffle depth or dry up stream reaches, preventing upstream migrants from entering streams or reaching normal spawning grounds.
- Low flows shrink spawning habitats, leading to low egg survival.
- Reservoir outflows can be curtailed by drought conditions, causing low-flow problems downstream

Table 4 shows the resiliency and response actions that can be taken to protect fish in natural settings during drought.

**Table 4. Resiliency and response actions to protect fish in nature. Lead Agency – Department of Fish and Wildlife**

| <b>Actions</b>   | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|--|----------------------------|-----------------|------------------|---|
| <b>Resiliency Actions</b>  |                            |                 |                  |   |
| Work with water managers on controlled streams to assure adequate consideration is given to fish needs. Develop written agreements that will minimize water-use conflicts and become incorporated into provisions determining project operations. For example, most FERC licenses include provisions for maintaining instream flows and enabling resource managers to advise project operators during drought years. | P                          | X               | X                | X                                       |
| Use the Hydraulic Project Approval (HPA) permitting authority to ensure that projects in or near the water are designed to protect fish.   | P                          |                 |                  | X                                       |
| <p>Purchase water rights to restore flows in critical areas with flow-limited fish habitat.</p> <p>Operate the state's hatchery system to support harvestable fisheries and preserve wild stocks.</p> <p>Remove long-standing fish-passage barriers to prime spawning and rearing habitat to improve resiliency.</p>   | P                          |                 |                  | X                                       |
| Set instream flow levels into administrative rule. Although instream flows do not put water back into the stream, they do protect existing flows from future appropriation for new uses, and from impairment from changes to existing water rights.  | P                          |                 |                  |   |

| Response Actions  |                     |          |           |                                  |
|---|---------------------|----------|-----------|----------------------------------|
| Actions   | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Work with water managers in highly diverted systems to develop coordinated pulse flow programs that provide temporarily adequate flows for upstream migration.        | P                   | X        | X         |                                  |
| Monitor for temperatures, blockages, and passage issues, including recreational rock dams, which can impede fish passage.   | P                   | X        | X         |                                  |
| Augment stream flows (or pulse flows) through acquisitions, temporary source exchanges, or leases and/or transfers of surface and groundwater rights.                 | P                   | X        | X         |                                  |
| Implement signage and outreach at recreation sites to prevent construction of rock dams for recreation and to alert recreational users to the needs of stressed fish. | P                   | X        | X         |                                  |
| Implement rescue operations to relocate fish from lakes and reservoirs suffering poor water quality or barrier issues.  | P                   |          |           |                                  |
| Prioritize drought-related HPA applications.  | PM                  |          |           |                                  |
| Implement emergency closures or restrictions on HPAs already issued (through permit modifications) as needed to protect fish  | P                   |          |           |                                  |
| Implement emergency rules closing or restricting pamphlet HPA activities as needed to protect fish.   | P                   |          |           |                                  |

| Response Actions   |                     |          |           |                                  |
|--|---------------------|----------|-----------|----------------------------------|
| Actions  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Assess and implement temporary changes to the Hydraulic Project Approval (HPA) permit program consistent with the provisions of RCW 43.83B.410 in order to adequately protect fish life under drought-related emergency conditions | P                   |          |           |                                  |

### *Hatchery Fish*

Table 5 shows the actions that can be taken to protect fish in hatcheries in the region during drought.

**Table 5. Resiliency and response actions to protect fish in hatcheries. Lead Agency – Department of Fish and Wildlife**

| Actions  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
|--|---------------------|----------|-----------|----------------------------------|
| Resiliency Actions   |                     |          |           |                                  |
| Prioritize improvements for hatcheries most vulnerable to drought, such as modifying intake systems, installing chillers, or putting in back-up wells. | P                   |          |           | X                                |
| Modify fishways to efficiently pass fish during low flow conditions  | P                   |          |           | X                                |
| Response Actions   |                     |          |           |                                  |

| <b>Actions</b>  | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|---|----------------------------|-----------------|------------------|---|
| Monitor for and respond to disease problems as they occur. Agency fish pathology experts should frequently consult with individual hatchery personnel to address such problems. | P                          |                 | X                |   |
| Manage dissolved oxygen levels in holding and rearing ponds with the use of bottled gas, oxygen generator systems, or mechanical aeration.                                      | P                          |                 | X                |   |
| Hatchery water supplies may need to be modified, or alternative water supplies employed, to provide adequate water supply and/or maintain adequate water quality.               | P                          |                 | X                |   |
| Fish may need to be released earlier or relocated to safe havens.   | P                          |                 | X                |   |
| Modify stream channels or make use of temporary fish collection weirs as needed to ensure fish passage to hatcheries and adequate broodstock collection.                        | P                          |                 | X                |   |

### **Terrestrial Wildlife**

Table 6 shows the actions that can be taken to protect fish in hatcheries in the region.

**Table 6. Resiliency and response actions to protect terrestrial wildlife. Lead Agency - Department of Fish and Wildlife**

| <b>Actions</b>   | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|--|----------------------------|-----------------|------------------|---|
| <b>Resiliency Actions</b>                                      |                            |                 |                  |   |
| Protect riparian ecosystems through Forest Practice Approvals. | P                          |                 |                  | X                                       |

| <b>Actions</b>  | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|---|----------------------------|-----------------|------------------|---|
| Prioritize habitat for protection and restoration, and encouraging development away from ecologically sensitive or vulnerable areas through watershed characterization and the Priority Habitats and Species Program.   | P                          |                 |                  | X                                       |
| Negotiate mitigation and settlement agreements for energy projects to benefit natural resources.  | P                          |                 |                  | X                                       |
| Prioritize and implement programs to sustain wildlife and protect public and private property.  | P                          |                 |                  | X                                       |
| Set instream flow levels into administrative rule.  | P                          |                 |                  | X                                       |
| <b>Response Actions</b>   |                            |                 |                  |   |
| Increase capability to capture and relocate dangerous wildlife that may come near the public in search of food or water, or to flee wildfires.  | P                          |                 |                  |   |
| Manage Wildlife Areas to provide additional forage for wildlife as necessary, such as reducing grazing leases, especially on winter range.  | P                          |                 |                  |   |
| Implement an emergency winter feeding program when necessary to ensure survival of wildlife.  | P                          |                 |                  |   |
| Close facilities as needed to protect wildlife or reduce fire danger.   | P                          |                 |                  |   |
| Work with landowners and local governments to prioritize and implement actions to protect water sources for fish and wildlife, including:<br><br>Construct fences and other exclusion structures to restrict wildlife access in selected areas where property damage is likely. | P                          |                 |                  |   |

| <b>Actions</b>   | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|--|----------------------------|-----------------|------------------|---|
| Where needed, temporarily impound or divert water to critical habitats or to upland watering devices.<br><br>Protect natural water sources by fencing and other infrastructure, such as piping and stock tanks, to provide water while preventing damage to riparian habitats. |                            |                 |                  |   |

### **Public Water Supplies**

Public water systems are generally designed and operated to avoid water shortages. However, water systems with certain characteristics may be more vulnerable. These characteristics include:

- Water systems dependent on a single source (i.e., no backup)
- Water systems dependent on shallow wells and unable to draw from deeper levels of declining aquifers.
- Water systems dependent on aging well construction and appurtenant equipment
- Water systems with excessive system leakage
- Water system with low operational capacity (the ability to pump at rates that match higher demand)
- Water systems that lack system redundancy
- Water systems with water quality treatment concerns

Table 7 shows the actions that can be taken to protect public water supplies in the region.

**Table 7. High risk Sector: Public Water Supplies. Lead Agency – Department of Health**

| <b>Actions</b>  | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|---|----------------------------|-----------------|------------------|---|
| <b>Resiliency Actions</b>   |                            |                 |                  |   |
| Assist utilities in their planning prior to realizing drought impacts (WAC 246-290-100 and -105).                     |                            |                 |                  |   |
| Ensure the consumer metering requirement is met and leakage is evaluated and addressed per rule (WAC 246-290 Part 8). |                            |                 |                  |   |



| Response Actions   |                     |          |           |                                  |
|--|---------------------|----------|-----------|----------------------------------|
| Actions  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Map at-risk areas for identify where at-risk water systems are located to enable targeted communications based on level of risk of drought.                            | M                   | X        |           |                                  |
| Survey large and medium water systems (>20,000) in anticipation of a drought declaration to assess existing conditions, drought preparedness, and response capability. | P                   |          |           |                                  |
| Establish regional operations contacts for addressing drought questions from water purveyors.  | P                   | X        |           |                                  |
| Create and distribute drought related technical assistance and publications targeted to water system size and level of risk.   | P                   | X        | X         |                                  |
| Coordinate with local health jurisdictions on Group B and private water system issues and concerns.  | P                   | X        |           |                                  |
| Develop and maintain a list of suppliers for trucked water.  | C                   |          |           |                                  |
| Respond to phone calls, emails, and requests for information from the public.  | M                   |          |           |                                  |
| Develop an action plan for Health's Office of Drinking Water response to water systems during the drought.   | P                   | X        |           |                                  |

| Response Actions   |                     |          |           |                                  |
|--|---------------------|----------|-----------|----------------------------------|
| Actions  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Proactively communicate with utilities in drought-sensitive water sources or locations when a drought is declared, including filling raw water reservoirs, and monitoring groundwater withdrawal and drawdown.   | P                   |          |           |                                  |
| Provide technical assistance to Ecology by evaluating requests for relief by public water systems, including emergency grant applications, temporary water rights transfers, and action on new water rights.   | P                   |          | X         | X                                |
| Provide direct technical assistance to water systems that are dealing with immediate impacts from drought conditions (i.e., emergency water supplies, broken water mains, trucked water, and emergency interties).   | M                   | X        | X         |                                  |
| Assist water system with access to emergency funding and grant applications. Offer technical and financial assistance through our emergency Salmon Recovery Fund loans to fund infrastructure improvements, such as deepening an existing well, rehabilitating an inactive source, constructing an intertie with an adjacent utility.                          | PM                  | X        | X         | X                                |
| Request Ecology prioritize review and decision making on drought response water right applications (emergency, temporary, or permanent) (i.e., write a Hillis letter; see WAC 173-152-050).  | P                   | X        | X         | X                                |
| The USDA can support municipal water system in emergency or disaster recovery scenarios, if needed (Federal program, but state can assist applicants.) See <a href="http://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index">http://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index</a> for more information. |                     | X        | X         |                                  |

| Response Actions   |                     |          |           |                                  |
|--|---------------------|----------|-----------|----------------------------------|
| Actions  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Consult with Ecology and the Governor's Office on anticipated impacts to public water systems.   | P                   |          | X         | X                                |
| Map at-risk areas to identify where at-risk water systems are located to enable targeted communications based on level of risk of drought.                             | M                   | X        |           |                                  |
| Survey large and medium water systems (>20,000) in anticipation of a drought declaration to assess existing conditions, drought preparedness, and response capability. | P                   | X        |           |                                  |
| Establish regional operations contacts for addressing drought questions from water purveyors.  | P                   | X        | X         |                                  |
| Create and distribute drought-related technical assistance and publications targeted to water system size and level of risk.   |                     | X        |           |                                  |
| Coordinate with local health jurisdictions on Group B and private water system issues and concerns.  |                     | X        |           | X                                |
| Develop and maintain a list of suppliers for trucked water.  | C                   |          |           |                                  |
| Respond to phone calls, emails, and requests for information from the public.  | MP                  |          |           |                                  |
| Develop an action plan for the Department of Health's Office of Drinking Water response to water systems during the drought.   |                     |          |           |                                  |

| Response Actions   |                     |          |           |                                  |
|--|---------------------|----------|-----------|----------------------------------|
| Actions  | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
| Proactively communicate with utilities in drought-sensitive locations or with drought-sensitive sources when Ecology and the Governor declare drought, including filling raw water reservoirs and monitoring groundwater withdrawal and drawdown |                     |          |           |                                  |

## Recreation

The recreation sector in the region are subject to the following vulnerabilities:

- Low snowpack can render areas unsuitable for skiing, snowboarding, snow-showing, snowmobiling and other forms of winter recreation.
- Low flows can render rivers and streams unsuitable for whitewater kayaking, rafting and canoeing.
- Low reservoir levels can strand boat ramps, making the reservoir inaccessible for flatwater boating.

Table 8 shows actions that can be taken to protect the recreation sector.

**Table 8. High Risk Sector: Recreation.**

| Actions            | Prioritization Code | Advisory | Emergency | Ongoing Action (outside drought) |
|--------------------|---------------------|----------|-----------|----------------------------------|
| Resiliency Actions |                     |          |           |                                  |

| <b>Actions</b>   | <b>Prioritization Code</b> | <b>Advisory</b> | <b>Emergency</b> | <b>Ongoing Action (outside drought)</b> |
|--|----------------------------|-----------------|------------------|---|
| Some ski resorts are diversifying their operations to include revenue-generating activities in the summer (e.g., mountain biking, summer concerts, waterslides, etc.)  |                            |                 |                  | X                                       |
| <b>Response Actions</b>  |                            |                 |                  |   |
| Boat launch modifications: Extreme low-water conditions can trigger the need to extend boat launches to keep them open. In some cases, gravel and rock berms that are created by repeated boat retrievals must be removed to keep a ramp open.   |                            |                 | X                |   |
| Downhill ski resorts and river guide services are private enterprises and generally not eligible for state funding. They may be eligible for Non-Agricultural Economic Injury Loans issued by the Federal Small Business Administration.<br><br>Snowmaking machines can compensate for the lack of snow, but their effectiveness is diminished in warm winters. Another strategy is to use machinery to concentrate snow where ski runs need it. |                            |                 |                  |   |
| WDFW has used drought funding in the past to maintain access to fishing opportunities, such as extending boat ramps in drawn-down reservoirs, and issuing closures to fishing activity to preserve fishing opportunities in the long run.  |                            |                 | X                |   |
| Access to state lands for recreational purposes when drought condition raise wildfire risk is overseen by the Department of Natural Resources.   | P                          | X               | X                |   |

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# Appendices

## Appendix A. Drought Monitoring and Forecasting

### Drought monitoring indicators

The simplest definition of drought is, “insufficient water to meet needs” (Redmond 2002), but ultimately, drought can be defined in different ways depending on the impacts experienced. For example, drought can influence water supply and quality, stream habitats, forest health, and hydropower generation. Many indices of varying complexity have been developed, some which rely solely on meteorological conditions, while others include hydrological information such as soil moisture. Different indices reflect different meteorological and hydrologic properties and it is therefore recommended that multiple drought indices be used to characterize droughts and their potential impacts (Heim 2002).

While Washington State’s formal definition of drought is based on water supply, consideration of multiple drought indicators can provide complementary information and a more comprehensive perspective on the state of the system. This section summarizes some of the most relevant drought indicators in the region and highlights during what stage of drought (i.e., onset, existing, and the end) each indicator is most suitable. A more comprehensive list of drought indicators can be found in the Handbook of Drought Indicators and Indices by the World Meteorological Organization and Global Water Partnership (2016), although their utility for the Pacific Northwest is not explored.

Most of the drought indicators described below use multiple variables in their definition, but there are several stand-alone variables that are useful for assessing drought conditions. The state’s Water Supply Availability Committee (WSAC) already uses many of these to monitor drought monthly. For example, the average temperature departure from normal, percent of normal precipitation, and streamflow percentiles are commonly assessed and can be determined for multiple time scales. Ideally, the period of normal precipitation is at least 30 years long. At the time of this writing, the official National Oceanic and Atmospheric Administration (NOAA) climatological period is from 1981 to 2010.

Current mountain snowpack conditions in the form of snow-water equivalent (SWE) are also useful during the winter months. Derived quantities, such as the percentage of normal for that particular time of year, or the percentage of peak snowpack, can be useful in assessing the statewide conditions. Another example would be stream temperatures in the spring and summer months, when high temperatures can indicate unfavorable conditions for certain species of fish. These indicators are relatively easy to understand and communicate to others, and are accessible. On the other hand, more sophisticated indicators, as described below, may have the potential to aid in identifying a developing drought sooner, which puts the State in a better position to respond quickly and proactively.

The improvement of sub-seasonal and seasonal weather forecasts has become more of a priority for the weather/climate community. Present research focuses on the potential sources of predictability and the methods for combining various sources of information to produce the best calibrated predictions, including attendant uncertainties.

On sub-seasonal time scales, a cycle on the 30- to 60-day time scale known, as the Madden-Julian Oscillation (MJO), shows considerable promise. The MJO is a tropical phenomenon with remote effects on the higher-latitude circulation that are akin to those associated with El Niño-Southern Oscillation. Experimental forecasts on the time scale of 3 to 4 weeks into the future are now being produced by NOAA's Climate Prediction Center; these forecasts are based on the MJO and extended predictions from operational weather models. Continued development of capabilities on these time scales is indicated in HR 353, "The Weather Forecasting and Innovation Act of 2017," an authorization bill passed by Congress and signed into law in April 2017. Section 201 of this bill is titled "Improving subseasonal and seasonal forecasts." Progress in forecast skill is not expected to be rapid. Still, given the interest and importance of weather predictions on intermediate time scales, it may be possible to anticipate the onset and cessation of droughts with somewhat more lead time in the foreseeable future.

The timing and magnitude of the early fall rains heralding the end of the dry season are matters of substantial concern to many utilities, water managers, and other interests in Washington State. There is considerable variability in the onset of the wet season. For example, September 2012 was the second driest on record, with only 0.16 inches of precipitation in terms of the statewide average; the following September 2013 was the wettest on record, with 5.60 inches. Wetter weather tends to arrive at least by October, but there are notable exceptions, such as October 1987, during which only 0.25 inches (about 7 percent of normal) precipitation occurred statewide. However, there is tentative evidence that seasonal forecasts of precipitation in Washington during fall are especially problematic. The recent track record of forecasts from NOAA's Climate Prediction Center indicates a relative lack of predictability for that time of year.

It is possible that there exist real barriers to forecast skill on seasonal time scales as the atmospheric circulation transitions from its summer to winter regime. Improvements in sub-seasonal forecasts may help during this time of year. Still, a small number of storms make the difference between dry and wet conditions, effectively limiting the ability to anticipate changes in water supplies with much confidence.

The following indicators are grouped by whether they focus on meteorology or hydrology. Within each category, they are listed from simple to more complex. There are also several indicators that are composites or blends that are grouped into a third composite category.

## **Meteorological Indicators**

### ***Standardized Precipitation Index***

The Standardized Precipitation Index (SPI) was first developed in Colorado in the early 1990s as an alternative drought index to the Palmer Drought Severity Index, described below (McKee et al. 1993). The Standardized Precipitation Index is now considered to be the global standard

index to identify meteorological drought by the World Meteorological Organization (Hayes et al. 2011; WMO and GWP 2016).

The index uses only precipitation and requires at least 30 years of complete data, although missing data are allowed (McKee et al. 1993). Precipitation is standardized using the mean and standard deviation over the period of record (McKee et al. 1993), and the probability of occurrence is determined by fitting the data to a Pearson Type III distribution (Guttman 1999).

The index spans values from -4 to 4 to indicate dry and wet periods. A value of -1 usually signifies the beginning of drought and as the index becomes more negative, it indicates increasingly severe and infrequent conditions (McKee et al. 1993).

Strengths of the SPI include the ability to identify dry and wet periods on multiple time scales (weekly to monthly to yearly), ease of use and availability (maps are available at the Western Regional Climate Center<sup>6</sup>), and consistent interpretation throughout the country (Guttman 1998, WMO and GWP 2016). The weaknesses are that the SPI is only a precipitation index, and does not consider temperature, nor does it differentiate precipitation that falls as rain or snow (WMO and GWP 2016).

### *Crop Moisture Index*

Palmer (1968) developed the Crop Moisture Index (CMI) as a response to criticism received about the Palmer Drought Severity Index (discussed below). It is a simple index meant to assess moisture on the short time scales for agricultural interests. It uses temperature and precipitation as inputs and a simple temperature-based estimation of potential evapotranspiration. The index is calculated on a weekly time scale and is the difference between the potential evapotranspiration and the moisture received (WMO and GWP 2016). Weekly maps are available at the Climate Prediction Center.<sup>7</sup>

Since the CMI is a short-term index, it may depict recovery from a long-term drought when, in actuality, long-term deficits persist. In addition, it resets to zero at the beginning of the growing season, and thus ignores multi-year drought (Keyantash and Dracup 2002). It is most effective during the warm season (Heim 2002), and is likely only relevant for non-irrigated agricultural areas of Washington State (e.g., dryland wheat and pastures).

### *Standardized Precipitation Evapotranspiration Index*

The Standardized Precipitation Evapotranspiration Index (SPEI) is a relatively new index that is similar to the SPI, but also includes temperature through estimating potential evapotranspiration (Vicente-Serrano et al. 2010). Like the SPI, the SPEI is available on monthly time scales, but can be calculated for varying time periods (e.g., weekly and daily). It identifies both wet and dry periods and can be compared between different locations.

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<sup>6</sup> SPI: <http://www.wrcc.dri.edu/spi-products/>

<sup>7</sup> CMI: [http://www.cpc.noaa.gov/products/analysis\\_monitoring/regional\\_monitoring/cmi.gif](http://www.cpc.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif)

Since the SPEI includes a temperature component, it is one of the few indices that can be used to identify trends due to a warming climate. In other words, it is one of the few indices that can identify an increase in drought severity in a warmer climate due to higher water demand (Vicente-Serrano et al. 2010).

Monthly maps of SPEI can be found on the WestWide Drought Tracker website.<sup>8</sup> Monthly maps can be considered a weakness, as the SPEI may miss a rapidly developing drought on a shorter time scale. Additionally, maps on the WestWide Drought Tracker site use estimated potential evapotranspiration using only temperature and the Thornthwaite equation (1948), which fails to represent evapotranspiration, as well as more physically explicit calculations (Hobbins et al. 2016). More sophisticated methods of calculating potential evapotranspiration can be used, however, if more input data are available. Finally, the SPEI cannot be calculated if there are missing data, making it less ideal in data-poor regions.

### *Reconnaissance Drought Index*

The Reconnaissance Drought Index (RDI) is based on precipitation, similar to the SPI, but it also includes potential evapotranspiration, making the index more representative of the full water balance (Tsakiris and Vangelis 2005). Ideally, the actual evapotranspiration would be used, since that represents the real system output, but because actual evapotranspiration is rarely measured and is sensitive to local effects, the index relies on pET estimated using temperature and the Thornthwaite equation (1948). These simple estimates based on temperature can be prone to error. Tsakiris and Vangelis (2005) found that the SPI often underestimated drought severity in their case study locations in Europe. However, adding in pET does give a more realistic representation of drought severity.

Like the SPI, the RDI can be calculated on multiple time scales, and the standardized version can be directly compared to the SPI. It is similar to the SPEI in that it uses similar inputs; however, it is calculated differently. While software to calculate the RDI is available,<sup>9</sup> real-time maps do not appear to be publicly available, making it problematic for monitoring conditions in Washington.

### *Palmer Drought Severity Index*

The Palmer Drought Severity Index (PDSI) was developed in the mid-1960s (Palmer 1965) and became the first widely used drought index. The index uses monthly precipitation and temperature as inputs, and then makes assumptions about the water content of the soil and evapotranspiration to compute a water balance. The PDSI is often referred to as a meteorological drought index, but it does reference hydrology and agriculture within its definition (Alley 1984), and has been highlighted for its usefulness in agricultural drought (Guttman 1998).

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<sup>8</sup> SPEI: <http://www.wrcc.dri.edu/wwdt/index.php>

<sup>9</sup> RDI: <http://drinc.ewra.net>



The main strengths of the PDSI are that it has been in use for a long time, has an easily accessible historical record, and is generally well known. There have been many studies that have highlighted its weaknesses, however. The most important shortcoming for application in the Pacific Northwest is that the index does not account for water stored as snow and assumes that precipitation is immediately available. It is therefore unsuitable during periods when snow water storage is important (Zargar et al. 2011). Other criticisms include that it was originally developed for Iowa and Kansas, and thus the assumptions may not be as applicable to the Northwest; that the thresholds for the severity of drought are somewhat arbitrary; and that soil type, soil moisture, and evapotranspiration do not change seasonally or with vegetation (Alley 1984).

It has also been recognized that since the PDSI is based on water balance, it is a long-term index that can lag behind the start of a drought (Guttman 1998). It is therefore not well-suited for identifying the onset or end of a drought. Weekly PDSI maps are available from a number of sources, including NOAA's Climate Prediction Center.<sup>10</sup>

### *Evaporative Demand Drought Index*

The Evaporative Demand Drought Index (EDDI)<sup>11</sup> is a new index that has the potential to identify developing drought conditions sooner than other indicators (Hobbins et al. 2016; McEvoy et al. 2016). The index computes potential evapotranspiration based on the North American Land Data Assimilation System (described below) model input (e.g., air temperature, specific humidity, pressure, solar radiation, wind) data, and is implemented on a 0.125-degree grid across the United States. The potential evapotranspiration computation uses the Penman-Monteith formula, which is a more physically based estimation than using temperature alone (Hobbins et al. 2016). The evaporative demand, or potential evapotranspiration, is then compared to the climatology over the period of interest.

Like many of the other indicators, the EDDI can be computed on weekly to monthly time scales. In addition, the classification scheme is the same as the one used for the U.S. Drought Monitor (described below), with the dry categories ranging from D0 to D4 (Hobbins et al. 2016).

McEvoy et al. (2016) showed that the EDDI identifies drought periods consistent with other indicators, such as the SPI, and has the potential to identify the onset of drought up to 2 months before the U.S. Drought Monitor shows drought conditions. Hobbins et al. (2016) illustrates the characteristics of the index using four example basins (none in Washington State). They showed that the longer-term EDDI calculations (10 to 12 months) were the best at identifying drought in the Upper Colorado Basin and identified drought before it was depicted in the U.S. Drought Monitor.

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<sup>10</sup> PDSI: [http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/regional\\_monitoring/palmer.gif](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif)

<sup>11</sup> EDDI description: [http://wwa.colorado.edu/publications/reports/EDDI\\_2-pager.pdf](http://wwa.colorado.edu/publications/reports/EDDI_2-pager.pdf)

Hobbins et al. (2016) hypothesized that shorter-term, the EDDI did not match the drought conditions as closely because of the snowmelt-dominated hydroclimatology of the basin. In other words, the EDDI would show dry climate anomalies during the snowpack season, while the Drought Monitor may not depict drought until the impacts are seen in the irrigation season, up to 5 months later. Though not tested, this may be the case for Washington, as well: the long-term EDDI may be better suited for the snowmelt basins in Washington, and the short-term version may be better suited for those that are more precipitation-dominated.

The concepts of long-term and short-term have not yet been defined for Washington State because the recent droughts have not been multi-year events. It is worth monitoring this product in the coming years to assess its applicability to Washington State and whether it can be used as an early drought indicator. Since it is a very new product, it has undergone less scrutiny than some of the other indicators. While this is still an experimental product, online maps are produced for Washington State on a weekly basis.<sup>12</sup>

## **Hydrological Indicators**

### *United States Geological Survey streamflow percentiles*

The United States Geological Survey (USGS) monitors streamflow throughout the United States, with more than 300 real-time stream gauges in Washington State. Percentiles of real-time, daily, 7-day average, 14-day average, 28 day-average, and monthly streamflow are available at these stations at USGS.<sup>13</sup> Record length varies at these sites, with many sites having at least a 65-year record. These sites are useful during ongoing drought, particularly during the low-flow summer season, and could potentially be used in determining the end of drought.

### *Palmer Hydrological Drought Index*

The Palmer Hydrological Drought Index (PHDI) is very similar to the Palmer Drought Severity Index (PDSI) and was created as a part of Palmer's drought suite (Palmer 1965). Similar to the PDSI, it uses monthly temperature, precipitation, and default values for the water-holding capacity of the soil as inputs. The difference is that the PHDI is meant to reflect hydrological conditions on longer time scales. In other words, it is slower to end a drought than the PDSI. According to Keyantash and Dracup (2002), "the PDSI considers a drought finished when moisture conditions begin an uninterrupted rise that ultimately erases the water deficit, whereas the PHDI considers a drought ended when the moisture deficit actually vanishes." For this reason, the PHDI may be particularly useful for indicating the end of a drought through its monitoring of the water supply.

Similar to the PDSI, the PHDI lacks a snow component and is therefore unsuitable for locations and times for which the snowpack represents a significant portion of the water supply. Additionally, irrigation and management decisions are not considered in terms of demands

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<sup>12</sup> EDDI: <ftp://ftp.cdc.noaa.gov/Public/mhobbins/EDDI/WADOE/>

<sup>13</sup> Streamflow Percentiles: <https://waterwatch.usgs.gov/index.php?m=real&r=wa&w=map>

(WMO and GWP 2016). Monthly maps of the PHDI are available at the National Centers for Environmental Information.<sup>14</sup>

### *Surface Water Supply Index*

The Surface Water Supply Index (SWSI) resembles the PDSI, with the inclusion of additional data on water supply (snowpack, streamflow, and reservoir data) and precipitation. It is calculated for basins on an individual basis, with the weighting of the different contributions to the water supply specific to the basin (Shafer and Dezman 1982; Doesken et al. 1991).

The SWSI works best in basins that have reservoir storage, which is not the case for every snowpack-dominated basin in Washington. Because the calculations and components vary by basin, it is not advised to make comparisons between regions (WMO and GWP 2016). On the other hand, this index directly accounts for snowpack and was developed with western drought in mind. For that reason, it has predictive capabilities, since hydrologic responses are often lagged in snowmelt-dominated basins (Doesken et al. 1991).

The SWSI is used by other Western states in their drought plans (e.g., Colorado), but is not calculated or available for Washington. It requires long-term and consistent data sets for calibration, but is an index that could be considered for use throughout Washington with additional research.

### *UW Drought Monitoring System for the Pacific Northwest*

The UW Drought Monitoring System for the Pacific Northwest<sup>15</sup> is a near-real-time (1-day lag), model-based system that represents hydrologic conditions throughout the Pacific Northwest, including the Canadian part of the Columbia River Basin. The system ingests meteorological station observations, which are processed and gridded to create a 1/16-degree dataset that is used as input to a macroscale hydrological model (the Variable Infiltration Capacity (VIC) hydrologic model; Liang et al. 1994). The hydrological model then creates daily gridded fields of soil moisture and SWE, which are combined as total moisture. The drought monitor displays these fields as percentiles relative to the same day for the historical period of 1920 to 2010. For example, a percentile value of 80 percent on May 1 means that the current May 1 is wetter than 80 percent of the May 1 days during the 1920-to-2010 period.

The system includes an archive that allows the user to view the percentile maps for other drought years on a monthly time scale. In addition to gridded maps of current soil moisture, total moisture, and SWE, the option exists to view the current calendar-year time series for watersheds throughout the state. A major strength of this tool is that it uses the VIC hydrologic model to fill in gaps where observations are not available, such as soil moisture and SWE, which are not widely observed. On the other hand, shows modeled values and not directly observed data.

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<sup>14</sup> PHDI: <https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/>

<sup>15</sup> UW Drought Monitoring System: [http://www.hydro.washington.edu/forecast/monitor\\_west/index.shtml](http://www.hydro.washington.edu/forecast/monitor_west/index.shtml)

The University of Washington, in collaboration with the University of California-Los Angeles, also operates similar systems for the entire West<sup>16</sup> (at 1/16 degree). Both systems derive from the UW Surface Water Monitor (described in Wood 2008), which since 2004 has produced daily analyses for the entire continental United States,<sup>17</sup> at a coarser resolution of 1/2 degree.

The ability of the system to capture surface water dynamics has been discussed in several studies that have compared historic droughts with their representation in the UW Drought Monitoring Systems. For example, Xiao et al. (2016) used output from the system to examine historical droughts in the Pacific Northwest. Shukla et al. (2011) compared different drought indices (including soil moisture percentiles) and their ability to identify the onset and termination of four major droughts in Washington State relative to recorded drought declarations. In all four droughts (water years 1977, 1989, 2001, and 2005), the products available from the drought monitoring system would have identified drought sooner than drought was declared by the State (Shukla et al. 2011).

## **Composite Indicators**

### *Objective Blends of Drought Indicators*

The U.S. Drought Monitor's Objective Blends of Drought Indicators (OBDI)<sup>18</sup> are weekly products that combine several drought indices into a short-term and a long-term blend:

- The short-term blend includes the PDSI (7 percent), the Palmer Z index (35 percent; essentially a short-term version of the PDSI), observed precipitation for the past month (20 percent) and past 3 months (25 percent), and a soil moisture index from the Climate Prediction Center (13 percent).
- The long-term blend includes the PHDI (25 percent); observed precipitation for the past 6 months (15 percent), 12 months (20 percent), 24 months (20 percent), and 60 months (10 percent); and the Climate Prediction Center's soil moisture index (10 percent).

The blended products are helpful for quickly looking at conditions on the two time scales, with some caveats. The Climate Prediction Center's Soil Moisture Model, for example, is a simple, one-layer hydrologic model that does not include snow, which compromises soil moisture estimates in mountainous regions of the western United States. The rest of the products are precipitation-focused, but do not differentiate between rain and snow, and do not account for soil or snow processes, so caution is warranted for use during the winter months. Finally, the climate division scale of the products is rather coarse for many drought applications.

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<sup>16</sup> West-Wide System: [http://www.hydro.washington.edu/forecast/monitor\\_cali/index.shtml](http://www.hydro.washington.edu/forecast/monitor_cali/index.shtml)

<sup>17</sup> Continental US: <http://hydro.washington.edu/forecast/monitor/>

<sup>18</sup> OBDI: <http://www.cpc.ncep.noaa.gov/products/predictions/tools/edb/droughtblends.php>

## *North American Land Data Assimilation System Soil Moisture*

In the late 1990s, the North American Land Data Assimilation System (NLDAS) began its first phase with four different land surface models (Noah, Mosaic, Variable Infiltration Capacity (VIC), and Sacramento). These land surface models provide information on hydrologic variables that are often sparsely observed (e.g., soil moisture, evaporation, etc.). The models all run on a common 0.125-degree grid and use four-dimensional data assimilation.

The first phase of NLDAS consisted of a 3-year period (1997 to 1999) when model comparisons and model validation were performed (Mitchell et al. 2004). Phase 1 resulted in substantial improvements to both the forcing data and the models.

Phase 2 extended the period to a 29-year retrospective (1979 to 2007; Xia et al. 2012b). As of 2014, the second-generation NLDAS models (NLDAS-2) are operational.

While there are multiple output variables derived from these models, the focus here is on soil moisture due to its applicability to drought. Model output for soil moisture anomalies and percentiles for each model and the average of the four (known as the ensemble) can be found on the NLDAS website.<sup>19</sup> The anomalies are based on a 28-year climatology (1980 to 2007), and maps for the top meter, as well as the total soil column, are available. The upgrades for NLDAS-2 have increased the agreement between the models for all variables, and the seasonal cycle in soil moisture averaged over the Northwest is consistent among each model (Xia et al. 2012a).

There are higher absolute soil moisture values for the Noah and Sacramento models compared to VIC and Mosaic. Examining the differences spatially shows that the biggest disparity between models are in the Cascade and Olympic mountains (Xia et al. 2012a). Therefore, it is important to exercise caution when viewing the mountain values for the state, since there is less agreement and more uncertainty among models. In addition, winter soil moisture anomalies in the mountains (or anywhere else where snow provides significant storage) are unrealistic, since snow is not accounted for in soil moisture anomalies.

Soil moisture anomalies, percentiles, and recent changes can help monitor drought, particularly later in the water year, and can also be useful for determining where drought is more likely to develop, or when it has eased. For example, an area with below-normal soil moisture can cause a feedback loop that exacerbates dry conditions. Dry soils lead to reduced evaporation, resulting in higher ground temperatures and warmer and drier days (Trenberth and Guillemot 1996). A benefit of the NLDAS-2 tool is that the different models are in one location, which emphasizes that these are indeed model simulations (with each having their own biases) and not observed data. Expect model improvements to continue, such as implementation of an improved soil moisture scheme developed by Nearing et al. (2016).

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<sup>19</sup> NLDAS: <http://www.emc.ncep.noaa.gov/mmb/nldas/drought/>

## *U.S. Drought Monitor*

The U.S. Drought Monitor<sup>20</sup> is an operational composite approach to quantifying drought (Svoboda et al. 2002; WMO and GWP 2016). Numerous indicators are considered in producing the weekly product; some examples (e.g., PDSI, weekly streamflow percentiles, and SPI) are shown on their classification webpage,<sup>21</sup> but these are just part of the information considered. One of the strengths of the U.S. Drought Monitor is that it is easily adaptable, with new indicators added as they are shown to be meaningful and become reliable. The process used involves a convergence-of-evidence approach that reflects a consensus of indicators (and impacts) in determining drought intensity.

The primary partners of the U.S. Drought Monitor include the National Drought Mitigation Center, USDA, and NOAA. The National Drought Mitigation Center is currently updating the types of impacts that occur at each drought category for each state (personal communication, Mark Svoboda) with the most valuable indicators being highlighted.

There are four drought categories and one drought watch category, which are tied to percentiles of drought likelihood based on the period of record available. The lowest category –D0 or abnormally dry – is used to show an area where drought may develop or where lingering impacts remain from a drought that is waning. The four drought categories increase in drought intensity from D1 to D4, representing moderate drought, severe drought, extreme drought, and exceptional drought, respectively. For guidance, the percentile chance of each category occurring in any given year in a location is shown in Table A-1.

**Table A-1. Chance of each drought category occurring in any given year at any given location.**

| <b>Drought Category</b> | <b>Likelihood of occurring per year</b> |
|-------------------------|---|
| D0                      | 21-30%                                  |
| D1                      | 11-20%                                  |
| D2                      | 6-10%                                   |
| D3                      | 3-5%                                    |
| D4                      | ≤ 2%                                    |

The final piece of the U.S. Drought Monitor composite is guidance from local, State, and Federal experts that tests the product by providing input (e.g., data, impacts) each week (Svoboda et al.

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<sup>20</sup> USDM: <http://droughtmonitor.unl.edu>

<sup>21</sup> <http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx>

2002). For Washington State, the Office of the Washington State Climatologist leads a weekly call when dry conditions exist to give suggestions based on local conditions. National Weather Service hydrologists from all four offices that cover Washington participate in the call, and occasionally, other local experts such as agricultural specialists participate, as well. In addition, there are short-term and long-term designations used on the maps to indicate the time scale of the drought conditions.

The U.S. Drought Monitor is a highly visible product that is often quoted by the media to describe the extent of drought conditions for a region. This could be perceived as both a benefit and a weakness. Since the U.S. Drought Monitor depicts different types of drought (such as agricultural, hydrologic, meteorological) and the state's definition is focused on water supply, there often can be a mismatch between the conditions depicted and whether the state has declared drought. This can lead to confusion, especially when the detailed nuances are not communicated.

While the U.S. Drought Monitor does not trigger State action, it can activate Federal financial assistance during grazing periods, according to the 2014 Farm Bill. Assistance is activated when a county is designated at a D2 level or worse for 8 consecutive weeks.

Another benefit that can also be interpreted as a weakness is the multiple indicators used to produce the map. While the convergence of indicators strengthens the drought depiction, some may find that the variety of indicators contributes to a lack of transparency about the relative weighting of the indicators used. There is a weekly narrative that accompanies the U.S. Drought Monitor map, however, which often explains the indicators that were relied upon for adjustments.

Lastly, the U.S. Drought Monitor is a monitoring tool, not a forecast tool, so it cannot be used to identify the onset of drought ahead of time. On the other hand, it may be possible to use it to help determine when to end a state drought declaration.

### **Strengths and Weaknesses of Drought Indicators**

The following three tables (Tables A-2, A-3, and A-4) summarize the topics discussed in the previous section and list the strengths and weaknesses of each indicator, as well as which stage of drought (i.e., onset, existing, end) the indicator is most useful for.

**Table A-2. Strengths and weaknesses of meteorological drought indicators**

| <b>Indicator</b>                                    | <b>Stage of Drought</b> | <b>Strengths</b>   | <b>Weaknesses</b>  |
|---|-------------------------|--|--|
| Standardized Precipitation Index                    | Existing                | Easily accessible; comparable across locations; calculated for multiple time scales  | Based only on precipitation; does not differentiate between rain or snow   |
| Crop Moisture Index                                 | Existing                | Weekly maps easily accessible; agriculture focused (non-irrigated)   | Only measures short-term drought; simple potential evapotranspiration (pET) estimate; snow not included                              |
| Standardized Precipitation Evapotranspiration Index | Existing                | Easily accessible; comparable across locations; detects trends in temperature; can use more complex pET estimate if data available | Temperature included but not used to differentiate between rain and snow; only monthly readily available; simple pET estimate common |
| Reconnaissance Drought Index                        | Existing                | Multiple time scales available; includes water balance component   | Lack of accessibility; simple pET estimate   |
| Palmer Drought Severity Index                       | Existing                | Well-recognized and accessible   | No snow included; not particularly suited for Washington   |
| Evaporative Demand Drought Index                    | Onset/<br>Existing      | Weekly to monthly scales; more physical pET calculation; identifies early onset of drought   | Experimental; short-term index may not be as useful to snowmelt dominated basins   |



**Table A-3. Strengths and weaknesses of hydrological drought indicators**

| <b>Indicator</b>                  | <b>Stage of Drought</b> | <b>Strengths</b>  | <b>Weaknesses</b>   |
|-----------------------------------|-------------------------|---|---|
| USGS Streamflow Percentiles       | Existing/<br>End        | Easily accessible; long historical record for context   | Only available for gauge locations; flows are affected by water resources operations (such as reservoir releases) |
| Palmer Hydrological Drought Index | Existing/<br>End        | Does not show drought ending until moisture deficits are gone   | Lacks a snow component; only monthly  |
| Surface Water Supply Index        | Onset/<br>Existing      | Empirical index, not a model; includes snow, reservoirs, and streamflow with western drought in mind  | Not available for Washington; intensive calculations and data required; varies by basin                           |
| UW Drought Monitoring System      | Onset/<br>Existing      | Fills in gaps where observations aren't available; identified past Washington droughts before state declarations; easily accessible; near real-time | Subject to model biases; can be difficult to understand data behind the maps                                      |

**Table A-4. Strengths and weaknesses of Composite drought indicators.**

| <b>Indicator</b>                       | <b>Stage of Drought</b> | <b>Strengths</b>   | <b>Weaknesses</b>  |
|--|-------------------------|--|--|
| Objective Blends of Drought Indicators | Existing                | Composite of multiple indicators; easily accessible                    | No snow included in the soil moisture model; does not differentiate between rain or snow; coarse scale |
| NLDAS Soil Moisture                    | Existing                | Multiple models used to give idea of uncertainty; maps provided online | Higher uncertainty in mountain soil moisture values  |

| <b>Indicator</b>   | <b>Stage of Drought</b> | <b>Strengths</b>   | <b>Weaknesses</b>  |
|--------------------|-------------------------|--|--|
| US Drought Monitor | Existing/<br>End        | Uses multiple indicators; produced weekly; summarize in sound byte | Represents multiple types of drought which do not all align with Washington State definition |

There is no single drought indicator that is suitable to define drought in Washington State. Washington State statute defines the technical trigger of drought as water supply at, or projected to be, below 75 percent of normal for a region. Thus, hydrological indicators are generally more relevant in defining drought in Washington State. Nevertheless, the meteorological indicators described above are useful for providing warning when drought conditions are developing. A combination of these indicators should be continually monitored, with the strengths and weaknesses of each kept in mind.

The Stage of Drought classification presented here (onset vs. existing vs. end) is based on the literature and is somewhat subjective, since it has not been assessed for Washington State explicitly. In addition to comprehensive analyses on the drought indicators and their applicability to Washington State, it is recommended that the drought indicators be reviewed on a semi-regular basis to address new research on drought monitoring indicators. It would also ensure that climate change does not strongly impact the temporal stability of the indicators and their applicability for depicting drought in Washington State.

## **Forecast Tools**

Droughts are declared due to a lack of sufficient water given present or anticipated conditions. Forecasts, like drought indicators, are made in a variety of different ways that focus primarily on climate parameters (temperature and precipitation) or hydrology (streamflow). Several of those methods are reviewed here. There are also two drought forecast products produced by the NOAA's Climate Prediction Center (monthly<sup>22</sup> and seasonal) that predict either improvement or development of drought in the areas with U.S. Drought Monitor designations.

### **Climate Forecast Tools**

The skill for two different seasonal climate forecast products are reviewed in this section: the temperature and precipitation seasonal forecasts from the Climate Prediction Center, and the National Multi-Model Ensemble (NMME) temperature and precipitation seasonal forecasts.

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<sup>22</sup> Monthly: [http://www.cpc.ncep.noaa.gov/products/expert\\_assessment/mdo\\_summary.php](http://www.cpc.ncep.noaa.gov/products/expert_assessment/mdo_summary.php) and Seasonal: [http://www.cpc.ncep.noaa.gov/products/expert\\_assessment/sdo\\_summary.php](http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php)

### *Climate Prediction Center forecast skill*

The Water Supply Availability Committee (WSAC) has been using NOAA's Climate Prediction Center produced monthly seasonal climate forecasts. An archive of past Climate Prediction Center seasonal forecasts of temperature and precipitation,<sup>23</sup> and corresponding observations, has been analyzed for the years of 1995 to 2015, focusing on Washington State. This archive includes seasonal forecasts for a series of lead times (the interval [in months] between the time that the forecast is produced and the start of the period being predicted). The focus is on forecasts with lead times of 0.5 and 3.5 month (e.g., mid-September [0.5-month lead time] and the 3-month seasonal forecasts for October through December that would have been made in mid-June [3.5-month lead time]) of the same year. Results for the seasons of January through March, April through June, and July through September are also analyzed separately.

The forecasts are categorical, indicating the probability of mean temperature and precipitation anomalies reaching thresholds of below- or above-normal conditions versus near-normal. The procedure used was to compare the forecasts with the observations for the five national forecast divisions (numbers 72 through 76) encompassing Washington State;<sup>24</sup> division number 73 extends into northeast Oregon and northern Idaho, and division number 74 extends into northeast Oregon (Table A-5). For these divisions, the Heidke Skill Score (HSS) was averaged over all five regions. The HSS is a measure of forecast accuracy and relates to the frequency of correct forecasts relative to that which would occur by chance. The HSS is estimated using the following equation:

$$\text{HSS} = (c - e) / (t - e) * 100$$

Where  $e$  is the number of grid points expected to be correct by chance,  $c$  is the number of correct grid points, and  $t$  is the total number of grid points.

The HSS has a range from -50 (the worst-possible forecast) to 100 (a perfect forecast) for a three-category forecast system. A value of 0 represents a forecast that is no better than flipping a coin (O'Lenic et al. 2008; Peng et al. 2012), and a score of 50 implies that two-thirds of the individual forecasts were verified as correct. An HSS value of around 30 represents the threshold of useful forecasts in many applications.

A second analysis was done using a different Climate Prediction Center website<sup>25</sup> with seasonal forecast verifications for lead time of 0.5 months over a historical period beginning in 1995. The

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<sup>23</sup> CPC Verification: <http://www.vwt.ncep.noaa.gov/>

<sup>24</sup> Map of divisions: [http://www.cpc.noaa.gov/products/predictions/long\\_range/poe\\_index.php?lead=1&var=t](http://www.cpc.noaa.gov/products/predictions/long_range/poe_index.php?lead=1&var=t)  
[http://www.cpc.noaa.gov/products/predictions/long\\_range/poe\\_index.php?lead=1&var=t](http://www.cpc.noaa.gov/products/predictions/long_range/poe_index.php?lead=1&var=t)

<sup>25</sup> CPC Verification: [http://www.cpc.ncep.noaa.gov/products/predictions/long\\_range/tools/briefing/seas\\_veri.grid.php](http://www.cpc.ncep.noaa.gov/products/predictions/long_range/tools/briefing/seas_veri.grid.php)

same four non-overlapping seasons from 1995 through 2016 were used for Washington State as a whole.

The number of correct forecasts of below- or above-normal conditions versus the number of category 2 errors (i.e., with a validation of opposite sign to the forecast) was also determined. For example, a category 2 error would occur if below-normal temperatures were forecast for a majority of Washington State, but in actuality, the temperatures were verified as above-normal for that same period. Periods with a near-neutral forecast or validation were disregarded. The counts of correct/incorrect forecasts are shown in Table A-6.

**Table A-5. Heidke Skill Scores for 0.5-month and 3.5-month lead times for Washington State (1995 to 2015)**

| Season    | 0.5-Month Lead temperature | 3.5-Month Lead temperature | 0.5-Month Lead precipitation | 3.5-Month Lead Precipitation |
|-----------|----------------------------|----------------------------|------------------------------|------------------------------|
| Oct - Dec | -1.5                       | 1.0                        | -7.5                         | 6.5                          |
| Jan - Mar | 38.1                       | 24.0                       | 7.6                          | 22.5                         |
| Apr - Jun | 22.5                       | 21.5                       | -1.5                         | 3.5                          |
| Jul - Sep | 30.0                       | 31.0                       | 25.0                         | 17.5                         |

**Table A-6. The number of correct and incorrect (by two categories) forecasts for temperature and precipitation in Washington State (1995 to 2016)**

| Season    | Correct temperature | Category 2 Errors (temperature) | Correct precipitation | Category 2 Errors (Precipitation) | Total forecasts |
|-----------|---------------------|---------------------------------|-----------------------|-----------------------------------|-----------------|
| Oct – Dec | 4                   | 3                               | 5                     | 6                                 | 21              |
| Jan - Mar | 12                  | 1                               | 5                     | 2                                 | 22              |
| Apr - Jun | 9                   | 5                               | 6                     | 3                                 | 22              |
| Jul - Sep | 8                   | 1                               | 8                     | 2                                 | 22              |

The results of the analysis support a couple of conclusions. First, seasonal temperature predictions tend to be more skillful than seasonal precipitation predictions, as found in previous studies (e.g., Peng et al. 2012). The overall difference in skill between the 0.5-month and 3.5-month lead times was small, with the shorter time horizon yielding substantially better predictions only for temperature in winter and for precipitation in summer. For precipitation in winter, the longer lead forecasts were superior.

The lack of skill is striking in the seasonal forecasts for both temperature and precipitation for the first 3 months of the water year (October through December). The October-through-December 0.5-month lead precipitation forecasts had the highest number of Category 2 errors in the 1995-to-2016 time period (Table A-6), although the temperature and precipitation 0.5-month lead forecasts for January through March had relatively few (1 and 2, respectively).

The results for all of the 0.5-month lead seasonal precipitation forecasts in all four 3-month periods from a statewide areal average basis have been combined into a contingency table (Table A-7) to illustrate which below-normal precipitation can be reliably predicted.

**Table A-7. The 0.5-month lead precipitation forecasts versus observed conditions for each forecast category and all seasons.**

|                 | <b>Observed<br/>Below</b> | <b>Observed<br/>Normal</b> | <b>Observed<br/>Above</b> | <b>Total<br/>Forecasts</b> |
|-----------------|---------------------------|----------------------------|---------------------------|----------------------------|
| Forecast Below  | 13                        | 4                          | 8                         | 25                         |
| Forecast Normal | 23                        | 10                         | 16                        | 39                         |
| Forecast Above  | 5                         | 7                          | 11                        | 23                         |
| Total Observed  | 31                        | 21                         | 35                        | 87                         |

Key results are summarized in the second column and second row of Table A-7 relating to the seasons with below-normal precipitation observed and forecast, respectively. Forecasts of below-normal precipitation preceded 13 of the 31 seasons with observed precipitation in the below-normal category, compared with five forecasts of above-normal precipitation. There were 25 seasons for which forecasts of below-normal precipitation were made, and slightly more than 50 percent of the time, the observed precipitation was also below normal. Almost one-third (8 out of 25) of the below-normal forecasts were associated with above-normal observed precipitation.

There were almost twice as many forecasts of normal precipitation (39) as observed (21). This illustrates that clear signals regarding seasonal precipitation are often lacking; in these cases, the Climate Prediction Center forecasts generally indicate equal chances of each category.

For all of the Climate Prediction Center seasonal forecast verification results presented here, it is the small sample size of the seasonal forecasts that were available for validation may have resulted in unrealistic and misleading Heidke Skill Scores. A longer period of historical seasonal forecasts would provide more statistical certainty, but might obscure long-term improvements in forecast skill.

#### *National Multi-Model Ensemble forecast skill*

The numerical forecasts from coupled global climate models constitute a primary source of information for the seasonal weather forecasts produced by NOAA's Climate Prediction Center

and by other climate centers. Motivated by research showing that combining outputs from multiple models could enhance forecast skill (e.g., Krishnamurti et al. 2000), the weather and climate prediction enterprise has launched multi-model prediction experiments.

In climate forecasting, NOAA leads the National Multi-Model Ensemble (NMME) experiment, which involves six centers running different climate models to predict climate for up to 7 months. Multi-model ensemble mean distributions of monthly and seasonal temperature and precipitation anomaly distributions give a range of outcomes, and are generally used to account for the uncertainty associated with individual model errors and biases. The NMME (and those of the related International Multi-Model Ensemble; IMME) are statistically merged, forming products that are available online in near real-time.<sup>26</sup>

This has been a recent effort, and online archives<sup>27</sup> of operational past NMME forecasts extend back to only 2011. The real-time NMME forecasts have been examined from a Washington statewide perspective for the 20 non-overlapping seasons from October to December 2011 through July to September 2016, considering only 0.5-month leads, and again from a categorical perspective.

Results show that 16 of the 20 temperature projections from the NMME were in the same category as the Climate Prediction Center forecasts. Of the four that were different, the Climate Prediction Center forecast was superior three times and inferior once, as compared with the NMME forecast. With regards to precipitation, there were six deviations between the two sets of 20 forecasts, with Climate Prediction Center and NMME each better 50 percent of the time (three each). In other words, the Climate Prediction Center and NMME forecasts were of comparable skill.

The interpretation of these results, which are highly tentative due to the small sample size, is that the Climate Prediction Center forecasts rely, to a substantial extent, on the results from numerical climate models. The other information used in making Climate Prediction Center's official seasonal forecasts (e.g., recent trends, empirical relationships based on El Niño-Southern Oscillation, and several statistical climate forecast tools) may be of secondary importance in forming the forecasts. It would be interesting and informative to evaluate the individual models whose forecasts comprise the NMME, especially if the full hindcast archive (1982 to 2010) can be leveraged to provide a larger sample size.

The output from global climate models is increasingly relied upon for seasonal climate forecasts, coupled with continued improvement of these models with time, so it could seem that seasonal forecasts are getting better. At least for Washington State, that does not appear to be the case. Time series of Climate Prediction Center official forecast skill (not shown) lack any sort of systematic trends in skill for temperature and precipitation. Moreover, the record readily

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<sup>26</sup> Current NMME Forecasts: <http://www.cpc.ncep.noaa.gov/products/NMME/>

<sup>27</sup> Archived NMME Forecasts: <http://www.cpc.ncep.noaa.gov/products/NMME/verif/seasindex.html>

available online for assessing regional prediction skill is too short to be able to establish meaningful trends of this sort.

It is known that the skill of climate models, and of seasonal climate predictions, is enhanced for the Pacific Northwest during El Niño-Southern Oscillation (ENSO) events (e.g., Higgins et al. 2004), which could lead to improved seasonal streamflow forecasts during such conditions (e.g., Hamlet et al. 1999; Wood et al. 2005). Ongoing research is being devoted to identifying and exploiting additional sources of predictability for the weather on seasonal time scales, but progress here is slow. The mid-latitude atmospheric circulation is chaotic on time scales longer than a few weeks, and hence there are inherent limits to the predictability of future weather beyond those time scales.

## **Streamflow Forecast Tools**

Current seasonal streamflow forecasting efforts are described in this section. The Water Supply Availability Committee already uses the seasonal water supply forecasts produced by the National Weather Service's (NWS) Northwest River Forecast Center and the NRCS when monitoring conditions around the state. The National Water Model is a relatively new product that has yet to be used on the state level.

### ***Northwest River Forecast Center seasonal water supply forecast***

A portion of the state's drought declaration process is triggered when water supply (i.e., seasonal runoff volumes) is either anticipated to or falls below a flow threshold of 75 percent of normal. The state currently relies heavily on the seasonal streamflow forecasts and runoff estimates provided by the NOAA/NWS Northwest River Forecast Center (NWRFC) to determine a river's observed or forecast condition with respect to this 75 percent threshold. The NWRFC produces seasonal water supply forecasts for a variety of predefined periods, including the April-through-September snowmelt runoff period.

Currently, the NWRFC offers forecasts in two related and adjusted configurations that differ in how they account for human activities upstream of a given location.

- The Water Supply configuration provides runoff adjustments for upstream storage at select stations, according to published rules. These rules are generally comparable to adjustment techniques used by other Federal agencies that produce water supply forecasts for the state.
- The Natural Forecast configuration attempts to re-create natural flow at specific locations. This method removes the effects of major diversions, upstream storage, consumptive use for irrigated areas, and routing effects.

The NWRFC currently publishes Water Supply forecasts at 30 locations in Washington State and Natural forecasts at 69 locations in the state. The forecasts are updated daily, beginning in July of the preceding water year, and use the NWS Community Hydrologic Prediction System model.

The forecast technique uses Ensemble Streamflow Prediction (ESP) to produce a range of possible future streamflows. Each ensemble member is the result of a model run that combines

current conditions (weather leading up to the present day) with temperature and precipitation in each year in the historical record (e.g., weather in 1948 is one ensemble member, weather in 1949 is another, and so on). The resultant ensemble provides a range of uncertainty based on past weather sequences. If each ensemble outcome is assumed equally likely to occur, which is the assumption used by the NWRFC, then by definition, the median of the ESP forecasts is the most expected outcome.

The historical data of the ESP is typically augmented by embedding the latest 5-day or 10-day weather forecast instead of the historical weather record for the initial part of the streamflow forecast. The NWRFC refers to the 10-day version as ESP10 and considers it to be the official NWS forecast.<sup>28</sup> The ESP5 forecast uses a 5-day weather forecast, while the ESP0 forecast uses only historical weather data, or climatology.

These forecasts do not consider the seasonal climate forecasts produced by NOAA's Climate Prediction Center. Instead, each historical weather year is considered to be equally likely, regardless of the current climate state or prediction (e.g., El Nino-Southern Oscillation phase). Forecast skill generally increases as the water year progresses and the determinants of runoff (precipitation, temperature, snowpack) become better known through observation.

### *NRCS statistical water supply forecasts*

Seasonal streamflow forecasts are also provided by the NRCS. In years past, NRCS and the NWRFC coordinated forecasts and produced only one for the Western states, but as of 2011, each agency now issues their own official forecast (Pagano et al. 2014). This is a benefit to water planners, as they may now consider two independent forecasts that use different methods when making decisions.

The NRCS streamflow forecast is a statistical forecast, which means that a statistical regression is used to forecast streamflow based on historical data. It uses snow, precipitation, antecedent streamflow, and El Nino-Southern Oscillation indices to produce a forecast for spring and summer streamflow. The forecasts are for natural flow and do not take any upstream influences into account; they are produced monthly from January through May.

Maps<sup>29</sup> showing the April through September streamflow percent of normal at the 50 percent exceedance level (the median forecast) are available online. The reports<sup>30</sup> have more information and list the 10 percent, 30 percent, 70 percent, and 90 percent exceedance probabilities for the April-through-September and the April-through-July periods for each forecast point. The 90 percent exceedance value means that there is a 90 percent chance that the actual streamflow volume will exceed the forecast value, and a 10 percent chance the actual

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<sup>28</sup> NWRFC Forecasts: <https://www.nwrfc.noaa.gov/ws/index.html>

<sup>29</sup> NRCS Maps: [https://www.wcc.nrcs.usda.gov/cgibin/colu\\_strmflow.pl?state=columbia\\_river](https://www.wcc.nrcs.usda.gov/cgibin/colu_strmflow.pl?state=columbia_river)

<sup>30</sup> NRCS Reports: <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wa/snow/waterproducts/?cid=stelprdb1265591>



streamflow volume will be less than the forecast value. The 90 percent exceedance forecast would be a more conservative value to base water supply decisions on compared to the median forecast.

Like the NWRFC seasonal streamflow forecasts, the NRCS forecast uncertainty decreases through the water year. One of the main drivers of uncertainty in these forecasts is the winter weather, so as the season progresses, the future conditions become known and uncertainties in the streamflow decrease. Winter snowpack is a good predictor of spring/summer water supply, so forecasting the water supply for rain-dominated basins is more challenging. For Washington State, that means that many of the forecast points in the rain-dominated regions of western Washington have higher uncertainty. This characteristic also applies to the NWRFC ESP forecasts, since their skill arises in specification of SWE and soil moisture conditions at the start of the forecast.

### *NOAA National Water Model*

In August 2016, the NOAA/NWS Office of Water Prediction announced the operational release of the National Water Model (NWM),<sup>31</sup> when it began running continuously on a National Centers for Environmental Prediction supercomputer. The initial version (v.1.0) forecasts streamflow and other aspects of the water cycle (e.g., precipitation, SWE, and soil moisture) on multiple time scales for 2.7 million river forecast points nationwide. The input data include current streamflow observations from USGS gauges and estimates of observed precipitation. The core of the National Weather Model is based on the Weather Research and Forecasting Hydrologic model from the National Center for Atmospheric Research (NCAR). The modular framework uses a suite of model options and weather inputs to produce hydrologic guidance across four time horizons – analysis (current), short-range, medium-range, or long-range (NOAA August 2016 Newsletter).

Of interest to Washington State's drought work is the long-range streamflow forecast, which spans 0 to 30 days and is produced daily using a 16-member ensemble on a 1 km grid. The forecast uses meteorological output from NOAA's Climate Forecast System (CFSv2). While 30 days is too short to be considered a seasonal climate forecast, the CFSv2 is a global model that initiates each meteorological forecast with the current state of the atmosphere-ocean system. In other words, the initialization considers current climate system conditions, such as the Ensemble Streamflow Prediction (ENSO) state and the Madden-Julian Oscillation, and could improve streamflow forecast during the relevant sub-seasonal window (out to 30 days). The CFSv2 produces a high number of simulations, which helps bound and describe the uncertainty ranges of the initial climate system conditions used.

While the National Water Model is operational in a technical sense, its output is experimental and currently undergoing extensive verification. Progress should be monitored to determine whether the forecasts of interest, such as the 30-day predictions, offer any skill. Although

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<sup>31</sup> National Water Model: <http://water.noaa.gov/about/nwm>

planned yearly enhancements may yield quality long-range forecasts that extend out 90 days or more, the National Water Model output will not replace the NWRFC seasonal forecasts in the foreseeable future. Still, the sub-seasonal horizon of its long-range forecast<sup>32</sup> could be useful as (experimental) supplementary guidance for the state's WSAC, particularly as the National Water Model matures. The long-range forecast provides information on an intermediary time scale, bridging the gap between short-term and seasonal forecasts. An added benefit of the National Water Model is that forecasts are provided at locations currently not available from the NWRFC.

The National Water Model has been, and will continue to be, a collaborative venture. The newly created NWS National Water Center works closely with NCAR, NWS headquarters and field offices, and other NOAA and external agencies to operate, assess, improve, and enhance the National Water Model. Subsequent versions are planned. (Brian Cosgrove, personal communication).

## **Related Research and Development**

The previous sections review current drought indicators and forecasting tools, and while not an exhaustive list, they provide a comprehensive review of some key tools. Climate and hydrologic research is always moving forward, however, and particularly with the recent drought in the Pacific Northwest, there are interesting and exciting projects on the horizon. The sections below highlight a few examples of work and resources that could help advance the state's process of determining and declaring drought in Washington should these projects move from the research stage to operational.

### ***Northwest Climate Toolbox***

The Northwest Climate Toolbox is a website<sup>33</sup> that provides interactive climate and water resources decision support. It is being developed by leads John Abatzoglou (University of Idaho), Katherine Hegewisch (University of Idaho), and Bart Nijssen (University of Washington), and funded by the Climate Impacts Research Consortium and the National Integrated Drought Information System (NIDIS).

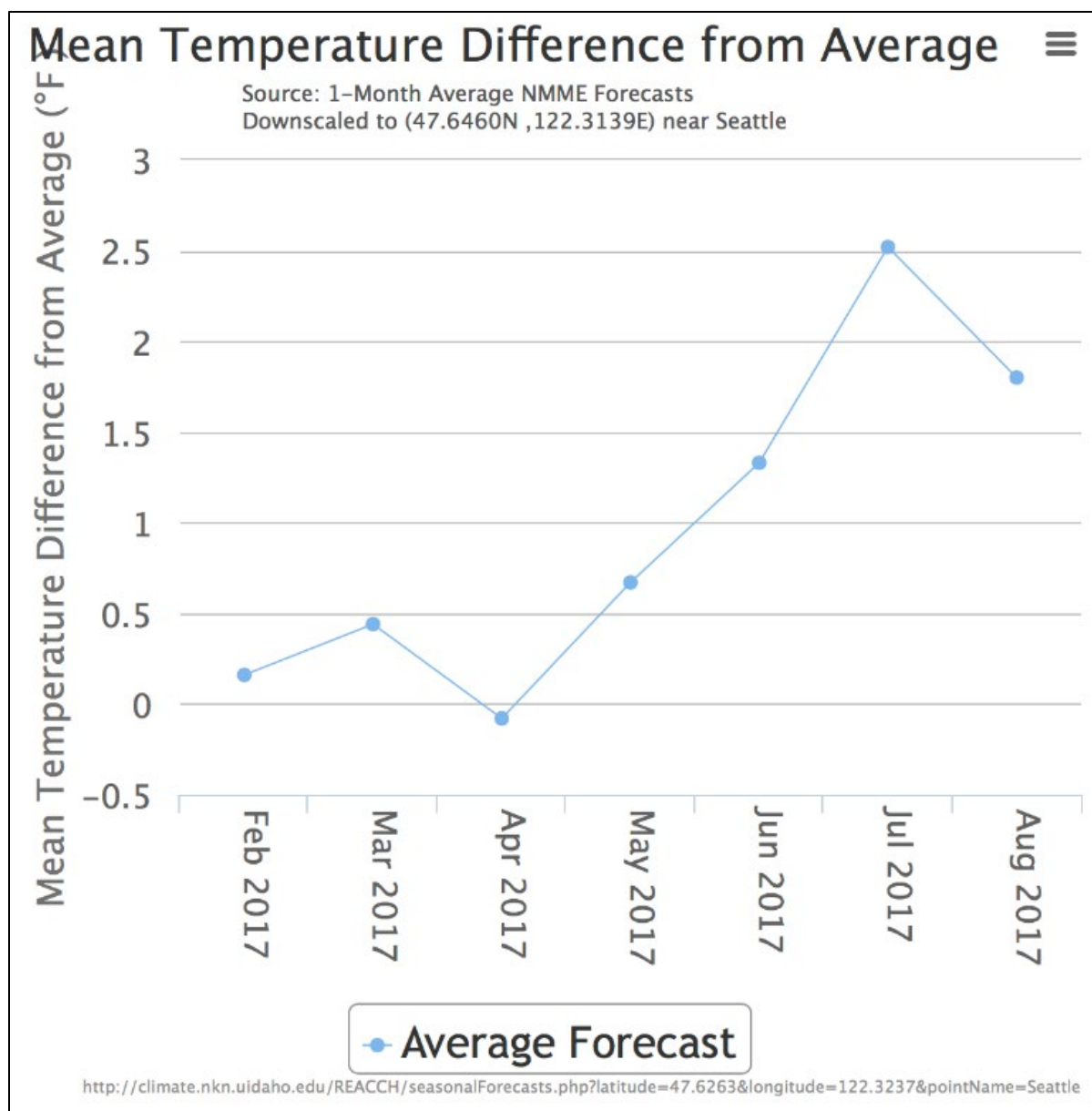
While still in development with expansion planned, the website is usable now to monitor potential drought conditions on the state level. For example, the website (under Tools and Seasonal Forecast Maps) shows the National Multi-Model Ensemble (NMME; described above) temperature and precipitation forecasts. These forecasts are downscaled to a chosen point, and offer more information than shown in the traditional NMME forecast maps. For example, the mean temperature difference average can be shown for a given point and forecasts can be viewed as a time series on the same graphic. Figure A-1 shows this for the NMME 1-month average temperature forecast near Seattle from February 2017 through August 2017. In addition, the

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<sup>32</sup> National Weather Model Forecast maps: <http://water.noaa.gov/map>

<sup>33</sup> Climate Toolbox: [www.climatetoolbox.org](http://www.climatetoolbox.org)

downscaled temperature or precipitation forecasts are available for different time periods (1-month to 7-month averages).



**Figure A-1. One-month temperature forecasts for the Seattle area (difference from 1981 - 2010 normal) from the NMME models.**

The Northwest Climate Toolbox also displays historical average climate data in graphical format using the University of Idaho gridded dataset.<sup>34</sup> Another section of the site is dedicated to future climate change projections for temperature, precipitation, wind, and potential evapotranspiration,

<sup>34</sup> Univ. of Idaho Surface Meteorological Dataset: <http://climate.nkn.uidaho.edu/METDATA/>

among other variables. The output is from Coupled Model Inter-comparison (CMIP5) models, which are described in the climate change portion of this drought plan. As mentioned previously, more developments are in store for the Northwest Climate Toolbox, including migrating the UW Drought Monitoring System (described in the Hydrological Indicators section above) over to the toolbox in the next few years. (The snow percentiles and soil moisture percentiles from the UW Drought Monitoring System are already available on both websites.) The UW Drought Monitoring System process will remain the same, but the meteorological input dataset will be different. The output and maps will be consistent with the products available on the Northwest Climate Toolbox.

### *Climate Prediction Center Experimental 3-week forecast*

A new product released in 2015 from NOAA's Climate Prediction Center attempts to fill the gap between short-term weather forecasts and longer-term seasonal predictions. The climate Prediction Center is producing experimental forecasts of temperature and precipitation for the United States on a time horizon of 3 to 4 weeks. These forecasts are updated once a week and available online.<sup>35</sup> The information consists of the expected distributions of the anomalous temperature and precipitation for the 3- to 4-week period as a whole in the same three-tier format used for the seasonal forecasts (below normal; equal chances of below, near-normal, or above; and above normal).

The site includes a forecast discussion indicating the basis for the forecasts includes output from ensembles of extended numerical weather prediction model simulations from NOAA's CFSv2 model and from model simulations of two other international centers. (Additional model simulations may be included in the future.) Consideration is also given to the present state of slowly varying components of the atmosphere-ocean-land system, such as ENSO. In addition, these forecasts exploit the Madden-Julian Oscillation, which represents a major source of variability in the tropics on 40- to 60-day time scales. The Madden-Julian Oscillation often has some predictability out a few weeks; the phase of the oscillation correlates moderately with the atmospheric circulation and weather at higher latitudes, including precipitation in the Pacific Northwest during October through March (Bond and Vecchi 2003).

It remains to be seen how much skill these 3- to 4-week forecasts will have in a real-time setting. The weather-and-climate community has substantial interest in exploiting the potential predictability on this time scale.

### *Water Resources Monitor and Outlook*

The Water Resources Monitor and Outlook (WRMO)<sup>36</sup> is a new online tool currently under development that integrates, synthesizes, and expands existing NOAA forecast products. NOAA

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<sup>35</sup> CPC 3- to 4-Week Outlooks: <http://www.cpc.ncep.noaa.gov/products/predictions/WK34/>

<sup>36</sup> WRMO Information: <http://www.cbrfc.noaa.gov/WRMO>

leads the effort, with involvement from NIDIS, the Western River Forecast Centers, the Physical Sciences Division, and the Climate Prediction Center.

The Water Resources Monitor and Outlook will provide access to the River Forecast Center's ESP water supply forecasts from all Western river basins, along with other visualization tools. The initial focus of this product is on the western United States (including the Pacific Northwest region) and will be released in Beta form in spring 2017 and refined based on stakeholder feedback through 2018.

The product is being designed based on the needs of water management users, and includes streamflow forecast information, verification of the forecasts, and visualization tools to help communicate forecast evolution. Ultimately the product suite will contain three web-based elements:

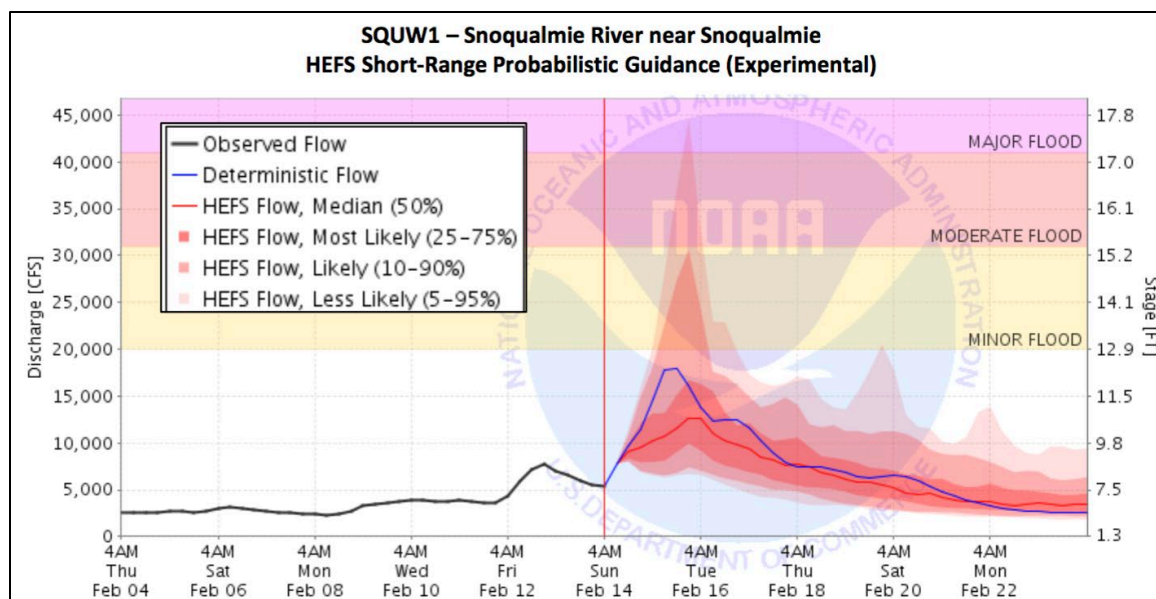
- Water resources monitoring information.
- Water resources outlook products that are an enhancement of the current operational NOAA River Forecast Center products (both elements 1 and 2 will be updated daily).
- Sub-seasonal to seasonal climate outlook for water resources, leveraging the existing analysis and operational forecasts from Climate Prediction Center.

### *NOAA/NWS Hydrologic Ensemble Forecast Service*

NOAA/National Weather Service's River Forecast Centers are currently experimenting with a probabilistic streamflow forecasting system known as the Hydrologic Ensemble Forecast Service (HEFS). HEFS is a nationwide effort that is run locally at individual River Forecast Centers. At the NWRFC, HEFS output is undergoing validation and is not available, but it is another product that may be useful to the state soon.

For the Northwest region, 63 headwater basins have been run through the ensemble forecast system. HEFS produces a daily probabilistic streamflow forecast from 0 to 365 days, thereby offering short-term and seasonal water supply forecasts. Figure 15 shows an example of the short-range forecast (0 to 10 days lead time) for potential flooding on the Snoqualmie River near Snoqualmie, Washington. Rather than having one deterministic forecast (blue line in Figure A-2 existing NWRFC river forecast capability), the HEFS forecast shows a range of possibilities (red envelopes) based on an ensemble of different model runs. HEFS envelopes help to describe the potential for a range of outcomes and can be a planning asset over deterministic single-answer forecasts in which uncertainty is generally not specified.

As for the model input, temperature and precipitation from the NWS Global Forecast System forces the first 15 days of the HEFS forecast. For days 16 to 270, the temperature is taken from the CFSv2 seasonal forecast model, and the precipitation is from the historical precipitation record. The precipitation portion of the model input for days 16 to 270 is similar to the current official Water Supply forecast from NWRFC. For days 271 to 365, the historical records for both temperature and precipitation records are used.



**Figure A-2. Example of a prototype short-term forecast product for the Snoqualmie River near Snoqualmie based on HEFS (NOAA)**

The entire HEFS forecast method contrasts with the NWRFC’s current ESP system that combines a short-term deterministic weather forecast (e.g., 10 days) with longer-term variables based on the climatological record of temperature and precipitation. The HEFS use of the CFSv2 for the temperature input is an exciting development, since seasonal temperature predictions are known to have skill and have been shown to improve streamflow forecast accuracy (Shukla and Lettenmaier 2011). Whether the streamflow forecasts for the Northwest are improved via the HEFS methodology is currently being verified. This type of forecast product, particularly in the 16- to 270-day range, can be valuable for WSAC once it becomes operational.

#### *The Over-the-Loop Seasonal Streamflow Forecast Demonstration Project*

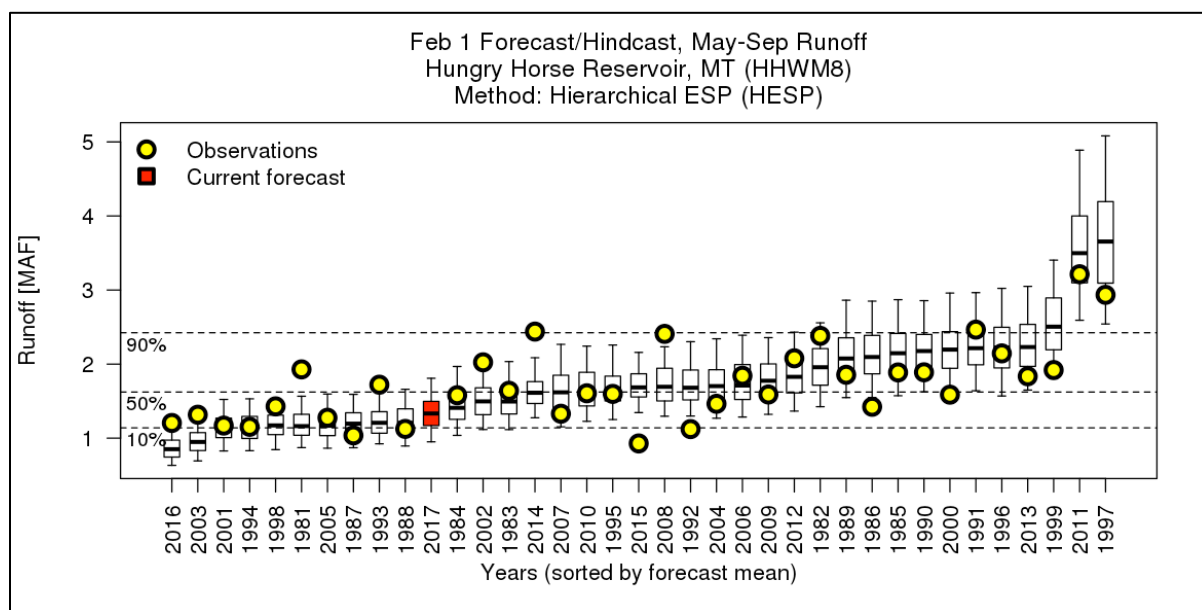
NCAR is leading an effort in collaboration with the University of Washington to investigate potential advances in short- to medium-range (1 to 15 days) and seasonal streamflow prediction methods. The Bureau of Reclamation, U.S. Army Corps of Engineers, and NOAA support the multi-year project. The overarching goal<sup>37</sup> is to assess forecasting strategies that incorporate scientific advances from the last several decades in the areas of modeling, weather and climate prediction, ensemble frameworks, and statistical techniques such as data assimilation. These strategies promote an over-the-loop paradigm, in contrast to the current in-the-loop paradigm in which expert forecasters modify forecast system states and outputs. This design follows the rationale that the automation and reproducibility of the predictions allow for systematic benchmarking and adoption of new alternatives, as well as an accurate documentation of forecast performance.

<sup>37</sup> Project description: [https://ncar.github.io/hydrology/projects/streamflow\\_forecasting](https://ncar.github.io/hydrology/projects/streamflow_forecasting)



Several water supply forecasting methods are being tested, including ensemble forecasting, statistical forecasting, and hybrid methods; the hybrid dynamical-statistical approaches have already been shown to boost water supply forecast skill by incorporating additional climate information. This initial testing is being done in the western United States.

An example of a new water supply forecast product that is enabled by the over-the-loop approach is a water supply forecast for the Hungry Horse Reservoir in Montana (Figure A-3). The forecast shown is based on a Hierarchical Ensemble Streamflow Prediction (ESP) that blends ESP and teleconnection-based climate information.



**Figure A-3. A water supply forecast product initialized February 1, 2017, for April-through-July Hungry Horse Reservoir inflow.**

The current forecast (red symbol, showing the 10, 30, 50, 70, and 90<sup>th</sup> percentiles) is presented along with the forecasts (open boxes) and observations (yellow dots) from a 35-year hindcast dataset made in a consistent workflow but for past years. The dotted lines are the 90<sup>th</sup>, 50<sup>th</sup>, and 10<sup>th</sup> percentiles from historic quantities.

As the real-time forecast is entirely consistent with a retrospective hindcast dataset (i.e., avoiding the real-time adjustments of the in-the-loop paradigm), it can be presented in the context of several decades of past forecasts from the same day of the year, along with their verifying observations. Aside from the benefits of climate information, this type of verification is a powerful tool for interpreting the quality of the predictions before connecting them to decisions (for more details, see Mendoza et al. 2017). As the project is currently running semi-operationally, these real-time forecasts for several Western basins, including one in Washington, are available online.<sup>38</sup>

<sup>38</sup> Seasonal Streamflow Predictability: <http://hydro.rap.ucar.edu/hydrofcst/forecasts>

As this is currently a demonstration project, its immediate use by the state for drought decisions is not recommended. Instead, the water agencies have supported this work to highlight promising opportunities and strategies for improving streamflow predictions. It can be used in the future, should increased streamflow forecast skill be shown for Washington streams by including climate information (as shown in previous studies, e.g., Shukla and Lettenmaier 2011), as this information is critical to the state's drought monitoring goal. Earlier, more reliable, and accurate water supply forecasts can help the state respond to developing drought faster.

## **Conclusions**

New resources and tools will be forthcoming, following this report. Projections are becoming increasingly probabilistic in character, and as part of this trend, will include uncertainty estimates that are better calibrated. Nevertheless, there are real limits in the predictability of the weather on time scales greater than a few weeks, and hence, there are limits to the ability to forecast changes in drought conditions. This critical point underscores the need for the state to place equal, if not greater, emphasis on preparedness.



## Appendix B. Vulnerability

### Overview

This section assesses the vulnerability of five sectors to drought – agriculture, drinking water, fish and wildlife, energy, and recreation. To date, the most comprehensive assessment of drought vulnerability in Washington State was conducted by researchers at the University of Washington in 2007, with support from Washington State agencies and others, following the statewide drought in 2005. This chapter summarizes their work and supplements it with information gained during the 2015 drought, which exhibited more severe hydrologic conditions across most of the geographic area of the state.

Additional perspective is provided by summarizing data on emergency drought permit authorizations issued in statewide droughts during 2001, 2005, and 2015.

Each statewide drought is characterized, in varying degrees, by anomalies in either precipitation, temperature, or both, which occur over different areas of the state. The character of these droughts is discussed in the Drought Monitoring and Forecasting Appendix. Resulting runoff patterns are depicted in the Appendix for Runoff Patterns in Drought Years.

Climate change projections for temperature and precipitation in the mid-21<sup>st</sup> century are also presented, including how this may impact future droughts in Washington State. In addition, information regarding drought impacts on groundwater conditions, and how climate change may affect groundwater recharge longer-term, also is discussed. The Puget Sound Water Supply Forum's assessment of groundwater vulnerability is highlighted.

### University of Washington Drought Project

Fontaine and Steinemann (2007) prepared a report on the impacts of the 2001 and 2005 droughts in Washington State. This is the most comprehensive assessment to date regarding the impacts of drought on a wide range of water uses in Washington State. Previous work addressing vulnerability of natural hazards and climate change had been published by the Intergovernmental Panel on Climate Change (IPCC 2001), Schröter and Metzger (2004), and others. Drawing upon the broader literature and their own findings in Washington State, Steinemann and Fontaine proposed a vulnerability assessment method to quantify vulnerability to drought. The conceptual model of the vulnerability assessment is based on the three variables of exposure, sensitivity, and adaptive capacity (Fontaine and Steinemann, 2009).

1. *Exposure* incorporates frequency and severity of drought; severity includes magnitude, duration, and spatial extent.
2. *Sensitivity* is the susceptibility of a water user (or users) to the effects of the drought.
3. *Adaptive capacity* is the ability of a water user to manage or reduce adverse effects of a drought, through actions taken before, during, or after the drought. Exposure and sensitivity determine the potential impact. Adaptive capacity determines the portion of the potential impact that becomes an actual impact.

The combination of the three components results in a net impact or vulnerability to the drought. These concepts can be illustrated by the following examples of several types of water users.

A large metropolitan city that also owns a large storage reservoir can compensate for the lack of natural precipitation or low snowpack. A city may also have the resources and technical staff available to forecast, model, and monitor water conditions. A city will likely have developed plans to manage low-water-year conditions. Additionally, it is not uncommon for large purveyors to have developed redundant sources of water (e.g., groundwater sources that can supplement surface water supplies and which are buffered from the impacts of short-term precipitation deficits). Finally, a city can use various tools (rates, public education, etc.) to influence water demand, which gives additional control over its ability to withstand drought impacts.

In contrast, a farmer who depends on naturally available streamflow to irrigate his or her fields is likely to have fewer resources to forecast water supplies and climate conditions. Without compensating storage, the farmer is at the mercy of year-to-year runoff. His or her ability to withstand low water years will also depend on the priority of his or her water right. A farmer with a junior water right may lose the ability to divert to protect more senior water rights. The ability to withstand drought conditions also will be affected by crop types. Loss of long-lived crops like fruit trees can result in economic losses extending years into the future.

Finally, fishery populations have a high exposure to drought conditions, as it directly affects their habitat requirements – abundant, cool water and the ability to move volitionally between upper and lower watershed areas. Their ability to adapt depends on their mobility, and their ability to locate areas of temperature refuge (e.g., where groundwater discharges into streams, and such factors as whether instream flows can be maintained via releases from water storage facilities).

Fontaine and Steinemann examined 34 subsector-region combinations to evaluate their vulnerabilities. They interviewed water users, using questions related to exposure, sensitivity, and adaptive capacity, and calculated a vulnerability score. They used Likert-type questions on these components with a five-part scale, ranging from 1-Very Low to 5-Extreme. They interviewed 67 water users from regions of the state affected by previous droughts and likely to be affected in future drought, and representing key sectors: agriculture, environment, municipal and industrial, recreation, and power. The vulnerability scores were grouped according to region of the state, as shown in **Figure B-1** and **Table B-1** and **B-2** below.

## **Exposure**

All areas and water uses carry some risk of exposure to drought conditions. Exposure was ranked the highest for dryland farmers (those who do not use irrigation), junior water-right holders, hydropower generators, ski areas, and fish populations in watersheds with large surface water withdrawals. All these subsectors have a large presence in Washington State.

## Sensitivity

Sensitivity was reported high for dryland farmers, junior water right holders farming exclusively fruit trees, and fish populations already stressed by surface water withdrawals and other habitat impacts. Salmon, which spend a long time rearing in freshwater streams, were considered especially sensitive to drought conditions. Dryland farmers depend solely on naturally available precipitation and generally do not supplement their fields using irrigation. Fruit trees cannot survive prolonged interruptions of water.

## Adaptive Capacity

Adaptive capacity was reported high for large municipalities and hydropower generators. Municipalities that have storage of surface water are better positioned to optimize their supply in conjunction with other measures using a combination of demand-side management, controlled releases, and other strategies.

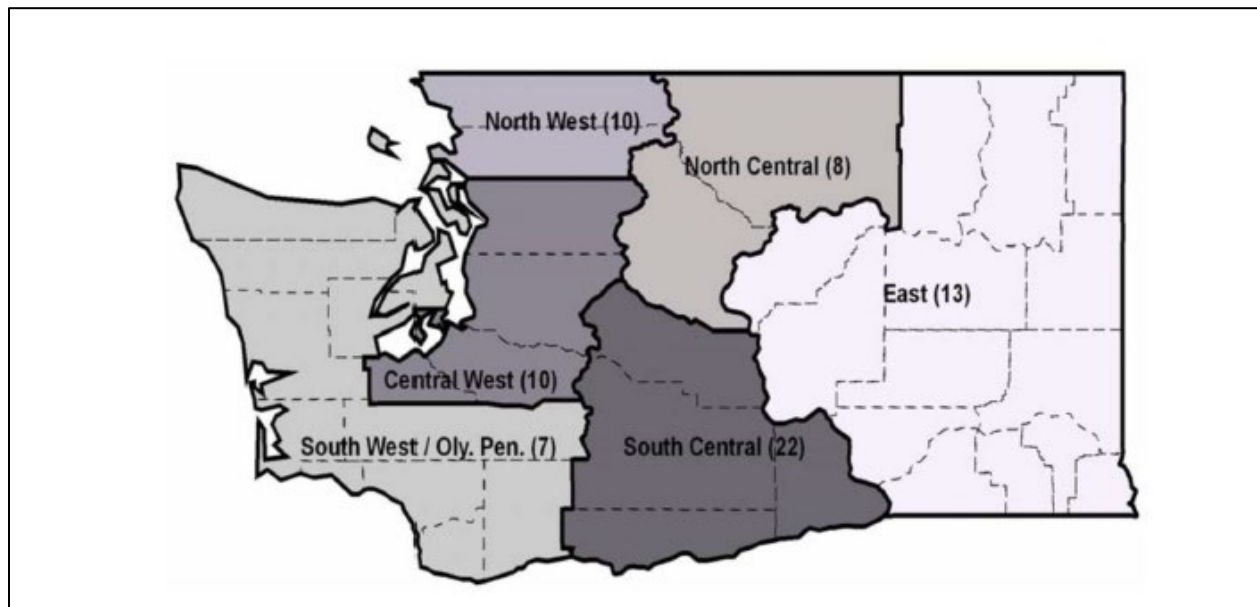


Figure B-1. Map showing regions and number of interviewees per region (adapted from Fontaine and Steinemann 2009)

**Table B-1. Counties and interviewees in each region**

| <b>Region</b>                 | <b>Counties</b>   | <b>Interviewees</b> |
|-------------------------------|---|---------------------|
| North West                    | Skagit, Whatcom   | 10                  |
| Central West                  | King, Pierce, Snohomish, Thurston   | 10                  |
| South West /Olympic Peninsula | Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, Kitsap, Lewis, Mason, Pacific, San Juan, Skamania, Wahkiakum            | 7                   |
| North Central                 | Chelan, Okanogan  | 8                   |
| South Central                 | Benton, Kittitas, Klickitat, Yakima   | 22                  |
| East                          | Adams, Asotin, Columbia, Douglas, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman | 13                  |

**Table B-2. Sectors analyzed within each region and average subsector vulnerability score**

| <b>Region and sector</b>                         | <b>Interviews</b> | <b>Subsector</b>                  | <b>Score</b> |
|--|-------------------|-----------------------------------|--------------|
| <b><i>Northwest region</i></b>                   | 10                |                                   |              |
| Agriculture                                      |                   | Irrigated berries                 | 1.88         |
| Agriculture                                      |                   | Irrigated row crops               | 2.17         |
| Agriculture                                      |                   | Landscape industry*               | 3.50         |
| Agriculture                                      |                   | Dairy                             | 2.00         |
| M&I  |                   | Purveyor                          | 2.50         |
| Environment                                      |                   | Fisheries                         | 3.25         |
| <b><i>Central west region</i></b>                | 10                |                                   |              |
| Agriculture                                      |                   | Landscape industry*               | 3.67         |
| M&I  |                   | Large municipality supplier       | 1.63         |
| Environment                                      |                   | Fisheries                         | 2.33         |
| <b><i>Southwest/Olympic Peninsula region</i></b> | 7                 |                                   |              |
| Agriculture                                      |                   | Landscape industry* <sup>39</sup> | 3.50         |
| Agriculture                                      |                   | Irrigated diverse agriculture     | 2.33         |
| Agriculture                                      |                   | Dairy                             | 2.00         |
| Agriculture                                      |                   | Irrigated berries                 | 3.50         |
| M&I  |                   | Municipal                         | 2.50         |
| Environment                                      |                   | Fisheries                         | 1.75         |
| <b><i>North central region</i></b>               | 8                 |                                   |              |
| Agriculture                                      |                   | Irrigated fruit trees             | 2.50         |
| Agriculture                                      |                   | Cattle ranchers                   | 2.33         |
| Environment                                      |                   | Fisheries                         | 3.46         |
| M&I  |                   | Municipal                         | 3.00         |

<sup>39</sup> *Landscape industry* is referred to as *green industry* in the original UW Drought Report. It includes growers, nurseries, landscapers, and other services / supplies for outdoor landscaping.

| Region and sector                  | Interviews | Subsector               | Score |
|------------------------------------|------------|-------------------------|-------|
| <b><i>South central region</i></b> | 22         |                         |       |
| Agriculture                        |            | Irrigated junior rights | 3.28  |
| Agriculture                        |            | Wine grapes             | 1.67  |
| Agriculture                        |            | Irrigated senior right  | 2.00  |
| Agriculture                        |            | Dryland                 | 4.50  |
| Agriculture                        |            | Cattle                  | 2.33  |
| M&I                                |            | Municipal               | 3.00  |
| Environment                        |            | Fisheries               | 4.08  |
| <b><i>East region</i></b>          | 13         |                         |       |
| Agriculture                        |            | Irrigated surface water | 2.50  |
| Agriculture                        |            | Irrigated ground water  | 2.33  |
| Agriculture                        |            | Dryland                 | 4.36  |
| M&I                                |            | Municipal               | 2.78  |
| Environment                        |            | Fisheries               | 3.06  |
| <b><i>No specific region</i></b>   |            |                         |       |
| Recreation                         |            | Golf courses            | 1.50  |
| Recreation                         | 3          | Ski areas               | 4.00  |
| Energy                             | 6          | Hydropower              | 1.67  |

(Adapted from Fontaine and Steinemann 2009)

## Primary Findings of Impacts

The University of Washington drought report identifies impacts of the 2001 and 2005 droughts in all regions of the state. The UW report's Analysis of Drought Vulnerability and Adaptive Capacity is excerpted as Appendix D. The drought impacts summarized in Steinemann and Fontaine (2009) are highlighted:

- In the agricultural sector, impacts were greatest in cases where lack of supply reduced the quantity and quality of product. Irrigators throughout the state reported increased cost associated with water management during drought.
- Tree fruit growers with proratable water rights<sup>40</sup> commonly reported reduced fruit quality; however, impacts to quantity were not as widely reported.
- Many proratable water users left row crop fields fallow to ensure adequate supply for perennial crops or to supply other fields that were planted.

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<sup>40</sup> *Proratable* refers to water rights in the Yakima Project with a May 10, 1905, or later priority date, which may receive less than full supply entitlements during drought.

- Reduced cuttings of hay and alfalfa were also widespread. The decrease in production of feed crops increased costs of feed for livestock. Dryland farmers reported crop reductions of up to 70 percent during drought.
- The landscape industry (the industry that grows, installs, and maintains landscaping, including landscape professionals, landscape nurseries, garden centers, horticulturists, and turf grass growers) in western Washington reported severe reductions in sales due to early advisories and perceptions of drought in western Washington.
- Interviewees also reported many secondary drought impacts, such as reduced sales of field equipment, increased unemployment, and reductions in assessed land value per capita.
- Fish management officials throughout the state reported that, in most years, fish are negatively affected by water withdrawals from streams and alteration of the natural hydrograph. Drought can magnify these harmful conditions, resulting in additional stress and increased mortality of adult fish migrating upstream, juvenile fish migrating downstream, and resident fish populations.
- The raw value of lost hydropower generation in the state was estimated to be approximately \$3.5 billion during the 2001 drought. Average annual value of hydroelectric energy for the Northwest was estimated as \$17.2 billion.
- In 2005, ski areas in Washington received less than a third of the business of an average year. (More information on impacts to ski area visits is provided below, updated to 2016.)

## **Ranking of Resources Requiring Protection**

Washington State's drought framework applies to all types of water users and does not explicitly prioritize resources according to importance. However, state law (including statutes and administrative rules) restricts emergency relief in the form of grants and loans to public entity recipients (irrigation districts, public utility districts, cities, tribes, etc.). The Washington State constitution prohibits lending to private parties.

With respect to emergency water right permitting, emergency permits may only be issued for a previously authorized use of water. Landowners who depend exclusively on rainfall to meet their needs are not eligible for emergency wells or diversions.

In the UW Drought Report, wheat growers in eastern Washington reported high vulnerability to drought. Wheat growing is a form of dryland agriculture that cannot benefit from emergency water right permitting. Individual wheat growers are not eligible for grants and loans from the state, but may be eligible for Federal relief. Support of conservation district technical assistance and extension services outreach may help wheat growers improve their production by adopting new practices.

Winter recreation in the form of skiing and snowboarding is vulnerable to low snowpack conditions. No state programs exist to mitigate impacts to ski resorts, which are private businesses. At the Federal level, the Small Business Administration offers economic injury

assistance loans for non-agricultural businesses in drought-affected areas. However, these areas are determined by drought status designations in the U.S. Drought Monitor, not whether the state has declared drought conditions according to its own definition. Some ski resorts are diversifying their operations by including revenue-generating activities in the summer (e.g., mountain biking, summer concerts, water slides).

## **Past Emergency Drought Authorizations**

Expedited water right permitting has been a key element of state drought response in every recent drought. RCW 43.83B authorizes Ecology to issue emergency water right permits to individuals with previously authorized diversions. The number and location of emergency permits issued historically can be used as an indicator of drought-related hardships and vulnerabilities, at least in areas where an emergency water right permit can reduce hardship experienced by the water user. Most emergency water right permits allow the withdrawal of water from an alternate source, such as the use of groundwater from an emergency drought well, when a surface water source is not available.

As indicated by Table B-3 and Table B-4 below, most emergency drought authorizations have been issued in the Upper and Lower Yakima watersheds in Kittitas and Yakima counties. Fewer than 5 percent of the emergency drought authorizations issued since 1994 have been issued on the west side of the Cascades (16 out of 363 total). Of the 16 emergency drought permits issued on the west side, 13 were issued in 2015.

The number of emergency water rights issued has dropped from a total of 169 in 2001, to 119 in 2005, to only 71 in 2015. This decline does not appear to correspond to the severity of drought conditions because runoff conditions were most severe in 2015 (Xiaodong and Wolock et al. 2016), the year of the fewest permits issued (although the level of proration for junior irrigation districts was more severe in 2005). Other factors affect the number of emergency permits:

- An emergency permit issued in a previous drought may have been in conjunction with infrastructure improvements that made a user more resilient to drought impacts.
- In the time between drought events, water users may have adopted more water-efficient practices or otherwise improved their adaptive capacity.
- The terms under which emergency permits are approved have changed. In 2015, users of emergency wells in the Yakima Basin were required to pay 50 percent of the cost of replacement mitigation water. No water charges were imposed by the state in prior droughts.
- The timing of drought declarations can differ. This affects the window of opportunity for accessing emergency permits. For example, in 2015, Ecology did not begin issuing emergency drought permits until May due to the evolving water supply forecast in the Yakima Basin, which was revised downward as the spring progressed. Irrigation districts in the Yakima Basin can begin delivering water as early as mid-March. The forecasted

proration amount in early March was 73 percent. In April, the forecast was revised downward to 60 percent. By May, the forecast had been revised downward to 47 percent.

**Table B-3. Number of emergency drought permits by county and drought year**

| <b>County</b> | <b>1994</b> | <b>2001</b> | <b>2005</b> | <b>2015</b> | <b>Total</b> |
|---------------|-------------|-------------|-------------|-------------|--------------|
| Benton        | 1           | 21          | 39          | 12          | 73           |
| Chelan        |             | 7           | 2           | 8           | 17           |
| Clallam       |             |             | 3           | 1           | 4            |
| Columbia      |             |             | 1           | 1           | 2            |
| Douglas       |             | 14          |             |             | 14           |
| Franklin      |             | 3           |             |             | 3            |
| Grant         |             |             |             | 2           | 2            |
| King          |             |             | 1           | 3           | 4            |
| Kittitas      |             | 44          | 10          | 7           | 61           |
| Klickitat     |             | 4           | 1           |             | 5            |
| Lincoln       |             |             | 1           |             | 1            |
| Okanogan      |             | 31          | 10          | 2           | 43           |
| Skagit        |             |             |             | 4           | 4            |
| Stevens       |             |             | 3           | 2           | 5            |
| Walla Walla   |             | 5           |             |             | 5            |
| Whatcom       |             |             |             | 4           | 4            |
| Yakima        | 3           | 40          | 48          | 25          | 116          |
| Grand Total   | 4           | 169         | 119         | 71          | 363          |



**Table B-4. Number of emergency drought permits by Water Resource Inventory Area and drought year**

| <b>Watershed</b>    | <b>1994</b> | <b>2001</b> | <b>2005</b> | <b>2015</b> | <b>Total</b> |
|---------------------|-------------|-------------|-------------|-------------|--------------|
| Alkali-Squilchuck   |             | 12          | 1           | 8           | 21           |
| Colville            |             |             | 3           | 2           | 5            |
| Duwamish-Green      |             |             |             | 1           | 1            |
| Elwha-Dungeness     |             |             | 3           | 1           | 4            |
| Esquatzel Coulee    |             | 2           |             |             | 2            |
| Foster              |             | 4           |             |             | 4            |
| Kitsap              |             |             | 1           |             | 1            |
| Klickitat           |             | 1           | 2           |             | 3            |
| Lower Crab          |             |             |             | 2           | 2            |
| Lower Skagit-Samish |             |             |             | 4           | 4            |
| Lower Snake         |             | 2           |             |             | 2            |
| Lower Yakima        | 3           | 56          | 81          | 35          | 175          |
| Methow              |             | 11          | 7           | 2           | 20           |
| Moses Coulee        |             | 12          |             |             | 12           |
| Naches              |             |             |             | 2           | 2            |
| Nooksack            |             |             |             | 4           | 4            |
| Okanogan            |             | 17          | 3           |             | 20           |
| Rock-Glade          | 1           | 4           | 6           |             | 11           |
| Snohomish           |             |             |             | 2           | 2            |
| Upper Crab-Wilson   |             |             | 1           |             | 1            |
| Upper Yakima        |             | 39          | 9           | 7           | 55           |
| Walla Walla         |             | 4           | 1           | 1           | 6            |
| Wenatchee           |             | 2           | 1           |             | 3            |
| Wind-White Salmon   |             | 3           |             |             | 3            |
| Grand Total         | 4           | 169         | 119         | 71          | 363          |

## Prior Appropriation and Regulation of Junior Water Rights

Curtailment is a double-edged sword that constitutes a vulnerability for junior water right holders, while at the same time reducing drought-caused vulnerabilities for senior water right holders (**Figure B-2**). Senior water rights may consist of privately held, adjudicated water rights or instream flow water rights held by the State, which have been established by rule (**Figure B-3**). In adjudicated basins<sup>41</sup>, senior water right holders may ask the state to curtail junior water rights

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<sup>41</sup> Ecology maintains a registry of adjudicated watercourses at:

[http://www.ecy.wa.gov/programs/wr/rights/Images/pdf/adj\\_complete\\_inc\\_petioned.pdf](http://www.ecy.wa.gov/programs/wr/rights/Images/pdf/adj_complete_inc_petioned.pdf). A map of adjudicated areas is available at: <http://www.ecy.wa.gov/programs/wr/rights/Images/pdf/State-Adj-Map-03042016.pdf>.

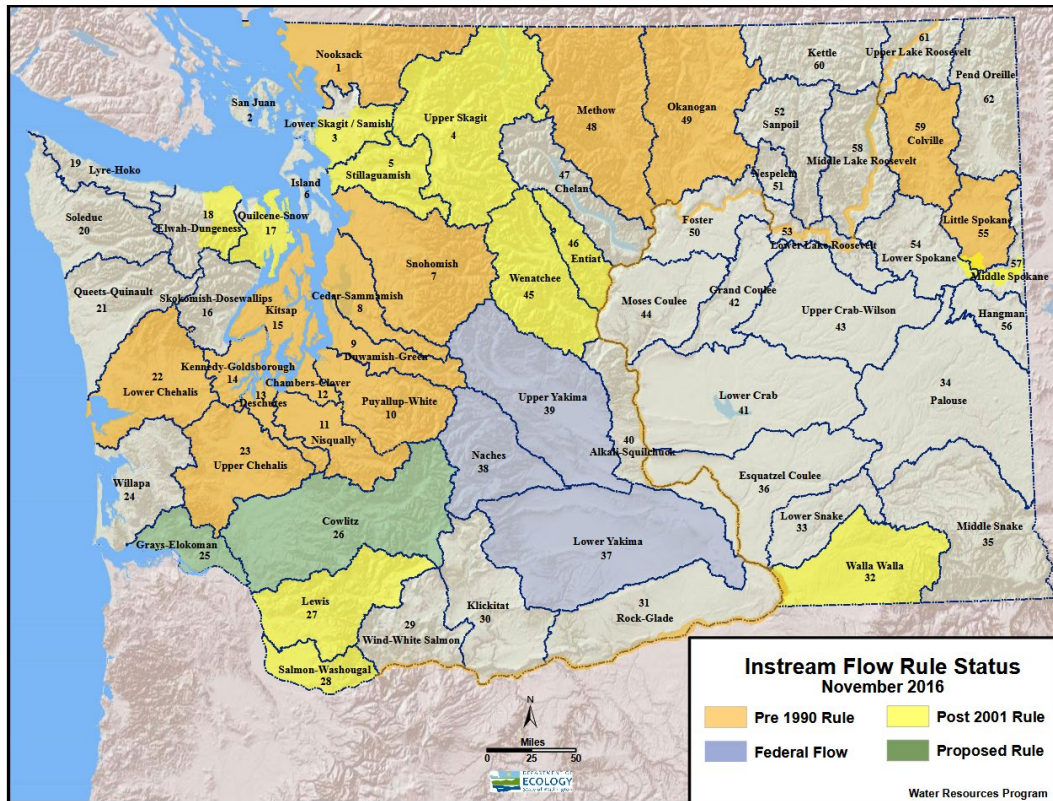


Figure B-2. Water Resource Inventory Areas where water rights were curtailed in the 2015 drought.

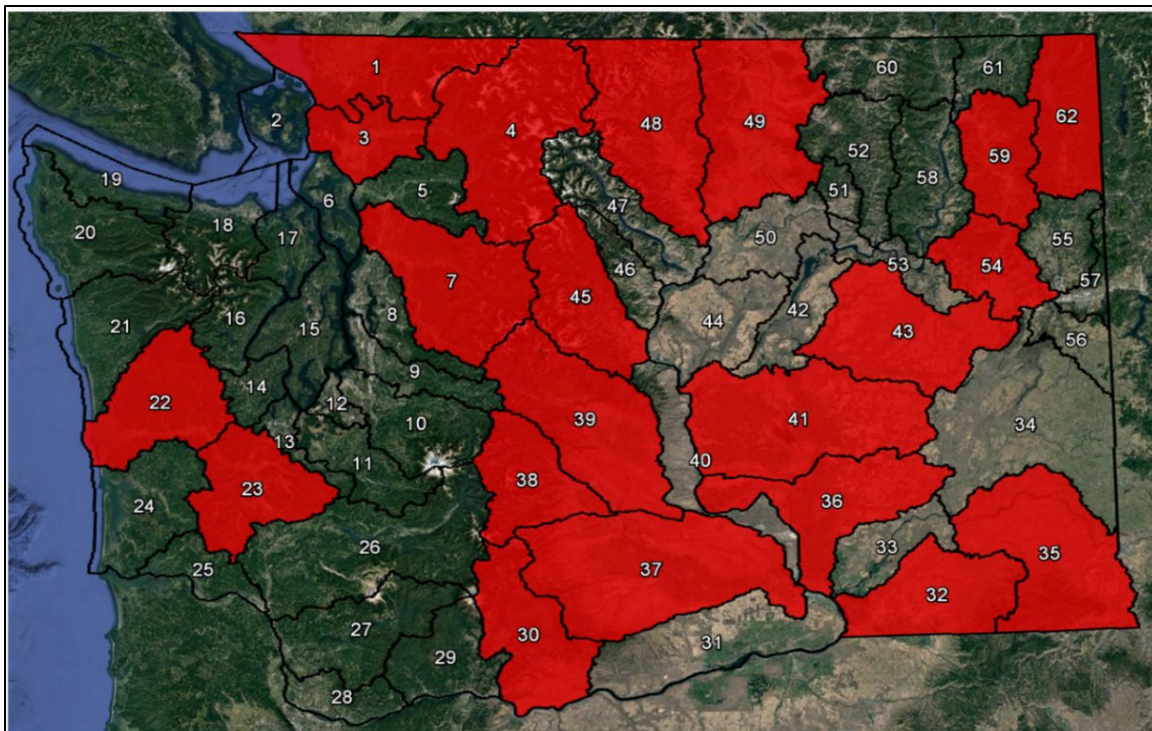


Figure B-3. Statewide map indicating watersheds where instream flow have been established by rule, or proposed for rulemaking, including WRIA identification number.

when they are unable to access their full water right. Curtailment is not a rarity even in years without a state-declared drought, because the sum of appropriations may exceed the amount of water naturally available (e.g., Walla Walla, Yakima, Chamokane near Spokane, Harvey Creek in the Okanogan).

The numbers of water right holders curtailed in any year will vary depending on whether a senior water user makes a call for water or streamflows drop below an instream flow rule threshold. In 2015, close to 900 water rights were curtailed in areas depicted in **Table B-5**.

Although Ecology has not been tracking the year-to-year number of curtailed water rights, the number curtailed in 2015 probably exceeds that of other years. In 2015, Ecology reported that curtailments began earlier than normal, and were in effect for a longer period. The 900 water rights curtailed represents a small percentage of the approximately 225,000 water right records (permits, certificates, and claims) contained in Ecology's water right database. This is largely because Ecology did not start adopting instream flows until the late 1970s/early 1980s. Instream flow regulations are therefore junior to most water rights. If more water rights are issued in basins with instream flow regulations, the number of water rights curtailed in low water years is likely to increase.

**Table B-5. Number of curtailed water rights by watershed during the drought of 2015**

| <b>Region</b>   | <b>Curtailed Water Rights</b> |
|---|-------------------------------|
| <b><i>Northwest Region</i></b>                                |                               |
| Nooksack River basin  | 9                             |
| <b><i>Southwest Region</i></b>                                |                               |
| Upper/Lower Chehalis River basin                              | 93                            |
| <b><i>Central Region</i></b>                                  |                               |
| Okanogan/Similkameen rivers                                   | 101                           |
| Wenatchee basin   | 91                            |
| Methow basin  | 70                            |
| Yakima basin  |                               |
| Post 1905 rights  | 18                            |
| Teanaway  | 55                            |
| Teanaway 2 <sup>nd</sup> notice (earlier priority date group) | 32                            |
| Cowiche Creek   | 74                            |
| Reecer Creel  | 4                             |
| Little Klickitat River  | 1                             |
| <b><i>Eastern Region</i></b>                                  |                               |
| Tucannon River/Asotin Creek                                   | 15                            |
| Harvey Creek  | 14                            |
| Colville River  | 58                            |
| Chamokane Creek   | 7                             |
| Cow Creek   | 20                            |
| Little Spokane basin  | 140                           |
| Touchet River basin   | 67                            |
| Yellow Hawk Creek   | 14                            |
| Walla Walla River basin                                       | 17                            |

## Vulnerability in the Yakima Basin

Steinemann and Fontaine (2009) found that irrigated agriculture in south-central Washington with junior irrigation water rights had an above-average vulnerability ranking. This geographic area includes the Yakima Basin, which consists of substantial portions of Kittitas, Yakima, and Benton Counties. The majority of emergency water right permitting actions in prior drought years has been to address water supply needs in the Yakima Basin.

The Bureau of Reclamation (Bureau) operates the Yakima Project, consisting of five separate reservoirs in the Upper Yakima, Naches, and Tieton watersheds (Kachess, Keechelus, Cle Elum, Rimrock, and Bumping Lake reservoirs). At full capacity, these reservoirs store 1,065,400 acre-feet. They supply water to about 450,000 acres of irrigation land. Total out-of-stream water right entitlements in the Yakima Basin equal 2,406,917 acre-feet (Bureau of Reclamation 2011).

Meeting these needs requires a combination of natural runoff from snowmelt and precipitation, releases from storage, and recapture of return flow from irrigated land. Natural unregulated runoff for the Yakima River near Parker during the April-through-September period averages about 2.2 million acre-feet (Vaccaro 1986). The average annual unregulated flow of the Yakima River Basin at the Parker gauge totals approximately 3.4 million acre-feet, ranging from a high of 5.6 million acre-feet (1972) to a low of 1.5 million acre-feet (1977). About 330,000 acre-feet of return flow, as measured at Parker, is used to meet total water supply as well (the amount is more in wet years, less in dry years).

In years when storage and runoff are not sufficient to meet water demand, water is apportioned, in order of priority, among three classes of users:

- Non-proratable users possessing water rights senior to May 10, 1905 (date of Congressional authorization of the Yakima Project) – So far, water supply has been sufficient for these users to receive their full water supply in all years. Still, some users on tributaries upstream of the Yakima Project, with confirmed adjudicated rights, have been curtailed to protect other, more senior water rights.
- Proratable users with a priority date of May 10, 1905 – These include most of the Roza Irrigation District and Kittitas Reclamation District, and portions of other districts. Together, these districts account for 383,000 irrigated acres. These users receive reduced supply in drought years (Table 21).
- Junior users with a priority date after May 10, 1905 – These users receive no water in drought years.

Historic data regarding the effect of drought years on total water supply in the Yakima Basin has been fully documented in support of the Yakima River Basin Integrated Water Resource Management Plan (Yakima Integrated Plan). Through this process, a 70 percent proration level has been identified as an approximate threshold at which proratable irrigation districts and farmers begin to experience major economic losses (**Table B-6**) (Bureau of Reclamation 2011).

**Table B - 6. Yakima Project proration years and percentages**

| <b>Water Year</b> | <b>Proration Percentage</b> |
|-------------------|-----------------------------|
| 1992              | 58                          |
| 1993              | 67                          |
| 1994              | 37                          |
| 2001              | 37                          |
| 2005              | 42                          |
| 2015              | 47                          |

Source: Bureau of Reclamation Yakima Integrated Plan Final Programmatic EIS and August 2015 Water Supply Forecast

In no years, to date, have senior, nonproratable users received less than 100 percent of their water allocation from Reclamation, but this could change if droughts become more severe. Prorated users historically have been able to apply for emergency drought permits to make temporary use of groundwater withdrawals. In 2015, emergency withdrawals totaled about 2,000 acre-feet. The withdrawals are authorized for use only while the State-declared drought emergency is in effect.

The longer-term continuation of this practice is contingent on funding and consent by Tribal, Federal, and State water managers. Emergency groundwater pumping is an out-of-priority use of water in the Yakima Basin, and the hydrologic connection between groundwater and surface water has been well established scientifically (Ely, et al., 2011). Pumping of emergency drought wells risks impairment of other surface and groundwater water rights in the basin. As most of these wells are deep within basalt formations, the effect is presumed to be delayed for months or even years, but ultimately, the extraction of groundwater will result in a flow depletion.

In more recent droughts, Ecology, Reclamation, and the Yakama Nation have agreed that pumping may proceed under the condition that the State offsets the long-term impact of pumping on surface waters by permanently acquiring senior water rights in the basin. This agreement also requires users to record and report their withdrawals to Ecology (see Appendix F). This agreement must be re-affirmed with every new drought emergency.

The vulnerability of proratable users may increase if funding to purchase mitigation water is not made available in future droughts. Without mitigation, other water users could oppose the use of emergency withdrawals, notwithstanding the remarkable level of current water-management cooperation in the Yakima Basin. Due to these risks, the use of emergency wells is best viewed as a stop-gap measure until more permanent solutions are implemented. Long-term, the Yakima Integrated Plan is designed to reduce the vulnerability of proratable users in drought years through a combination of irrigation system upgrades, enhanced surface water storage, structural and operational changes, groundwater storage, and water markets (Bureau of Reclamation 2011).



## Vulnerability in Agriculture Statewide

More than \$10 billion worth of crops are grown annually each year in Washington State, which ranks first in the nation in the production of 11 different commodities. More than 300 commodity types are grown in total, at more than 37,000 farms. The overall value of the state's food and agriculture industry is \$51 billion, making agriculture 12 percent of the state economy. The top counties in market value are listed in **Table B-7**Error! Reference source not found..

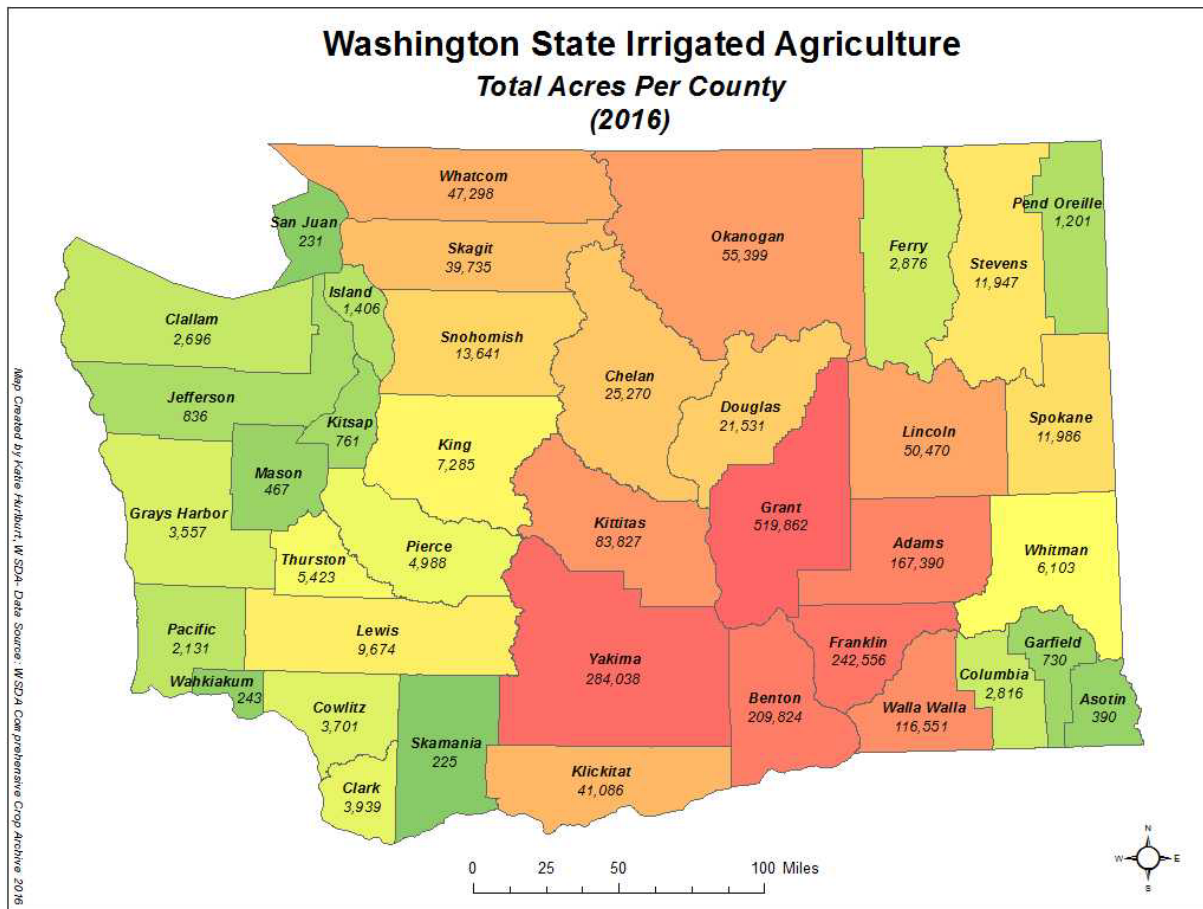
**Table B-7. Top agricultural counties in order of market value<sup>42</sup>**

| County      | Crops                              |
|-------------|------------------------------------|
| Grant       | Apples, cattle, potatoes           |
| Yakima      | Apples, milk, hay                  |
| Benton      | Potatoes, apples, grapes           |
| Franklin    | Potatoes, apples, hay              |
| Walla Walla | Cattle, wheat, apples              |
| Adams       | Potatoes, wheat, apples            |
| Whitman     | Wheat, barley, peas, and lentils   |
| Whatcom     | Milk, raspberries, blueberries     |
| Okanogan    | Apples, cherries, pears            |
| Skagit      | Nursery/greenhouse, milk, potatoes |

Estimates of irrigated acres in Washington State range from 1.6 million (2013 data, National Agriculture Statistics Service Census Survey Data) to 1.9 million acres (2015 data, WSDA crop mapping). Approximately one-quarter of those acres (464,000) are in the Yakima River Basin in Yakima, Kittitas, and Benton Counties. Another 671,000 acres are served by the Columbia Basin Project in portions of Grant, Lincoln, Adams, and Franklin counties. Most of the additional irrigated acres are located on the east side of the Cascades, as well. Reference **Figure B-4 and Table B-8**.

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<sup>42</sup> A complete map of the agriculture value of all counties in Washington, based upon 2012 USDA Agriculture Census Data, is available at <http://agr.wa.gov/AgInWa/docs/126-CropMap2015-ForCopier.pdf>



**Figure B-4. Washington State acres of irrigated agriculture by county map**

**Table B-8. Acres of irrigated agriculture by county**

| County       | NASS (2012) | WSDA (2016) |
|--------------|-------------|-------------|
| Adams        | 127,046     | 167,390     |
| Asotin       | 482         | 390         |
| Benton       | 197,305     | 209,824     |
| Chelan       | 22,778      | 25,270      |
| Clallam      | 4,164       | 2,696       |
| Clark        | 3,721       | 3,939       |
| Columbia     | 4,083       | 2,816       |
| Cowlitz      | 7,556       | 3,701       |
| Douglas      | 18,311      | 21,531      |
| Ferry        | 2,823       | 2,876       |
| Franklin     | 207,151     | 242,556     |
| Garfield     | 795         | 730         |
| Grant        | 428,200     | 519,862     |
| Grays Harbor | 8,635       | 3,557       |

| <b>County</b> | <b>NASS (2012)</b> | <b>WSDA (2016)</b> |
|---------------|--------------------|--------------------|
| Island        | 1,586              | 1,406              |
| Jefferson     | 1,179              | 836                |
| King          | 4,122              | 7,285              |
| Kitsap        | 495                | 761                |
| Kittitas      | 66,908             | 83,827             |
| Klickitat     | 21,748             | 41,086             |
| Lewis         | 8,235              | 9,674              |
| Lincoln       | 34,655             | 50,470             |
| Mason         | 777                | 467                |
| Okanogan      | 51,723             | 55,399             |
| Pacific       | 2,487              | 2,131              |
| Pend Oreille  | 903                | 1,201              |
| Pierce        | 2,834              | 4,988              |
| San Juan      | 343                | 231                |
| Skagit        | 19,239             | 39,735             |
| Skamania      | 352                | 225                |
| Snohomish     | 5,331              | 13,641             |
| Spokane       | 10,286             | 11,986             |
| Stevens       | 6,690              | 11,947             |
| Thurston      | 5,309              | 5,423              |
| Wahkiakum     | 48                 | 243                |
| Walla Walla   | 91,108             | 116,551            |
| Whatcom       | 35,484             | 47,298             |
| Whitman       | 4,293              | 6,103              |
| Yakima        | 224,386            | 284,038            |
| <b>TOTAL</b>  | <b>1,633,571</b>   | <b>2,004,090</b>   |

### **Impacts to Agriculture from the 2015 Drought**

The WSDA Natural Resources Assessment Section (NRAS), at Ecology's request, conducted an analysis of the 2015 harvest and drought impacts (Washington State Department of Agriculture 2017). It is summarized here:

Regional highlight areas were the Kittitas Reclamation District, the Roza Irrigation District, the Wapato Irrigation Project, and Skagit County. WSDA collected data in these regions through targeted mapping, anonymous interviews, and information collected by Washington State University's Skagit County Extension. In addition to the regional highlight areas, WSDA reviewed data from the USDA's National Agricultural Statistics Service for a selection of 15 crops, which account for 77.5 percent of the cultivated acreage in Washington. NRAS staff assessed the drought's impact on dairy and cattle operations in Washington, as well as through



an online survey focusing on increased expenses for feed purchase, lease of additional land for grazing, and productivity losses.

Based on information from commodity-specific and regional grower's groups, WSDA estimates Washington State blueberries grown from 2015 were reduced in yield, size, and quality, with losses of \$7.76 million. Red raspberries were reduced in both size and quality, with losses of \$13.9 million. Across the Yakima Valley, growers reported reductions in both yield and quality, increased fallowing, and changes in crop rotations. Some growers deferred planting permanent crops depending on access to emergency drought wells.

In the Kittitas Reclamation District, the analysis was based on targeted mapping work by WSDA, supported by district staff, and focusing on unharvestable or fallowed fields. The mapping survey included discussions with growers within the district to verify that damage was drought-related and gather qualitative information. Most of the damage was observed in timothy hay, alfalfa, and pasture, consisting of reduced cuttings on hays and dry pastures, and reduced grazing opportunities. Additionally, WSDA observed losses in apple, oat, pear, and other grass hays. The amount of acreage affected was paired with the 5-year average price per acre (2010 to 2014) to determine a total economic impact of \$11,401,115.

In the Roza Irrigation District, WSDA also conducted mapping work to identify unharvestable or fallowed fields, as well as anonymous individual interviews with growers to identify additional expenses incurred due to drought. Mapping results identified dry, dead, unharvestable, or fallowed fields in apricot, nectarine/peach, pear, triticale, and wheat. WSDA interviews with growers documented reduced size, quality, and yield in apple, cherry, hops, blueberry, wine grape, juice grape, field corn, and alfalfa. Growers also reported increased costs for pest and weed control, emergency drought wells, and expected continued impacts during the 2016 growing season. Total losses for the Roza Irrigation District growers are estimated at \$75,783,834.

WSDA conducted anonymous interviews with growers relying on water from the Wapato Irrigation Project. Growers reported losses in timothy hay, alfalfa, mint, carrot seed, wheat, apples, cherries, and potatoes, although losses were not consistent over the entire area. Based on consultation with the Wapato Irrigation Project board and growers, WSDA applied these losses to 90 percent of the acreage and estimated a total loss of \$32,691,211.

Information on drought effects in Skagit County were compiled by Washington State University's Skagit County Extension, which estimated a 10 percent loss throughout the county on average, with a total loss of \$27,200,000.

WSDA used data from the National Agriculture Statistics Service to identify additional losses across the state in a selection of crops that constitutes 77.5 percent of the total cultivated acreage in Washington. Data from 2015 was compared to historic results (2010 to 2014, 5-year average) for total crop acreage, price per acre, and yield per acre to assess losses due to reduced yield, reduced quality, or unplanted acreage. The 15 crops selected were wheat, barley, dry peas, lentils, apples, mint, dry beans, hops, sweet corn (processed), sweet corn (fresh), hay (excluding

alfalfa), pears, cherries, alfalfa, and field corn. Based on these three methodologies, losses of \$501,002,853 were estimated statewide.

WSDA, with the assistance of the Washington State Dairy Federation, invited dairy and cattle producers to respond to a short online survey about their location, operation size, and potential additional costs incurred through the purchase of feed, rental of additional grazing land, milk or calving losses, and the potential for continued increased costs or losses in 2016. Respondents reported purchases of additional feed, both timothy hay and alfalfa, leasing additional land for grazing, and reductions in milk production. These results were extrapolated to all dairy producers based on advice from the Washington State Dairy Federation. Because there were relatively few responses from cattle producers, the analysis was not extended to the cattle industry in Washington. Total losses to the dairy industry are estimated at \$33,279,564.

WSDA concludes that the estimated economic loss due to the 2015 drought reached between \$633 million and \$773 million. WSDA recommends that this report serve as a starting point rather than a final summary.

Among the agency's recommendations is that an assessment should be conducted of the statewide distribution of irrigation districts, identifying which growers rely on surface and groundwater, which have water rights that are susceptible to curtailment in low water years, and where access to emergency drought wells exists. In addition, now is the time to develop a robust plan for continued data collection. Identifying strategies for collecting needed data and ongoing analysis will give Washington State the ability to assist growers and plan for a future that includes increased incidence of severe weather events, such as the 2015 drought.

## **Vulnerability of Fish and Wildlife**

Fish populations are an important aspect of Washington State's economy, ecology, and quality of life. For Indian tribes, fish are culturally and economically significant. Most Tribes have treaty rights that grant fishing rights, and in some cases, at least 50 percent of the harvestable fish. Many specific salmon stocks are considered threatened or endangered pursuant to the Federal Endangered Species Act. Annual economic activity associated with commercial and sport fishing in Washington State totals \$2.5 billion annually. More than 175 million salmon, steelhead smolt, trout, and warm-water fish are reared at state hatcheries for release into Washington waters each year.

Steinemann and Fontaine's (2007) analysis indicated that fish are highly vulnerable to drought conditions in nearly all regions of the state. Vulnerability was classified as lower in southwest Washington and the Olympic Peninsula than in other regions of the state, which may reflect that low streamflows were most evident on the east side of the mountains in the 2001 and 2005 droughts (see Appendix E Runoff Patterns). Fish managers throughout the state reported that, in most years, fish are negatively affected by water withdrawals from streams and alteration of the natural hydrograph. These deleterious conditions can be magnified by drought, resulting in additional stress and increased mortality of adult fish migrating upstream, juvenile fish migrating

downstream, and resident fish populations. High air temperatures, in conjunction with lower flow volume, may cause water temperatures to increase, placing additional stress upon fish.

WDFW has identified a list of fish and wildlife vulnerabilities, which are described below. The vulnerabilities are classified according to whether they affect fish in their natural habitat, fish in hatcheries, or terrestrial wildlife.

### **Effects of 2015 Drought on Columbia River Fisheries**

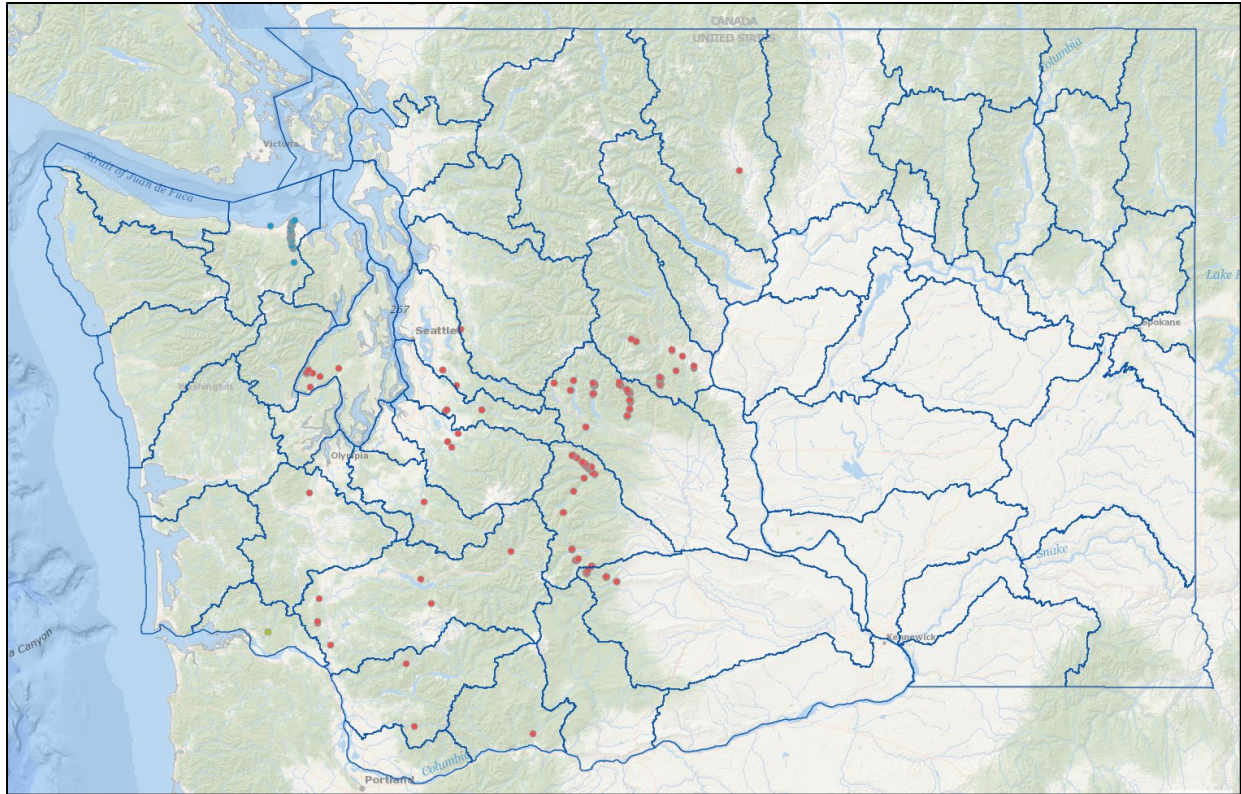
The 2015 drought demonstrated the importance of water temperature during drought conditions. In the mainstem Columbia and Snake Rivers, unprecedented high temperatures led to catastrophic loss of sockeye fish in the Columbia River system (Columbia Basin Fish and Wildlife Bulletin 2015). Temperatures in the Okanogan River reached 85° F, significantly above the lethal threshold of 68° F (Fish Passage Center Memorandum 2015).

NOAA Fisheries concluded that, "...although June and July river temperatures in 2015 were unprecedented, it is reasonable to expect that similar events could occur in the future. If rare, events are unlikely to have a large or lasting impact to the viability of sockeye salmon populations because their complex life histories provide resiliency against catastrophic events. However, should similar events occur frequently, sockeye salmon populations in the Columbia River basin would be substantially impacted" (Northwest Power and Conservation Council 2016).

### **Evidence of Blockages and Rock Dams from 2015 Drought**

During the 2015 Drought, observed April-through-September runoff at many USGS stations was the lowest observed in the prior 64 years (Northwest River Forecast Center, Natural Flow Runoff Ranks). WDFW biologists and field staff recorded approximately 312 locations in 17 watersheds where migratory movement of fish in rivers and streams was impeded by the low-flow constrictions or human-made recreational rock dams (e.g., locations where boulders have been rearranged to create wading pools) (**Figure B-5**). These rock dams, if left in place, can prevent fish from moving up and down a stream corridor, particularly if they span an entire channel. WDFW and Tribal biologists, Conservation Corps workers, and volunteers removed boulders and restored connectivity to the stream reaches.

Reported locations do not represent a comprehensive survey of blockages, only those locations observed by or reported to WDFW. It is reasonable to assume that the extent and number of blockages resulting from extreme low summer runoff was more extensive than reported and that, in rivers where flow-related constrictions form even in normal years, such barriers manifested themselves earlier in the season than average.



**Figure B-5. Locations of reported stream blockages in 2015 (WDFW)**

## Public Water Supplies

More than 5.5 million Washington State residents, 85 percent of the state's population, get their drinking water from public water systems. The remainder are dependent on individual private wells. Large water systems (those with more than 1,000 service connections) and new Group A community water systems in Washington State are required to prepare water system plans that are reviewed and approved by the State Department of Health. Smaller water systems must develop and implement a Small Water System Management Program, but these plans are subject to less oversight and do not require Department of Health's approval.

Public water systems are required to demonstrate that existing and projected demand can be safely and reliably met. Therefore, the drinking water sector is generally well-prepared for drought conditions. All water systems with more than 1,000 connections are required to prepare water shortage response plans, which describe how a system manager will gradually escalate the level of response from advisory, to voluntary, mandatory, and emergency reductions in water use. Other public water systems are required to prepare water shortage response plans if they are experiencing or anticipate experiencing shortages. A water shortage can be any situation in which water supply is inadequate to meet demand. Causes may include drought, but also other circumstances like water contamination, loss of power, and equipment failures.

Water systems are not required to notify the Department of Health if a formal water shortage response strategy is activated. The lack of systematic tracking of shortage incidents may lead to

an under-awareness of the stresses faced by communities and small systems in times of drought. Currently, awareness largely depends on ad-hoc communication with utility managers, word of mouth, and media reports. Nevertheless, there have been few reports of water systems encountering serious water supply challenges (i.e., risk of significant or total loss of supply) in previous droughts. Those that are reported have included the drying up of spring sources, declining water levels in shallow wells, stressing of existing system vulnerabilities, reduced reservoir storage, and difficulty meeting demand while abiding by diversion constraints associated with instream flow protection measures.

Less than 5 percent of emergency drought permits issued in the 2001, 2005, and 2015 droughts were for municipal purposes. Still, some municipalities reported implementing other coping measures, such as the activation of emergency backup sources, storing water above normal pool levels in reservoirs, and activating voluntary or mandatory reductions of water use by water utility customers.

The Department of Health has developed a preliminary drought vulnerability assessment that can be used as a filter to identify water systems that are most vulnerable to drought-caused water supply interruptions (**Table B-9**). This filter considers the following factors:

- Individual source susceptibility: a qualitative rating that evaluates each water source's depth, construction, aquifer characteristics (thickness, confined or unconfined), age, use, and capacity.
- System aggregate sources' capacity (combined capacity for multiple sources), operational capacity (system size and population), and redundancy. (System size serves as a rough proxy of resources and management capacity.)
- Where information is unknown or unavailable, a moderate level or higher level of risk is assigned.

**Table B-9. Number of systems considered more susceptible to drought vulnerabilities (Health)**

| <b>Description from DOH Sentry Database</b>   | <b># of Systems</b> | <b>Drought Risk</b> |
|---|---------------------|---------------------|
| Group A systems with a single source and depth between 1 & 50 ft.   | 232                 | Tier 1 A            |
| Group B systems with a single source and depth between 1 & 50 ft.   | 1046                | Tier 1 B            |
| Group A systems with combined source capacity less than 10 gallons per minute. This includes all Group A system types: community, NTNC, & TNC. This also includes systems with only a single source.  | 263                 | Tier 2 A            |
| Group B systems with combined source capacity less than 10 gallons per minute. This includes systems with only a single source.   | 2029                | Tier 2 B            |
| Group A systems with a single source & depth between 51 & 100 ft.   | 533                 | Tier 3 A            |
| Group B systems with a single source & depth between 51 & 100 ft.   | 2992                | Tier 3 B            |
| Group A systems with combined source capacity greater than 10 gallons per minute & less than 20 gallons per minute. This includes all Group A system types: community, NTNC, and TNC. This also includes systems with only a single source. | 237                 | Tier 4 A            |
| Group A systems with zero or missing source capacity. This includes all Group A system types: community, NTNC, and TNC. This also includes systems with only a single source.   | 118                 | Tier 5 A            |
| Group B systems with combined source capacity greater than 10 gallons per minute and less than 20 gallons per minute. This includes systems with only a single source.  | 1940                | Tier 4 B            |
| Group B systems with zero or missing source capacity listed. This includes systems with only a single source.   | 966                 | Tier 5 B            |
| Group A systems with a single source & no depth listed  | 193                 | Tier 5 A            |
| Group B systems with a single source where the depth listed is blank or zero  | 1379                | Tier 5 B            |

Tiers denote level of vulnerability (lower number = greater vulnerability)

A or B refers to Water System Class (Group A or B). Group A systems are those systems which have 15 or more residential connections.

NTNC = Non-Transient, Non-Community: A public water system that regularly supplies water to at least 25 of the same people at least 6 months per year. Some examples are schools, factories, office buildings, and hospitals, which have their own water systems.

TNC = Transient Non-Community Water System (TNCWS): A public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time.

## Energy

Washington relies on hydroelectric power for about 66 percent of its electricity supply (years 2000 to 2015), and the availability of hydroelectric power varies significantly from year to year. This variation in hydroelectric output is due to year-to-year variations in precipitation, especially during the fall and spring. Some precipitation is stored in the form of snowpack. As the snow melts in the spring and summer, the operators of hydroelectric facilities manage the runoff to meet multiple objectives, including power generation, fish passage, flood control, and irrigation. In most years, the spring and summer runoff is greater than the capacity of the hydroelectric system to generate electricity or store the water behind dams, and some water is spilled over the dams without generating electricity.

Drought conditions in the summer affect power generation by reducing the amount of stored water that is available to generate electricity. The actual reduction in water entering the state's rivers as rainfall is a small factor in the drought effect. The more significant effect of drought is that fish passage requirements become a constraint on the amount of water available for generation. For example, in 2001, drought conditions prompted modifications to the operations of hydroelectric projects to ensure compliance with Federal requirements to protect threatened and endangered species of salmon and steelhead.

Drought conditions would not be expected to endanger the adequacy of electric power supplies in the state. This is because the operators of the regional power system incorporate critical-year, low-water conditions in planning for electric power resource adequacy. These conditions are based on the worst precipitation years in the historical record. Utilities maintain enough non-hydropower capacity – including natural gas, coal, nuclear, and wind – to meet projected consumer demand during adverse hydrologic conditions.

Relative to total supply, hydroelectric energy's share has been declining over the past 14 years, as a greater share has been taken up by other sources such as natural gas and wind. These trends are illustrated in **Figure B-6** below, provided by the Northwest Power Planning Council.

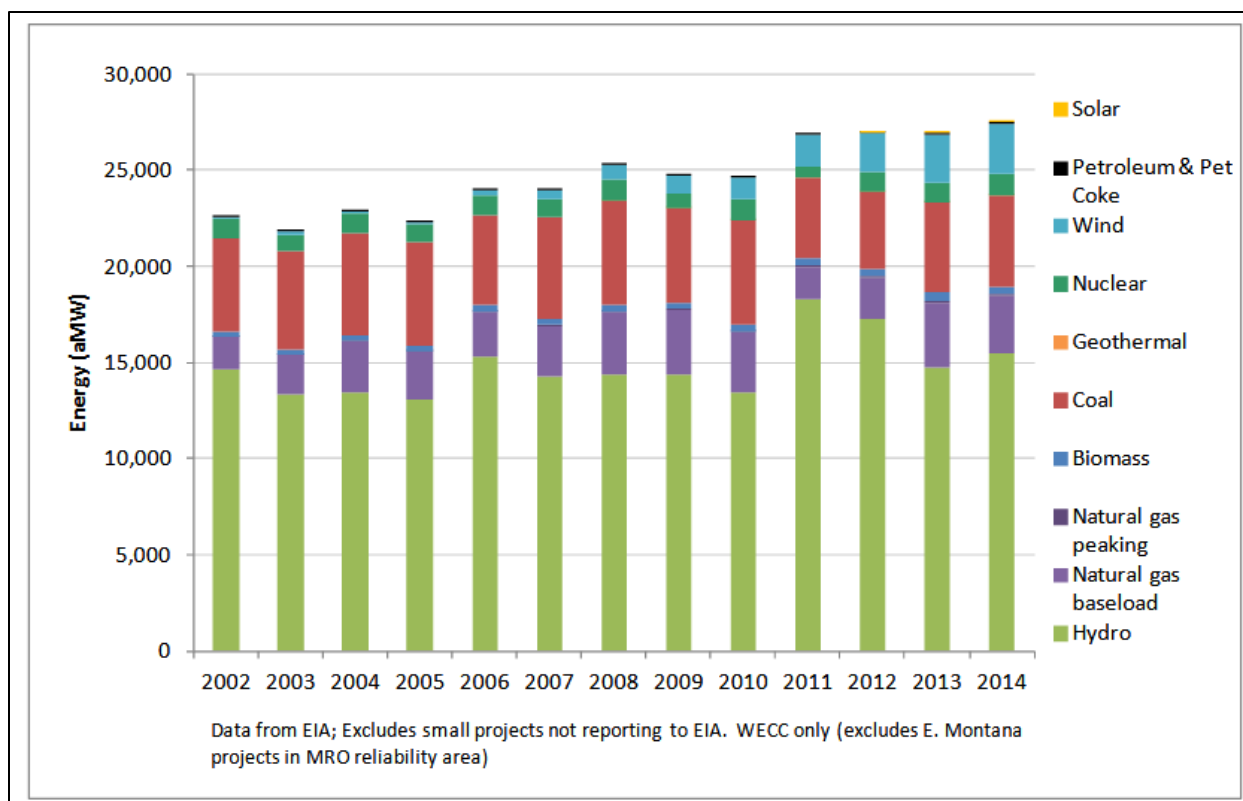


Figure B-6. Historical energy production in the Northwest since 2002

## Recreation

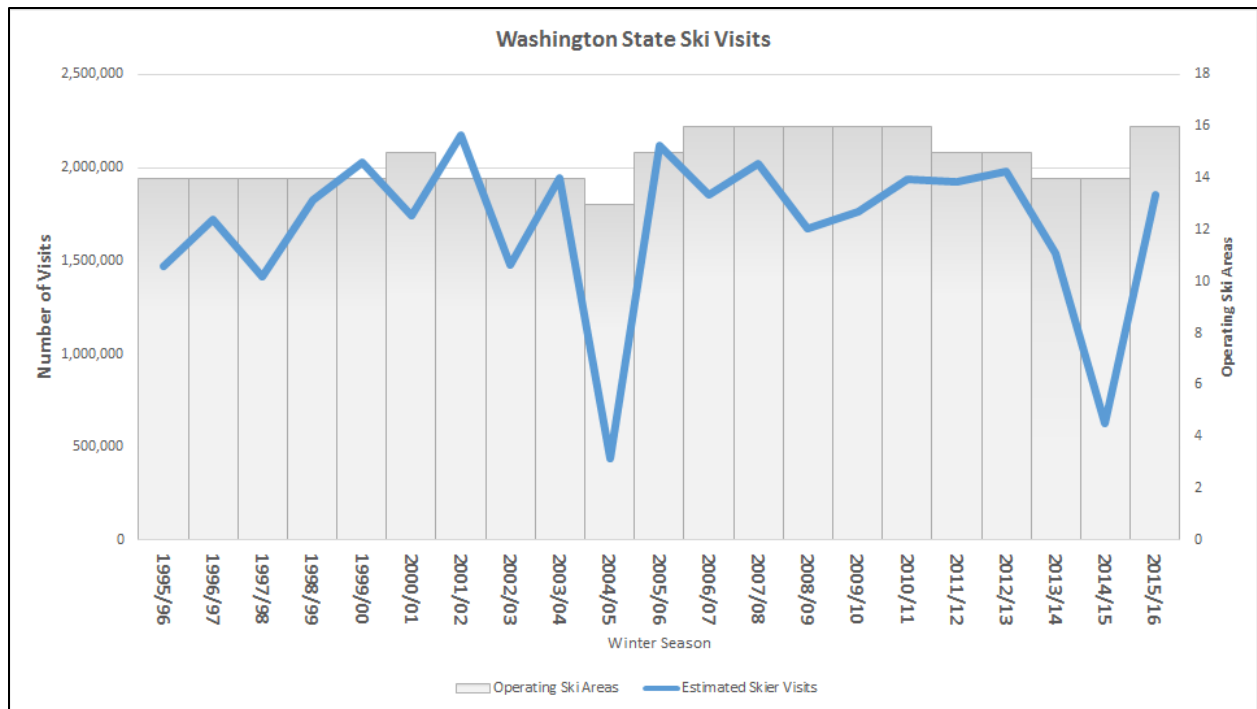
### Skiing and Snowboarding

Winter sports such as skiing, snowboarding, and snowmobiling have a high vulnerability because of their reliance on snowpack accumulation. Snowmaking machines can provide some compensation, but their effectiveness is diminished in warm winters. Other strategies include using machinery to concentrate snow where ski runs need it and diversifying into recreational activities suitable for summer months, such as mountain biking, hiking, sightseeing, and slides. Information regarding visits to ski resorts was provided by the National Ski Areas Association and is depicted in **Figure B-7**.

In years of major snow droughts, visitation dropped significantly. In the winter of 2004-2005, visitation to Washington State ski resorts dropped by 1.5 million visits from the prior year, a decrease of 77 percent.

During the 2014-2015 winter, visitation numbers dropped by more than 900,000 visits from the previous year, a decrease of 59 percent. For 6 of 12 measurement stations located at or near ski resorts, 2015 ranked as having the least snow depth ever measured on April 1 (**Table B-10**, Northwest Avalanche Center Snow Climatology Data 2016).





**Figure B-7. Washington State ski visits (Source: National Ski Area Association)**

**Table B-10. April 1 snow depths at select Washington and Oregon Ski resorts (inches)**

| Resort              | Climate average depth | Maximum depth (thru 2016)/year |      | Minimum depth (thru 2016)/year |      |
|---------------------|-----------------------|--------------------------------|------|--------------------------------|------|
| Hurricane           | 105                   | 252                            | 1999 | 12                             | 2015 |
| Mt Baker            | 173                   | 311                            | 1999 | 17                             | 2015 |
| Stevens             | 100                   | 192                            | 1956 | 22                             | 2015 |
| Snoqualmie          | 85                    | 170                            | 1956 | 2                              | 1992 |
| Stampede            | 99                    | 183                            | 1956 | 17                             | 1992 |
| Mission             | 46                    | 86                             | 1983 | 0                              | 2015 |
| Crystal             | 71                    | 144                            | 1999 | 66                             | 1941 |
| Paradise            | 174                   | 327                            | 1956 | 66                             | 1941 |
| White Pass          | 55                    | 110                            | 1997 | 0                              | 1992 |
| Timberline (Oregon) | 161                   | 300                            | 1999 | 57                             | 2015 |
| Meadows (Oregon)    | 127                   | 199                            | 2008 | 33                             | 2015 |

## Sno-Park Permits

Washington State Sno-Park permits are required for the use of more than 120 designated parking areas that provide access to cross-country skiing, snowshoeing, and snowmobile trails in Washington State. The Washington State Department of Parks provided permit and revenue data for Sno-Park areas in the state for four winter seasons. Purchases of Sno-Park permits during the 2014-2015 winter season were down considerably from the previous winter. That winter also

had experienced below normal snowpack conditions until conditions dramatically reversed in February. Both years experienced lower permit sales and accompanying revenue compared to years with more normal snowpack conditions (**Table B-11**).

**Table B-11. Sno-Park permit sales 2012 through 2016**

| <b>Winter Season</b> | <b>Total Permit Sales</b> | <b>Total Revenue</b> |
|----------------------|---------------------------|----------------------|
| 2012-2013            | 33,089                    | \$1,048,140          |
| 2013-2014            | 21,035                    | \$679,460            |
| 2014-2015            | 13,033                    | \$455,120            |
| 2015-2016            | 38,322                    | \$1,176,540          |

The National Park Service did not open its snow-play, downhill sledding area at the Paradise Visitor Center on Mt. Rainier at all during the winter of 2014-2015, because snow never reached the minimum required depth of 60 inches.

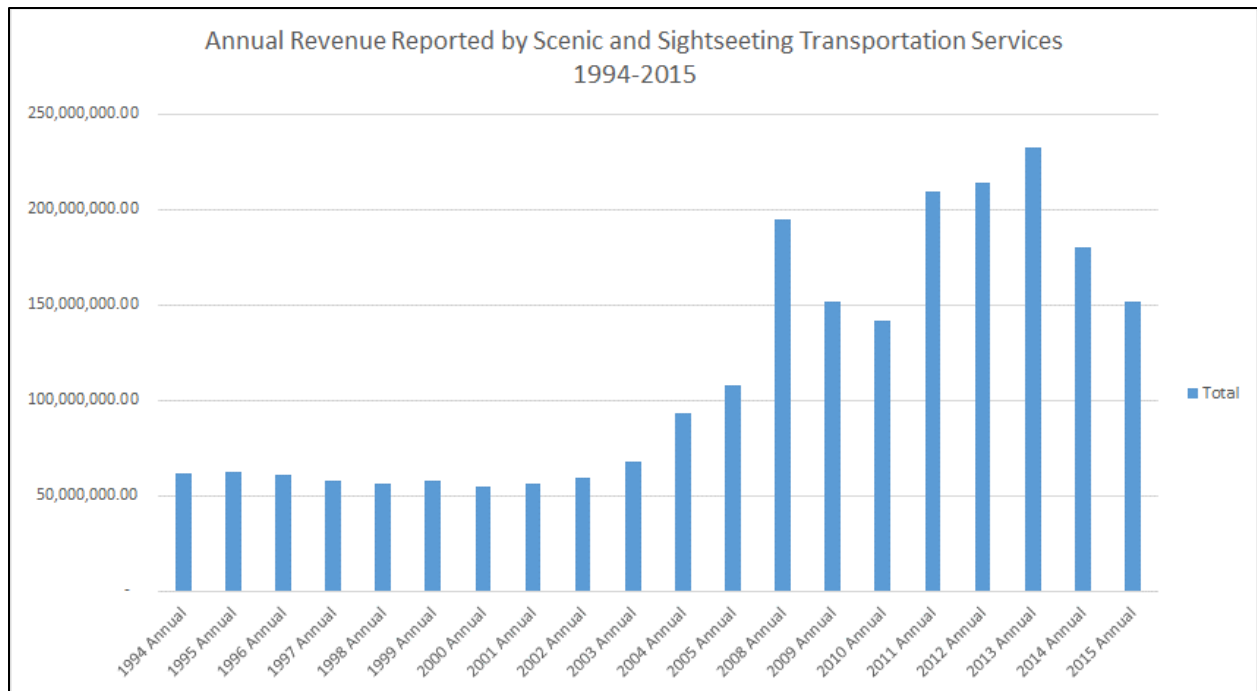
## **River Recreation**

Visitation numbers for recreational river guiding services were not available for this plan. The state Department of Revenue collects reported business income for water-related scenic and sightseeing businesses (NAICS 4872)<sup>43</sup>. This sector includes whitewater rafting companies and activities like dinner and sightseeing cruises. Whitewater recreation is dependent on sufficient flow for riverine navigation and challenge. Cruises occur on larger rivers and bodies of both fresh and saltwater, where the primary concerns are dock and moorage access and sufficient navigational depth.

It is not possible, using NAICS data, to determine specifically how whitewater businesses fared in 2015 compared with other years. Aggregate revenue for all water-related scenic and sightseeing businesses is depicted in **Figure B-8**. Overall revenue in 2015 was down significantly, but it is unclear whether this can be attributed to drought conditions or other factors. A survey of individual businesses is beyond the scope of this analysis. One press report profiled a rafting company in Wenatchee, which adapted to low water conditions by marketing rental opportunities for paddleboards and inner-tubing, even offering to shuttle clients back upriver so they could re-run stretches of the river (KING5 News, 2015).

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<sup>43</sup> The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for collecting, analyzing, and publishing statistical data related to the U.S. business economy.



**Figure B-8. Annual revenue reported by scenic and sightseeing transportation services (based on 2016 Department of Revenue data)**

Reduced runoff during low snowpack years also affects the availability of flows suitable for individual whitewater enthusiasts. The American Whitewater Affiliation provided a summary of the 2015 Drought impacts to the 10 most popular whitewater rivers in the North Cascades. For these rivers, whitewater boater opportunities were “substantially impacted with summer opportunities effectively unavailable” (Department of Revenue 2016). This analysis identified the date at which the descending limb of the snowmelt hydrograph dropped below optimal flow, compared to an average year (**Table B-12**). “In 2015 all these rivers had substantially shorter seasons with many of the rivers below optimal flow shortly after Memorial Day.” As the table below summarizes, optimal flows became unavailable a few weeks to 3 months earlier than usual and, for some rivers, flows never reached a level suitable for boating.

**Table B-12. Whitewater flow availability, average year versus 2015 drought**

| <b>River name and segment</b>  | <b>Average date of drop</b> | <b>Date in 2015 Drought</b> |
|--|-----------------------------|-----------------------------|
| Wenatchee, Leavenworth to Monitor  | July 31                     | June 14                     |
| Skykomish, Index (Sunset Falls) to Railroad Bridge                         | July 20                     | May 31                      |
| Skykomish, Railroad Bridge to Big Eddy                                     | July 20                     | May 31                      |
| Snoqualmie, Middle Fork, Concrete bridge to Tanner (Middle-Middle)         | July 16                     | April 5                     |
| Sauk, Whitechuck River to Darrington                                       | August 20                   | June 13                     |
| Skykomish, N. Fork, Bear Creek (Drumbeater) to South Fork confluence       | June 8                      | Never reached optimal flow  |
| Wenatchee, Tumwater Campground to Leavenworth (Tumwater Canyon)            | September 8                 | July 13                     |
| Nooksack, N. Fork, Douglas Fir Campground to Mt. Baker Highway milepost 27 | September 9                 | July 12                     |
| Sultan, Powerhouse to Fishing Access                                       | Meets flows all year        | May 22                      |
| Methow, McFarland Creek access to Pateros (Black Canyon)                   | August 2                    | July 3                      |

## Groundwater

Ecology investigated the impacts of the 2015 drought on groundwater levels in Washington. On the west side of the mountains, only two Ecology monitored wells (near Sequim in the Dungeness watershed) exhibited 2015 water levels that consistently fell below the wells' normal water level range. Both wells have experienced significant ongoing water level declines in recent years, however. This suggests that their-lower-than-normal water levels in 2015 may not be drought-related, but rather reflective of changes in water management practices – in this case, converting from open-ditch systems to pressurized pipes, which reduced the amount of leakage to shallow aquifers and caused water levels to drop. The 2015 water levels for other west-side wells varied by month and ranged from slightly above to slightly below normal values. Collectively, these data suggest the drought had little overall impact on groundwater levels/storage in monitored wells west of the Cascades.

On the east side of the Cascades, particularly in the greater Yakima and Columbia Basins, substantial ongoing declines in groundwater levels/storage have occurred in recent decades. Consequently, the spring 2015 water levels for a significant number of wells in these basins were already either below normal or at the lowest levels ever measured, even before the full brunt of the drought was felt. Similar responses were observed in water level networks managed by other organizations, including the U.S. Geological Survey, Walla Walla Basin Watershed Council, and the Palouse Basin Aquifer Committee.

Over all, Ecology found:

- The data indicate little impact of the drought on groundwater levels.
- The time lag between a drought's occurrence and corresponding water level responses (particularly in deep basaltic wells) makes it difficult to discern cause-and-effect relationships.
- It is often difficult to detect short-term, drought-related trends due to widespread regional groundwater declines.

However, detection of short-term drought influences from longer-term ambient water level trends are hampered by the lack of wells with consistent long-term (more than 10 years) monthly water level measurement histories. Long-term measurement records are essential for defining normal monthly water level ranges. Additionally, not all wells are consistently measured each year.

### **Puget Sound Water Supply Forum evaluation of groundwater impacts from drought**

The Puget Sound Water Supply Forum is a planning process comprising utilities in King, Pierce, and Snohomish Counties in the Puget Sound area. The cities of Seattle, Tacoma, and Everett, and the Cascade Water Alliance are the largest members. Collectively they serve a population of approximately 3,000,000 people, which is 40 percent of Washington State's population.

This process included a broad assessment of drought effects on groundwater supplies in King, Pierce, and Snohomish counties. Collectively, more than 900 wells are owned by water systems in the three counties. A Supply Forum survey of 45 different utilities indicated that only 8.33 percent of the respondents had ever had a groundwater supply not recover after seasonal recharge. Approximately 63 percent said that groundwater had always recovered. However, the study also noted that dry years can stress groundwater resources:

- Groundwater sources are generally more resilient to drought than surface water sources. Many groundwater sources appear to be relatively unaffected by short-term events. Nonetheless, there are drought conditions that can stress aquifers in the Puget Sound Lowlands.
- An extended, multi-year drought with low precipitation (not just low snowpack) would have the largest potential impact on groundwater resources. This would be especially problematic if the extended drought included hot, dry summers that increase demand and prompt larger withdrawals from aquifers. Hot, dry summers are less problematic if they are accompanied by normal rainfall in the ensuing fall and winter months. In this type of event, high demands may temporarily stress aquifers, but winter rains typically recharge the aquifers, so there is less of a cumulative impact.
- Finally, droughts consisting of low snowpack have the least impact on the region's aquifers because snowpack occurs at higher elevations that are outside the primary recharge areas. However, in a year with low snowpack, surface streams commonly

experience low flows, and this can indirectly limit water users' ability to pump from their wells. In addition, years with low snowpack can drive water users to pump aquifers more heavily where streamflow does not limit groundwater use, and this can put stress on aquifers, at least temporarily.

The forum identified three main physiographic regimes in the Puget Sound Lowlands: (1) major river valleys; (2) glaciated uplands; and (3) foothills/mountains. Aquifers in these different types of landforms vary somewhat in their response to drought, although broad patterns are similar and aquifers can be connected from one regime to another. The foothills/mountain aquifers are typically the most vulnerable, because they tend to be shallow or thin and store limited quantities of groundwater. However, these areas tend to have smaller population centers compared with the other two landforms. In the glaciated uplands, drought effects will be highly variable based on location and the particulars of the setting. By contrast, most of the major river valleys in the Puget Sound Lowlands have deep, unconsolidated sediments that can support aquifers with significant storage. Deep aquifers in the major river valleys, especially those at low elevations, where the valleys are often widest and deepest, will be the least vulnerable to drought (Puget Sound Water Supply Forum 2016).

# **UW Drought Project: Analysis of Drought Vulnerability and Adaptive Capacity.**

Excerpt from University of Washington Drought Project, 2007.

## **Vulnerability**

Vulnerability, in this study, will be defined as the susceptibility of a water user, a region, or a sector to drought hazard. Severity of drought hazards is based on the duration, magnitude, and spatial extent of drought impacts. Vulnerable sectors will be identified based on results of the impacts assessment performed in Phase 1 of this project. Vulnerability will consider two main factors: (1) frequency and severity of previous drought impacts, and (2) likelihood and severity of future drought impacts. In addition, adaptive capacity and the ability to mitigate impacts will be considered in the assessment of vulnerability.

## **Northwest**

### *Agriculture*

Prior impacts of drought to the agricultural community were described as minor. The primary challenge in meeting crop demands during drought occurs due to limitations of existing irrigation systems. Representatives from this sector with less robust irrigation systems are the most vulnerable to this type of drought impacts. Farmers may enhance their ability to cope with drought by predicting increasing plant demands in advance and making existing irrigation systems more robust.

When making decisions regarding row crops, one farmer reported planting crops in soils that have better moisture retention properties when drought is expected, though this is not likely to be a viable option for some farmers.

Dairy farmers in the region are affected by increased costs for feed. Production of feed onsite can also be reduced. Dairy farmers have limited capacity to adapt to increases in feed prices.

Golf courses in the region are especially vulnerable to use restrictions in cases where water is obtained from a purveyor. Golf courses have a considerable amount of adaptability when dealing with water shortage, including prioritizing watering locations, altering watering methods, and modifying horticultural practices. Interviewees from the golf course industry report that golfers are more accepting of dry hard grass than flooded soggy turf, further enhancing adaptive capacity of courses. The primary impact reported from droughts is over-watering, which is under the complete control of the golf course.

### *M&I*

No interviewees reported drought impacts to the M&I sector.

### *Environment*

The environmental sector is vulnerable to impacts caused by low stream flows. No interviewees identified significant environmental impacts during previous droughts. Challenges in meeting fish demands can occur during drought, and will be magnified by extractions from surface water.

## **Central West**

### ***Agriculture***

The green industry reports severe impacts from drought during previous years. In this unique case, the green industry is most vulnerable to the expectation of drought by customers during the spring rather than actual shortages during the summer. The green industry feels that they cannot exert control on operations of municipal supply. When drought is anticipated, they can increase efforts to ensure that potential customers form their water supply expectations on accurate information, rather than on perceptions (from the media).

Because nurseries plant much of their product several years in advance, they have limited adaptive capacity other than scaling back onsite operations when reduced sales are expected. Retail nurseries and residential landscape companies may adapt to drought by reducing labor costs and purchasing. These labor and purchasing reductions have secondary impacts within the community.

Golf courses in the region are especially vulnerable to use restrictions in cases where water is obtained from a purveyor. Golf courses have a considerable amount of adaptability when dealing with water shortage, including prioritizing watering locations, altering watering methods, and modifying horticultural methods. Interviewees from the golf course industry report that golfers are more accepting of dry hard grass than flooded soggy turf, further enhancing the adaptive capacity of courses. The primary impact reported from droughts is over-watering, which is under the complete control of the golf course.

### ***M&I***

The primary impact of drought on water purveyors is economic losses from reduced sales during use restrictions. Suppliers have some ability to adapt to these potential economic losses by creating reserve funds and modifying water management strategies to reduce the necessity for use restrictions. Management strategies cited by interviewees include using a dynamic rule curve, altering maintenance schedules, and optimizing the combined use of water sources. M&I water users are affected by use restrictions during drought. They may adapt to these conditions by changing their practices to ones that require less water, including gardening with drought tolerant plants.

### ***Environment***

The environmental sector is vulnerable to impacts of drought during all seasons of the year. Flexibility of the environmental sector is limited. Impacts can be reduced by increasing monitoring and maintenance of fish devices and using manual methods to transport fish. In some controlled watersheds environmental advisory boards have been formed to enhance coordination between M&I operations and fisheries demands. Coordinating supplemental flows from reservoirs with fish needs is another way the environmental sector adapts to drought.



## **Southwest/Olympic Peninsula**

### ***Agriculture***

Prior impacts of drought to the agricultural community in the southern portion of this region can be described as minor. The primary challenge in meeting crop demands for southern irrigators occurs due to limitations of existing irrigation systems. Representatives from this sector with less robust irrigation systems are the most vulnerable to this type of drought impact. Farmers may enhance their ability to cope with drought by predicting increasing plant demands in advance, and making existing irrigation systems more robust. Adaptive capacity of smaller farms is limited because of less ability to finance new projects. Irrigation districts in the northern portion of this region have reported some significant impacts from drought. The primary cause for these impacts is low stream flows. Farmers of cruciferous row crops, which are planted the previous fall and grown for seed, are drought tolerant and rarely impacted. Farmers of hay and alfalfa and farmers of perennial fruit trees have the least flexibility to respond to drought conditions because these crops are permanent and they require significant amounts of water late in the season to produce quality crops. In some cases decisions can be made to increase flexibility; farmers can decide not to plant additional fields or not to increase acreage of perennial crops when drought is expected.

Dairy farmers in the region are affected by increased feed costs or decreased feed production. Operations that rely solely on purchased feed are most vulnerable to impacts from drought, and also have extremely limited ability to adapt. Many dairy farmers in this region produce their own feed and are have more flexibility in their own operations to avoid increased costs. One method for reducing potential impacts is to leave alfalfa crops intact for another season, instead of rotating fields to corn.

Golf courses in the region are especially vulnerable to use restrictions in cases where water is obtained from a purveyor. Golf courses have a considerable amount of adaptability when dealing with water shortage, including prioritizing watering locations, altering watering methods, and modifying horticultural methods. Interviewees from the golf course industry report that golfers are more accepting of dry hard grass than flooded soggy turf, further enhancing adaptive capacity of courses. The primary impact reported from droughts is over-watering, which is under the complete control of the golf course.

### ***M&I***

No impacts of drought were reported in the M&I sector. Vulnerability of this sector to drought is currently low. Vulnerability to drought is likely to increase in areas experiencing population growth. Difficulty in procuring additional water rights has been identified in one location.

### ***Environment***

Some impacts to migrating fish have been reported in the Dungeness River, where irrigation reduces natural flows during the migration period. Flexibility exists to confront this problem. Coordinated irrigation reductions have proven to be effective at providing necessary flows for returning adults to migrate upstream.

## **North Central**

### ***Agriculture***

According to Weekly Drought Reports produced by the Washington Department of Ecology, several rivers in the North Central region, including the Wenatchee, Okanogan, Stehekin, Entiat, Chiwawa, and Similkameen Rivers, reported record-low daily stream flows during the 2005 growing season. Several of these rivers recorded daily record-low flows in multiple months. Despite these record-low river levels, growers of tree fruit reported only minimal impacts from drought. One interviewee reported that 2005 proved that water supply in the region is less vulnerable to drought than he had thought. Growers did face challenges meeting water demand during the 2005 drought. Some water use restrictions were imposed. This indicates that the agricultural sector is vulnerable to drought impacts during more extreme droughts. This vulnerability may increase as growth in the region increases. Tree fruit growers in the region have some capacity to adapt to water shortage. Options for reducing demand include increasing watering efficiency, widening weed control strips, alternating watering from one side of trees to another, limiting irrigation in the spring to reduce foliage development thereby reducing water demand in the summer, using heat reflective spraying, and removing marginal blocks of trees.

Dairy farmers in the region are affected by increased feed costs or reduced feed production. Operations that rely solely on purchased feed are most vulnerable to impacts from drought, and also have extremely limited ability to adapt. Dairy farmers that produce their own feed are less susceptible to drought impacts and have more flexibility in their own operations to avoid increased costs. In the North Central region one method for reducing potential impacts from water restrictions is to plant more drought tolerant forage crops.

Beef cattle ranchers reported experiencing some impacts from drought, including rangeland water supplies running dry before forage runs out and increased feed costs. Ranchers have some flexibility in range operations which allows adaptation to drought conditions. Herd size can be cut back to stay within the reduced carrying capacity for given range conditions, herd rotation can be increased (at increased costs), water can be supplied by truck (cattle are often inaccessible by truck), and production schedules can be altered.

### ***M&I***

No impacts were reported by the M&I sector; however, the water intake for the city of Cashmere was reported to be dangerously close to running out of water coverage. This indicates that future droughts could affect M&I supply in the region. Modification of intake levels or obtaining alternative supplies during extreme drought may be difficult and time consuming.

### ***Environment***

Impacts to fish have been reported in the North Central Region during previous droughts. These impacts include increased stress and in some years hundreds of returning Summer Chinook Salmon and Sockeye Salmon perish before spawning. The adaptive capacity of the environmental sector is increased in years where emergency drought funds are made available. Impacts to fisheries can be reduced by more intensive monitoring and management of fish

devices. Monitoring can also be performed on known problem areas in the river in order to identify stranded fish. Water can also be bought back from agricultural users returning some of the natural flow to rivers. When temperatures below Osoyoos Lake become high and tributaries of the Okanagan are dewatered, adaptive capacity decreases significantly.

## **South Central**

### *Agriculture*

The agricultural sector in the South-Central region is highly vulnerable to drought impacts. In 11 of the past 35 years water supply from the Yakima Project has not fully met the demands of irrigated agriculture. According to an interviewee, the Yakima Project was able to provide 42 percent of normal water supply to proratable water users in 2005. This is the third lowest final proration estimate in the last thirty years; however, preliminary proration estimates in March of 2005 predicted only 34 percent of normal water supply for proratable users, which would have been the lowest proration in 35 years.

Inability to meet agricultural demands in the Yakima Project has led to a variety of impacts to junior (proratable) water right holders. Impacts vary from farm to farm. Proratable users who farm hay or alfalfa realized fewer cuttings. Those that grew tree fruit reported reduced quality, and in some cases entire crops were lost.

In general operations growing exclusively apples have the least adaptive capacity. Apples require very large amounts of water in every season: to protect from frost in the spring, to produce fruit, and to protect fruit from heat and sun during the hottest summer days. When proration is low growers may struggle to keep the orchard alive; production of high quality crop is even more challenging.

On the other end of the spectrum, diverse operations have more flexibility, for example a farmer of tree fruit, wine grapes, and row crops is flexible in several ways. Firstly, wine grapes require three to four times less water than apples, so when proration is low, water from the grapes can be used to help insure tree fruit quality. In addition, row crop fields can be left fallow to concentrate water on the most profitable crops or those that represent the largest investment (fruit trees are usually both). In some cases, a certain section of trees may produce a variety of fruit that is only marginally marketable. In these cases, growers may opt to remove the marginal block of trees to conserve water for more marketable fruit. Growers can also invest in more efficient irrigation systems.

In addition to methods of managing water within farming operations, official drought declaration enables proratable users to apply for approval to transfer water between irrigation units on their own land, to lease water rights from others on a temporary basis, and for emergency water rights to drill new groundwater wells or reactivate existing emergency ground water wells. Farmers may also purchase extra land to fallow during drought years and transfer water to acreage with more valuable production.

Irrigation districts also have some capacity to adapt to drought conditions. Districts made up of proratable users may choose to purchase extra water from non-proratable districts, especially in

situations where the proratable farmers produce more valuable crops or cases where the proratable farmers grow perennial crops. Districts may also choose to shut down irrigation operations for short periods in order to conserve water for later in the summer when water is more essential for crop development.

During the 2005 drought, one proratable irrigation district was able to purchase enough water from senior districts to supply its users with approximately 49-51 percent of normal water supply rather than the normal 42 percent proration realized by proratable users who didn't obtain extra water. Trading was also used by this district during the 2001 drought, but with less success. In 2001, approximately 42-43 percent of normal supply was delivered rather than the 37 percent that would have been delivered otherwise.

Dairy farmers in the region are affected by increased feed costs or reduced feed production. Operations that rely solely on purchased feed are most vulnerable to impacts from drought, and also have extremely limited ability to adapt. Dairy farmers that produce their own feed are less susceptible to drought impacts and have more flexibility in their own operations to avoid increased costs. In the South Central region one method for reducing potential impacts from water restrictions is to plant more drought tolerant forage crops.

Beef cattle ranchers reported experiencing some impacts from drought including rangeland water supplies running dry before forage runs out and increased feed costs. Ranchers have some flexibility in range operations which allows adaptation to drought conditions. Herd size can be cut back to stay within the reduced carrying capacity for given range conditions, herd rotation can be increased (at increased costs), water can be supplied by truck (cattle are often inaccessible by truck), and production schedules can be altered.

Dryland farmers in the South Central region also experience impacts from droughts when crops don't receive adequate rain. Impact to dryland farmers may be increased if nitrogen is applied that plants can't consume due to drought. Dryland farmers have some adaptive capacity for dealing with drought. For example, quantities of nitrogen applied to crops are based on expectations for available moisture during the growing season. If more nitrogen is applied than the plant can use based on available water then investment in fertilizer is lost; if the crop cannot make use of all available water due to nitrogen deficiency, then potential yield is lost. With accurate predictions of available moisture during a growing season, farmers can avoid lost fertilizer investments or lost crop yields.

In the South Central region, various dryland crop cycles are used depending on average precipitation. In some cases, a winter wheat summer fallow two-year rotation is used; in other cases, a three-year winter wheat, spring wheat, summer fallow rotation is used. Other rotations combinations are also possible, but most dryland operations in Washington State include at least one rotation of winter wheat. Depending on available moisture in the soil before planting and seasonal moisture expectations, this planting cycle can be modified to reduce impacts of drought.

During winter wheat rotations, fall nitrogen applications can be reduced and, if winter moisture is higher than expected, crops can be side-dressed with additional nitrogen in the spring (this practice increases application costs). Spring crop rotations can be skipped if soil moisture and

precipitation expectations are too low. Dryland farmers may also place lands that perform poorly during dryer conditions into the Conservation Reserve Program. In most cases, the ability of dryland farmers to adapt to drought conditions depends on accurate determination of existing soil moisture and predictions of available precipitation during the growing season. In cases where production is extremely low, farmers may choose not to harvest if operation costs of the combine will be larger than revenue from wheat sales.

### ***M&I***

No M&I impacts were reported by interviewees. Vulnerability of the M&I sector can be expected to increase as populations in the South Central region grow.

### ***Environment***

The environmental sector experiences impacts from unnatural flows and reduced base flows on all years; these impacts are greatly magnified during drought. The environmental sector has some ability to adapt to drought conditions. This ability is enhanced by drought declarations, which make additional funding available to fisheries personnel for mitigation of impacts.

Fisheries organizations can reduce drought impacts by increasing monitoring and maintenance of fish devices, such as ladders and screens, in the system. Monitoring of trouble locations can also be increased to enhance ability to respond to stranded fish. Fish can be transported and fisheries personnel can make appropriate decisions regarding whether to allow fish migration into areas that may become dewatered later in the fall. A Systems Operation Advisory Committee (SOAC) has been established in the South Central region to advise operations of the Yakima Project on issues regarding fish. This organization makes recommendations to the USBR on flows that should be maintained during different seasons. These recommendations include recommendations for artificial spring freshets, minimum summer base flows, recommended flows during fall spawning that determine access of spawning fish to areas outside the main channel, and winter flows required to prevent redds from being dewatered.

## **East**

### ***Agriculture***

Agriculture in the East region is highly vulnerable to drought. Dryland farming operations in general are particularly vulnerable, as the water supply for these crops comes directly from precipitation. Impact to dryland farmers may be increased if nitrogen is applied that plants can't consume due to drought. Dryland farmers have some adaptive capacity for dealing with drought. For example, quantities of nitrogen applied to crops are based on expectations for available moisture during the growing season. If more nitrogen is applied than the plant can use based on available water then investment in fertilizer is lost; if the crop cannot make use of all available water due to nitrogen deficiency, then potential yield is lost. With accurate predictions of available moisture during a growing season, farmers can avoid lost fertilizer investments or lost crop yields.

In the East region, various dryland crop cycles are used depending on average precipitation. In some cases, a winter wheat summer fallow two-year rotation is used; in other cases, a three-year

winter wheat, spring wheat, summer fallow rotation is used. Other rotations combinations are also possible, but most dryland operations in Washington State include at least one rotation of winter wheat. Depending on available moisture in the soil before planting and seasonal moisture expectations, this planting cycle can be modified to reduce impacts of drought. During winter wheat rotations, fall nitrogen applications can be reduced and, if winter moisture is higher than expected, crops can be side-dressed with additional nitrogen in the spring (this practice increases application costs). Spring crop rotations can be skipped if soil moisture and precipitation expectations are too low. Dryland farmers may also place lands that perform poorly during dryer conditions into the Conservation Reserve Program. In most cases, the ability of dryland farmers to adapt to drought conditions depends on accurate determination of existing soil moisture and predictions of available precipitation during the growing season. Several interviewees stated that El Niño years have proven to be warmer and dryer, so dryland farmers may adapt to drought by responding appropriately to the ENSO signal. This includes reduced nitrogen fertilizer application during El Niño years.

Irrigated operations in the East region are only slightly vulnerable to drought. Irrigated farming operations receive surface water from the Columbia Basin project or other smaller irrigation projects. Some pump water directly from small tributaries. Others irrigate with water pumped from groundwater. No interviewees reported impacts from supply restrictions or groundwater drawdown. The main impacts reported from irrigated farming operations were increased costs to pump water. These operations can also be vulnerable to reductions in crop quantity or quality if water supply is unable to meet demands from evapotranspiration on extremely dry years. Farmers that don't have a high percentage of perennial crops have some adaptive capacity. Crops placed within one irrigation unit can be diversified so that large amounts of water are required at different times in each field within the irrigation unit. For example, an irrigation unit that supplies water to five fields may limit potato production to two of those fields because potatoes require very large quantities of water during tuber development.

### *M&I*

The M&I sector is not particularly vulnerable to drought in the East region. No interviewees identified any physical impacts of water shortage, such as water use restrictions. Walla Walla and Moses Coulee/Foster Creek WRIA's reported restrictions of growth in the region; however, this may be an appropriate response to water supply limitations that have been identified. Growth restrictions will help limit vulnerability of the M&I sector.

### *Environment*

The environmental sector is affected on most years due to stream dewatering. These impacts are magnified by drought, which indicates medium vulnerability. The environmental sector has some ability to adapt to drought conditions. This ability is enhanced by drought declaration, which makes additional funding available to fisheries organizations for mitigation of impacts. Fisheries organizations can reduce drought impacts by increasing monitoring of streams, particularly problem locations. This can enhance the ability of this sector to respond to stranded fish. Fish can be transported and fisheries personnel can make appropriate decisions regarding

whether to allow fish migration into areas that may become dewatered later in the fall. When low spring flows are affecting outmigration of juvenile fish, coordinated irrigation reductions can provide artificial freshets aiding fish migration and reducing impacts to fish.

### *Power*

Because river flow is the primary fuel for hydropower producers in the state, hydropower producers will always be vulnerable to drought; however, from dealing with past droughts, hydropower producers have developed strategies making the sector better equipped to adapt to drought conditions. Some of the vulnerability of hydropower producers to drought stems from quantities agreed upon in sales agreements. In a worst-case scenario, when supply agreements can't be met, power must be purchased on the open market. In 2001 the cost of purchasing replacement power was compounded by inflated market prices for electricity.

Using results of flow modeling simulations and climate forecasts, water managers in the hydropower sector can make decisions that make hydropower producers less vulnerable to impacts from drought similar to those experienced in 2001. If less flood control space is necessary managers may decide to keep more water in reservoirs during the spring. Water may be purchased from irrigators in order to ensure better flows for generation. Electricity may be bought back from the direct service industry (DSI buyback). DSI buyback makes large quantities of electricity available to meet supply agreements during drought. Other production units may be paid to turn generators on or alter generation schedules to produce electricity for lower prices than those available on the open market.

Impacts to fisheries and hydropower generation potential are often inseparable. Many power producers have established agreements to sacrifice power generation in order to provide more water over spillways for downstream fish migration. The cost of this spilled water is magnified during drought when power must be purchased to meet supply commitments. Hydropower producers have several methods for dealing with fish flow requirements during drought to decrease vulnerability. During drought, water managers may decide to pool more water in the spring and summer to increase fuel supply for the winter. This may mean that fish flow requirements are not met, in which case fish capture and transport below the dams is increased.

### *Recreation*

Many recreation industries in the state depend on adequate supply of water to meet the demands of their operations. This report focuses on the ski industry, which requires adequate snow pack to open operations and to attract customers. Low snow pack results in reduced visits and can have large impacts on profit, making the ski industry extremely vulnerable to drought. The ski industry has limited adaptive capacity. The primary method used by ski area operators is to minimize staffing and reduce operations. One interviewee indicated that early season hiring is minimized during times of uncertain supply to reduce vulnerability. Ski areas may also be opened on a limited capacity to reduce vulnerability, e.g. opening only one restaurant rather than five when snow pack is low.





## Appendix C. Drought Frequency and Severity under Climate Change

Occasional droughts are an important feature of the climate of Washington State and have a long history of occurring, as reviewed in the Drought Monitoring and Forecasting section of this plan. Global climate change is projected to affect the frequency and severity of droughts in future decades. Though there are many different types of drought (e.g., low snowpack due to low precipitation, low snowpack due to increased temperatures, and spring/summer low precipitation), the focus on this section and many of the studies herein is on the precipitation-deficit type of drought. This section reviews the likely changes in the climate of Washington over future decades, relying primarily on the recent scientific literature.

### Changes in Temperature

Washington State, and the Pacific Northwest as a whole, has warmed in recent decades relative to earlier in the 20<sup>th</sup> century, and there is high confidence that this trend will continue in the 21<sup>st</sup> century (e.g., Rupp et al. 2016). Average temperatures in the Pacific Northwest (Washington, Oregon, and Idaho) have warmed about 1.3°F (0.7°C) from 1895 through 2011 (Snover et al. 2013). Expanding the period to 2015 results in a similar temperature change with 1.5°F (0.8°C) of warming for Washington State alone (National Center for Environmental Information). Future warming is projected for the region. The magnitude of warming expected across Washington State – using an ensemble average of 37 CMIP5 models<sup>44</sup> – is illustrated in Figures C - 1 and C - 2 for the years of 2040-2069 relative to the historical period of 1979 to 2008. During the cool, wet season of November through January, there is a projected warming of roughly 4.5°F (2.5°C). For the warm, dry season of June through August, a warming of 5.4°F (3.0°C) is projected. For purposes of comparison, the average temperatures for Washington were 2.5°F (1.4°C) above the 1979-to-2008 average for November 2014 through January 2015 and 4.5°F (2.5°C) above average for June through August 2015. Therefore, the projected average temperatures for the 2040-to-2069 period are warmer than what the state experienced during the recent temperature-driven drought of 2015.

Geographically, there is greater warming indicated for east of the Cascade crest. The west side of the state is more strongly influenced by the ocean, which is projected to undergo approximately

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<sup>44</sup> The projections shown here are based on the latest Coupled Model Inter-Comparison (CMIP5) model results for the Representative Concentration Pathway 8.5 (RCP8.5). This is the highest greenhouse gas scenario of the 4 used in the Intergovernmental Panel on Climate Change (IPCC) report, and is used because it best resembles recent observed greenhouse gas emissions and concentrations. The projections shown are multi-model ensembles of 37 CMIP5 models and are displayed on a website maintained by NOAA's Earth System Research Laboratory: [www.esrl.noaa.gov/psd/ipcc/](http://www.esrl.noaa.gov/psd/ipcc/). Projections for the middle portion of the 21<sup>st</sup> century are used; changes over this period are not highly sensitive to the RCP model experiments used but are generally large enough to be detectable above the natural variability in the climate.

3.2°F (1.8°C) of warming over the same interval (not shown). For the Pacific Northwest as a whole (Washington, Oregon, and Idaho), all of the 37 models used to form ensemble averages indicate warming of greater than 2.7°F (1.5°C) by 2050; 80 percent of the members are within about 1.4°F (0.8°C) of the mean values shown in Figures C - 1, C - 2.

## **Changes in Seasonal Precipitation**

Projections for the change in winter (November through January) and summer (June through August) precipitation for the mid-21<sup>st</sup> century are shown in Figures C - 3 and C - 4. The climate models indicate that the wet season is likely to become wetter and that the dry season will become drier. In other words, the model simulations suggest that the climate of Washington state will become more Mediterranean in nature. The absolute changes during the wet season are projected to be greater on the west side of Washington State, but on a percentage basis, both sides of the state have projected increases of roughly 7 percent for November through January. The projections for June through August include larger decreases from both an absolute and percentage perspective for western versus eastern Washington. Projected changes in total annual precipitation for the state as a whole average about 5 cm, which represents an increase of roughly 4 percent over that of the 1979-to-2008 period.

The inter-model differences in projected precipitation are greater than those for temperature, and hence there is more uncertainty in future projections for precipitation compared to temperature. Figure C-5 (reproduced from Rupp et al. 2016) illustrates the range of precipitation projections from the individual climate models for different times of year for the Columbia River watershed. Some of the model projections indicate drier wet seasons (October through January and February through May) and wetter summers (June through September) through the 2080s. Nevertheless, by the 2050s and through the 2080s, there is a reasonably strong consensus that both the early and late portions of the wet season will include net increases in precipitation, and that the summer months will be drier, with somewhat less confidence.

## **Snowpack and Streamflow Timing**

Increasing temperature will impact the timing of streamflow in many Washington river basins. This is significant because the winter snowpack in the mountains represents an important supply of water in late spring and summer for many of Washington's streams. Due to the warming climate, the snowmelt in spring is anticipated to occur 3 to 4 weeks earlier by the middle of the 21<sup>st</sup> century for snowmelt-dominated basins in the Cascade Mountains (Snover et al. 2013).

A recent drought year (2015) represents an example of what may become average in the 21<sup>st</sup> century. From a statewide perspective, the winter (November through March) of 2014-15 was about 3.5°F (2.0°C) warmer than the 1981-to-2010 normal, with near-average precipitation. The result was more rain than snow than usual at higher elevations, resulting in relatively high streamflows during the winter. There were exceedingly low streamflows during late spring through summer on many rivers due to both a lack of snowpack and faster runoff because of warm temperatures, which led to widespread shortages in water supplies and quality. This kind of scenario is expected to play out in future decades with increased frequency, as shown in

various studies using hydrologic models forced by projected temperature and precipitation distributions. An example is shown in Figure C-6 from Tohver et al. (2014)<sup>45</sup>. Their results indicate the shift of most presently snow-dominant watersheds to the transition category (also known as a mixed rain/snow basin), which typically includes both winter and spring peaks in streamflow. Many of the transition watersheds will shift to the rain-dominant type with peak flows in winter during periods of heavy precipitation. These shifts become quite evident by the 2040s. A complementary perspective is shown in Figure C-7 (excerpted from Elsner et al. 2010). Projected average monthly streamflows for examples of the three types of watersheds indicate the greatest relative changes in seasonal streamflows on the Yakima River, which is now in the transient/mixed category but apt to become increasingly rain-dominant with time. This is likely to have extremely important implications for summer water supplies for agriculture in the Yakima Valley, which presently relies on snowmelt for a considerable fraction of the water required during the growing season.

More evidence that spring snowmelt supply will become an issue in the future comes from another study by Lute et al. (2015) considering model projections of snow throughout the West. Low mountain-snowfall years will become more frequent by mid-century (Figure C-8, reproduced from Lute et al. 2015) due to the shift in precipitation type from snow to rain, despite continued variability in wintertime precipitation totals. The Olympic and Cascade Mountains are relatively low in elevation compared to the Rocky Mountains, for example, with higher wintertime average temperatures, meaning that shifting precipitation type is expected to become a problem sooner than in higher-elevation mountains (Mote et al. 2005).

The impact of temperature on snowpack and streamflow timing is important, but the amount of precipitation matters, too. Continued variability in winter precipitation is expected, and some winters in future decades will be dry as well as warm. An especially early and meager snowmelt during dry years may result in late-spring and summer streamflows that are lower than experienced in the historical record. In more quantitative terms, the model results of Tohver et al. (2014) indicate that for streams draining the Cascade Mountains, the lowest 7-day mean flows in the 2040s during the low flow summer season will be on the order of 70 to 80 percent of their counterparts in the historical record (not shown). This reduction can be attributed to increases in evapotranspiration due to warming, in combination with years of particularly low snowpack (Hamlet et al. 2013).

## **Soil Moisture**

Future projections suggest decreases in summer (July 1) soil moisture across much of Washington State in the future (Figure C-7; Elsner et al. 2010<sup>46</sup>). There tend to be greater

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<sup>45</sup> This study used an older version of the climate models (CMIP3) and two different emission scenarios. The RCP8.5 scenario previously mentioned in this section assumes higher greenhouse gas emissions than either the A1B or B1 shown in Figure 3.

<sup>46</sup> The older CMIP3 models and the A1B and B1 scenarios are used for this study.

decreases in soil moisture on the west side of the Cascade Mountains, which Elsner et al. (2010) attribute to warming and earlier snowmelt. Some areas of the Columbia River Basin may experience increases in summer soil moisture, likely due to increases in winter precipitation and greater infiltration into deep soil layers.

## Multi-year Droughts

Droughts in Washington state since the middle of the 20<sup>th</sup> century have generally been relatively short-lived (about 1 year), which raises the question of whether multi-year precipitation deficit droughts might be more likely or less likely in future decades. Examining the average 1-year lag correlation in annual total precipitation statewide during 1979-2008, and comparing it to the same values for the 2040-2069 model projections<sup>47</sup>, can indicate the likelihood of multi-year droughts. During the period of 1979 to 2008, values of the correlation coefficient range from about 0.1 to 0.3 (not shown), with generally lower values of the correlation (i.e., persistence from one year to the next) in the wetter parts of the state. Considering output from RCP8.5 model simulations, the ensemble-average 1-year lag correlation in annual total precipitation during the years of 2040 to 2069 is slightly less than that during the years of 1979 to 2008 across Washington State (Figure C-9). These results suggest little reason to expect that back-to-back dry years (or wet years) will be more likely or less likely in the future.

With respect to temperature, the climate models indicate an increase in 1-year lag correlation across the entire western United States, but little change in standard deviations of annual mean temperature. In other words, there may be more incidences of back-to-back warm years (or relatively cool years) in a changing future climate. The enhanced persistence in temperatures might be a result of feedbacks related to soil moisture, as represented in global climate models, but confirming that as an important mechanism is outside the scope of the present treatment. As noted above, increases in temperature will be accompanied by decreases in winter snowpack and summer flows in many streams. It is therefore reasonable to assume that Washington will experience a greater frequency of temperature-related droughts, such as what occurred in 2015, relative to the more precipitation-driven droughts of 1977 and 2001. While a precedent is lacking in the historical record, it is highly likely that there will be a winter in the next few decades that will be as warm as 2015 but also considerably drier than normal. The impacts of such an event are liable to be severe, and conceivably persist for an extended time into a period of more typical weather that follows.

With regards to extended (multi-year) events, Ault et al. (2014) used climate model simulations carried out for the IPCC to assess the future risk of decadal (11 year) and multi-decadal (35 year) droughts in the western United States. Droughts are defined as the periods in which mean precipitation totals are below certain threshold relative to annual amounts during a reference period of 1950-2000. For the Pacific Northwest and especially Washington State, the model

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<sup>47</sup> The NOAA/ESRL web application used in the changes in temperature and precipitation discussion above was used to compute these values.

simulations suggest a reduced risk of these long-term types of droughts during the period of 2050 to 2100 relative to that of 1950 to 2000 (not shown).

Overall, the research that has been carried out on the future climate of the Pacific Northwest has found minimal changes in the character of the short-term (seasonal to interannual) variability. These findings are based on climate model simulations, with attendant caveats associated with model limitations. The existing evidence strongly indicates that the mean conditions, namely warmer temperatures and reduced mountain snowpack, will be the primary factors related to drought. In other words, the change in baseline conditions implies that relatively modest temperature and precipitation anomalies, for the climate of the time, will result in streamflows and water supplies during the dry season characteristic of more extreme anomalies of the historical record.

## **Demand**

Future droughts will depend on demands for water, and while more effort has gone into assessing how climate change will influence the supply side, future demands have been estimated. For Washington State, a particularly valuable resource is a draft report prepared by the Washington State Department of Ecology (Ecology). The agricultural sector is by far the biggest user of water; its overall demand is estimated to decline by about 5 percent due to an earlier growing season and a switch to crops with lower water needs. The extent that this decrease in overall demand will be accompanied by a decrease in water that will be drawn from streams is unclear. Groundwater represents a significant source in parts of Washington, notably portions of the Yakima Valley (Ely et al. 2011). Current rates of pumping may not be sustainable from a long-term perspective, which may mean that the proportion of water drawn from streams will increase. Changes in average supply and demand can mask the conflicts that occur during drought years when low-flow conditions arise. During years with low flows, maintenance of instream flows for ecological purposes and fulfillment of tribal water rights can constrain water supplies. Other users of water, for example major municipalities and hydropower operators, have made projections of future demands relative to supplies as part of their long-term plans. Projected changes in cropping practices are likely to lead to modest changes in agricultural water demand relative to past conditions, but climate change is likely to lead to significant changes in the timing and amount of water supplied. Overall, climate change is more likely to influence the supply than the demand side of water use in Washington State.

## **Considerations for the Columbia River Basin**

The mainstem Columbia River represents a special case from a Washington State drought perspective. Climate change is expected to bring an increase in precipitation for its watershed, especially at its higher elevations in northwestern Montana and southern British Columbia. As with most streams in Washington, the accompanying increase in runoff is expected to occur during the winter through early spring (Georgakakos et al. 2014; Bureau of Reclamation 2016), with the consequence that flows during summer may drop more often below State and Federal targets. The threat of low summer flows may be alleviated, however, since the Columbia River is

highly regulated. While agricultural users can expect continued deliveries of adequate amounts of water from the Columbia Basin Project during the growing season, other uses (e.g., hydropower) and constraints (e.g., timing of flows for fish migrations) will continue to require balancing.

## **Considerations for Future Drought Definitions**

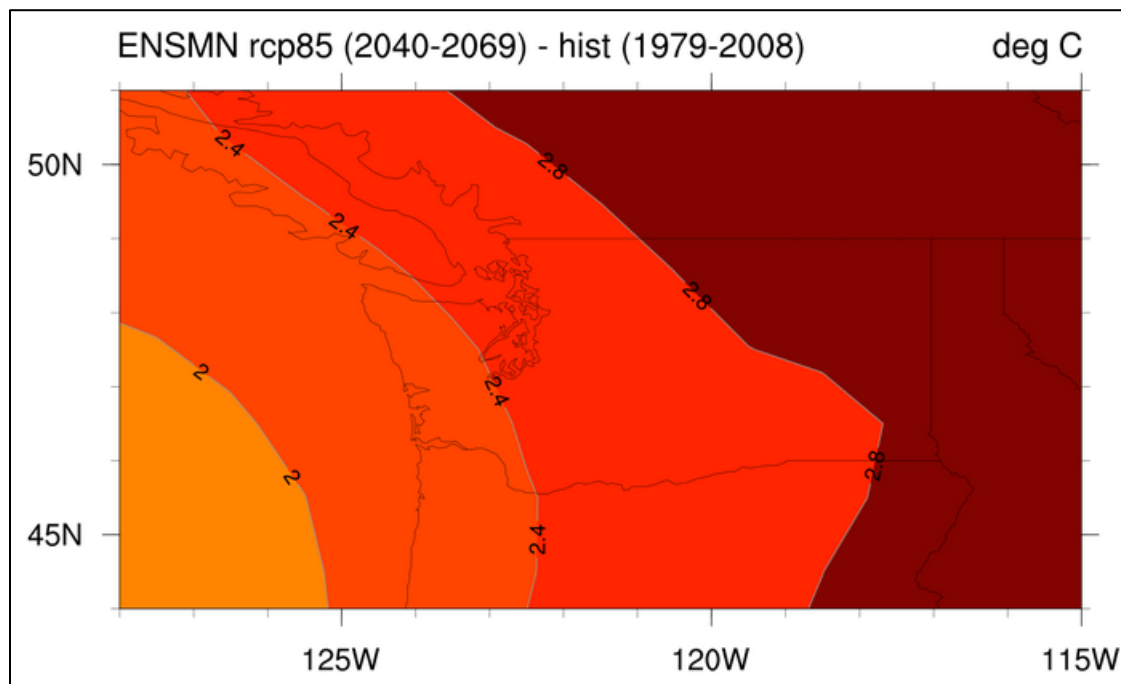
An important and unresolved issue relates to whether the State's current definition of drought may need to be altered because of climate change. Normal values of seasonal precipitation, snowpack, streamflow, etc., in the future will be different than their counterparts in the past. It may be necessary to establish thresholds based on actual values of current or short-term predicted water supplies rather than a fixed percentage of historical averages. The latter become less meaningful for gauging abnormalities in the state of the system during periods of systematic and substantial trends. Ultimately, the State may wish to better quantify the thresholds that constitute water scarcity hardships in the Water Resource Inventory Areas (WRIAs) of the state, and to use these thresholds (which may need to be adjusted due to evolving demands on a regional basis) to set absolute values of water supplies and streamflows that represent drought conditions.

## **Concluding Remarks**

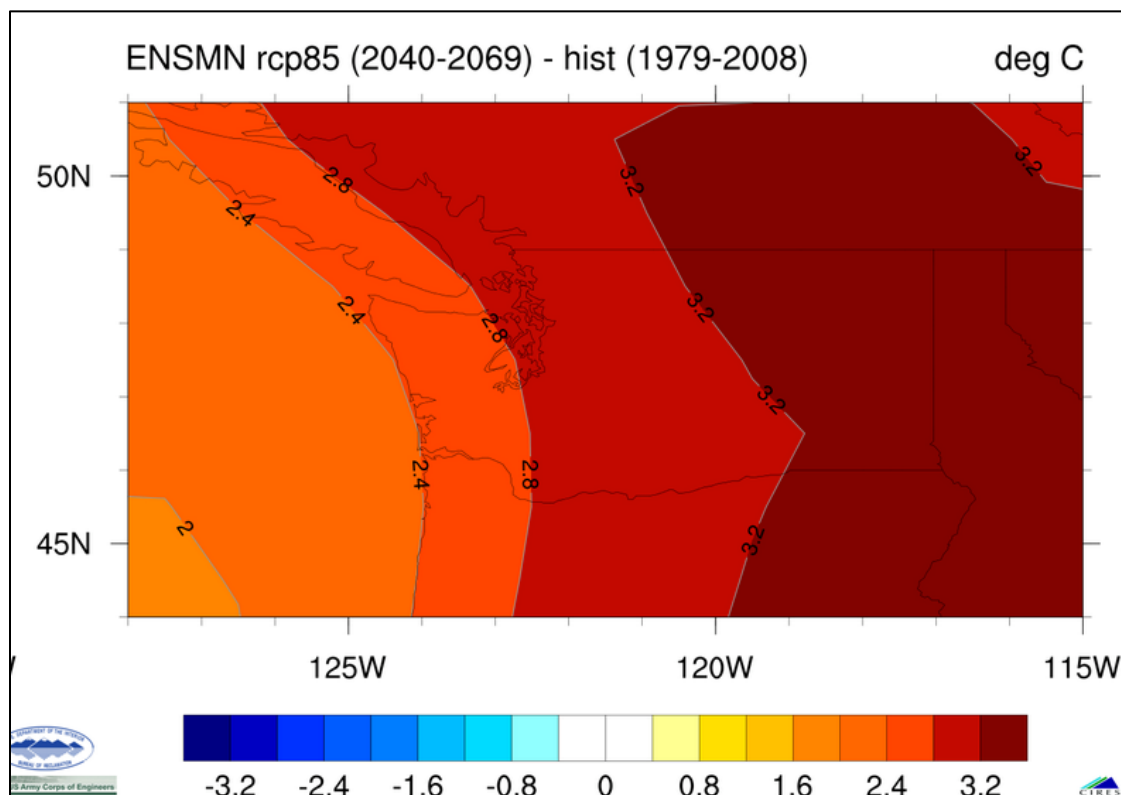
The objective of this section has been to summarize recent findings of how climate change may impact droughts in Washington State. Despite confidence in predicting several future changes in the regional climate (e.g., warming, less spring snowpack, earlier timing of streamflow in transient or snowmelt-driven watersheds), significant year-to-year variability will continue to affect the state's hydrologic conditions and water supplies. Much of this variability is not directly tied to global climate change, and should be expected to continue in the future. For example, the state will still experience anomalously wet winters periodically, as well as winters with snowpack that exceeds historical averages. Water managers will need to consider both the long-term changes in hydrologic conditions and the shorter-term variability when making policy, programmatic, and infrastructure decisions. Considerable research is devoted to improving predictive capabilities of shorter-term variability (e.g., El Nino or a regional marine heat wave), and to understanding how these climate anomalies impact Washington's weather and ultimately its water supplies.

Numerous resources describing what regional climate change impacts can be expected, and the uncertainties that are associated with the projections, are available. Examples include reports from the Environmental Protection Agency (2016), Washington State Department of Ecology (2016), Bureau of Reclamation (2016), the Climate Impacts Group of the University of Washington (2009 and 2013), and the Climate Impacts Research Consortium of Oregon State University (2013). These reports are available online; the URLs for them are included in the References section above.

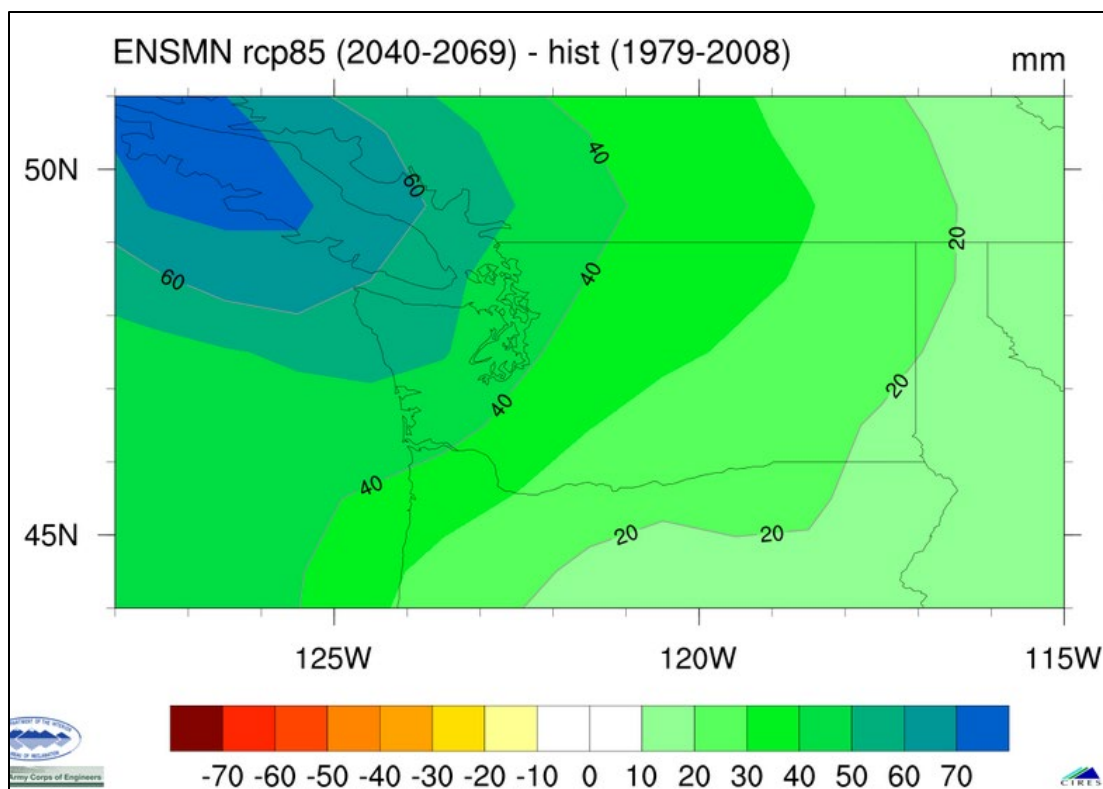
## Figures



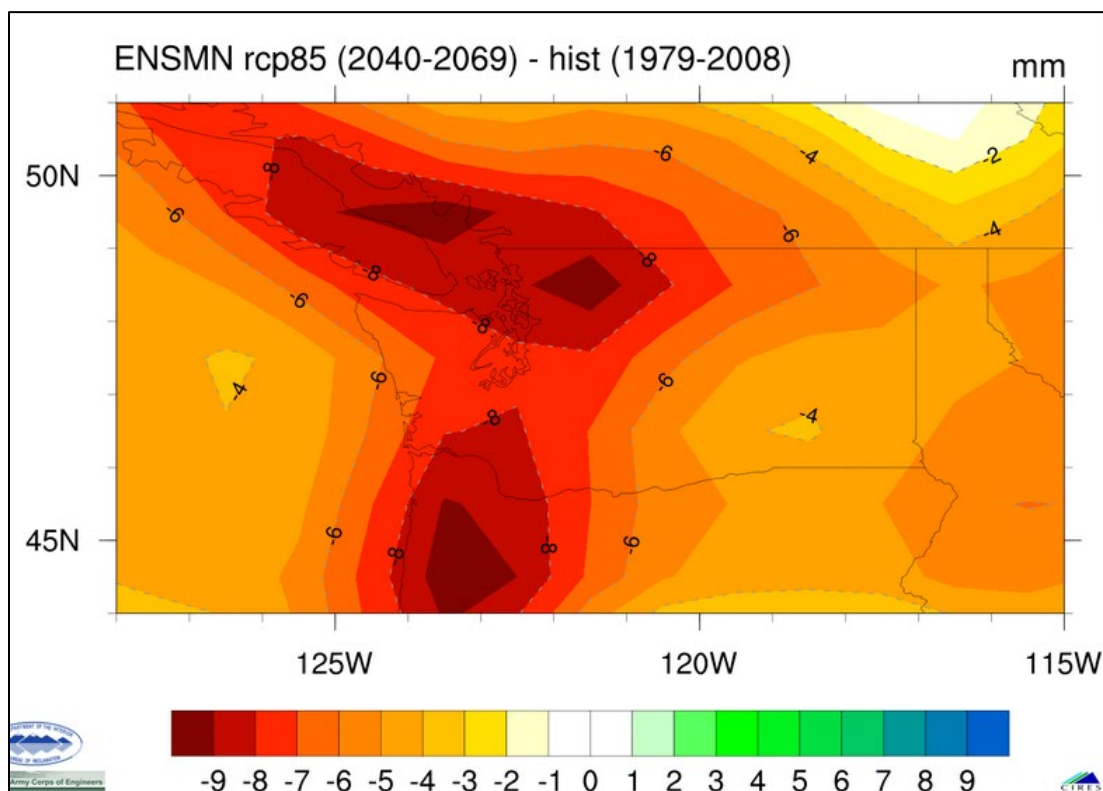
**Figure C-1. Ensemble-mean change in modeled average November through January temperature (degrees C) from the period of 1979-2008 to the period of 2040-2069 under the RCP8.5 pathway.**



**Figure C-2. Ensemble-mean change in modeled average June through August temperature (degrees C) from the period of 1979-2008 to the period of 2040-2069 under the RCP8.5 pathway**

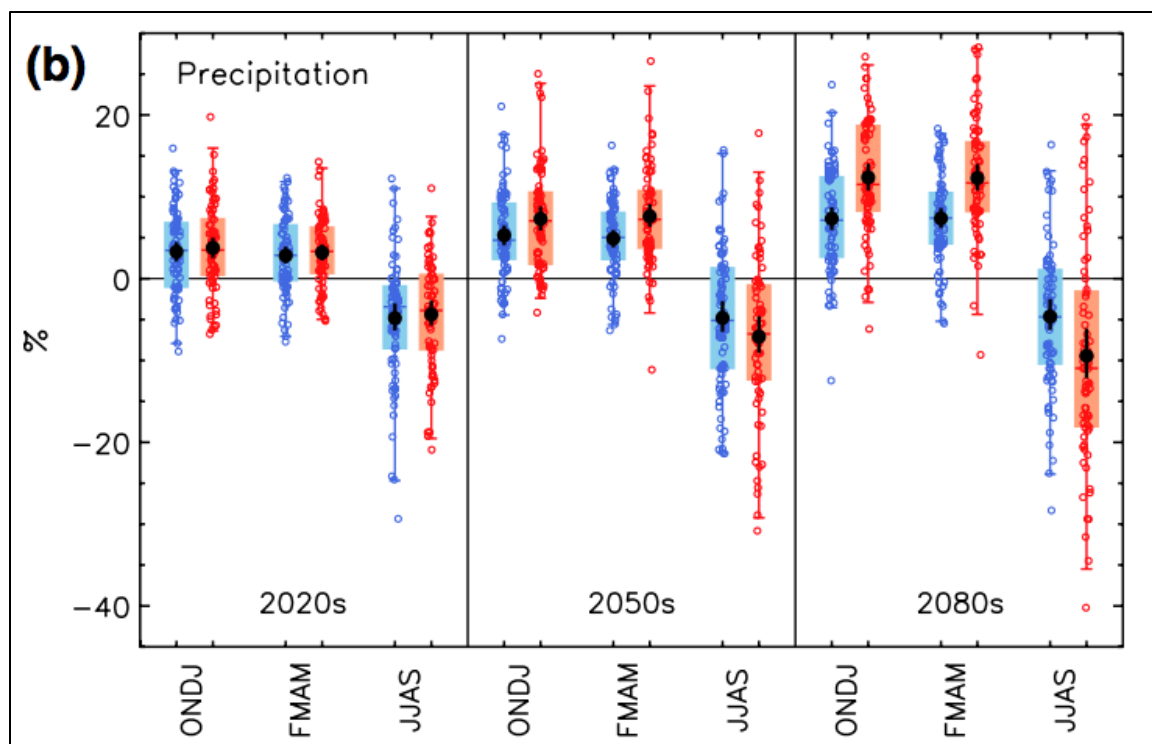


**Figure C-3. Ensemble-mean change in November through January modeled precipitation (mm) from the period of 1979-2008 to the period of 2040-2069 under the RCP8.5 pathway.**



**Figure C-4. As in Figure C-3, but for the season of June through August.**





**Figure C-5. Change in 30-year averages of seasonal precipitation between 1970–1999 and three future periods: 2010–2039 (2020s), 2040–2069 (2050s), and 2070–2099 (2080s), for the Columbia Basin above Bonneville Dam for the RCP4.5 (blue) and RCP8.5 (red) scenarios.**

*Open circles* show individual CMIP5 simulations (all available ensemble members) and the *box and whiskers* show inner quartiles and inner 95th percentiles, respectively. *Black circles and vertical black lines* show the mean of all simulations and the 95th percentile confidence limits on the mean, respectively (from Rupp et al. 2016).

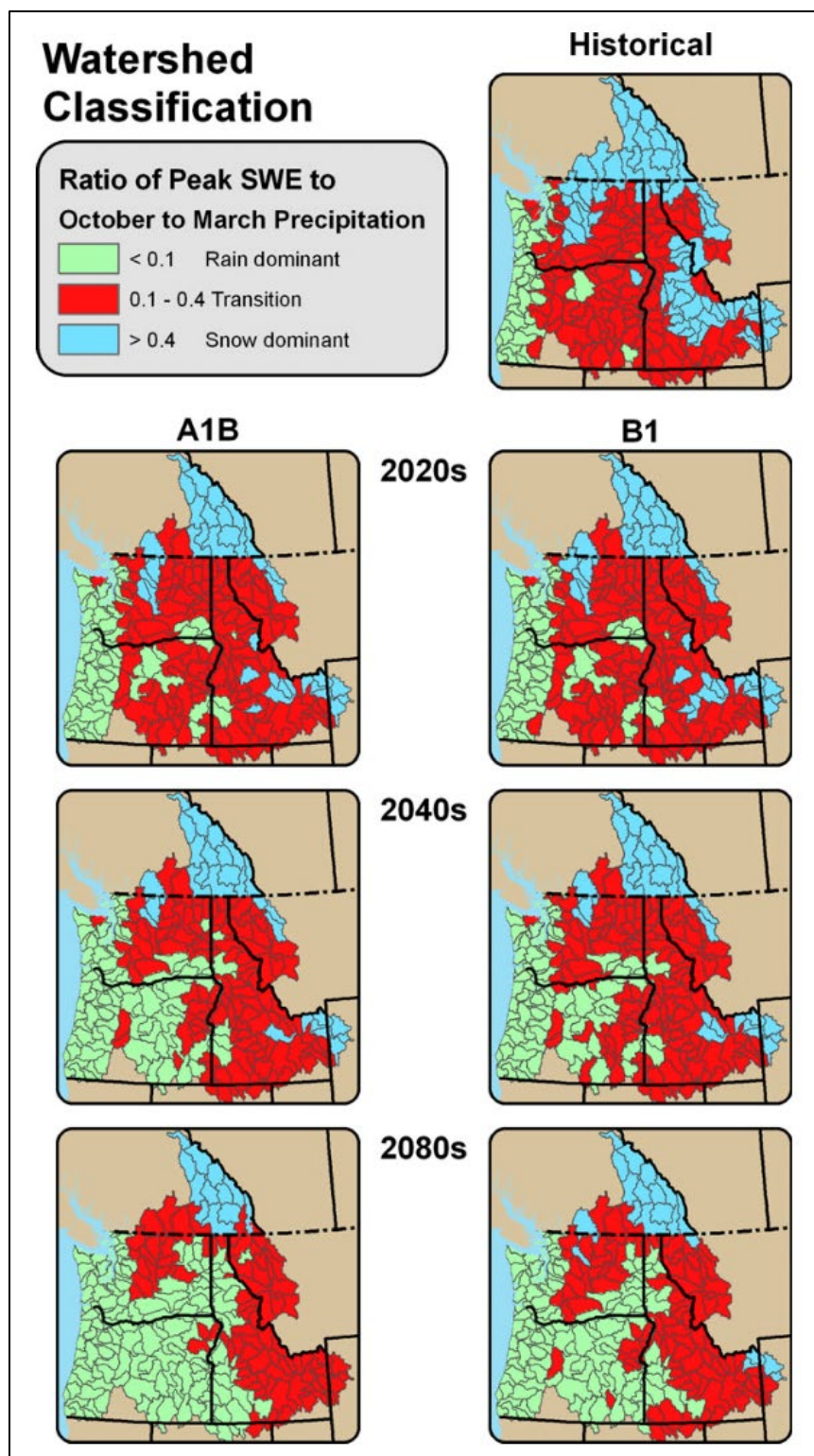


Figure C-6. Average ratios of modeled peak snow water equivalent to total precipitation during the season of October-March. The model simulations under the A1B scenario feature higher CO<sub>2</sub> concentrations than those under the B1 scenario (from Tohver et al. 2014).

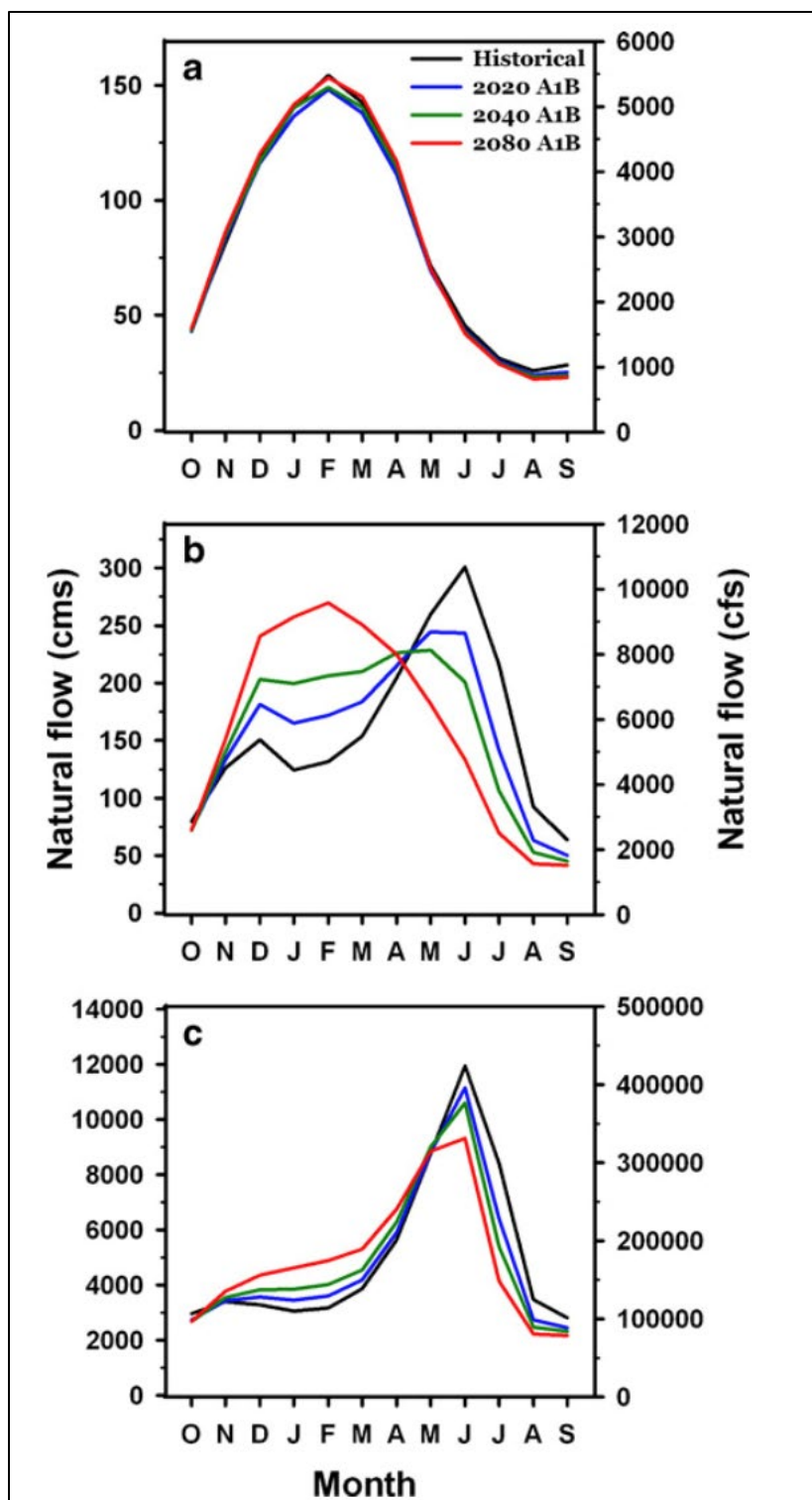
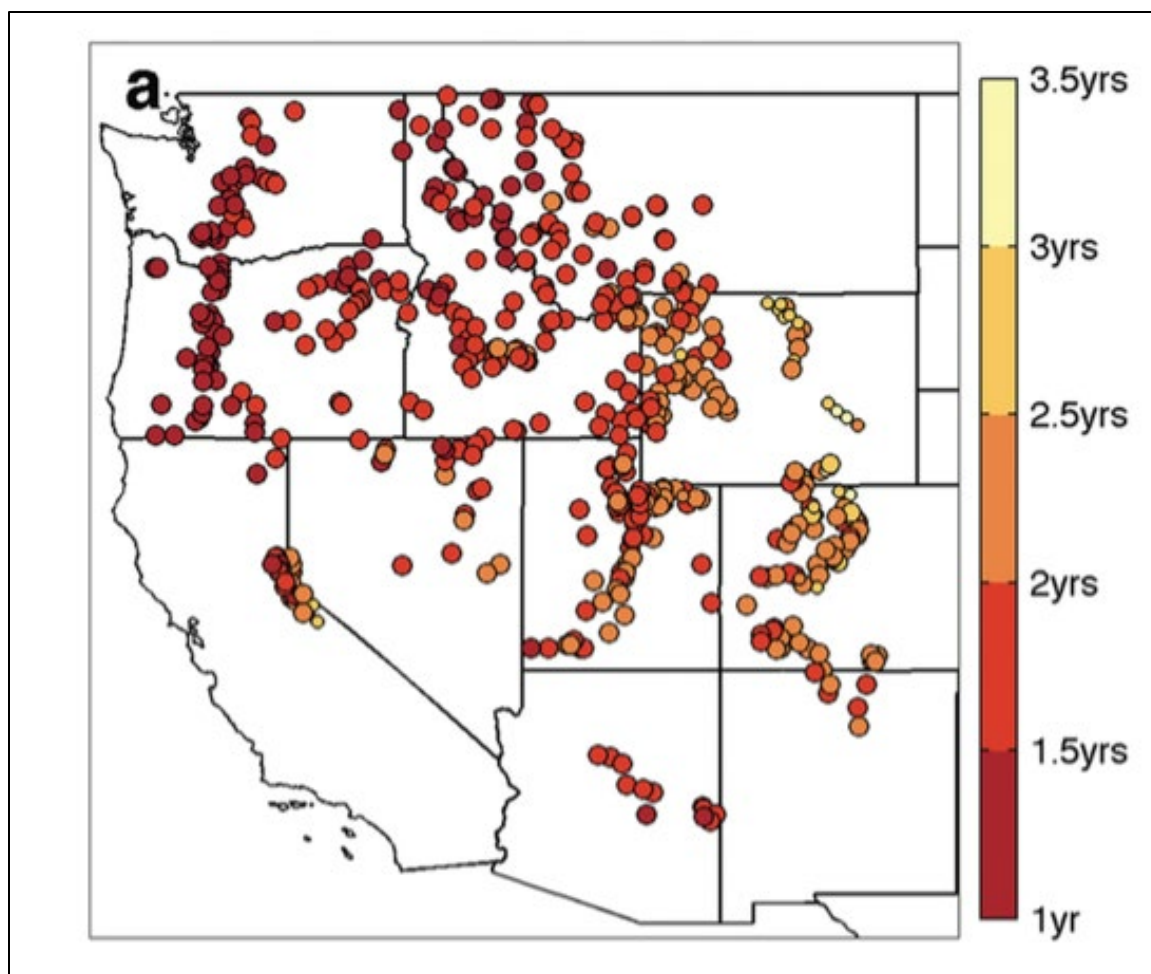
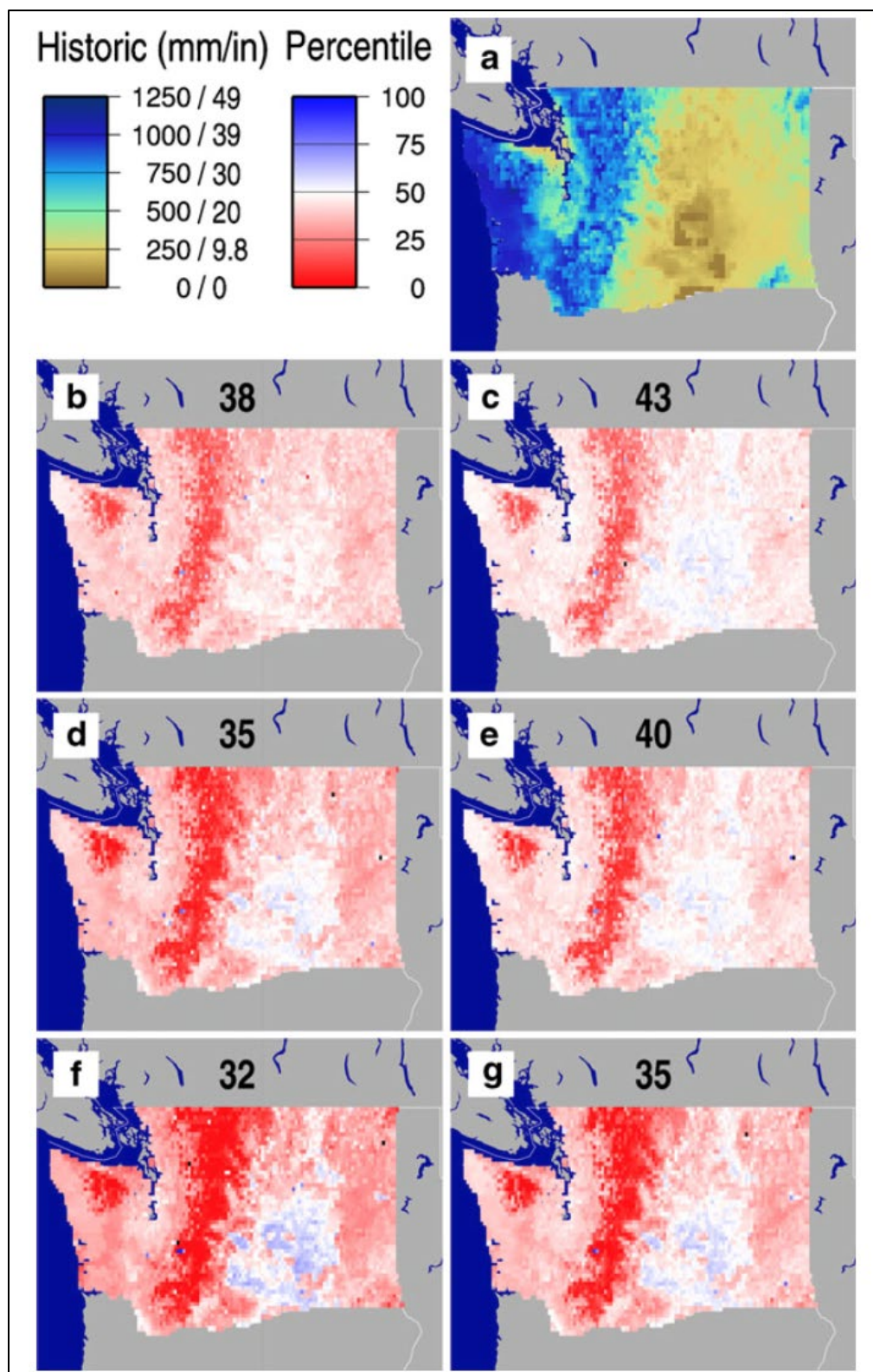


Figure C-7. Projected average monthly streamflows using the A1B scenario for three watersheds: (a) Chehalis River at Porter, (b) Yakima River at Parker, and (c) Columbia River at The Dalles. The changes expected by the 2020s, 2040s, and 2080s are represented by the blue, green, and red traces, respectively (from Elsner et al. 2010).



**Figure C-8.** Mean return intervals of low-snowfall years (defined as the 25<sup>th</sup> percentile for the historical period of 1950-2005) during the period of 2040-2069 based on ensemble-mean model simulations under RCP8.5.





**Figure C-9. Projected change in 1 July soil moisture as a percentage of simulated historical mean values for the 2020s (b and c), 2040s (d and e) and 2080s (f and g). The left and right columns of projections are using the A1B and B1 scenarios.**

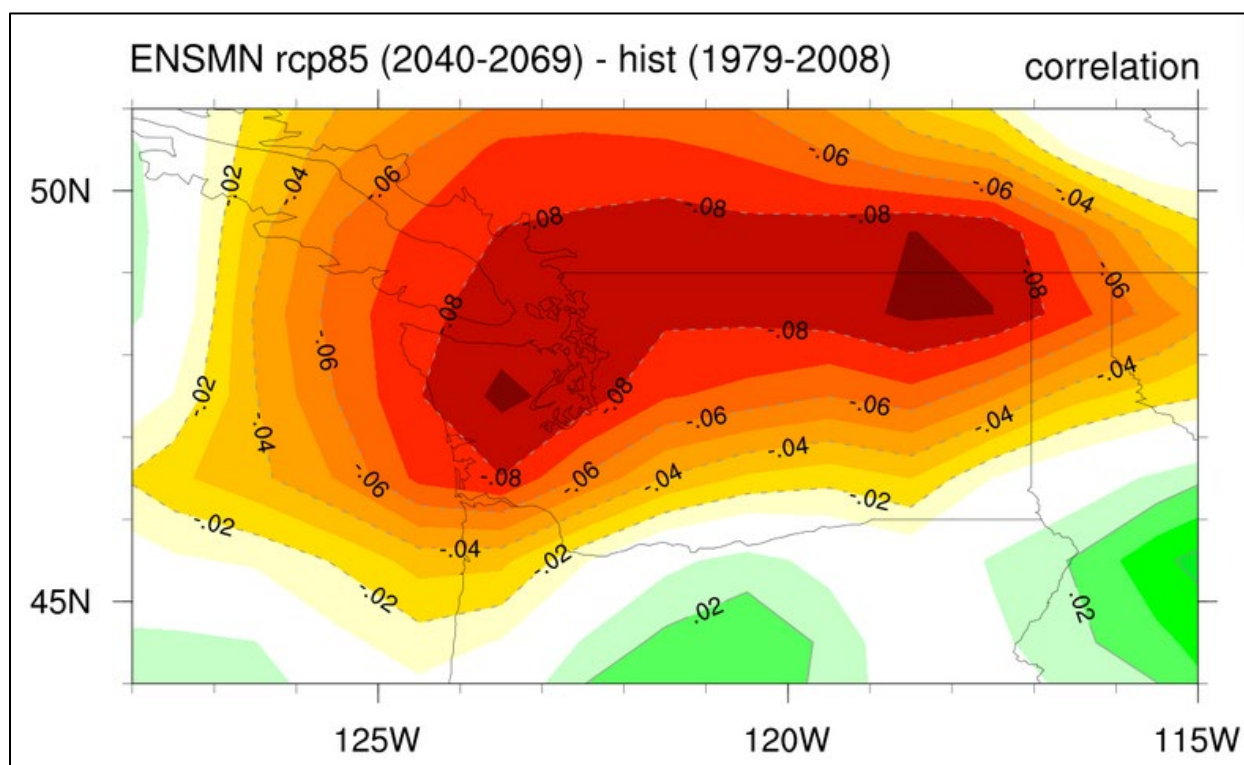


Figure C-10. Ensemble-mean change in modeled 1-year lag correlation in annual precipitation from the period of 1979-2008 to the period of 2040-2069 under RCP8.5. See text for details.

## **Appendix D. Analysis of the Standardized Precipitation Index**

DATE: 28 February 2017

TO: Jeff Marti, WA State Department of Ecology (ECY)

FROM: Office of the Washington State Climatologist (OWSC)

SUBJECT: Results from analysis of SPI drought thresholds

As part of the Drought Task Force convened by ECY, the OWSC has conducted analysis of thresholds that could be used towards declaring drought in Washington state. Current statute includes a quantitative definition of drought. Specifically, when water supply is at or below 75% of normal for a particular region of the state, or projected to fall below that threshold, that region can be considered to be in drought. The analysis carried out by the OWSC was designed to evaluate that threshold, considering the historical record and a common index used to signify drought, the Standardized Precipitation Index (SPI).

The SPI was developed in Colorado in the early 1990s, and is now considered to be the global standard index to identify meteorological drought by the World Meteorological Organization. The index uses only precipitation and is standardized using the mean over the period of record and the standard deviation for the same period. Large negative (positive) values of this index signify extremely dry (wet) periods; values near zero indicate close to normal conditions. A value of -1 usually signifies the beginning of drought and as the index becomes more negative, indicates increasing severe and infrequent conditions. The strengths of the SPI include the ability to identify dry and wet periods on multiple time scales (weekly to annual), ease of use and availability, and consistent interpretation from place to place. A major weakness is that the SPI is only a precipitation index. Since it does not account for temperature and precipitation type (rain versus snow), it relates only indirectly to streamflow.

Monthly precipitation totals for each of the 10 climate divisions of Washington state during the years of 1895-2016 were used to compute the SPI on the time scales of 1, 3, 6, 9 and 12 months. The number of occurrences of each value of SPI was used to estimate mean return periods for the historical period, and the results are summarized below.

A value of 75% of normal precipitation corresponds with different values of SPI, which depends on the magnitude of the variability relative to the mean. In Washington state, there tends to be greater relative variability during the dry season and east of the Cascade crest. In specific terms, the SPI associated with 75% of normal precipitation for a period of 1-month ranges from roughly -0.2 for eastern WA climate divisions in summer to -0.7 for western climate divisions during early winter. The relative variability in precipitation also decreases with time scale, implying that the 75% threshold corresponds with a smaller magnitude of the SPI for 1 month than for longer periods. From a statewide perspective, and considering 3-month totals, the 75% threshold is equivalent to a SPI of about -1 for November through January and a SPI of -0.45 for June through August. A value of -1 for the SPI occurs about every 4 years for each climate division, with minimal differences in the return periods between shorter (1-month) and longer (12-month)

time intervals. The SPI threshold of -1 represents precipitation that is one standard deviation below normal, and is often used to specify drought. More information on how the severity of a drought relates to the SPI is available in a report for the state of Colorado (see Table 1:

<http://cwc.state.co.us/water-management/drought/Documents/StateDroughtMitPlan2013/AnnexDDroughtMonitoringIndices.pdf>).

The time series of SPI values were examined in the context of WA droughts in recent past decades. The SPI values for WA were consistent across time scales in showing drought in 2001 and 2005. Conversely, the SPI did not provide as clear of a signal for the onset of the more temperature-based droughts of 1992 and 2015. In particular, the statewide 3-month and 6-month values of the SPI dropped below -1 in June 2015, well after it was evident that water supplies would be an issue across much of WA state.

Overall, the 3-month SPI appears to be a suitable index for signifying precipitation-type droughts in WA. It effectively averages out the usual month-to-month fluctuations in precipitation, while still providing reasonably early detection of accumulating deficits. Moreover, there is more consistency between neighboring climate divisions in the 3-month (and longer) SPI than in the 1-month SPI, with a tendency for the western and eastern WA climate divisions to group separately.

In summary, analysis carried out by the OWSC suggests that a value of -1 for the 3-month SPI would constitute a logical definition for declaring precipitation-driven droughts in WA state at the advisory level. It bears emphasizing that other factors, namely temperature, snowpack and reservoir levels, are important and sometimes dominant in terms of water supplies, and that the SPI should be used in conjunction with other information in declaring the onset and termination of drought conditions.

Nicholas Bond

Karin Bumbaco



## Appendix E. Runoff Patterns in Statewide Drought Years

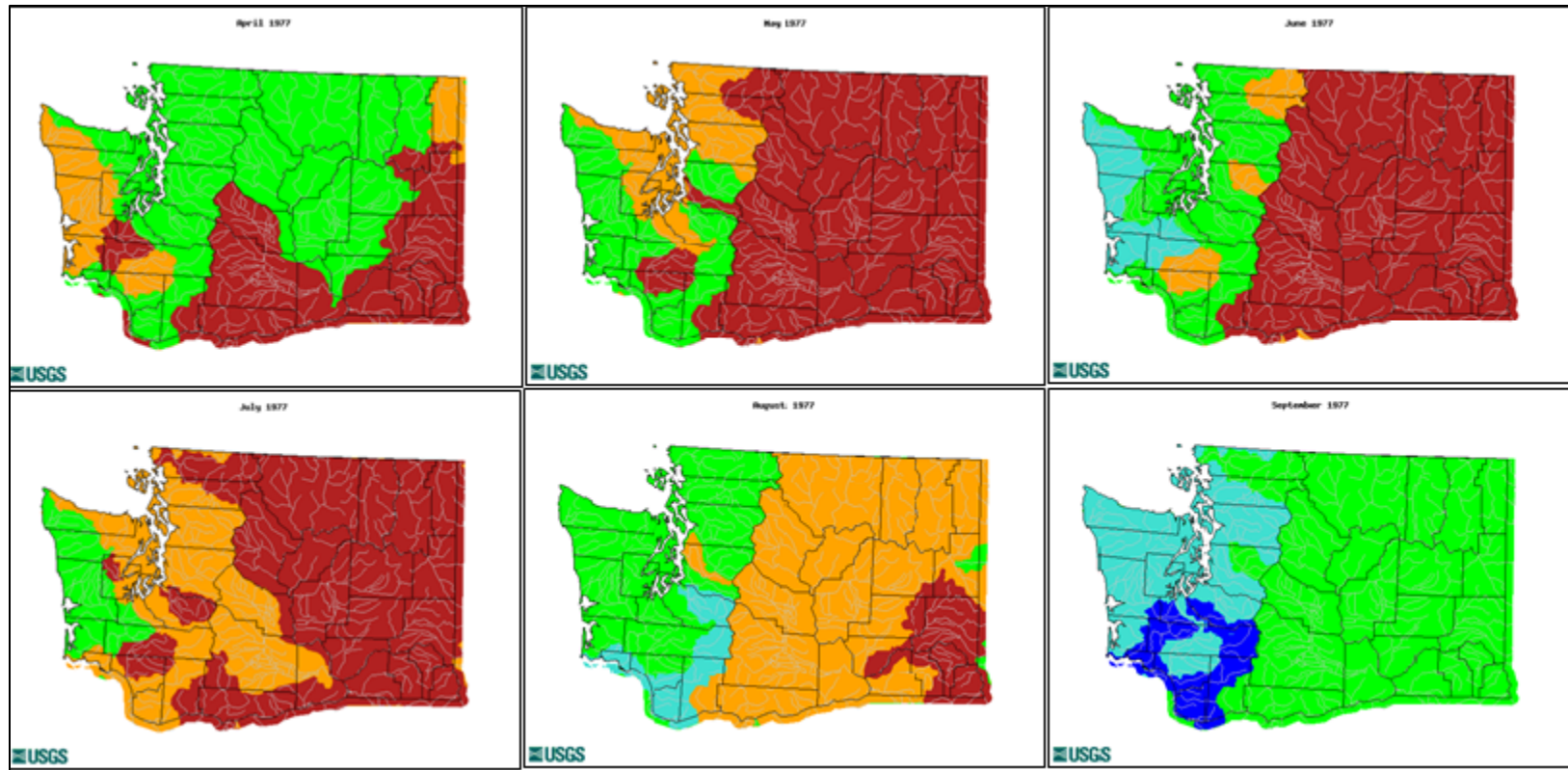


Figure E-1. Runoff Patterns April through Sept 1977

| Explanation - Percentile classes |                   |              |        |              |                   |      |         |
|----------------------------------|-------------------|--------------|--------|--------------|-------------------|------|---------|
|                                  |                   |              |        |              |                   |      |         |
| Low                              | <10               | 10-24        | 25-75  | 76-90        | >90               | High | No Data |
|                                  | Much below normal | Below normal | Normal | Above normal | Much above normal |      |         |

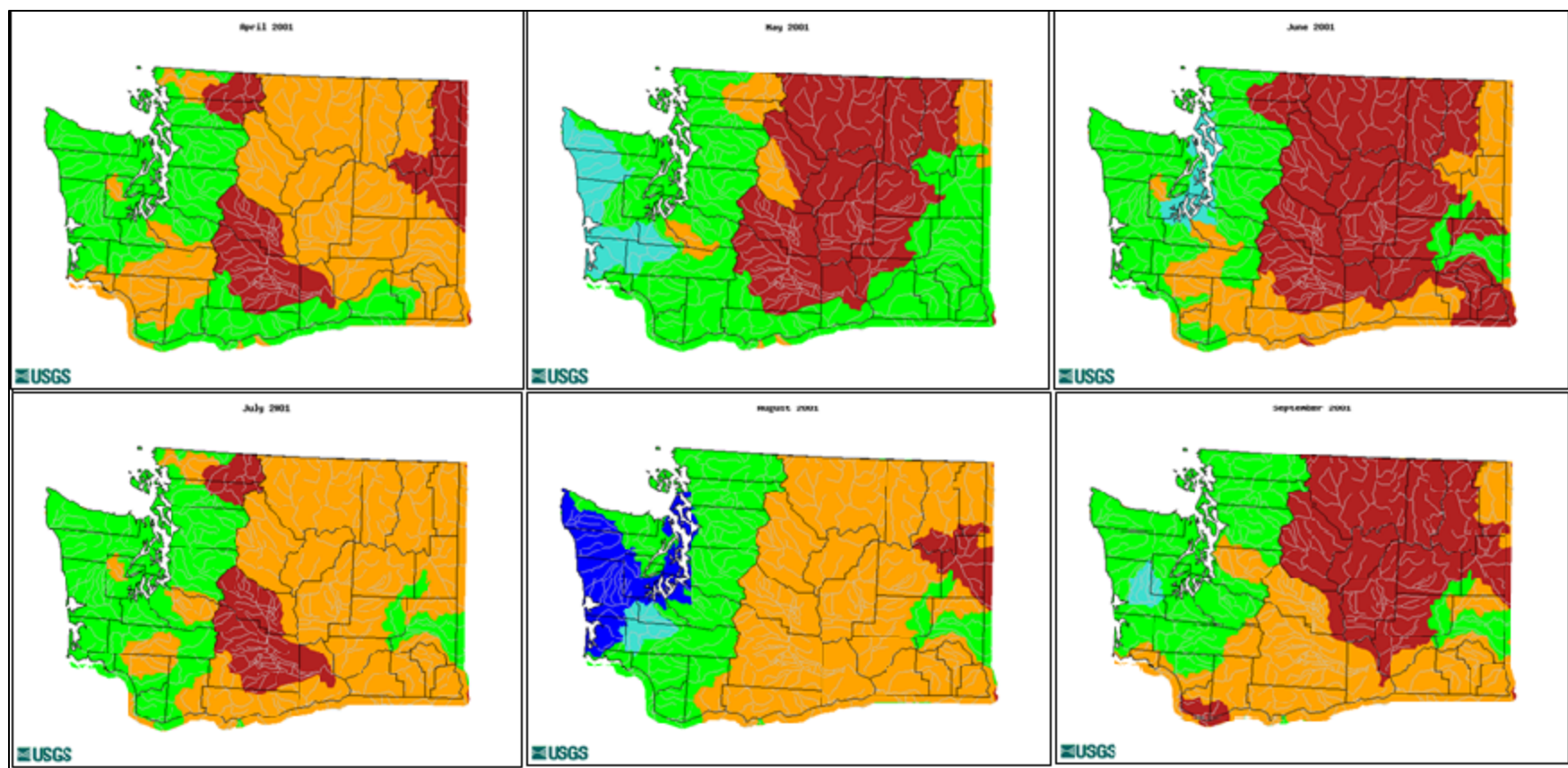


Figure E-2. Runoff Patterns April through September 2001

| Explanation - Percentile classes |                   |              |        |              |                   |      |         |
|----------------------------------|-------------------|--------------|--------|--------------|-------------------|------|---------|
|                                  |                   |              |        |              |                   |      |         |
| Low                              | <10               | 10-24        | 25-75  | 76-90        | >90               | High | No Data |
|                                  | Much below normal | Below normal | Normal | Above normal | Much above normal |      |         |

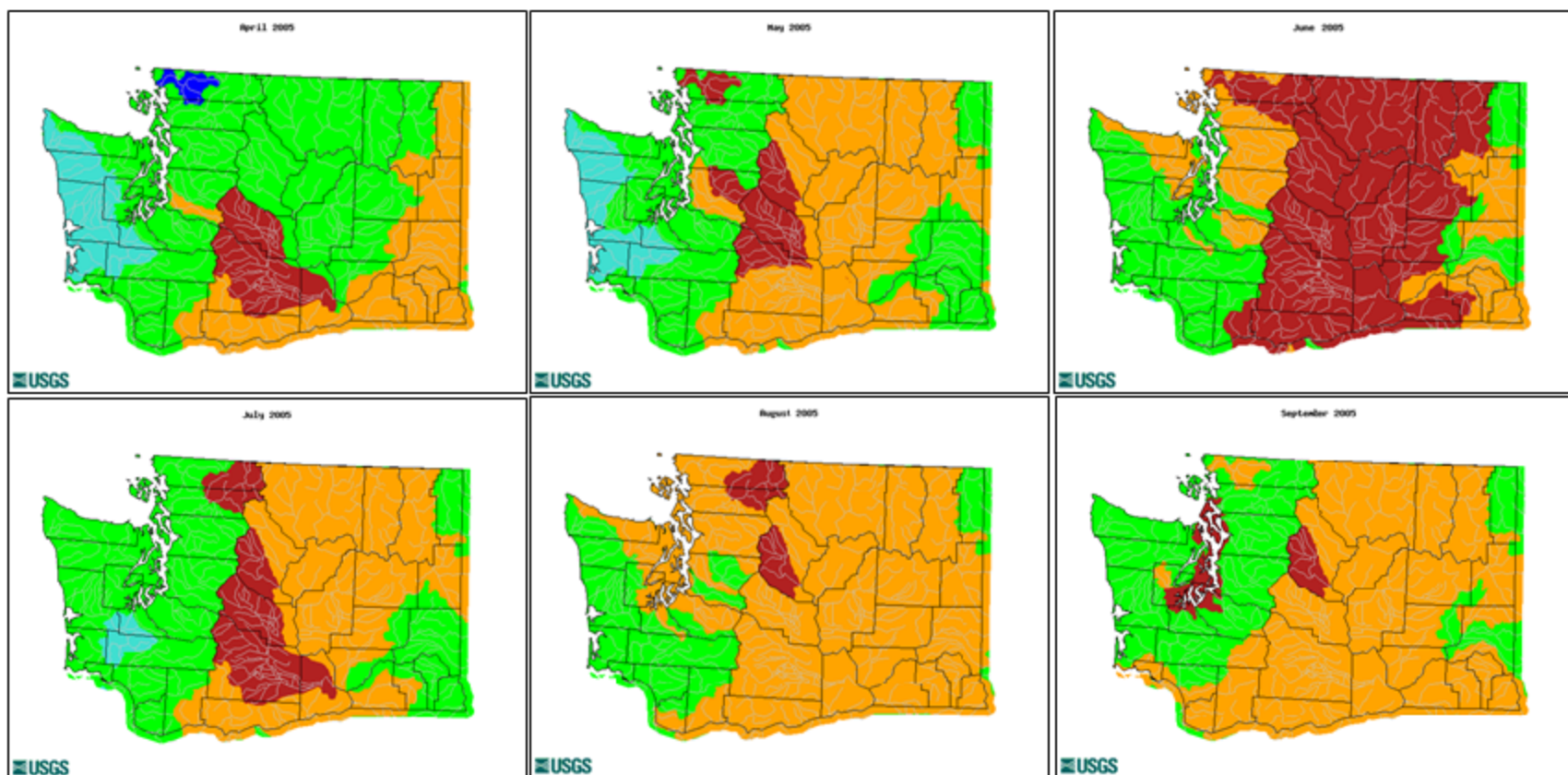


Figure E-3. Runoff Patterns April through September 2005

| Explanation - Percentile classes |                   |              |        |              |                   |      |         |
|----------------------------------|-------------------|--------------|--------|--------------|-------------------|------|---------|
|                                  |                   |              |        |              |                   |      |         |
| Low                              | <10               | 10-24        | 25-75  | 76-90        | >90               | High | No Data |
|                                  | Much below normal | Below normal | Normal | Above normal | Much above normal |      |         |



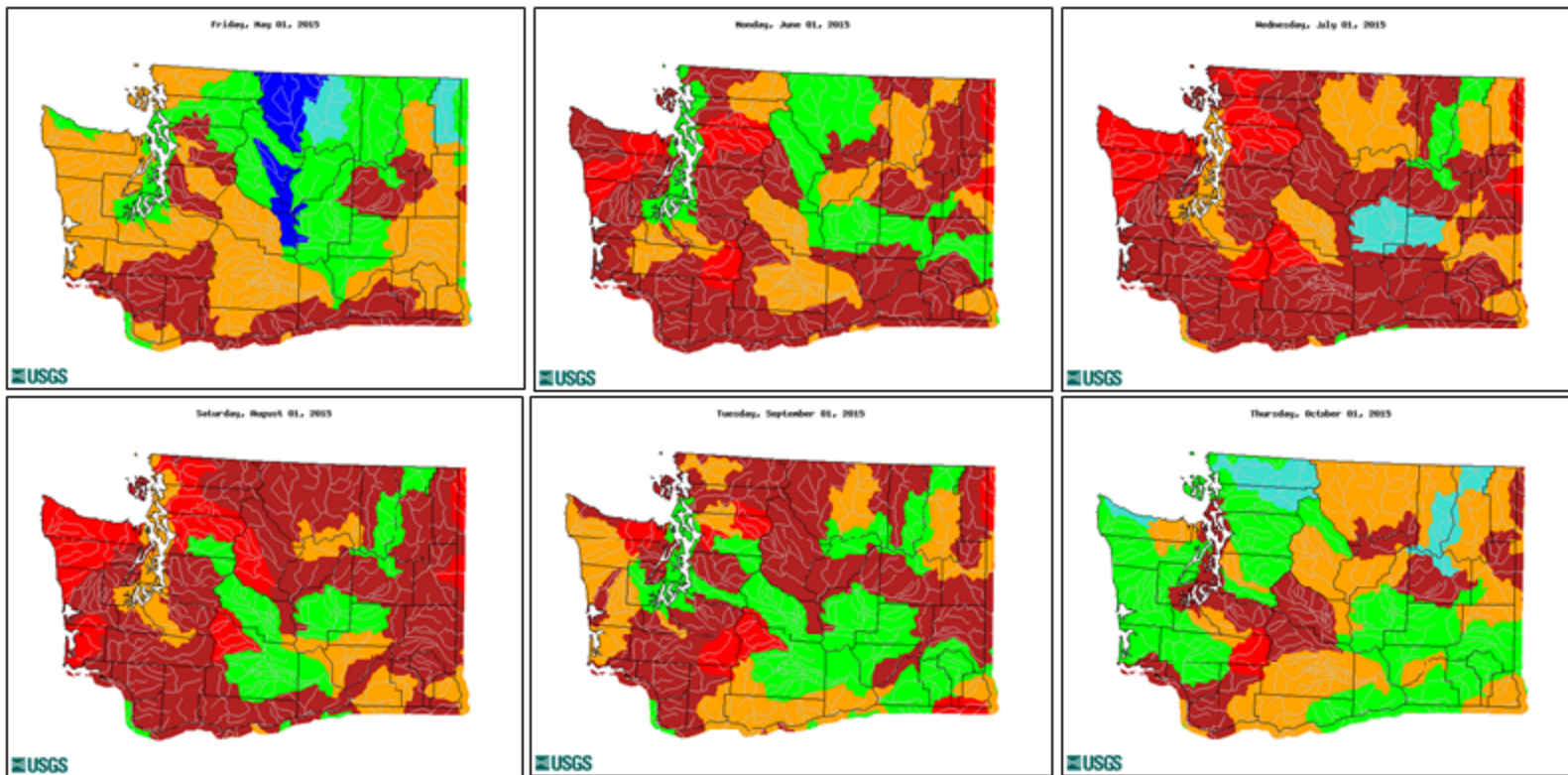


Figure E-4. Runoff Patterns April through September 2015

| Explanation - Percentile classes |                   |              |        |              |                   |      |         |
|----------------------------------|-------------------|--------------|--------|--------------|-------------------|------|---------|
|                                  |                   |              |        |              |                   |      |         |
| Low                              | <10               | 10-24        | 25-75  | 76-90        | >90               | High | No Data |
|                                  | Much below normal | Below normal | Normal | Above normal | Much above normal |      |         |

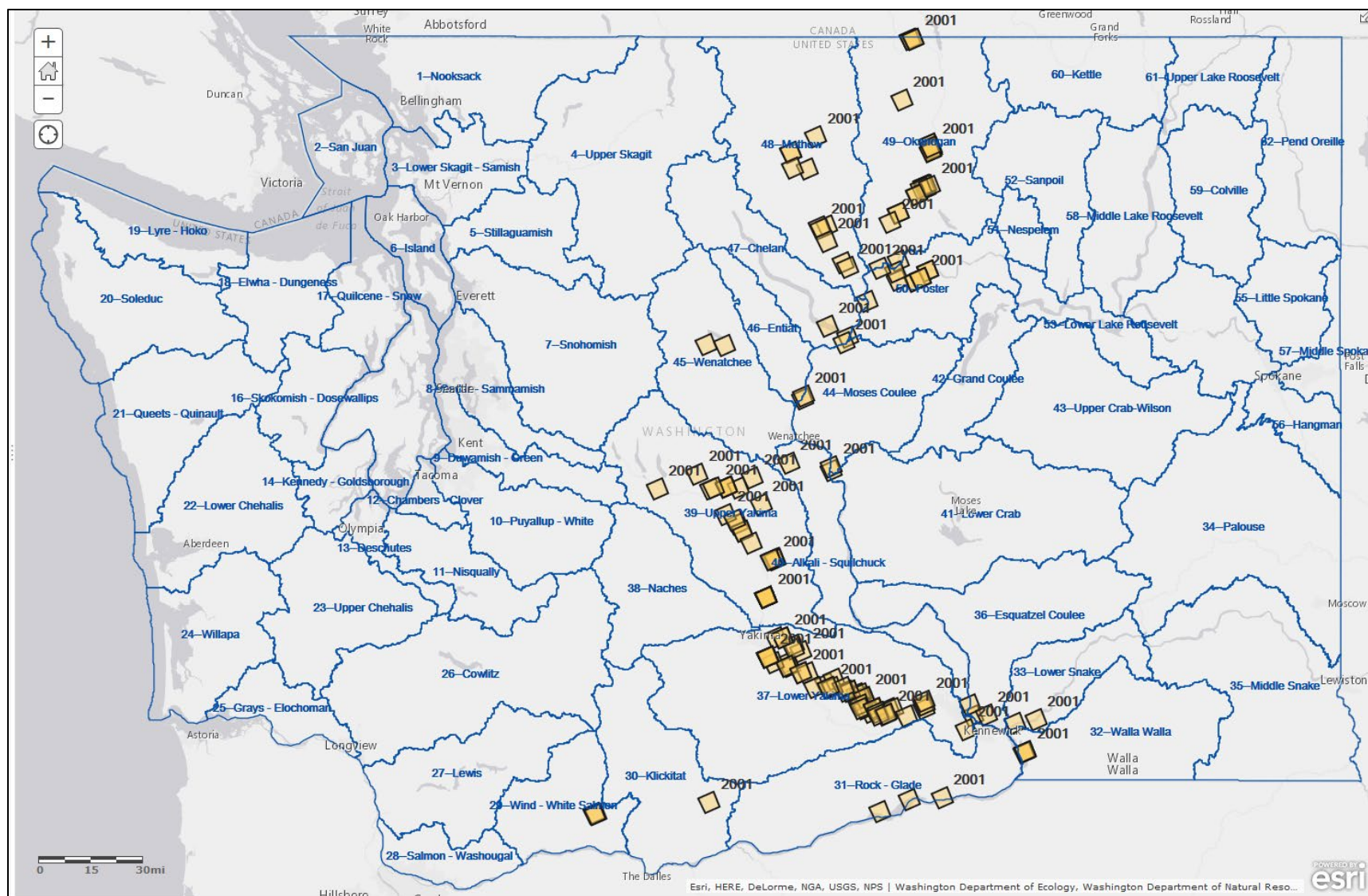


Figure E-5. Emergency Drought Permit Authorizations 2001 (169 total)



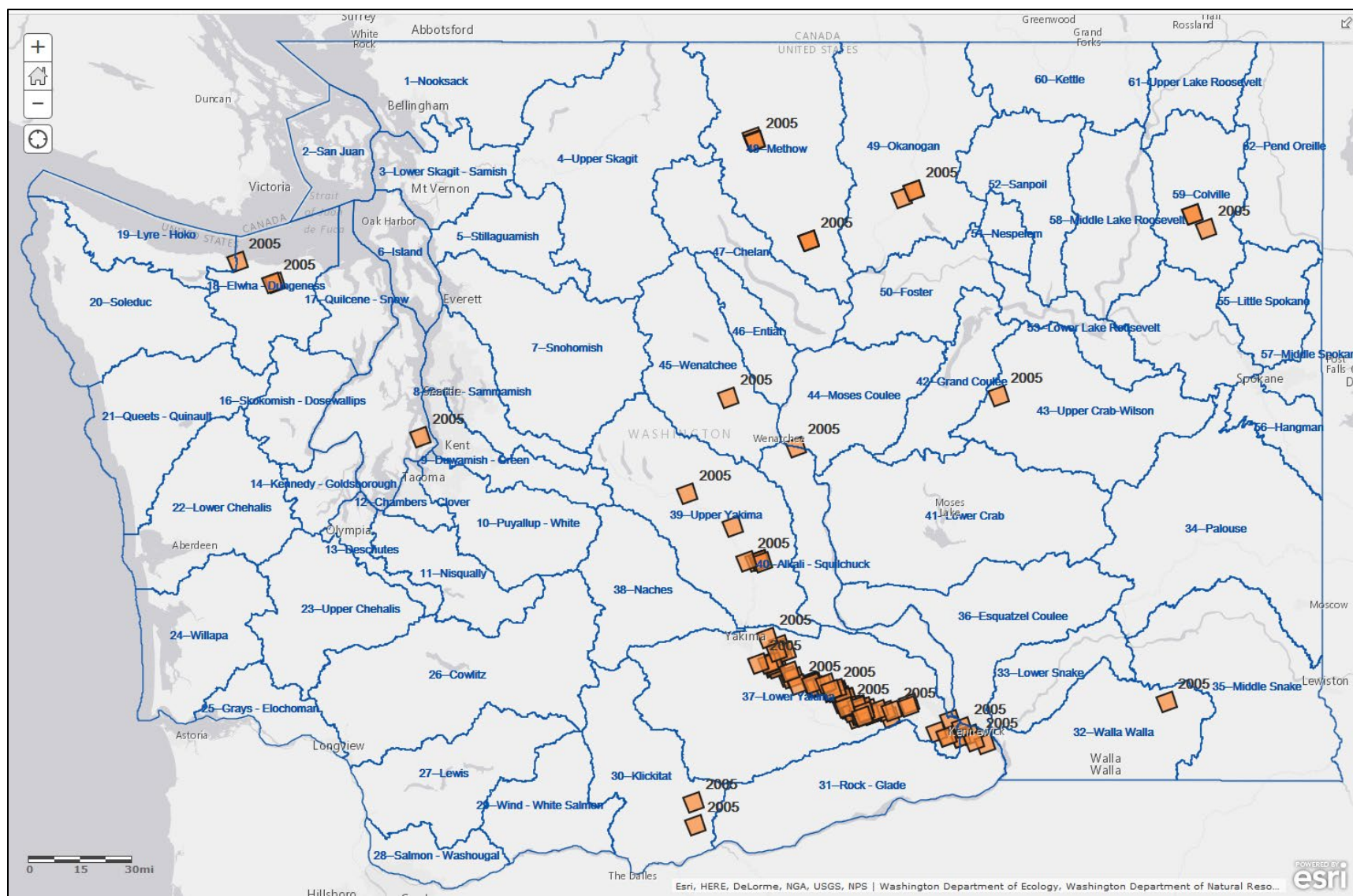


Figure E-6. Emergency Drought Authorizations 2005 (119 total)

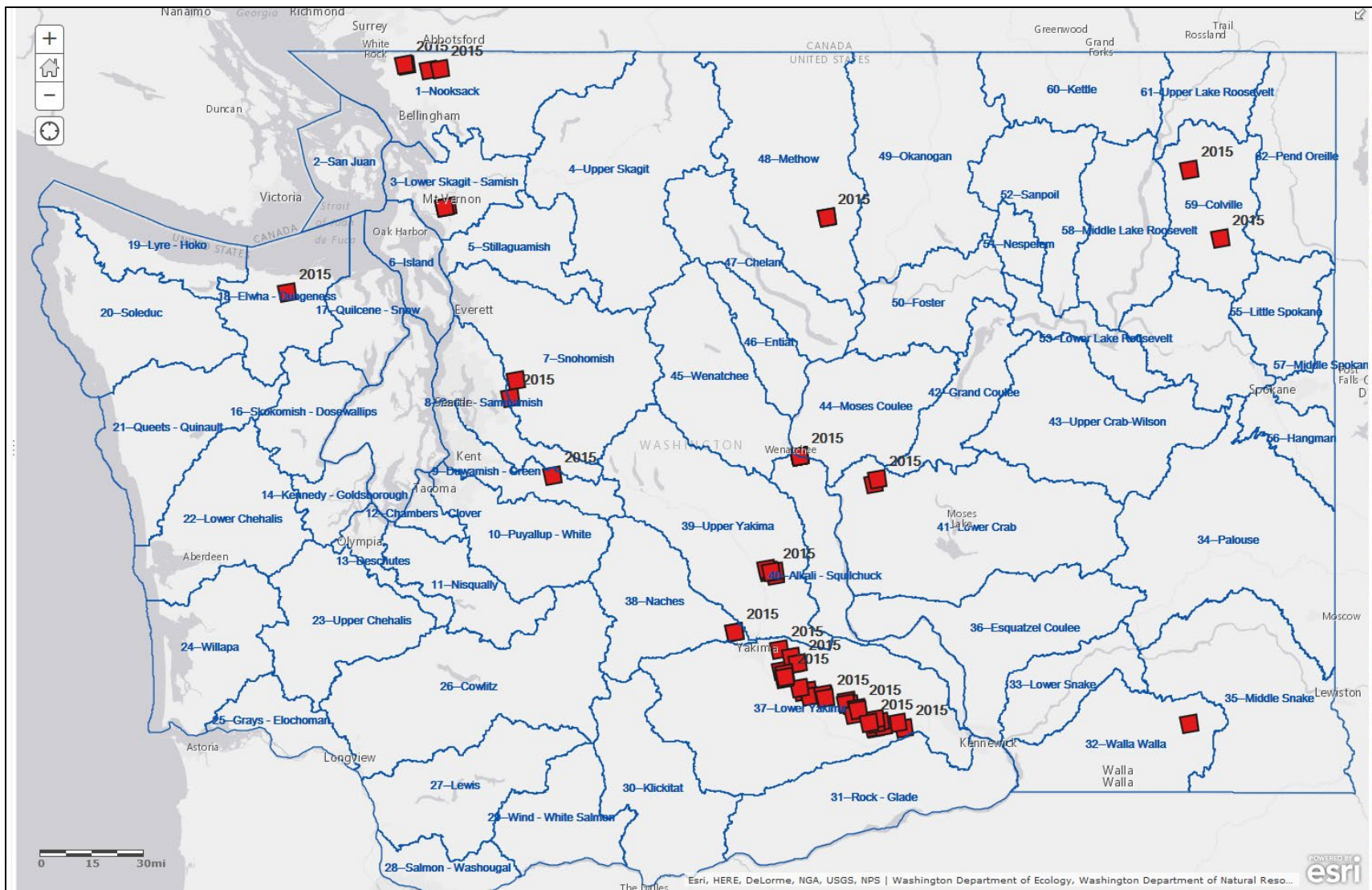


Figure E-7. Emergency Drought Authorizations 2015 (71 total)

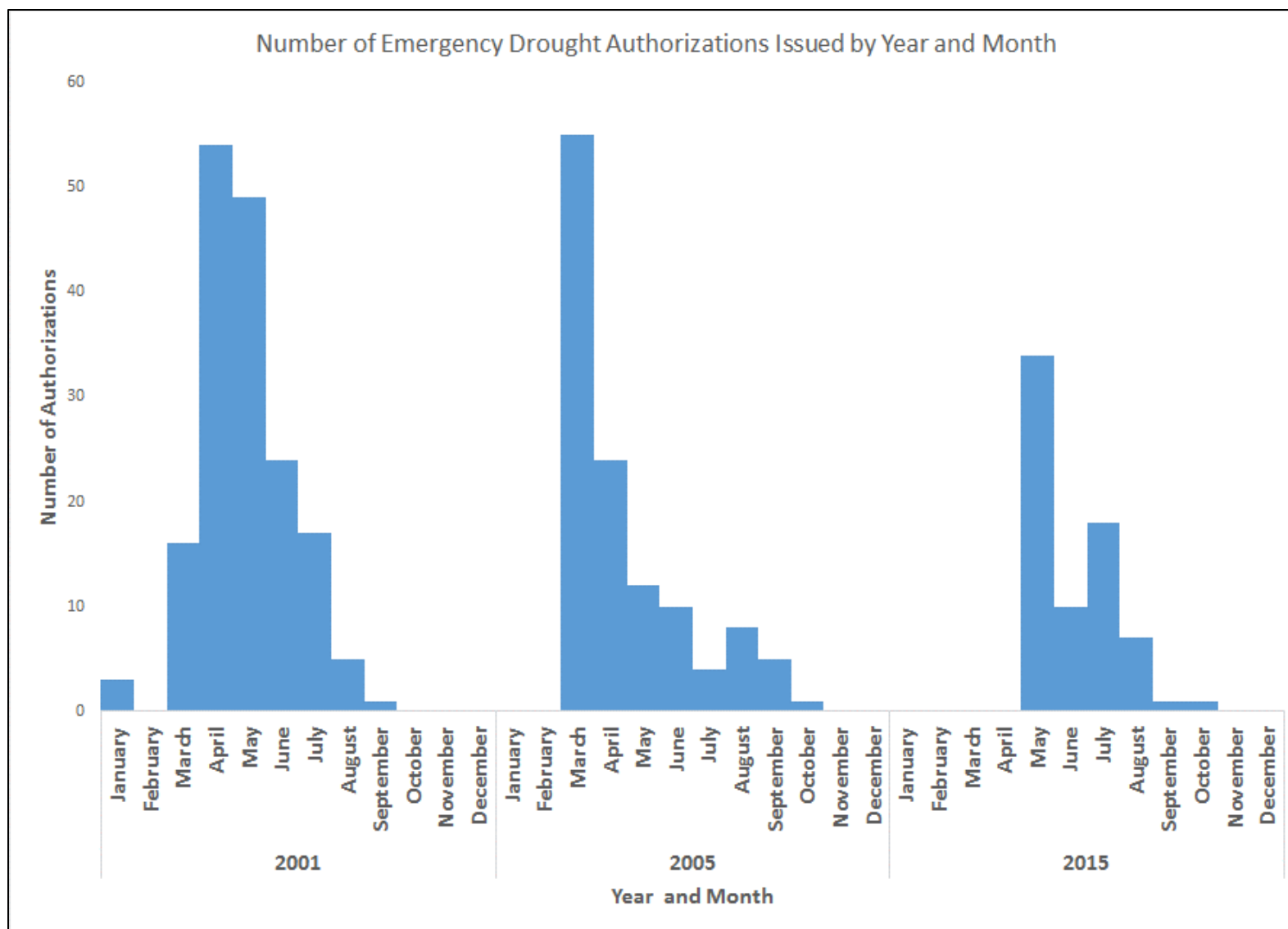


Figure E-8. Number of drought emergencies issued, by month and year



## **Appendix F. Mutual Aid**

(first page only – full document available from the Water/Wastewater Agency Response Network at [wawarn.org](http://wawarn.org))

**Mutual Aid and Assistance Agreement for Washington State for Intrastate  
Water/Wastewater Agency Response Network (WARN)**

*As of: 04/13/09*

This Agreement ("Agreement") is made and entered into by public water and wastewater utilities that have executed this Agreement.

**ARTICLE I  
PURPOSE**

Recognizing that emergencies may require aid or assistance in the form of personnel, equipment, and supplies from outside the area of impact, the signatories hereby establish an Intrastate Network for Mutual Aid and Assistance (the "Network"). Through the Network, Members (as further defined in this Agreement) may coordinate response activities and share resources during emergencies.

**ARTICLE II  
DEFINITIONS**

A. Authorized Official – An employee or officer of a Member agency that is authorized to:

1. Request assistance;
2. Offer assistance;
3. Decline to offer assistance;
4. Decline to accept offers of assistance, and
5. Withdraw assistance under this Agreement.

B. Emergency – A natural or human-caused event or circumstance causing, or imminently threatening to cause, loss of life, injury to person or property, human suffering, significant financial loss, or damage to environment. For example, Emergencies may include fire, explosion, flood, severe weather, drought, earthquake, volcanic activity, spills or releases of oil or hazardous material, contamination, utility or transportation emergencies, disease, blight, infestation, civil disturbance, riot, intentional acts, sabotage and war that are, or could reasonably be beyond the capability of the services, personnel, equipment, and facilities of a Member to fully manage and mitigate by itself.

C. Member – Any public agency which provides supply, transmission or distribution of water; or collection, conveyance or treatment services of storm water or waste water that executes this Agreement (individually a "Member" and collectively the "Members"). The Members are further classified as follows:

1. Requesting Member – A Member who requests aid or assistance under the Network.
2. Responding Member – A Member that responds to a request for aid or assistance under the Network.

D. Period of Assistance – The period of time when a Responding Member

Page 1 of 10

Mutual Aid and Assistance Agreement for Washington State WARN

## **Appendix G. Yakima Basin Drought Wells MOU**

Supplemental Memorandum of Understanding among the Yakama Nation and United States Bureau of Reclamation and Washington State Department of Ecology related to Surface Water Transfer Activities during the FY 2015 Drought

### **I. INTRODUCTION**

This Memorandum of Understanding (MOU) is entered into by the Yakama Nation (Yakama), United States Bureau of Reclamation (Reclamation), and Washington State Department of Ecology (Ecology) for the purposes stated below.

### **II. PURPOSE AND SCOPE**

#### **A. Purpose**

The parties agree that there is need to supplement the Memorandum of Agreement dated August 12, 1999, under Section VI of that agreement, for the purpose of addressing issues associated with the drought of 2015. This supplemental agreement will identify actions to be taken by the parties with respect to surface water transfer proposals and the issuance of emergency ground water permits this year. The general terms of the state's Yakima drought response strategy were discussed among Reclamation, Ecology, and Yakama staff on March 16, April 16, May 13, and May 18, 2015.

### **III. PROVISOS**

A. All provisos in the original MOA shall apply under this supplemental agreement.

B. None of the information used or actions taken by the parties during this drought emergency shall be introduced as evidence by the parties in court, and resolution of water transfer proposals within this agreement will have no bearing upon resolution of similar transfer proposals during subsequent water short years or upon permanent transfer proposals. Nonetheless, a party to this MOU will not be restrained in any way from any action regarding evidence introduced by third parties to effectively defend a party's interest. Provisions within this supplemental agreement will apply only to the resolution of selected water transfer actions and emergency ground water permit actions associated with the 2015 drought. Approval shall not be used as evidence of nor waive any argument concerning future proposed permanent or temporary transfers under either applicable Federal law or contract or state law, including RCW 90.03.380. The use of the procedure for approval here is also not intended by any party to be a concession as to the appropriate procedures for transfers in the future.

### **MITIGATION STRATEGY**

#### **A. Background**

Kittitas Reclamation District (KRD), Reclamation and Ecology have agreed to work together to provide supplemental water from Reclamation owned/KRD maintained irrigation facilities to enhance fisheries during the 2015 drought. KRD proposes to deliver and release the water to the

creeks and Ecology will manage that flow through the lower reaches of each stream. A combined 10 cfs from KRD's Yakima River point of diversion at Easton will be conveyed to five streams crossed by the KRD main canal: Tucker Creek, Big Creek, Little Creek, Spex Arth and Tillman Creek.

Yakima Tieton Irrigation District (YTID), Reclamation, and Ecology are also working together to provide supplemental water from Reclamation owned/ YTID maintained irrigation facilities to enhance fisheries to the South Fork of Cowiche Creek during the 2015 drought. YTID can convey and release approximately 2 cfs to the South Fork.

The state has completed a reverse auction to obtain water rights, which is targeting tributaries upstream of the City of Yakima in both the Naches and Yakima River systems. The purpose of the reverse auction is to lease water primarily to improve instream flows for fisheries.

The state is proposing to administer a program of emergency ground water permits to allow certain water users primarily within the Kittitas Reclamation District and Roza Irrigation District to utilize ground water sources as an emergency supplemental supply of water during the 2015 season. The pumps will be metered and Ecology will perform routine site visit, periodic monitoring of electrical and flow meters to quantify water usage. Therefore, the volume of ground water to be withdrawn under the emergency groundwater permits during the 2015 irrigation season will be verified.

The Roza-Sunnyside Board of Joint Control proposes the capture and reuse of up to approximately 15 cfs of water. Under this proposal, as much as 2500 acre-feet of the captured water is proposed for transfer from Sunnyside Valley Irrigation District (SVID) to the Roza Irrigation District (RID).

The water pumped from the Sunnyside Drains would be used by SVID if not for this proposed transfer. The total water supply available (TWSA) would not be reduced by the proposed transfer from SVID to RID. Because the pumps will be metered, actual quantities can and will be verified.

The state recognizes the substantial public interest associated with water quality standards compliance in the lower Yakima River and the need to ensure that the Yakama's time immemorial right to instream flows for fisheries is protected.

## B. Strategy

The parties agree that the guiding principle during the current drought is to use all the available tools to manage the Yakima River basin for the benefit and protection of all the basin's resources, including both instream and out of stream uses of water within the limits of law and existing water rights.

The 2015 drought response strategy applies to off-reservation emergency groundwater well use and surface water right transfers between off-reservation entities. Any requests for transfers within the reservation or emergency groundwater well use on the Reservation must be approved by the Yakama Tribal Council. Any requests for transfers from an on-reservation source to an

off-reservation entity must be approved by the Yakama Tribal Council before being forwarded to the state for its consideration.

Ecology will manage its emergency ground water well permit program to ensure that effects to the Yakima River will be mitigated in the long term and that permitting actions will not reduce TWSA in the current year. Ecology agrees to acquire water for placement into trust to benefit instream flows in the Yakima River and its tributary streams.

The water pumped from the Sunnyside Drains would not be used by SVID if not for the emergency drought actions. The proposed transfer of a portion of the captured return flow from SVID to RID would reduce Yakima River flows downstream of Sunnyside Dam. Because the pumps will be metered, actual quantities can and will be verified.

Water leases of up to 5,000 acre feet from fallowed ground in SVID will be transferred to Roza Irrigation District. That water would have been used by SVID if not for the water transfer and the total water supply available will not be reduced as a result of the transfer.

Acquisition of water to replace the net flow reduction in the lower Yakima River would ensure that the public's interests are protected and the Yakama's rights are not harmed by the state's approval of the transfer. Ecology agrees to work with Reclamation and Yakima Nation and acquire water to replace the water lost to that reach of the river. In doing so, we agree to the following approach to guide the acquisition of replacement water:

The objectives:

- 1) Ecology, in consultation with the Yakama Nation and Reclamation, will seek to lease or purchase water for in-time, in-place, and in-kind mitigation this year or;
- 2) If water cannot reasonably be acquired to accomplish #1, Ecology, in consultation with the Yakama Nation and Reclamation, pursue alternative means to acquire water that provides in-time benefits upstream and which is of equal or greater benefit ecologically. Ecology will implement the agreed strategy.

If the parties agree that water is not reasonably available to meet either #1 or #2 above, Ecology will either acquire water rights to be placed into the State Trust Water Rights Program for instream flow purposes or provide funding based on the market value of the water to the YRBWEP Acquisition Fund for replacement water and/or habitat. The parties will jointly list, analyze, and select other long-term and sustainable acquisition options. Land and/or water acquisitions will be jointly evaluated for longer-term ecological benefits and will be implemented by Reclamation.

Ecology, Reclamation and the Yakama will:

Implement the agreed strategy as soon as possible after its selection or as soon as fund transfer is completed, whichever occurs first.

Nothing herein is intended to quantify, diminish, or define the Yakama's water rights nor serve as an admission as to instream flows in the Yakima Basin. All other terms of the original

Memorandum of Agreement shall remain in force and effect and are incorporated herein by reference.

This amendment to the original MOA shall apply only during the year 2015. Any action taken by Reclamation to implement measures pursuant to this Agreement is contingent upon any necessary compliance with relevant Federal laws, including but not limited to the Endangered Species Act.

Maia D. Bellon  
Director  
Department of Ecology

Date: \_\_\_\_\_

JoDe L. Goudy  
Chairman, Tribal Council  
Yakama Nation

Date: \_\_\_\_\_

Dawn Wiedmeier  
Columbia-Cascades Area Manager  
U.S. Bureau of Reclamation

Date: \_\_\_\_\_

## Appendix H. Communication

### Overview

The Washington State Drought Contingency Plan lays out a multi-agency response to drought or potential drought conditions. As the state's water resource manager, the Department of Ecology facilitates the declaration process and leads the response, but close coordination with other state agencies is vital for response success, including communications.

This chapter provides guidance on how to develop and deliver strong, synchronized communications in the event of a drought advisory or emergency declaration in Washington State.

### Lessons learned from 2015

Washington has experienced a handful of water-short years in recent memory, but 2015 stands out as the most severe. Here are high-level lessons learned from our experiences communicating during that year:

- Drought does not impact everyone equally
- Coordination among the state family and close partners is critical
- People want to know what we are doing and how they can get relief

These lessons, and others, are woven into this chapter.

### Communications Summary

**Table H - 1. The actions and communications associated with water supply communication**

|                                   | <b>Actions</b>   | <b>Communications</b>  |
|-----------------------------------|--|--|
| Water supply updates (year-round) | Ecology regularly convenes the Water Supply Advisory Committee (WSAC) to review conditions and anticipate potential problems<br><br>Ecology continues its drought mitigation efforts | Ecology updates its website, blog and social media based on WSAC findings<br><br>Other state agencies are involved in communications, as necessary<br><br>Highlight successful projects or plans that increase drought resilience (e.g. Office of Columbia River work) |

|   | <b>Actions</b>  | <b>Communications</b>   |
|---|---|---|
| <b>Stage 1 – Advisory</b><br>(regional or statewide)              | <p>Ecology issues an advisory for the affected area(s)</p> <p>Involved state agencies have heightened awareness and increased preparation</p> <p>Involved agencies may begin mobilizing resources and preparing for drought response actions</p> <p>Ecology invites water users who anticipate hardships to petition for assistance with drought preparedness/ response actions</p> | <p>Ecology convenes the drought communication coordination team</p> <p>Ecology leads the effort to communicate about existing conditions and forecasted climate outlooks</p> <p>Coordinate communication with major water managers and affected governments (county, city and tribal)</p> <p>Tone: Concerned but not panicked; clear and conversational</p>   |
| <b>Stage 2 – Emergency declaration</b><br>(regional or statewide) | <p>Ecology issues a drought declaration for the affected area(s)</p> <p>Ecology activates systems for response as defined in the state’s drought contingency plan</p> <p>Involved agencies mobilize resources</p>   | <p>The drought communication coordination team (Ecology convenes this group, if advisory step is skipped) highlights information about relief efforts and how affected people can access resources</p> <p>Ecology continues communicating about existing conditions and forecasted climate outlooks; state agencies support</p> <p>Team coordinates communication with major water managers and affected governments (county, city and tribal)</p> <p>Tone: Calm, direct and empathetic</p> |

## Coordination Team

In the event of drought conditions, communications staff representing each involved state agency will meet regularly. Ecology will convene this team. Their work will involve:

- Discussion and decisions on roles, responsibilities and expectations
- Updates from each state agency on its preparation or response activities



- Discussion and decisions on communication goals, tactics and strategies
- Coordination of messages and messengers
- Reviewing each agency's audiences and strategies to reach target groups
- Identifying the best approaches for managing online content and media outreach
- Determine where information will be housed online
- Determine the lead on media outreach, including news releases and spokespeople
- Connecting with key stakeholders (cities, water districts, PUDs, irrigation districts, etc.) and their messaging
- Reviewing the impact of our communications – what's working and what's not

Members of this group will be responsible for channeling communications updates to and from their leadership teams. These internal updates could include:

- What other agencies (Federal, State, county, local and Tribal) are doing
- Big media stories or inquiries
- Stakeholder outreach for their respective state agency

## **Goals of Multi-agency Communication**

- Remain a trusted source on water supply conditions
- Work as a singular state family

## **Objectives**

- Keep audiences informed about current and forecasted water supply conditions
- Share information about resources and how to access them
- Coordinate and amplify messages
- Leverage agencies' unique relationships with stakeholders to reach target audiences

## **Audiences**

The involved state agencies have relationships with specific audiences that could be used during a drought advisory or emergency declaration. Here are the audiences each agency is best at reaching during drought:

### **Department of Ecology**

- Media
- Water rights holders
- Governor's Office

- Environmental groups
- Tribes

#### **UW Office of State Climatologist**

- Media
- State agencies
- Universities and agricultural groups for presentations

#### **Washington State Conservation Commission**

- Conservation districts (can reach all 45 directly via [delivery.gov](http://delivery.gov))
- Rural landowners

#### **Department of Agriculture**

- Washington Water Resources Association
- Washington Tree Fruit Association
- Washington Grain Commission
- Western Washington Agricultural Association
- Washington Dairy Federation

#### **Washington Department of Fish and Wildlife**

- Tribal Natural Resource and Fish Managers
- Recreational water users
- Commercial and recreational fishermen

#### **Department of Commerce**

- Media
- Energy utilities
- Association of Washington Business
- Businesses (local, national)
- Local governments
- Community action agencies and related service providers

#### **Department of Health**

- Group B water systems
- General public

## **Department of Natural Resources**

- Private and public timberland managers
- Wildfire first responders
- Managers of agricultural land owned by DNR
- Emergency managers

## **Other critical audiences for drought communication include:**

- Lawmakers, including the Joint Legislative Drought Task Force
- Residential customers of water systems
- Residents relying on private wells
- Businesses
- City/county officials
- Other agency stakeholders
- Water Resource Advisory Committee members (Ecology)
- Tribes
- Internal agency staff and executives

## **Strategies**

- Use plain talk
- No surprises: Be the first and best source of information on what's going on
- Implement a cohesive online strategy
- Encourage dialogue on social media – Consider sharing a hashtag
- Work with media to reach affected communities, including non-English-speaking communities (Translate as much as possible.)
- Partner closely with Ecology's regional communications managers, and if possible, involve state agencies' regional communications staff

## **Tactics**

Ecology will take the lead on external communication tactics but will need support from other state agencies. Each agency will handle its own internal communication and messaging to its stakeholders. All communications, internal and external, will be discussed (and coordinated, as appropriate) during drought communication coordination team meetings.

- Communications plan and talking points

- Media outreach
  - Issue news releases, as necessary (coordinate roles among state agencies)
  - Clearly set lanes when answering reporter questions
  - Work with diverse media outlets
- Blog posts
  - Water supply conditions and forecasts
  - What we're doing; how to access resources
  - Guest posts
- Website
  - Identify a strategy to share information online
  - Coordinate with state agencies on content and messages
- Social media
  - Share latest information and/or success stories
  - Advertise blog posts
  - Promote web page updates
  - Promote sister agencies' web pages, when appropriate
  - Engage and elevate regionals' and partner agencies' accounts
- Creative thinking
  - Podcasts, livestream interviews, etc.
  - Photo albums of impacts

## **Recommendations**

### **Stay connected to water suppliers**

In 2015, many residents were confused when Ecology declared a statewide drought but people saw water being used normally – local parks being irrigated, for example. Or, citizens heard that fish are flopping in dry streams but saw neighbors refilling backyard pools. Confusion can arise when representatives from the state say one thing and people hear another message (or see contradictory behavior) elsewhere.

Much of this confusion took place in areas served by municipal water suppliers. Coordination with key water management groups, especially municipalities and other water purveyors, can help avoid conflicting messaging. About 85 percent of water users in the state are connected to a water system. Communications need to clearly address how water system users are affected by an advisory or emergency declaration, or clearly state where they can learn about those impacts.

People using a water system will need to contact their local water supplier to get more information. This will require regular and open communication with water suppliers to ensure consistent messaging.

**Note about large utilities:** In the event of a drought advisory or emergency declaration, EWEC-level staff would contact the state’s largest utilities (Seattle, Tacoma, Everett, and the Pierce County regional system). Once communication is established, the drought communication coordination team will assist by:

- Opening dialogue about local messaging plans
- Identifying and discussing any potential conflicting messages
- Sharing messages and talking points
- Integrating communications, as appropriate (e.g., sharing quotes in news releases)
- Staying connected with utilities for the duration of the advisory/declaration
- Adjusting as needed

### **Call out affected groups**

Clearly and frequently specify who or what is most affected by drought conditions – irrigators, fisheries, drinking water suppliers, etc. This will help people quickly determine whether they will be affected.

### **Maintain consistent messaging**

Ecology will take the lead on developing messages, but all involved entities must be consistent with:

- Terminology
- Format
- Facts

Message coordination will occur through the drought communication coordination team.

### **Use plain language and repeat definitions**

A formal drought advisory or emergency declaration will need to be accompanied by plain-language communications (news release, web updates, social media, etc.) that address:

- When
- Where
- Who
- How bad

Don’t assume the advisory or declaration language will be widely understood on its own. Studies show that many audiences do not understand the difference between warnings, watches,

advisories, statements, etc. Ecology must clearly define the information and continue to define it for the duration of the advisory or declaration (or beyond).

### **Make impacts relatable**

Technical or academic language like, “An anomaly of 1.5 degrees Celsius,” may not be understood by most audiences. Impacts need to use plain language and describe relevant information.

When possible, connect impacts to the local level. This will help people understand what to expect in their community. When discussing impacts, share stories about what is being done to help those affected by drought conditions.

### **Acknowledge uncertainties**

A drought’s impact can vary widely, even in a small geographic area. Research shows that emphasizing uncertainties and probabilities can provide helpful context. This could reduce the frustration that comes with forecast uncertainty. The drought communication coordination team could consider using terms like *best case*, *worst case*, and *most-likely case* to describe the range of potential impacts to an area or community.

### **Work with Portland media in southwest Washington**

Portland media outlets reach into the southwest portion of Washington. If a drought advisory or emergency declaration is issued in this region, it will be important to:

- Ask for guidance from southwest-based regional communicators (Ecology or other state agencies) on how to best reach Portland media
- Intentionally include Portland media on news distribution lists

### **Coordinate with the Bureau of Reclamation**

The Bureau of Reclamation is a co-water manager in the Yakima River Basin, an important agricultural center for the state. Ecology worked closely with Reclamation staff on response actions (the drought well program and Columbia drought insurance program) during the 2015 drought. This partnership will need to continue and include dialogue about messaging. Ecology’s Central Regional Office communications staff could help build necessary connections.

## **Sample Communications**

### **News releases**

*Governor Inslee declares drought for three Washington regions*

March 13, 2015

OLYMPIA - Snowpack conditions across Washington state mountains are near record low levels, prompting Gov. Jay Inslee to declare a drought emergency for three key regions.

Watersheds on the Olympic Peninsula, east side of the central Cascade Mountains including Yakima and Wenatchee, and Walla Walla region will be hit hardest with drought conditions.

Snowpack is a mere 7 percent of normal in the Olympic Mountains. It ranges from 8 to 45 percent of normal across the Cascades, and is 67 percent of normal in the Walla Walla region.

"We can't wait any longer, we have to prepare now for drought conditions that are in store for much of the state," said Inslee. "Snowpack is at record lows, and we have farms, vital agricultural regions, communities and fish that are going to need our support."

An unusually warm winter has caused much of the precipitation to fall as rain, leaving mountain snowpack a fraction of normal. And a healthy snowpack is what would slowly feed rivers across the state and sustains farms and fish through the drier summer months.

"We've been monitoring the snow conditions for months now, hoping for a late-season recovery," said Washington Department of Ecology Director Maia Bellon. "Now we're gearing up to help provide relief wherever we can when the time comes. Hardships are on the horizon, and we're going to be ready."

Short and long-range weather forecasts are not expected to bring relief, calling for warmer and drier weather.

With snowpack statewide averaging 27 percent of normal, 34 of the state's 62 watersheds are expected to receive less than 75 percent of their normal water supplies.

Ecology has requested \$9 million in drought relief from the legislature. The money would pay for agricultural and fisheries projects, emergency water-right permits, changes to existing water rights, and grant water-right transfers.

For now, water suppliers in the Seattle, Tacoma and Everett areas are in decent shape and are not projecting much hardship.

To track snow and watershed totals, Ecology is posting daily updates to its drought website - [www.ecy.wa.gov/drought](http://www.ecy.wa.gov/drought), and providing routine updates on Facebook and Twitter - search @ecologywa or #wadrought.

#### *Emergency funds support three drought-relief projects*

Projects in Eastern, Central and Western Washington help with water shortages

OLYMPIA - Emergency funding is going to support three drought-relief projects in Eastern, Central and Western Washington. The money will help pay for a new well in Stevens County, water conservation in Benton County, and protect spawning salmon in the Dungeness River on the Olympic Peninsula.

"We're moving quickly to support critical water supplies for communities, farmers and fish across the state who are enduring extreme hardships in this unprecedented drought," said Director Maia Bellon of the Washington Department of Ecology.

Ecology has approved three grants to help pay half the cost of projects that will bring much needed relief.

Stevens County Public Utility District will receive \$47,000 to help drill a new well to replace the failing main production well of the Riverside Water System. The new well will help provide

reliable drinking water to 385 residents. Declining groundwater levels have been reducing production from the existing well since October 2014.

Kennewick Irrigation District will receive \$28,872 to help increase water conservation by 23,000 customers in Kennewick, Richland, West Richland, and incorporated Benton County. The district will advertise on TV and radio to increase awareness, and -hired a code enforcement officer to ensure compliance.

Jamestown S'Klallam Tribe will receive \$74,430 to monitor and address fishing stranding and/or blockages. The effort will include acquiring and installing multiple temporary "diversion dams" in the Dungeness River that will concentrate flow to help spawning salmon migrate upstream. Flows in the Dungeness River are currently 35 percent of normal and 1.3 million pink salmon are expected to return this season. The tribe is working in cooperation with the Washington Department of Fish and Wildlife.

The money for these projects is coming from the \$16 million approved by the 2015 Legislature to use over the next two years to help relieve drought hardships statewide.

Through the grant program, public entities such as cities, public utilities and irrigation districts can get help paying for developing alternative water supplies or deepening existing groundwater wells.

Additional applications for grant funding have been received, and Ecology is working quickly to review the applications. The agency expects to fund more drought-relief projects in the coming weeks.

Gov. Jay Inslee made the entire state eligible for drought relief funding when he declared a statewide drought May 15, 2015.

Application forms and information on qualifications for drought relief grants are available on Ecology's website: 2015 Drought Emergency Grant Program.

## **Blog posts**

Friday, July 31, 2015

*How bad is the drought? 2015 is shaping up to be the worst of Washington's statewide droughts*  
*by Dan Partridge, communications manager, Water Resources*

The U.S. Drought Monitor has now classified all but a smidgen of Washington state as being in a "severe" drought (99.99 percent) and says that more than 31 percent of our state is in an "extreme" drought.



It's the first time the state has reached these conditions in a decade.



Exposed rock and boulders at  
Skykomish River Bridge

Photo: Seth Preston

Ginny Stern with the Washington Department of Health is a veteran of drought relief work. She says simply that this drought is "way worse" than the statewide droughts of 2001 and 2005.

The health department is seeing water systems starting to switch to emergency water supplies, driven by the demand for water created by 90-degree temperatures. In fact, the National Weather Service (NWS) reports that July has been the warmest month in recorded Seattle weather history dating back to 1890.

Next week, the health department will be sharing with county health directors a list of drinking water systems at risk of water shortages.

*Stream flows, crop losses, fish issues are indicators of record drought*

The impacts on our drinking water supplies are certainly not the only sign that 2015 is shaping up to be the worst drought in Washington modern history:

- Almost 80 of our streams and rivers are running at below normal or record low flows.
- The Walla Walla River went dry a week ago as measured by the USGS gauge near Touchet. This was caused both by the drought itself and by the large amount of water being diverted from the Walla Walla's tributaries to fight the Blue Creek fire.
- Ecology has curtailed the water use for almost 500 irrigators across the state to sustain stream flows. Some of these water rights date back to the 1800s.
- Crops are at risk of failure in areas where farmers have had to stop their diversions. In the Yakima Basin, that means orchards, hay and alfalfa crops on some 2,153 acres. In the Dungeness Basin, irrigators' choice to curtail water use from the Dungeness River because of low flows means they will lose their last cutting of hay.
- Record-breaking warm water temperatures from "the Blob" in the North Pacific Ocean are increasing harmful algae blooms, closing shellfish harvests and causing unfavorable conditions for salmon and other marine life in Puget Sound.

- The cities of Everett, Seattle and Tacoma have implemented the first stage of their water shortage response plans, which means they are asking customers to carefully manage their water use and make sure they are not wasting water.
- The state Department of Fish & Wildlife is closing areas to fishing or restricting fishing at an unprecedented rate: more than 40 closures so far this year. This is to relieve stress on fish already struggling with high water temperatures and low stream flows.

*Ecology, partner agencies focused on drought response*

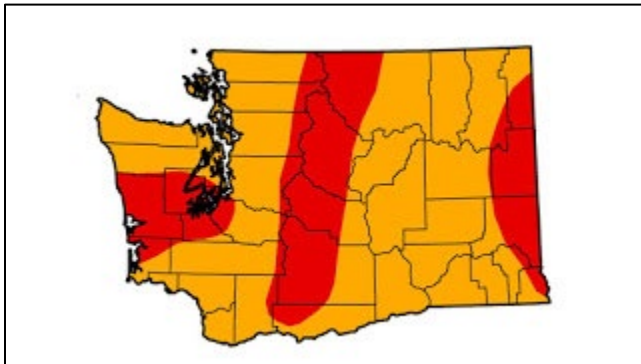
Ecology is working with the state departments of Health, Fish & Wildlife, Agriculture and Natural Resources to help relieve the hardships that are occurring due to water shortages. Ecology will soon announce our first round of recipients for drought relief funds. Our grant program is supporting projects designed by cities, utilities and irrigation districts to help protect public health and safety from effects of the drought and to reduce economic or environmental impacts from water shortages. The Legislature authorized \$16 million over the next two years for Ecology's drought relief work, including the grant program.

*No relief from drought conditions on the horizon*

And the hot weather driving these shortages shows no sign of relenting.

Neither the state weather forecast nor the West Coast outlook offer much hope of relief from the drought in the months ahead.

The August forecast calls for more hot and dry weather in Washington and the long-term forecast is calling for a strong El Niño weather pattern to continue into next year. If accurate, this will mean another low snowpack and another year of drought.



The U.S. Drought Monitor this week classified 99.99% of Washington state as being in a “severe” drought. The red swaths on the map show the 31% of the state classified as being in “extreme” drought.

*Friday, August 21, 2015*

*Help us tell the story: Half of state in “extreme drought”*

Send us your photos of dry river beds, fish kills, crop losses

*By Dan Partridge, communications manager, Water Resources Program*

The U.S. Drought Monitor now considers half of Washington to be in “extreme drought.” The entire state is classified as being in “severe drought.”

As fires rage in Eastern Washington and low stream flows are turning some rivers and streams into beds of bare rocks and boulders, it’s essential that we document the drought’s impacts and what’s being done to mitigate the hardships from those conditions. And we need your help to do that.

Find updates as they happen on our drought page.

This week, we posted a more streamlined Washington Drought 2015 Web page that provides links to the latest fire information, air quality alerts about smoke from the fires, and information about how the drought is impacting our communities, farms and migrating salmon. The page also allows you to track the work Ecology and our partners are doing to relieve the rapidly mounting hardships across the state. We are also spotlighting the water conservation work of our cities, towns and irrigation districts with a weekly blog series.



Story of the drought in pictures, charts and graphs

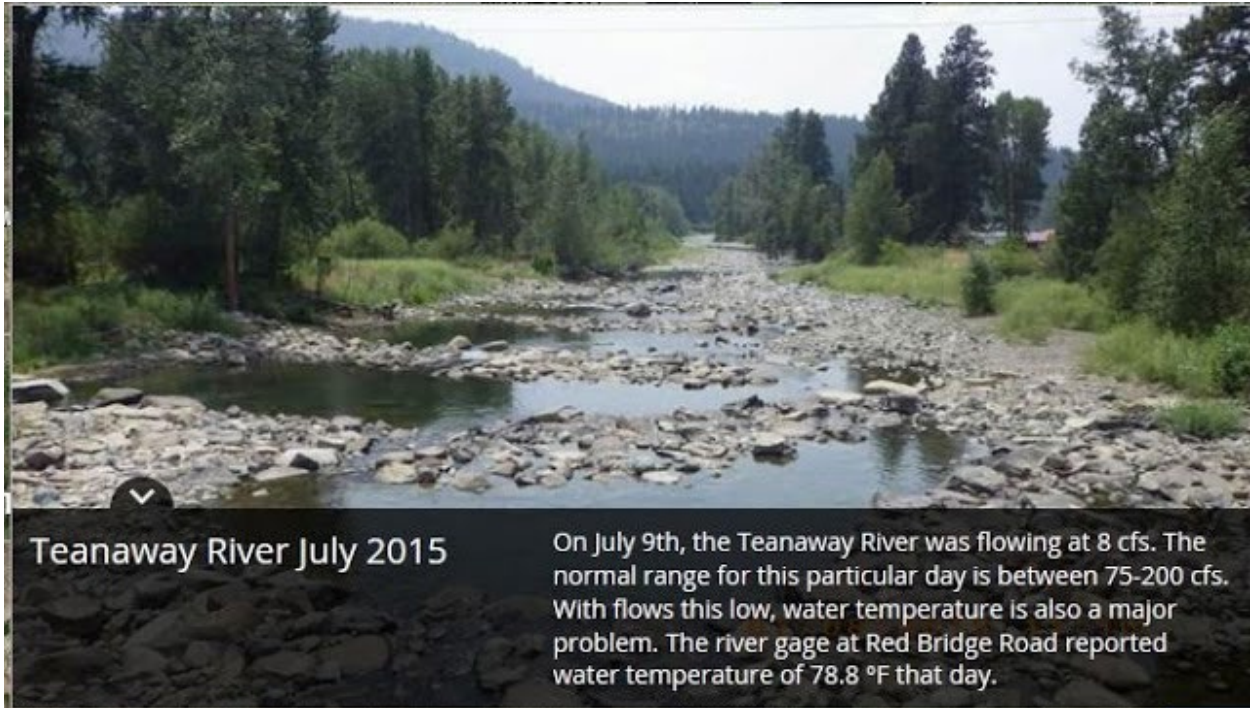
In conjunction with the new Web page, we have posted a Washington State 2015 Drought Photo Tour. At this site, you will find photos of scant snowpack, streams reduced to a trickle and charts and graphs that illustrate what is shaping up to be the state’s worst drought in modern history.

#### *Submit your photos*

Ecology is working with the state departments of Agriculture, Health and Fish & Wildlife to provide information, photos and analysis, but we also need the public’s help in documenting the impacts of the drought. If you see dry stream beds, wildlife struggling to get to water, fish stranded in shallow pools or crops dying in the fields, fill out this simple form and submit your photos for the Drought Photo Tour.

Your contribution will alert staff to conditions they may not be aware of and help us in our efforts to alleviate hardships across the state from a drought that shows no signs of subsiding soon.

Below is one of our stories of declining river flows:



Posted by Lynne Geller at 4:28 PM No comments:

Labels: drought, drought photos, Water Resources, water shortage

## Videos

<https://youtu.be/AyWifdwCD64>



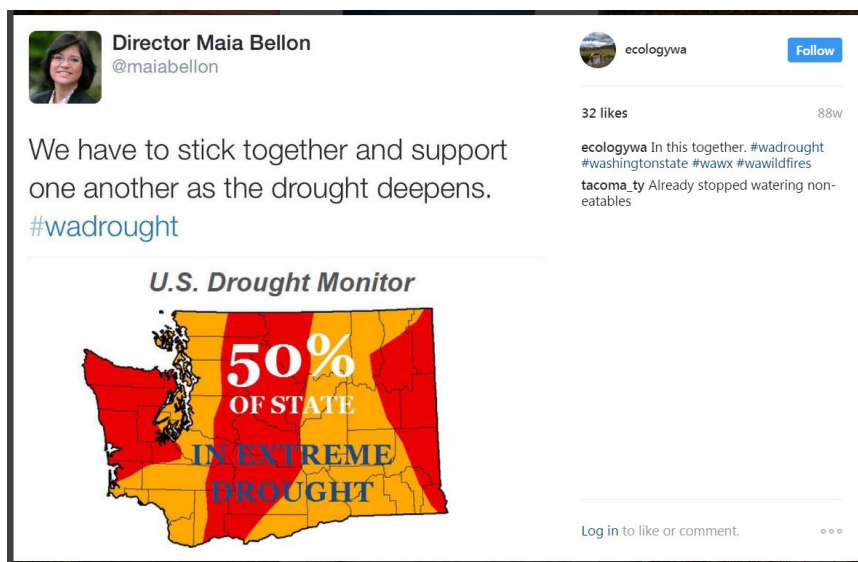


## Photos

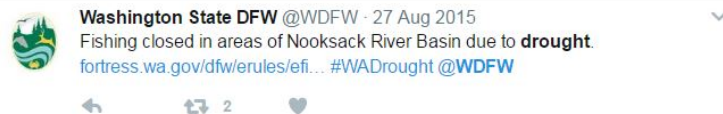
<https://www.flickr.com/photos/ecologywa/albums/72157656690948883>



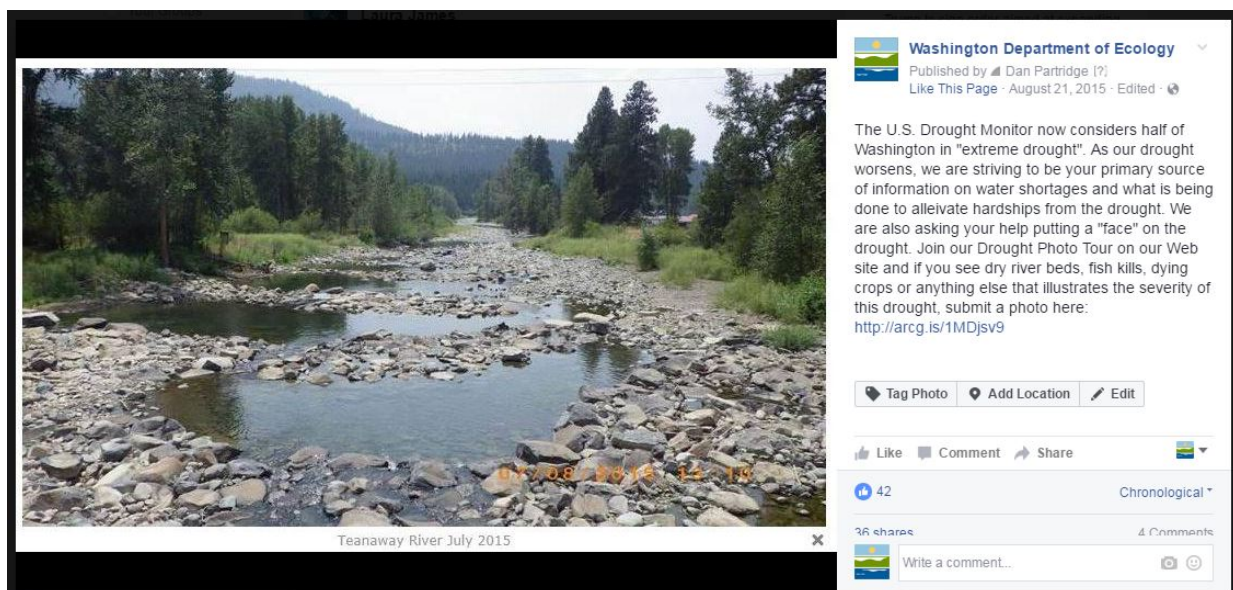
<https://www.instagram.com/ecologywa/>



## Tweets



## Facebook



# Appendix I: Examples of Administrative Documents

The following administrative documents have been bundled as a separate file, for the purpose of providing examples and templates to refer to in future drought actions.

[Drought Contingency Plan Summary Page](#)

|   |      |
|---|------|
| Example Agenda for Water Supply Availability Committee indicating topics assigned to specific participants (February 24, 2017) .....  | I-3  |
| May 11, 2015, email and May 13, 2015, agenda for the Executive Water Emergency Committee to evaluate WSAC recommendations and discuss potential for hardship .....  | I-4  |
| Position Description form and required skills and competencies for entry-level temporary drought hire at region office.....   | 1-6  |
| Statement issued after April 13, 2015 from certain members of the Joint Legislative Committee on Water Supply during Drought communicating recommendations and request to the Executive Water Emergency Committee .....   | 1-11 |
| Statement issued after April 13, 2015 from the Chair of the Joint Legislative Committee on Water Supply during Drought communicating recommendations and request to the Executive Water Emergency Committee.....  | 1-12 |
| July 13, 2015 Letter from Maia Bellon, Director, to Chairperson Secena of the Chehalis Confederated Tribes communicating adoption of emergency drought funding rule .....   | I-13 |
| March 31, 2015 Letter from the City of White Salmon to Governor Jay Inslee, requesting consideration for inclusion in the geographic area of emergency drought declaration so that the City would have access to emergency drought permitting and funding ..... | 1-14 |
| March 14, 2015 letter from the Chelan County Board of Commissioners requesting that the Lake Chelan and Stemilt-Squilchuck Watersheds be included in the geographic area of drought declaration   | I-15 |
| May 15, 2015 message from Maia Bellon, Director to the Tribal Chairs communicating that the drought declaration has been made statewide and status of potential drought funding. A table of contact addresses also is included .....                            | I-18 |
| March 15, 2015 Order and Determination of Emergency Drought Conditions.....   | I-22 |
| April 22, 2015 Order and Determination of Emergency Drought Conditions .....  | I-25 |
| May 21, 2015 Order and Determination of Emergency Drought Conditions.....   | I-28 |
| Communications Plan 2015 Emergency Drought Funding Rule dated 07/07/2015.....   | I-30 |
| ECOLOGY-WAC_TRACK ListServ message regarding filing of emergency drought funding rule .....   | I-35 |

|   |      |
|---|------|
| CR-103E Rule Making Order Form filed July 10, 2015 adopting Chapter 173-167 WAC, the emergency drought funding rule .....   | I-36 |
| Emergency Rules Development Timeline .....  | I-38 |
| Rule Adoption Approval CR-103 Rule Adoption Packet.....   | I-39 |
| May 14, 2015 Rule Authorization Document (RAD) to present the Senior Management Team about the program’s strategic decision to initiate rule-making .....   | 1-40 |
| July 8, 2015 Rule Development Plan, including evaluation of need to conduct and economic evaluation .....   | I-45 |
| July 8, 2015 Memo to File re: Applicability of State Environmental Policy Act to Adoption of the Emergency Drought Funding Rule.....  | I-54 |
| Spring 2015 Drought Declaration formatted for publication in Newspaper as official notice .....   | I-55 |
| Geographic Description of Drought – Sample Language for Drought Declaration Order .....   | I-56 |
| July 2015 Memo from Jennifer Holderman to Maia Bellon regarding Adoption of Chapter 173-167 Emergency Drought Funding Rule.....   | I-58 |
| July 2015 Rule Adoption Notice Focus Sheet.....   | I-60 |
| Citation List for Adoption of Chapter 173-167 WAC.....  | I-62 |
| July 2015 Final Rule Implementation Plan, Emergency Drought Funding Chapter 173-167 WAC.....  | I-66 |
| Unsigned Interagency Agreement between the Departments of Ecology and Fish and Wildlife for the purpose of providing funding to WDFW, describing a statement of work, budget and related provisions .....               | I-73 |
| Unsigned Interagency Agreement between the Department of Ecology and the State Conservation Commission for the purpose of providing funding to WDFW, describing a statement of work, budget and related provisions..... | I-82 |
| A copy of a Drought Relief Grant Application used during the 2015 Drought. This form was used to determine general eligibility for funding from the Drought Relief Program .....  | I-88 |



## Example WSAC Meeting Agenda

### **Water Supply Availability Committee Meeting Agenda February 24, 2017 10:00 a.m. – 11:10 a.m.**

| Time          | Subject  | Responsible                  | Representing |
|---------------|--|------------------------------|--------------|
| 10:00 – 10:10 | Welcome  | Jeff Marti                   | Ecology      |
| 10:10-10:20   | Regional Climate                                 | Karin Bumbaco/Nick Bond      | OWSC         |
| 10:20-10:30   | Mountain Snowpack                                | Scott Pattee                 | NRCS         |
| 10:30-10:40   | River Forecasts                                  | Brent Bower/Katherine Rowden | NWS          |
| 10:40-10:50   | Streamflow Conditions                            | Mark Mastin                  | USGS         |
| 10:50 -10:55  | Ecology Water Supply Webpage Housekeeping        | Chris Anderson               | Ecology      |
| 10:55-11:10   | Reports from water managers/general info sharing | All                          |              |

## Example email to EWEC

Sent from Ecology Director's Office.

**From:** North, Teri (ECY)  
**Sent:** Monday, May 11, 2015 3:40 PM  
**To:** Duff, Robert (GOV) <[robert.duff@gov.wa.gov](mailto:robert.duff@gov.wa.gov)>; Unsworth, James W (DFW) <[Jim.Unsworth@dfw.wa.gov](mailto:Jim.Unsworth@dfw.wa.gov)>; Bonlender, Brian (COM) <[Brian.Bonlender@commerce.wa.gov](mailto:Brian.Bonlender@commerce.wa.gov)>; Peinecke, Dale (ESD) <[DPeinecke@ESD.WA.GOV](mailto:DPeinecke@ESD.WA.GOV)>; GOLDMARK, PETER (DNR) <[Peter.Goldmark@dnr.wa.gov](mailto:Peter.Goldmark@dnr.wa.gov)>; Ezelle, Robert (MIL) <[Robert.Ezelle@mil.wa.gov](mailto:Robert.Ezelle@mil.wa.gov)>; Schumacher, David (OFM) <[David.Schumacher@ofm.wa.gov](mailto:David.Schumacher@ofm.wa.gov)>; Guichard, Maryanne (DOH) <[Maryanne.Guichard@DOH.WA.GOV](mailto:Maryanne.Guichard@DOH.WA.GOV)>; Austin, JT (GOV) <[jt.austin@gov.wa.gov](mailto:jt.austin@gov.wa.gov)>; Clark, Mark (SCC) <[MClark@scc.wa.gov](mailto:MClark@scc.wa.gov)>  
**Cc:** Isiordia, Alberto (ESD) <[Alsiordia@ESD.WA.GOV](mailto:Alsiordia@ESD.WA.GOV)>; Mathews, Carole (ESD) <[CMathews@ESD.WA.GOV](mailto:CMathews@ESD.WA.GOV)>; Anderson, Mark (COM) <[mark.anderson@commerce.wa.gov](mailto:mark.anderson@commerce.wa.gov)>; Antolin, Peter (MIL) <[peter.antolin@mil.wa.gov](mailto:peter.antolin@mil.wa.gov)>; YOUNG, LENNY (DNR) <[LEONARD.YOUNG@dnr.wa.gov](mailto:LEONARD.YOUNG@dnr.wa.gov)>; Stohr, Joseph S (DFW) <[Joe.Stohr@dfw.wa.gov](mailto:Joe.Stohr@dfw.wa.gov)>; Hancock, Jaclyn (AGR) <[JHancock@agr.wa.gov](mailto:JHancock@agr.wa.gov)>; Castro, Hector (AGR) <[HCastro@agr.wa.gov](mailto:HCastro@agr.wa.gov)>; Robinson, Kirk (AGR) <[KRobinson@agr.wa.gov](mailto:KRobinson@agr.wa.gov)>; Peck, Sandi (ECY) <[spec461@ECY.WA.GOV](mailto:spec461@ECY.WA.GOV)>; Anderson, Chris (ECY) <[CAND461@ECY.WA.GOV](mailto:CAND461@ECY.WA.GOV)>; Christensen, Dave (ECY) <[davc461@ECY.WA.GOV](mailto:davc461@ECY.WA.GOV)>; Bellon, Maia (ECY) <[maib461@ECY.WA.GOV](mailto:maib461@ECY.WA.GOV)>; Terpening, Dustin (ECY) <[DTer461@ECY.WA.GOV](mailto:DTer461@ECY.WA.GOV)>; Clifford, Denise (ECY) <[decl461@ECY.WA.GOV](mailto:decl461@ECY.WA.GOV)>; Sherwood, Karisa (COM) <[karisa.sherwood@commerce.wa.gov](mailto:karisa.sherwood@commerce.wa.gov)>; Goldenberger, Irene M (DFW) <[Irene.Goldenberger@dfw.wa.gov](mailto:Irene.Goldenberger@dfw.wa.gov)>; Partridge, Dan (ECY) <[dpar461@ECY.WA.GOV](mailto:dpar461@ECY.WA.GOV)>; Marti, Jeff (ECY) <[jema461@ECY.WA.GOV](mailto:jema461@ECY.WA.GOV)>; Loranger, Thomas (ECY) <[tlor461@ECY.WA.GOV](mailto:tlor461@ECY.WA.GOV)>; Bergener, Terry (DOH) <[Terry.Bergener@DOH.WA.GOV](mailto:Terry.Bergener@DOH.WA.GOV)>; Mattos, Liz (OFM) <[Liz.Mattos@OFM.WA.GOV](mailto:Liz.Mattos@OFM.WA.GOV)>; Streuli, Nick (ESD) <[NStreuli@ESD.WA.GOV](mailto:NStreuli@ESD.WA.GOV)>  
**Subject:** Agenda - May 13 EWEC

Attached is the agenda for the next Executive Water Emergency Committee meeting, scheduled for Wednesday, May 13 from 10:00 a.m. to 12:00 p.m.

Also attached are four letters that Director Bellon mentioned at the last EWEC meeting. The letters are relating to drought declaration areas and determining hardship in this year's drought.

*Teri North, Assistant to the Director*  
*Department of Ecology*  
*(360) 407-7009*  
[teri.north@ecy.wa.gov](mailto:teri.north@ecy.wa.gov)

## **Emergency Water Executive Committee Meeting**

### **AGENDA**

May 13, 2015

10:00 AM – 12:00 PM

Senate Rules Room

**10:00 AM    Introductions and Opening Remarks**

*Director Maia Bellon, Department of Ecology*

**10:10 AM    Current Water Supply Conditions**

*Jeff Marti, Drought Coordinator, Department of Ecology*

**10:30 AM    Discussion of Hardship Occurring or Expected**

*Agriculture*

*Fish and Wildlife*

*Health*

*Commerce*

*Natural Resources*

*Emergency Management and Military*

**11:00 AM    Discuss Expanding Drought Declaration**

*All*

**11:30 AM    Next Steps**

*Rob Duff, Governor's Office*

*Maia Bellon and Sandi Peck, Department of Ecology*



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

**Department of Ecology  
Washington General Service (WGS)  
POSITION DESCRIPTION**

**Pressing F11 will move you through the input fields on this form**

|   |   |   |  |
|---|---|---|--|
| 1. Position Action (Create or Maintain Position)<br><input type="checkbox"/> Establish <input type="checkbox"/> Reallocate <input type="checkbox"/> Update Data (Indicate Change)   |   |   |  |
| 2. Position Staffing Status<br><input checked="" type="checkbox"/> Vacancy - Open <input type="checkbox"/> Vacancy - Occupied <input type="checkbox"/> Vacancy - On Hold  |   | 3. Date Last Reviewed (If Established Position)   |  |
| 4. Object Abbreviation (Position #)   | 5. Current Class Title                        |   | 6. Proposed Class Title<br><b>Environmental Specialist 1</b>                                 |
| 7. Job - Working Title  |   | 8. Assignment Pay (Capture In Essential Functions)<br><input type="checkbox"/> Dual Language <input type="checkbox"/> Other |  |
| 9. Pay Scale Type<br><b>01 Classified Gov</b>   |   | 10. Pay Scale Area (Non-Rep or Collective Bargaining Unit)<br><b>WFSE</b>   | 11. Salary Range<br><b>38</b>  |
| 12. Incumbent's Name (If Filled Position)   |   | 13. Business Area (Agency)<br><b>Ecology, CRO-Union Gap</b>   | 14. Org Unit (Program/Section/Unit)<br><b>Permitting &amp; Operations Unit</b>               |
| 15. Address Where Position Is Located<br><b>1250 W Alder Street, Union Gap, WA 98903</b>  |   |   |  |
| 16. Personnel Sub-Area<br><b>WFSE</b>   | 17. Employee Group<br><b>Non-permanent</b>    | 18. Indicate work schedule<br><input type="checkbox"/> Part Time <input checked="" type="checkbox"/> Full Time              | 19. Overtime Eligible<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 20. Supervisor's Object Abbreviation (Position #)<br><b>0762</b>  | 21. Supervisor's Name<br><b>Thomas Perkow</b> |   | 22. Supervisor's Phone<br><b>509-454-4261</b>  |
| <b>Position Objective</b>   |   |   |  |
| 23. Describe in a few sentences what the position is required to accomplish. Summarize the scope of impact, responsibilities, and how the position supports/contributes to the mission of the organization. Include an organizational chart.<br><b>Serves as entry-level environmental specialist. Under close supervision of the Section Manager and Operations and Permitting Unit Supervisor, performs the following tasks related to the Central Regional Office, Water Resources 2015 drought response. Provides technical assistance by phone and to walk in customers regarding drought conditions. Researches information regarding existing water rights. Assists senior staff with conducting investigations of complaints, monitors water use related to existing permits and certificates, brings issues to the attention of higher level environmental staff, assists with the regulation of existing water rights and the enforcement of illegal water use. Assists in the review of water right and change applications related to drought, including researching existing water rights. Measures stream flows and performs rating curve analyses.</b> |   |   |  |
| <b>Supervisory or Lead Worker Relationships</b>   |   |   |  |
| 24 (a). Is this a lead position? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No      Is this a supervisory position? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>If <b>supervisory</b> , list the subordinate employees by job classification and if full time or part time.  |   |   |  |
| Job Classification (Name Optional)  |   |   | Full Time or Part Time   |
|   |   |   |  |

24 (b). Check the boxes that apply to this position

☐ Assigns Work    ☐ Instructs and Checks the Work of Others    ☐ Evaluates    ☐ Corrects

\* ☐ Disciplines    \* ☐ Hires    \* ☐ Terminates Others    (\* Has the authority to effectively recommend these actions.)

Summarize the following information in narrative format.

- How is work assigned?
- With whom does the position interact to accomplish work?

Add any additional information that clarifies this position's lead or supervisory responsibilities.

**Work is assigned by the Section Manager and/or Unit Supervisors.**

### Essential Functions

Ecology Guidance on essential functions: <http://aww.ecology/services/es/EssentialFunctions.htm>

25. List the essential functions of this position. Functions listed in this section are primary duties and are fundamental to why the position exists. (Do not assign percentage of time in this section.)

See attached [Essential Functions Analysis Form](#) (if new position or essential functions have changed)

**Accountability – Stays focused on tasks in spite of distractions and interruptions. Makes the best use of available time and resources. Focuses on results and desired outcomes and how to best achieve them.**

**Service Focus – Build and maintain internal and external satisfaction with the services offered by the agency. Provide timely service and response to the general public requesting information about water rights and related issues. Have the ability and knowledge to use various databases, digital data, maps, aerial photographs, and data systems to efficiently collect, analyze, and input water right information.**

**Trust and Integrity – Present unpleasant information relating to water rights in an appropriate manner, both internally and externally. Keep promises and commitments made to the public and co-workers.**

**Relationships – Build positive relationships with co-workers and the public. Seek assistance from senior staff to ensure accurate information is provided.**

**Communication – Work effectively in a stressful environment and with clients that may be upset or mad. Maintain professional demeanor, calm, composed and respectful in all situations.**

**Adaptability and Flexibility – Work comfortably with people of widely differing styles, temperaments, and preferences. Ability to assess a client's knowledge of water resources rules and regulations and provide explanations geared to the client's level of knowledge. Deals maturely with anger, frustration and disappointment.**

## Working Conditions

26. Describe working environment and anticipated variation in working hours. Some or all of these conditions may be noted under the essential functions section.

Position is expected to accommodate frequent travel, including overnight travel, and perform field investigations. Normal movement within an open office space environment. Must be able to travel both by vehicle and on foot for extended periods of time over rough and uneven terrain during field investigations. Must be able to use a personal computer for extended periods of time.

## Key and Other Work Activities

Spreadsheet for calculating percentages on the Department of Personnel web site: [DOP Forms - calculating percentages](#)

27 (a). List and note percentage of time assigned to key work activities of the position and identify tasks performed in support of key activities.

**55% Assists senior professional staff in conducting on site field investigations related to the regulation of junior water right holders. Field investigations may include: navigation and map reading to locate sites, observation, written documentation, photography, recording GPS readings, measurement of water levels in wells, measurement of stream flows, walking over uneven terrain in hot weather and driving on farm roads that require 4-wheel drive. Field verifies compliance with regulatory orders, including installation verification and meter readings, on water sources requiring regulation due to low flow and drought conditions. Assists in the investigation of illegal water users both in the field and office. Office research involves normal office environment duties, including file review, microfiche examination, and computer work on a GIS among other programs and databases.**

**10% Provides technical assistance to private individuals, corporations, local government entities and other parties related to the filing of applications for new water rights and changes to existing water rights and in response to requests for information on water law, rules and policies. Receives and assists with investigations of illegal water use, and coordinates complaint responses with the Environmental Resource Tracking System (ERTS) coordinator and Section Manager.**

**15% Conducts technical research of existing water rights to determine actions to be taken in the event of regulation in the response to drought. Sets up databases as required inputting data on regulated ground and surface water sources. Prepares field investigation packets, including preparation of maps and summaries of water rights including WRTS searches (Water Rights Tracking System).**

**15% Measure stream flows and performs rating curve analyses to determine responses to be taken in the event low flow conditions require regulatory action. Measures water levels in wells to evaluate aquifer conditions and responses to drought.**

27 (b). List and note percentage of time assigned to other work activities.

**5% Other assigned duties as required.**

Placeholder for user to incorporate the in-training plan if appropriate for position

## General Qualifications

Link to DOP Guidance on Competencies and Qualifications:

<http://www.dop.wa.gov/strategichr/WorkforcePlanning/Competencies/Pages/default.aspx>

Link to Ecology Core Competencies: <http://aww.ecology/services/es/CoreCompetencies.htm>

### 28 (a). Required Education, Experience, Skills and Abilities/Competencies

**A Bachelor's degree involving major study in environmental, physical, or one of the natural sciences, environmental planning or other allied field and two years of professional level experience in environmental analysis or control or environmental planning.**

**Experience at or above the Environmental Technician level or equivalent will substitute, year for year, for education. Experience at the Environmental Technician level includes performing technical duties in support of professional environmental staff in the following areas:**

- 1) Reviewing and processing applications for environmental permits or certification such as water rights, hazardous waste, public water supply, hydraulic projects, etc. Explaining and interpreting pertinent regulations and procedures to applicants and others;**
- 2) Conducting literature research and evaluating researched documents to determine inclusion and value to an environmental program library or to support environmental activities such as developing required quarterly reports or various Environmental Protection Agency cooperative agreements; and**
- 3) Assisting professional staff by conducting field inspections or field investigations by collecting, analyzing and organizing environmental documents and/or environmental data.**

### 28 (b). Preferred/Desired Education, Training, Skills and Abilities/Competencies for Recruiting Purposes

**Knowledge of: field investigative techniques and data gathering and basic research; practices and methods of environmental problem solving; water measuring methods and techniques; principles, practices, and methods of environmental science, natural resource management, applicable state, federal, and local environmental regulations.**

**Ability to: use sound judgment in performing assigned tasks; understand and apply environmental regulations and related laws; write clearly and concisely and prepare maps, plans, charts and graphs, using Geographic Information System (GIS) and other appropriate methods; communicate effectively with agency staff, other agencies, industry and the general public.**

## Special Requirements/Conditions of Employment

29. List any licensing, certification, or other special requirements and/or conditions of employment which are beyond general qualifications.

**Washington State Driver's License**

**The job duties as defined above are an accurate reflection of the work to be performed by this position.**

|      |  |  |                        |
|------|--|--|------------------------|
| Date | Supervisor's Phone No.<br><b>509-454-4261</b>      | Supervisor's Title<br><b>Operations &amp; Permitting Unit<br/>Supervisor</b> | Supervisor's Signature |
| Date | Department Head or Approving Authority's Signature |  |                        |

**As the incumbent in this position, I have received a copy of this position description.**

|      |                      |
|------|----------------------|
| Date | Employee's Signature |
|------|----------------------|

**Position details and related action have been taken by Human Resources as reflected below.**

| For Human Resource/Payroll Office Use Only |         |                         |        |                            |  |                         |                           |  |                             |      |      |             |
|--|---------|-------------------------|--------|----------------------------|--|-------------------------|---------------------------|--|-----------------------------|------|------|-------------|
| Effective Date                             |         | End Date                |        | Position Short Description |  |                         | Position Long Description |  |                             |      |      |             |
| EEO Category<br>▼                          |         | Employee Sub-Group<br>▼ |        |                            | Position Retirement Eligible<br><input type="checkbox"/> Yes <input type="checkbox"/> No |                         |                           | Position is<br><input type="checkbox"/> Funded <input type="checkbox"/> Non-funded |                             |      |      |             |
| Workers Comp. Code<br>▼                    |         | County Code<br>▼        |        | Business Area<br>▼         |  |                         |                           | Personnel Area (FEIN)<br>▼   |                             |      |      |             |
| Cost Center Codes                          |         |                         |        |                            |  |                         |                           |  |                             |      |      |             |
| FUND                                       | MSTR-IX | APP-IX                  | PGM-IX | ORG-IX                     | PROJECT  | OBJECT                  | W-C                       | ALLOC  | BUDGET UNIT                 | CNTY | CITY | PRORATION % |
|  |         |                         |        |                            |  |                         |                           |  |                             |      |      |             |
|  |         |                         |        |                            |  |                         |                           |  |                             |      |      |             |
|  |         |                         |        |                            |  |                         |                           |  |                             |      |      |             |
|  |         |                         |        |                            |  |                         |                           |  |                             |      |      |             |
| Date                                       |         | HR Designee's Name      |        |                            |  | HR Designee's Title     |                           |  | HR Designee's Signature     |      |      |             |
| Date                                       |         | Budget Designee's Name  |        |                            |  | Budget Designee's Title |                           |  | Budget Designee's Signature |      |      |             |

The Public Records Act, Chapter 42.56 RCW, requires disclosure of public records unless they are exempt. If requested, non-exempt public records in the possession of the Department will be released. Exempt records will be withheld from public disclosure or exempt portions of records will be redacted from records prior to release.



We, the undersigned members of the Joint Legislative Committee on Water Supply during Drought, in light of the meeting held on April 13<sup>th</sup>, 2015, offer the following recommendations and requests to the Executive Water Emergency Committee, that the Department of Ecology:

- Follow the Yakima Basin Integrated Plan principles for managing water to ensure protection of both senior water rights and instream resources, including threatened and endangered species; and
- Support the goal in the Yakima Basin Integrated Plan during times of drought to provide 70 percent of normal water supply to irrigators; and
- Not permit use of drought wells that do not have approved mitigation to protect senior water rights; and
- Consider pursuing cost-share by water users for the costs of acquiring mitigation to leverage public financial resources to assist more people in need; and
- Use existing funds that are available for drought response in a responsible manner to provide protection of senior water rights, instream resources and relief for irrigators suffering hardship; and finally that
- Seek supplemental funding to pay for costs of permitting, completing, and mitigating for the use of emergency drought wells.



Derek Stanford, Vice Chair  
State Representative  
1<sup>st</sup> Legislative District



John McCoy  
State Senator  
38<sup>th</sup> Legislative District



Brian Blake  
State Representative  
19<sup>th</sup> Legislative District



431 John A. Cherberg Building  
PO Box 40466  
Olympia, WA 98504-0466  
(360) 786-7410

## Washington State Legislature

270 John L. O'Brien Building  
PO Box 40600  
Olympia, WA 98504-0600  
(360) 786-7117

We, the undersigned members of the Joint Legislative Committee on Water Supply during Drought, in light of the meeting held on April 13th, 2015, offer the following recommendations and requests to the Executive Water Emergency Committee:

That the Department of Ecology prioritize as immediate, the need to expedite both opening existing wells that are authorized for emergency use during a declaration of drought; and

Permitting new drought emergency wells; and

That any mitigation necessary for the use of the water from these drought emergency wells, receive the same immediate priority; and finally,

Acknowledging the Department's ability to use existing funds to begin the process of permitting the use of existing drought emergency wells, that the Department seek supplemental funding to pay for the costs of permitting, completing, and mitigating for the use of existing and future drought emergency wells.

Respectfully submitted,

Senator Jim Honeyford, Chair





## City of White Salmon Office of City Hall

March 31, 2015

**To:** Governor Jay Inslee

**cc:** Norm Johnson, District 14 Representative  
Gina McCabe, District 14 Representative  
Dorothy Tibbetts, Regional Manager, Department of Health  
Sage Park, Section Manager, Ecology Central Region Office

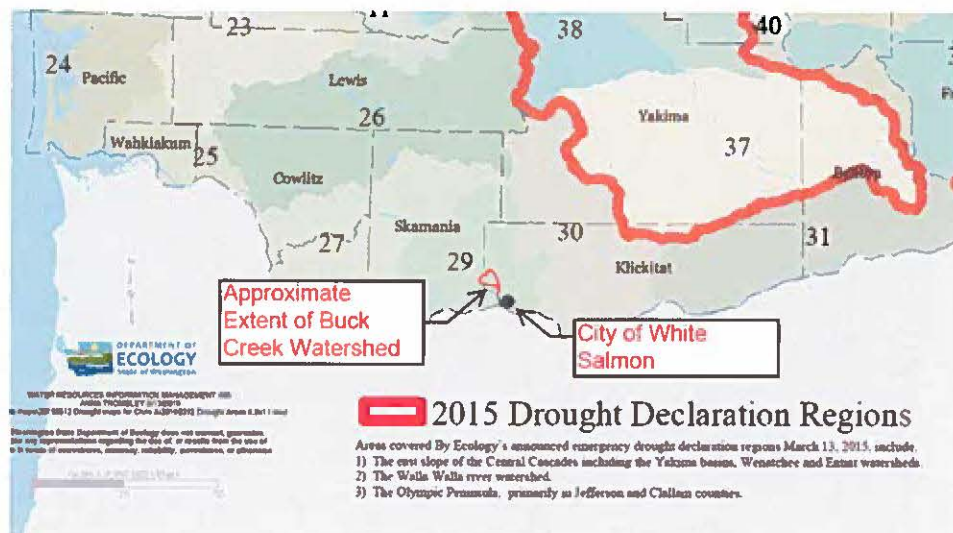
**From:** David Poucher, Mayor of White Salmon

**Re:** 2015 Drought Emergency Consideration

---

Dear Governor Inslee,

On behalf of the City of White Salmon (White Salmon), I am writing to request consideration for inclusion in the 2015 Drought Declaration. We ask that the White Salmon area, and in particular, the Buck Creek watershed be added to the Drought Declaration. White Salmon's municipal water supply is heavily dependent on surface water from Buck Creek, from which we receive almost 60% of our water. The remaining 40% of White Salmon's water supply comes from groundwater, which has been in decline for the past decade. White Salmon is in the midst of implementing an Aquifer Storage and Recovery (ASR) project in conjunction with Ecology's Office of the Columbia River, but it's still in a pilot phase and is not fully permitted for use at this time. The City of White Salmon and the Buck Creek Basin are shown below for your reference.



PO Box 2139  
142 E. Jewett Blvd.  
White Salmon, WA 98672

Office: (509) 493-1133  
Fax: (509) 493-1231  
Web Site: [white-salmon.net](http://white-salmon.net)

White Salmon is currently projecting drought in Water Year 2015 (WY2015) that will be worse than prior droughts in both WY2001, and WY2005. Snowpack in those years was 69% of average (WY2001) and 38% of average (WY2005). Based on the peak snowpack in our region for WY2015, we've received only 28% of average. Since that peak (December 30<sup>th</sup>, 2014), conditions have only worsened, and this year is set to be the earliest bare-ground spring based on analysis of local SNOTEL site data - approximately 53 days earlier than average, and still 36 days earlier than the WY2005 drought. Flow from Buck Creek is already diminished relative to prior years, and appears to be less than 60% of normal base-flow.

We are seeking access to drought funding to assist in the development of short-term source reliability options, which may include water right transfers, rehabilitation of existing water supply wells, or other emergency supplies. In addition to our own water supply, White Salmon has an interlocal agreement with the City of Bingen and the Port of Klickitat to supply a portion of our well field production. Funds used to rehabilitate our wells would also help support our partner entities. Additional options may include working with the City of Bingen to shift some portion of the water supply to their own well field and efforts to promote conservation.

Without access to drought relief, we expect to face diminished water supply, and potentially a shortage that will affect the cities of White Salmon and Bingen, as well as the Port of Klickitat.

In closing, please consider our request to declare a drought for the City of White Salmon, and the Buck Creek Watershed.

Respectfully,

A handwritten signature in blue ink, appearing to read "David Poucher", with a large, stylized loop at the end.

David Poucher  
Mayor of White Salmon



BOARD OF COMMISSIONERS  
**CHELAN COUNTY**

STATE OF WASHINGTON  
 COUNTY ADMINISTRATION BUILDING  
 400 DOUGLAS STREET, SUITE #201  
 WENATCHEE, WA 98801  
 PHONE (509) 667-6215 FAX (509) 667-6599

CATHY MULHALL  
 County Administrator  
[cathy.mulhall@co.chelan.wa.us](mailto:cathy.mulhall@co.chelan.wa.us)

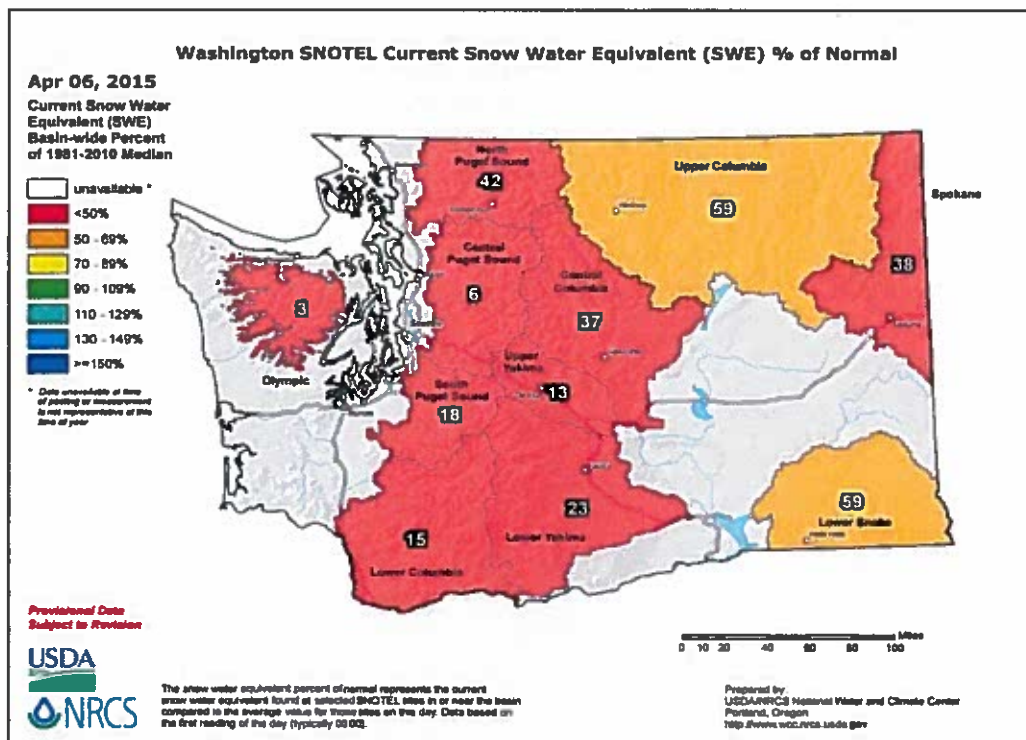
CARLYE BAITY  
 Clerk of the Board  
[Carlye.baity@co.chelan.wa.us](mailto:Carlye.baity@co.chelan.wa.us)

April 14, 2015

Governor Jay Inslee  
 Office of the Governor  
 P.O. Box 40002  
 Olympia, WA 98504

Dear Governor Inslee,

Chelan County requests the inclusion of the Lake Chelan (WRIA 47) and Stemilt-Squilchuck (WRIA 40A) watersheds under your March 17, 2015 drought declaration. We believe that these watersheds meet the statutory requirements that specify that (1) an area has to be experiencing or projected to experience a water supply that is below 75 percent of normal (see below), and (2) water users within those areas will likely incur undue hardships as a result of the shortage. As of April 6, snow water equivalent in both of these areas was less than 50% of normal.





We expect that residents, growers, cities and other water users will face diminished supply in these watersheds as a result of the historically low snowpack conditions. Additionally, fish populations in the tributaries will likely be adversely affected. In both of these watersheds, detailed watershed plans have been developed that show limited water resources for in-stream and out-of-stream uses under normal circumstances. While there are water supply development projects under way in these areas, including additional storage in WRIA 40A and identification of water conservation and supply opportunities in WRIA 47, they will not be complete in time for this summer's critical period. We are particularly concerned for tree fruit agriculture in these areas which can not withstand interruption in water supply.

We are seeking access to drought funding to assist in the development of short-term source reliability options, which may include water right transfers, rehabilitation of existing water supply well, or other emergency supplies. Without access to these funds, we are concerned that our communities will not be able to adequately address water shortages this year and that the future viability of agriculture may be affected.

We appreciate your consideration of our request.

Sincerely,

Chelan County Commissioners

  
\_\_\_\_\_

  
\_\_\_\_\_

  
\_\_\_\_\_

CC: Senator Linda Evans Parlette  
Representative Cary Condotta  
Representative Brad Hawkins  
Maia Bellon, Director, WA Department of Ecology  
Tom Tebb, Regional Director, WA Department of Ecology

**From:** [Laurie, Tom \(ECY\)](#)  
**To:** [Adam Osbekoff](#); [Foster, Alix \(non-ATG\)](#); [Amy Seiders](#); [Andy Whitener \(awhitener@squaxin.us\)](#); [Anne Savery \(asavery@tulaliptribes-nsn.gov\)](#); [BJ Kieffer \(bjk@spokanetribe.com\)](#); [Bruce Jones \(bjones@nwifc.org\)](#); [Byron Rot](#); [Carla Carlson \(Carla@muckleshoot.nsn.us\)](#); [Chris Woodward \(cwoodward@samishtribe.nsn.us\)](#); [Crane, Stuart](#); [Darla Boyer](#); [Darren Williams \(Darrenw@nezperce.org\)](#); [Daryl Williams](#); [Dave Bingaman \(dbingaman@quinault.org\)](#); [David Troutt \(troutt.david@nisqually-nsn.gov\)](#); [Dawn Vyvyan](#); [dherrera@skokomish.org](#); [Lekanof, Debra](#); [dr@ucut-nsn.org](#); [dwilliams@suquamish.nsn.us](#); [Ed Knight \(eknight@swinomish.nsn.us\)](#); [ehutchinson@swinomish.nsn.us](#); [Fran Wilshusen NWIFC](#); [Fuller, Dave](#); [grayum@nwifc.org](#); [Hare, Jon \(jonhare@comcast.net\)](#); [hgeastman@tulaliptribes-nsn.gov](#); [Hollowed, John](#); [Isabel Tinoco@muckleshoot.nsn.us](#); [James W. Weber](#); [Jeff Dickison \(jdickison@squaxin.us\)](#); [Jennifer Hagen \(jennifer.hagen@quileutenation.org\)](#); [Jeremy Freimund \(jeremyf@lummi-nsn.gov\)](#); [John O'Leary \(joleary@suquamish.nsn.us\)](#); [John Sirois \(john@ucut-nsn.org\)](#); [jparker@nwifc.org](#); [JPavel@skokomish.org](#); [Karen Allston \(kallston@quinault.org\)](#); [kimberly ordon](#); [kris@Yakama.com](#); [Krueger, Katie \(katie.krueger@quileutenation.org\)](#); [Larry Wasserman](#); [Lauren Rich](#); [leroyd@lummi-nsn.gov](#); [Lisa Ganuelas](#); [lois.trevino@colvilletribes.com](#); [Lori E. Nies \(lnies@skokomish.org\)](#); [Lorraine Loomis](#); [mallen@suquamish.nsn.us](#); [Marc Gauthier \(marc@ucut-nsn.org\)](#); [Matt Baerwalde \(mattb@snoqualmtribe.us\)](#); [Mel Moon \(mel.moon@quileutenation.org\)](#); [Meyer, Tony](#); [Miguel Perez-Gibson](#); [mwhite@chehalistribe.org](#); [Nancy Rapin \(Nancy.Rapin@muckleshoot.nsn.us\)](#); [naomistacy@ctuir.org](#); [nreynolds@cowlitz.org](#); [Passmore, Gary](#); [Patti Bailey \(Patti.Bailey@colvilletribes.com\)](#); [Paul Lumley \(plumley@critfc.org\)](#); [Paul McCollum \(paulm@pgst.nsn.us\)](#); [Rankis, Andy](#); [Rich Brooks](#); [ROSE LONGORIA \(rose@yakamafish-nsn.gov\)](#); [Rudy Peone \(rudy@spokanetribe.com\)](#); [Schuster, Jeff \(jeffschuster@att.net\)](#); [Scott Chitwood \(schitwood@jamestowntribe.org\)](#); [Yanity, Shawn](#); [slecuyer@swinomish.nsn.us](#); [smorris@sauk-suiattle.com](#); [sschuyler@upperskagit.com](#); [Suagee, Steve \(non-ATG\)](#); [Steve Robinson \(Water4fish@comcast.net\)](#); [Steven Mullen-Moses \(steve@snoqualmtribe.us\)](#); [Stevenson, Pat \(pstevenson@stillaguamish.com\)](#); [Taylor Aalvik](#); [Terry Williams \(terrywilliams@tulaliptribes-nsn.gov\)](#); [tmitchell@swinomish.nsn.us](#); [Todd Bolster](#); [Tom Ring \(ringt@yakama.com\)](#); [tostrom@suquamish.nsn.us](#)  
**Subject:** FW: Statewide Drought Declaration & Emergency Rule for Drought Relief Funding  
**Date:** Friday, May 15, 2015 10:10:00 AM

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FYI, This is a copy of a letter from Director Maia Bellon to tribal chairs this morning.

Sorry for duplications, please forward to anyone in your organization who may have an interest.

**- Tom**

C. Thomas Laurie | Senior Advisor for Tribal & Environmental Affairs | Washington State Dept. of Ecology  
PO Box 47600, Olympia, WA 98504-7600 <http://www.ecy.wa.gov/>  
email: [tom.laurie@ecy.wa.gov](mailto:tom.laurie@ecy.wa.gov) phone: 360/407-7017 cell: 360/790-4110

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**From:** North, Teri (ECY) **On Behalf Of** Bellon, Maia (ECY)  
**Sent:** Friday, May 15, 2015 9:53 AM  
**To:** [chairman@chehalistribe.org](#); [jim.boyd@colvilletribes.com](#); [wiyall@cowlitz.org](#); [marial@hohtribe-nsn.org](#); [rpierre@kalispeltribe.com](#); [frances.charles@elwha.nsn.us](#); [timothyb@lummi-nsn.gov](#); [tj.greene@makah.com](#); [virginia.cross@muckleshoot.nsn.us](#); [mccloud.farron@nisqually-nsn.gov](#); [Kelly, Bob](#); [jeromys@pgst.nsn.us](#); [bill.sterud@puyalluptribe.com](#); [naomi.jacobson@quileutenation.org](#); [fsharp@quinault.org](#); [Wooten, Tom](#); [njoseph@sauk-suiattle.com](#); [ddavis@shoalwaterbay-nsn.gov](#); [gmiller@skokomish.org](#); [carolyn@snoqualmtribe.us](#); [rudy@spokanetribe.com](#); [dlopeman@squaxin.us](#); [Yanity, Shawn](#); [lforsman@suquamish.nsn.us](#); [bcladoosby@swinomish.nsn.us](#); [melsheldon@tulaliptribes-nsn.gov](#); [Jenniferw@upperskagit.com](#); [JoDe@yakama.com](#); [NPTEC@nezperce.org](#); [garyburke@ctuir.org](#); [Allen, Ron](#)  
**Cc:** Laurie, Tom (ECY); [Jeff Dickison](#); [quincye@nezperce.org](#); [darrenw@nezperce.org](#)  
**Subject:** Statewide Drought Declaration & Emergency Rule for Drought Relief Funding

Dear Tribal Chair:

I have spoken with many tribal leaders over the past few weeks as our drought declarations have included more and more watersheds. Today, Governor Inslee expanded the drought declaration to be a statewide declaration.



In the past month, the already poor water supply conditions have gotten significantly worse. Overall, state snowpack dropped from 24 percent of normal to 17 percent of normal, and is the lowest ever recorded in about three-quarters of the sites that are measured. Stream flows are already at record lows in many watersheds, with projections of a warm, dry spring and summer created the expectation of likely problems later this summer throughout the state. Excluding the Columbia main stem, run-off from the diminished snowpack for this spring and summer is projected to be the lowest on record in the past 64 years.

The declaration will provide authority for state agencies to assist with hardship. The Governor's Office of Financial Management submitted a budget request of \$9.5 million to the legislature for this fiscal year for drought funding assistance.

If the legislature approves drought funding, I will immediately adopt an emergency rule to set up the process for getting the funding to where is needed most. The rule will define the funding criteria for projects to alleviate drought hardships. The initial legislative policy direction is to require cost-share match from local entities, except in cases of financial hardship.

If the legislature approves drought relief funding, we will be able to assist public entities for projects addressing drinking water, agricultural or fish and wildlife survival, such as:

- Communities that have vulnerable public water supplies, especially smaller water systems that rely on surface water or shallow wells.
- The Department of Fish and Wildlife to mitigate the impacts of reduced stream flows on fisheries resources, including fish passage barriers and hatchery operations.
- Irrigation districts to transfer water from lower value annual crops like hay, to higher value crops such as fruit and hops, which cannot forgo irrigation without long term significant losses.

Many municipal water systems have indicated that they do not anticipate problems from this year's "snowpack drought." Some larger utilities, such as Seattle, Tacoma and Everett have sufficient water stored in their reservoirs to meet both their customers' needs and release enough water to meet instream flow agreements downstream from their facilities. Other large utilities use groundwater that may be unaffected by the poor snowpack conditions.

I look forward to working with you and your team as we address drought response needs in these areas. If you or your staff have any questions, please contact us.

More detailed information about the drought, including actions we are taking in response, is on our web page at: <http://www.ecy.wa.gov/drought/>.

Sincerely,  
Maia D. Bellon  
Director, Department of Ecology

| Tribe                               | Chair First Name | Chair Last Name | Phone          | Email  | Street/Box                  | City/State/Zip             | Fax #        |
|-------------------------------------|------------------|-----------------|----------------|--|-----------------------------|----------------------------|--------------|
|                                     |                  |                 |                |  |                             |                            |              |
|                                     |                  |                 |                |  |                             |                            |              |
| <b>Chehalis Confederated Tribes</b> | Don              | Secena          | (360) 273-5911 | <a href="mailto:chairman@chehalistribe.org">chairman@chehalistribe.org</a>               | 420 Howanut Road            | Oakville, WA 98568         | 360-273-5914 |
| <b>Colville Confederated Tribes</b> | Jim              | Boyd            | (509) 634-2219 | <a href="mailto:jim.boyd@colvilletribes.com">jim.boyd@colvilletribes.com</a>             | P.O. Box 150                | Nespelem, WA 99155         | 509-634-4116 |
| <b>Cowlitz Indian Tribe</b>         | William          | Iyall           | (360) 577-8140 | <a href="mailto:wiyall@cowlitz.org">wiyall@cowlitz.org</a>                               | 1055 9th Avenue Suite B     | Longview, WA 98632         | 360-577-7432 |
| <b>Hoh Tribe</b>                    | Maria            | Lopez           | (360) 780-0533 | <a href="mailto:marial@hohtribe-nsn.org">marial@hohtribe-nsn.org</a>                     | P.O Box 2196                | Forks, WA 98331            | 360-374-6549 |
| <b>Jamestown S'Klallam Tribe</b>    | Ron              | Allen           | (360) 683-1109 | <a href="mailto:rallen@jamestowntribe.org">rallen@jamestowntribe.org</a>                 | 1033 Old Blyn Highway       | Sequim, WA 98382           | 360-681-4643 |
| <b>Kalispel Tribe</b>               | Glen             | Nenema          | (509) 445-1147 | <a href="mailto:rpierre@kalispeltribe.com">rpierre@kalispeltribe.com</a>                 | P.O. Box 39                 | Usk, WA 99180              | 509-445-1705 |
| <b>Lower Elwha Klallam Tribe</b>    | Frances          | Charles         | (360) 452-8471 | <a href="mailto:frances.charles@elwha.nsn.us">frances.charles@elwha.nsn.us</a>           | 2851 Lower Elwha Road       | Port Angeles, WA 98363     | 360-452-3428 |
| <b>Lummi Nation</b>                 | Timothy          | Ballew II       | (360) 312-2000 | <a href="mailto:timothyb@lummi-nsn.gov">timothyb@lummi-nsn.gov</a>                       | 2665 Kwina Road             | Bellingham, WA 98226       | 360-380-1850 |
| <b>Makah Tribe</b>                  | Timothy J.       | Greene, Sr.     | (360) 645-3231 | <a href="mailto:tj.greene@makah.com">tj.greene@makah.com</a>                             | P.O. Box 115                | Neah Bay, WA 98357         | 360-645-2788 |
| <b>Muckleshoot Tribe</b>            | Virginia         | Cross           | (253) 939-3311 | <a href="mailto:virginia.cross@muckleshoot.nsn.us">virginia.cross@muckleshoot.nsn.us</a> | 39015 172nd Avenue SE       | Auburn, WA 98092           | 253-931-8570 |
| <b>Nisqually Tribe</b>              | Cynthia          | Iyall           | (360) 456-5221 | <a href="mailto:iyall.cynthia@nisqually-nsn.gov">iyall.cynthia@nisqually-nsn.gov</a>     | 4820 She-Nah-Num Drive SE   | Olympia, WA 98513          | 360-486-9553 |
| <b>Nooksack Tribe</b>               | Bob              | Kelly           | (360) 592-5164 | <a href="mailto:bkelly@nooksack-nsn.gov">bkelly@nooksack-nsn.gov</a>                     | P.O. Box 157                | Deming, WA 98244           | 360-592-4506 |
| <b>Port Gamble S'Klallam Tribe</b>  | Jeromy           | Sullivan        | (360) 297-2646 | <a href="mailto:jeromys@pgst.nsn.us">jeromys@pgst.nsn.us</a>                             | 31912 Little Boston Road NE | Kingston, WA 98346         | 360-297-7097 |
| <b>Puyallup Tribe</b>               | Bill             | Sterud          | (253) 573-7815 | <a href="mailto:bill.sterud@puyalluptribe.com">bill.sterud@puyalluptribe.com</a>         | 3009 East Portland Avenue   | Tacoma, WA 98404           | 253-680-5996 |
| <b>Quileute Nation</b>              | Naomi            | Jacobson        | (360) 374-2218 | <a href="mailto:naomi.jacobson@quileutenation.org">naomi.jacobson@quileutenation.org</a> | P.O. Box 279                | La Push, WA 98350          | 360-374-6311 |
| <b>Quinault Nation</b>              | Fawn             | Sharp           | (360) 276-8211 | <a href="mailto:fsharp@quinault.org">fsharp@quinault.org</a>                             | P.O. Box 189                | Taholah, WA 98587          | 360-276-4191 |
| <b>Samish Nation</b>                | Tom              | Wooten          | (360) 293-6404 | <a href="mailto:tomwooten@samishtribe.nsn.us">tomwooten@samishtribe.nsn.us</a>           | P.O. Box 217                | Anacortes, WA 98221        | 360-299-0790 |
| <b>Sauk-Suiattle Tribe</b>          | Norma            | Joseph          | (360) 436-0131 | <a href="mailto:njoseph@sauk-suiattle.com">njoseph@sauk-suiattle.com</a>                 | 5318 Chief Brown Lane       | Darrington, WA 98241       | 360-436-1511 |
| <b>Shoalwater Bay Tribe</b>         | Doug             | Davis           | (360) 267-6766 | <a href="mailto:ddavis@shoalwaterbay-nsn.gov">ddavis@shoalwaterbay-nsn.gov</a>           | P.O. Box 130                | Tokeland, WA 98590         | 360-267-6778 |
| <b>Skokomish Tribe</b>              | Charles "Guy"    | Miller          | (360) 426-4232 | <a href="mailto:gmler@skokomish.org">gmler@skokomish.org</a>                             | North 80 Tribal Center Road | Skokomish Nation, WA 98584 | 360-877-5943 |
| <b>Snoqualmie Tribe</b>             | Carolyn          | Lubenau         | (425) 888-6551 | <a href="mailto:carolyn@snoqualmietribe.us">carolyn@snoqualmietribe.us</a>               | P.O. Box 969                | Snoqualmie, WA 98065       | 425-888-6727 |
| <b>Spokane Tribe</b>                | Rudy             | Peone           | (509) 458-6500 | <a href="mailto:rudys@spokanetribe.com">rudys@spokanetribe.com</a>                       | P.O. Box 100                | Wellpinit, WA 99040        | 509-458-6575 |
| <b>Squaxin Island Tribe</b>         | Dave             | Lopeman         | (360) 426-9781 | <a href="mailto:dlopeman@squaxin.us">dlopeman@squaxin.us</a>                             | 10 SE Squaxin Lane          | Shelton, WA 98584          | 360-426-6577 |
| <b>Stillaguamish Tribe</b>          | Shawn            | Yanity          | (360) 652-7362 | <a href="mailto:syanity@stillaguamish.com">syanity@stillaguamish.com</a>                 | P.O. Box 277                | Arlington, WA 98223-0277   | 360-659-3113 |
| <b>Suquamish Tribe</b>              | Leonard          | Forsman         | (360) 598-3311 | <a href="mailto:lforsman@suquamish.nsn.us">lforsman@suquamish.nsn.us</a>                 | P.O. Box 498                | Suquamish, WA 98392-0498   | 360-598-3135 |
| <b>Swinomish Tribe</b>              | Brian            | Cladoosby       | (360) 466-7205 | <a href="mailto:bcladoosby@swinomish.nsn.us">bcladoosby@swinomish.nsn.us</a>             | 11404 Moorage Way           | La Conner, WA 98257        | 360-466-7363 |
| <b>Tulalip Tribes</b>               | Melvin           | Sheldon, Jr.    | (360) 716-4000 | <a href="mailto:melsheldon@tulaliptribes-nsn.gov">melsheldon@tulaliptribes-nsn.gov</a>   | 6406 Marine Drive           | Tulalip, WA 98271          | 360-716-0209 |
| <b>Upper Skagit Tribe</b>           | Jennifer         | Washington      | (360) 854-7000 | <a href="mailto:Jenniferw@upperskagit.com">Jenniferw@upperskagit.com</a>                 | 25944 Community Plaza       | Sedro-Woolley, WA 98284    | 360-854-7004 |
| <b>Yakama Nation</b>                | JoDe L.          | Goudy           | (509) 865-5121 | <a href="mailto:JoDe@yakama.com">JoDe@yakama.com</a>                                     | P.O. Box 151                | Toppenish, WA 98948        | 509-865-5528 |

#### **OUT OF STATE TRIBES**

|   |                 |             |                |  |                            |                         |              |
|---|-----------------|-------------|----------------|--|----------------------------|-------------------------|--------------|
| <b>Coeur d'Alene Tribe</b>              | Chief J.        | Allan       | (208) 686-5803 | <a href="mailto:chairman@cdatribe-nsn.gov">chairman@cdatribe-nsn.gov</a> | 850 A Street; P.O. Box 408 | Plummer, ID 83851       | 208-686-1182 |
| <b>Grand Ronde Confederated Tribes</b>  | Reynold L.      | Leno        | (503) 879-5211 | <a href="mailto:reyn.leno@grandronde.org">reyn.leno@grandronde.org</a>   | 9615 Grand Ronde Road      | Grand Ronde, OR 97347   | 503-879-5964 |
| <b>Kootenai Tribe of Idaho</b>          | Gary            | Aitken, Jr. | (208) 267-3519 |  | P.O. Box 1269              | Bonnars Ferry, ID 83805 | 208-267-2960 |
| <b>Nez Perce Tribe</b>                  | Silas C.        | Whitman     | (208) 843-2253 | <a href="mailto:NPTEC@nezperce.org">NPTEC@nezperce.org</a>               | P.O. Box 305               | Lapwai, ID 83540        | 208-843-2253 |
| <b>Umatilla Confederated Tribes</b>     | Gary            | Burke       | (541) 429-7030 | <a href="mailto:garyburke@ctuir.org">garyburke@ctuir.org</a>             | 46411 Timine Way           | Pendleton, OR 97801     | 541-276-3095 |
| <b>Warm Springs Confederated Tribes</b> | Eugene "Austin" | Greene, Jr. | (541) 553-3257 | <a href="mailto:austin.greene@wstribe.org">austin.greene@wstribe.org</a> | PO Box 1299                | Warm Springs, OR 97761  | 541-553-1268 |



STATE OF WASHINGTON  
DEPARTMENT OF ECOLOGY

PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000

711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

### ORDER AND DETERMINATION BY THE DIRECTOR

Washington has experienced record-warm temperatures this winter and, as a result, extremely low snowpack statewide. While precipitation has been largely normal statewide, consistently warm weather and high freezing levels have caused most precipitation to fall as rain rather than snow. With many sites in the mountains already completely void of snow, what little snowpack remains will likely melt several weeks ahead of normal. Washington could face serious water shortages this spring and summer.

Traditionally, many communities across the state have relied on a healthy snowpack to slowly feed rivers, farms and communities through the drier spring and summer months. The Natural Resources Conservation Service and the Northwest River Forecast Center project water supplies for snowpack-dependent watersheds to be well below normal April through September. And the state Water Supply Availability Committee identified 34 watersheds out of 62 that will likely receive less than 75 percent of their normal water supply (a statutory drought threshold) because of the diminished snowpack.

For perspective, snowpack in the Olympic Mountains is fluctuating around 10 percent of normal right now. A few days ago it was down to just 4 percent; yesterday it briefly spiked to 14 percent; and today it's down to 11 percent. With long-range weather forecasts calling for a warmer, drier spring, snowpack is expected to remain in a dire state.

The shortage in water supplies creates the strong possibility of undue hardships for water users in the following watersheds:

- **Yakima River Basin:** The Bureau of Reclamation announced that pro-rationed water users will see their water deliveries reduced to a level less than 75 percent of their normal supply. Orchards cannot withstand interruption in water supply and low stream flows in tributaries can hamper salmon migration and survival.
- **Wenatchee and Entiat Basins:** The water supply forecast calls for much less than 75 percent of normal water supply; orchards cannot withstand interruption in water supply.
- **Walla Walla Basin:** Even during a normal year, there is not enough water available to supply the demands of all users. Insufficient stream flows can block salmon and trout migration in this basin.



- **Olympic Peninsula:** The forecasted water runoff from April through September for the Dungeness River is expected to be the lowest in the past 45 years. This will threaten the reliability of community water systems. Streamflow conditions are expected to become significantly adverse for fish habitat, with the potential for migratory barriers and fish stranding. Salmon runs are especially important to Tribal communities on the peninsula.

The National Oceanic and Atmospheric Administration Climate Prediction Center predicts warmer and drier conditions this spring. Given these projections, there is a strong likelihood that water supply forecasts will be revised downward in the coming weeks.

The water supply shortfall poses a serious threat to irrigated crops, public water supplies, and fisheries in the following Water Resources Inventory Areas:

- |                     |                  |
|---------------------|------------------|
| 17. Quilcene-Snow   | 32. Walla Walla  |
| 18. Elwah-Dungeness | 37. Upper Yakima |
| 19. Lyre-Hoko       | 38. Lower Yakima |
| 20. Soleduck-Hoh    | 39. Naches       |
| 21. Queets-Quinault | 45. Wenatchee    |
|                     | 46. Entiat       |

Therefore, in accordance with the provisions of RCW 43.83B.405, IT IS ORDERED that the above listed Water Resource Inventory Areas are hereby under a drought emergency. This order is effective immediately and shall remain in effect through December 31, 2015, unless terminated prior to that date.

In accordance with the provisions of WAC 173-166-060, Department of Ecology may, under the terms of this order, take the following emergency actions:

1. Issue emergency permits for water.
2. Approve temporary transfers of water rights.
3. Provide funding assistance to public agencies to alleviate drought conditions.
4. Take other actions depending on future developments in drought conditions.

Other state and local agencies with authority to issue permits or authorizations related to the drought emergency actions must provide a decision to an applicant within fifteen (15) calendar days of the date of application.

In accordance with the proclamation of the Washington Governor, dated January 3, 1989, (Centennial Accord), nothing herein shall impair or infringe upon the treaty reserved rights or governmental authority of any federally recognized Indian tribe nor shall this order be deemed an assertion of state authority over Indian reservation lands. The Department of Ecology intends to work cooperatively, on a government-to-government basis, with all affected tribes.

Further details about this order or the actions available under it, may be obtained by contacting:

Jeff Marti  
Department of Ecology  
PO Box 47600  
Olympia, WA 98504-7600  
360-407-6627  
[Jeff.marti@ecy.wa.gov](mailto:Jeff.marti@ecy.wa.gov)

Applications for emergency water permits or temporary transfers of water rights are available by contacting one of the Department of Ecology's regional offices:

|   |   |
|---|---|
| Northwest Regional Office<br>Bellevue, WA<br>Office: 425-649-7020<br>Email: <a href="mailto:arha@ecy.wa.gov">arha@ecy.wa.gov</a>    | Central Region Office<br>Yakima, WA<br>Office: 509-575-2597<br>Email: <a href="mailto:sueb461@ecy.wa.gov">sueb461@ecy.wa.gov</a>    |
| Southwest Regional office<br>Lacey, WA<br>Office: 360-407-6859<br>Email: <a href="mailto:oday461@ecy.wa.gov">oday461@ecy.wa.gov</a> | Eastern Regional Office<br>Spokane, WA<br>Office: 509-329-3541<br>Email: <a href="mailto:awat461@ecy.wa.gov">awat461@ecy.wa.gov</a> |

DATED this 17th Day of March, 2015.



Maia D. Bellon, Director  
Department of Ecology



STATE OF WASHINGTON  
DEPARTMENT OF ECOLOGY

PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000

711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

**ORDER AND DETERMINATION BY THE DIRECTOR**

Washington State is experiencing record-low snow pack conditions. Many of our major rivers are forecasted to have April through September runoff volumes that will be the lowest in the past 64 years. This shortfall is a serious threat to municipal and domestic water supplies, irrigated agriculture, and fisheries.

With the concurrence of Governor Inslee and following consultation with affected Indian Tribes, I hereby expand the geographic coverage of Washington State's drought emergency to include thirteen additional Water Resource Inventory Areas (WAC 173-500). These areas are at risk of experiencing less than 75 percent of normal water supply and associated hardship. The Watershed Resource Inventory Areas added to the Washington State drought declaration are as follows:

Western Washington Water Resource Inventory Areas:

- Nooksack (1)
- Lower Skagit-Samish (3)
- Upper Skagit (4)
- Stillaguamish (5)
- Puyallup-White (10)
- Skokomish-Dosewallips (16)
- Cowlitz (26)
- Lewis (27)
- Salmon-Washougal (28)

Central Washington Water Resource Inventory Areas:

- Wind-White Salmon (29)
- Klickitat (30)
- Alkali-Squilchuck (40)
- Okanogan (49)

Snowpack conditions across the state have continued to decline since the initial regional drought was first declared on March 13, 2015. In fact, the statewide average snowpack conditions have further deteriorated since that date. The statewide average is at 20 percent, far below the 40 percent of average that was present in 2005 when Washington State last experienced a statewide drought. As of today, more than 70 percent of Washington State snow monitoring stations are at record-lows.

### **Western Washington**

In watersheds originating on the western slopes of the Cascade Mountains, there is a high risk that fish populations will experience extreme low-flow conditions this year. Low flows mean that hatcheries will face a high likelihood of operational challenges ranging from warm water, disease management, and interruption of water supplies. Tributaries and smaller streams may drop to levels where stream channels become impassible to fish. Pools of water will become disconnected from other pools, isolating fish from other fish and increasing the risks of predation and harassment.

Reduced snowpack in these watersheds also create risks to municipal and domestic water supplies. The Department of Health has identified numerous water systems that draw water from shallow alluvial aquifers, which themselves are dependent on groundwater recharge from snowmelt.

### **Central Washington**

The Alkali-Squilchuck and Okanogan watersheds contain large areas with high value crops (e.g. apples, cherries, and pears) that rely on irrigation from surface water. The Klickitat watershed has communities that have faced water supply challenges in previous drought years, and fisheries are expected to face serious challenges from reduced water supplies. With snowpack in the White Salmon watershed at historic lows, the City of White Salmon has petitioned the state to declare its area in a drought emergency.

Therefore, in accordance with the provisions of RCW 43.83B.405, IT IS ORDERED that the above-listed Water Resource Inventory Areas are hereby under a drought emergency. This order is effective immediately and shall remain in effect through December 31, 2015, unless terminated prior to that date. This Order supplements my March 17, 2015, Order and Determination in which eleven Water Resource Inventory Areas were declared to be under a drought emergency.

In accordance with the provisions of WAC 173-166-060, the Department of Ecology may, under the terms of this order, take the following emergency actions:

1. Issue emergency permits for water.
2. Approve temporary transfers of water rights.
3. Provide funding assistance to public agencies to alleviate drought conditions.
4. Take other actions depending on future developments.

Other state and local agencies with authority to issue permits or authorizations related to the drought emergency actions must provide a decision to an applicant within fifteen (15) calendar days of the date of application.

In accordance with the proclamation of the Washington Governor, dated January 3, 1989, (Centennial Accord), nothing herein shall impair or infringe upon the treaty reserved rights or governmental authority of any federally recognized Indian tribe nor shall this order be deemed an



assertion of state authority over Indian reservation lands. The Department of Ecology intends to work cooperatively, on a government-to-government basis, with all affected tribes.

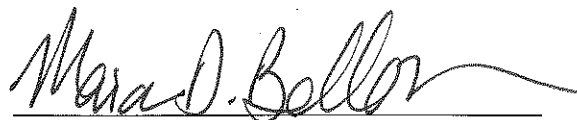
Further details about this order or the actions available under it, may be obtained by contacting:

Jeff Marti  
Department of Ecology  
PO Box 47600  
Olympia, WA 98504-7600  
360-407-6627  
[Jeff.marti@ecy.wa.gov](mailto:Jeff.marti@ecy.wa.gov)

Applications for emergency water permits or temporary transfers of water rights are available by contacting one of the Department of Ecology's regional offices:

|  |   |
|--|---|
| Northwest Regional Office<br>Bellevue, WA<br>Office: 425-649-7020<br>Email: <a href="mailto:arha461@ecy.wa.gov">arha461@ecy.wa.gov</a> | Central Region Office<br>Yakima, WA<br>Office: 509-575-2597<br>Email: <a href="mailto:sueb461@ecy.wa.gov">sueb461@ecy.wa.gov</a>    |
| Southwest Regional office<br>Lacey, WA<br>Office: 360-407-6859<br>Email: <a href="mailto:oday461@ecy.wa.gov">oday461@ecy.wa.gov</a>    | Eastern Regional Office<br>Spokane, WA<br>Office: 509-329-3541<br>Email: <a href="mailto:awat461@ecy.wa.gov">awat461@ecy.wa.gov</a> |

DATED this 22<sup>nd</sup> day of April 2015.



Maia D. Bellon, Director  
Department of Ecology



STATE OF WASHINGTON  
DEPARTMENT OF ECOLOGY

*PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000*

*711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341*

**ORDER AND DETERMINATION BY THE DIRECTOR**

Washington State is experiencing a drought emergency. We have record-low snowpack in the mountains, and snowmelt through the spring and summer is what traditionally keeps rivers flowing, crops watered, and fish alive. We are starting to feel the pain from this snowpack drought. Impacts are already severe in several areas of the state.

More than 70 percent of the state's snow monitoring stations have record-low snowpack. As a result, many of our major rivers are forecasted to have record-low flows – the lowest in the past 64 years – between April and September. This shortfall is a serious threat to municipal and domestic water supplies, irrigated agriculture, and fisheries throughout Washington.

With the concurrence of Governor Inslee and following consultation with affected Indian Tribes, I hereby expand the drought emergency to include all of Washington State.

Snowpack conditions across the state have continued to decline since the initial regional drought declaration on March 13, 2015. Dozens of major rivers are at record-low flows for this date. The longer-term weather forecast is for warmer and drier-than-normal conditions for this spring and summer. Conditions are likely to get worse.

Reduced snowpack creates risks to municipal and domestic water supplies. The Department of Health has identified numerous water systems throughout the state that draw water from shallow alluvial aquifers, which are dependent on groundwater recharge from snowmelt.

Agriculture faces a risk of crop loss throughout the state. Farmers in the Yakima and the Walla Walla basins are being curtailed, which could have devastating impacts on orchards and vineyards. Curtailment is likely to occur in the Little Spokane, Nooksack, and Chehalis basins, and could occur for the first time ever in the Colville Basin. Loss to perennial crops in these regions would be a significant hardship to individual farmers and agricultural communities.

Throughout the state, there is a high risk that fish populations will experience hardship from extremely low flowing rivers this year. Hatcheries will face warmer water, increased risk of disease, and potential loss of water supply. Tributaries and smaller streams may drop to levels where stream channels become impassible to fish. Pools of water will become disconnected from other pools, isolating fish and increasing the risks of predation and harassment.

Therefore, in accordance with the provisions of RCW 43.83B.405, IT IS ORDERED that all of Washington state is hereby under a drought emergency. This order is effective immediately and shall remain in effect through December 31, 2015, unless terminated prior to that date.

In accordance with the provisions of WAC 173-166-060, the Department of Ecology may, under the terms of this order, take the following emergency actions:

1. Issue emergency permits for water.
2. Approve temporary transfers of water rights.
3. Provide funding assistance to public agencies to alleviate drought conditions.
4. Take other actions depending on future developments.

Other state and local agencies with authority to issue permits or authorizations related to the drought emergency actions must provide a decision to an applicant within fifteen (15) calendar days of the date of application.

In accordance with the proclamation of the Washington Governor, dated January 3, 1989, (Centennial Accord), nothing herein shall impair or infringe upon the treaty reserved rights or governmental authority of any federally recognized Indian tribe nor shall this order be deemed an assertion of state authority over Indian reservation lands. The Department of Ecology intends to work cooperatively, on a government-to-government basis, with all affected tribes.

Further details about this order or the actions available under it, may be obtained by contacting:

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[Jeff.marti@ecy.wa.gov](mailto:Jeff.marti@ecy.wa.gov)

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| Southwest Regional Office<br>Lacey, WA<br>Office: 360-407-6859<br>Email: <a href="mailto:oday461@ecy.wa.gov">oday461@ecy.wa.gov</a>    | Eastern Regional Office<br>Spokane, WA<br>Office: 509-329-3541<br>Email: <a href="mailto:awat461@ecy.wa.gov">awat461@ecy.wa.gov</a> |

DATED this 21<sup>st</sup> day of May, 2015.

  
Maia D. Bellon, Director  
Department of Ecology

## **Situation**

Gov. Jay Inslee declared a statewide drought on May 15, 2015 when the state met the drought emergency criteria of reduced water supplies resulting in undue hardship as defined in RCW 43.83B.405. Since then, worsening drought conditions have increased the need for emergency drought funding which was authorized by the Legislature on June 30, 2015.

A total of \$16 million was approved by the Washington state Legislature to be used over two years to help ensure reliable public water supplies, augment water supplies for farmers, and provide water to support stream flows for fish.

On July 10, 2015, Ecology Director Maia Bellon signed an emergency drought funding rule setting the criteria for disbursing a portion of the drought relief funding -- \$5.9 million -- for public projects to alleviate health, welfare, economic, or environmental hardships arising from the 2015 drought.

### **For 2015 an expenditure of \$9.5 million in drought relief funding is planned in these categories:**

- \$5.9 million for 2015 Drought Emergency Grant Program that will provide:
  - \$3.9 million for public agricultural irrigation projects water leasing and/or acquisition
  - \$2 million to municipal water utilities for emergency drought funding
- \$1.18 million for salmon and trout protection
- \$2.21 million for Yakima emergency well pumping mitigation
- \$187,000 to hire temporary staff
- \$100,000 for stream flow monitoring
- \$25,000 for conservation education

### **Ecology will provide grants to cities, public utility and irrigation districts, and other public water suppliers for the following uses:**

- Modifying an existing water source or deepening an existing well.
- Developing an emergency or alternate water source.
- Purchasing or leasing water or water rights to be used during the drought.
- Constructing an emergency intertie or connection to another approved public water supply.
- Building transmission pipelines, diversion structures, storage devices and acquiring pumps and accessories for moving water.
- Detecting and repairing leaks and lining water canals.
- Emergency regional water conservation programs and education programs to alleviate hardships from water shortages.

Grants will require 50 percent matching funds from applicants with one exception. No matching funds are required of drinking water supply projects serving a population of less than 25,000 with water users having a mean household income of 80 percent or less of the state average.

### **Key messages:**

- **Drought conditions have gotten worse since the governor declared a statewide drought May 15, 2015.**
- **Hardships from water shortages are expected to increase through the summer and fall.**
  - Streams and rivers have dropped to below normal or record low flows because of the lack of snowmelt and run-off that normally feeds our rivers and streams.
  - Farmers have been curtailed in their water use in central and eastern Washington.
  - Reports are increasing of low flows creating barriers to fish migration, canceling fishing seasons in some areas and contributing to higher water temperatures which can be deadly to fish.
  - Small water systems that rely solely on well water are at increasing risk of declines in groundwater connected to surface water.

### **Communication tactics and schedule for announcing and implementing the 2015 Drought Emergency Grant Program**

| Date    | Tool  | Channel  | Who<br>-content manager<br>-reviewers  |
|---------|---|--|--|
| July 10 | Maia signs<br>Emergency Drought<br>Funding rule   | No news<br>release Friday<br>afternoon   |  |
| July 13 | News release<br>announcing grant<br>program<br><br>Posting of new <u><a href="#">2015 Drought Emergency Grant Program Web Page</a></u> with link to grant application forms | Twitter &<br>Facebook<br>posts on news<br>release<br><br>Notifications<br>for these<br>Listservs:<br>1. Drought, 2.<br>Water<br>Resources and<br>3. Water<br>Resources | <b>Partridge:</b> News release,<br>social media posts,<br>Listserv notifications<br><br><b>Chris Anderson/<br/>Partridge:</b> Web page<br>updates and review<br><br><b>Dave Christensen:</b><br>Notification of city and<br>public utility associations<br>of grant availability |



|                |                            |   |   |
|----------------|----------------------------|---|---|
|                |                            | Advisory Committee  |   |
| July-September | Tracking of grants awarded | Monthly posting on Web page: 1. Descriptions of projects<br>2. Amounts awarded<br>3. Progress on projects | Chris Anderson/<br>Rebecca Inman: Web page text and posting |

## Ecology's overall drought response

The drought response work that Ecology began on March 13 with the governor's first drought declaration continues with the drought relief funding approved by the Washington Legislature.

This work entails:

- Identifying hardships for people, farms and fish that may result from water shortages.
- Providing drought relief as needed in the form of technical assistance and financial aid for:
  - **Reliable public water supplies:** Drilling new wells, deepening existing ones, constructing necessary infrastructure (intakes, pumps, piping) and providing interties for emergency water supply.
  - **Agriculture:** Facilitating the leasing of water rights from lower economic value crops, such as hay, to higher economic value crops such as fruit.
  - **Protecting fish and fisheries resources:** Leasing water from irrigators to boost stream flows and reduce harm to fish from low flows. Coordinating with state Department of Fish and Wildlife, state and federal biologists to identify stream reaches where fish passage would be affected and where possible construct new channels and remove barriers so that fish can continue to migrate upstream.
  - **Assisting local conservation efforts:** Providing funds to local conservation districts to educate landowners and provide technical assistance on water conservation and irrigation management.
  - **Hydropower:** Working in cooperation with the FERC-licensed hydropower suppliers to ensure adequate instream flows are maintained during the drought.

## Opportunities

- With announcement of the drought relief funding and the public projects grant program, we will increase public confidence in Ecology's ability to quickly respond to hardships and provide drought relief assistance.
- We have received funding for two years from the Legislature so we are better prepared to provide drought relief beyond 2015.

- Media and the public are looking to Ecology’s Website as a clearinghouse of information on the work of all state agencies that have a role in drought response and for up-to-date, accurate and helpful information on the use of drought relief funds.
- Media are picking up our success stories on saving crops, boosting stream flows, protecting public water supplies, helping fight wildfires.
- Ecology will partner with local jurisdictions on water conservation campaigns as communities come together to find solutions to water shortages. Ecology is developing a series of water conservation videos.

## **Challenges**

- Explain the worsening statewide drought conditions in a way that doesn’t create concern among water users about the reliability of their water supplies. Utilities in the Puget Sound region, for example, (where most people in the state live) have reservoirs that hold adequate supplies.
- Our spending of the drought relief funds will be closely scrutinized by local government, legislators and the general public. We need to be transparent in how drought relief funds are used. This includes the application process for public projects grant program, which will have to be both transparent and easy to understand, or we will be held up as an example of government inefficiency.
- Develop water conservation messages in cooperation with landscapers and other businesses who need to assure their customers that for the most part, the drought will not affect water supplies for homes and gardens.
- Coordinate messages and public education and outreach with all agencies involved in drought response or risk creating a perception that the state’s drought response is disorganized and state agencies are ill-prepared to respond to a natural disaster.

## **Goal**

Our implementation of the drought relief public projects grant program reflects the goals of the 2015 Drought Plan and our communications strategy is designed to provide details to the public and Legislature on our drought response work in every region of the state.

## **Objectives**

- Continue to monitor water supply conditions and prepare to quickly alleviate hardships from water shortages wherever possible.
- Keep the governor, Ecology’s director and the Legislature informed about our agency’s work providing drought relief.
- Keep our partner state and federal agencies informed and involved in our work ensuring clean and adequate water supplies for people, farms and fish in drought hardship areas.
- Provide a clearinghouse of information on drought response, relief funding and how those suffering hardships can access drought relief help and financial assistance.
- Ensure that expenditures of drought relief funds are transparent and cost-effective.

## **Audiences**

- Media
- Legislators
- Governor's office
- Attorney General's office
- Residents
- Businesses
- Environmental groups: CELP, Sierra Club, Trout Unlimited, Washington Water Trust
- All members of WRAC, our stakeholder group.
- Drought Listserv members
- Internal staff and executives
- City/county officials
- Ecology's partners in water supply monitoring and drought response: U. S. Geological Survey, National Weather Service, Natural Resources Conservation Service, U.S. Bureau of Reclamation, Army Corps of Engineers, Bonneville Power Administration, Office of State Climatologist, the Washington Conservation Commission and the state departments of Emergency Management, Agriculture, Fish & Wildlife, Health and Commerce.

## **Contacts**

- Jeff Marti, Water Resources drought response coordinator, 360-407-6627
- Tom Loranger, Water Resources program manager, 360-407-6672
- Dave Christensen, manager, Program Development and Operations Support Section, 360-407-6647
- Dan Partridge, drought communications lead, 360-407-7139
- Joye Redfield Wilder, CRO communications manager, 360-575-2610
- Chase Gallagher, SWRO communications manager, 360-407-6239
- Larry Altose, NWRO communications manager, 425-649-7009
- Brook Beeler, ERO communications manager, 509-329-3478
- Rebecca Inman, drought emergency grant coordinator, 360-407-6450
- Add other key members of the drought response team.



## Rossiter, Tony (ECY)

---

**From:** Dumar, Laurie (ECY)  
**Sent:** Monday, July 13, 2015 12:59 PM  
**To:** ECOLOGY-WAC-TRACK@LISTSERV.WA.GOV  
**Subject:** Ecology filed the following: Chapter 173-167 WAC - Emergency Drought Funding

The Washington State Department of Ecology has filed the following:

July 10, 2015

Chapter 173-167 WAC, Emergency Drought Funding – Emergency Rulemaking Order

<http://www.ecy.wa.gov/programs/wr/rules/167-docs.html>

Thank you for using WACTrack.

Have a good day!

---

To join or leave ECOLOGY-WAC-TRACK click here:

<http://listserv.wa.gov/cgi-bin/wa?A0=ECOLOGY-WAC-TRACK>



# RULE-MAKING ORDER

**CR-103E (July 2011)**  
(Implements RCW 34.05.350)

**Agency:** Department of Ecology

AO #15-05

**Emergency Rule Only**

**Effective date of rule:**

**Emergency Rules**

☒ Immediately upon filing.

☐ Later (specify) \_\_\_\_\_

**Any other findings required by other provisions of law as precondition to adoption or effectiveness of rule?**

☐ Yes

☒ No

If Yes, explain:

**Purpose:**

The rule making adopts rules in Chapter 173-167 WAC.

**Citation of existing rules affected by this order:**

Repealed: n/a

Amended: n/a

Suspended: n/a

**Statutory authority for adoption:** EHB 1115, section 3084, Laws of 2015, 3<sup>rd</sup> special session

**Other authority :**

**EMERGENCY RULE**

Under RCW 34.05.350 the agency for good cause finds:

- ☒ That immediate adoption, amendment, or repeal of a rule is necessary for the preservation of the public health, safety, or general welfare, and that observing the time requirements of notice and opportunity to comment upon adoption of a permanent rule would be contrary to the public interest.
- ☐ That state or federal law or federal rule or a federal deadline for state receipt of federal funds requires immediate adoption of a rule.
- ☐ That in order to implement the requirements or reductions in appropriations enacted in any budget for fiscal year 2009, 2010, 2011, 2012, or 2013, which necessitates the need for the immediate adoption, amendment, or repeal of a rule, and that observing the time requirements of notice and opportunity to comment upon adoption of a permanent rule would be contrary to the fiscal needs or requirements of the agency.

**Reasons for this finding:**

An emergency rule is necessary to protect public health and safety and promote timelines that are in the best interest of the public. Once the rule is in place, Ecology may distribute funds to alleviate hardship. Drought can cause immediate impacts to public bodies. To address these impacts, drought funds need to be administered in a timely fashion.

**Date adopted:** July 10, 2015

**NAME (TYPE OR PRINT)**

Maia D. Bellon

**SIGNATURE**

**TITLE**

Director

**CODE REVISER USE ONLY**

OFFICE OF THE CODE REVISER  
STATE OF WASHINGTON  
FILED

**DATE: July 10, 2015**

**TIME: 11:38 AM**

**WSR 15-15-062**

(COMPLETE REVERSE SIDE)

**Note: If any category is left blank, it will be calculated as zero.  
No descriptive text.**

**Count by whole WAC sections only, from the WAC number through the history note.  
A section may be counted in more than one category.**

**The number of sections adopted in order to comply with:**

|   |     |           |         |          |          |          |
|---|-----|-----------|---------|----------|----------|----------|
| <b>Federal statute:</b>                 | New | <u>0</u>  | Amended | <u>0</u> | Repealed | <u>0</u> |
| <b>Federal rules or standards:</b>      | New | <u>0</u>  | Amended | <u>0</u> | Repealed | <u>0</u> |
| <b>Recently enacted state statutes:</b> | New | <u>10</u> | Amended | <u>0</u> | Repealed | <u>0</u> |

**The number of sections adopted at the request of a nongovernmental entity:**

|     |          |         |          |          |          |
|-----|----------|---------|----------|----------|----------|
| New | <u>0</u> | Amended | <u>0</u> | Repealed | <u>0</u> |
|-----|----------|---------|----------|----------|----------|

**The number of sections adopted in the agency's own initiative:**

|     |           |         |          |          |          |
|-----|-----------|---------|----------|----------|----------|
| New | <u>10</u> | Amended | <u>0</u> | Repealed | <u>0</u> |
|-----|-----------|---------|----------|----------|----------|

**The number of sections adopted in order to clarify, streamline, or reform agency procedures:**

|     |           |         |          |          |          |
|-----|-----------|---------|----------|----------|----------|
| New | <u>10</u> | Amended | <u>0</u> | Repealed | <u>0</u> |
|-----|-----------|---------|----------|----------|----------|

**The number of sections adopted using:**

|                                       |     |          |         |          |          |          |
|---------------------------------------|-----|----------|---------|----------|----------|----------|
| <b>Negotiated rule making:</b>        | New | <u>0</u> | Amended | <u>0</u> | Repealed | <u>0</u> |
| <b>Pilot rule making:</b>             | New | <u>0</u> | Amended | <u>0</u> | Repealed | <u>0</u> |
| <b>Other alternative rule making:</b> | New | <u>0</u> | Amended | <u>0</u> | Repealed | <u>0</u> |

## Emergency Rules Development Timeline

WAC # 173-167 Title: Emergency drought funding

| Action  | Target Date |
|---|-------------|
| <b>Planning Phase</b>                                     |             |
| RAD-SMT Briefing  | 5/8/2015    |
| <b>Adoption Phase</b>                                     |             |
| PIO-Pre CR-103 meeting (Once your RAD has been approved)  | 5/8/2015    |
| Final Rule Language to OTS (if time allows)               | 7/1/2015    |
| Adoption Date   | 7/10/2015   |
| CR-103 Filed  | 7/10/2015   |
| Effective Date  | 7/10/2015   |
| Emergency Rule Expiration Date (120 days after filing)    | 11/7/2015   |
| <b>Implementation Phase</b>                               |             |
| Submit rule file to the Rules Unit (2 weeks after filing) | 7/24/2015   |



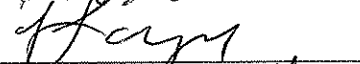

**Department of Ecology**  
**Rule Adoption Approval - CR-103 – Emergency Rule**  
**Director Briefing Scheduled: July 10, 2015**

**Instructions:**

- Answer the four questions below and use the router to get approval for your rule filing packet.
- After the Director signs your CR-103 form you must:
  - Return your filing packet to the Rules and Accountability Unit.
  - Send electronic files to [rulemaking@ecy.wa.gov](mailto:rulemaking@ecy.wa.gov) and attach the:
    - CR-103 form – without signature or date (MS Word).
    - Final rule language - OTS copy (PDF).

**Chapter 173-167 WAC Emergency Drought Funding**

|   |  |
|---|--|
| <b>1. Is this a significant legislative rule?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No   |  |
| <b>2. Does the filing of this CR-103 form require another agency to file their CR-103 form at the same time?</b><br><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Agency _____<br>Contact Name _____<br>Contact Phone _____   | <b>3. Has the program AAG reviewed and provide consultation on this rule adoption packet?</b><br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| <b>4. The Agency Rules Coordinator will confirm that the following is in your CR-103 packet:</b><br><b>For emergency rule making:</b> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Cover memo to the Director</li> <li><input checked="" type="checkbox"/> CR-103 Form</li> <li><input checked="" type="checkbox"/> OTS copy of rule language (print the PDF from OTS)</li> <li><input checked="" type="checkbox"/> Rule Development Plan</li> <li><input checked="" type="checkbox"/> Rule Implementation Plan</li> <li><input checked="" type="checkbox"/> Draft Rule Adoption Notice (finalize date after adoption)</li> <li><input checked="" type="checkbox"/> SEPA documentation (EIS, DNS, etc.) (if applicable) <del>WAC</del> exempt-memo to file</li> <li><input checked="" type="checkbox"/> Citation List (if appropriate)</li> <li><input type="checkbox"/> Letter to Tribes <i>draft</i></li> </ul> |  |

| TITLE                    | SIGNATURE   | NAME             | DATE    |
|--------------------------|---|------------------|---------|
| Unit Supervisor          |   |                  |         |
| Section Head             |  | Dave Christensen | 7/8/15  |
| Agency Rules Coordinator |  | Bari Schreiner   | 7/8/15  |
| Program Manager          |  | Tom Loranger     | 7-8-15  |
| Director                 |  | Maia D. Bellon   | 7-10-15 |

Return the signed packet to the Rules & Accountability Section for filing in the WA State Register.

# DEPARTMENT OF ECOLOGY

## Rule Authorization Document (RAD)

The purpose of the RAD is to inform the Senior Management Team (SMT) about your program's strategic decision to initiate rule making and to get approval from SMT to officially initiate rule making. See an example of a signed RAD.

### INSTRUCTIONS

**Step 1: Fill out the RAD**

Answers should be clear and concise. Delete the yellow highlighted text. Use bulleted lists and tables when appropriate.

**Step 2: Schedule SMT briefing**

SMT meet every Friday. Contact Teri North about two weeks before you want to brief SMT. Teri will work with you to get time on the SMT agenda. Make sure your Program Manager can attend.

**Step 3: Distribute your RAD**

Send your RAD to Teri North, as an e-mail attachment, at least 3 working days before your scheduled SMT briefing. Teri will distribute the RAD to SMT members for you.

**Step 4: Brief SMT**

Use the RAD you sent to Teri to deliver your briefing to SMT. Be prepared to answer questions. Bring a copy that an SMT member can sign. This copy will also have your program manager's signature on it.

**Step 5: Let the Agency Rules Coordinator know that you have an approved RAD.**

When SMT approves your rule an SMT member will sign your RAD. If Bari wasn't at the SMT meeting, send an email to Bari Schreiner to let her know the RAD was approved.

### SMT DECISION PROCESS

There are four possible decision making scenarios that can come out of your SMT briefing.

**Decision 1: SMT will approve your rule at the time of the SMT briefing.**

If they approve your rule, you can initiate rulemaking.

**Decision 2: SMT will deny your rule at the time of the SMT briefing.**

If they deny your rule, you can not proceed with any rule-making activities until you get approval from SMT.

**Decision 3: SMT will approve your rule with conditions.**

Conditions include follow-up tasks that SMT expects you to complete during rule making.

**Decision 4: SMT will ask you to return with more information.**

You can not proceed with any rule making activities until you go back to SMT with more information to get approval.



## RULE-AUTHORIZATION DOCUMENT (RAD)

### Emergency Drought Funding Chapter 173-167 WAC

**1) Subject of possible rule making.**

The Water Resources Program is requesting permission to start a new emergency rulemaking. This rulemaking will propose a new chapter re-using WAC number 173-167. It will spell out how Ecology will allocate funds among qualifying entities suffering undue hardship as a result of the current drought emergency.

**2) Select which type of rule-making process your program anticipates using:**

- ☐ Standard rule making
- ☐ Expedited rule making
- ☒ Emergency rule making

**3) Please indicate which are the one or two main reasons why your program is recommending moving forward with this rule making at this time?**

The rule adoption/amendment/update:

- ☐ Is required by a federal/state law, court order, or to maintain federally delegated/authorized program.
- ☒ Is necessary for budget reasons.
- ☒ Is necessary to protect public health or the environment.
- ☐ Is requested by the regulated community or other interested parties.
- ☒ Would benefit the regulated community or other interested parties.
- ☐ Could potentially create or expand economic opportunities, including but not limited to new jobs, business opportunities, cost-savings or efficiencies, or community resources.
- ☒ Would assist economic recovery and/or job creation.
- ☐ Would streamline the rule or include other efficiencies (provide more detail in question 5.)
- ☐ Other reasons.

**4) Provide description of reasons why rules on this subject may be needed and what they might accomplish.**

This rulemaking is necessary in order to allocate funds to qualifying entities suffering undue hardship as a result of the current drought emergency. Funds will be used to implement projects to address drought related shortages to drinking water supply, agricultural projects and stream flows. Addressing hardship through the allocation of funds will provide support for

local entities responsible for protecting public health. Getting relief on the ground will help protect the environment.

- 5) **Would this rule streamline any existing requirements, improve rule clarity, or improve consistency (with other requirements in this chapter or with other state/federal laws and rules)? If yes, explain.**

No

- 6) **What are the consequences if Ecology doesn't do this rule making now?**

The governor has declared a drought emergency. Distributing funds in accordance with this declaration requires emergency rulemaking. Without immediate rule making, impacts to public health and the environment are likely imminent.

- 7) **Provide the specific statutory authority that allows Ecology to adopt this rule. Is it sufficient to adopt this rule?**

2015 drought funding allocation is authorized under RCW 43.83.020 and the state building construction account. This account shall be used exclusively for the purposes of carrying out the provisions of the capital appropriation acts.

- 8) **Have you consulted with your AAG on this rule making?**

☒ Yes

☐ No

- 9) **How does this rule making fit into the agency's strategic focus? (Get input from your program manager to answer this question.)**

Effective water management requires attentiveness to the water needs of instream and out-of-stream uses. When drought is declared and economic hardship is suffered, this balance becomes more challenging. The current dialogue concerning climate change impacts says we may experience similar water supply concerns in the future. Preparing for drought will in turn prepare the program for addressing these prospective changes to the landscape.

- 10) **How would you rank this rule making?**

1 = Low controversy, 2 = medium controversy, and 3 = High controversy (enter the number and phrase below with a brief explanation)

1; There is general agreement that Ecology should provide funds to qualifying entities to take appropriate action to protect public health and the environment.



- 11) Anticipated Timeline. When do you expect to file a CR 101, CR-102, and CR-103 (CR-105 if appropriate)? How does this timing relate to other activities in your program (permits, other rule making, etc.)?**

We anticipate filing the CR-103e on May 22, 2015.

- 12) Do you anticipate the need for cross program coordination/communication? Should this be done through the Environmental Program Management Team (EPMT)? What about other federal or state agencies? Provide a brief explanation.**

Through EPMT, SMT and other informal channels, the Water Resources program will provide briefing to these interests and keep them informed on the services we're providing to the regulated public. Additionally the program will work with the Bureau of Reclamation to implement projects in the Yakima Basin. We anticipate the need for coordination with state agencies such as DFW relating to fish survival, DOH for public health issues, Agriculture for irrigation issues, DNR on fire issues, Commerce on impacts to business, and the state office of emergency management on how to manage the drought emergency.

- 13) What interested parties, stakeholders, etc. does this rule making most heavily impact? Why are they interested or concerned?**

Interested parties include water purveyors, municipalities, irrigation districts, environmental groups, Tribes. These groups may suffer undue hardship that could be alleviated with these funds.

- 14) How do you intend to *involve* regulated entities, interested parties, and tribes in the rule-making process?**

The nature of an emergency rule precludes the involvement of the regulated community, interested parties and tribes from the rulemaking process.

These interests are aware of the rulemaking and intend to apply once funds are available and the rule is in place.

An email to tribal chairs will be sent out in advance of the rule being adopted.

- 15) How do you intend to communicate with small businesses and/or local governments on how the impact of the rule can be mitigated? (include other groups you will be consulting with, if applicable)**

Funding made available through this rule will be available for public bodies which include local governments. During the grant program roll-out, we'll sponsor a webinar explaining the application process with a focus on developing projects most suitable to address the need to alleviate undue hardship. This rule making doesn't require cost benefit and small business impact analysis.

The grant roll-out will be announced via the Water Resources Listserv, the Drought Listserv, the agency web site, and a news release.

16) Does this rule raise taxes or impose or increase fees as defined in RCW 43.135.055 (Initiatives 960 and 1053)?

☐ Yes

☒ No

If the answer is yes,

Have you consulted with your Assistant Attorney General about the effect on your rule?

☐ Yes

☐ No

Does the fee have legislative approval if so when?

☐ Yes, when was the legislative approval granted (reference and date granted):

☐ No

Is there a deadline by when the agency must adopt the fee?

☐ Yes, when: \_\_\_\_\_

☐ No

17) Program Manager's Approval

*Lauren*  
Program Manager Signature

5-8-15  
Date

SMT Decision and Signature

☒ Authorized to proceed.

☐ Not authorized to proceed.

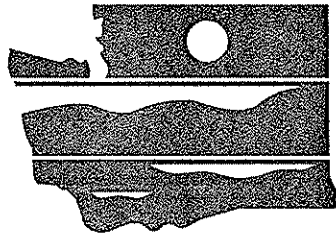
☐ Return with additional information, see notes below.

☐ Authorization to proceed with conditions, see notes below.

*Marial Beller*  
Signature of member of SMT

5/14/15  
Date

Notes to rule writer:



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

## RULE DEVELOPMENT PLAN

### Chapter 173-167 WAC Emergency Drought Funding

AO #15-05

#### Signature Approval

The following signatures are required to approve this Rule Development Plan. You must have a signed copy of your RDP to file a CR-101.

| RDP approved by:         | Signature:           | Date:  |
|--------------------------|----------------------|--------|
| Rule Writer              | <i>[Signature]</i>   | 7-8-15 |
| Agency Rules Coordinator | <i>Bapi Schneier</i> | 7-8-15 |
| Program Manager          | <i>[Signature]</i>   | 7-8-15 |

# RULE DEVELOPMENT PLAN

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## SECTION A: AUTHORIZATION

Attach a scanned version of the signed Rule Authorization Document (RAD).

## SECTION B: TIMELINE

Attach a detailed timeline. Download the proper template at  
<http://partnerweb/sites/GR/rules/ruleFiles/Template%20Library/Timeline.docx>

## SECTION C: ISSUES AND CONCERNS

Describe the issues and/or concerns related to this rule making.

The main issue for this rule making is timeliness. In order to curtail the potential hardship associated with this drought emergency it is important to disburse funding to qualifying entities in a timely manner.

Additionally the appropriation may not be sufficient to address all drought hardship. Ensuring that the rule balance priorities with needs to fund projects that can be implemented in a timely fashion to address drought related hardship are an imperative.

## SECTION D: FINANCIAL AND LEGAL SUPPORT

It is important to make sure your program's current budget can support this rule making. Rule making can create extra costs for things like meeting facilitation, technical assistance, economic analysis, SEPA, etc. You also need to contact your Assistant Attorney General (AAG) early to get them involved in the rule making process.

### D.1 Provide details about the extra resources and costs related to this rule making.

Our current program budget has the capacity to support this rule making.

### D.2 Provide contact information for the AAG assigned to this rule making.

Name: David Stearns      Phone: 360.586.6749      E-mail: [david.stearns@atg.wa.gov](mailto:david.stearns@atg.wa.gov)

## SECTION E: OTHER REQUIREMENTS

### E.1 Provide contact information for the Economist assigned to your rule making.

Name: Tryg Hoff      Phone: 360.407.6631      E-mail: [tryg.hoff@ecy.wa.gov](mailto:tryg.hoff@ecy.wa.gov)

### E.2 Does this rule making need to comply with SEPA (State Environmental Policy Act)?

For help with this decision call Ecology's SEPA unit at (360) 407-6922.

☐ Yes      ☒ No

## **SECTION F: COMMUNICATION STRATEGY**

Insert a scanned version of the signed Communication Strategy. Communication strategies will vary depending on the rule. Download the template for a basic communication strategy at [http://partnerweb/sites/GR/rules/ruleFiles/Template%20Library/Comm\\_strat.doc](http://partnerweb/sites/GR/rules/ruleFiles/Template%20Library/Comm_strat.doc)

**Chapter 173-167 WAC  
EMERGENCY DROUGHT FUNDING**

**PART I  
DROUGHT FUNDING—GENERAL CRITERIA**

NEW SECTION

**WAC 173-167-010 Funding available to public bodies.** The department of ecology (ecology) is authorized to provide funding to public bodies for projects designed to alleviate hardship arising from drought conditions which may affect public health and safety or cause significant economic or environmental impacts including, but not limited to:

- (1) Municipal drinking water supplies;
- (2) Agricultural activities;
- (3) Maintaining instream flows to protect fish and wildlife habitat.

NEW SECTION

**WAC 173-167-020 Purpose and authority.** This emergency rule establishes criteria by which ecology may disburse funds appropriated for drought relief within an area with a state declared drought as defined in WAC 173-166-030(2). This rule is supplemental to chapter 173-166 WAC. In the event that there is any conflict between this rule and chapter 173-166 WAC, the provisions of this chapter control.

Ecology is authorized to expend drought relief funds in 2015 under EHB 1115, section 3084, Laws of 2015 3rd special session.

NEW SECTION

**WAC 173-167-030 Qualifying public bodies.** These include any federal, state, local agency, political subdivision, taxing district, or municipal corporation thereof, and those Indian tribes now or hereafter recognized as such by the federal government for participation in the federal land and water conservation program and which may constitutionally receive grants from the state of Washington.

## NEW SECTION

**WAC 173-167-040 Funding limitations.** (1) Ecology will administer grants in accordance with the "*Administrative Requirements for Recipients of Ecology Grants and Loans*." (Publication No. 91-18). Revised September 2005.

(2) Except for state agency applicants and as provided for in subsection (3) of this section, applicants must provide cash match totaling fifty percent of the total eligible cost of the project. Funds used as match may not originate from other state funds.

(3) If an applicant proposes a drinking water supply project to address the immediate hardship arising from drought conditions and it serves a population of less than twenty-five thousand individuals with a mean household income of eighty percent or less of the state average, these applicants qualify for an exemption from the cash match requirement provided the project demonstrates a cost effective approach.

(4) The highest level of funding the department may provide to an applicant is five hundred thousand dollars.

## NEW SECTION

**WAC 173-167-050 Eligibility for funding.** To be eligible for funding, the proposed project must meet the following criteria:

(1) The applicant must be a public body, as defined under WAC 173-167-030.

(2) The reduction in water supply must be presently causing, or likely to cause, undue hardship for the applicant.

(3) The proposed project must be for the purpose of supplying water to a previously established activity that is authorized under an existing water right.

(4) The proposed project must be able to timely assist in alleviating the current water shortage caused by drought conditions. The applicant must obtain all required permits and approvals for the proposed project before payment is authorized.

(5) The proposed project must be completed during the current drought declaration and the capacity to complete the project in a timely fashion must be demonstrated to ecology.

## NEW SECTION

**WAC 173-167-060 Applications and assistance.** Applications for funding assistance under this section or any questions about funding assistance under this section should be directed to:

Rebecca Inman  
Washington State Department of Ecology  
P.O. Box 47600  
Olympia, WA 98504-7600  
360-407-6450  
rebecca.inman@ecy.wa.gov

## NEW SECTION

**WAC 173-167-070 Related permits to be processed expeditiously.** Under RCW 43.83B.410 (1)(b):

(1) All state and local agencies, including ecology, will issue permits or other authorizations for the proposed project within fifteen calendar days; and

(2) Drought relief projects funded through this program are exempted from any statutory requirements of public notice, competitive bidding, and chapter 43.21C RCW, State Environmental Policy Act.

## NEW SECTION

**WAC 173-167-080 Examples of eligible water supply projects.** (1) Projects eligible for funding include, but are not limited to, water conservation, acquiring alternate water sources, or temporarily changing or transferring water rights. Eligible projects must represent an additional cost to the applicant as the result of drought conditions, and not normal water supply costs. Measures to implement water conservation projects eligible for funding include, but are not limited to:

(a) Irrigation scheduling programs and activities;

(b) Water use reduction programs and activities;

(c) Emergency regional water conservation programs, with preference given to applications submitted by multiple public entities; and

(d) Education programs designed to alleviate water shortage and hardship emergency.

(2) Examples of water supply projects eligible for funding include, but are not limited to:

(a) Modifying an existing source or deepening an existing well;

(b) Developing an emergency or alternate water source;

(c) Purchasing or leasing water or water rights to be used during the drought period;

(d) Constructing an emergency intertie to another approved public water supply;

(e) Building transmission pipelines, diversion structures, storage devices, discharge lines, and/or pumps and accessories;

(f) Installing source meters and measuring devices;

(g) Improving canals and laterals with control structures;

(h) Detecting and repairing leaks and lining leaky canals; and

(i) Regulating reservoirs;

(3) Costs of providing personnel necessary to implement the activities in subsection (1) of this section, and for construction, operation, and maintenance associated with subsection (2) of this section are also eligible for funding under this program.

## NEW SECTION

**WAC 173-167-090 Priority for funding.** (1) Priority will be given to proposed projects which incorporate elements that most effectively conserve water, represent the more efficient use of available



water supplies, and that will address shortages that pose the greatest hardship arising from drought conditions which may affect public health and safety or cause significant economic or environmental impacts.

(2) Priority will also be given to applicants demonstrating the clearest need for alternate emergency water supplies to avoid undue hardship where the proposed project will address the need before the current drought declaration expires. Need will be measured by:

(a) The short-term and long-term effects the water shortage would have on agricultural crops, livestock operations, or a municipality or utility's ability to provide drinking water in its service area, in the absence of drought relief.

(b) The capability and reliability of the proposed project to provide an emergency water supply to the applicant.

(c) The percent of water shortage experienced or forecast for the applicant.

#### NEW SECTION

**WAC 173-167-100 Preferences.** Where there are two or more eligible projects of equal or similar priority but funding limitations preclude funding both, applications that fulfill the following criteria will be preferred:

(1) Demonstrating that reasonable efforts to address their water supply shortage by implementing measures such as water conservation plans, water system efficiency improvements, water shortage response plans, or other drought contingency actions, have already been completed.

(2) Providing cash match from other local or federal sources in addition to the minimum cash match requirements set out in WAC 173-167-040.

(3) Demonstrating the cost benefit of the proposed project through a calculation of the cost per unit of water developed under this funding. Water supply developed in a more cost effective manner will be preferred.

(4) For municipal drinking water projects, applicants who have developed and are following a water shortage response plan.

**From:** [Christensen, Dave \(ECY\)](#)  
**To:** [Hoff, Tryg \(ECY\)](#); [Holderman, Jennifer \(ECY\)](#)  
**Cc:** [Marti, Jeff \(ECY\)](#); [Rossiter, Tony \(ECY\)](#)  
**Subject:** RE:  
**Date:** Thursday, May 14, 2015 9:26:43 AM

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Nice concise summary, Tryg. Thank you!

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**From:** Hoff, Tryg (ECY)  
**Sent:** Thursday, May 14, 2015 9:10 AM  
**To:** Holderman, Jennifer (ECY)  
**Cc:** Marti, Jeff (ECY); Rossiter, Tony (ECY); Christensen, Dave (ECY)  
**Subject:**

Hi Jennifer,

For the purposes of the Drought Emergency Rule, no economic evaluations for the public are formally required under the Administrative Procedures Act or the Regulatory Fairness Act

You may use this statement for the rule filing.

**SBEIS:**

[RCW 19.85](#)

Regulatory Fairness Act

Application of chapter - Limited

19.85.025(3) This chapter does not apply to the adoption of a rule described in RCW [34.05.310](#)(4).

[RCW 34.05.310](#)

Administrative Procedure Act

Prenotice inquiry – Negotiated and pilot rules

(3)(b) An agency must include a written justification in the rule-making file if an opportunity for interested parties to participate in the rule-making process prior to publication of the proposed rule has not been provided.

(4) This section does not apply to:

(a) Emergency rules adopted under RCW [34.05.350](#);

**CBA:**

[RCW 34.05.328](#)

Significant legislative rules, other selected rules

(5)(b) This section does **not** apply to:

(i) Emergency rules adopted under RCW [34.05.350](#);

Tryg Hoff  
Economic and Regulatory Research, Water Resources  
Department of Ecology  
P. O. Box 47600

Olympia, WA 98504-7600  
Phone (360) 407-6631  
Email [thof461@ecy.wa.gov](mailto:thof461@ecy.wa.gov)

July 8, 2015

Memo to File

Applicability of the State Environmental Policy Act RCW 43.21C to the adoption of Chapter 173-167 WAC-Emergency Drought Funding:

WAC 197-11-880

Emergencies.

Actions that must be undertaken immediately or within a time too short to allow full compliance with this chapter, to avoid an imminent threat to public health or safety, to prevent an imminent danger to public or private property, or to prevent an imminent threat of serious environmental degradation, shall be exempt. Agencies may specify these emergency actions in their procedures.

[Statutory Authority: RCW 43.21C.110. WSR 84-05-020 (Order DE 83-39), § 197-11-880, filed 2/10/84, effective 4/4/84.]

In addition:

- RCW 43.83B.410 exempts drought authorizations for withdrawals and diversions and all related permits and authorizations.
- RCW 43.21C.210 exempts certain actions during a state of emergency declared by the governor under RCW 43.06.210.



## ORDER AND DETERMINATION BY THE DIRECTOR

Washington has experienced record-warm temperatures this winter and, as a result, extremely low snowpack statewide. While precipitation has been largely normal statewide, consistently warm weather and high freezing levels have caused most precipitation to fall as rain rather than snow. With many sites in the mountains already completely void of snow, what little snowpack remains will likely melt several weeks ahead of normal. Washington could face serious water shortages this spring and summer.

Traditionally, many communities across the state have relied on a healthy snowpack to slowly feed rivers, farms and communities through the drier spring and summer months. The Natural Resources Conservation Service and the Northwest River Forecast Center project water supplies for snowpack-dependent watersheds to be well below normal April through September. And the state Water Supply Availability Committee identified 34 watersheds out of 62 that will likely receive less than 75 percent of their normal water supply (a statutory drought threshold) because of the diminished snowpack.

For perspective, snowpack in the Olympic Mountains is fluctuating around 10 percent of normal right now. A few days ago it was down to just 4 percent; yesterday it briefly spiked to 14 percent; and today it's down to 11 percent. With long-range weather forecasts calling for a warmer, drier spring, snowpack is expected to remain in a dire state.

The shortage in water supplies creates the strong possibility of undue hardships for water users in the following watersheds:

- **Yakima River Basin:** The Bureau of Reclamation announced that pro-rated water users will see their water deliveries reduced to a level less than 75 percent of their normal supply. Orchards cannot withstand interruption in water supply and low stream flows in tributaries can hamper salmon migration and survival.
- **Wenatchee and Entiat Basins:** The water supply forecast calls for much less than 75 percent of normal water supply; orchards cannot withstand interruption in water supply.
- **Walla Walla Basin:** Even during a normal year, there is not enough water available to supply the demands of all users. Insufficient stream flows can block salmon and trout migration in this basin.
- **Olympic Peninsula:** The forecasted water runoff from April through September for the Dungeness River is expected to be the lowest in the past 45 years. This will threaten the reliability of community water systems. Streamflow conditions are expected to become significantly adverse for fish habitat, with the potential for migratory barriers and fish stranding. Salmon runs are especially important to Tribal communities on the peninsula.

The National Oceanic and Atmospheric Administration Climate Prediction Center predicts warmer and drier conditions this spring. Given these projections, there is a strong likelihood that water supply forecasts will be revised downward in the coming weeks.

The water supply shortfall poses a serious threat to irrigated crops, public water supplies, and fisheries in the following Water Resources Inventory Areas:

17: *Quilcene-Snow*; 18: *Elwah-Dungeness*; 19: *Lyre-Hoko*; 20: *Soleduck-Hoh*; 21: *Queets-Quinault*; 32: *Walla Walla*; 37: *Upper Yakima*; 38: *Lower Yakima*; 39: *Naches*; 45: *Wenatchee*; 46: *Entiat*.

Therefore, in accordance with the provisions of RCW 43.83B.405, IT IS ORDERED that the above listed Water Resource Inventory Areas are hereby under a drought emergency. This order is effective immediately and shall remain in effect through December 31, 2015, unless terminated prior to that date.

In accordance with the provisions of WAC 173-166-060, Department of Ecology may, under the terms of this order, take the following emergency actions:

1. Issue emergency permits for water.
2. Approve temporary transfers of water rights.
3. Provide funding assistance to public agencies to alleviate drought conditions.
4. Take other actions depending on future developments in drought conditions.

Other state and local agencies with authority to issue permits or authorizations related to the drought emergency actions must provide a decision to an applicant within fifteen (15) calendar days of the date of application.

In accordance with the proclamation of the Washington Governor, dated January 3, 1989, (Centennial Accord), nothing herein shall impair or infringe upon the treaty reserved rights or governmental authority of any federally recognized Indian tribe nor shall this order be deemed an assertion of state authority over Indian reservation lands. The Department of Ecology intends to work cooperatively, on a government-to-government basis, with all affected tribes.

Further details about this order or the actions available under it, may be obtained by contacting: *Jeff Marti*, Ecology; PO Box 47600; Olympia, WA 98504-7600; 360-407-6627; Email: [Jeff.marti@ecy.wa.gov](mailto:Jeff.marti@ecy.wa.gov)

Applications for emergency water permits or temporary transfers of water rights are available by contacting one of the Department of Ecology's regional offices:

- *Northwest Regional Office*; Bellevue, WA; 425-649-7020; Email: [arha@ecy.wa.gov](mailto:arha@ecy.wa.gov)
- *Central Region Office*; Yakima, WA; 509-575-2597; Email: [sueb461@ecy.wa.gov](mailto:sueb461@ecy.wa.gov)
- *Southwest Regional Office*; Lacey, WA; 360-407-6859; Email: [oday461@ecy.wa.gov](mailto:oday461@ecy.wa.gov)
- *Eastern Regional Office*; Spokane, WA; 509-329-3541; Email: [awat461@ecy.wa.gov](mailto:awat461@ecy.wa.gov)

DATED this 17th Day of March, 2015.

I-55

*Maia D. Bellor*  
Maia D. Bellor, Director, Department of Ecology

## **Geographic Description of Drought For Washington State Drought Contingency Plan**

**(DRAFT – Aug. 17, 2016)**

Three levels of information provided when announcing a stage of drought:

1. Affected counties (partly or wholly)
2. Affected watersheds within those counties (generally by WRIA or sub-WRIA)
3. Likely types of users affected and not affected within those watersheds.

### **EXAMPLE 1: Hydrologic conditions indicate drought in northwest corner of state**

A Stage X drought is declared for parts of Whatcom, Skagit, and Snohomish Counties. This stage means: \_\_\_\_\_.

River basins affected within those counties are the Nooksack, Lower Skagit/Samish, Upper Skagit, and Stillaguamish basins (WRIAs 1, 3, 4, and 5).

#### Affected Areas:

The affected water users and natural resources may include farms relying on natural rainfall for a large portion of their water needs; communities drawing from surface water sources; communities and homeowners drawing from shallow wells in unconfined aquifers; and fish in each of the affected basins, especially in smaller creeks.

Customers of other public water systems in the affected area should look for communications from their local water utility to determine whether shortages are expected.

#### Unaffected Areas:

The City of Bellingham lies in the affected area but is not expected to experience shortages this year if current weather trends continue.

The City of Everett and communities receiving water from Everett's regional water supply system lie outside the affected area of Snohomish County, and are not currently expected to experience shortages this year. This unaffected area includes Arlington, Lynnwood, Marysville, the Alderwood Water and Wastewater District, and other communities in the southern half of Snohomish County.

## **EXAMPLE 2: Hydrologic conditions indicate drought in central Washington**

A Stage X drought is declared for parts of Chelan, Douglas, Grant, Kittitas, Yakima and Benton Counties. This stage means: \_\_\_\_\_.

River basins affected within those counties are the Wenatchee, Entiat, Chelan, Lower Yakima, Upper Yakima, Naches and Alkali-Squilchuck. (WRIAs 27, 38, 39, 40, 45, 46, 47).

### Affected areas:

The affected water users and natural resources may include farms that rely on surface water sources; communities drawing from surface water sources; communities and homeowners drawing from shallow wells in unconfined aquifers; and fish in each of the affected basins including tributary streams.

Farms in the Yakima River Basin that receive water from the Bureau of Reclamation should consult with their irrigation district managers. As of the current date, Reclamation has indicated Total Water Supply Available of \_\_\_\_ percent. The TWSA forecast will be confirmed or updated by Reclamation, at least monthly.

Customers of public water systems in the affected area should look for communications from their local water utility to determine whether shortages are expected.

### Unaffected Areas:

Farms and communities receiving water from the Columbia River and Lake Roosevelt are not expected to experience shortages this year if current weather trends continue.

## DEPARTMENT OF ECOLOGY

July 10, 2015

**TO:** Maia D. Bellon  
Director

**FROM:** Jennifer Holderman  
Water Resources Program

**SUBJECT:** Adoption of Chapter 173-167, WAC Emergency Drought Funding

Attached is the filing package to adopt the above referenced rule. Your signature is requested on July 10, 2015, the proposed adoption date. The rule becomes effective immediately after filing.

***Is this a ☒ new or ☐ a change to existing WAC?***

***What is the purpose of this rule making?***

This rule making will propose a new WAC number 173-167. It will spell out how Ecology will allocate funds among qualifying entities suffering undue hardship as a result of the current drought emergency.

***What are the issues involved in developing this rule?***

To qualify for funding, an applicant must be a public body residing in an area covered by the drought declaration that has or may experience undue hardship due to drought conditions. Applicants will be required to clearly demonstrate this hardship and propose projects to address it. To ensure adequate response to these hardships, the agency will need to distribute funds in a timely fashion as well as direct funding towards projects that are feasible and address the need. Applicants will also need to provide cash match. The rule provides exceptions from the match requirement for disadvantaged communities. As we balance these considerations through the administration of funding, issues of public perception concerning consistency and equity may arise.

**If the rule has a small business impact or an impact to local government, describe how we consulted with small businesses and/or governments on how the impacts of the rule can be mitigated** (Executive Order 11-03 OFM guidance memo).

Funding made available through this rule will be available for public bodies which include local governments. During the grant program roll-out, we'll sponsor a webinar explaining the application process with a focus on developing projects most suitable to address the need to alleviate undue hardship. This rule making doesn't require cost benefit and small business impact analysis.



**If appropriate, what online resources and technology are you planning to use related to the rule adoption, to maximize efficiency of the rule-making process for stakeholders.** (Executive Order 11-03 OFM guidance memo).

After rule adoption there will be a news release to the media, social media posts (Twitter and Facebook), Listserv notifications (Drought list and Water Resources list, Water Resources Advisory Committee list), notification of city and public utility associations, and postings to the web site.

Ecology will also post monthly web site updates of descriptions of projects, amounts awarded and progress on projects.

***Describe any remaining opposition to the rule.***

Public bodies will likely experience impacts from drought at various times throughout the course of the year as well as beyond the current declaration. We want to ensure that funds will be available during the full duration of potential impact. Balancing the immediate need with long term planning is critical.

To approve this rule adoption please:

1. Sign the attached Code Reviser Form CR-103E,
2. Add your signature to the attached router, and
3. Forward the package to Bari Schreiner, Agency Rules Coordinator, for filing.

Attachments (if appropriate):

- CR-103 Form
- Official OTS Rule Text
- SEPA documentation
- Citation List
- Rule Implementation Plan
- Draft Rule Adoption Notice
- Letter to Tribes

## **Emergency Drought Funding, WAC 173-167**

Ecology adopted an emergency drought rule on July 10 for the entire state that describes how Ecology will allocate relief funding to qualifying public entities. Projects eligible for funding must alleviate hardships arising from current drought conditions. Eligible projects must alleviate hardship affecting public health and safety, economic and environmental impacts.

### **What is Chapter 173-167 WAC?**

This emergency rule establishes a process the Department of Ecology will use to disburse funds appropriated for drought relief. The emergency rule establishes three general categories for funding: municipal water supply, agricultural activities and maintaining instream flows to protect fish and wildlife habitat.

### **Whom does this rule affect?**

Applicants for drought emergency funding must be a public entity, as defined by WAC 173-167-030, which includes:

- Federal, state, or local agencies, political subdivisions, taxing districts, or municipal corporations thereof, and
- Indian tribes, recognized as such by the federal government for participation in the federal land and water conservation program, and which may constitutionally receive grants or loans from the state of Washington.

Qualifying entities must demonstrate undue hardship caused by drought. Funds are available for proposals that timely alleviate the impacts of drought. The rule provides further guidance on how the agency will make funding decisions.

**More information** For more information visit the Washington Drought 2015 web site. It is updated frequently with the latest drought information: <http://www.ecy.wa.gov/drought/index.html>

To get updates on Ecology's rule-making activities, sign-up for the WACTrack e-mail list at [www.ecy.wa.gov/maillist.html](http://www.ecy.wa.gov/maillist.html).

#### **WHY IT MATTERS MORE INFORMATION**

The Department of Ecology will distribute emergency drought funding to qualifying entities (Federal, state, and local agencies, political subdivisions, taxing districts, municipal corporations, and Indian tribes) to alleviate hardships caused by drought conditions that affect water availability in Washington state.

#### **Important dates:**

**Effective July 10, 2015**  
**Expires November 7, 2015**

#### **Contact information:**

Rebecca Inman, Emergency Drought Funding Coordinator  
(360) 407-6450  
[Rebecca.inman@ecy.wa.gov](mailto:Rebecca.inman@ecy.wa.gov)

#### **Special accommodations:**

If you need this document in format for the visually impaired, call the Water Resources program at (360) 407-6872.

Persons with hearing loss, call 711 for Washington Relay Service. Persons with a speech disability, call 877-833-6341.

## **Appeal procedures**

This adoption can be appealed under procedures described in the Administrative Procedure Act (RCW 34.05.330). For more information about appealing this rule adoption, please contact Bari Schreiner, Agency Rules Coordinator, at (360) 407-6998 or [bari.schreiner@ecy.wa.gov](mailto:bari.schreiner@ecy.wa.gov).

# Citation List Instructions

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- ADMIN, AQ, EAP, SPILLS, HWTR, NW, TCP, WR, W2R use the template on page 2.
- SEA and WQ must use the template on page 3.

If you have questions, contact [Bari.Schreiner@ecy.wa.gov](mailto:Bari.Schreiner@ecy.wa.gov); 360-407-6998

# Citation List

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## **Chapter 173 – 167 WAC**

### **Drought emergency 2015**

#### **AO # 15-05**

This citation list contains references for data, factual information, studies, or reports on which the agency relied in the adoption for this rule making (RCW 34.05.370(f)).

1. Chapter 173-167 WAC Emergency Drought Funding. <http://www.ecy.wa.gov/laws-rules/archive/wac173167.html>
2. Chapter 173-166 WAC Emergency Drought Relief. <http://apps.leg.wa.gov/wac/default.aspx?cite=173-166>
3. 2005 Drought Response, Report to the Legislature. Publication Number 06-11-001, February 2006.
4. EHB 1115, section 3084, Laws of 2015, 3<sup>rd</sup> special session

### **Citation List Template For SEA and WQ programs only.**

**Instructions:**

1. Include the Citation List as an appendix in your Concise Explanatory Statement (CES)  
Under RCW 34.05.272(2)(c) citation list “must categorize the sources of information as belonging to one or more of the categories listed below.
2. Delete instructions before publishing in CES.

### **Appendix [enter letter]: Citation List [make this match the heading format in you CES]**

**Chapter [XXX] – [XXX] WAC**

**[Title]**

**AO # [XX] – [XX]**

This citation list contains references for data, factual information, studies, or reports on which the agency relied in the adoption for this rule making (RCW 34.05.370(f)).

At the end of each citation is a number in brackets identifying which of the citation categories below the sources of information belongs. (RCW 34.05.272).

| <b>Citation Categories</b> |  |
|----------------------------|--|
| 1                          | Peer review is overseen by an independent third party.   |
| 2                          | Review is by staff internal to Department of Ecology.  |
| 3                          | Review is by persons that are external to and selected by the Department of Ecology.   |
| 4                          | Documented open public review process that is not limited to invited organizations or individuals.   |
| 5                          | Federal and state statutes.  |
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| 9                          | Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under other processes. |
| 10                         | Records of best professional judgment of Department of Ecology employees or other individuals.   |
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**1. Enter first citation here. [#]**

2. Enter citation here. [ #]

3. Enter additional citations if appropriate.



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

# **Rule Implementation Plan**

## **Emergency Drought Funding**

### **Chapter 173-167 WAC**

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July 2015  
Publication no. 15-11-009



## Publication and Contact Information

This report is available on the Department of Ecology's website at  
<https://fortress.wa.gov/ecy/publications/SummaryPages/1511009.html>

For more information contact:

Publications Coordinator  
Water Resources Program  
P.O. Box 47600  
Olympia, WA 98504-7600

E-mail: [Briana.Phillips@ecy.wa.gov](mailto:Briana.Phillips@ecy.wa.gov)  
Phone: 360-407-6624

Washington State Department of Ecology - [www.ecy.wa.gov](http://www.ecy.wa.gov)

|                                     |              |
|-------------------------------------|--------------|
| Headquarters, Olympia               | 360-407-6000 |
| Northwest Regional Office, Bellevue | 425-649-7000 |
| Southwest Regional Office, Olympia  | 360-407-6300 |
| Central Regional Office, Yakima     | 509-575-2490 |
| Eastern Regional Office, Spokane    | 509-329-3400 |

Ecology publishes this document to meet the requirements of the Washington State Administrative Procedure Act (RCW 34.05.325)

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*Persons with hearing loss, call 711 for Washington Relay Service. Persons with a speech disability, call 877-833-6341.*

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# Purpose

The Washington State Department of Ecology (Ecology) provides the information in this implementation plan to meet agency and Administrative Procedure Act (RCW 34.05.328) requirements related to rule adoptions.

# Introduction

On July 10, 2015, Ecology adopted Chapter 173-167 WAC Emergency Drought Funding (AO # 15-05). Ecology is adopting this rule to establish criteria for disbursing funds appropriated by the Legislature for drought relief. Establishing these criteria will promote the development of projects that address hardship caused by drought and the implementation of these projects in a timely fashion.

The purpose of this rule implementation plan is to inform those who must comply with Chapter 173-167 WAC about how Ecology intends to:

- Implement and enforce the rule.
- Inform and educate persons affected by the rule.
- Promote and assist voluntary compliance for the rule.
- Evaluate the rule.
- Train and inform Ecology staff about the new or amended rule.

Also included in this plan is information about:

- Supporting documents that may need to be written or revised because of the new rule or amended rule.
- Other resources where more information about the rule is available.
- Contact information for Ecology employees who can answer questions about the rule implementation.

# Implementation and Enforcement

This rule will be implemented by Ecology's Water Resources' Program Development and Operational Support staff and appropriate Regional Offices staff. Qualifying entities will apply for funding in a competitive application process. Ecology staff will make funding decisions based on the eligibility criteria and priorities listed in the rule.

This rule does not include enforcement measures.

# Informing and Educating Persons Affected by the Rule

Upon rule adoption there will be a news release to the media, social media posts (Twitter and Facebook), Listserv notifications (Drought list and Water Resources list, Water Resources

Advisory Committee list), notification of city and public utility associations, and postings to the web site.

Ecology will also post monthly web site updates of descriptions of projects, amounts awarded and progress on projects.

A webinar on the emergency drought funding program will be made available via the agency web site. Ecology has produced focus sheets and step-by-step instructions on applying and competing for a grant. Staff will also be available to provide technical assistance for applicants throughout the application for development and implementation of their grant project.

## **Promoting and Assisting Voluntary Compliance**

This rule does not create a compliance obligation for the regulated public. Those that wish to apply for funding through the Emergency Drought Grant Program are required to meet eligibility requirements set in rule. The rule, the grant web site, the application, and the instructions provide additional guidance on how proposals will be evaluated, supporting applicants in developing sound proposals.

Ecology and local partners will promote voluntary water conservation using methods and messaging that have worked well in the past.

## **Evaluating the Rule**

Public bodies will likely experience impacts from drought at various times throughout the current drought declaration. We want to ensure that funds will be available when a need arises. Balancing the immediate need with long term planning is critical. In balancing these interests, it is essential that projects are chosen based on their effectiveness to alleviate hardship and will be implemented in a timely fashion. Fulfilling these criteria will in turn help us determine effectiveness of rule implementation.

## **Training and Informing Agency Staff**

Ecology will use staff meetings, agency web site and e-mail to train and inform agency staff about the drought emergency grant program. The agency drought funding coordinator and regional representatives will collaborate to implement the rule.

## **List of Supporting Documents that May Need to be Written or Revised**

All documents related to this grant program have been updated.

## **More Information**

For more information: <http://www.ecy.wa.gov/drought/index.html>

# Contact Information

## **Headquarters**

Rebecca Inman      360.407.6450 [rebecca.inman@ecy.wa.gov](mailto:rebecca.inman@ecy.wa.gov)  
PO Box 47600, Olympia, WA 98504-7600

## **Southwest Regional Office**

Mike Gallagher      360.407.6058 [mike.gallagher@ecy.wa.gov](mailto:mike.gallagher@ecy.wa.gov)  
PO Box 47775, Olympia, WA 98504-7775

## **Central Regional Office**

Sage Park      509.454.7647 [sage.park@ecy.wa.gov](mailto:sage.park@ecy.wa.gov)  
1250 West Alder Street, Union Gap, WA 98903-0009

## **Eastern Regional Office**

Keith Stoffel      509.329.3464 [keith.stoffel@ecy.wa.gov](mailto:keith.stoffel@ecy.wa.gov)  
4601 N Monroe, Spokane, WA 99205-1295

## **Northwest Regional Office**

Tom Buroker      425.649.7270 [thbu461@ecy.wa.gov](mailto:thbu461@ecy.wa.gov)  
3190 160<sup>th</sup> Ave SE, Bellevue, WA 98008-5452



**IAA No.**

**INTERAGENCY AGREEMENT (IAA)**

**BETWEEN**

**THE STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY**

**AND**

**THE STATE OF WASHINGTON DEPARTMENT OF FISH AND WILDLIFE**

**THIS INTERAGENCY AGREEMENT** ("Agreement" or "IAA") is made and entered into by and between the state of Washington, Department of Ecology, hereinafter referred to as "ECOLOGY," and the the state of Washington Department of Fish and Wildlife hereinafter referred to as the "RECIPIENT," pursuant to the authority granted by Chapter 39.34 RCW.

**THE PURPOSE OF THIS AGREEMENT** is to provide emergency drought funding to the RECIPIENT in order to respond to the statewide drought declaration of May 15, 2015. The water shortage and low-flow conditions statewide severely impacting fish and wildlife species.

**WHEREAS**, *a statewide drought declaration was signed by the Governor on May 15, 2015;*

**WHEREAS**, *funding for drought response was not availble to Ecology until the State Capital Budget was signed by the Governor;*

**WHEREAS**, *an enacted State Capital Budget was not signed and effective until July 10, 2015;*

**THEREFORE, IT IS MUTUALLY AGREED THAT:**

**1) STATEMENT OF WORK**

RECIPIENT shall furnish the necessary personnel, equipment, material and/or service(s) and otherwise do all things necessary for or incidental to the performance of the work set forth in Appendix A, attached hereto and incorporated herein.

**2) PERIOD OF PERFORMANCE**

Subject to its other provisions, the period of performance of this IAA shall commence on **July 1, 2015**, or date of final signature, whichever comes later, and be completed by **June 30, 2016**, unless terminated sooner as provided herein. Amendments extending the period of performance, if any, shall be at the sole discretion of ECOLOGY.

### **3) COMPENSATION**

Compensation for the work provided in accordance with this IAA has been established under the terms of RCW 39.34.130, and in accordance with Governor's Executive Order 10-07 and RCW 39.26.180(3). This is a performance-based contract, in which payment is based on the successful completion of expected deliverables. The parties have determined that the cost of accomplishing the work herein will not exceed \$XXXXX. Payment for satisfactory performance of the work shall not exceed this amount unless the parties mutually agree to a higher amount. Compensation for services shall be based on the terms set forth in accordance with the tasks listed in Appendix A, Statement of Work and Budget, which is attached hereto and incorporated herein. ECOLOGY will not make payment until it has reviewed and accepted the completed work.

### **4) BILLING PROCEDURE**

RECIPIENT shall submit state form, Invoice Voucher A19-1A for payment requests. Payment will be made within thirty (30) days of a properly completed invoice, form A19-1A, with supportive documentation. Each invoice shall reference this Agreement (IAA) number and clearly identify the items related to performance under this Agreement. All expenses invoiced shall be supported with copies of invoices paid. Upon expiration of this Agreement, any claim for payment not already made shall be submitted within 30 days after the expiration date or the end of the fiscal year, whichever is earlier.

Invoices are to be sent to:

|  |
|--|
| Department of Ecology<br>Attn: Jim Skalski<br>P.O. Box 47600<br>Olympia, WA 98504-7600 |
|--|

Invoices may be submitted on a monthly basis or at the completion of the work.

Payment for approved and completed work will be issued through Washington State's Department of Enterprise Services Statewide Payee Desk. To receive payment you must be registered as a state-wide vendor. To register submit a state-wide vendor registration form and an IRS W-9 form at website, <http://www.des.wa.gov/services/ContractingPurchasing/Business/VendorPay/Pages/default.aspx>. If you have questions about the vendor registration process you can contact DES at the Payee Help Desk at (360) 407-8180 or email [payeehelpdesk@des.wa.gov](mailto:payeehelpdesk@des.wa.gov).

### **5) ALTERATIONS AND AMENDMENTS**

This Agreement may be amended by mutual agreement of the parties. Such amendments shall not be binding unless they are in writing and signed by personnel authorized to bind each of the parties.

### **6) SUBCONTRACTORS**

RECIPIENT agrees to take complete responsibility for all actions of any Subcontractor used under this Agreement for the performance. When federal funding is involved there will be additional subcontractor requirements and reporting.

RECIPIENT shall identify subcontractor(s) who will perform services in fulfillment of Agreement requirements, including their name, the nature of services to be performed, address, telephone, WA State Department of Revenue Registration Tax number (UBI), federal tax identification number (TIN), and anticipated dollar value of each subcontract.



## **7) ASSIGNMENT**

The work to be provided under this Agreement, and any claim arising thereunder, is not assignable or delegable by either party in whole or in part, without the express prior written consent of the other party, which consent shall not be unreasonably withheld.

## **8) DISPUTES**

Parties to this Agreement shall employ every effort to resolve a dispute themselves without resorting to litigation. In the event that a dispute arises under this Agreement that cannot be resolved among the parties, it shall be determined by a Dispute Board in the following manner. Each party to this Agreement shall appoint one member to the Dispute Board. The members so appointed shall jointly appoint an additional member to the Dispute Board. The Dispute Board shall review the facts, agreement terms, and applicable statutes and rules, and then make a determination of the dispute. The determination of the Dispute Board shall be final and binding on the parties hereto, unless restricted by law. The cost of resolution will be borne by each party paying its own cost. As an alternative to this process, if state agencies, either of the parties may request intervention by the Governor, as provided by RCW 43.17.330, in which event the Governor's process will control. The parties may mutually agree to a different dispute resolution process.

## **9) FUNDING AVAILABILITY**

ECOLOGY's ability to make payments is contingent on availability of funding. In the event funding from state, federal, or other sources is withdrawn, reduced, or limited in any way after the effective date and prior to completion or expiration date of this Agreement, ECOLOGY, at its sole discretion, may elect to terminate the agreement, in whole or part, for convenience or to renegotiate the agreement subject to new funding limitations and conditions. ECOLOGY may also elect to suspend performance of the agreement until ECOLOGY determines the funding insufficiency is resolved. ECOLOGY may exercise any of these options with no notification restrictions.

## **10) GOVERNING LAW AND VENUE**

This Agreement is entered into pursuant to and under the authority granted by the laws of the state of Washington and any applicable federal laws. The provisions of this Agreement shall be construed to conform to those laws. This Agreement shall be construed and interpreted in accordance with the laws of the state of Washington, and the venue of any action brought hereunder shall be in the Superior Court for Thurston County.

## **11) INDEPENDENT CAPACITY**

The employees or agents of each party who are engaged in the performance of this Agreement shall continue to be employees or agents of that party and shall not be considered for any purpose to be employees or agents of the other party.

## **12) ORDER OF PRECEDENCE**

In the event of an inconsistency in the terms of this Agreement, or between its terms and any applicable statute or rule, the inconsistency shall be resolved by giving precedence in the following order:

- a. Applicable federal and state of Washington statutes, regulations, and rules.
- b. Mutually agreed written amendments to this Agreement.
- c. This Agreement.
- d. Statement of Work and Budget.
- e. Any other provisions of this Agreement, including materials incorporated by reference.

### **13) RECORDS MAINTENANCE**

The parties to this Agreement shall each maintain books, records, documents and other evidence that sufficiently and properly reflect all direct and indirect costs expended by either party in the performance of the service(s) described herein. These records shall be subject to inspection, review or audit by personnel of both parties, other personnel duly authorized by either party, the Office of the State Auditor, and federal officials so authorized by law. All books, records, documents, and other material relevant to this Agreement will be retained for six years after expiration and the Office of the State Auditor, federal auditors, and any persons duly authorized by the parties shall have full access and the right to examine any of these materials during this period.

Records and other documents, in any medium, furnished by one party to this Agreement to the other party, will remain the property of the furnishing party, unless otherwise agreed. The receiving party will not disclose or make available this material to any third parties without first giving notice to the furnishing party and giving it a reasonable opportunity to respond. Each party will utilize reasonable security procedures and protections to assure that records and documents provided by the other party are not erroneously disclosed to third parties.

### **14) RIGHTS IN DATA**

Unless otherwise provided, data which originates from this Agreement shall be "works for hire" as defined by the U.S. Copyright Act of 1976 and shall be owned by ECOLOGY. Data shall include, but not be limited to, reports, documents, pamphlets, advertisements, books magazines, surveys, studies, computer programs, films, tapes, and/or sound reproductions. Ownership includes the right to copyright, patent, register, and the ability to transfer these rights.

### **15) SEVERABILITY**

If any provision of this Agreement or any provision of any document incorporated by reference shall be held invalid, such invalidity shall not affect the other provisions of this Agreement which can be given effect without the invalid provision, if such remainder conforms to the requirements of applicable law and the fundamental purpose of this agreement, and to this end the provisions of this Agreement are declared to be severable.

### **16) TERMINATION FOR CAUSE**

If for any cause, either party does not fulfill in a timely and proper manner its obligations under this Agreement, or if either party violates any of these terms and conditions, the aggrieved party will give the other party written notice of such failure or violation. The responsible party will be given the opportunity to correct the violation or failure within 15 working days. If failure or violation is not corrected, this Agreement may be terminated immediately by written notice of the aggrieved party to the other.

### **17) TERMINATION FOR CONVENIENCE**

Either party may terminate this Agreement upon thirty (30) days' prior written notification to the other party. If this Agreement is so terminated, the parties shall be liable only for performance rendered or costs incurred in accordance with the terms of this Agreement prior to the effective date of termination.

### **18) ASSURANCES**

Parties to this Agreement agree that all activity pursuant to this contract will be in accordance with all the applicable current federal, state and local laws, rules, and regulations.

### **19) CONFORMANCE**

If any provision of this contract violates any statute or rule of law of the state of Washington, it is considered modified to conform to that statute or rule of law.

## 20) WAIVER

A failure by either party to exercise its rights under this Agreement shall not preclude that party from subsequent exercise of such rights and shall not constitute a waiver of any other rights under this Agreement unless stated to be such in a writing signed by an authorized representative of the party and attached to the original Agreement.

## 21) AGREEMENT MANAGEMENT

The representative for each of the parties shall be responsible for and shall be the contact person for all communications and billings regarding the performance of this Agreement.

| The ECOLOGY Representative is:   | The RECIPIENT Representative is:          |
|--|---|
| Name: Dave Christensen<br>Address: P.O. BOX 47600<br>Olympia, WA 98504<br>Phone: 360-407-6647<br>Email: <a href="mailto:davc461@ecy.wa.gov">davc461@ecy.wa.gov</a> | Name:<br>Address:<br><br>Phone:<br>Email: |

## 22) ALL WRITINGS CONTAINED HEREIN

This Agreement contains all the terms and conditions agreed upon by the parties. No other understandings, oral or otherwise, regarding the subject matter of this Agreement shall be deemed to exist or to bind any of the parties hereto.

The signatories to this Agreement represent that they have the authority to bind their respective organizations to this Agreement.

**IN WITNESS WHEREOF**, the parties have executed this Agreement.

**State of Washington**  
**Department of Ecology**  
**By**

**State of Washington**  
**Department of Fish & Wildlife**  
**By**

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Tom Loranger

\_\_\_\_\_  
Print Name:

\_\_\_\_\_  
Water Resources Program Manager

\_\_\_\_\_  
Title:

Approved as to form:  
Attorney General's Office

## **APPENDIX A STATEMENT OF WORK**

Ecology will provide up to \$XXX to Washington Department of Fish and Wildlife (WDFW) for the period July 1, 2015 through June 30, 2016 to support emergency-drought-related activities.

### **Task 1: Drought Response Coordination**

WDFW will execute a coordinated approach to both internal and external actions and activities relating to evaluation, planning, development, and implementation of WDFW's statewide emergency drought response, including:

- Coordinate internally within WDFW to ensure cross-program and cross-region drought responses are executed in a synchronized manner;
- Interagency coordination, liaison, and meetings; including with the Department of Ecology, the Governor's Office and other state, federal, and tribal agencies, as required.
- Manage drought contracts and funds;
- Develop WDFW drought impact remediation programs and projects for 2015;
- Coordinate prioritization and implementation of projects;
- Work with Ecology and/or local entities to achieve improvements to stream flows for the 2015 season;
- Prepare materials and messages for outreach on drought impacts to fish and wildlife;
- Prepare reports on WDFW drought-related activities, as requested and required.

### **Task 2: WDFW Hatcheries Drought Preparations & Responses**

WDFW staff and partners will implement activities to respond to drought conditions at WDFW hatchery facilities, such as:

- Purchase and apply medications and other treatments to protect fish from or help fish overcome diseases experienced at higher water temperatures;
- Extra effort, supplies, and labor involved in relocating fish among facilities in order to reduce drought-related stress;
- Develop and implement emergency modifications of existing water supply structures or operations to support fish rearing, provide for fish passage (into and out of the hatchery and around diversion structures), and/or provide for attraction, collection, and holding of returning adults;
- Purchase devices and monitor dissolved oxygen in hatchery facilities;

- Purchase and operate aerators, recirculation pumps, or other approaches to distribute supplemental water supply, to maintain oxygen levels, re-use water, or manage water temperature;
- Pay additional energy costs associated with increased reliance on pumps and aeration equipment;
- Provide supplemental water supplies and the infrastructure to deliver those supplies;
- Modify fish return structures at some hatcheries, or implement trap-and-haul operations to facilitate passage and collection of adult fish for broodstock;
- Increase enforcement activities necessary to protect fish that are delayed from migrating and may be concentrated in low-flow and high-water-temperature areas or otherwise vulnerable to harassment and/or illegal harvest.

### **Task 3 – WDFW Lands and Water Access Drought Responses**

Implement drought responses on agency-owned and/or agency-managed lands, such as:

- Review and prepare water right change applications that facilitate use of agency water rights to contribute to stream flows;
- Actions to maintain public water access or safety during low drought flows or water levels (e.g., extension of boat ramps, safety signage);
- Land management actions such as those necessary to implement fire and other safety restrictions or closures;
- Wildlife crop predation mitigation actions (e.g., hazing, supplemental feeding) and to compensate for crop losses related to drought-deprived wildlife;
- Winter wildlife feeding programs made necessary by drought-caused lack of forage.

### **Task 4: Drought Response Technical Assistance – Fish Salvage & Habitat Actions**

WDFW staff and partners may implement habitat-related drought responses, such as:

- Participate in emergency drought-related decisions about flow releases and other water management provisions pursuant to FERC licenses, HCPs, water purveyor operations, and settlement agreements;
- Identify water leases, acquisitions, pulse flows, or source exchanges to provide adequate flows and reduced temperatures in critical streams;
- Assess, develop and implement emergency fish salvage projects (channel modifications for upstream and downstream passage of juvenile and adult salmon and other fish, trap-and-haul projects to move fish around blockages, fish relocation, etc.);

- Salvage stranded salmonids and other fish due to low flow in streams and side channels, and at fishways and water diversion structures;
- Prepare and issue hydraulic project approvals on an emergency basis for drought-funding-related water supply, fish protection, or WDFW facility projects;
- Reconnaissance and remediation work necessary to address illegal hydraulic activities, including recreational dams that impede fish migration. Work can include monitoring streams for presence of recreational rock dams and remove or modify those structures to allow for fish movements.

### **Task 5 – External assistance for drought response**

WDFW might need to contract with external partners or entities in order to receive assistance in implementing elements and activities falling under Tasks 1 through 4. Examples of

- Reconnaissance and remediation work necessary to address recreational dams that impede fish migration. Work can include monitoring streams for presence of recreational rock dams and remove or modify those structures to allow for fish movements;
- Water temperature and fish presence monitoring;
- Assistance implementing fish salvage activities;
- Vegetation removal;
- Emergency Response communications center;
- Targeted outreach on drought-impacts and remediation;
- Other new work to remediate previously-unanticipated drought effects.

### **Task 6 – Contingency**

WDFW may need additional funding for tasks 1 through 5 as the ability to specifically estimate costs during emergency operations requires flexibility.

- Other new work to remediate previously-unanticipated drought effects.

### **Deliverables**

WDFW will provide weekly reports via conference call to Ecology Drought Coordinator Jeff Marti regarding progress on WDFW's drought response, and a final report summarizing drought preparations, response, and lessons learned.

## Budget

Between July 1, 2015 and June 30, 2016, WDFW anticipates expenditures as shown in Table 1.

Changes in expenditures among tasks may occur as necessary to respond to emergent needs and priority changes during the period through June 30, 2016.

**Table 1 – WDFW Anticipated 2015 Drought Expenditures**

| Task   | Cost Category                    | Direct      | Indirect<br>-exempt | Indirect  | Total       |
|--------|----------------------------------|-------------|---------------------|-----------|-------------|
| Task 1 | Coordination                     | \$75,000    | \$0                 | \$21,908  | \$96,908    |
|        | Drought "Let 'em Pass" signs     | \$1,000     | \$0                 | \$292     | \$1,292     |
|        | Water right transfer assistance  | \$20,000    | \$0                 | \$5,842   | \$25,842    |
| Task 2 | Hatchery impacts                 | \$856,100   | \$389,500           | \$136,294 | \$992,394   |
| Task 3 | Maintain water access            | \$80,000    | \$80,000            | \$0       | \$80,000    |
|        | Drought hazard signs             | \$1,000     | \$0                 | \$292     | \$1,292     |
| Task 4 | Fish Salvage                     | \$50,000    | \$0                 | \$14,605  | \$64,605    |
| Task 5 | Additional contracted assistance | \$400,000   | \$0                 | \$58,420  | \$258,420   |
| Task 6 | <b>Contingency</b>               | 175,000     |                     |           |             |
|        | <b>Totals</b>                    | \$1,283,100 |                     | \$237,653 | \$1,520,753 |

Note: Cost categories are provided for comparison to February 2015 estimates only, and are not intended to represent separate tasks or allotments.

\* All figures include indirect at the current WDFW rate of .2921. Changes in costs attributable to changes in WDFW's indirect rate will necessitate an amendment to this agreement.



**IAA No.**

**INTERAGENCY AGREEMENT (IAA)**

**BETWEEN**

**THE STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY**

**AND**

**WASHINGTON STATE CONSERVATION COMMISSION**

**THIS INTERAGENCY AGREEMENT** ("Agreement" or "IAA") is made and entered into by and between the state of Washington, Department of Ecology, hereinafter referred to as "ECOLOGY," and the Washington State Conservation Commission hereinafter referred to as the "COMMISSION," pursuant to the authority granted by Chapter 39.34 RCW.

**THE PURPOSE OF THIS AGREEMENT** is to provide the COMMISSION with funds from ECOLOGY to mitigate hardship due to the drought.

**THEREFORE, IT IS MUTUALLY AGREED THAT:**

**1) STATEMENT OF WORK**

COMMISSION shall furnish the necessary personnel, equipment, material and/or service(s) and otherwise do all things necessary for or incidental to the performance of the work set forth in Appendix A, attached hereto and incorporated herein.

**2) PERIOD OF PERFORMANCE**

Subject to its other provisions, the period of performance of this IAA shall commence on **July 1, 2015**, or date of final signature, whichever comes later, and be completed by **December 31, 2015**, unless terminated sooner as provided herein. Amendments extending the period of performance, if any, shall be at the sole discretion of ECOLOGY.

**3) COMPENSATION**

Compensation for the work provided in accordance with this IAA has been established under the terms of RCW 39.34.130, and in accordance with Governor's Executive Order 10-07 and RCW 39.26.180(3). This is a performance-based contract, in which payment is based on the successful completion of expected deliverables. The parties have determined that the cost of accomplishing the work herein will not exceed \$51,350.00. Payment for satisfactory performance of the work shall not exceed this amount unless the parties mutually agree to a higher amount. Compensation for services shall be based on the terms set forth in accordance with the tasks listed in Appendix A, Statement of Work and Budget, which is attached hereto and



incorporated herein. ECOLOGY will not make payment until it has reviewed and accepted the completed work.

#### **4) BILLING PROCEDURE**

COMMISSION shall submit state form, Invoice Voucher A19-1A for payment requests. Payment will be made within thirty (30) days of a properly completed invoice, form A19-1A, with supportive documentation. Each invoice shall reference this Agreement (IAA) number and clearly identify the items related to performance under this Agreement. All expenses invoiced shall be supported with copies of invoices paid. Upon expiration of this Agreement, any claim for payment not already made shall be submitted within 30 days after the expiration date or the end of the fiscal year, whichever is earlier.

Invoices are to be sent to:

|  |
|--|
| State of Washington<br>Department of Ecology<br>Attn: Rose Bennett<br>P.O. Box 47600<br>Olympia, WA 98504-7600 |
|--|

Invoices may be submitted on a monthly basis or at the completion of the work.

Payment for approved and completed work will be issued through Washington State's Department of Enterprise Services Statewide Payee Desk. To receive payment you must be registered as a state-wide vendor. To register submit a state-wide vendor registration form and an IRS W-9 form at website, <http://www.des.wa.gov/services/ContractingPurchasing/Business/VendorPay/Pages/default.aspx>. If you have questions about the vendor registration process you can contact DES at the Payee Help Desk at (360) 407-8180 or email [payeehelpdesk@des.wa.gov](mailto:payeehelpdesk@des.wa.gov).

#### **5) ALTERATIONS AND AMENDMENTS**

This Agreement may be amended by mutual agreement of the parties. Such amendments shall not be binding unless they are in writing and signed by personnel authorized to bind each of the parties.

#### **6) SUBCONTRACTORS**

COMMISSION agrees to take complete responsibility for all actions of any Subcontractor used under this Agreement for the performance. When federal funding is involved there will be additional subcontractor requirements and reporting.

Prior to performance, COMMISSION shall identify subcontractor(s) who will perform services in fulfillment of Agreement requirements, including their name, the nature of services to be performed, address, telephone, WA State Department of Revenue Registration Tax number (UBI), federal tax identification number (TIN), and anticipated dollar value of each subcontract.

#### **7) ASSIGNMENT**

The work to be provided under this Agreement, and any claim arising thereunder, is not assignable or delegable by either party in whole or in part, without the express prior written consent of the other party, which consent shall not be unreasonably withheld.

## **8) DISPUTES**

Parties to this Agreement shall employ every effort to resolve a dispute themselves without resorting to litigation. In the event that a dispute arises under this Agreement that cannot be resolved among the parties, it shall be determined by a Dispute Board in the following manner. Each party to this Agreement shall appoint one member to the Dispute Board. The members so appointed shall jointly appoint an additional member to the Dispute Board. The Dispute Board shall review the facts, agreement terms, and applicable statutes and rules, and then make a determination of the dispute. The determination of the Dispute Board shall be final and binding on the parties hereto, unless restricted by law. The cost of resolution will be borne by each party paying its own cost. As an alternative to this process, if state agencies, either of the parties may request intervention by the Governor, as provided by RCW 43.17.330, in which event the Governor's process will control. The parties may mutually agree to a different dispute resolution process.

## **9) FUNDING AVAILABILITY**

ECOLOGY's ability to make payments is contingent on availability of funding. In the event funding from state, federal, or other sources is withdrawn, reduced, or limited in any way after the effective date and prior to completion or expiration date of this Agreement, ECOLOGY, at its sole discretion, may elect to terminate the agreement, in whole or part, for convenience or to renegotiate the agreement subject to new funding limitations and conditions. ECOLOGY may also elect to suspend performance of the agreement until ECOLOGY determines the funding insufficiency is resolved. ECOLOGY may exercise any of these options with no notification restrictions.

## **10) GOVERNING LAW AND VENUE**

This Agreement is entered into pursuant to and under the authority granted by the laws of the state of Washington and any applicable federal laws. The provisions of this Agreement shall be construed to conform to those laws. This Agreement shall be construed and interpreted in accordance with the laws of the state of Washington, and the venue of any action brought hereunder shall be in the Superior Court for Thurston County.

## **11) INDEPENDENT CAPACITY**

The employees or agents of each party who are engaged in the performance of this Agreement shall continue to be employees or agents of that party and shall not be considered for any purpose to be employees or agents of the other party.

## **12) ORDER OF PRECEDENCE**

In the event of an inconsistency in the terms of this Agreement, or between its terms and any applicable statute or rule, the inconsistency shall be resolved by giving precedence in the following order:

- a. Applicable federal and state of Washington statutes, regulations, and rules.
- b. Mutually agreed written amendments to this Agreement.
- c. This Agreement.
- d. Statement of Work and Budget.
- e. Any other provisions of this Agreement, including materials incorporated by reference.

## **13) RECORDS MAINTENANCE**

The parties to this Agreement shall each maintain books, records, documents and other evidence that sufficiently and properly reflect all direct and indirect costs expended by either party in the performance of the service(s) described herein. These records shall be subject to inspection, review or audit by personnel of both parties, other personnel duly authorized by either party, the Office of the State Auditor, and federal officials so

authorized by law. All books, records, documents, and other material relevant to this Agreement will be retained for six years after expiration and the Office of the State Auditor, federal auditors, and any persons duly authorized by the parties shall have full access and the right to examine any of these materials during this period.

Records and other documents, in any medium, furnished by one party to this Agreement to the other party, will remain the property of the furnishing party, unless otherwise agreed. The receiving party will not disclose or make available this material to any third parties without first giving notice to the furnishing party and giving it a reasonable opportunity to respond. Each party will utilize reasonable security procedures and protections to assure that records and documents provided by the other party are not erroneously disclosed to third parties.

#### **14) RIGHTS IN DATA**

Unless otherwise provided, data which originates from this Agreement shall be "works for hire" as defined by the U.S. Copyright Act of 1976 and shall be owned equally. Data shall include, but not be limited to, reports, documents, pamphlets, advertisements, books magazines, surveys, studies, computer programs, films, tapes, and/or sound reproductions. Ownership includes the right to copyright, patent, register, and the ability to transfer these rights.

#### **15) SEVERABILITY**

If any provision of this Agreement or any provision of any document incorporated by reference shall be held invalid, such invalidity shall not affect the other provisions of this Agreement which can be given effect without the invalid provision, if such remainder conforms to the requirements of applicable law and the fundamental purpose of this agreement, and to this end the provisions of this Agreement are declared to be severable.

#### **16) TERMINATION FOR CAUSE**

If for any cause, either party does not fulfill in a timely and proper manner its obligations under this Agreement, or if either party violates any of these terms and conditions, the aggrieved party will give the other party written notice of such failure or violation. The responsible party will be given the opportunity to correct the violation or failure within 15 working days. If failure or violation is not corrected, this Agreement may be terminated immediately by written notice of the aggrieved party to the other.

#### **17) TERMINATION FOR CONVENIENCE**

Either party may terminate this Agreement upon thirty (30) days' prior written notification to the other party. If this Agreement is so terminated, the parties shall be liable only for performance rendered or costs incurred in accordance with the terms of this Agreement prior to the effective date of termination.

#### **18) ASSURANCES**

Parties to this Agreement agree that all activity pursuant to this contract will be in accordance with all the applicable current federal, state and local laws, rules, and regulations.

#### **19) CONFORMANCE**

If any provision of this contract violates any statute or rule of law of the state of Washington, it is considered modified to conform to that statute or rule of law.

#### **20) WAIVER**

A failure by either party to exercise its rights under this Agreement shall not preclude that party from subsequent exercise of such rights and shall not constitute a waiver of any other rights under this Agreement unless stated to be such in a writing signed by an authorized representative of the party and attached to the original Agreement.

## 21) AGREEMENT MANAGEMENT

The representative for each of the parties shall be responsible for and shall be the contact person for all communications and billings regarding the performance of this Agreement.

| The ECOLOGY Representative is:   | The COMMISSION Representative is:  |
|--|--|
| Name: Jim Skalski<br>Address: PO Box 47600<br>Olympia, WA 98504-7600<br>Phone: (360) 407-6617<br>Email: <a href="mailto:jim.skalski@ecy.wa.gov">jim.skalski@ecy.wa.gov</a> | Name: Jon Culp<br>Address: 921 Murray Street<br>Okanogan, WA 98840<br>Phone: (509) 385-7509<br>Email: <a href="mailto:jculp@scc.wa.gov">jculp@scc.wa.gov</a> |

## 22) ALL WRITINGS CONTAINED HEREIN

This Agreement contains all the terms and conditions agreed upon by the parties. No other understandings, oral or otherwise, regarding the subject matter of this Agreement shall be deemed to exist or to bind any of the parties hereto.

The signatories to this Agreement represent that they have the authority to bind their respective organizations to this Agreement.

**IN WITNESS WHEREOF**, the parties have executed this Agreement.

**State of Washington**  
**Department of Ecology**  
**By**

**State of Washington**  
**(Agency Name)**  
**By**

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Print Name:

\_\_\_\_\_  
Print Name:

\_\_\_\_\_  
Title:

\_\_\_\_\_  
Title:

Approved as to form:  
Attorney General's Office

## **APPENDIX A**

### **STATEMENT OF WORK**

ECOLOGY will provide funds to the CONSERVATION COMMISSION for Drought Technical Assistance to conservation districts. Funding for the grant program will consist of;

1. Funds for the CONSERVATION COMMISSION for administering the grant program.
2. Technical assistance to qualified conservation districts. The grants will be awarded based on demonstrated need and environmental benefit criteria as coordinated with the Washington Department of Fish and Wildlife.

### **BUDGET**

| Contract Object         | Total     |
|-------------------------|-----------|
| Technical Assistance    | \$ 44,652 |
| Contract Administration | \$ 6,698  |
| Total                   | \$ 51,350 |

### **INVOICE IDENTIFICATION & INFORMATION**

Each invoice voucher submitted to ECOLOGY by the CONSERVATION COMMISSION will clearly reference ECOLOGY Contract Number #\_\_\_\_\_.

**DROUGHT RELIEF  
GRANT APPLICATION**

|                    |  |  |  |  |  |  |
|--------------------|--|--|--|--|--|--|
| Application Number |  |  |  |  |  |  |
| D2015              |  |  |  |  |  |  |
| Date               |  |  |  |  |  |  |

The information provided in this application will be used to determine general eligibility for funding from the Drought Relief Program, and the priority or ranking of the proposal amongst other competing proposals.

Separate application must be made for any needed emergency drought authorization. Before final approval of grant funding, the applicant must submit copies of all required permits and other authorizations needed for the proposal to Ecology for our review.

|   |
|---|
| <p><b>1. APPLICANT NAME (PUBLIC BODY) AND ADDRESS</b></p> <p>(a) Authority (State Law) _____</p> <p>(b) Date Organized _____</p>  |
| <p><b>2. CONTACT PERSON, TITLE, ADDRESS, EMAIL, AND PHONE NUMBER</b></p>  |
| <p><b>3. PROJECT(S) DESCRIPTION</b></p> <p>Provide a description of the proposed project(s) and a detailed scope of work. Attach additional sheet(s) if necessary. Attach a map (U.S.G.S. Quad or comparable) showing the geographic location of the proposed project(s).</p> |

#### **4. DESCRIPTION OF NEED**

Describe what would occur without the benefit of the proposed project(s), including: the nature of the actual hardship, both short-term and long-term impacts, the expected loss of normal water supply by percentage, and the estimated potential financial losses. Explain why these circumstances constitute a water supply emergency resulting from natural-caused drought conditions, rather than a pre-existing condition during a normal water year.

#### **5. EXPECTED OUTCOME(S)**

Describe how the projects would reduce or avoid harm or hardships and any measures planned to assure the capability and reliability of the proposed project(s) to provide an emergency water supply to the applicant.

#### **6. WATER SHORTAGE RESPONSE ACTIONS ALREADY TAKEN**

Describe the measures taken by the applicant to plan for or mitigate the effects of drought (e.g., conservation, irrigation efficiency measures, leakage, elimination of non-essential uses).

## **7. WATER RIGHTS**

- (a) Describe whether you have or will be submitting an application for an emergency drought authorization and or have other pending water right applications
  
  
  
  
  
  
  
  
  
  
- (b) List the applicant's legal water rights to divert or withdraw water for use on land within the applicant's legal boundaries, and attach copies.

## **8. INTERGOVERNMENTAL COORDINATION**

Provide a summary of how the applicant has and/or will consult with affected agencies and/or Indian Tribes prior to and during implementation of the proposed project(s). Include a list of the affected agencies and Indian Tribes and a summary of impacts/approvals if known. (Attach an additional sheet if necessary.)

## **9. PROJECT(S) SCHEDULE/DURATION**

- (a) When do you expect to have all the required permitting, approvals, and funding?
  
  
  
  
  
  
  
  
  
  
- (b) Approximately how long will the proposed project(s) take to complete?
  
  
  
  
  
  
  
  
  
  
- (c) Expected project(s) schedule, including start date, completion date, and significant intermediary steps:



## 10. PROJECT COMPONENTS

Check appropriate box or boxes and complete estimated cost for proposed activities under this grant.

- (a) ☐ Engineering design and report \$ \_\_\_\_\_
- (b) ☐ Project(s) plans and specifications \$ \_\_\_\_\_
- (c) ☐ Purchase of land, rights-of-way, easements \$ \_\_\_\_\_
- (d) ☐ Construction \$ \_\_\_\_\_
- (e) ☐ Construction engineering \$ \_\_\_\_\_
- (f) ☐ Education and outreach \$ \_\_\_\_\_
- (g) Other \$ \_\_\_\_\_

## 11. FUND SOURCES

- (a) Total estimated project(s) cost
- (b) Total estimated eligible project(s) cost
- (c) Ecology grant share
- (d) Match fund source(s): (specify)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

☐ Applicant may be exempt under WAC 173-167-040(3) from the fund match requirement

### Estimated total project cost

100 % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_

### Estimated eligible project cost

100 % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_  
\_\_\_\_ % \$ \_\_\_\_\_

## 12. CERTIFICATION

I certify to the best of my knowledge that the information in this application is true, complete, and correct and that I am legally authorized to sign and submit this information on behalf of the applicant.

\_\_\_\_\_  
PRINTED NAME

\_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
TITLE

\_\_\_\_\_  
DATE

## 13. Send original, including attached sheets, maps, copies of water rights, and other supporting documents, to:

**Department of Ecology  
Water Resources Program  
PO Box 47600  
Olympia, WA 98504-7600  
ATTN: Rebecca Inman**

If you require this document in an alternate format, please contact the Water Resources Program at (360) 407-6600 or TTY (for the speech or hearing impaired) at 711 or 1-800-833-6388.

## Instructions

### General Instructions

Applicants are encouraged to submit applications for grant funding as *early as possible*, once a proposal is identified that would reduce or avoid hardships that would otherwise result from the current drought emergency. Take care to *provide accurate and complete answers* to each question in the application, to the best of your ability. Incomplete applications will be returned.

The answers supplied in this application will be used to determine:

- The eligibility of the applicant and the proposal for funding under the Drought Relief Grant Program.
- The priority and ranking of the proposal in regard to competing proposals.

Once a proposal is selected for potential funding, further information and clarification may be requested.

### Questions

1. Applicants must be public bodies, as defined in WAC 173-167-030. Provide the name and mailing address of the public body that is applying for funding. Identify the type of organization (if, not evident from the name), the date of formation, and the authority it was organized under.

Examples:

|                                |           |
|--------------------------------|-----------|
| City or Town                   | RCW 35.02 |
| Irrigation District            | RCW 87.03 |
| Public Utility District        | RCW 54.08 |
| Utility Local Improvement Dist | RCW 88.32 |
| Water – Sewer District         | RCW 57.04 |

2. Provide the name and contact information for the applicant's representative for questions or actions related to the grant application.
3. Describe the proposal as completely as possible, including the specifics from questions 9 (timeline) and 10 (project components). Attach an area map that shows the project site location. If available, also provide the layout of the proposal.
4. Describe how the drought has or is expected to harm or cause hardship for the applicant and its constituents:
  - What portion (percentage) of the normal water supply is not available?
  - What is the potential impact that will be reduced or avoided by the proposal?
  - Are the potential losses short-term (loss of an annual crop, bottled water deliveries necessary), or long-term (loss of mature fruit trees, permanent damage to diversion or delivery systems, loss of breeding stock)?
  - If possible, provide an estimate of the potential financial loss to the applicant and their constituents should the impacts of the drought go unabated.
  - Explain why these circumstances are drought related, rather than an ongoing problem during normal water years.

5. Describe how the proposal would reduce or avoid the harm or hardships described in 4 (above). Include information on factors that ensure the capability and reliability of the proposal to alleviate the impacts of the drought. (Examples include: Adaptive management plan, contingencies, consultation with experts in the field, staff expertise, maintenance plan, etc.)
6. Describe any other measures taken by the applicant to reduce or eliminate drought impacts *beyond* the scope of the current proposal, such as drought planning, tiered utility rates, programs that promote or enforce conservation, piping ditches, repairing or replacing leaking piping, irrigation efficiency measures.
7. Emergency drought authorizations grant temporary access to alternative water supplies when drought has reduced supplies available under existing legal water rights. Ecology processes these requests within a short time-frame, but may only grant authorization if other existing rights will not be impaired. When approved, the emergency water right expires at the conclusion of the declared emergency and a new application must be filed to renew the use even in subsequent drought emergencies.
8. Affected agencies include those with permitting, funding, or other jurisdictional approval. Affected tribes may not be restricted to those having a local reservation. The [Federally Recognized Tribes of Washington State map](#) can help you determine which tribes to contact.
9. Emergency drought relief projects funded under this grant program must be given expedited permit processing (two weeks). Priority is given to those projects that provide the most benefit during the current declared drought. The proposal must be completed before January 1, 2016 when the current drought emergency declaration expires.
10. Enter the estimated costs associated with each activity that is necessary to complete your proposal. Do not include the costs of activities that are already complete.
11. Use the responses in #10 above to determine the total estimated project cost. Refer to the “[Yellow Book](#)” for guidance on “eligible project costs.” WAC 173-167-040 (3) exempts drinking water suppliers that serve a population under 25,000, where the mean household income is less than 80 percent of the state average. Contact Rebecca Inman at (360) 407-6450 if you have questions on how to verify eligibility for the exemption.
12. An authorized representative of the applicant must sign the application indicating that the information provided is true, complete, and correct.
13. Send the original signed application and supporting documents to:

Dept of Ecology  
Water Resources Program  
PO BOX 47600  
Olympia WA 98504  
Attn: Rebecca Inman

If you have questions or any problems completing this application, please contact Rebecca Inman at (306) 407-6450 or [Rebecca.Inman@ecy.wa.gov](mailto:Rebecca.Inman@ecy.wa.gov).