Integrating Climate Resilience into

Washington State Water System Planning

CLIMATE IMPACTS GROUP

EARTHLAB
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Acknowledgments

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Table of Contents

Cover Photo Spada Lake Reservoir, City of Monroe WA

Glossary of Acronyms

CWSP Coordinated Water System Plans
DOH Department of Health
DOH ODW Department of Health Office of Drinking Water
EPA Environmental Protection Agency
ERP Emergency Response Plan
GWI Groundwater under the Influence of Surface Water
MWS Municipal Water Supplier
NTNC Non-transient Non-community
SWPP Source Water Protection Program
SWS Small Water Systems
SWSMP Small Water System Management Program
TNC Transient Non-community
UW CIG University of Washington Climate Impacts Group
WSP Water System Plan
WSRP Water Shortage Response Plan
WUE Water Use Efficiency Program

List of Figures

Introduction

Recent droughts, heatwaves, and climate-related hazards (e.g. wildfire and flooding), made worse by climate change (Abatzoglou and Park 2016, Phillip at al. 2021) are compromising the ability of water systems to meet current demands and threaten the reliability and safety of our region's drinking water supplies. As the climate continues to warm, intensifying climate impacts and hazards will present additional technical, operational and financial challenges for water systems in the future. Washington state is projected to warm in all seasons (Snover et al. 2013), which is expected to increase water demand for multiple uses. Climate change is also expected to modify the water cycle, causing more precipitation in winter, but less snowpack and less precipitation in summer (Snover et al. 2013). More frequent and longer seasonal water shortages could affect sources of drinking water for systems throughout the state if sufficient planning and action is not implemented. Warmer air temperatures are also expected to increase water temperatures, which can adversely affect water quality. Changes in the climate are superimposed on changes in development patterns and population growth that also affect the supply and demand of drinking water and require long-term planning.

A Systematic Review of Water System Plans

Through a systematic review of existing water system plans and case study analysis, we explored if and how Washington state's water system planning process could be a mechanism for climate resilience planning among small drinking water systems. Under Washington state rule WAC 246-290-100, Group A Community Systems with 1,000 or more service connections[1] are required to periodically develop and gain approval for a Water System Plan (WSP) from the Department of Health's Office of Drinking Water to demonstrate 1) system capacity to provide safe and reliable drinking water and 2) how the system will address present and future needs in a manner consistent with other relevant plans and local, state, and federal laws. To achieve this, WSPs are required to develop demand forecasts and a source supply analysis for at least a twenty-year planning period. Although an assessment of future climate impacts is not directly required, the requirement to develop future demand forecasts and a source supply analysis is an opportunity to consider the long-term effects of changes in the climate on demand and the quantity and quality of water sources. WSPs are also used by the State to determine drinking water system eligibility for low-interest financing of climate resilience projects and the Drinking Water State Revolving Funds, which can provide systems with funding for emergency response to climate-related hazards.

1 Other types of Group A systems may also be required to develop a Water System Plan, under the following conditions:
1) Is a new Group A water system proposes to do any of the following:
    a) Make infrastructure changes to increase the approved number of connections
    b) Expand the service area identified in a previously approved planning document or engineering project
    c) Expand the geographical area where direct service is already provided if a planning or engineering document has not been previously approved.
4) Seeks to be eligible for the "document submittal exception" process
5) Is directed to submit a WSP because of demonstrated operational, managerial, or financial problems
6) Is municipally-owned or located in a critical water supply area.
7) Seeks to be eligible for Drinking Water State Revolving Fund resources and does not have a current WSP that addresses the proposed project.

Given the expected changes in the climate and the State requirements that regulate water system operations, there is both an emerging need and an opportunity to integrate climate resilience into water system planning, further underscored by growing political momentum to include climate resilience elements into state-mandated planning processes (e.g. Proposed HB 1099[1] and SB 5626[2]). In Washington State, large municipal water systems such as those serving Seattle, Tacoma, and Everett have made significant progress in the last two decades on planning and preparing for climate resilience (Water Supply Forum, 2016), yet smaller water systems still lag behind these efforts likely for multiple reasons including many related to resources and capacity. Integrating climate change considerations into water system planning is one possible approach to ensure that water systems are prepared for climate impacts and the approaches taken by large municipal systems may offer insights for smaller systems.

This review of Water System Plans in Washington state asked four questions:

- To what extent are drinking water systems in Washington state already considering climate change impacts in their existing Water System Plans?
- How do climate change considerations in Water System Plans vary by water system size, supply source, and location?
- Which required elements of Water System Plans could be further leveraged for climate resilience planning?
- What lessons can be learned from Water System Plans that already include climate change considerations?

The water system planning process is not the only pathway for integrating climate resilience into water system management and operations. Adaptation to climate impacts is already occurring among water systems, outside of the WSP process. However, as the requirement for water system planning already exists, WSPs present an opportunity to integrate adaptation into an established planning process without developing new policies or requirements. Thus, the goal of this analysis is to identify the extent to which water system planning can be a mechanism for water system operators to plan for climate resilience, including smaller water systems.

[1] HB 1099 proposes improving the state's climate response through updates to the state's comprehensive planning framework.
[2] SB 5626 proposes adding a climate resilience element to water system plans

System Classification & Scope

The classification of water systems was used to define the scope of our work because each classification is subject to both differing levels of regulation and access to resources received from federal, state, and local government agencies. Thus, these classifications tell us which systems are required to develop WSPs. In Washington state, the three main types of drinking water system classifications are:

Private Wells

Private wells, or individual wells, usually serve a single home. Prior to new construction, individual well owners must provide proof of adequate water supply. However, once homes are built, individual well owners do not need to show continuing proof of adequate water.

Group B Systems

Group B Systems are public[1] water systems that serve more than one home. They serve fewer than 15 connections and either fewer than 25 people per day for 60 or more days, or any number of people for fewer than 60 days per year. Group B systems provide water to two percent of the state's population. As of July 2022, there are 13,517 Group B systems in Washington. Given the large number of Group B systems and the relatively small population these systems serve, these systems have been difficult to regulate. The Department of Health's Office of Drinking Water (DOH ODW) typically works with local health jurisdictions to provide oversight and support to these systems.

Group A Systems

Group A Systems are public water systems that serve either 15 or more connections, or 25 or more people per day for 60 or more days per year. Group A systems have comprehensive monitoring requirements under the United States Environmental Protection Agency's (EPA) Safe Drinking Water Act.

Environmental Protection Agency
System Classifications

The EPA also has several classifications for public water systems that are applicable to Group A systems, as follows:

Community

A public system that supplies water to the same population year-round.

Non-Transient Non-Community (NTNC)

A public water system that regularly supplies water to at least 25 of the same people at least six months per year (e.g.. schools, factories, office buildings, and hospitals that have their own water systems).

Transient Non-Community (TNC)

A public system that provides drinking water to a population that changes day to day (e.g. campgrounds, hotels, rest areas, and restaurants with their own water supplies).

Although other types of Group A systems may be required to develop a WSP, **this review is limited to active Group A Community Systems with 1,000 or more service connections** because this is the system classification that has a multidecadal history of WSP development and approval by ODW. All Group A community systems with fewer than 1,000 service connections, and non-community systems that are not required to develop a WSP must develop a Small Water System Management Program (SWSMP), but submission of the SWSMP to DOH for approval is not required except in specific circumstances[2]

[1] According to the EPA, a public water system provides water for human consumption to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year. A public water system may be publicly or privately owned.

[2] A water system is required to submit a SWSMP for DOH review and approval when a) A new NTNC public water system is created;b) An existing system has operational, technical, managerial, or financial problems, as determined by the department; or c) An existing system without approved construction documents is seeking as-built system approval under WAC 246-290-140; or d) A system applies for funding under chapter 246-296 WAC.

Research Methods

This study used a representative sampling approach to reflect the geographic and size characteristics of the 243 drinking water systems under this classification. As of 2018, there were 2,200 active Group A Community Systems[1], but only 243 of these systems have at least 1,000 service connections. We reviewed 36 WSPs, representing 15% of the all active Group A Community Systems with over 1,000 total service connections, excluding federal, state and county-owned systems **(See Fig 1)**.

Region

Given Washington state's diverse climate and physiography, geographic location can serve as an indicator of the type of climate impacts a water system may need to manage as well as provide insight on regional trends in resilience planning. Geographic classifications for this analysis followed DOH ODW's regional planning areas for Washington: Eastern, Northwest, and Southwest **(See Fig 2)**.

Size

Size categories were determined through a cumulative distribution function, based on maximum total population served. Rather than using the number of service connections, we used population size as an indicator for capacity because this directly indicates how many people are served by a water system. As a general rule, one service connection typically serves 2.5 people, although this is not always the case. Size categories[2] are:

Small	Medium	Large
Serves a max. total population of 5,000. about 1,000-2,000 service connections	**Serves a max. total population of 5,001-25,000.** about 2,000 - 10,000 service connections	**Serves a max. total population of 25,001 or more** more than 10,000 service connections

For this study, public water systems that serve fewer than 1,000 service connections were defined as very small water systems. Limited data are available on planning by very small water systems because they are not required to develop WSPs. Therefore, such systems were not included in this study.

Number of Sources and Source Type

Source water is a critical component of climate preparedness for drinking water systems. Where systems receive their source water and how much water they have access to indicate potential issues of climate-related water availability and quality. For example, water systems that rely heavily on surface water – such as streams, rivers, lakes and reservoirs – may experience hardship as summer streamflow decreases as a result of higher spring temperatures and the earlier melting of snowpack (Snover et al. 2013). On the other hand, water systems that rely on groundwater may be more resilient to short-term drought impacts, relative to well depth and aquifer recharge, but they may also be more sensitive to trends in increasing demand (DOE, 2016; Water Supply Forum, 2016). A water system may have multiple sources and source types, which can be an indicator of resilience. A water system's source supply also has implications for water system planning. Source of supply was not used to define the sample, but the relationship between source water and climate change considerations were analyzed in the review.

[1] As of July 16, 2022, it's 2,216 active Group A Community systems and 245 with 1,000 or more connections.
[2] EPA uses different size categories; these categories were developed to better model Washington's water system size variation.

Figure 1. Representative Sampling by Water System Size and Region

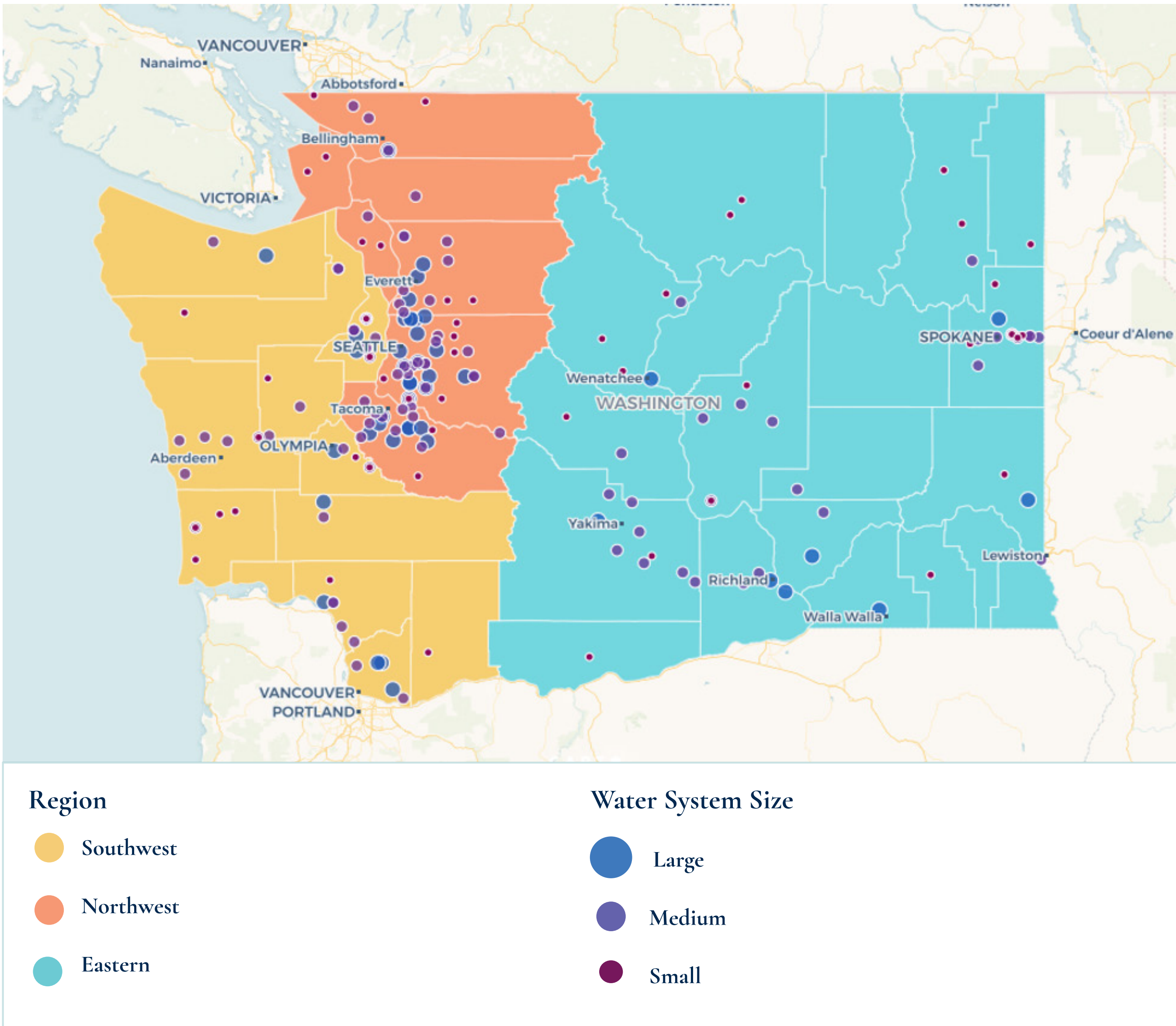
Category	Total (N)	Sample (15%)
Group A Community Systems over 1000 service connections excluding Federal, State, or County owned systems	243	36
Size Range by Maximum Total Population (MTP)		
Small (1,000 - 5,000 MTP)	65	10
Eastern	26	4
Northwest	22	3
Southwest	17	3
Medium (5,001 - 25,000 MTP)	108	16
Eastern	33	5
Northwest	46	7
Southwest	29	4
Large (25,000 and over MTP)	60	10
Eastern	11	2
Northwest	37	6
Southwest	12	2

Water System Plan Availability

WSPs reviewed for this study were selected from an online database of Group A water systems. However, this database was published in 2018[1], so it may not capture all systems currently under this classification. This study is also limited to existing WSPs that have been made publicly available online, either through the water system's website or when requested via email. Given limitations on data availability and collection, findings from the review are intended as a snapshot of climate planning in WSPs, not a comprehensive assessment. However, these findings provide insight on gaps, needs, and challenges around climate resilience planning through WSPs, and they direct future research specifically tailored towards small water systems.

[1]Washington State Department of Health. 2018. Group A General Data. https://doh.wa.gov/data-statistical-reports/environmental-health/drinking-water-system-data/data-download

Figure 2. Regional distribution of Group A Community Systems with over 1,000 service connections by size. The majority of Group A Community Systems with over 1,000 service connections are concentrated in densely populated urban areas and are sparse in rural areas of DOH ODW's planning regions.



Virtual Workshop

An Introudction to Resilience Planning

for Small Water Systems in Washington State

In parallel to our review of WSPs, we also hosted a virtual training to introduce very small to medium water systems to climate resilience planning. On March 1, 2022, in partnership with ODW, we held a three-hour online workshop for system operators which featured speakers from the UW Climate Impacts Group (UW CIG), University of Washington Civil and Environmental Engineering Department, Office of the Washington State Climatologist, and the Department of Health. The workshop was attended by 149 people: 60 from very small water systems (fewer than 1,000 service connections), 39 from small and medium-sized systems (1,001-25,000 service connections) and 9 from large systems (over 25,000 service connections).

Workshop sessions covered climate impacts related to drought, surface water supply, groundwater availability, water quality, and natural hazards and how these climate impacts might affect water system resilience. We held interactive sessions in which participants shared their experiences and challenges with climate-related impacts and provided technical guidance to support the initial steps of climate resilience planning. Although the workshop was not intentionally designed to be a means for data collection, it provided us with the opportunity to directly engage with small water system operators and learn about their perspectives on, and experiences with, climate impacts. The first-hand accounts of climate change and resilience shared by operators of small water systems during the workshop provided important contextual knowledge that informed our analysis of WSPs.

Findings

In this section, findings from the review are presented by climate impact. Here, we begin with a general assessment of climate change in WSPs through the use of a maturity model. The maturity model measures the extent to which climate change is considered in WSPs, ranging from no consideration to the implementation of climate resilience actions. However, through this assessment, we found that many systems are considering and planning for climate impacts such as drought, wildfire and flooding, without acknowledging or attributing these impacts directly to climate change. Reasons for the omission of the term "climate change" in these WSPs may include local socio-political dynamics, uncertainties in incorporating climate change into the planning context, or general lack of awareness. For this reason, we implemented a simpler approach to understanding the extent to which three climate impacts—drought, flooding, and wildfire— are considered in WSPs.

Although many water systems already experience effects of climate change today, resilience planning requires the anticipation of future changes in the frequency and severity of potential climate-related natural hazards. Therefore, the analyses of drought, flooding and wildfire are based on any consideration of future changes in the occurrence of these impacts, regardless of whether they are attributed to climate change. In the following sections, we detail how these three climate impacts might affect drinking water systems, required elements of the WSPs that enable or regulate the management of these impacts, and general findings from the systematic review.

Climate Change

For this analysis, climate change was defined as the future change in the long-term average of temperature, precipitation, and other weather variables at a given location, including changes due to human-induced increases in greenhouse gas concentrations. Some WSPs include annual averages of temperature and precipitation based on historical climate data, but this study specifically assessed acknowledgments and planning considerations of forward-looking changes in the climate.

Figure 3. Maturity Model for Climate Change Considerations in WSPs

Stage	Description	N=36
No Consideration	Climate change is not explicitly acknowledged in the WSP.	26
Understand	The WSP acknowledges climate change and how future climate trends may broadly impact water use, availability and quality in the region, service area or utility.	2
Assess	The WSP uses projected climate data to assess the system's vulnerability to future climate risks.	1
Plan	The WSP conducts a vulnerability assessment and identifies potential adaptation actions to address future climate impacts to utility infrastructure and operations.	2
Implement	The WSP indicates that previously identified climate adaptation actions have been implemented.	5

Overall, most of the WSPs we reviewed (about 72%) did not directly mention climate change. Among WSPs that did acknowledge climate change, there was more resilience planning in plans developed by large, municipal-owned water systems (see Fig 3). Trends related to size and ownership were attributed to more access to funding and capacity available to systems with a larger consumer base or that are municipally owned. Higher degrees of climate planning were also seen in water systems in the Northwest (see Fig 4), which can be attributed to the concentration of large systems in this region and the greater capacity of its systems to access relevant climate data; approximately 60% of large Group A Community systems are located in Northwest. Large systems in the Plan and Implement phase often used climate change projections to model future supply and demand that exceeded the required 20-year planning horizon; these scenarios were used as the basis for the development of resilience actions. Large and medium-sized systems in the Understand and Assess phases indicated an understanding of regional climate trends, but they did not incorporate this information into planning and action, citing reasons such as 1) the lack of local-scale climate data, 2) uncertainties such as the interaction between climate-related changes, population growth and development, and water use efficiency measures, and 3) the system is expected to be resilient to future climate change impacts (See Case Studies:City of Vancouver for Understand; Port Townsend for Assess).

Most medium-sized systems (approximately 70%) did not directly mention climate change or include climate change considerations in their WSPs. However, they often included either historical climatological data for temperature and precipitation as basic planning data. WSPs from medium systems often included language describing climate trends and impacts, without explicitly using the term "climate change." These observations may suggest that medium-sized systems tend to plan for the climate of the past, or do not acknowledge climate change even though they are already experiencing and managing climate-related risks.

None of the small systems explicitly mentioned climate change in their WSPs, nor did they include a description of climate trends. However, through a review of existing studies outside of WSPs, state-administered surveys and direct engagement with small water system operators during our 2022 Introduction to Resilience Planning workshop, we found that small water systems are experiencing the direct and indirect impacts of climate change and may be responding to these impacts, regardless of their capacity to include these considerations in their WSPs.

Figure 4. Climate Change Considerations in WSPs by Size Classification

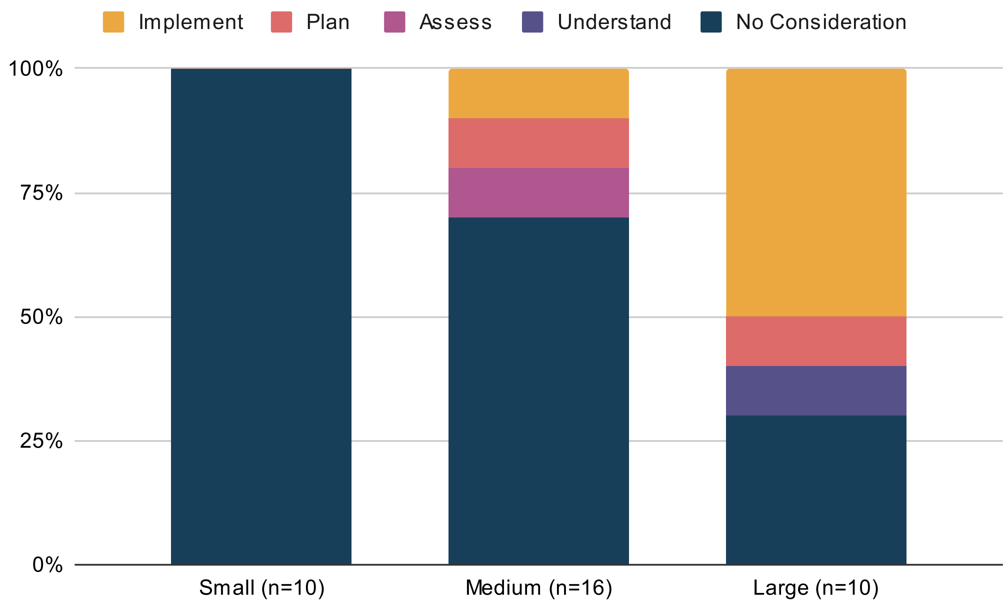
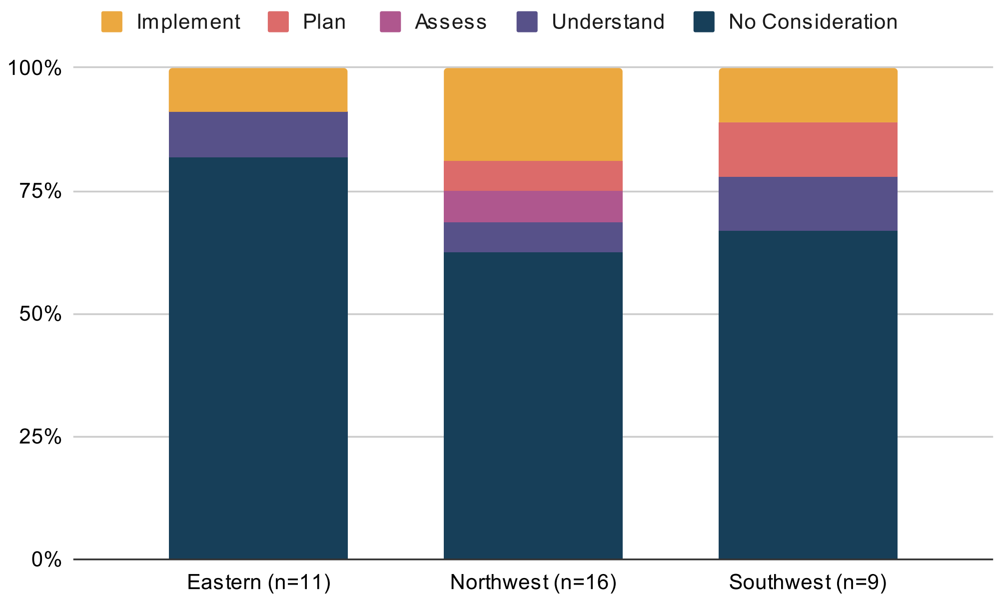


Figure 5. Climate Change Considerations in WSPs by Region



Drought

Driven by the rise of global temperatures, Washington is projected to experience hotter and drier summers, less summer precipitation, reduced snowpack, and earlier and lower spring and summer streamflow (Snover et al. 2013). Any of these changes in the climate and water cycle climate-driven can contribute to more frequent and prolonged periods of drought, impacting water supply, demand, and quality. Declines in surface water flows can immediately affect water supply. Groundwater sources are typically resilient to short-term droughts. However, limited availability of surface water can create over-reliance on groundwater, resulting in excessive pumping, aquifer depletion, and saltwater intrusion. Groundwater sources may also be vulnerable to extended, multi-year droughts. Although droughts in the Pacific Northwest have historically been seasonal or interannual in nature, there is uncertainty about the future likelihood of multi-year droughts (DOE, 2018). Reduced water availability can also have critical implications for water quality and treatment, such as increased geological contaminants and turbidity.

In the context of WSPs, several elements are required so that drinking water systems can plan for limited water availability. Mainly, all water systems are required to develop a Water Shortage Response Plan (WSRP), as a component of the reliability and emergency response requirements under WAC 246-290-420. The WSRP outlines how, in the event of a shortage, water system operators will manage the response from advisory to emergency reductions in water use. However, WSRPs are typically not reserved for drought conditions, and they may be used to respond to shortages due to system failures, loss of power, or compromised water quality. Moreover, water systems are not required to inform DOH if a WSRP action has been activated, creating challenges in the monitoring of drought impacts. There are several other required elements of WSPs where drought considerations and response strategies may be included:

Demand Forecasting and Source Analysis. All WSPs must include a description of how their current source supply will meet current and projected demand. Although it is not required, some water systems may use historical drought data in the development of their supply and demand scenarios.

Water Use Efficiency Program (WUE). Under the Municipal Water Law (RCW 90.03.015(3)), WUE requirements apply to all water systems that are defined as municipal water suppliers (MWS)[1]. Most Group A Community systems, those with both over and under 1,000 service connections, are considered MWS. This element of the rule requires the collection of water production and consumption data, evaluation of system leakage, evaluation of water rate structures, forecast of future water demands, and the implementation of WUE measures. However, these evaluations are not required to explicitly consider how changes in the future climate could affect water demand or system functions.

Emergency Response Plan (ERP). In accordance with America's Water Infrastructure Act of 2018, the EPA requires community water systems serving populations greater than 3,300 to develop both a risk assessment[2] and Emergency Response Plan. The ERP is not limited to natural hazards and often includes an assessment of contamination, power outages, main breaks, or security threats. Because of security concerns, it is common that these risk assessments either are not made publicly available or are published with redacted information.

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[1] RCW 90.03.015 defines a MWS to include all water systems that serve 15 or more residential connections, which includes most Group A community water systems. However, not every Group A system is an MWS. Some non-community water systems may be an MWS. Non-community water systems providing water used in a residential manner (such as drinking, cooking, cleaning, and sanitation) may be considered an MWS.

[2] The risk assessment (previously called a vulnerability assessment) is a separate document that informs an emergency response program.

Public drinking water systems have several requirements that encourage planning and preparedness for current drought conditions. However, because they do not explicitly consider future changes in drought, they could leave water systems insufficiently prepared. The Department of Health has developed a preliminary drought vulnerability assessment to use as a filter to identify water systems most vulnerable to drought-caused water supply interruption. 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.

Group A systems with a single source, and depth of 1-50 ft are considered most susceptible to drought, followed by Group A systems with a combined source capacity of fewer than 10 gallons per minute (DOE, 2018).

50%

of WSPs reviewed contained direct mention or consideration of drought.

Overall, drought was considered in WSPs evenly across water system size and region. Half (n=18) of the 36 plans reviewed contained direct mention or consideration of drought, but only nine of these plans identified future changes to the severity and frequency of drought, and only eight linked drought to climate change.

Most large systems (90%) explicitly acknowledge and are comprehensively planning for drought in their WSPs, primarily through their WSRP or ERP. Given the near-term planning context of WSRPs and ERPs, there is an implication that drought is addressed only through a recovery approach. However, of the large systems considering drought, more than half (6 out of 10) acknowledged future changes in the frequency and severity of drought conditions. In some large-system plans, drought information was used to develop future supply and demand scenarios. For example, the City of Everett conducted a hypothetical analysis of how the worst drought on record would affect their ability to meet forecasted demand for the 20-year planning horizon under either of two extreme conditions: 1) if drought occurred two years in a row, or 2) if its severity increased to where the City was unable to meet projected demand, even with mitigation measures deployed. This analysis concluded that, with instream flow reductions and voluntary curtailment measures, Everett's water system would be resilient to extreme drought events. Although drought assessment and planning is prevalent among large systems, drought resilience was a common theme in WSPs for large systems because they often have a robust, diverse water supply, adequate funding to access emergency sources, and the operational capacity to deploy cost-effective conservation measures.

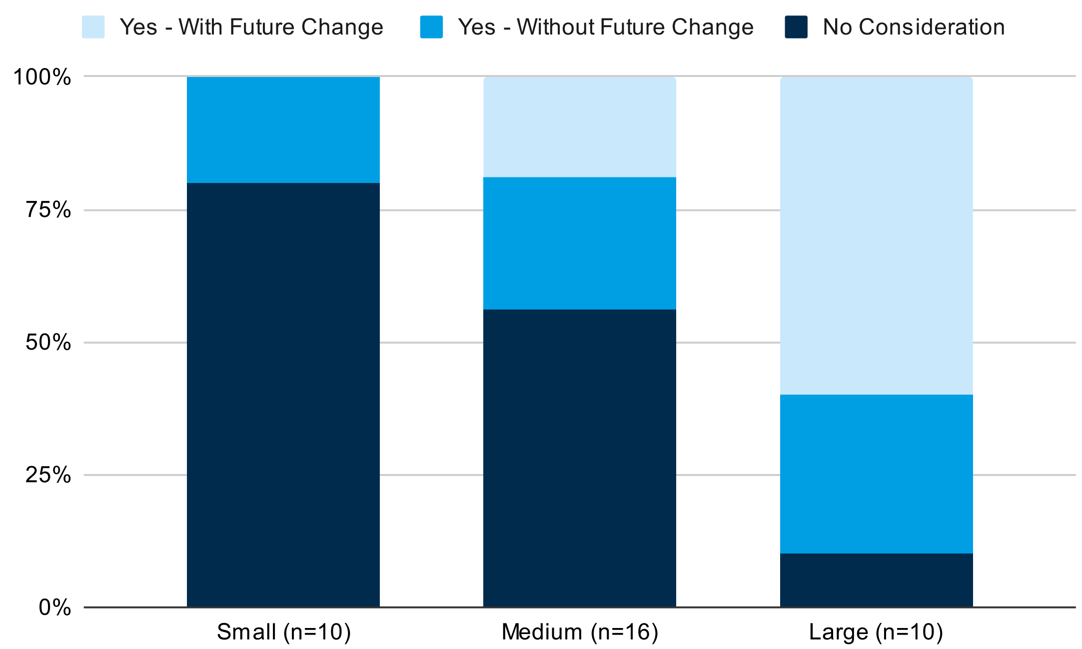
Figure 6. Assessment Model for Drought Considerations in WSPs

Stage	Description	N=36
No Consideration	No cosnideration of drought,	**18**
Consideration Without Future Change	Considers historical or current drought condtions.	**9**
Consideration With Future Change	Acknowledges future changes in drought conditions.	**9**
Action	Includes actions to address current and/or future drought conditions and its impacts to water supply, demand, and quality.	**18**

Conversely, the majority of small- and medium-sized systems did not directly acknowledge drought in their WSPs. Although more than half of medium-sized systems did not include drought considerations, nearly all developed a WSRP. Fewer than 25% of all medium-sized systems acknowledged a future change in drought conditions, implying that most of these systems may not perceive drought to be a climate-driven occurrence. Moreover, the majorityof medium-sized systems that did include drought considerations had only a single source type (groundwater or surface water), and they reported a consistent annual decline in groundwater levels. Of the medium-sized systems that did develop a WSRP, the majority did not cite drought as a critical hazard, indicating that they may be experiencing water shortages due to reasons other than drought. The exclusion of drought as a driver of water shortage could indicate that groundwater depletion may be less drought-related, and a result of water management practices-such as excessive groundwater withdrawals (DOE, 2015).

Over 75% of small systems did not consider drought in their WSPs; among those that did, drought was only briefly mentioned or discussed in the context of historical conditions. The majority of small systems did not have a WSRP; among those that did, only one acknowledged drought as a potential cause of shortage.

Figure 7. Drought Considerations in WSPs by Size Classification



Overall, drought planning and response was more prevalent among water systems in the Eastern and Northwest regions of the state. Across water systems in Eastern Washington, more than half (6 out of 10) included elements that addressed drought. However, the majority of these plans (5 out of 6) did not consider future changes in drought conditions and mainly addressed drought through their ERP. Given Eastern Washington's arid climate, drought is more common there. Lack of a forward-thinking approach to drought in this region can indicate that many Eastern water systems are historically accustomed to responding to drought events and thus assume that they are resilient, regardless of future changes. More than half of Northwest water systems included drought considerations; this likely reflects both drought awareness despite the relatively wetter climate, and that the larger systems in this region have a greater capacity to conduct planning. Nearly 75% (6 out of 9) of water systems in the Southwest region did not include considerations for drought, which is expected given the moist, cool climate of this region. Of the three Southwest water systems that did have drought considerations, all had a single source type and were planning for future changes in drought conditions.

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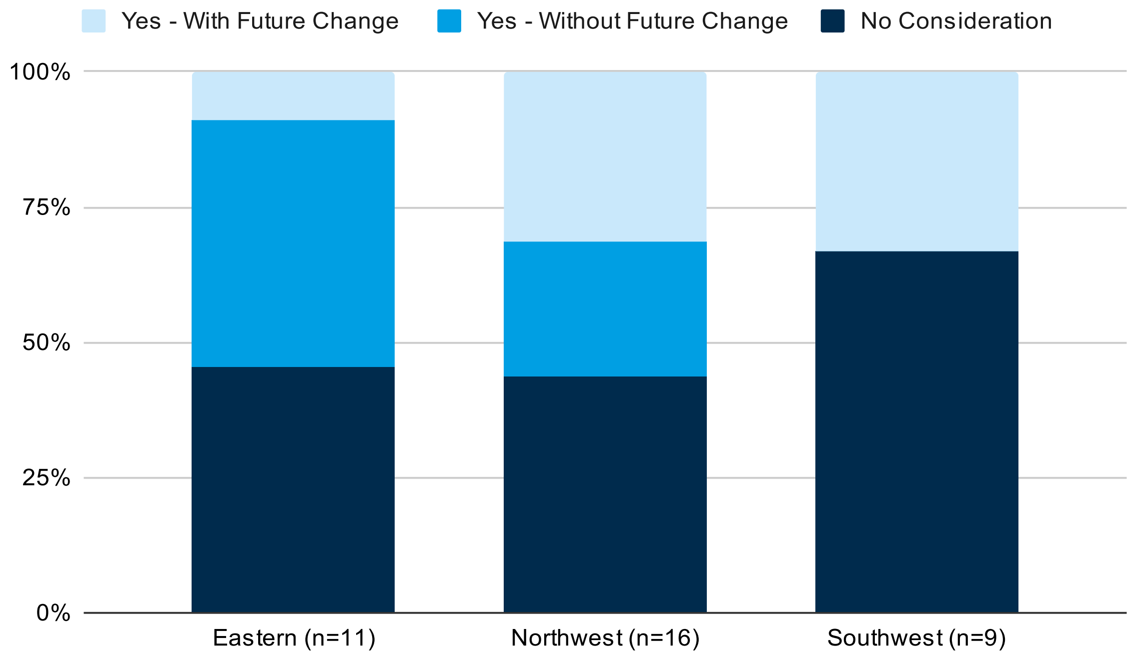
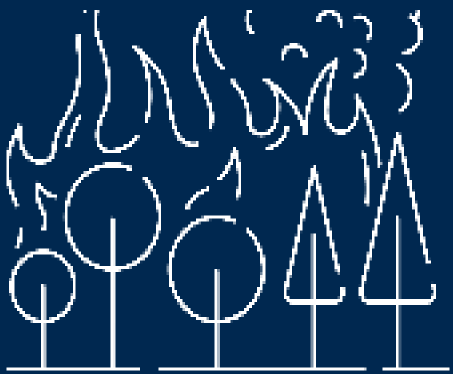
Figure 8. Drought Considerations in WSPs by Region



Wildfire



Climate changes, including higher temperatures and drier summers, are contributing to longer fire seasons and increasing the area burned by wildfires across the West (Abatzoglou and Parks 2016). Drinking water systems can experience contamination of source water after a fire event, resulting from increased turbidity and the input of volatile organic compounds into rivers, lakes, and streams. Such effects may require additional water treatment protocols or significant changes in infrastructure or supply, increasing costs, especially for small water systems. Wildfires can also result in flash floods and landslides, further increasing turbidity and other concerns for water quality. Wildfires can damage electricity distribution infrastructure, leading to power outages that disrupt the function of water systems equipment.

No direct regulations require water systems to develop a wildfire management plan. However, all Group A systems are required to develop a Source Water Protection Program (SWPP) under WAC 246-290-135, both in WSPs and SWSMP. Requirements for the SWPP include to assess and plan for any potential sources of contamination of source water, such as wildfire, and source water decline. The type of SWPP that a water system must develop depends on their source type, as follows:

- **Wellhead Protection Program.** Required for all Group A public water systems using a groundwater source (e.g. wells or springs), except for systems that purchase or receive their source water through interties[1].
- **Watershed Control Program.** Required for all Group A public water systems using surface water or groundwater under the influence of surface water sources (GWI).

Water systems that draw from both surface water and groundwater may be required to develop both types of SWPPs. Wildfire risk also may be addressed in WSRPs and ERPs.

Figure 9. Assessment Model for Wildfire Considerations in WSPs

Stage	Description	N=36
No Consideration	No cosnideration of wildfire.	29
Consideration Without Future Change	Considers historical or current wildfire condtions.	4
Consideration With Future Change	Acknowledges future changes in wildfire conditions.	3
Action	Includes actions to address current and/or future wildfire conditions and its impacts to water supply, demand, and quality.	7

1 Interties include interconnections between public water systems permitting exchange or delivery of water to serve as primary or secondary sources of supply, but do not include development of new sources of supply to meet future demand.

80%

of WSPs reviewed did NOT include any consideration of wildfire.

Among the seven WSPs that did inlcude wildfire considerations, only three acknowledged future changes to the frequency and severity of wildfire and attributed these projected increases to climate change. Six of the seven WSPs that assessed and managed wildfire risk have surface water as their main source of supply, even if the system also drew from groundwater sources.

Although the consideration of wildfire risk is uncommon across all WSPs, large systems showed the most consideration of wildfire risk (See Fig 10); this size trend is consistent with previous findings in this report. More than half of WSPs that did include wildfire risk response (4 out of 7) were large systems in Northwest and Eastern Washington, i.e. the cities of Seattle, Tacoma, Everett, and Yakima, possibly because these larger systems tend to own parts of the source watershed and therefore have more control over land management for fire risk reduction. Despite the high likelihood of wildfire across Eastern Washington, small water systems did not consider wildfire response actions that are within their control. Wildfire response actions were cited in two of 16 medium-sized system plans and in only one of 10 small system plans, all of which were in Southwest Washington. It was common in the seven plans that did address wildfire risk to cite wildfire as potential source contamination in their Source Water Protection Program. Two small and medium-sized systems addressed wildfire risk in their ERPs, and only one cited wildfire risk as a threat to demand and supply.

A common theme across all seven of these plans was the collaboration among federal, state, and local agencies as a critical aspect of wildfire preparedness and mitigation because of their jurisdictional authority over watersheds. The majority of water systems do not directly plan for and respond to wildfire risk but instead work with the US Forest Service and Bureau of Land Management to manage federal lands and the Department of Natural Resources to manage state and private lands. Only the City of Seattle has its own Wildland Fire Crew. In Eastern Washington, where wildfire is common, various levels of government, community organizations, and natural resource managers support wildfire management. These include regional- and community-scale partnerships, such as Western Watershed Enhancement Partnership or the Yakima Valley Fire Adapted Communities Coalition.

Figure 10. Wildfire Considerations in WSPs by Size Classfication

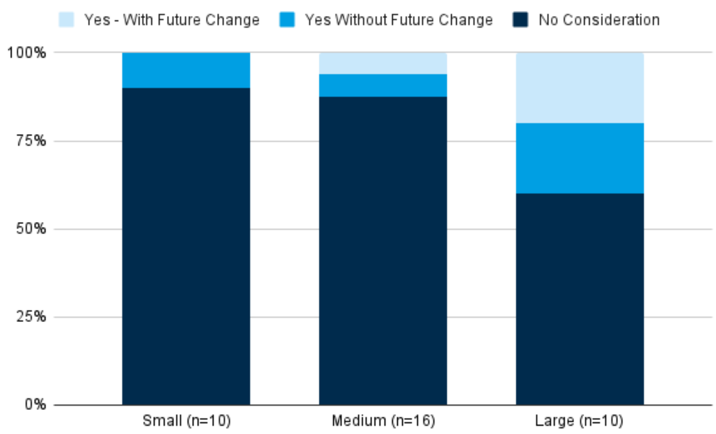
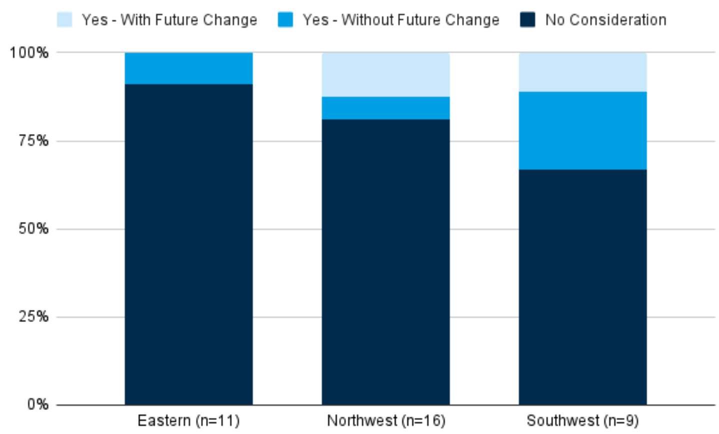


Figure 11. Wildfire Considerations in WSPs by Region



Flooding

With climate change, Washington is expected to shift from a snow-dominant to a rain-dominant system. Although precipitation will vary across the state, projected increases in heavy rainfall events will occur by midcentury. With increased temperatures, more precipitation will fall as rain instead of snow and Washington will experience earlier melting of snowpack, increasing the risk of winter and spring flooding (Frankson et al., 2022). Flooding can compromise the quality of a system's source supply, damage critical infrastructure and disrupt system operations. Heavy rainfall and flooding around wellheads can flush out surface contaminants into groundwater sources, while increasing turbidity in surface water sources. This level of contamination complicates treatment and distribution, and may require water systems to rely on emergency storage or alternative sources (DOH, 2019). In addition, water systems vulnerable to sea level rise and coastal flooding might need to raise or relocate infrastructure or add flood protection barriers.

Multiple aspects of the WSP can enable flood risk planning and management, although this is most commonly seen in the ERP. When a water system is in a floodplain, floodway, or flood hazard area, flood risk is acknowledged in the Basic Planning Data section of the WSP. Given the threat that flooding poses to system operations, this threat is often addressed in the Operations and Maintenance Program (WAC 246-290-415), such as:

- **Emergency Response Plan.** Required for all Group A public water systems using a groundwater source (e.g. wells or springs), except for systems that purchase or receive their source water through interties.

- **Water Quality Monitoring Program.** Required for all Group A public water systems using surface water or groundwater under the influence of surface water sources (GWI).

In some cases, flooding may also be cited in the SWPP and the WSRP, as a potential source of contamination and shortage, respectively. Because flooding can often compromise infrastructure, some capital-intensive flood resilience measures may be found in the Capital Improvement Program.

Figure 12. Assessment Model for Flooding Considerations in WSPs

Stage	Description	N=36
No Consideration	No cosnideration of flooding.	10
Consideration Without Future Change	Considers historical or current flood condtions.	24
Consideration With Future Change	Acknowledges future changes in flood conditions.	3
Action	Includes actions to address current and/or future flood conditions and its impacts to water supply, demand, and quality.	27

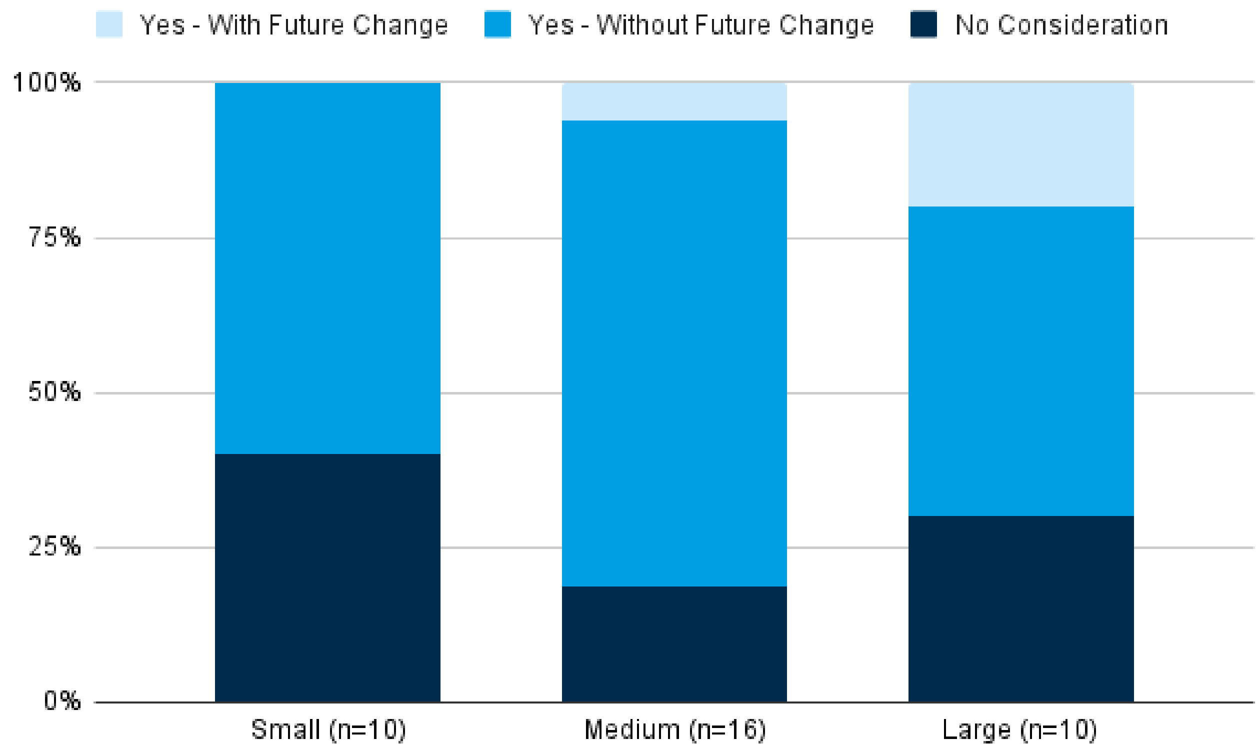
72%

of all WSPs reviewed included response or preparedness actions related to flooding.

Nearly three-quarters (about 72%) of all WSPs included response or preparedness actions related to flooding. This is not surprising, because flooding is considered a common impact across communities in Washington. Among the 26 WSPs that addressed flooding, only three acknowledged future changes in the frequency of severity of flooding. All WSPs that considered flood risk included flooding in their ERP.

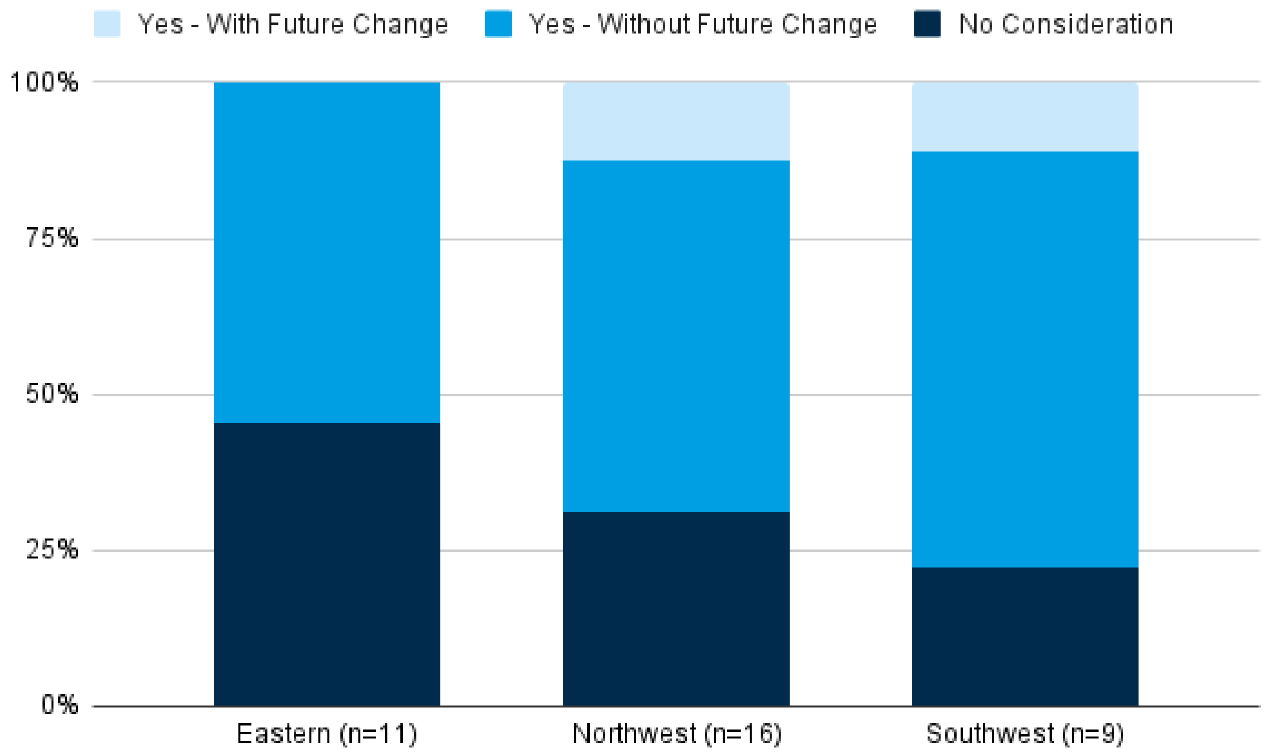
Actions to address flood risk are included by the majority of WSPs across all size classifications. Flood risk is assessed by 60% of small systems, only through their ERPs. The isolated consideration of flooding in ERPs, which is prevalent across small systems' WSPs, could imply that SWS perceive flooding primarily as a short-term disruption to regular operations and maintenance, rather than a regular or long-term impact to water supply, demand, and infrastructure. Most (80%) medium-sized systems assess flood risk, both in their ERP and in sections of the WSP that evaluate water quality, such as chapters on System Analysis and Asset Management, Source Water Protection, Water Quality Monitoring, and Water Treatment. About 70% of large systems have assessed and developed plans to address flood risk, focusing on building flood resilience across critical infrastructure. Large systems often monitored and proposed improvements to engineered flood management systems, such as dams and levees, surrounding their water system—probably because large systems have the financial and operational capacity to engage in resource-intensive capital projects that improve their flood preparedness.

Figure 13. Flood Considerations in WSPs by Size Classification



From a regional perspective, flooding is also considered by the majority of the systems across all three regions. About 78% of WSPs from the Southwest included an assessment of flood risk and flood response actions. About 55% of WSPs from Eastern Washington include an assessment of flooding, with none considering any future change. Eastern water systems commonly evaluate flooding as a low-probability event, with moderate damage. Although flooding may not occur as frequently in this region as in areas west of the Cascade Mountains, systems in Eastern Washington might not have the infrastructure to adequately respond to flood events when they do occur. Flooding is assessed in 69% of WSPs from the Northwest region. Only two of the 11 plans considering flood risk in the Northwest region consider future change, and both plans were from large systems. About 78% of WSPs from the Southwest region included an assessment of flood risk, but only one of these plans considered future changes in flooding. Most water systems in the Northwest and Southwest regions cited infrastructure located in flood-vulnerable areas, which is expected given the common occurrence of heavy rainfall events in western Washington.

Figure 14. Flood Considerations in WSPs by Region



Integrating Climate Resilience into Water System Planning

Conclusions & Recommendations

The purpose of this review is to identify if and how climate resilience planning can be incorporated into existing Washington state water system planning requirements to increase climate resilience among public drinking water systems. The review demonstrated the current state of climate resilience planning among Group A water systems with over 1,000 service connections within WSPs. Direct engagement with water system operators and discussions with DOH ODW staff provided insights into practical challenges and regulatory complexities that informed broader recommendations for advancing climate resilience of water systems.

This review of WSPs highlights that the existing planning process is one feasible mechanism to support climate resilience among drinking water systems that are required to develop the plans. Our review confirmed that typically only the largest systems comprehensively engage in climate resilience planning through WSPs. We also found that many of the large systems find, after conducting some form of risk assessment that they are affected by climate impacts and that they are already sufficiently resilient to future impacts, often because of high system capacity and redundancy. However, this is not the case for most small and medium systems. These systems are not using WSPs for climate resilience planning currently.

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Summary of Recommendations

For Intergating Climate Resilinece into Water System Planning in Washington State

Recommendation	Type of Water System Impacted
The required 20-year planning horizon for supply and demand analysis could support the integration of future climate trends and projections into WSPs.	All Group A Community Systems that serve 1,000 or more connections and any other Group A community systems that are required to develop WSPs.
The requirement of consistency with local government planning could enable climate resilience planning among municipal water suppliers.	All water systems that are defined as Municipal Water Suppliers.
Emergency Response Plans and Water Shortage Plans enable water systems to assess and anticipate the impacts of acute climate-related natural hazards on their operations, but these plans are not a substitute for a comprehensive climate resilience planning process because they are intentionally designed for short-term system recovery.	Emergency Response Plan • All community water systems serving a population of over 3,300 people Water Shortage Response Plan • All public water systems
Water Use Efficiency programs are ongoing and could enable water systems to plan and prepare for some chronic climate impacts, such as trends in warming and drought, because they are a mechanism to manage increases in year-over-year consumer usage.	All water systems that are defined as Municipal Water Suppliers.
Climate resilience planning for water systems could be advanced by including an element in WSPs that centralizes climate data and responses to facilitate the evaluation of internal consistency in WSPs.	All Group A Community Systems that serve 1,000 or more connections; and any other Group A community systems that are required to develop WSPs.
Requiring climate resilience in planning for very small systems, such as the Small Water System Management Program, has the potential to increase climate resilience for very small systems if requirements are supported with provisions that increase resources, training, and technical assistance for these systems to support implementation.	All non-expanding community water systems that are not required to complete a WSP.
Climate resilience planning could be enhanced for very small water systems by adapting the climate resilience planning tools and resources developed for WSPs for use in the Small Water System Management Program.	All non-expanding community water systems that are not required to complete a WSP.
Regional and collaborative approaches to climate impacts assessment and resilience planning could effectively scale up climate resilience efforts by meeting the needs of the many very small systems simultaneously.	All non-expanding community water systems that are not required to complete a WSP and Group B Systems

For the small to medium systems, who make up about 72% of all active Group A community systems with over 1,000 service connections, there are existing pathways within the current regulatory framework for Water System Planning that could be leveraged to advance climate resilience:

The required 20-year planning horizon for supply and demand analysis could support the integration of future climate trends and projections into WSPs. Demand projections, based on future population and service connections for the service area, are planned for a 20-year period minimum. Water systems must also assess their physical, operational and financial capacity to meet future demands and thus, are also required to evaluate their source of supply for the next 20 years. Therefore, the 20-year planning horizon supports a long-term, forward looking assessment of climate-related impacts, such as climate-driven population growth, the potential for warming and extreme heat to increase demand, or the influence of more frequent drought and changes to precipitation patterns on water supply and quality. The review of WSPs showed that some large systems incorporated these impacts into their supply and demand analysis, but many systems chose to omit climate data in their projections due to technical challenges in planning for uncertainties. However, within a climate resilience planning framework, methods exist to manage uncertainties and develop strategic responses for a range of possible future conditions (WUCA, 2021). Valuable lessons can also be derived from planning for other uncertain aspects of the future that affect water systems, such as pandemics, population growth, land use and development, and economic instability.

The requirement of consistency with local government planning could enable climate resilience planning among municipal water suppliers. Under the requirements of WAC 246-290-100(7) and WAC 246-290-108, all municipal water supplies must demonstrate consistency with local comprehensive plans, development regulations and other local codes in order to minimize conflict, and to receive the benefits of the Municipal Water Law. Over 50% of all active Group A community systems with over 1,000 service connections are municipal water suppliers. If local government plans have applicable climate data, these water systems must demonstrate that their WSP is not inconsistent with those plans. Because of this requirement for consistency, programs such as the Washington State Department of Commerce program to support cities and counties to plan for climate resilience in their comprehensive plans, could also advance climate resilience planning for drinking water systems through WSPs.

For small to medium systems, the local government consistency requirement could enable regional collaboration towards climate resilience because they also require WSPs to align with Coordinated Water System Plans (CWSPs) and WSPs from adjacent and nearby systems. For example, CWSPs require multiple water systems to cooperate towards regional supply needs. Whatcom County is an example of a critical service area with a CWSP and a county-wide drought contingency plan that is applicable to multiple water systems in the county.

Emergency Response Plans and Water Shortage Plans enable water systems to assess and anticipate the impacts of acute climate-related natural hazards on their operations, but these plans are not a substitute for a comprehensive climate resilience planning process because they are intentionally designed for short-term system recovery. In this review of WSPs, we found that the majority of water systems address climate impacts, such as drought, wildfire, and flooding through their ERPs and WSRPs. However, these two requirements were intentionally designed to support short-term system recovery to acute events that temporarily disrupt operations or water supply, rather than planning for or responding to any trends in the likelihood of hazards over longer time periods. Thus, the development of ERPs and WSRPs does not substitute for a comprehensive climate resilience planning process that would address long-term trends and chronic stresses to the systems, help prevent supply shortages, or reduce the need for emergency responses.

The relegation of climate impacts to an emergency condition can set systems up for failure because action only occurs when the system has already been compromised. In addition, the use of climate data is not encouraged by the short timescales and isolated geographies of emergency plans and operations. ERPs and WSRPs do not take into account prolonged emergencies, the ramifications of geographically large impacts, and permanent changes. For example, what would a system that relies on interties with neighboring systems do if all systems in the region were challenged by multi-year drought? Resilience planning calls for ongoing consideration of changing climate impacts and taking pre-emptive action to avoid emergency scenarios.

Water Use Efficiency programs are ongoing and could be a mechanism to plan and prepare for some climate impacts, such as extreme heat and drought, because they are a strategy to manage increases in year-over-year consumer usage. Although WUE programs do not facilitate physical resilience improvements, they target long-term consumer water use habits through demand management and using conservation measures such as seasonal or inclining block rate structures. In addition, the development of a WUE program is required for municipal water suppliers and non-municipal water suppliers who are required to develop a WSP, or small water systems who must develop a SWSMP. Given the broad coverage of this requirement, further integration of climate considerations into the WUE program could advance resilience to for both small water systems and larger systems that are required to develop WSPs.

Climate resilience planning for water systems could be advanced by including an element in WSPs that centralizes climate data and responses to facilitate the evaluation of internal consistency in WSPs. As WSPs are designed primarily for compliance to various Washington state regulations, climate change and its impacts are often addressed in a siloed and unconnected manner. For example, some WSPs address climate change in its supply and demand forecasts but do not use climate data in their plans to address drought, wildfire, or flooding. In this sense, the design of WSPs is not well suited to address intersecting effects of climate change or to provide a holistic assessment of how climate change could affect the system. To adequately plan for climate change impacts to water systems, system managers need to make this shift in thinking and build their adaptive capacity by integrating climate change considerations into multiple parts of the planning process. A separate climate resilience plan, or a section of the WSP dedicated specifically to climate change, could support a more holistic and comprehensive approach to assessing climate vulnerabilities and planning for resilience.

Additional efforts to support resilience among small water systems outside of the WSP framework will be necessary to achieve regional climate resilience for drinking water because most systems are not required to develop WSPs.

As of July 2022, there are 2,216 active Group A Community systems and 245 have 1,000 or more connections. Across this water system classification, only about 11% are required to develop WSPs (excluding new or expanding systems). Our review also did cover very small systems – Group A systems with fewer than 1,000 service connections and Group B systems – because they are not normally required to develop WSPs. As of July 2022, there are 13,517 Group B systems in Washington state. Given the large number of Group B systems and the relatively small population these systems serve, these systems have been difficult to regulate historically. The Department of Health's Office of Drinking Water (ODW) typically works with local health jurisdictions to provide oversight and support to these systems. Therefore, the design and implementation of efforts to support climate resilience of small and very small water systems is most likely to be successful if it considers several regulatory challenges for these systems specifically.

Currently very small systems are not held to the same requirements as larger systems for developing and submitting WSPs for state approval because they often lack the resources and capacity to engage in comprehensive planning. A requirement to do so could create an undue burden on these systems, yet in many cases these are the systems that are most vulnerable to climate change because they lack redundancy in water supply and have limited capital for system upgrades. These are also the systems with the fewest resources and most limited capacity to plan and implement risk reduction activities.

Requiring climate resilience in planning for very small systems, such as the SWSMP, has the potential to increase climate resilience for very small systems if requirements are supported with provisions that increase resources, training, and technical assistance for these systems to support implementation.

Given the sheer number of very small water systems in Washington state, substantial resources would be required to provide sufficient technical assistance to enable very small water systems to include climate resilience in Small Water System Management Programs. Information is limited on the experience and needs of very small water systems in managing climate change impacts. A needs assessment that directly engages operators of very small water systems could identify specific capacity constraints, verify assumptions about vulnerability, document empirical response to climate impacts, and to identify feasible, cost-effective pathways towards greater climate resilience of Washington state's drinking water systems.

Climate resilience planning could be enhanced for very small water systems by adapting the climate resilience planning tools and resources developed for WSPs for use in the SWSMP.

Although all very small systems are required to develop SWSMP, unlike WSPs, these are typically not subject to DOH approval. This lack of regulatory oversight could lead to ineffective or inconsistent use of climate data. This could be addressed through regional collaboration and training on the use of climate information. In addition, very small systems will still lack the engineering, operational, and financial capacity necessary to implement resilience strategies such as those being implemented by larger systems.

Regional and collaborative approaches to climate impacts assessment and resilience planning could effectively scale up climate resilience efforts by meeting the needs of the many very small systems simultaneously.

A regional approach to climate resilience planning could provide benefits to small and very small systems because water systems in the same region can rely on similar climate change data and are typically exposed to similar types of climate impacts. Resource sharing in the process of climate risk assessment and resilience planning offers a cost-effective, low-barrier approach to obtaining, interpreting, and using climate data. However, differences in water system infrastructure and water sources will still require a system-specific analysis of system sensitivities and vulnerabilities.

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Case Studies

Through this review, we identified several WSPs that illustrate how water systems consider climate change across different stages of resilience planning. Following the climate change maturity model used for this review (see Fig 3), each case study below provides practical examples of the process, outcomes, and lessons learned from WSPs that have integrated climate change considerations in the four stages: Understand, Assess, Plan, and Implement.

Understand

City of Vancouver

Year Published
2015

Region
Southwest

Size
Large

Source Type
Groundwater Only

Plan Section

Chapter 2 - Planning Data and Water Demand Forecast

Process

The City of Vancouver conducted an analysis of the historical relationship between temperature and precipitation with demand. The WSP references projected future trends, such as warmer temperatures year-round, wetter winters, more intense storm events, and drier summers from a regional report on Climate Change in the Northwest. The WSP also acknowledges that demand has the potential to increase in the future, given these anticipated changes in the climate. However, it did not incorporate future climate data into demand projections for the 20-year planning period because of (1) the uncertain magnitude and timing of local effects and (2) the difficulty in correlating historical climate and demand data. The plan recognizes that demands may increase in the future given anticipated climate changes.

Outcome

The WSP recommends that the City of Vancouver may want to develop a model to better track demand with temperature and rainfall for future demand planning. The City may also benefit from participating in regional studies to quantify potential local climate impacts.

Lessons Learned

Based on this review of WSPs, some planners understood how future climate trends could impact source supply and quality, but many are similar to the City of Vancouver in that they have chosen to omit climate data in their supply and demand analysis because of uncertainty. Multiple plans noted that more specific climate data are needed to plan for the future. As a result, meaningful climate change considerations, even if based on generalized data, are left out of sometimes decades-long planning periods, potentially perpetuating water system vulnerability to long-term shifts in the climate.

Assess

City of Tumwater

Year Published
2021

Region
Southwest

Size
Medium

Source Type
Groundwater Only
Multiple Sources

Plan Section

Chapter 3 - Demand Projections
Chapter 4 - Water Resource Analysis

Process

The City of Tumwater's WSP assesses effects of climate on future supply and demand. The WSP details three climate change scenarios based on the Water Supply Forum's 2009 Regional Water Supply Outlook. In the climate change scenarios of "none" to "warm" to "warmest", the "warm" and "warmest" models project, respectively, a 2% and 5% increase in demand by 2040. The plan then shows that the city's pending water rights will already be able to meet this demand through the planning period.

The City of Tumwater also analyzed how climate change would impact supply. They conclude that climate models generally project warmer, wetter winters, and hotter, drier summers, but that annual precipitation is not expected to significantly change for the Tumwater area. The City's groundwater sources will continue to receive similar recharge volumes; thus, risks of climate change on supply are small. One concern in the plan is that climate change could affect the flow pattern of the Deschutes River, which could change the water level in one well of the Palmero wellfield.

Outcome

The City of Tumwater's plan includes a detailed analysis of how climate change will impact water demand and supply over the next 20 years. They conclude that climate change will have some impact, but that the system is resilient to most projected changes; thus, they do not outline specific, concrete actions in response to climate-driven changes.

Lessons Learned

Systems like Tumwater that incorporate climate projections into their supply and demand analysis show that they understand and assess some climate impacts to their water systems. Many of these systems do not detail additional steps, because they often have more than enough capacity through existing water rights to meet a growing demand. Most small and medium systems are entirely reliant on groundwater, and many conclude that, on an annual basis, recharge will remain approximately the same in the future. Although groundwater systems might not be as vulnerable as surface water systems to variations in seasonal rainfall and snowmelt changes, wells may become compromised by shifts in seasonal or geographic water supply, as is mentioned with respect to the Deschutes River in the Tumwater WSP.

The required sections on demand and supply forecasting in WSPs are a relevant place to introduce climate data, as shown for the Tumwater plan. Most systems include a population growth projection in demand analysis and a water rights inventory in the supply analysis; including climate trends adds complexity and requires accessible knowledge and data on potential climate trends. The demand and supply sections assess the whole water system and can show the general vulnerability and capabilities of the entire system. The adaptation actions that these whole-system analyses show are also general, such as curbing demand through a conservation plan or applying for more water rights. These general sections lack detail on how climate change may impact specific infrastructure of the system, such as a well that would become newly in a floodplain. This kind of specific analysis may lead to more specific action actions.

Plan

City of Port Townsend

Year Published
2019

Region
Southwest

Size
Medium

Source Type
Surface Water Only

Plan Section

Chapter 3 - Demand Projections
Chapter 4 - Water Resource Analysis

Process

ince the Port Townsend water system relies exclusively on surface water as its source, the Watershed Protection Program is a key component in which the City's WSP addresses climate change impacts to water supply and quality.

In the Watershed Protection Program, the City concludes that climate change will alter streamflow magnitude and timing by increasing winter flows and reducing late-summer flows. Because of these shifts, the City might not be able to meet demand by just drawing on the Big Quilcene and Little Quilcene Rivers as it normally does. Instead, the City will have to depend more on stored lake water. Mitigation planning is underway; the WSP explains the actions and importance of implementing conservation measures, improving water use efficiency, drought-resistant landscaping, and expanding water storage capacity to be able to capture winter and spring runoff for use in the drier months.

In addition to climate change impacts to water supply and demand, Port Townsend faces increasing impacts of wildfire, turbidity, and flooding.

The WSP explicitly links effects of climate change to greater likelihood of disturbance to the watershed due to wildfire. Wildfires in the watershed increase stormwater runoff, adversely affecting water quality. To effectively prevent and suppress wildfire, the City works closely with the US Forest Service through a Cooperative Watershed Protection Program created in 1994. Due to budget and staffing cutbacks, the USFS has been unable to maintain all monitoring actions specified in the 1994 Cooperative Watershed Protection Plan. In 2013, the Washington State Department of Health informed the City of the noncompliance, and the City implemented a filtration system instead of committing the resources necessary to address all the DOH's issues and remain an unfiltered water system.

The potential increase in stormwater runoff and changes in streamflow from climate change also expands the likelihood of high-turbidity and flood events. During these events, the City's plan is to switch their source to stored lake water, again increasing dependence on these reservoirs.

Outcome

Given that Port Townsend relies heavily on a single, surface-water supply source, the City has a strong understanding of how climate change will impact water supply and quality. The WSP also describes plans to address current and future vulnerability, including water conservation actions, infrastructure improvements, and partnerships. Overall, the City expects to depend more on their reserves of stored water as the climate impacts of summer drought and flood events increase the need to further manage lake reservoirs.

Plan

City of Port Townsend

Year Published
2019

Region
Southwest

Size
Medium

Source Type
Surface Water Only

Lessons Learned

Chapter 3 - Demand Projections
Surface water systems as in Port Townsend face changes in streamflow timing and quality of water, especially with reduced streamflow during late summer and the increased likelihood of heavy rainfall in winter.. Port Townsend's WSP also shows how different climate impacts, such as low summer flows and more common flood events, when combined, lead to both more seasonal variability in surface water and more dependence on less-sustainable stored water.

Planning for these impacts requires watershed-scale partnerships and agreements with other agencies, municipalities, and organizations. Port Townsend offers an example of a long-term partnership with the USFS and WA DNR to manage the watershed landscape through a joint program and written agreements; however, this comes with its own complexities and funding challenges.

Many of the reviewed WSPs include a Watershed/Wellhead Protection Program Chapter. This section of the plan usually focuses on the physical vulnerabilities of particular parts of the water system and could offer a structure and mechanism to discuss climate impacts and infrastructure needs. Whereas the supply and demand sections of the WSP can holistically evaluate the needs of the system, the protection program section often ha smore concrete and specific vulnerabilities and actions.

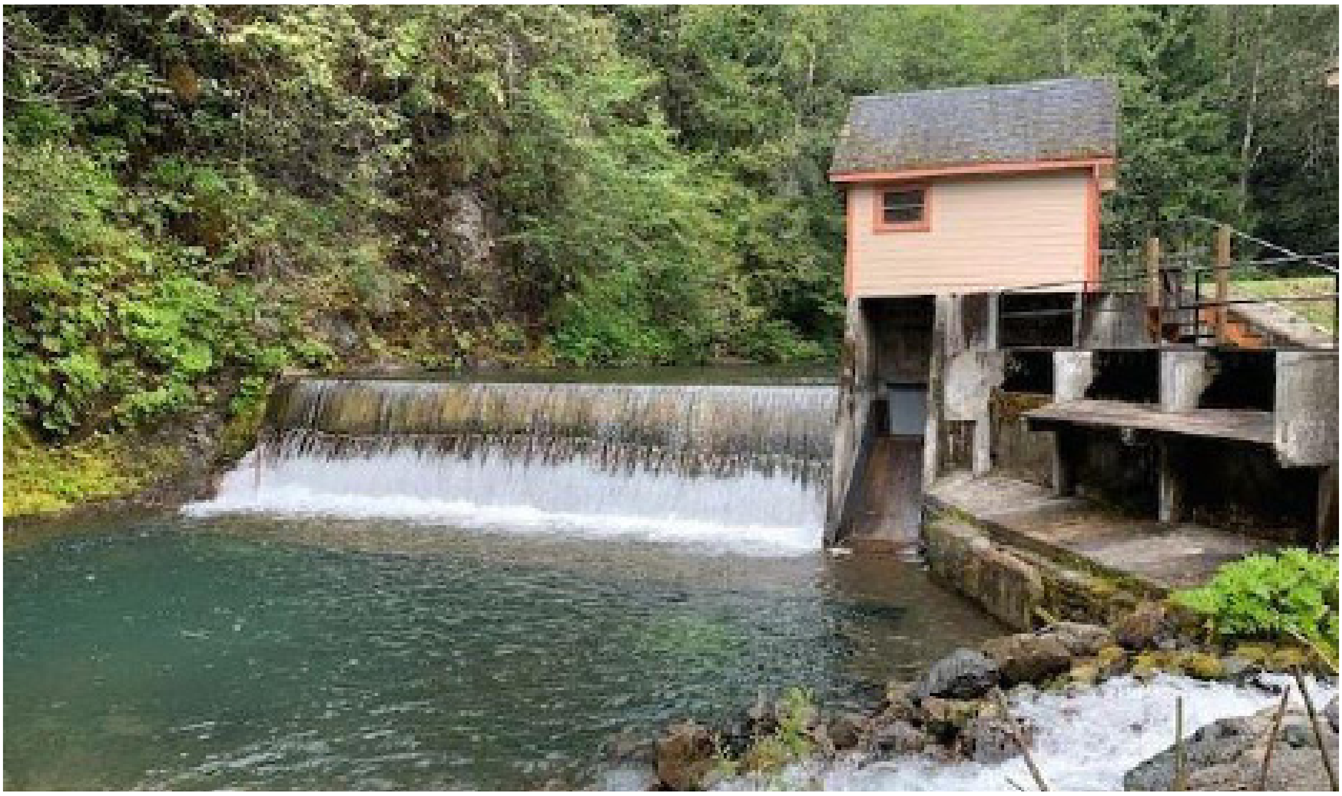

Photo Credit Quilcene River, City of Port Townsend WA

Implement

City of Olympia

Year Published
2021

Region
Southwest

Size
Large

Source Type
Groundwater Only
Multiple Sources

Plan Section
Chapter 1 - System Overview
Chapter 7 - Groundwater Protection Program

Process
The City of Olympia in its WSP directly acknowledges that climate change will have long-term and gradual impacts to the watersheds of the region through increased temperatures, snowpack decline, precipitation uncertainty, and sea level rise. Citing reports from the Climate Impacts Group and a 1992 City of Olympia Report, the WSP details two direct and specific impacts to the City's water system: increased summer temperatures and saltwater intrusion from sea level rise. Hotter summer temperatures increase water demand. To counteract increases in demand, the City invests in water conservation measures. Because of sea level rise, the well site of the city's previous primary water source was at risk of saltwater intrusion. The City developed a new wellfield from which to draw most of its water to mitigate this risk. Now, only a secondary site of wells remains at risk of saltwater intrusion. These wells are monitored often for saltwater intrusion.

The WSP also describes plans for drought events and supply issues. During drought, regardless of degree of threat of impact, the utility can implement its Water Shortage Response Plan, which details procedures for water curtailment. The plan has the capacity to assume loss of major supply wells and the City has the capability to fall back on partner cities through interties with the cities of Tumwater, Lacey, and the Thurston Public Utility District. The WSP also identifies future potential sources of water and details work on development of sources.

Outcome
The City of Olympia's WSP not only discusses macro-level impacts to the local watershed; it also identifies distinct ways the water system will be impacted and summarizes actions the City has taken to mitigate climate risk. Through infrastructure development, robust working partnerships, drought and conservation planning, and monitoring programs, the City's WSP shows capacity for implementing climate adaptation actions.

Lessons Learned
Some groundwater systems like Olympia are facing increased precarity at their wellsites. Changing floodplains, rising sea levels, and uncertainty in precipitation may put wellsites at risk of contamination or failure. This is often a localized issue for the area surrounding the wellhead, and it sometimes is hard to plan for because of the geographically generalized nature of climate models and predictions. Olympia required infrastructure investment to develop new sources of water. As a large system and the capital of the state, Olympia has more capacity for this kind of preventive development than do many smaller systems.

Olympia is similar to many medium and large utilities in their response to drought. Many systems have a Water Shortage Response Plan, which is meant to both guide water conservation efforts and act in times of emergency. The emergency actions in the plan are meant to respond to any kind of loss of water supply, and Olympia's WSRP relies on switching to interited water. As a response to climate change, these emergency management actions might not be enough. No part of the Water Shortage Response Plan addresses multi-year drought events or what to do if the intertied systems are also undergoing drought; both scenarios are increasingly likely in the future.

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