Council Study Session

May 2, 2022

Agenda Item	2022 Water Resources Update	
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Item Type	Requested by Council ☐ Update ☒ Request for Direction ☐ Presentation ☐	

SUMMARY

Before the Council is a comprehensive update of the City's water resources, including an overview of the following:

1. Approved Drought Management Strategy
2. Water System Planning and Supply Analysis
3. Regional Water Planning
4. Current Water Supply Information
5. Conservation and Efficiency Programs

POLICIES, PLANS & GOALS SUPPORTED

Council Goals:

Essential Services

- Water

Value Services

- Address Climate Change

Department Goals:

- Maintain existing infrastructure to meet regulatory requirements and minimize life-cycle costs
- Deliver timely life cycle capital improvement projects
- Maintain and improve infrastructure that enhances the economic vitality of the community
- Evaluate all city infrastructure regarding planning management and financial resources

Plans:

- Water Master Plan - "Adopt an integrated water master plan that addresses long-term water supply including climate change issues, security and redundancy, watershed health, conservation and reuse and stream health."
- Water Management & Conservation Plan
- Climate and Energy Action Plan (CEAP)
  - ➢ Manage and conserve community water resources
  - ➢ Conserve water use within city operations

BACKGROUND AND ADDITIONAL INFORMATION

City of Ashland Water Management Strategy for Drought:

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As a matter of previous practice, recommended by AWAC and approved by the City Council, Public Works follows a specific strategy for drought management. That strategy is to recommend voluntary conservation from the community during the summer season, utilize the Talent Irrigation District supplemental (TID) source early to supplement Reeder Reservoir water, thus **protecting the Reeder supply for as long as possible**. If TID is unavailable or after water delivery ends for the season, the City has access to the Talent-Ashland-Phoenix (TAP) intertie system for additional treated water supply from the Medford Water Commission if needed. The TAP supply is available all year, but under the approved drought strategy it is utilized after TID becomes unavailable.

Due to the significant impacts of drought on the City's water rights associated with the TID supply and the inability to use this source for supplemental supply during the 2022 season, Public Works will begin using the TAP source as needed for supplemental supply during the 2022 season. Use of any supplemental source is typically instituted after the drawdown of Reeder Reservoir begins.

TAP 2021 Use

During the 2021 season the City pumped 550.6 acre feet of TAP water or 179 MG. Using this source during the 2021 season provided an additional benefit to the City related to "certifying" the Lost Creek water right permit. Water rights are issued in two stages: The first stage is the "water right permit," which serves as the initial authorization for a water user to develop the source and begin making use of water. The second stage is the final certificate, which is issued after the water use is fully developed and put to use. The certification date based on the acquisition of the original Lost Creek water right permit was September 7, 2021. This means the City must certify all or a portion of the use and/or request a time extension for the "development" of the remainder of the water right.

To certify the permit a "Claim of Beneficial Use" (COBU) must be developed that shows the water was put to use during a water year (October 1 – September 30). Public Works is working with GSI Water Solutions and was able to "certify" the use of 550.6 acre-feet and obtain a partial perfection water right certificate from the Oregon Water Resources Department (OWRD) on April 12, 2022. Partial perfection references only a portion of the total water right was perfected or shown to be used during the time period. Public Works has requested a time extension to certify the remainder of the Lost Creek stored water right.

Curtailment

In addition to voluntary water reductions and conservation program efforts, the City has a very well-developed curtailment ordinance that has been employed to various levels in the past to assist in managing water supply limitations due to drought conditions. Often the City requests a level of "voluntary" curtailment from the community before declaring a water shortage and formally activating mandatory curtailment measures. A copy of the complete curtailment code is attached for reference (#1). Curtailment restrictions can also be applied to the TAP system if the Medford Water Commission enacts its curtailment plan.

Water System Planning

The City has put significant effort into Water System Planning to ensure adequate supply, meet regulatory requirements and provide for overall system resiliency. Recent planning efforts include:

- 2012 Comprehensive Water Master Plan (Link)
- 2013 Water Management and Conservation Plan (Link)
- 2020 Water Master Plan Update (Link)
- 2020 TAP Master Plan (Link)

2011 Water Conservation and Reuse Study (Climate Impacts)
The City has proactively prepared for the impacts of climate change on its water resources. The City performed an extensive long-term water supply evaluation, "*Water Conservation and Reuse Study*" as part of the 2012 Water Master Plan development process. In the analysis, the City reviewed likely impacts of climate change on the City's main water supply: The East and West Forks of Ashland Creek. According to *Effects on Climate Change on Ashland Creek, Oregon* (Hamlet, 2010), climate change models predict less spring snowpack and lower flows in Ashland Creek. Numerous water supply options were reviewed for how to address the risk of climate change to the City's supply while still meeting growing demands. Final recommendations from the water supply evaluation were to implement water conservation and develop either the TAP Intertie to provide supply redundancy or construct a new WTP. Additional recommendations included moving more aggressively towards acquiring additional Ashland Creek or TID water rights, performing groundwater testing, and evaluating raw water storage options such as shading, snow fencing, and silviculture practices. Since completion of the 2011 water supply study, the TAP Intertie has been developed, the City is actively developing a new WTP, and the City continues to implement a successful water conservation program.

Water Management and Conservation Plan
In 2013 the City developed as required a Water Management and Conservation Plan (WMCP). A Municipal Water Management and Conservation Plan provides a description of the water system, identifies the sources of water used by the community, and explains how the water supplier will manage and conserve supplies to meet future needs. Preparation of a plan is intended to represent a proactive evaluation of the management and conservation measures that suppliers can undertake. The planning program requires that municipal water suppliers consider water that can be saved through conservation practices as a source of supply to meet growing demands if the saved water is less expensive than developing new supplies. As such, a plan represents an integrated resource management approach to securing a community´s long-term water supply.

Staff will be coordinating a full update to the WMCP for 2023
This update is not only required on a five year basis, but also required because the City just received a partial perfection certificate for its Lost Creek Lake stored water right. The Oregon Water Resources Department requires an updated WMCP when the status of a municipalities water rights change.

The 2023 update will take a fresh look at the City's water supply sources including re-use, projected future demand and it will make recommendations for changes if necessary. The update will include the coordinated water rights management and sharing plan developed between the MWC Partner Agencies (see below). Also, staff expects to include climate modeling analysis in the update associated with the various supply sources in order to account for climate change impacts on our water supplies.

Coordinated Water Rights Management and Water Sharing Plan
In addition to master planning specific to the City's water system there is also regional water management planning done between the "Partner" communities who utilize the Medford Water Commission (MWC) source for treated water delivery. The Partner communities have been working with MWC on a regional water rights management and sharing plan. A one-page summary of the work to date is included as attachment #4.

The project initially started with developing a strategy between all the Partners on when to certify their own held water rights to ensure the total volume of rights does not exceed the capacity for production at the Duff Treatment Plant, this will help protect each community's formal water rights.

The City of Ashland has 1000 acre-feet of stored water right in Lost Creek Reservoir that utilizes the Duff Treatment Plant as the point of diversion for delivery of treated water through the TAP system. Not only does this regional planning outline a water right certification strategy for all Partners to follow, it also develops a water sharing plan. Under the water-sharing plan framework, the Partner Cities would retain ownership and control of their water rights and continue to use water under their own water rights from May 1 through September 30 each year. At the end of each year, Medford Water Commission would compare each city's water use to the volume of water authorized by its water rights. Any Partner Cities that used more water than authorized by their water rights would provide compensation to the other Partner Cities for use of water under their rights. This compensation relates directly to the Operations and Maintenance fees paid by each jurisdiction for water storage associated with their water rights.

Staff expects to present the Intergovernmental Agreement detailing the parameters of the coordinating water rights management and sharing plan at a future Council meeting for approval. The Medford Water Commission has reviewed the draft and recommended moving forward with the approval process by all Partner Cities.

2022 Water Supply & Storage Sources

The City has three (3) distinct sources of water, both raw and treated; Reeder Reservoir and Ashland Creek water, Talent Irrigation District (TID) via the Ashland Canal and the Talent-Ashland-Phoenix (TAP) Intertie from the Medford Water Commission (fully treated water).

Reeder Reservoir Source

Reeder Reservoir is the City's primary raw water source and has a storage capacity of **800 acre-feet or 260 million gallons (MG)**. The reservoir is feed from the flows of the east and west forks of Ashland Creek and during good water years typically supplies all the City's raw water required for residential and commercial use. Last year, Geographic Information Systems staff developed a Water Supply Dashboard as a public information tool, where the public can view Ashland's water supply and demands daily, reference figure 3 below.

Current Conditions (Reeder Reservoir)

Water Treatment Plant staff started filling Reeder in early April, due to the lower than average snowpack. Public Works felt it best to begin filling the reservoir in preparation for summer season. Typically, the reservoir reaches full capacity in May and spills through the spillway for some time before demand outpaces inflow at which time the reservoir begins the "**drawdown**". The drawdown can begin as early as June or as late as July. As of April 21st, Reeder Reservoir was 93.2% full and spilling through the spillway. In May, Water Treatment Plant staff will lower the spillway gates and fill the reservoir to 100%. Typically during supply impacted years the City has requested the community to enact voluntary water reductions measures and this year will be no different. The City has found a target of 4.5 million gallons per day beneficial with respect to a targeted consumption amount we can normally sustain during the summer season with what is expected to be a limited summer season.

Figure 1 below shows a graph of the annual water demand by the community with average day and wintertime demand thresholds. In general, one-billion gallons of water is treated and delivered to the community annually. Over ½ of the total water demand of the community occurs during the summer months (June-September).

Snowpack:
The current snowpack conditions lend themselves to a below average water year with respect to the Reeder Reservoir supply. As of April 21st, 2021, there was 49 inches of snow with a Snow Water Equivalent (SWE) of 15.1 inches, recorded at the Big Red Mountain SNOTEL site just southwest of Ashland (60% of the 30-year average). There are also three additional sites on Mt. Ashland that are measured manually at the end of each month by the Jackson County Water Master. These SNOTEL sites provide valuable snowpack information and related climate data that allow us to analyze the City's water supply conditions for the year.

Table 1: Mount Ashland Snowpack

	Snow Depth (inches)				Snow Water Equivalent (SWE) inches			
Snow Course/Aerial Marker Sites	**2019**	**2020**	**2021**	**2022**	**2019**	**2020**	**2021**	**2022**
*** Big Red Mountain SNOTEL Site 6,050 ft.**	**49**	**19**	**34**	**49**	**24.2**	**11**	**17.8**	**15.1**
Caliban 6,500 ft.	**66**	**26**	**45**	**31**	**30.2**	**11.2**	**20**	**12**
Mt. Ashland Switchback 6,430 ft.	**59**	**18**	**28**	**21**	**27.5**	**8.3**	**13**	**7.8**
Ski Bowl Road 6,070 ft.	**31**	**2**	**18**	**13**	**15.1**	**.8**	**7.3**	**6.3**

*** Big Red Mountain SNOTEL Site is an automated site that provides daily snowpack data. The three additional sites are measured manually by the Jackson County Water Master at the end of each month (March 31, 2022). The Big Red Site information for 2021 was taken on April 21nd, 2021.**

Figure 1: Annual Water Use Patterns (2020)

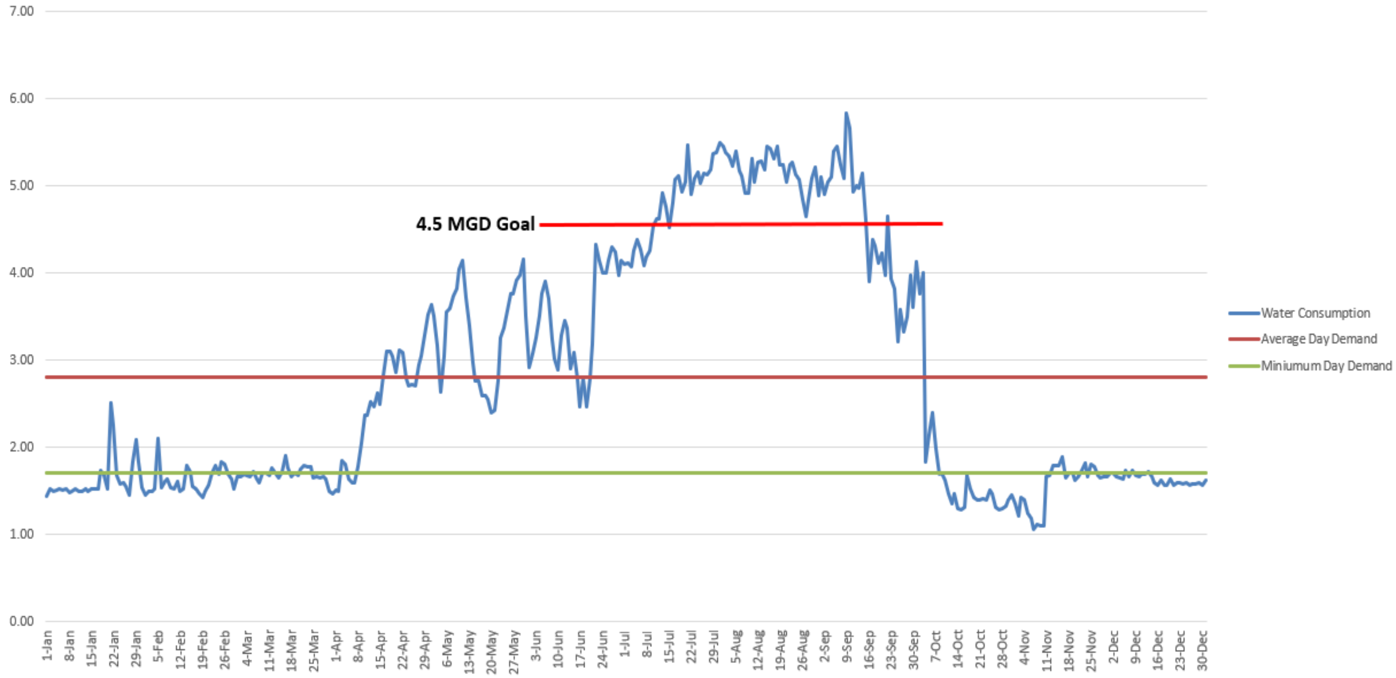

Figure 2: 2021 Reeder Reservoir Drawdown

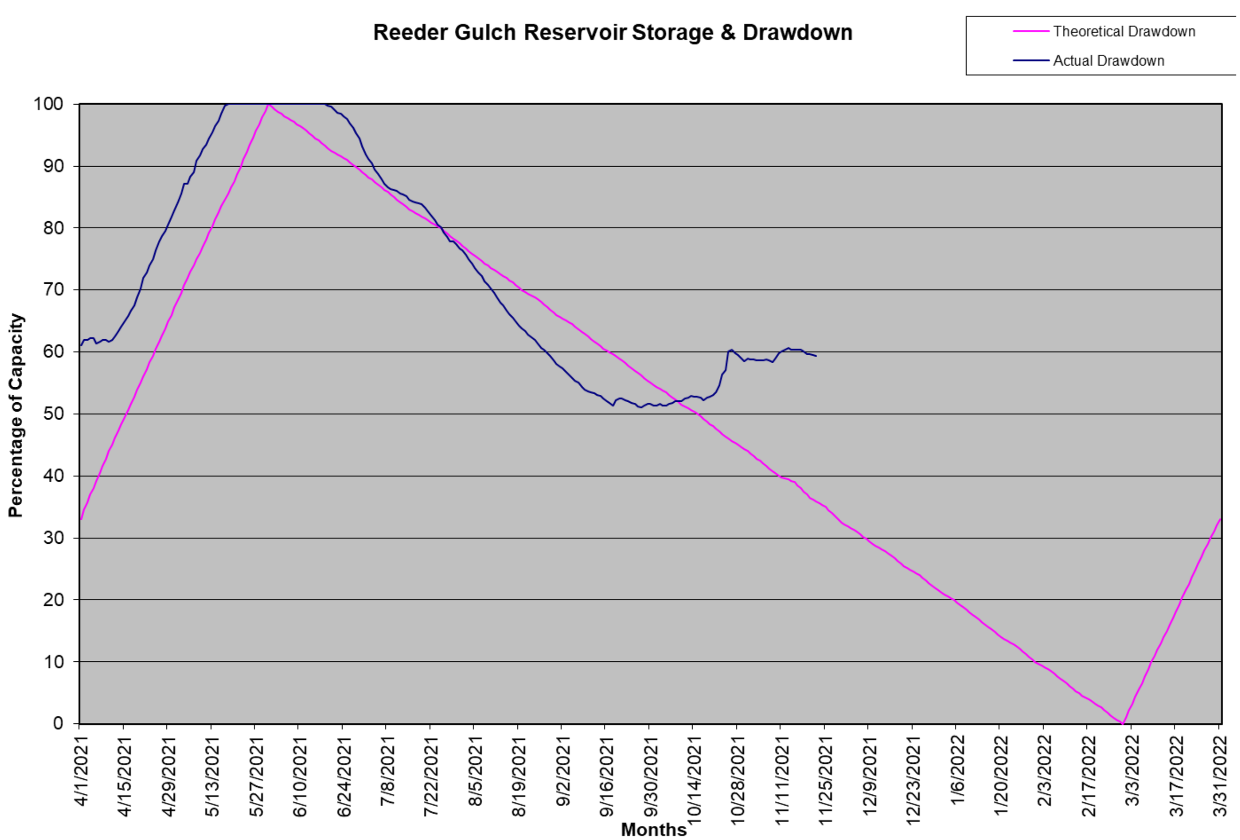

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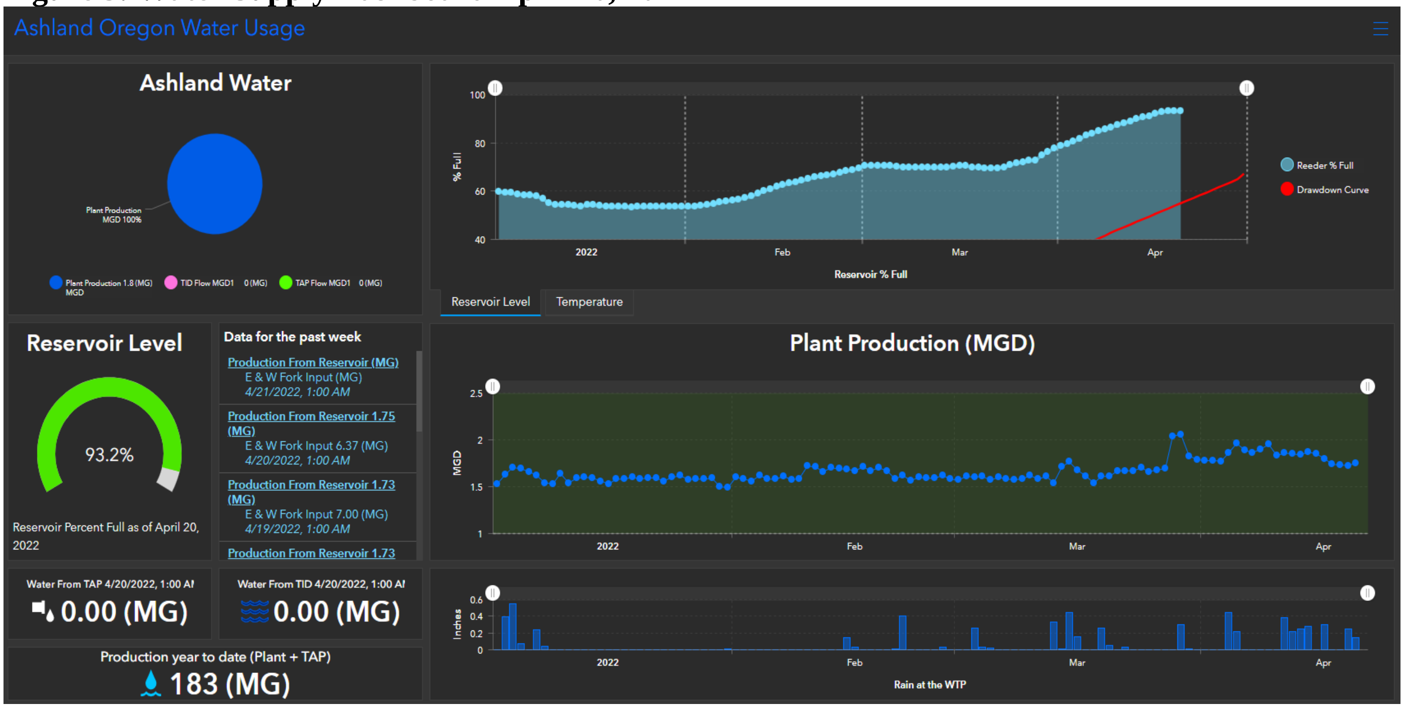
Figure 3: Water Supply Dashboard April 20, 2022



<u>Talent Irrigation District (TID) Source</u>

The City has a total of **1369 acre feet or 446 MG** of domestic/municipal and irrigation water rights that are delivered through the TID canal system to the Ashland Canal. The City has the ability to pump this water source to the Water Treatment Plant as a supplemental water source during drought years. This source is only available during irrigation season, which typically runs from May to October. Due to persistent drought conditions the TID source has been impacted severely and use reductions have been implemented the past few years.

<u>Current Conditions</u>

Staff expects the TID source to be severely diminished this year. TID recently posted an update on their website regarding the 2022 irrigation season: April 11, 2022 TID Update. This update describes that, based on water supply they expect to only run around 25 days this irrigation season. Similar to last year staff does not expect to have access to the TID source as a raw water source to supplement Reeder Reservoir water. The TID Board will make the decision on when to begin the irrigation season at their May meeting.

<u>Talent-Ashland-Phoenix (TAP) Source</u>

The City has the rights to **1000-acre feet or 325 MG** of water for municipal use from Lost Creek Lake delivered from the Medford Water Commission through the TAP intertie.

<u>Current Conditions</u>

Currently Lost Creek Reservoir is at 60% (April 20th) of capacity and Public Works expects to have the full availability of the 1000-acre feet of stored water rights from Lost Creek this year for use as supplemental treated water after the drawdown of Reeder Reservoir begins. Staff has already begun coordination efforts with the Medford Water Commission, Phoenix and Talent regarding the use of the TAP source for the 2022 season.

City of Ashland Total Supply:
Figure 4 below represents a comparison of the storage associated with the City's water supply sources. The total combined storage supply is 3169 acre feet or just over 1 billion gallons. Figure 5 shows the relationship between storage reservoirs in the Rogue Valley.

Figure 4: City of Ashland Raw Water Storage Supply

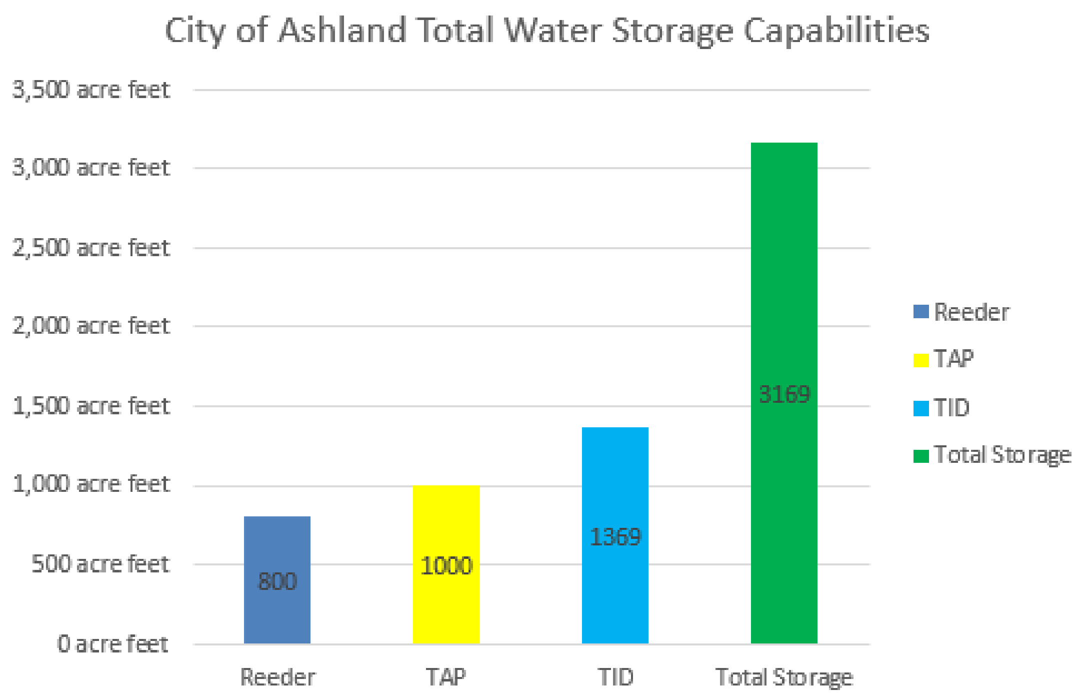


Figure 5: Reservoir Storage Comparisons (4/20/2022)

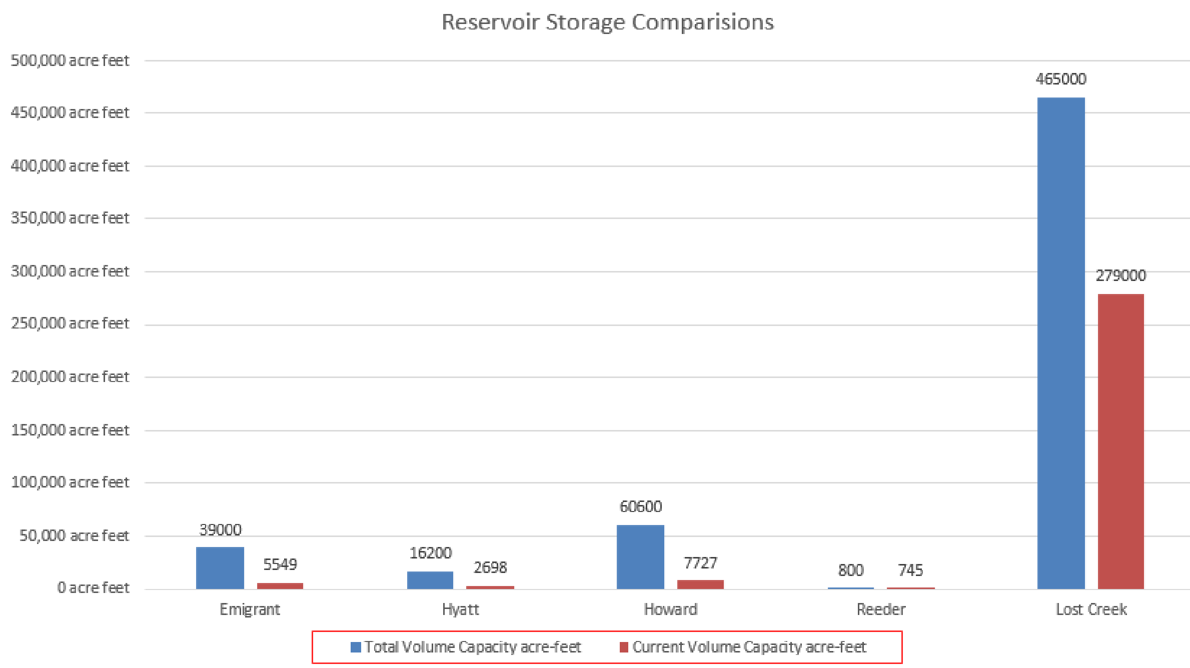


Figure 5: Irrigation Reservoirs T-Cup Diagram (2022)

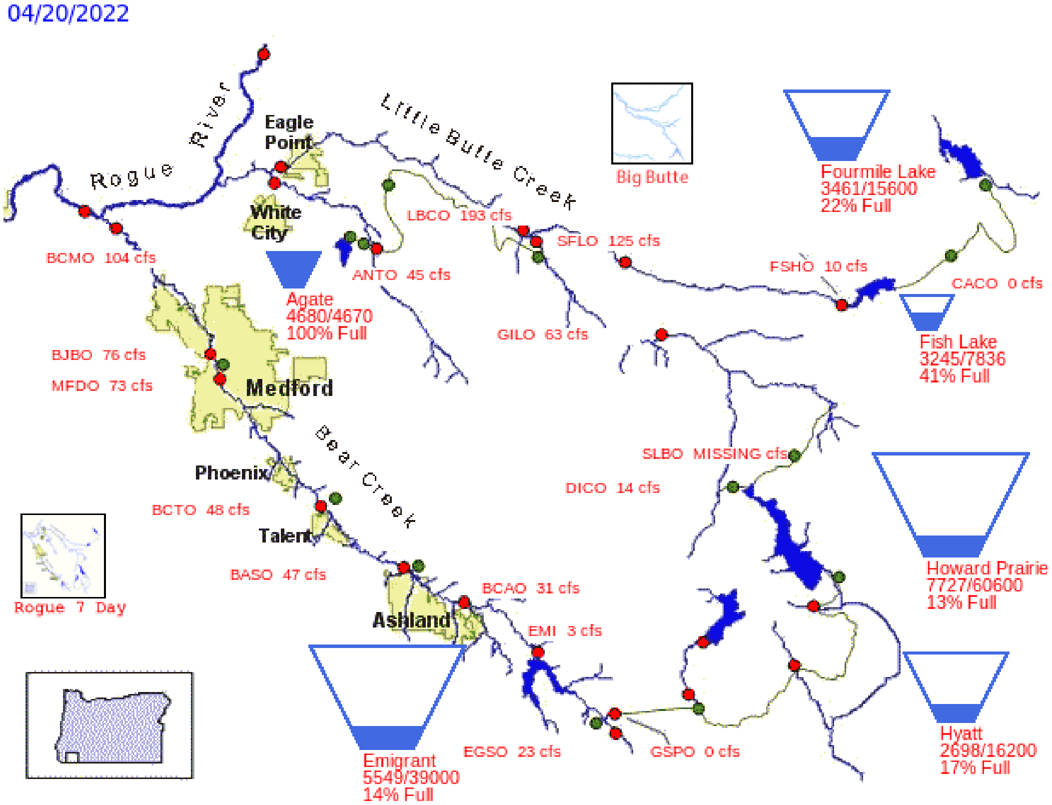
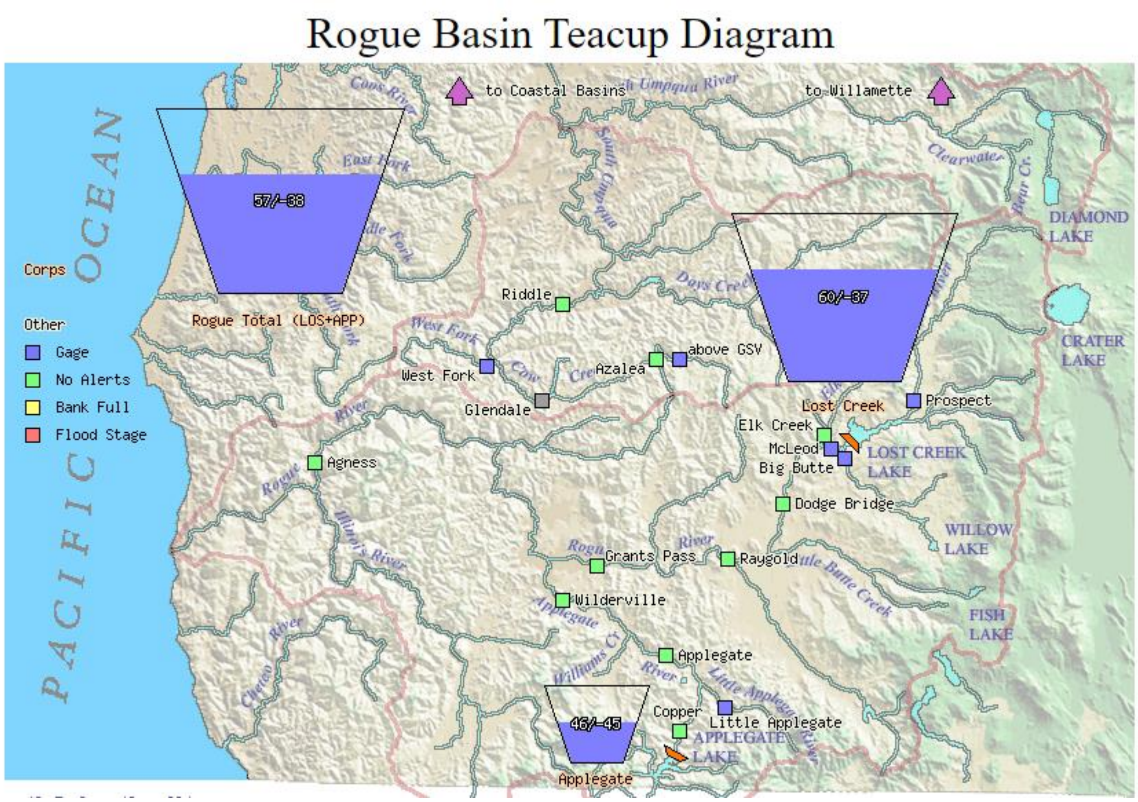


Figure 6: Lost Creek Reservoir T-Cup Diagram (2022)



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2020 Water Master Plan Storage Criteria

Not only has the City evaluated its raw water supply sources, the 2020 Water Master Plan developed storage criteria for treated water within the City's system. The treated water storage criteria accounts for operational use, emergency use and fire flow. The storage criteria is evaluated for each defined water distribution system "zone" served by the City's treated water storage tanks.

The City has 4 treated water storage reservoirs or "tanks". These tanks store 6.7 million gallons of potable water.

- Crowson Reservoir (2.1 MG)
- Alsing Reservoir (2.1 MG)
- Granite Reservoir (2.0 MG)
- Fallon Reservoir (0.5 MG)

Table 1: Storage Criteria

Parameter	Criterion
Operational Storage	0.25 times MDD of the area served by each reservoir
Fire Flow Storage	Provide volume for single most severe required fire flow and duration for each reservoir service area. Systemwide, provide volume for two largest fires.
Emergency Storage	0.5 times MDD of the area served by each reservoir *Or* ES = (MDD – Firm Supply Capacity) (1 day)

Outside of operational storage the most critical storage need for the City is associated with fire flow. The fire flow storage requirements are developed per zone and provide storage for the largest fire within distribution system zone. The overall system storage also accounts for the two largest fire flow requirements citywide.

Wildland and urban structure fires rely on a predictable water supply for controlling fire spread and or limiting damage to property while protecting lives. Wildfires on the edges, or inside the city limits require water from either the City's hydrant system or access to ponds, streams, and reservoirs. Under the Reeder Reservoir water use agreement, the U.S. Forest Service routinely has helicopters dip from the reservoir to suppress fires in the watershed. The City's hydrant system is critical as a pressurized source for more routine structure fires as well as more serious interface fires.

Table 2: Fire Flow requirements.

Land Use Category	Fire Flow Requirement (gpm)	Flow Duration (Hours)
Single-family Residential	1,500	2
Multi-family Residential	2,500	3
Commercial/Industrial	4,000	4

The 2020 master plan evaluation concluded adequate storage for operational, emergency and fire flow use through the planning period if recommendations in the 2020 Master Plan are enacted. The recommendations included continued conservation efforts, replacement of the Granite Reservoir, and expanding the Alsing Reservoir service area.

Supply/Demand Capabilities

In addition to storage requirements for treated water, the City continuously treats water to maintain adequate reservoir levels and can increase production to meet increasing demand.

The water treatment plant is rated at 7.5 MGD (million gallons per day) or 5067 GPM (gallons per minute. The TAP system can provide 2.13 MGD or 1480 GPM.

Total combined supply between the two sources equals 9.63 MGD or 6506 GPM

TID water supplied to the treatment plant for treatment averages 1.5 MGD or 1041 GPM and would be part of the total production at the water treatment plant if TID is utilized.

To put that in perspective the maximum day demand from 2021 was 6 MGD or 4166 GPM.

Conservation and Efficiency

The City has a robust conservation and efficiency program that offers many rebates and incentives to the community to improve water use efficiency. The City itself also implements its own water conservation efforts to ensure supply sustainability.

In March of 2021 the City entered into an Intergovernmental Agreement with the Medford Water Commission to assist the City in delivering its water conservation and efficiency program to the community (Staff Report) . The City entered into this agreement due to the fact that a long time water conservation employee left employment with the City to join the MWC team. Under the agreement the City has the ability to utilize MWC conservation staff to perform indoor and outdoor audits associated with the conservation program. The City provides administrative staff support and office access as needed to support the audits and public education/outreach.

The first year implementation of this IGA worked well and Public Works is continuing to coordinate with MWC for ongoing conservation activities for the 2022 season. Public Works will be organizing appointments for community members who wish to receive an indoor or outdoor audit of their water use and systems. **Audits will be scheduled on a first come first served basis, please email conserve@ashland.or.us or call (541) 488-2062 for more information.**

This year Public Works plans to advertise the conservation programs in the Sneak Preview, in the Ashland Directory, on a banner across E. Main Street, and on digital Reader Boards using our "Use Water Wisely" slogan, and the "Ashlandsaveswater.org" website. Numerous resident volunteers have also contacted Public Works about volunteering to provide conservation related information and materials at community events including Earth Day. Public Works staff would like to thank community volunteers promoting water conservation programs.

Public Works is also in the process of creating a new updated webpage on the City's website that will act as a repository for specific conservation and water related information that is adjusted seasonally:

ashland.or.us/watersupply

City Based Conservation Efforts:

- Sprinkler head replacements in the Siskiyou Boulevard median islands
- Drought tolerant landscaping upgrades
- Recycled water reuse for irrigation at the wastewater treatment plant
- Formal curtailment ordinance that outlines water reductions during certain levels of curtailment
- Review of development landscape plans
- Water rate tiered structure
- Operations switch from water pressure washing to compressed air for certain maintenance activities

Parks Department Conservation Efforts:

- Parks Department will have a new central control system to allow for improved water use and monitoring
- Reduced potable water for irrigation at City Parks
- Drought tolerant landscaping upgrades

Conservation and Efficiency Programs: We continue to encourage customers to use water efficiently and invest in long term conservation measures, not only to minimize the impact of future limitations, but to also ensure we have a sufficient supply to sustain our community for years to come.

In conjunction with water supply strategies, the water conservation team offers water customers the following programs:

- **Lawn Replacement Rebate** - for removal of irrigated lawns that are replaced with low water use landscapes and efficient irrigation systems.
- **Irrigation System and Indoor Water Use Evaluations** - free for residents and businesses. Evaluations of individual systems uncover ongoing water waste and leaks.
- **Smart Irrigation Controller Rebate** – to install a *WaterSense* labeled smart controller.
- **Appliance Rebates** - are also available for installing high efficiency *WaterSense* labeled toilets and *Energy Star* labeled washing machines.
- **Giveaways** - free low flow showerheads, faucets aerators and spray rinse valves for commercial dishwashing are available for residences and businesses.
- **Water Wise Landscaping Website** - www.ashlandsaveswater.org, to help people design landscapes with plants that use less water. The site includes a watering calculator and links to city's programs and rebates.
- **Public Presentations -** on long term water efficiency changes, as well as information on the City's drinking water system.
- **City Website** - with descriptions of programs, savings tips, weather data and watering recommendations, educational handouts, and more

Additional Measures:

- ***Love Your Water* Campaign** – Reusable bags and soil moisture meters for customers who sign up for a water evaluation, either indoor or outdoor.
- **Monthly City Source** newsletter articles in utility bills that discuss water savings tips and provides information about the City's water efficiency programs and rebates. Due to a lack of staffing this is currently not available as a resource.
- **Movie Theater Advertisement** - To help promote the efficient use of the community's resources, a combined water and energy conservation ad will play at both movie theaters during the months of July-September.
- **City Owned Property Irrigation Upgrades** – We continue to identify and replace inefficient sprinklers on City and Parks owned properties.
- **Waterwise and Firewise Demonstration Garden** - was installed in front of Fire Station #1 downtown. The garden also incorporates deer resistant and pollinator plants.
- **Southern Oregon Landscape Association** - provide education and resources to local landscape contractors on water efficiency in the landscape.
- **Ongoing Research** - of new technologies in water efficiency and continue to evaluate future programs and incentives to help our customers.

FISCAL IMPACTS

The water fund is appropriately funded for the remainder of the biennial budget.

DISCUSSION QUESTIONS

Does the Council have any questions regarding water resources?

SUGGESTED NEXT STEPS

None.

REFERENCES & ATTACHMENTS

Attachment #1: Water Curtailment Ordinance
Attachment #2: Oregon Water Conditions Report 4-19-2022
Attachment #3: State of Oregon Executive Order 22-06 "Drought Emergency"
Attachment #4: 2011 Water Conservation and Reuse Study Executive Summary
Attachment #5: 2010 Effects of Climate Change in Ashland Creek Oregon
Attachment #6: Coordinated Water Rights Management and Water Sharing Plan Draft Intergovernmental Agreement

Chapter 14.06
WATER CURTAILMENT

Sections:

14.06.010 Definitions

The following words and phrases whenever used in this chapter shall be construed as defined in this section unless from the context a different meaning is intended.

A. “Billing period” means that period used by the City for the reading of water meters consisting of approximately 30 calendar days.

B. “City water” means water sold or delivered by the City of Ashland and includes Talent Irrigation District water delivered through the City’s water system.

C. “Cf” means cubic feet.

D. “Customer” means that person or persons designated in City records to receive bills for water service.

E. “multi-family dwelling” means a building containing two or more residential units.

F. “Outside plants” means grass, lawns, ground cover, shrubbery, gardens, crops, vegetation and trees not located within a fully enclosed building.

G. “Permanent resident” means a person who resides at the dwelling at least five days a week, nine months a year.

H. “Temporary or Drop-In Guest” means a person who resides at the dwelling less than 3 consecutive months per year.

I. “Water Allocation Table” means that table of meter types and sizes and maximum volumes of water set forth in AMC 14.06.015.

J. “Waste” means:

1. To use City water to irrigate outside plants:

   a. Between the hours of 10:00 a.m. and 8:00 p.m. May through July or between 10:00 a.m. and 7:00 p.m. August through October, except that drip irrigation systems may be used during these times.

   b. in such a manner as to result in runoff on a street, sidewalk, alley or adjacent property for more than five minutes.

2. To use City water to wash sidewalks, walkways, streets, driveways, parking lots, open ground or other hard surfaced areas except where necessary for public health or safety.

3. To allow City water to escape from breaks within a plumbing system for more than 24 hours after the person who owns or is in control of the system is notified or discovers the break.

4. To use City water to wash cars, boats, trailers, aircraft, or other vehicles by hose without using a shutoff nozzle except to wash such vehicles at commercial or fleet vehicle washing facilities using water recycling equipment.

5. To serve City water for drinking at a restaurant, hotel, cafe, cafeteria or other public place where food is sold, served or offered for sale, to any person unless expressly requested by such person.

6. To use City water to clean, fill or maintain decorative fountains, lakes or ponds unless all such water is re-circulated.

7. Except for purposes of building construction, to use City water for construction, compaction, dust control, cleaning or wetting or for building wash down (except in preparation for painting).

8. To use City water for filling swimming pools or for filling toy, play or other pools with a capacity in excess of 100 gallons provided, however, that water may be added to swimming pools to replace volume loss due to evaporation.

K. “HOA” means Home Owners Association (Ord. 3011, amended, 05/04/2010; Ord. 2869, amended, 05/15/2001)

14.06.015 Water Allocation Table

CATEGORY	METER SIZE	STAGE 1	STAGE 2	STAGE 3	STAGE 4
Res Irrig	0.75	1800	600	100	0
Res Irrig	1.00	1800	600	100	0
Res Irrig	1.50	1800	600	100	0
Res Irrig	2.00	1800	600	100	0
Com Irrig	0.75	3200	1100	100	0

CATEGORY	METER SIZE	STAGE 1	STAGE 2	STAGE 3	STAGE 4
Com Irrig	1.00	6100	2100	200	0
Com Irrig	1.50	10400	3700	400	0
Com Irrig	2.00	15200	5300	500	0
Com Irrig	3.00	30400	10600	1100	0
Gov Irrig	0.75	3200	1100	100	0
Gov Irrig	1.00	6100	2100	200	0
Gov Irrig	1.50	10400	3700	400	0
Gov Irrig	2.00	15200	5300	500	0
Gov Irrig	3.00	30400	10600	1100	0
Gov Irrig	4.00	48100	16800	1700	0
TID Irrig	4.00	48100	16800	1700	0
Comm=l	0.75	6400	4800	3200	1600
Comm=l	1.00	12200	9200	6100	3100
Comm=l	1.50	20900	15600	10400	5200
Comm=l	2.00	30400	22800	15200	7600
Comm=l	3.00	60800	45600	30400	15200
Comm=l	4.00	96200	72200	48100	24100
Comm=l	6.00	186400	139800	93200	46600
Comm=l	8.00	304400	228300	152200	76100
Condo/multi-family	All	2700	2000	1300	700
Resid=1	.075	3600	2500	1800	900
Resid=l	1.00	3600	2500	1800	900
Resid=l	1.50	3600	2500	1800	900

(Ord. 3011, amended, 05/04/2010)

14.06.020 Determination of Water Shortage

A. The City Manager is authorized to prohibit waste as defined in AMC 14.06.010 or implement water curtailment stages upon determination that a water shortage emergency condition exists. Such determination shall be based on an analysis of the demand for water in the City, the volume of water in Reeder Reservoir, the standard drawdown curve for Reeder Reservoir, the projected curtailment date for Talent Irrigation District water and flows in the east and west forks of Ashland Creek. The determination of the City Manager under this section shall be effective until the next meeting of the City Council following such determination, at which time the City Council shall either ratify or invalidate the determination.

B. The City Manager is authorized to terminate waste prohibitions or water curtailment stages upon determination that a water shortage emergency condition no longer exists. Such determination shall be based upon factors listed in subsection A of this section and the billing cycle. The termination shall be effective until the next meeting of the City Council following the determination of the City Manager, at which time the City Council shall either ratify or invalidate the determination. (Ord. 3192 § 109, amended, 11/17/2020; Ord. 3011, amended, 05/04/2010; Ord. 2869, amended, 05/15/2001)

14.06.030 Water Curtailment Stages

Depending on the severity of the potential water shortage, the City Manager may implement the following water curtailment stages. During any stage, no person shall waste City water.

Stage 1. The following restrictions are effective during water curtailment Stage 1:

1. No customer shall receive through the water meter assigned to such customer more than the maximum volume of water for such meter indicated for Stage 1 in the Water Allocation Table.

2. Government agencies and HOAs, including but not limited to parks, schools, colleges and municipalities, may have separate account allotments combined into one "agency" allotment and are exempt from Stage 1 restrictions if their water consumption is otherwise reduced by 20% from the volume of water delivered in the same billing period for the first previous nonwater curtailment year.

Stage 2. The following restrictions are effective during water curtailment Stage 2:

1. No customer shall receive through the water meter assigned to such customer more than the maximum volume of water for such meter indicated for Stage 2 in the Water Allocation Table.

2. Government agencies and HOAs, including but not limited to parks, schools, colleges and municipalities, may have separate account allotments combined into one "agency" allotment and are exempt from Stage 2 restrictions if their water consumption is otherwise reduced by 30% from the volume of water determined under Stage 1.

Stage 3. The following restrictions are effective during water curtailment Stage 3:

1. No customer shall receive through the water meter assigned to such customer more than the maximum volume of water for such meter indicated for Stage 3 in the Water Allocation Table.

2. Government agencies and HOAs, including but not limited to parks, schools, colleges and municipalities, may have separate account allotments combined into one "agency" allotment and are exempt from Stage 3 restrictions if their water consumption is otherwise reduced by 40% from the volume of water determined under Stage 2.

Stage 4. The following restrictions are effective during water curtailment Stage 4:

1. No customer shall receive through the water meter assigned to such customer more than the maximum volume of water for such meter indicated for Stage 4 in the Water Allocation Table.

2. Government agencies and HOAs, including but not limited to parks, schools, colleges and municipalities, may have separate account allotments combined into one "agency" allotment and are exempt from Stage 4 restrictions if their water consumption is otherwise reduced by 50% from the volume of water determined under Stage 3.

3. No City water shall be used to irrigate outside plants, except for trees, shrubs and food plants. If the customer has an irrigation meter, the irrigation meter shall not be used. The watering of trees, shrubs and food plants shall be through the nonirrigation meter and the total allocation shall not exceed the amount allowed for the nonirrigation meter. (Ord. 3192 § 110, amended, 11/17/2020; Ord. 3011, amended, 05/04/2010)

14.06.060 Exemptions and Appeals

A. Any person who wishes to be exempted from a restriction imposed by any water curtailment stage shall request an exemption in writing on forms provided by the City and file the request for exemption in writing with the Utility Billing Office.

B. Requests will be reviewed after a water audit is conducted by the City and a determination made by the Conservation Analyst as to the validity of the request for an exemption. No exemptions will be considered until the City has conducted a water audit.

C. Exemptions may be granted for the following:

1. Any person with substantial medical requirements as prescribed in writing by a physician. Examples would be hydrotherapy pools or life support systems.

2. Residential connections with more than four permanent residents in a single-family residence or three permanent residents per unit in a multifamily dwelling can receive up to 350 cf per month per additional permanent resident. A census may be conducted to determine the actual number of permanent residents per living unit. Temporary or drop-in guests will not be considered for additional allocations.

3. For commercial or industrial accounts where water supply reductions will result in unemployment or decrease production, after confirmation by the City that the account has instituted all applicable water efficiency improvements.

4. For any other reason upon showing of good cause and where necessary for public health or safety.

5. For commercial accounts where water meter is undersized (as determined under the Uniform Plumbing Code) for the current occupancy, the allocation for such accounts may be increased up to the allocation for the water meter size designated for such occupancy in the Uniform Plumbing Code.

D. Exemptions will not be allowed for steam cleaning or similar uses of water. The amount allocated for any given customer will include such uses and no additional allocation will be allowed.

E. The Conservation Analyst shall report to the Director of Public Works the findings and conclusions resulting from the review. The Director shall approve or deny the request for exemptions and may impose conditions. Such conditions may include the amount volume restrictions may be exceeded and that all applicable plumbing fixtures or irrigation systems be replaced or modified for maximum water conservation. If the Director and the applicant are unable to reach accord on the exemption, or if the applicant is dissatisfied with the decision, the applicant may appeal to the City Manager in writing. The City Manager will make the final determination.

F. Except for an exemption granted under subsections C.1, C.2 and C.5 of this section, the water consumption surcharge specified in AMC 14.06.080 shall apply to all exemptions. (Ord. 3192 § 111, amended, 11/17/2020; Ord. 3011, amended, 05/04/2010; Ord. 2869, amended, 05/15/2001)

14.06.080 Excess Water Consumption Surcharge – Flow Restrictor Installation

For any full billing period that begins after the City Manager's determination is made and ratified as provided in AMC 14.06.060:

A. Any customer who exceeds the maximum volumes established in the Water Allocation Table for Stages 1, 2 or 3 shall pay a surcharge of four (4) times the rate for water delivered in excess of the established maximum volume.

B. During Stage 4, any customer who exceeds the maximum volumes established in the Water Allocation Table shall pay a surcharge of ten (10) times the rate for water delivered in excess of the established maximum volume.

C. Notwithstanding the above, at any time the City may install a flow restricting device upon a service exceeding the maximum volume for more than one billing period. For services up to one and one-half-inch size the City may install a flow restricting device of two gallon-per-minute capacity, and, for larger services, comparatively sized restricting devices for larger services, for a period of seven days. Before normal service will be restored, a flow restrictor installation and removal charge of $100.00 shall be paid by the person who subscribes for the water service. Appeals are as provided in AMC 14.06.060. (Ord. 3192 § 112, amended, 11/17/2020; Ord. 3137, amended, 2017; Ord. 2869, amended, 05/15/2001)

14.06.090 Penalties and enforcement

Any person who violates any provision of this Chapter is subject to Section 1.08.020 of the Ashland Municipal Code. In addition to other legal and equitable remedies available to the City of Ashland, including restriction or termination of service:

A. Violation of any section of this chapter AMC 14.06 is a Class II violation. (Ord. 3137, amended, 2017; Ord. 3029, amended, 08/03/2010; Ord. 3011, amended, 05/04/2010)

The Ashland Municipal Code is current through Ordinance 3195, passed December 1, 2020.

Disclaimer: The City Recorder's office has the official version of the Ashland Municipal Code. Users should contact the City Recorder's office for ordinances passed subsequent to the ordinance cited above.

Note: This site does not support Internet Explorer. To view this site, Code Publishing Company recommends using one of the following browsers: Google Chrome, Firefox, or Safari.

City Website: www.ashland.or.us
City Telephone: (541) 488-5307
Code Publishing Company

Oregon Water Conditions Report

April 18th, 2022

HIGHLIGHTS

Thus far in 2022, seven counties have received Executive Orders issuing state drought declarations, while four additional counties have requested drought declarations.

According to the US Drought Monitor, over 88% of Oregon is classified as experiencing moderate (D2) to exceptional (D4) drought conditions. While there has been little change in overall coverage of drought, there has been an increase in coverage of extreme drought (D3) conditions. See more information below.

Statewide snow water equivalent (SWE) is measuring 95% of the long-term median at NRCS SNOTEL sites. While all basins received an influx of late-season snowfall over recent weeks, many basins peaked well below the median peak value.

Precipitation over the past two weeks has been variable throughout the state. Nearly all of western Oregon and the Columbia River corridor received above to well above average precipitation. Eastern Oregon received a mixture of above and below average precipitation.

Recent temperatures were cooler than average throughout all of Oregon. Temperatures ranged between 4 and 10 °F below average for much of the state, with some areas between -2 and 0 °F below average mostly along the coast and Coast Range.

Soil moisture profiles continue to vary in degree of wetness, with a majority of the state experiencing well below average moisture content. While precipitation over recent weeks has benefitted root zone and surface soil wetness, much of Oregon is still experiencing near historical dryness.

The near-term climate outlook suggests probabilities favoring below average temperatures statewide over the next 8-14 days, with increased variability for precipitation. Above average precipitation is expected for much of northern Oregon, while the rest of the state has equal chances of above or below average.

Recent streamflows have measured below to well below average throughout much of Oregon with trends worsening from west to east.

Reservoir storage contents in USBR (including Klamath) and USACE systems continue to measure well below average throughout much of Oregon. Irrigation activities have begun in some basins, but conditions will likely impact water supply allocation.

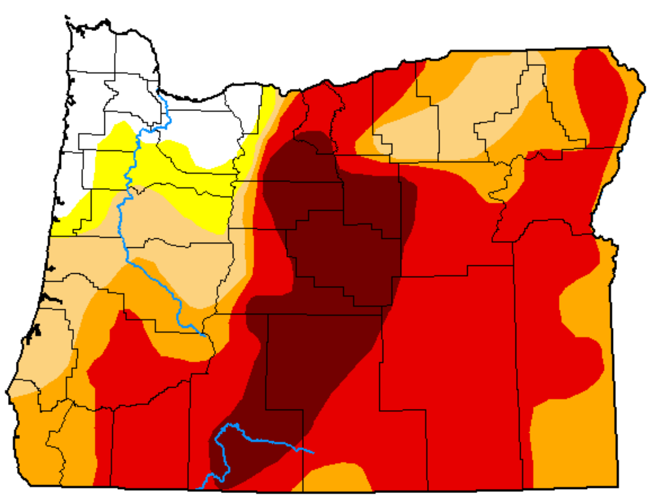
DROUGHT CONDITIONS

The US Drought Monitor indicates over 88% of Oregon is experiencing drought conditions. Extreme drought conditions have expanded in Douglas, Harney, Lake, and Malheur Counties due to a mixture of low streamflows and dry soil moisture profiles.

U.S. Drought Monitor

Oregon

April 12, 2022
(Released Thursday, Apr. 14, 2022)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

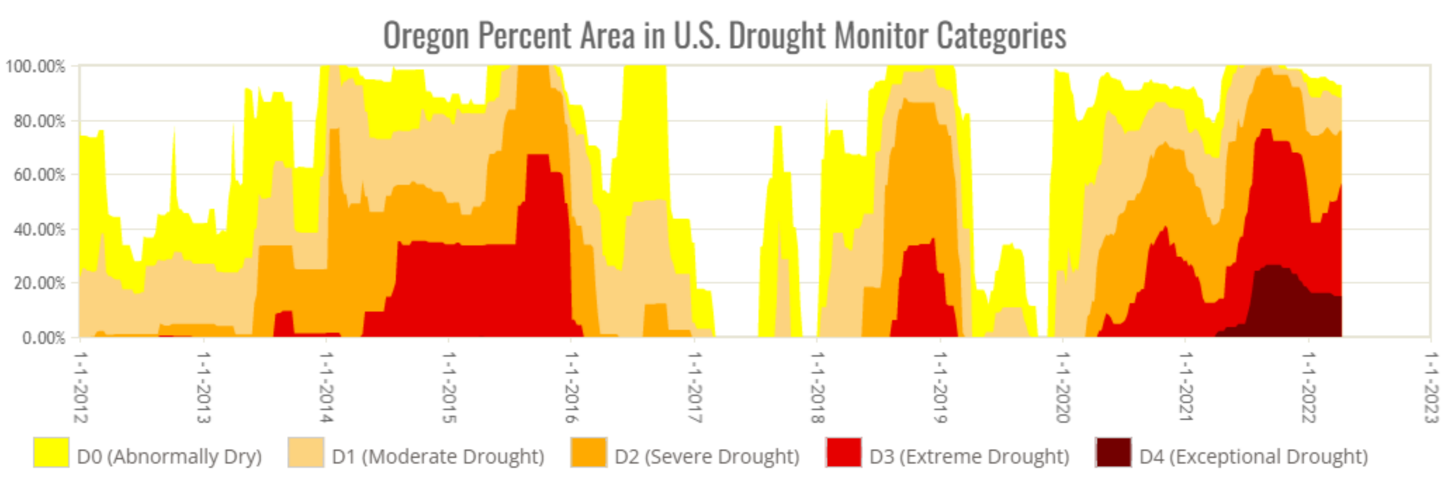
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	7.23	92.77	88.12	75.88	56.72	15.01
Last Week *04-05-2022*	7.16	92.84	88.10	75.88	54.05	15.01
3 Months Ago *01-11-2022*	4.66	95.34	88.23	74.05	42.05	16.22
Start of Calendar Year *01-04-2022*	4.16	95.84	89.75	75.37	50.84	17.27
Start of Water Year *09-28-2021*	0.00	100.00	100.00	96.47	72.10	26.59
One Year Ago *04-13-2021*	16.95	83.05	65.95	42.60	14.12	2.22

Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

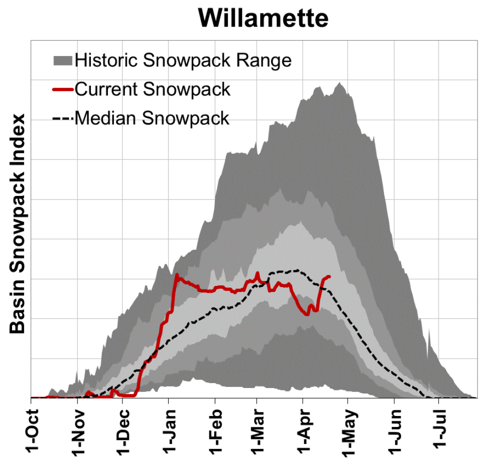
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

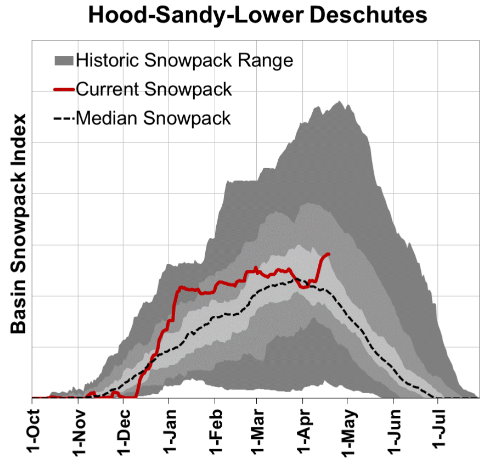
Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

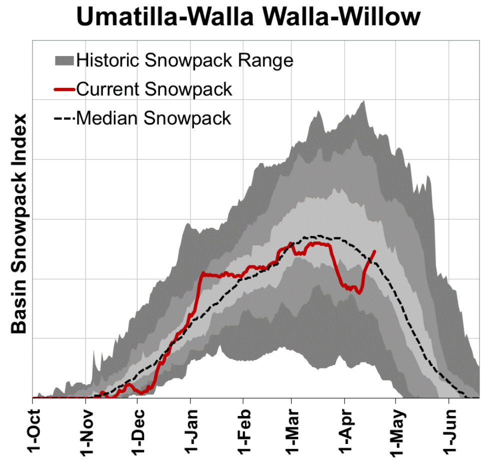
droughtmonitor.unl.edu

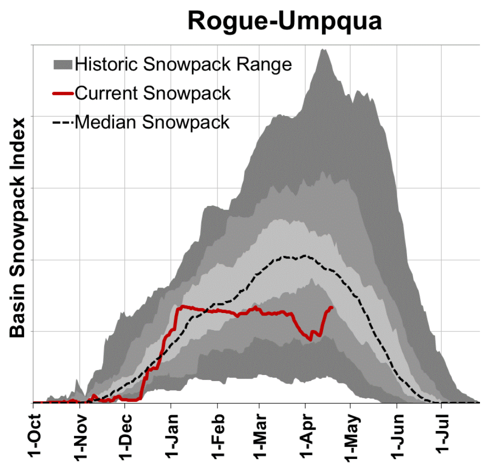


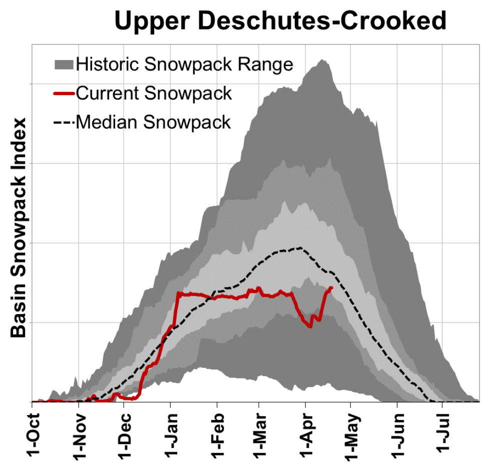
SNOWPACK

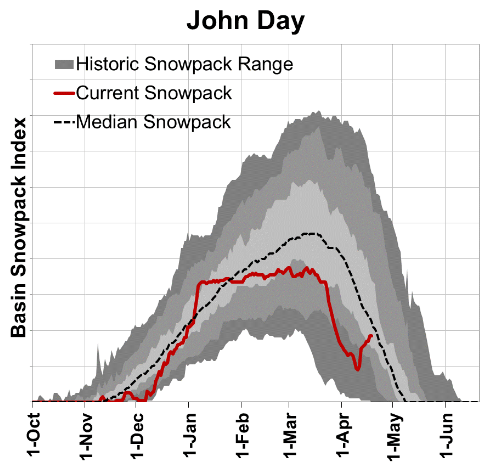

Willamette
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul


Hood-Sandy-Lower Deschutes
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul

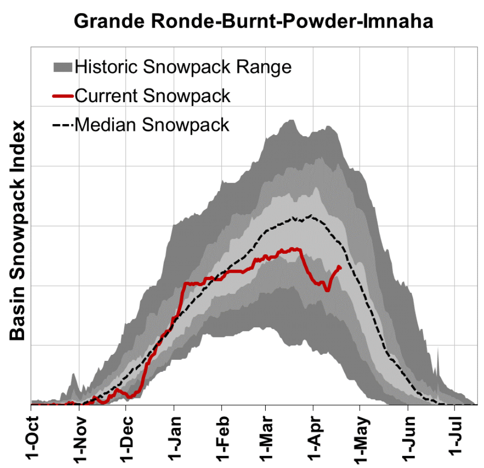

Umatilla-Walla Walla-Willow
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun

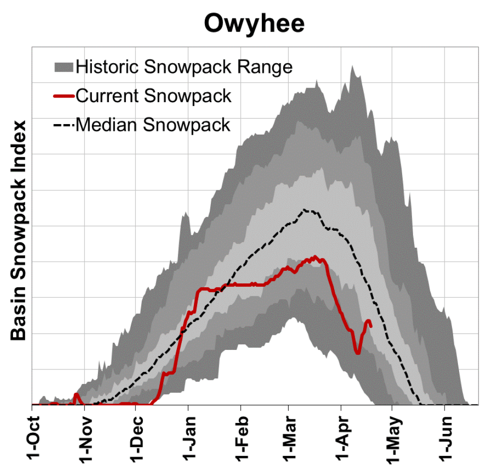

Rogue-Umpqua
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul

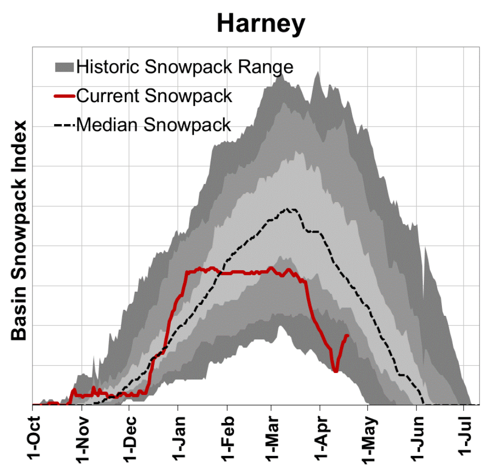

Upper Deschutes-Crooked
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul

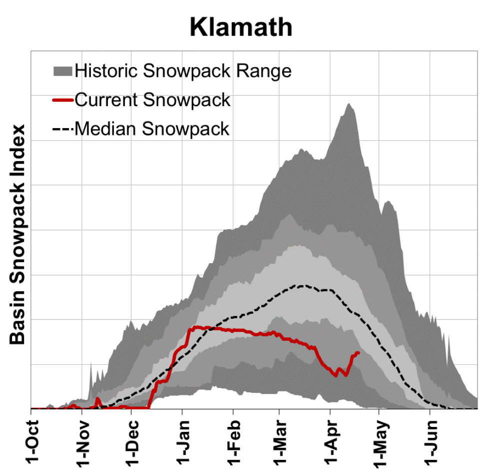

John Day
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun

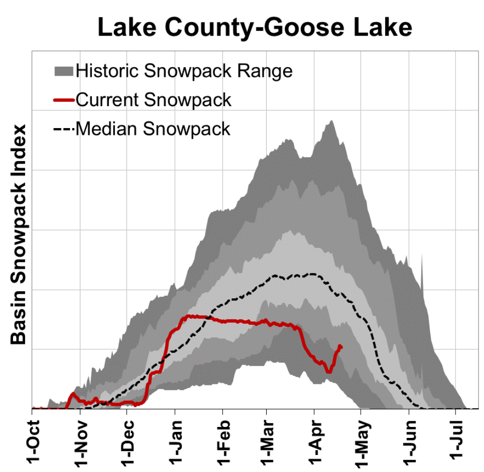
SNOWPACK


Grande Ronde-Burnt-Powder-Imnaha
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul


Owyhee
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun


Harney
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul


Klamath
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun


Lake County-Goose Lake
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
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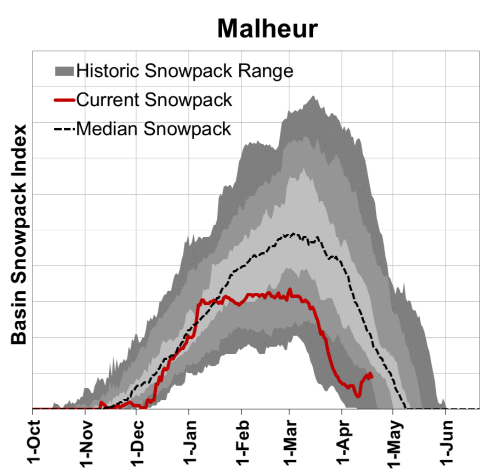
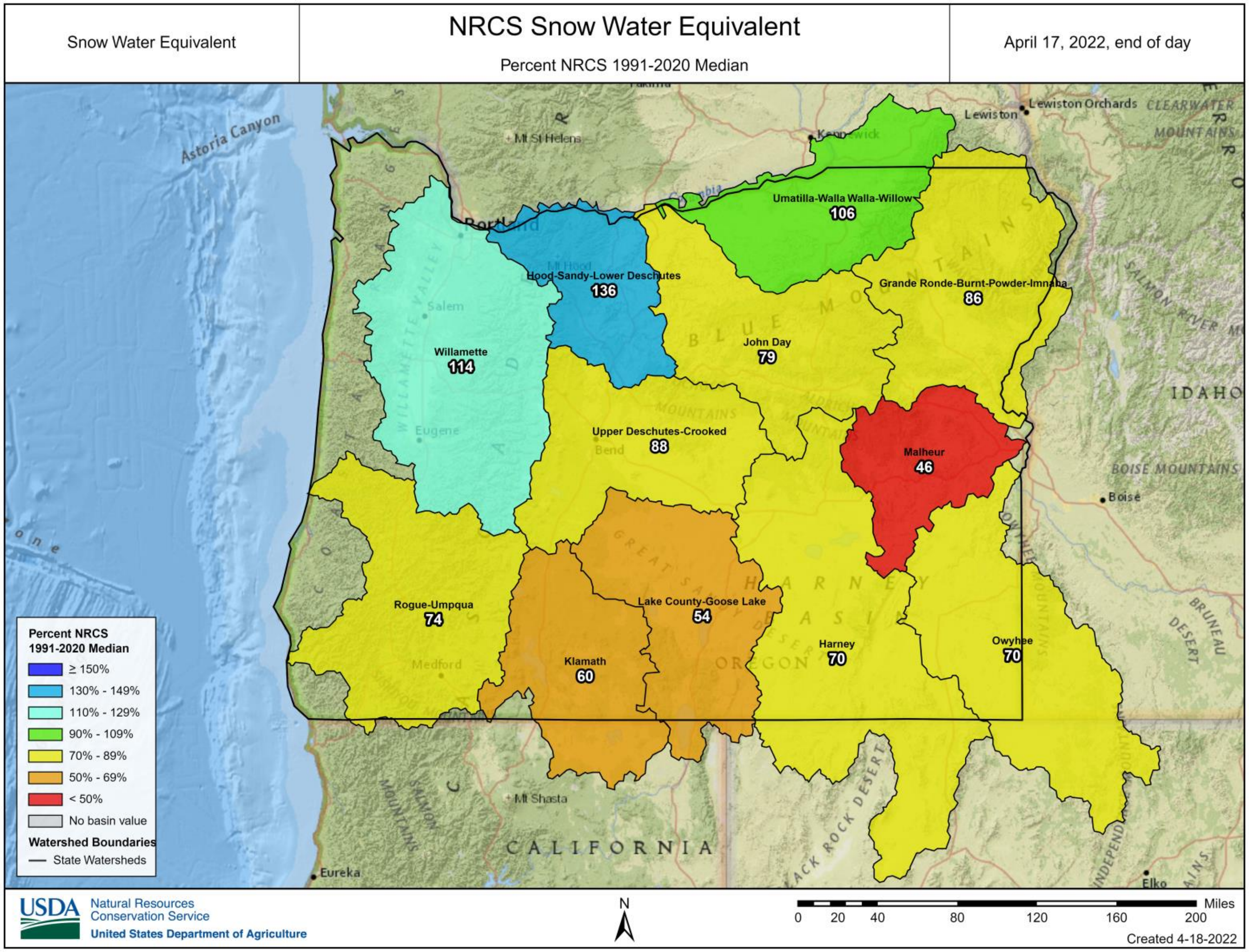
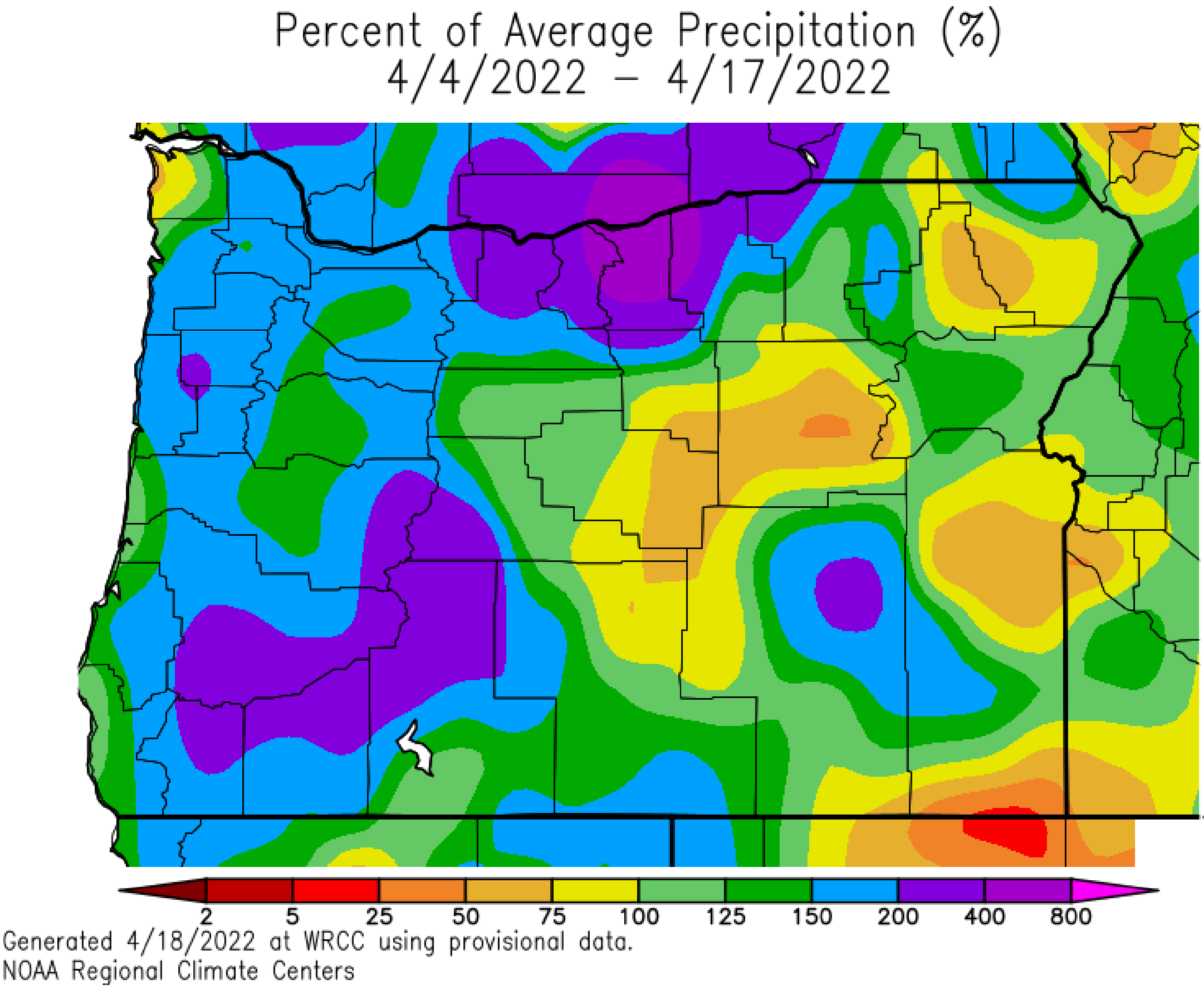
1-May
1-Jun
1-Jul


Malheur
Historic Snowpack Range
Current Snowpack
Median Snowpack
Basin Snowpack Index
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun

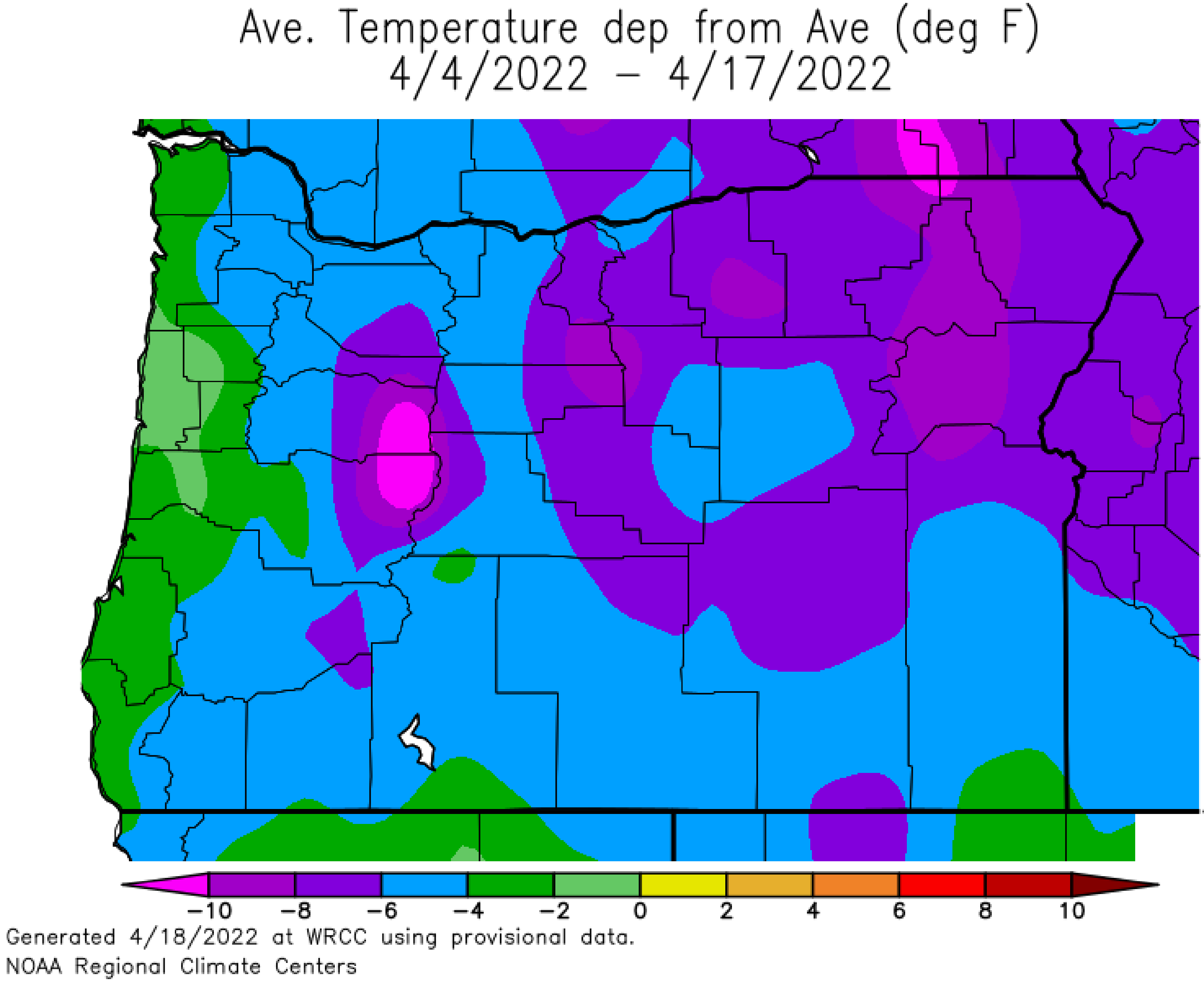
SNOW WATER EQUIVALENT

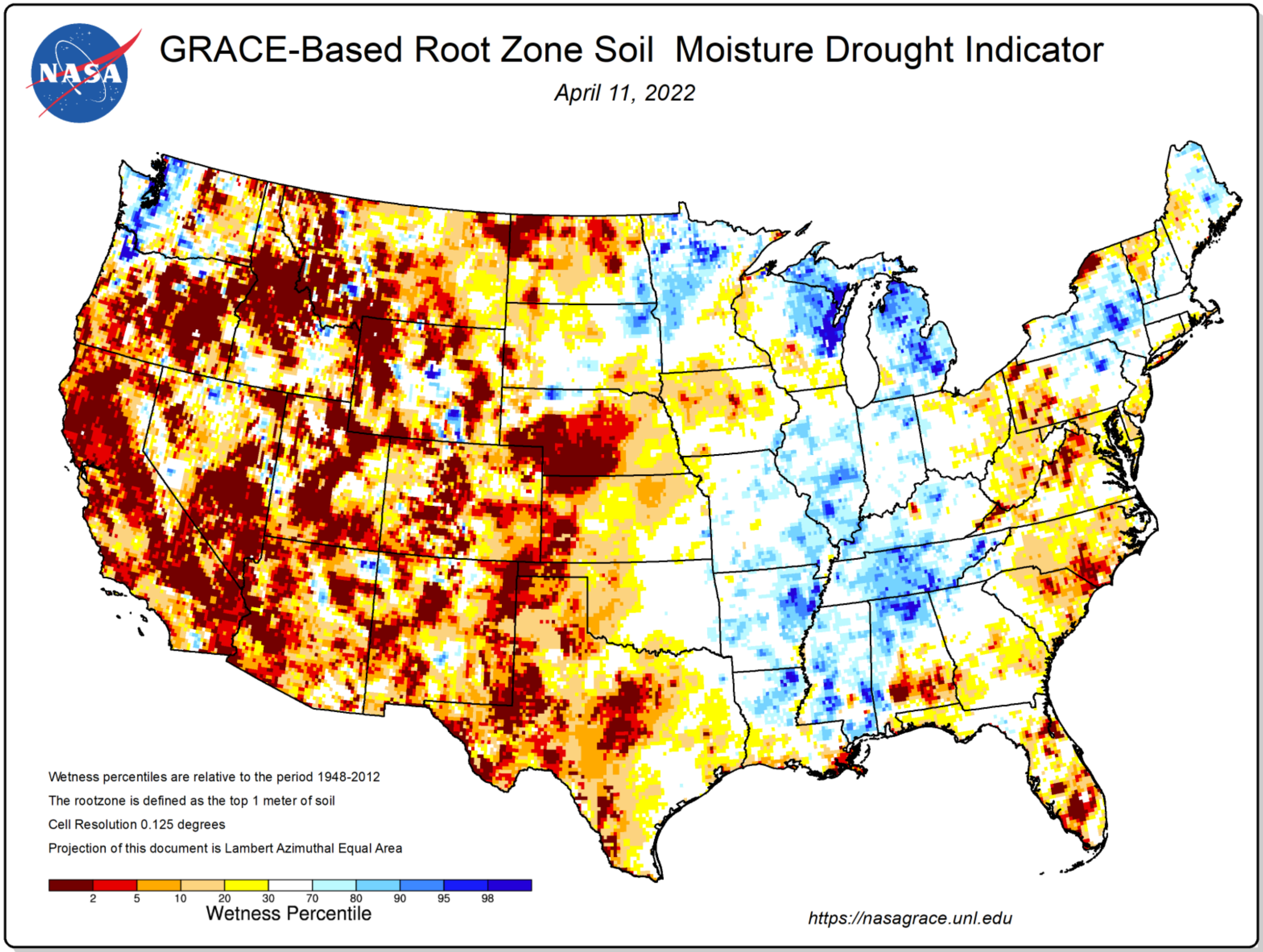


PRECIPITATION

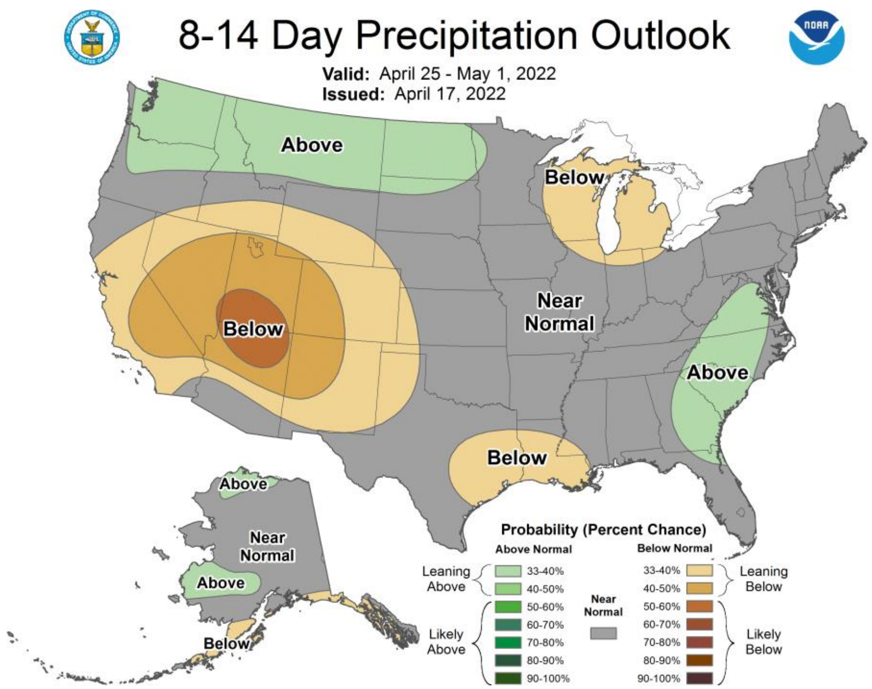


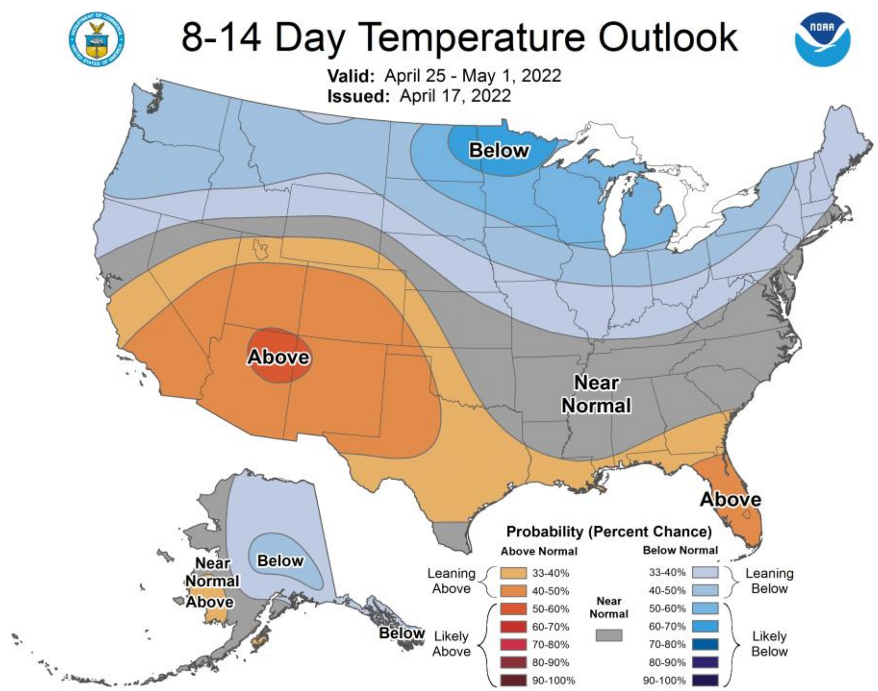
TEMPERATURE




GRACE-Based Root Zone Soil Moisture Drought Indicator
April 11, 2022
Wetness percentiles are relative to the period 1948-2012
The rootzone is defined as the top 1 meter of soil
Cell Resolution 0.125 degrees
Projection of this document is Lambert Azimuthal Equal Area
2
5
10
20
30
70
80
90
95
98
Wetness Percentile
https://nasagrace.unl.edu

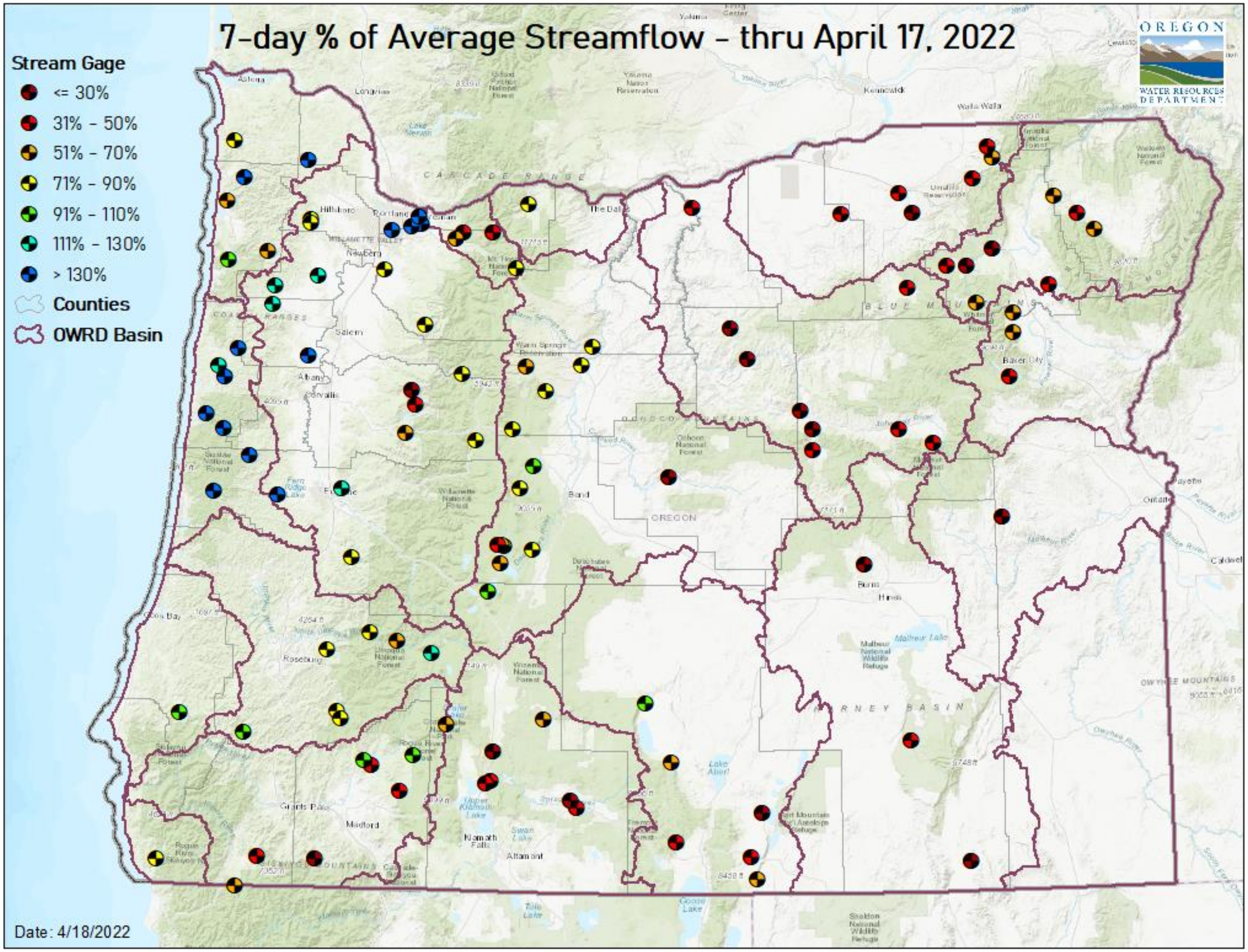
CLIMATE OUTLOOK



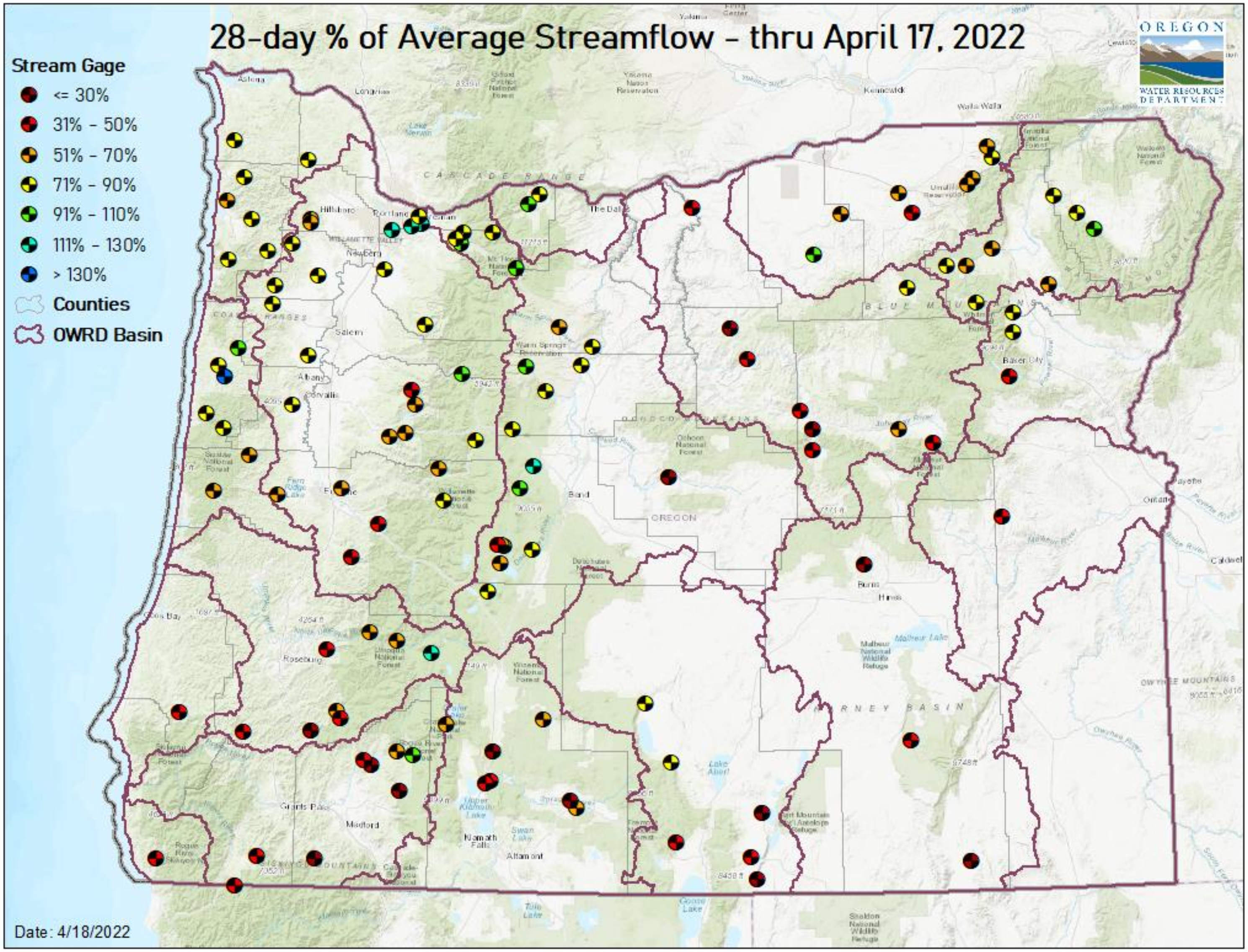


STREAMFLOW

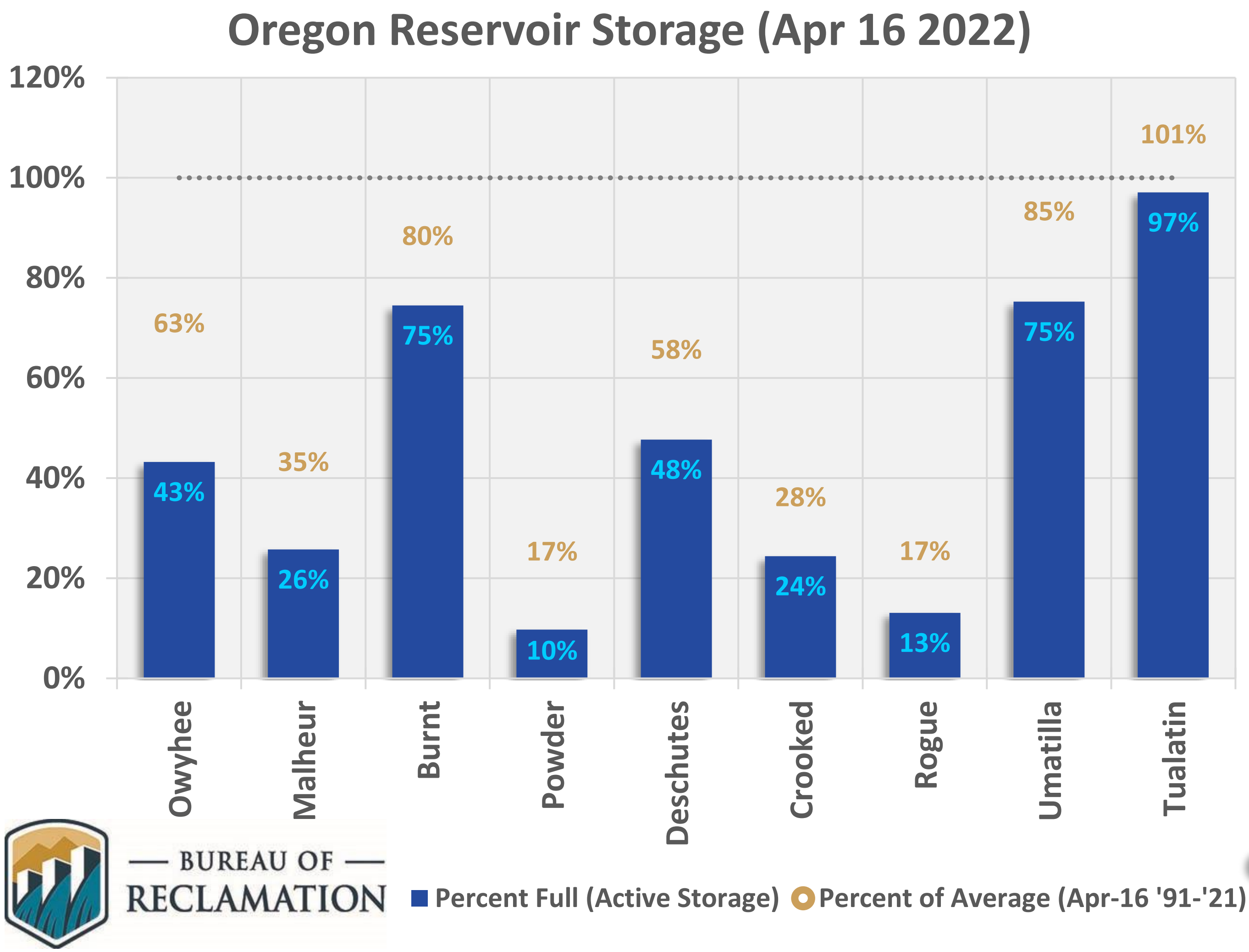
7-DAY



28-DAY



28-day % of Average Streamflow - thru April 17, 2022
Stream Gage
<= 30%
31% - 50%
51% - 70%
71% - 90%
91% - 110%
111% - 130%
> 130%
Counties
OWRD Basin
OREGON
WATER RESOURCES DEPARTMENT
Date: 4/18/2022


Oregon Reservoir Storage (Apr 16 2022)
120%
100%
80%
60%
40%
20%
0%
63%
43%
35%
26%
80%
75%
17%
10%
58%
48%
28%
24%
17%
13%
85%
75%
101%
97%
Owyhee
Malheur
Burnt
Powder
Deschutes
Crooked
Rogue
Umatilla
Tualatin
BUREAU OF RECLAMATION
Percent Full (Active Storage)
Percent of Average (Apr-16 '91-'21)

RESOURCES/REFERENCES

Please visit Oregon Water Resources Department's drought information page to learn about current drought conditions, assistance programs, and potential drought tools.

If you are interested in submitting local drought-related conditions and impacts, please visit the drought impacts toolkit to learn more. Click here to visit the map of condition monitoring observer reports.

Released every Thursday, the US Drought Monitor provides a weekly assessment of drought conditions. The USDM provides a network infographic which depicts the network of observers who gather and report information about conditions and drought impacts.

The WestWide Drought Tracker uses data from PRISM to provide easy access to fine-scale drought monitoring and climate products, such as the figures depicting climate conditions within this report.

The National Weather Service's Climate Prediction Center offers weekly, monthly, and seasonal climate outlooks illustrating the probabilities of temperatures and precipitation.

The Regional Climate Centers (RCC) working with NOAA partners, deliver climate services at national, regional, and state levels. Climate anomaly maps of Oregon are updated daily at around noon PST.

NASA's Gravity Recovery and Climate Experiment (GRACE) provide satellite-based observations of soil moisture conditions that are useful as drought indicators, helpful in describing current wet or dry soil conditions.

USGS Water Watch provides maps of real-time and average streamflow conditions at USGS sites throughout the state.

Reservoir storage "teacup" diagrams are offered by both the US Bureau of Reclamation and US Army Corps of Engineers. The diagrams represent the level of fill in the reservoirs as both percent full and as a ratio of volume of water currently in the reservoir to the volume of water in the reservoir when it is full.

Oregon wildfire information can be found through InciWeb and the Oregon Department of Forestry's Wildfire News, along with the National Interagency Fire Center which offers outlooks on the significant wildland fire potential.

Oregon Office of Emergency Management maintains a hydrology/meteorology dashboard which shows state and local drought declarations, as well as hosts many of the data sources to generate this report. Use the selection arrows at the bottom of your browser to navigate through the various sources.

US Department of Agriculture provides the Weekly Weather and Crop Bulletin as a vital source of information on US and global weather, climate, and agricultural developments, along with seasonally appropriate agrometeorological charts and tables. USDA's Drought Programs and Assistance offers links to programs and resources to help those struggling with persistent drought.

EXECUTIVE ORDER NO. 22-06

DETERMINATION OF A STATE OF DROUGHT EMERGENCY IN GILLIAM, HARNEY, AND JACKSON COUNTIES.

At the request of Gilliam County (by Resolution No. R2022-03, dated March 16, 2022, adopted by the Gilliam County Court), Harney County (by Resolution No. 2022-03, dated March 16, 2022, adopted by the Harney County Court), and Jackson County (by Order No. 47-22, dated March 23, 2022, ordered by the Jackson County Board of Commissioners) and based on the recommendations of the Drought Readiness Council and the Water Supply Availability Committee, and pursuant to ORS 536.740, I find the low snowpack, low reservoir levels, and low streamflow have caused or will cause natural and economic disaster conditions in Gilliam, Harney, and Jackson Counties.

Forecasted water supply conditions and precipitation levels are not expected to improve. Drought is likely to have a significant economic impact on the farm, ranch, vineyard, recreation, and natural resources sectors, as well as an impact on drinking water, fish and wildlife, and important minimum flows for public instream uses and other natural resources dependent on adequate precipitation, stored water, and streamflow in these areas. Extreme conditions are expected to affect local growers, increase the potential for fire, shorten the growing season, and decrease water supplies.

Conditions continue to be monitored by the State's natural resource and public safety agencies, including the Oregon Water Resources Department, the Oregon Office of Emergency Management, the Oregon Office of the State Fire Marshal, and the Oregon Department of Forestry's Fire Protection Division.

Preparation and resiliency to drought are vital to the health and safety of persons, property, and the economic security of the citizens and businesses of these counties. I, therefore, declare that a severe, continuing drought emergency exists and is likely to continue to exist in Gilliam, Harney, and Jackson Counties.

NOW, THEREFORE, IT IS HEREBY DIRECTED AND ORDERED:

I. The Oregon Department of Agriculture is directed to coordinate and provide assistance in seeking federal resources to mitigate drought conditions and assist in agricultural recovery in Gilliam, Harney, and Jackson Counties.

Contains Recycled Materials

Office of the Governor
State of Oregon

II. The Oregon Water Resources Department and the Water Resources Commission are directed to coordinate and provide assistance to water users in Gilliam, Harney, and Jackson Counties as the Department and Commission determine necessary and appropriate in accordance with ORS 536.700 to 536.780.

III. The Oregon Water Resources Department is directed to seek information from the Oregon Department of Fish and Wildlife to help understand the impacts of water availability on Oregon's fish and wildlife, as necessary and appropriate in accordance with ORS 536.700 to 536.780.

IV. The Office of Emergency Management is directed to coordinate and assist as needed with assessment and mitigation activities to address current and projected conditions in Gilliam, Harney, and Jackson Counties.

V. All other state agencies are directed to coordinate with the above agencies and provide appropriate state resources as needed to assist affected political subdivisions and water users in Gilliam, Harney, and Jackson Counties.

VI. This Executive Order expires on December 31, 2022.

Done at Salem, Oregon, this 7th day of April, 2022.

Kate Brown
GOVERNOR

ATTEST:

Shemia Fagan
SECRETARY OF STATE

Contains Recycled Materials

CITY OF ASHLAND

EXECUTIVE SUMMARY

WATER CONSERVATION AND REUSE STUDY

FINAL

June 2011

CITY OF ASHLAND

WATER CONSERVATION AND REUSE STUDY

EXECUTIVE SUMMARY

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City of Ashland

EXECUTIVE SUMMARY

1 INTRODUCTION

The City of Ashland (City) recognizes the importance of securing water resources to support the long-term health, economic viability, and environmental sustainability of the community. The purpose of the Water Conservation and Reuse Study (WCRS) was to identify an appropriate long-term water supply strategy for the City. Specific objectives included:

- Evaluate the impacts of climate change on the City's Ashland Creek supply.
- Identify an appropriate conservation target for the City and take into account its impact on the City's water supply needs.
- Identify and evaluate future sources of supply, including expansion of the existing supplies through a new impoundment, expansion of the Talent Irrigation District (TID) supply, water reuse, groundwater, and the Talent Ashland Phoenix (TAP) Pipeline.
- Evaluate the alternative sources based on financial, environmental, and other factors.
- Select a long-term water supply strategy through an integrated public process that effectively engages stakeholders.

2 GRANT REQUIREMENTS

The WCRS was funded in part by a grant from the Oregon Water Resources Department's (OWRD) Water Conservation, Reuse and Storage Grant Program. The original grant was amended based on a letter from the OWRD dated February 26, 2010. The final grant included the objectives listed in Table 1; these objectives are shown along with the specific attachments that address each objective.

Table 1 Summary of Grant Requirements

Grant Requirement	Attached Information
1. Develop RFP and award contract	Attachment A – Request for Proposals
2. Review, analyze, validate, and identify gaps in Ashland's existing water master plans and water sources.	Attachment B – Gap Analysis Attachment F – Existing Supplies
3. Identify the City's future water needs to the year 2058.	Attachment C – Water Needs Analysis Attachment D – Conservation Analysis Attachment E – Level of Service Goals
4. Identify and fully describe all alternative water sources.	Attachment N – Alternative Supplies Attachment M – Water Rights Attachment J – Groundwater Evaluation Attachment L – Reeder Reservoir Expansion

Table 1 Summary of Grant Requirements

Grant Requirement	Attached Information
5. Identify options that explore the right water for the different water uses; potable, irrigation (sources and uses).	Attachment K – Talent Irrigation District Analysis
6. Identify benefits and challenge to using irrigation water.	Attachment K – Talent Irrigation District Analysis
7. Analyze environmental harm or impacts with the long term use of various irrigation water sources for City irrigation use.	Attachment P – Environmental Analysis
8. Evaluate hydrological benefits and challenges and anticipate the effects of climate change with regard to water needs and water use.	Attachment F – Climate Change Analysis
9. Identify benefits and challenges to using recycled water.	Attachment H – Recycled Water Analysis Attachment I – Recycled Water Piping
10. Identify options and cost estimates.	Attachment N – Alternative Supplies
11. Identify potential use of a water exchange to help meet wastewater treatment plant temperature limitations (TMDL).	Attachment Q – Water Exchange Evaluation
12. Complete a consolidated engineering and financial feasibility study and cost benefit analysis of the preferred alternatives. Identify the link between conservation and enhanced conservation efforts and the preferred alternative.	Attachment O – Right Water Right Use
13. Identify the specific community and public benefits accruing from the proposed alternative including estimated project costs, financing for the project, and projected financial returns from the project.	Attachment O – Right Water Right Use

3 LEVEL OF SERVICE GOALS

As part of the WCRS, the City established an Ashland Water Advisory Council (AWAC). The AWAC process was funded wholly by the City, separate from the OWRD grant funding. The role of the AWAC was to serve as an advisory group to the Council and the City's water staff, providing a link with the community and involving impacted persons and interest groups with the WCRS and CWMP. One of the main responsibilities of the AWAC was to establish level of service (LOS) goals that would inform the water supply alternatives developed through the WCRS. The LOS goals established by the AWAC are summarized in Table 2.

Table 2 Selected LOS Goals

Goal Area	Goal
Water System Capacity	Have sufficient supply to meet projected demands that have been reduced based on 5 percent additional conservation. However, City will have a goal of achieving 15 percent conservation.
Water System Reliability	Community will accept curtailments of 45 percent during a severe drought.
Water System Redundancy	Implement redundant supply project to restore fire protection and supply for indoor water use shortly after a treatment plant outage.
Regulatory Requirements	Meet or exceed all current and anticipated regulatory requirements.

4 WATER NEEDS AND CONSERVATION

Future water needs were assessed both with and without additional conservation. Water needs under curtailment conditions were also assessed to meet the AWAC's LOS goal for 45 percent curtailment during severe drought.

The City's future water needs were initially projected through 2060 based on the current level of conservation and the following data:

- Average water use of 157 gallons per capita per day based on annual supply volumes and populations for years 2005 through 2009.
- Projected population of 30,326 people in 2060 based on the City's 1981 Comprehensive Plan.
- Peaking factor (ratio of demand on maximum day to annual average daily demand) of 2.06, based on 2005 through 2009 supply data.

The projected average and maximum day demands for 2060 with no additional conservation are 4.76 mgd and 9.81 mgd, respectively.

Potential conservation impacts were then projected based on an evaluation of the City's current conservation programs, assessment of indoor versus outdoor use and residential versus commercial use, and benchmarking against water use in other communities. Three potential conservation levels were explored: 5, 10, and 15 percent additional conservation. All conservation levels were applied assuming the 75 percent of the reductions by volume would be achieved in outdoor use and 25 percent in indoor use. The resulting average day and maximum day demands for the three conservation levels are summarized in Table 3. Potential new conservation programs were identified to support reaching the City's conservation goals. The AWAC's LOS goal for 45 percent curtailment during a severe drought was then applied, resulting in the projected monthly water use patterns for 2060. The curtailment goal was applied assuming a 45 percent reduction during the maximum month of usage.

Table 3 Projected Maximum Day Demands with Varying Levels of Conservation

Year	Projected Demands (million gallons per day)(3)					
	5 percent reduction		10 percent reduction		15 percent reduction	
	ADD	MDD	ADD	MDD	ADD	MDD
2010	3.38	7.14	3.38	7.14	3.38	7.14
2020[1]	3.50	7.59	3.41	7.32	3.32	7.04
2030[2]	3.69	8.00	3.49	7.40	3.30	6.79
2060	4.52	9.36	4.29	8.66	4.05	7.95

Notes:
(1) Assumes half of the targeted additional conservation level is achieved by 2020.
(2) Assumes the targeted additional conservation level is achieved by 2030.
(3) ADD – average day demand; MDD – maximum day demand.

5 EXISTING SUPPLIES

Existing water supplies were evaluated for their ability to meet the projected 2060 water needs. The evaluation included the City's two sources of supply, consisting of the Ashland Creek supply (which is stored in Reeder Reservoir) and the Talent Irrigation District (TID). Descriptions of the two supplies and a summary of the evaluation of the adequacy of the existing raw water supplies and treatment facilities are provided herein.

5.1 Ashland Creek Supply

Both the West and East Forks of Ashland Creek drain to Reeder Reservoir. Supply can be taken from the reservoir, or directly from diversions on the creeks. During the summer, the City mainly depends on the stored water in Reeder Reservoir; Ashland Creek flows are typically low and the City's use is limited based on the rights of senior water rights holders and environmental requirements.

An analysis of climate change impacts on the Ashland Creek supply was completed by Dr. Alan Hamlet of the Climate Research Center at the University of Washington. The study used a Distributed Hydrologic Surface Vegetation Model (DHSVM) to project anticipated alterations to water resources in the City's watershed. A total of eight climate change scenarios for years 1920 through 2006 were investigated; the average of the eight scenarios was used for the evaluations.

5.2 Talent Irrigation District

TID water is provided to Ashland via the Ashland Canal, the lower portion of which is operated by the City of Ashland. Water to the Ashland portion of the canal is metered by TID and regulated according to the City's water right of 769-acre feet per year (AFY), available during the irrigation season of April through October. This water is divided among three uses: losses (due to the unlined canal and operational overflows), irrigation users, and potable water (by being pumped to the Ashland WTP). TID water is used for irrigation by a number of public and private properties, including Lithia Park; these uses are generally not metered. TID water can be conveyed to the Ashland WTP via the Terrace Street Pump Station to produce potable water. It was estimated that approximately 223 AFY is available for this use. A detailed climate change evaluation was not conducted on the TID supply. Based on evaluations conducted in previous projects, it was estimated that 50 percent of the TID supply would be available in the third year of a prolonged, severe drought.

5.3 Water Supply Model

The objective of the water supply model was to compare the available supplies to the estimated demands and identify limitations of the existing supply system to meet future demands, especially under different drought conditions. Both Ashland Creek (Reeder Reservoir levels) and TID supplies were considered to generate available water for the City's use. The supplies were evaluated for three drought scenarios:

- Worst Drought (1928-1931) without Climate Change;
- Worst Drought (1924) with Climate Change; and
- 1-in-10 year drought (1987) without Climate Change.

The additional supply requirements in 2060 projected by the water supply model for the three scenarios are shown in Table 4.

Table 4 Summary of Supply Model Analysis

Additional Conservation Goal	Additional Supply Capacity Needed in 2060 (AF)(1)		
	1928-1931 No Climate Change	1924 With Climate Change	1987 No Climate Change
5 percent	238	619	849
10 percent	34	414	645
15 percent	0	210	467

Notes:
(1) MG – millions of gallons; AF – acre feet.

Required water treatment capacity to meet projected peak day water needs was also assessed. The current capacity of the water treatment plant was assumed to be 7.5 million gallons per day (mgd), based on the experience of plant staff and historical plant performance. The projected capacity deficits at maximum day ranged from 0.5 mgd for 15 percent additional conservation to 2.3 mgd for no additional conservation.

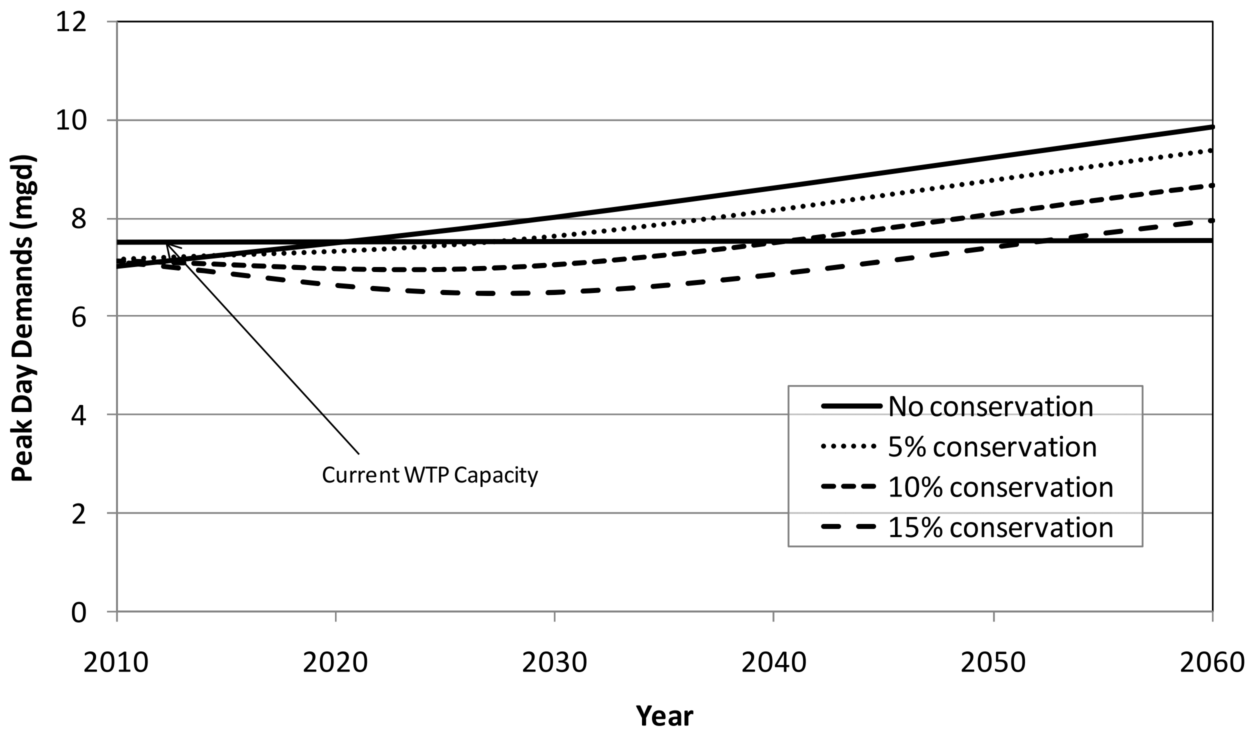


Figure 1 Project Maximum Day Demands Compared to Current WTP Capacity

6 ALTERNATIVE SUPPLIES

The WCRS considered eight water supply alternatives; some alternatives increase raw water supplies, some increase peak potable water availability, and some do both. The water supply alternatives being evaluated for this study vary greatly in the degree to which they have previously been investigated. Significant engineering has been completed on some alternatives, whereas other alternatives are being evaluated for the first time based on preliminary information. The costs and other information presented herein are based on the best information available at this time. All alternatives would require additional studies following completion of the WCRS to gather missing information and then to develop a design for the required facilities. Such further studies may reveal additional issues not identified to date that may significantly impact the cost, capacity, or feasibility of the water supply alternative. The specific alternatives are summarized herein.

6.1 Water Reuse

The Ashland Wastewater Treatment Plant (WWTP) has the ability to produce up to 2.3 mgd of Class A Reclaimed Water. Class A recycled water can be used for irrigation of crops, including crops for human consumption, and can also be used to irrigate parks, playgrounds, residential landscapes, and other landscapes accessible to the public. The WCRS evaluated delivery of the reclaimed water from the WWTP to non-residential properties within the City. The properties currently get their water from one of three sources: the City's potable water system, senior Ashland Creek water rights, or TID water (either from the City's portion of the Ashland Canal or from their own TID water rights). Three different scenarios for purple pipe systems were developed, which varied in the extent of the system and whether they assumed participation of properties with existing Ashland Creek water rights. The specific properties to be served (and their current irrigation water source) were identified for all scenarios. An additional scenario was later added consisting of delivering water only to the Imperatrice property (which is owned by the City) allowing the property's TID water rights to be used by the City. All scenarios included a new recycled water pump station to pump water from the WWTP to an equalization reservoir on the Imperatrice Property followed by a gravity piping system that would deliver water to the selected properties.

The capacities of the recycled water scenarios ranged from 831 AF to 1,657 AF (not including the Imperatrice scenario). The scenarios offset peak potable water demands by only 0.1 to 0.6 mgd, as most of the offset demands are currently served by TID water. The recycled water system would not provide a redundant potable water supply. Key issues associated with this alternative include the requirement for the participation of individual landowners (some of whom would need to transfer their existing water rights to the City) and the potential need for the City to replace a portion of the recycled water removed from Bear Creek to provide environmental benefits.

6.2 TAP Pipeline

The City participated with the cities of Talent and Phoenix, along with support from the Rogue Valley Council of Government and the Medford Water Commission, to reserve capacity and share in the cost of building the TAP Pipeline and Regional Booster Pump Station. The City of Ashland has a reserved capacity of 1.5 mgd in the existing portion of the TAP Pipeline. Under this supply alternative, the existing TAP pipeline would be extended to the City of Ashland. The new pipeline is assumed to be a 16-inch diameter ductile iron pipeline with a total length of approximately 21,050 feet. This supply alternative would also include a new pump station that would be wholly owned and operated by the City of Ashland. The raw water supply would be from the City's existing rights in Lost Creek Reservoir. A key issue associated with this alternative is the loss of water supply independence, including a lack of control over future wholesale water rates.

The capacity of the TAP pipeline was assumed to be 1.5 mgd based on previously-completed work. The TAP supply is treated, potable water, so the full capacity would be used to meet peak potable water demands. This supply would provide a redundant potable water supply. The assumed peak season capacity is approximately 690 AF, assuming the system would only be operated during the reservoir drawdown period during non-emergencies.

6.3 Expanded Talent Irrigation District Supply

Two potential alternatives were evaluated for expanding the TID supply. The first was piping the Ashland Canal from Green Springs Turnout to the Terrace Street Pump Station. It was determined that acquiring new water rights for the water saved through implementation of this alternative would likely not be possible, hence this alternative was eliminated from further consideration. The second alternative is piping the City's portion of the Ashland Canal, from the Starlite Monitoring Station to its terminus at Wright's Creek. The water gained would be in the form of reduced water losses; current losses could only be approximated, as use of TID water is generally unmetered. This alternative would have the additional benefit of preventing contamination of the TID water along that reach of the canal and ceasing overflows to Ashland Creek.

The Ashland Canal piping project would not affect available peak day supplies, assuming recovered water would be treated at the City's water treatment plant and used for potable water supply. If the City were to instead deliver recovered flows to additional properties for irrigation use, the offset would be on the order of 0.8 mgd. The estimated capacity gained through the Ashland Canal piping project is 274 AF (89 MG), based on estimated losses from the City's portion of the canal. A new Ashland Creek impoundment would not provide a redundant potable water supply; this alternative would not address the redundancy level of service goal. A key issue associated with this supply is the uncertainty of the capacity gains and their insufficiency in meeting projected capacity shortfalls on their own.

6.4 New Ashland Creek Impoundment

The current evaluation focused on a new Ashland Creek impoundment at the Winburn Site, located approximately one mile upstream of Reeder Reservoir. A potential new reservoir at this site has been evaluated in several previous studies. Due to the configuration of the site, it appears possible to "right-size" the alternative to meet the projected storage deficit of 619 AF. The new impoundment would not affect available peak day supplies, as all flows would need to be treated at the City's water treatment plant, and this alternative would not provide a redundant potable water supply. The key issues associated with this alternative include significant environmental and community impacts; over 25 acres of clear/inundated forest land, a new 9,000 foot access road, and around one million cubic yards of imported material. It also appears it would be very difficult to obtain water rights for a new impoundment.

6.5 Potable Groundwater System

An evaluation of local groundwater resources was conducted for a 700 square mile area surrounding the City, including review of over 10,000 well logs. The average production of the wells was 8 gpm, with a few wells producing more than 350 gpm. Given the uncertainty in the availability and reliability of groundwater resources, a range of cost estimates was developed for this alternative based on differences in individual well capacities, treatment requirements, and new wells versus use of existing ones.

It was assumed that the groundwater system would be sized to meet the AWAC's LOS goal for redundant capacity, providing a peak capacity of 1.5 mgd. This capacity would reduce but not eliminate the projected peak day supply deficiency. This capacity would provide an annual volume of 690 AF (based on use only during the Reeder Reservoir drawdown period), sufficient to meet the projected supply shortage. Key issues include the significant uncertainty in whether the required capacity could be achieved through a reasonable number of wells and whether those wells would be a reliable source of supply. Well water may also require significant treatment for water quality and may change the aesthetics of the water.

6.6 Aquifer Storage and Recovery

In the proposed aquifer storage and recovery (ASR) system, surface water would be stored underground during high flow periods by being pumped into the ASR wells. During drought periods when additional supply is needed, the water would be pumped out of the ASR wells and conveyed to the City via the TID system including the Ashland Canal. The area appearing most promising for an ASR system, based on available geologic data, is in the vicinity of the Howard Prairie and Hyatt Reservoirs. As there are no well logs available for this area, feasibility of this option cannot be determined at this time. There is also insufficient data available to estimate the potential capacities or costs of ASR wells, hence no cost information was developed.

6.7 Intertie with City of Talent

The City of Ashland recently signed an intertie agreement with the City of Talent. The intertie pipeline would follow the route of the proposed TAP pipeline extension, extending approximately two thirds (14,000 feet) of its total length. A temporary pump station may be required to deliver flows to the City of Ashland System. It is recommended that the City of Ashland work with the City of Talent to confirm the capacity and additional infrastructure requirements of the intertie, if implementation of this alternative is pursued. The estimated cost for this alternative does not include a pump station to lift flows into the City of Ashland's distribution system nor any capital cost sharing for facilities (e.g., their planned new reservoir) within the City of Talent system. This alternative provides the possibility of providing water to the City of Ashland during the winter, pending confirmation of feasibility given environmental flow requirements in the winter.

6.8 Water Treatment Plant Expansion

The existing water treatment plant has a capacity of approximately 7.5 mgd, based on the plant's historical performance and input from operations staff. The water treatment plant was previously designed to a capacity of 10 mgd and this design capacity could be realized by restoring two existing filters that are currently not in service. These improvements would be sufficient to meet the projected deficiency in peak day capacity, but would not affect total available supplies and would not provide a redundant source of potable water.

6.9 Water Treatment Plant Flood Wall

Implementation of a storm/flood wall at the existing water treatment plant to improve reliability of the existing facilities was evaluated. The wall was assumed to have a length of approximately 1,000 feet and height of 10 feet, based on input from City staff on water levels at the water treatment plant during previous floods. The wall would not directly meet any of the LOS goals established by the AWAC, but would decrease the vulnerability of the existing plant, thereby reducing the need for a redundant supply.

6.10 Emergency Water Treatment Plant

Two alternatives were evaluated for an emergency water treatment plant: (1) having a contract with a membrane system manufacturer to provide a membrane system in an emergency and (2) purchasing the system and putting it in operation during an emergency. The latter alternative was determined to be more cost effective, and is discussed here. The system was assumed to have an overall capacity of 1.5 mgd, including a trailer mounted membrane system, a low-lift pump station, and allowances for site preparation. The back-up treatment plant would provide a redundant source of potable water, but would not help meet peak or annual supply capacity requirements as it would only be operated in an emergency.

6.11 New Water Treatment Plant

An alternative for a new water treatment plant was developed later in the project based on input from the AWAC. This new facility would have an initial capacity of 2.5 mgd and be expandable to eventually replace the existing WTP as it reaches the end of its useful life (ultimate capacity of about 10 mgd). The intent is that the new WTP would be located in a less vulnerable location and would be operated year-round; the planned capacity of 2.5 mgd is sufficient to meet current winter demands. The existing WTP would then only be operated during the summer months, when demands are greater.

6.12 Water Exchange Evaluation

An evaluation of exchanging wastewater with TID to meet total maximum daily load (TMDL) requirements for temperature was completed as part of the City's Sewer Master Plan. This does not impact the water supply alternatives; a summary is included here as this evaluation was included in the OWRD grant funding. The TID exchange would involve discharging the City's effluent into the TID irrigation system. The likely discharge location would be Talent Canal. One of the benefits of this alternative would be the reduced chemical requirements needed to remove phosphorous, because most of the water would be reused or land applied downstream. This alternative would mitigate concerns about near field impacts to aquatic habitat, and would reduce the thermal load requirements to the extent that the effluent is reused downstream.

The TID Board identified a number of concerns associated with alternative, including real and perceived concerns with receiving effluent, presence of chemicals in the water, and the approval of their patrons. Given the significant TID concerns as well as other regulatory and O&M issues, it was recommended that this alternative not be pursued at this time. However, the plan acknowledges that it may be viable in the future as public perception changes and if drought conditions make the water resources more valuable.

7 PLANNING LEVEL COST ESTIMATES

Planning-level cost estimates were developed for each of the water supply alternatives. These estimates are presented as total project costs in August 2010 dollars, corresponding to an Engineering News Record (ENR) 20-Cities Construction Cost Index (CCI) of 8,858. Costs are at a planning level (+50/-30 percent accuracy), unless otherwise noted. Estimates should be refined as project- and site-specific requirements are further developed. Estimated capital and O&M costs for the individual alternatives are summarized in Table 5.

Table 5 Estimated Capital and O&M Costs for Water Supply Alternatives

Water Supply Alternative	Planning Level Estimated Costs		
	Capital ($ Million)(1)	O&M ($1,000/year)	NPV ($ Million)(2)
Reclaimed Water	$10.8 – 20.7	$85 - 122	$10.3 – 19.1
Reclaimed Water – Imperatrice	$5.3	$50	$5.2
TAP Pipeline	$12.2	$337	$16.0
TID – Ashland Canal Piping	$2.7	-	$2.2
Ashland Creek Impoundment	$79.7	$100	$66.6
Groundwater	$3.5 – 20.3	$82 - 164	$4.3 – 19.5
Talent Intertie	$5.3	-	$4.3
WTP Expansion	$0.8	-	$0.7
Protected WTP - Floodwall	$1.83	-	$1.5
Emergency WTP	$8.4		$6.9
New WTP	$12.0		$9.8

Notes:
(1) Costs include the following contingencies: 20 to 30 percent estimating contingency; 15 percent for contractor overhead and profit; and 20 to 25 percent for engineering, legal and administration (ELA) costs.
(2) Net Present Value (NPV) based on: capital improvements completed by 2020; O&M expenses for 2020 through 2060; discount rate of 3 percent.

8 WATER SUPPLY PACKAGES

The individual water supply alternatives were then combined into six initial water supply packages. All of the water supply packages fully met the AWAC's LOS goals. The one exception was Package 3, which did not fully meet the supply shortage. The packages were evaluated according to thirteen criteria, as presented in Table 6. The criteria rankings were reviewed by the AWAC and revised according to their input. Packages including an emergency supply to provide system redundancy included the cost for the Talent Intertie, which was the lowest-cost emergency supply alternative evaluated.

Table 6 Summary Criteria Evaluation

Criterion	Water Supply Packages					
	Package 1 - Recycled Water + Emergency Supply + WTP Expansion	**Package 2 - TAP Extension + WTP Expansion**	**Package 3 - TID Expansion (Ashland Canal) + Emergency Supply + WTP Expansion**	**Package 4 - Winburn Dam + Emergency Supply + WTP Expansion**	**Package 5 - Potable Groundwater + WTP Expansion**	**Package 6 - Aquifer Storage and Recovery (ASR) + Emergency Supply + WTP Expansion**
Reliability	**+** Includes redundant potable water supply	**+** Includes redundant potable water supply	**+** Includes redundant potable water supply	**+** Includes redundant potable water supply	**+** Includes redundant potable water supply	**+** Includes redundant potable water supply
Cost Effectiveness	**- to 0** $20.2 – 29.0 M	**0** $21.6 M	**+** $12.1 M	**-** $76.5 M	**0 to +** $9.9 – $25.1 M	**-** Undefined
Financial Risk	**0** Conceptual costs and relatively low-risk construction	**+** Well-developed option	**0** Conceptual costs and relatively low-risk construction	**-** Technical details are sparse and costs are already high	- Little information on reliable capacity (may need more wells)	**-** Technical details don't exist and potential costs are very high
Appropriateness of Use	**+** Offsets potable water use with recycled water	**0** No improvement	**0** No improvement	**0** No improvement	**0** No improvement	**0** No improvement
Environmental Friendliness	**0** Pipelines along City roadways	**0** Pipeline along highway	**0** Pipeline in open areas	**-** Massive environmental impact during construction	**0** Construction at multiple sites	**Undefined** Depends on project configuration
Public Acceptability	To be defined by AWAC	To be defined by AWAC	To be defined by AWAC	To be defined by AWAC	To be defined by AWAC	To be defined by AWAC
Independence	**+** Local resource	- Supply from Medford	- Supply from TID	**+** Local resource	+ Local resource	**-** Coordination with TID and Bureau
Community Impacts	**0** Impacts during construction only	**0** Impacts during construction only	**0** Impacts during construction only	**-** Impacts during construction and potentially thereafter	**0** Impacts during construction only	**+** Impacts during construction only, and distant from communities
Water Quality	**0** Maintain existing potable supplies	**0** Comparable to current	**-** Different quality than Reeder	**0** Provides additional Ashland Creek water	- Iron, manganese and total dissolved solids	- Provides additional TID water
Operational Flexibility	**0** Incremental expansion possible, would take time	**0** Temporary additional supplies may be available from Talent, total capacity limited	**0** Temporary additional supplies may be available	**-** Once constructed, dam expansion not likely feasible	0 Incremental expansion possible, would take time	**0** May be possible to expand supply
Operational Manageability	**-** New pump station, reservoir and distribution system	**0** New pump station and single pipeline	**+** Simplifies ongoing operations for City canal	**-** Additional dam and related facilities to operate and maintain	**-** 10 +/- new wells to operate, likely with new treatment systems	**-** Additional distant facilities to operate and maintain
Scalability	**0** Can extend to additional properties, but not at equal efficiency	**-** City has purchased 1.5 mgd capacity in pipeline	**-** No clear opportunity to develop required additional supply	**0** Storage can be sized for demand projections	+ Wells can be constructed to meet demands	**0** Wells can be added if basin supports it
Implementation Risk	**0** Requires cooperation of individual property owners	**+** Most well-developed of the alternatives	**+** City can pipe own portion of canal without cooperation	**-** Given the limited information, risk is high	**-** Risk of poor water quality, low reliability of supply	**-** Given the limited information, risk is high

9 WATER SUPPLY DECISION

The AWAC decided to divide the overall water supply plan into two separate components: (1) addressing the need for a redundant water supply and (2) increasing annual storage volumes. Given that annual storage volumes are not anticipated to be deficient until after 2030, it was decided that a decision on a water supply alternative should be delayed until the next plan. However, the AWAC did provide the following recommendations:

- A new Ashland Creek impoundment and ASR should be eliminated from consideration as a water supply alternative.
- Groundwater testing to further evaluate the groundwater alternative should be added to the City's CIP in the amount of $150,000.
- The City should move aggressively to acquire additional Ashland Creek or TID water rights as they come available.
- Additional storage should be evaluated as part of the next Water Master Plan Update, including alternative methods such as shading, snow fencing, and silviculture practices; tanks or reservoirs may or may not be included.

The AWAC was able to reduce the alternatives being considered for system redundancy to two options: the Talent intertie and a new WTP. It was decided that the rate impacts of both alternatives will be determined and presented to the City Council to make the final decision on a new redundant water supply. This decision is anticipated in Fall 2011. Regardless of the initial alternative selected, the AWAC recommended that phased replacement of the existing WTP at a less vulnerable location would be a better investment than expansion at the existing location.

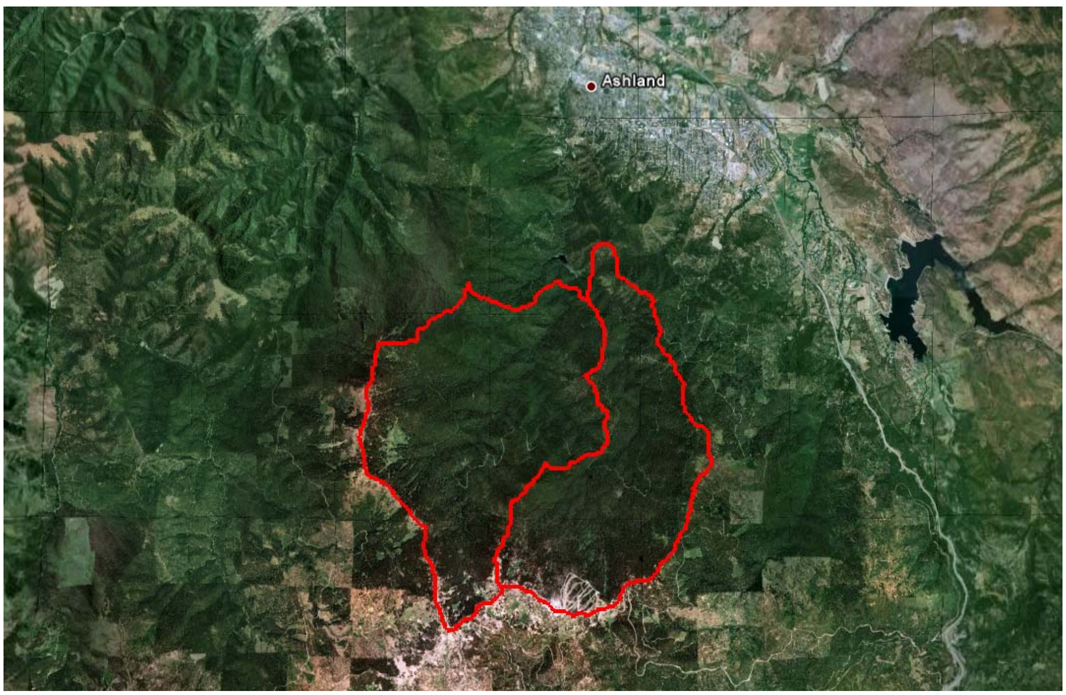
EFFECTS OF CLIMATE CHANGE IN ASHLAND CREEK, OREGON

July 2010

Introduction

Ashland Creek is located in Jackson County, Oregon, United States, near Interstate 5 and the California border, and located in the south end of the Rogue Valley. The West Fork basin has an area of 10.5 mi^2 and the East Fork has an area of 8.14 mi^2. Both branches of the Ashland creek drain to the Reeder Reservoir. In this study we implemented the Distributed Hydrological Vegetation Model over the East and West branches of the river with the objective to simulate the effects of Climate Change.

Figure 1 East and West Fork of Ashland Creek



Hydrologic Model

The Distributed Hydrologic Surface Vegetation Model (DHSVM) (Wigmosta et al. 1994) which explicitly represents the effects of topography and vegetation on water fluxes through the landscape has been implemented in the Ashland Creek, Oregon. DHSVM is typically applied at high spatial resolutions on the order of 50 m for watersheds up to 100,000 km2 and at sub-daily timescales for multi-year simulations. This distributed hydrologic model has been applied predominantly to mountainous watersheds in the Pacific Northwest in the United States.

DHSVM, as with any distributed hydrologic model, requires extensive information about the simulated basin. The first type of information is static data and can be divided in three main categories: elevation, vegetation cover and soils. The second type is dynamic, or time series, information which includes meteorological data that can be obtained from weather stations or derived from others models. In the basins modeled, observing stations do not have sufficiently long records or do not exist in a spatially relevant location. Therefore, gridded products provide the spatial coverage that observing stations may lack

DHSVM consists of computational grid cells centered on Digital Elevation Model (DEM) elevation nodes, which explicitly represent the effects of topography in the basin. DEM data are used to define absorbed shortwave radiation, precipitation, air temperature, and down-slope water movement. In DHSVM each cell may exchange surface and subsurface water with its neighbors resulting in a three-dimensional redistribution across the basin. This water is routed across the basin using the defined stream channel network.

In this study, we implemented DHSVM v2.4 developed by Wiley (2009 in prep). Some modifications to the code in comparison with previous versions include the addition of a deep groundwater layer, expansion of surface and subsurface flow paths from 4 to 8 directions, allowance of the re-infiltration of water from the stream channel network back into the soil layer, the division of surface flows resulting from runoff from impervious surfaces by the fraction of impervious area, and the calculation of water temperature within the channel network. For a more complete description of these changes see Wiley (2009 in prep).

Figure 2 DHSVM conceptual model

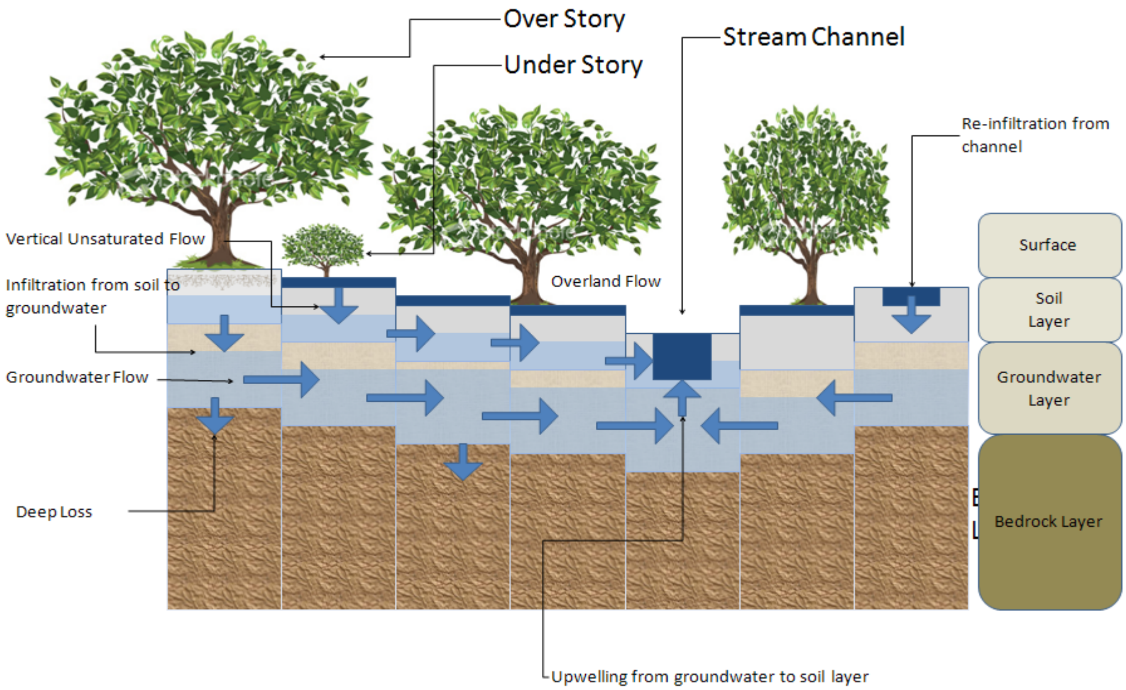


Figure 3 Stream Networks Utilized by the Hydrological Model

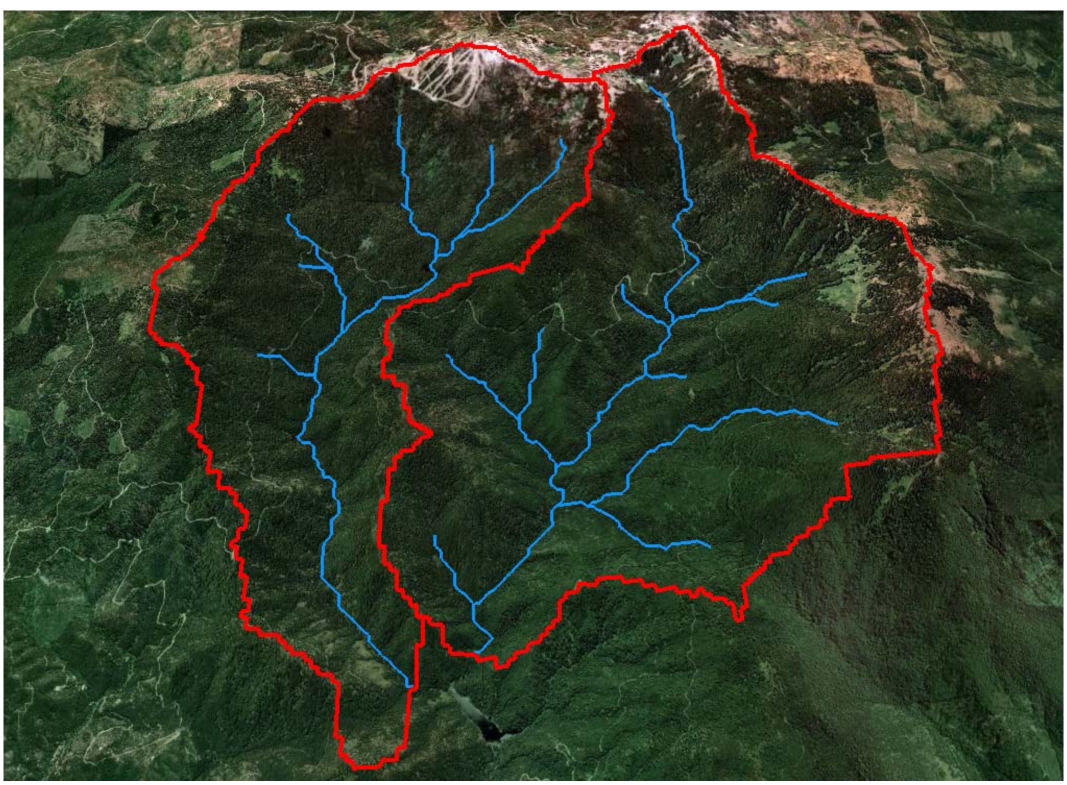


Figure 4 Digital Elevation Model Utilized by the Hydrological Model

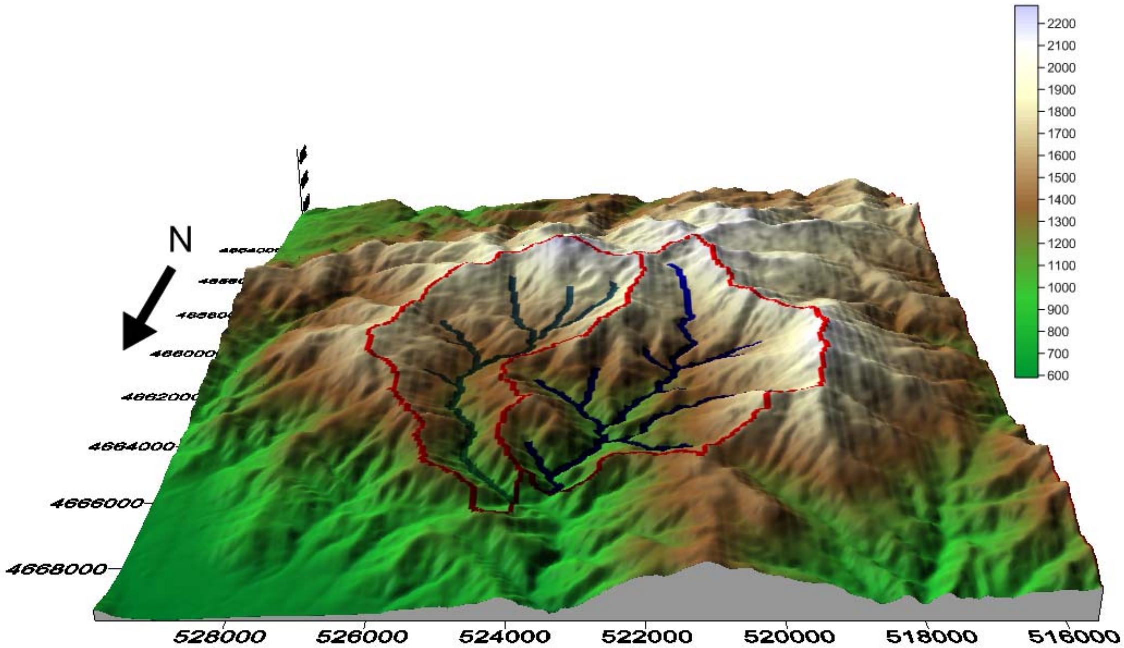


Figure 5 Soil Depth Utilized by The Hydrological Model

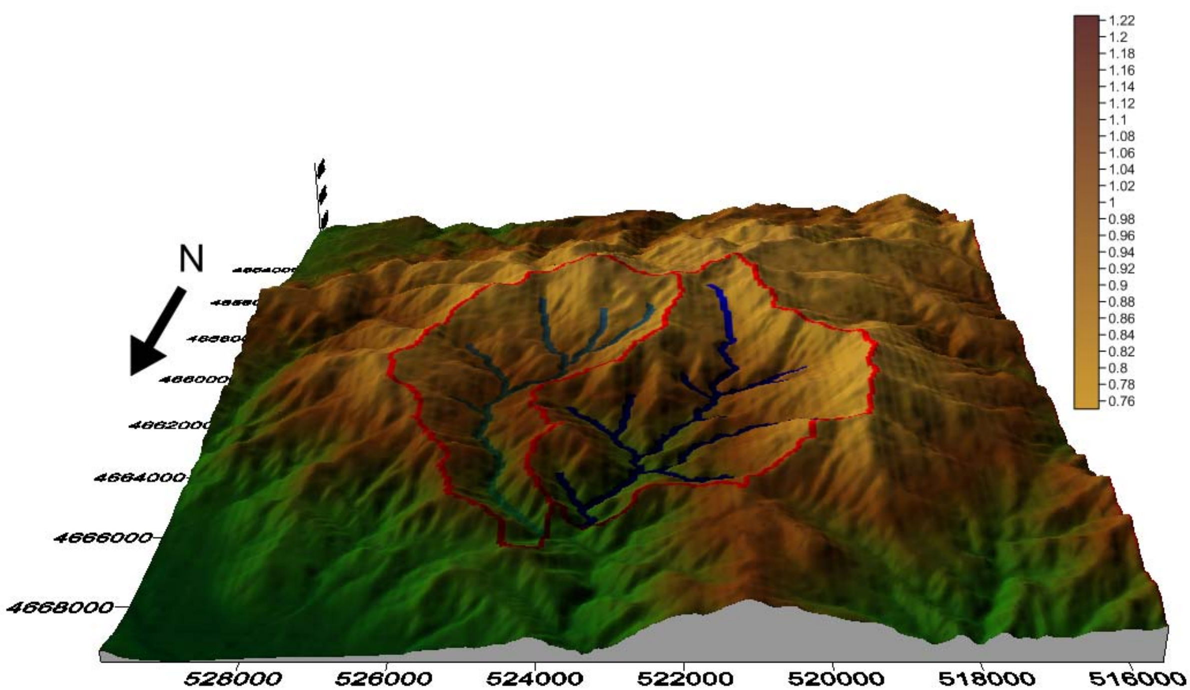
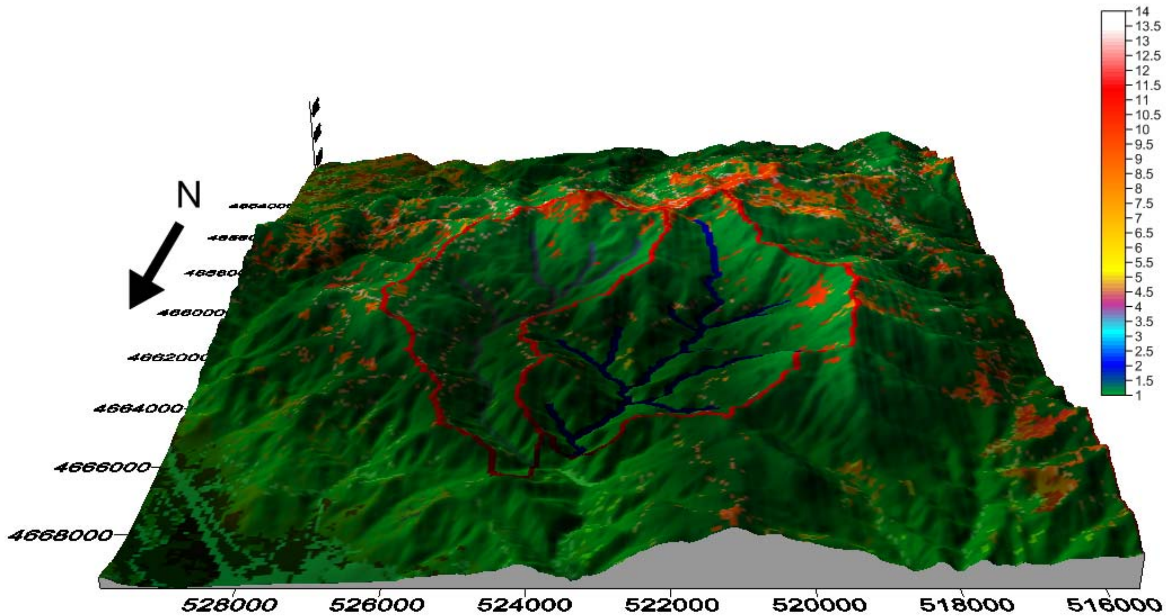


Figure 6 Land Cover



Model Implementation

Climate Change Scenarios

The Climate Change Scenarios which were evaluated with DHSVM were downscaled from GCM models to 1/16 degree resolution cells following Salathe et al. The data downscaled were monthly averages for maximum temperature, minimum temperature and precipitation. The downscaled GCM data was used to bias correct the historical gridded meteorological data series (Wood et al., 2002). In this process the historical dataset is aggregated to monthly time step and bias corrected against the spatially downscaled dataset to produce a new dataset with the realistic variability of storms from the historical dataset and the climate change signals of the spatially downscaled dataset, including projected changes in climate variability and magnitude of change.

Figure 7 Overview of the downscaling process

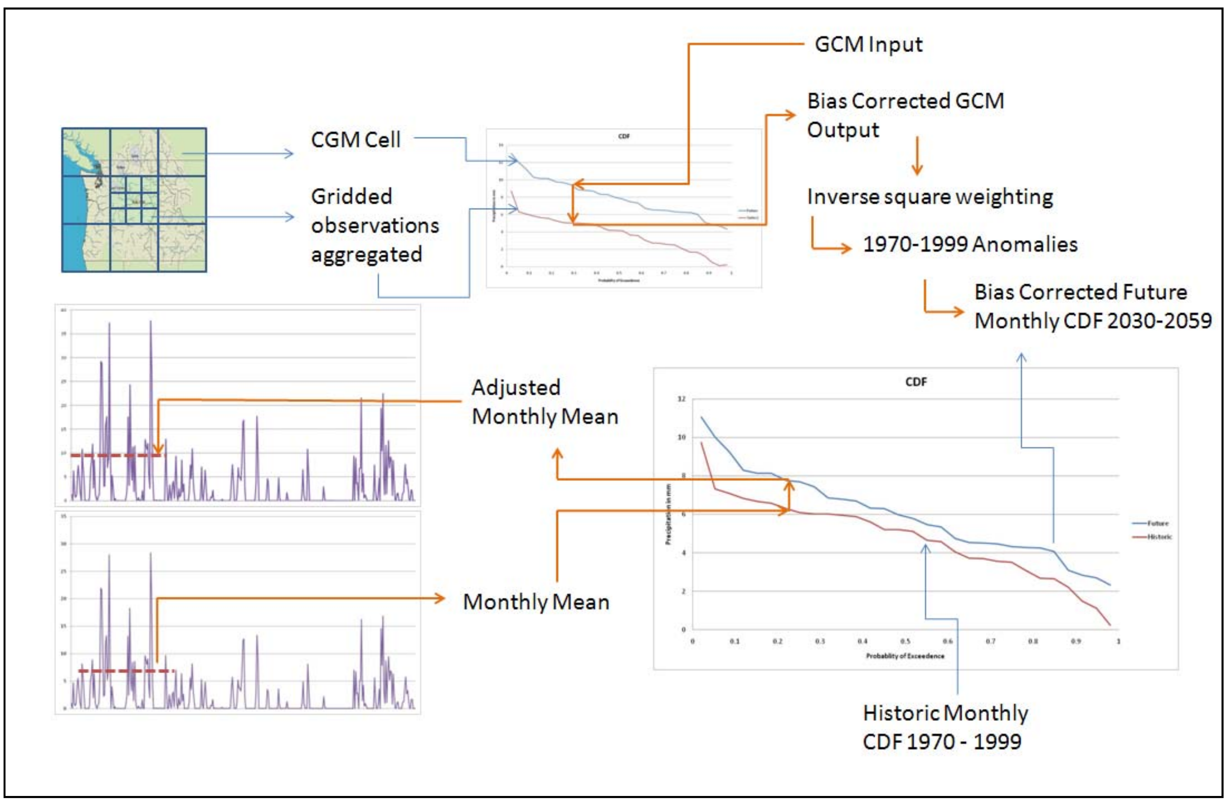


Table 1 Average Monthly Temperature in Celsius Degrees

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	6.2	8.0	7.8	7.9	8.2	8.4	8.7	8.3	8.4	8.3	7.9
November	0.8	2.5	1.7	2.2	2.8	2.0	2.5	2.2	2.5	2.7	2.4
December	-1.2	-0.3	0.0	-0.2	0.2	-0.2	0.2	0.3	0.8	0.8	0.3
January	-2.7	-1.4	-0.9	-2.0	-2.4	-1.4	-2.2	-0.2	-0.8	-0.6	-0.9
February	-1.6	0.4	0.3	-1.1	-1.0	0.0	-0.9	0.3	0.3	0.4	-0.8
March	-0.6	1.2	1.5	0.0	-0.4	0.9	0.6	1.6	1.0	1.4	0.3
April	1.6	2.7	2.0	2.4	2.8	3.1	3.0	2.9	3.5	3.0	3.2
May	5.6	7.9	6.4	6.5	7.0	6.6	7.4	8.0	7.4	7.8	6.9
June	9.0	12.0	10.6	11.2	11.3	10.8	12.3	12.7	11.7	11.4	10.7
July	14.1	17.9	16.8	16.6	16.0	16.4	19.7	18.0	16.7	16.6	16.0
August	13.8	17.6	16.9	16.4	15.8	16.3	17.6	17.4	16.9	16.5	15.8
September	11.2	13.4	13.3	13.2	13.5	13.7	14.8	15.2	13.9	14.0	13.6

Table 2 Monthly Precipitation in mm

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	46.2	44.2	46.8	40.0	49.2	44.6	41.7	45.9	48.4	57.6	52.5
November	95.5	97.7	102.5	116.8	94.7	101.5	102.0	92.2	108.2	136.5	88.9
December	123.2	126.0	126.1	129.2	135.4	92.6	118.7	112.9	181.7	157.0	112.7
January	114.2	74.9	141.9	122.8	127.9	113.7	116.1	106.1	157.8	117.0	102.0
February	89.8	72.5	99.9	97.6	76.2	95.3	90.2	73.4	126.7	80.8	91.8
March	81.5	86.6	90.6	78.9	95.6	95.3	77.6	78.3	107.9	85.0	90.4
April	53.6	64.9	70.1	62.5	51.5	49.6	53.2	54.5	59.1	48.5	56.0
May	45.0	35.2	40.4	40.5	41.6	48.0	34.0	37.4	41.8	33.4	43.7
June	26.4	18.8	21.3	17.5	15.8	21.4	15.1	15.0	17.6	34.7	23.5
July	8.3	2.1	5.5	4.4	4.8	4.6	5.8	10.9	6.0	7.7	6.1
August	11.8	3.2	15.5	8.4	22.1	6.7	7.0	14.3	9.5	12.0	7.5
September	21.5	22.6	18.4	17.9	19.7	16.1	19.2	19.0	21.7	13.4	17.3

Figure 8 Average Temperature

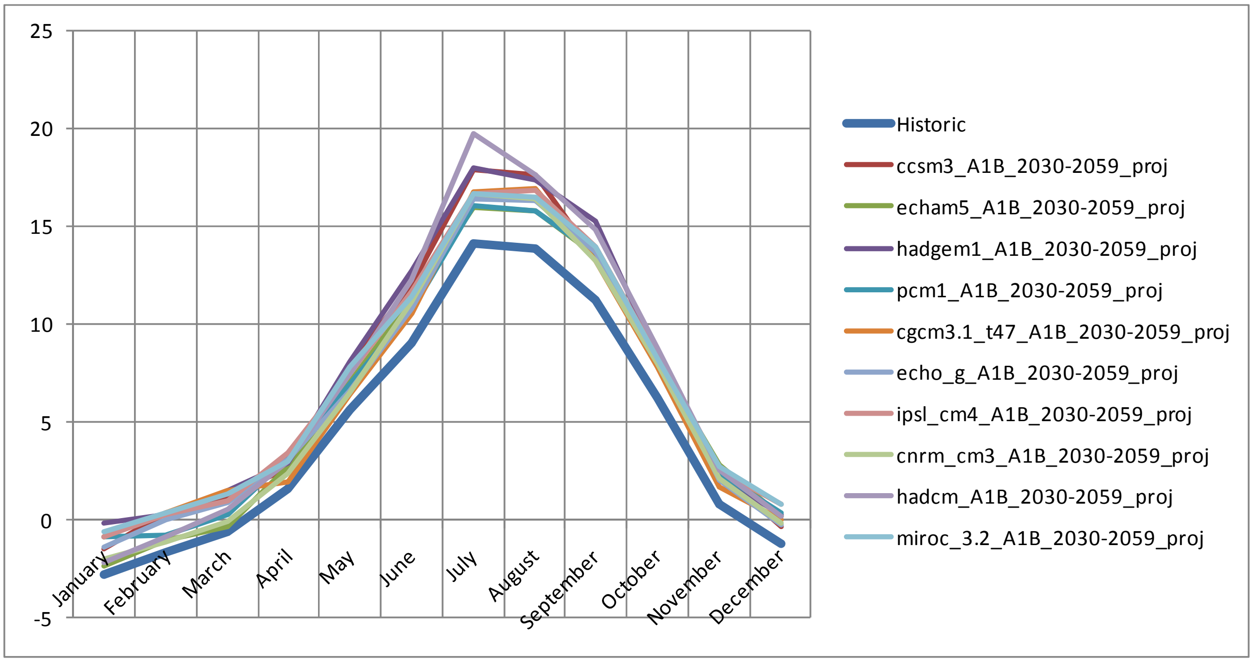


Figure 9 Average Precipitation

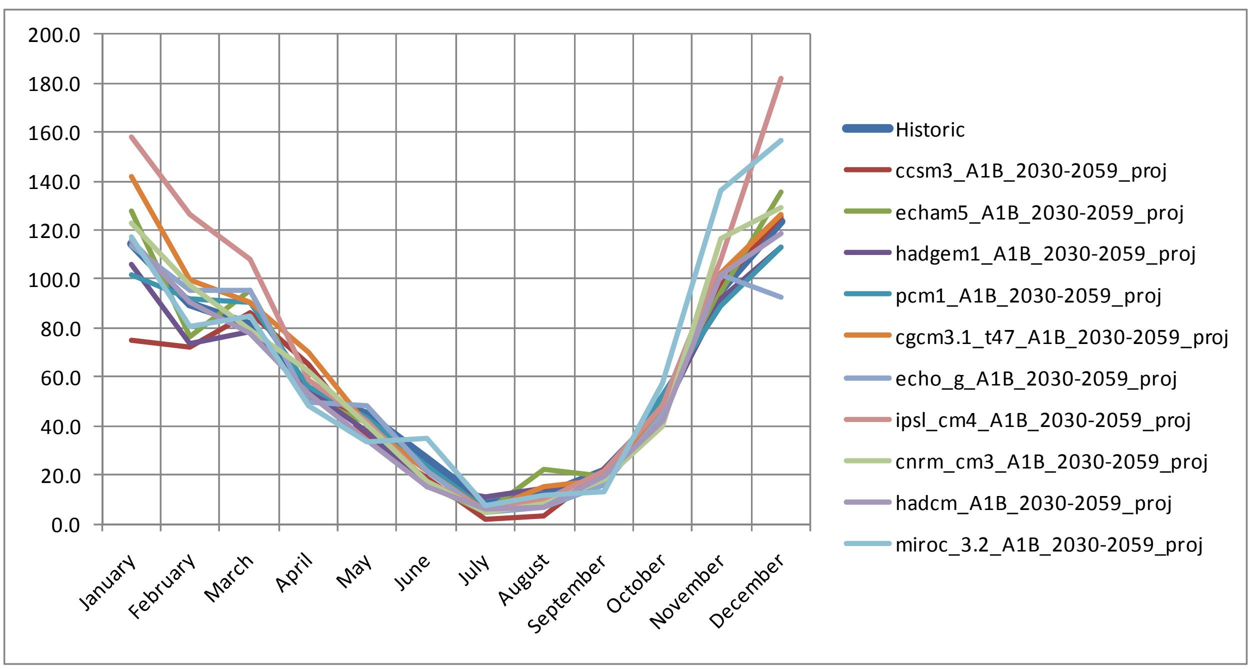


Figure 10 Average Meteorological data from 1916 to 2006

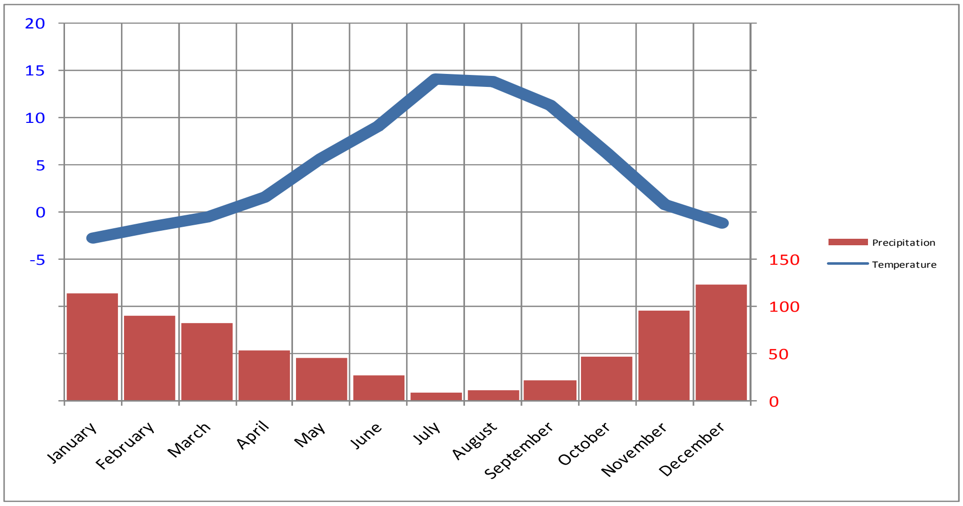


Figure 11 Average Meteorological data from 2030 to 2059 for ccsm3_A1B

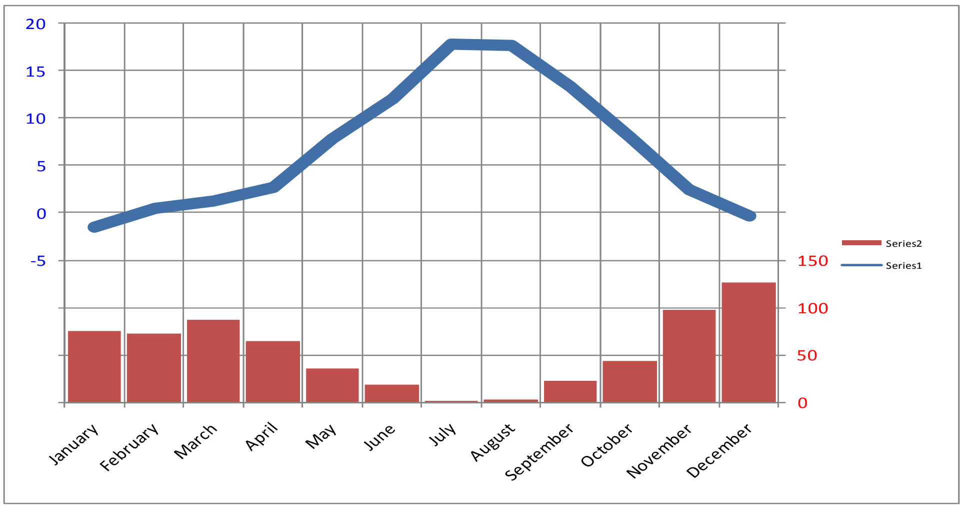


Figure 12 Average Meteorological data from 2030 to 2059 for echam5_A1B

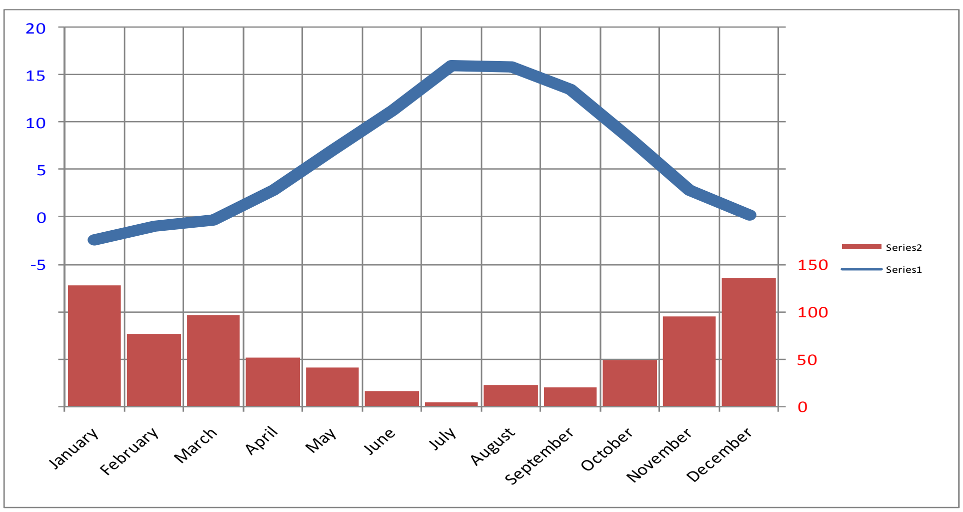


Figure 13 Average Meteorological data from 2030 to 2059 for hadgem1_A1B

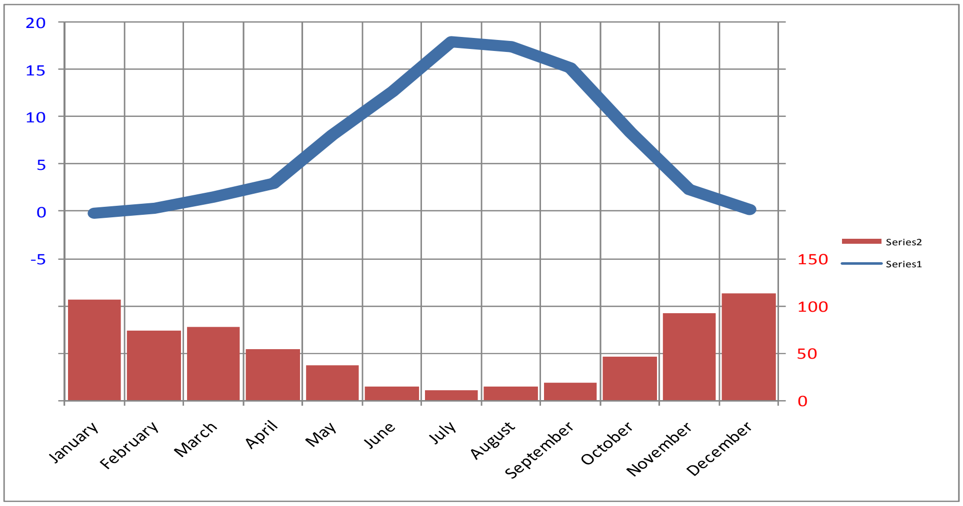


Figure 14 Average Meteorological data from 2030 to 2059 for pcm1_A1B

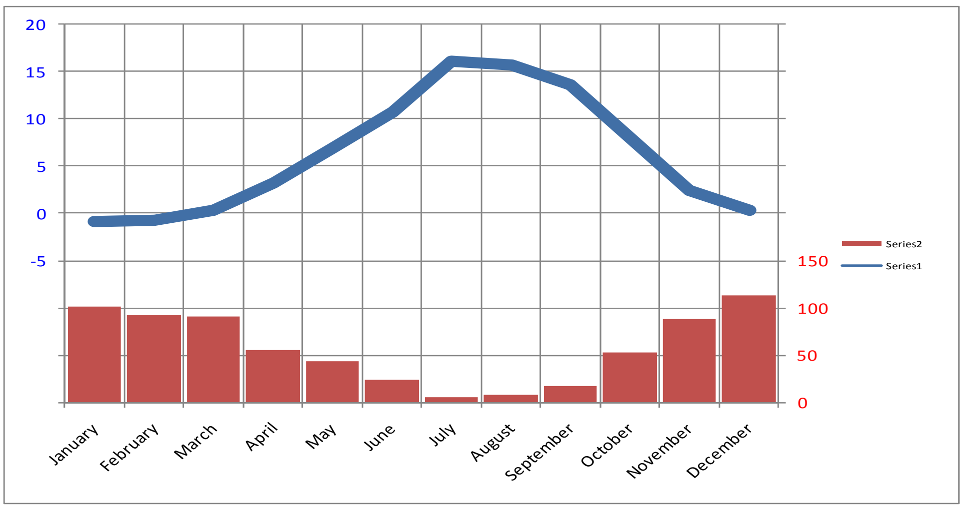


Figure 15 Average Meteorological data from 2030 to 2059 for cgcm3.1_t47_A1B

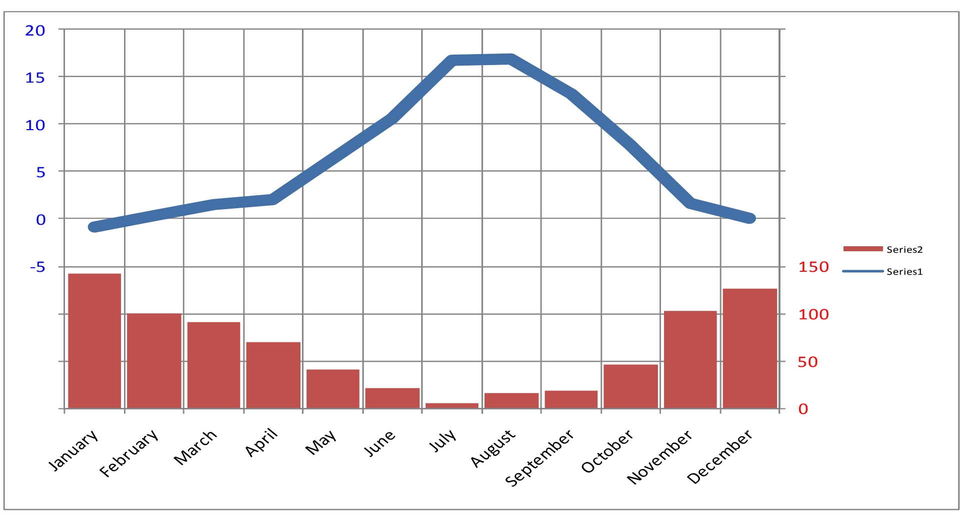


Figure 16 Average Meteorological data from 2030 to 2059 for echo_g_A1B

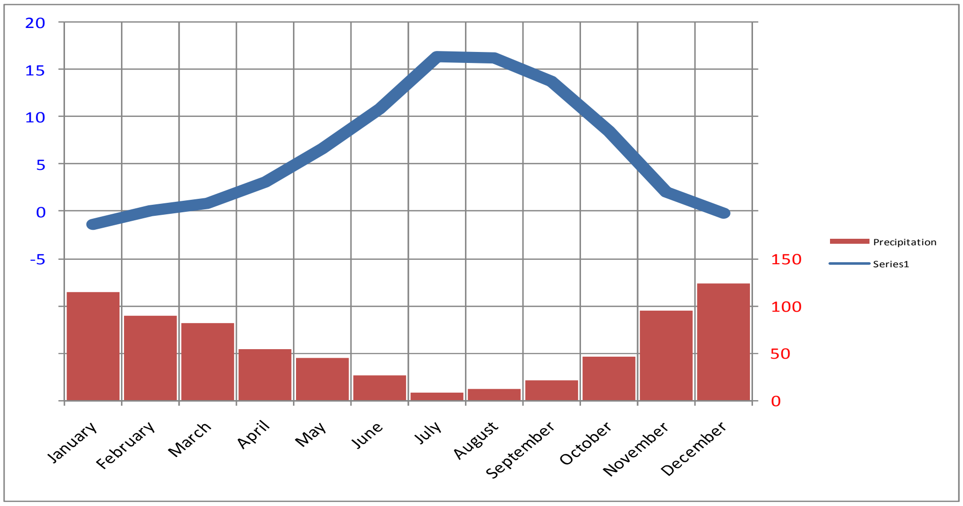


Figure 17 Average Meteorological data from 2030 to 2059 for ipsl_cm4_A1B

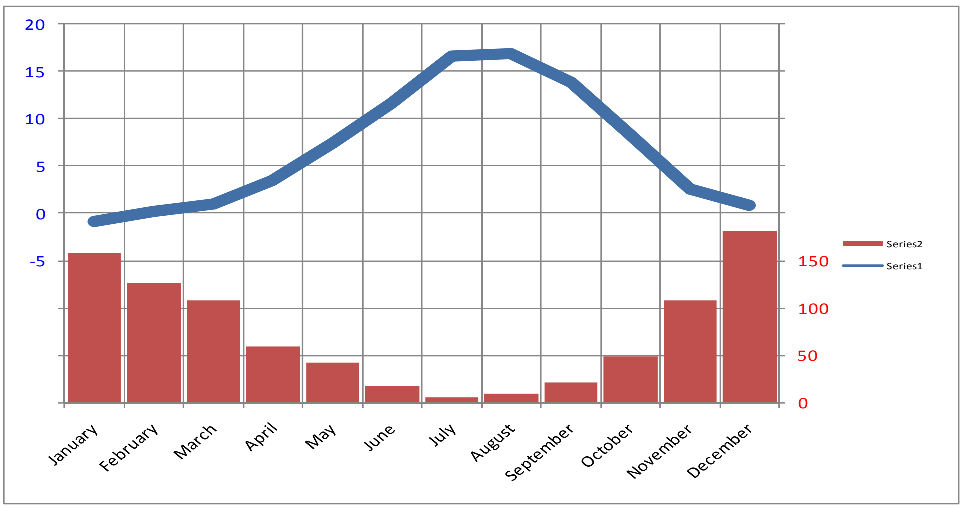


Figure 18 Average Meteorological data from 2030 to 2059 for cnrm_cm3

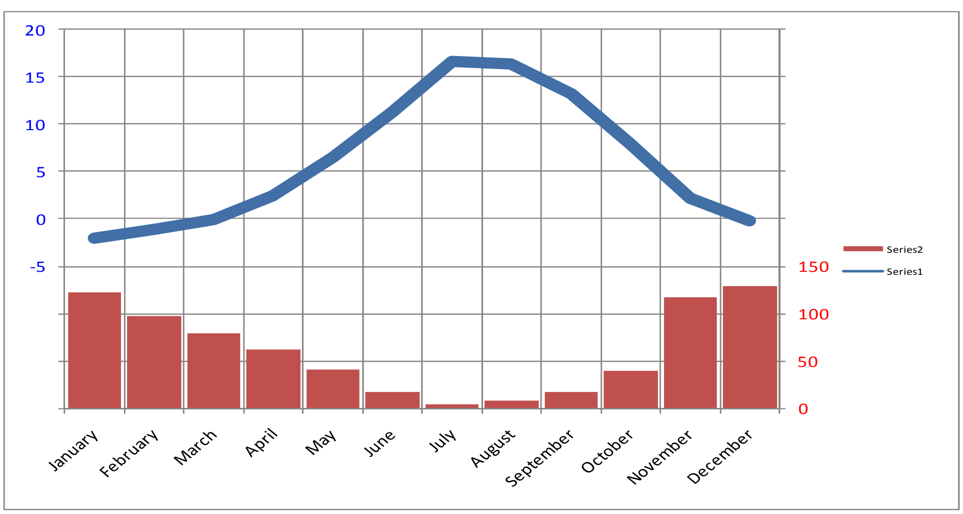


Figure 19 Average Meteorological data from 2030 to 2059 for hadcm_A1B

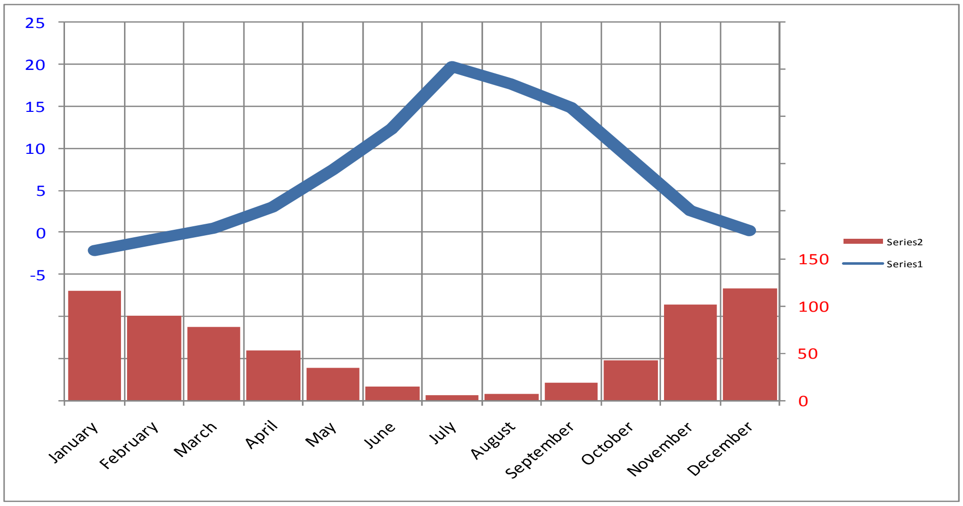
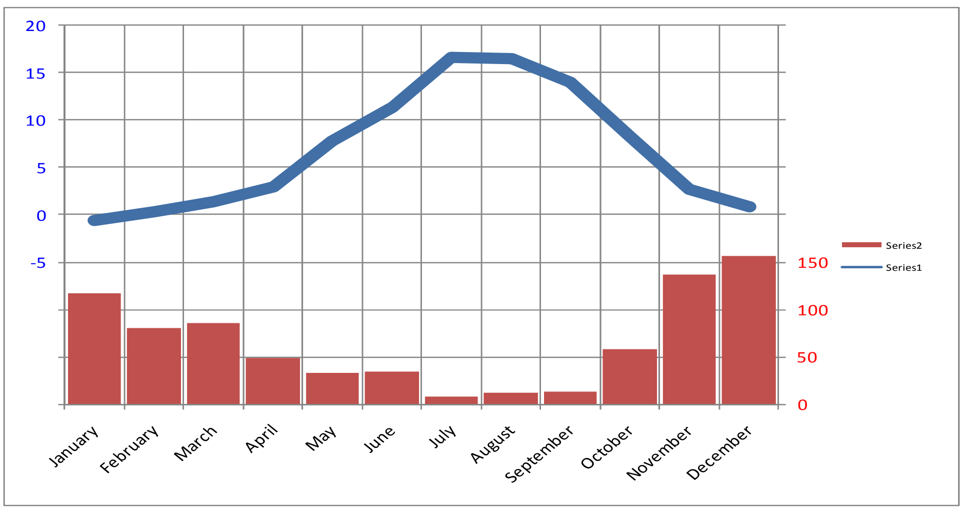


Figure 20 Average Meteorological data from 2030 to 2059 for miroc_3.2_A1B



StreamFlow Data Stations

West Fork Ashland Creek near Ashland, OR

Location.

Lat 42° 08'55", long 122° 42'55" near line between NW 1/4 SW 1/4 sec.28, T.39 S., R.1 E., Jackson County, Hydrologic Unit 17100308, in Rogue River National Forest, on left bank 0.3 mi upstream from city diversion, 2.5 mi south of Ashland, and at mile 0.4.

Drainage Area.

10.5 mi^2, at diversion dam 0.3 mi downstream.

Period of Record.

September 1924 to January 1933, water years 1954-60, 1963, annual maximum; December 1974 to September 1982, Oct. 2002 to current year. Monthly discharge only for some periods published in WSP 1318.

Gage.

Water-stage recorder and crest-stage gage. Datum of gage is 2,961.75 ft above NGVD of 1929. Sept. 10, 1924, to Jan. 31, 1933, water-stage recorder at site about 0.2 mi upstream at different datum. Oct. 14, 1953 to Sept. 30, 1963, crest-stage gage at diversion dam 0.3 mi downstream at different datum. Oct. 1, 2002 to Aug. 29, 2005, water-stage recorder at same site at datum 1.00 ft higher.

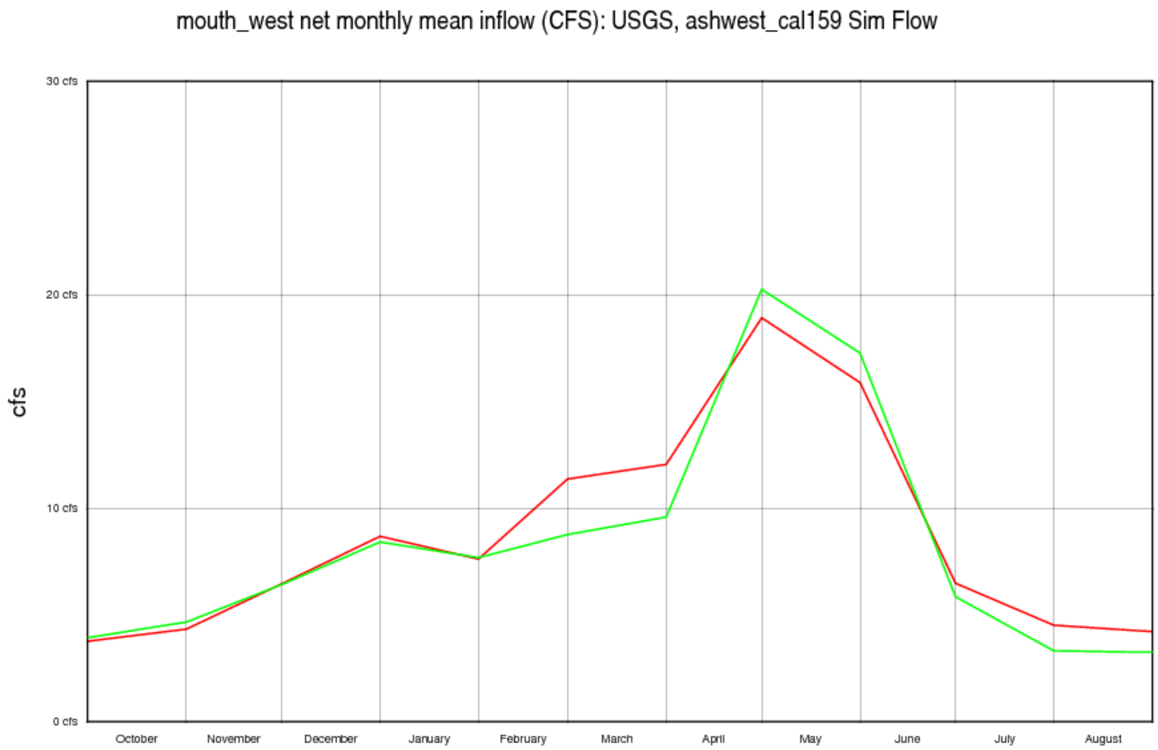
Remarks.

No regulation or diversion above station.

Extremes for Period of Record.

Maximum discharge, 330 ft^3/s Dec. 2, 1962, gage height,15.51 ft, site and datum then in use, from rating curve defined by computation of peak flow over dam; minimum, 0.8 ft^3/s Sept. 7, 2005

Figure 21 Hydrograph for the Calibration Period January 1974 to December 1978, Validation Period January 1979 to December 1982



Calculated stats for period: 1975, 1 to 1978 ,12

	Obs	Sim	Sim/Obs
Avg Flow	8.8	8.7	0.98
Std Dev	6.6	7.2	1.08

Correlation Coefficient	=0.831
RMSE	= 4.047
RMSE/Obs Mean	= 0.459
MSE/Obs Var	= 0.372
Nash-Sutcliff Eff.	= 0.680

Monthly Stats:

Mon	ObsAvg	SimAvg	Bias	RMSE	ObsStDev	SimStDev
1	9.69	8.45	-1.24	2.21	5.75	4.32
2	8.14	7.83	-0.31	3.25	3.94	2.91
3	10.66	8.70	-1.96	5.63	6.08	4.02
4	11.25	8.90	-2.34	4.82	4.91	4.03
5	16.45	18.84	2.39	7.93	11.28	11.98
6	16.42	19.79	3.37	7.44	13.27	17.09
7	6.86	6.47	-0.39	1.13	3.90	4.35
8	4.81	3.72	-1.09	1.61	4.39	5.45

9	4.60	3.59	-1.01	1.09	4.56	5.45
10	3.55	3.85	0.30	0.64	5.43	4.91
11	5.41	5.82	0.41	0.77	3.59	3.07
12	8.06	8.01	-0.05	1.41	4.17	2.84

Calculated statistic for validation period for period: 1979, 1 to 1980, 12

	Obs	Sim	Sim/Obs
Avg Flow	9.3	8.3	0.90
Std Dev	7.2	6.2	0.86

Correlation Coefficient	= 0.899
RMSE	= 3.330
RMSE/Obs Mean	= 0.360
MSE/Obs Var	= 0.211
Nash-Sutcliff Eff.	= 0.715

Monthly Stats:

Mon	ObsAvg	SimAvg	Bias	RMSE	ObsStDev	SimStDev
1	4.66	8.29	3.62	3.62	4.59	0.01
2	5.56	7.09	1.54	1.54	3.69	1.20
3	14.17	9.04	5.12	5.12	4.92	0.75
4	15.29	12.36	-2.93	2.93	6.04	4.07
5	28.81	25.92	-2.88	2.88	19.56	17.63
6	13.79	7.18	-6.61	6.61	4.54	1.11
7	4.97	3.37	-1.61	1.61	4.27	4.92
8	3.38	1.70	-1.68	1.68	5.87	6.59
9	2.65	1.85	-0.79	0.79	6.60	6.44
10	4.64	4.31	0.33	0.33	4.61	3.98
11	6.60	6.97	0.37	0.37	2.65	1.32
12	6.47	11.42	4.95	4.95	2.78	3.13

East Fork Ashland Creek Near Ashland, OR

Location.

Lat 42° 09'10", long 122° 42'30", in NW 1/4, NW 1/4 sec.28, T.39 S., R.1 E., Jackson County, Hydrologic Unit 17100308, in Rogue River National Forest, on left bank 0.1 mi upstream from city diversion dam, 2.5 mi south of Ashland, and at mile 0.2.

Drainage Area.

8.14 mi^2, at diversion dam 0.1 mi downstream.

Period Of Record.

September 1924 to January 1933, water years 1954-60, 1963, annual maximum; December 1974 to September 1982, Oct. 2002 to current year.

Gage.

Water-stage recorder and crest-stage gage. Datum of gage is 2,903.70 ft above NGVD of 1929. Sept. 10, 1924 to Jan. 31, 1933, water-stage recorder at site about 200 ft downstream at different datum. Oct. 19, 1953 to Sept. 30, 1963, crest-stage gage at diversion dam 0.1 mi downstream at different datum.

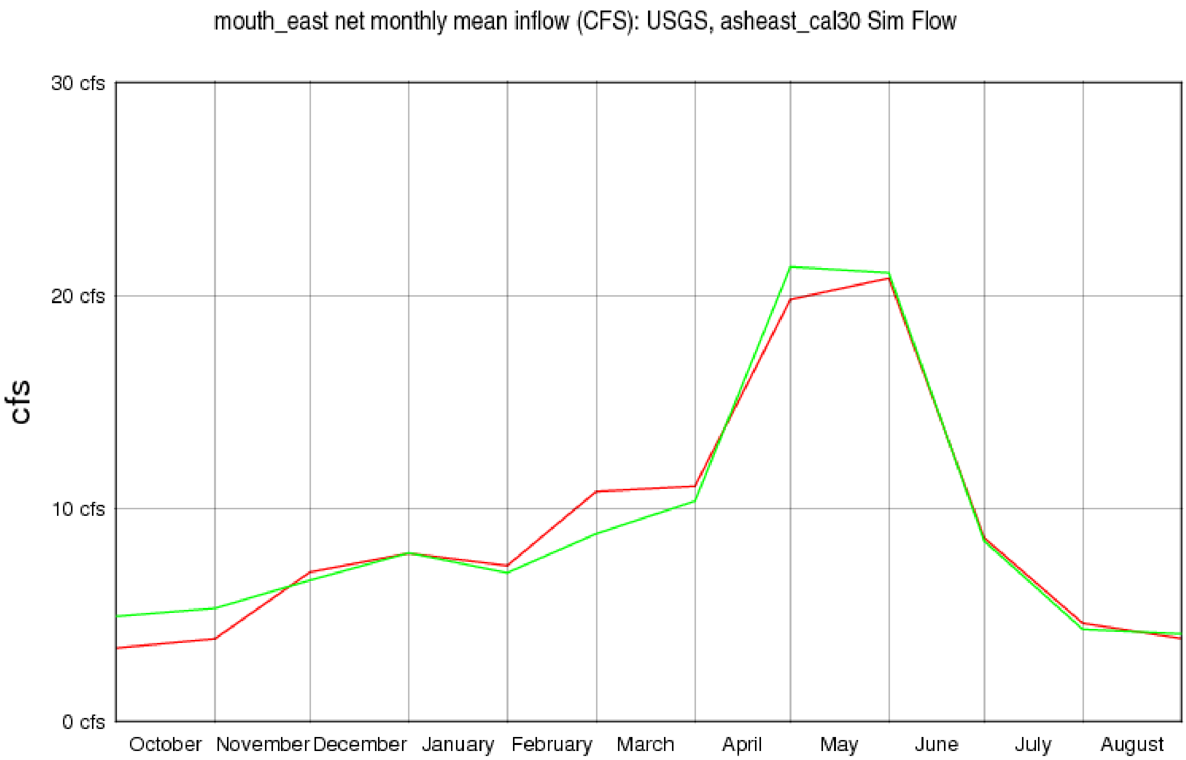
Extremes For Period Of Record.

Maximum discharge, 335 ft^3/s Dec. 2, 1962, gage height, 5.42 ft, site and datum then in use, from rating curve defined by computation of peak flow over dam; minimum discharge, 0.47 ft^3/s Mar. 14, 1977, result of freeze up.

Extremes Outside Period Of Record.

Flood of Jan. 15, 1974, is the highest since at least 1925. Discharge, 5,630 ft^3/s by slope-area measurement of peak flow, gage height, 10.2 ft from flood marks. Peak believed to be affected by release from debris dams breaking upstream.

Figure 22 Hydrograph for the Calibration Period January 1974 to December 1978, Validation Period January 1979 to December 1982



Calculated stats for period: 1975, 1 to 1978 ,12

	Obs	Sim	Sim/Obs
Avg Flow	9.2	9.6	1.04
Std Dev	8.7	7.9	0.91

Correlation Coefficient	= 0.854
RMSE	= 4.574
RMSE/Obs Mean	= 0.498
MSE/Obs Var	= 0.277
Nash-Sutcliff Eff.	= 0.667

Monthly Stats:

Mon	ObsAvg	SimAvg	Bias	RMSE	ObsStDev	SimStDev
1	8.27	7.83	-0.44	1.66	4.75	3.82
2	7.56	7.08	-0.48	2.60	4.27	3.08
3	10.09	8.65	-1.45	4.23	6.18	4.05
4	9.92	9.54	-0.38	3.66	5.19	3.78
5	17.57	18.85	1.28	8.80	12.79	10.80
6	21.92	24.21	2.29	10.56	21.88	20.95
7	9.16	9.66	0.50	1.37	4.94	6.13
8	4.88	4.91	0.04	2.45	4.65	5.63
9	4.08	4.56	0.48	1.10	5.35	5.52

10	3.19	4.79	1.59	1.67	6.05	4.89
11	4.86	6.64	1.79	1.84	4.49	3.10
12	8.78	8.29	-0.49	2.49	5.31	3.14

Calculated statistic for validation period for period: 1979, 1 to 1980, 12

	Obs	Sim	Sim/Obs
Avg Flow	10.5	10.3	0.97
Std Dev	6.9	7.1	1.03

Correlation Coefficient	= 0.887
RMSE	= 3.352
RMSE/Obs Mean	= 0.318
MSE/Obs Var	= 0.237
Nash-Sutcliff Eff.	= 0.778

Monthly Stats:

Mon	ObsAvg	SimAvg	Bias	RMSE	ObsStDev	SimStDev
1	13.40	10.93	-2.47	4.99	7.57	2.75
2	10.86	9.38	-1.48	2.26	4.52	2.93
3	12.97	9.84	-3.13	3.29	2.51	0.56
4	14.06	14.75	0.69	2.75	3.83	4.63
5	24.44	27.80	3.36	3.45	14.55	17.89
6	18.25	14.80	-3.46	5.69	7.92	7.78
7	9.07	6.82	-2.24	2.29	3.03	4.63
8	4.54	2.37	-2.18	2.27	6.07	7.90
9	3.37	2.45	-0.92	0.92	7.18	7.81
10	3.68	4.70	1.02	1.02	6.91	5.63
11	4.27	7.30	3.03	3.12	6.43	3.04
12	7.60	12.03	4.42	4.49	2.95	2.03

Results

EAST

Snow Water Equivalent

Figure 23 Mean Snow Water Equivalent for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

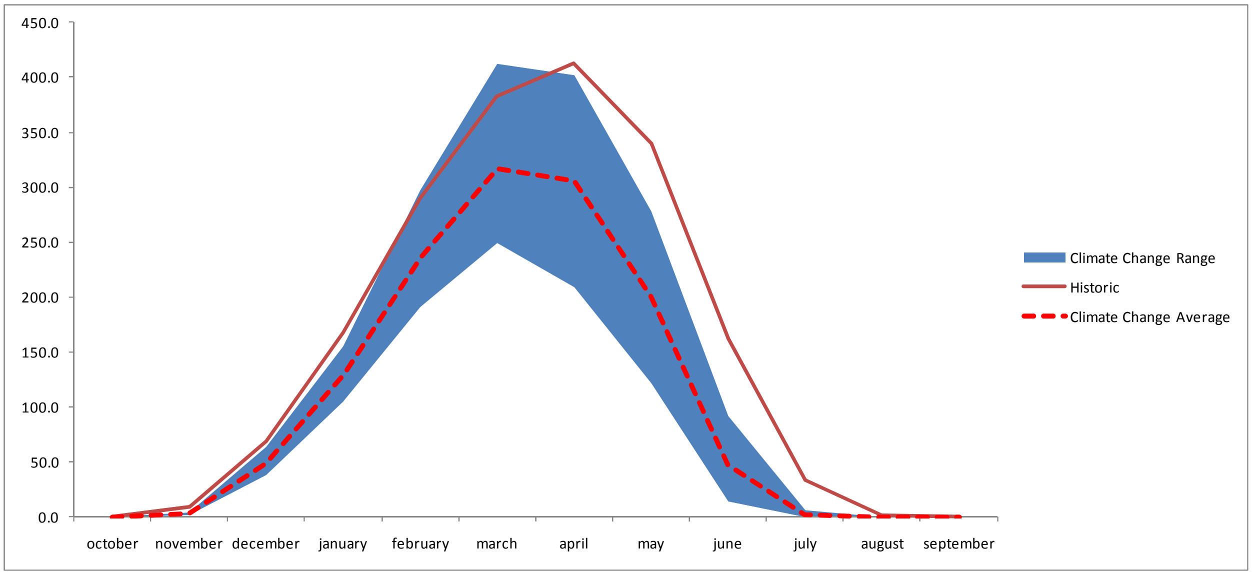


Figure 24 Mean Snow Water Equivalent for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

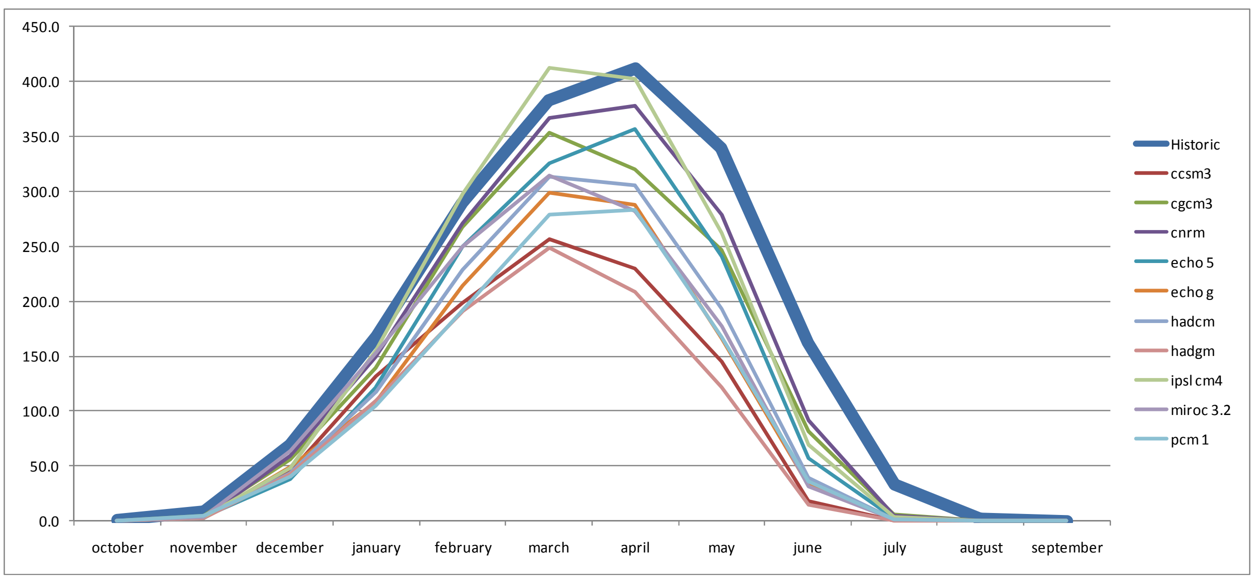


Table 3 Mean Monthly Snow Water Equivalent for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	0.6	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
November	8.6	3.3	4.2	2.8	4.0	2.7	2.0	2.5	3.8	3.9	4.3
December	69.1	44.3	55.6	58.8	38.2	49.1	44.1	42.7	48.7	63.9	40.2
January	167.4	131.2	139.8	149.0	121.2	108.8	117.5	109.7	155.5	153.0	105.0
February	289.1	198.4	267.4	270.7	249.9	213.8	228.3	190.8	297.6	249.3	192.2
March	383.0	256.9	353.8	367.3	325.0	298.9	313.4	249.0	412.5	314.3	278.4
April	412.2	230.0	320.5	377.9	356.9	288.1	306.0	208.8	402.2	281.9	283.5
May	339.1	145.6	247.0	278.4	241.3	166.8	192.9	121.7	261.9	177.2	167.8
June	162.1	18.0	81.3	92.1	57.0	32.7	39.4	14.3	69.5	31.3	35.5
July	33.5	0.1	6.3	5.1	2.7	1.1	1.2	0.1	3.7	1.1	1.2
August	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4 Snow Statistics for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059, Julian Day of 10% accumulation (JD 10% SWE) , Julian Day of maximum accumulation (JD MAX SWE), Julian Day of 90% melting of the accumulated snow (JD 90% MELT SWE), Maximum Snow Water Equivalent (MAX SWE) , Days Between 10% of accumulation to 90 % of melting (DAYS 10% - 90%)

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
JD 10% SWE	57.0	57.4	57.6	58.8	64.1	56.7	61.1	59.3	62.9	54.3	62.5
JD MAX SWE	180.4	165.3	166.6	176.5	177.2	168.4	169.5	159.2	169.7	162.4	171.0
JD 90% MELT SWE	258.6	228.9	246.5	246.9	241.6	237.4	234.9	226.3	242.8	234.6	235.7
MAX SWE	443.8	284.9	379.8	411.6	378.1	329.6	343.6	271.4	447.2	337.7	316.7
DAYS 10% - 90%	201.6	171.5	189.0	188.1	177.4	180.7	173.7	167.0	180.0	180.3	173.2

Evapotranspiration

Figure 25 Accumulated Monthly Evapotranspiration for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

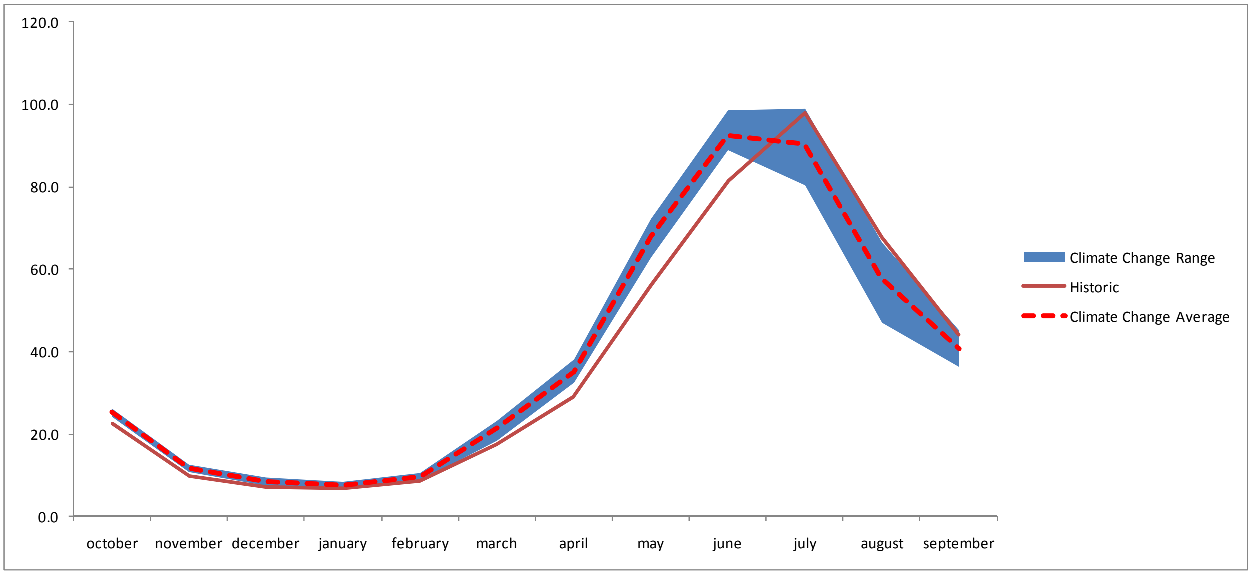


Figure 26 Accumulated Monthly Evapotranspiration for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

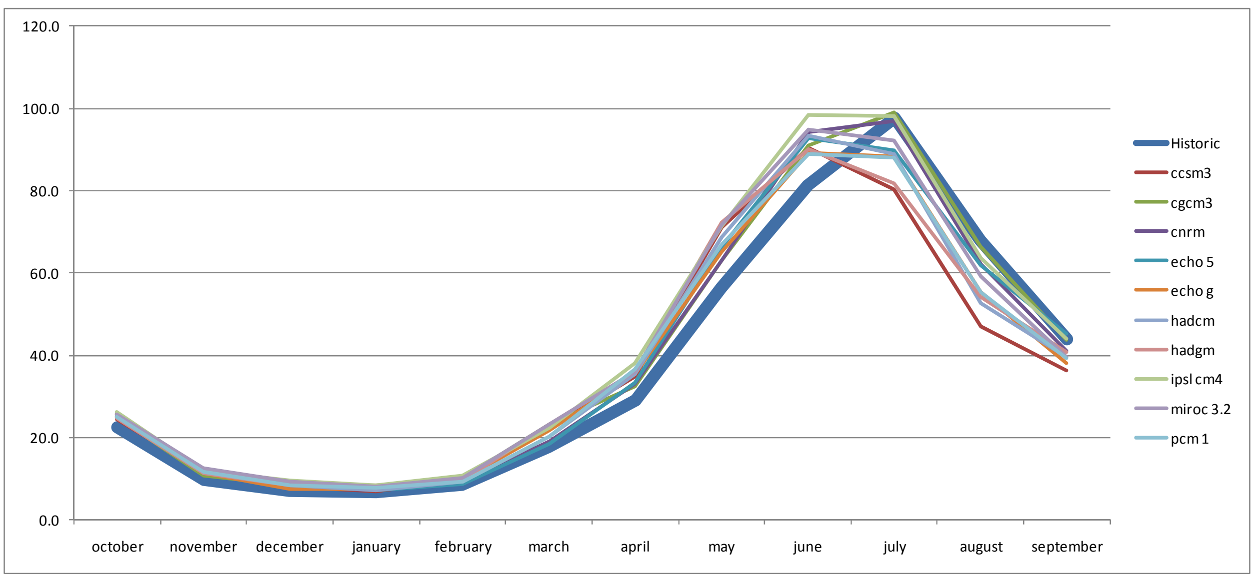


Table 5 Accumulated Monthly Evapotranspiration for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	22.4	24.3	25.0	24.9	25.8	25.6	25.3	24.6	26.3	25.6	24.9
November	9.8	11.7	10.9	11.6	12.3	11.3	11.7	11.3	12.0	12.7	11.7
December	7.2	7.9	8.2	8.1	8.5	7.6	8.3	8.3	9.5	9.2	8.4
January	6.8	6.8	8.2	7.3	7.1	7.5	7.1	8.4	8.5	8.2	7.7
February	8.5	9.7	10.2	9.1	8.8	10.0	9.3	9.7	10.6	10.2	9.3
March	17.6	22.4	23.1	19.0	18.5	21.6	20.3	23.3	22.2	23.1	20.2
April	29.1	34.7	32.6	33.0	33.3	35.3	35.4	35.9	38.1	36.0	36.5
May	56.2	71.1	63.0	62.9	66.2	65.1	68.6	72.2	71.5	71.8	66.9
June	81.3	90.4	90.8	94.3	92.9	89.2	93.4	89.9	98.5	94.9	89.0
July	97.8	80.4	98.9	96.9	89.9	88.2	88.8	81.7	98.2	92.1	88.1
August	67.9	47.1	66.4	62.1	61.9	55.4	52.6	54.1	63.7	59.2	55.3
September	44.0	36.4	43.7	41.0	45.2	38.1	39.7	40.7	44.2	39.5	39.4

Streamflow

Figure 27 Average Monthly Streamflow for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

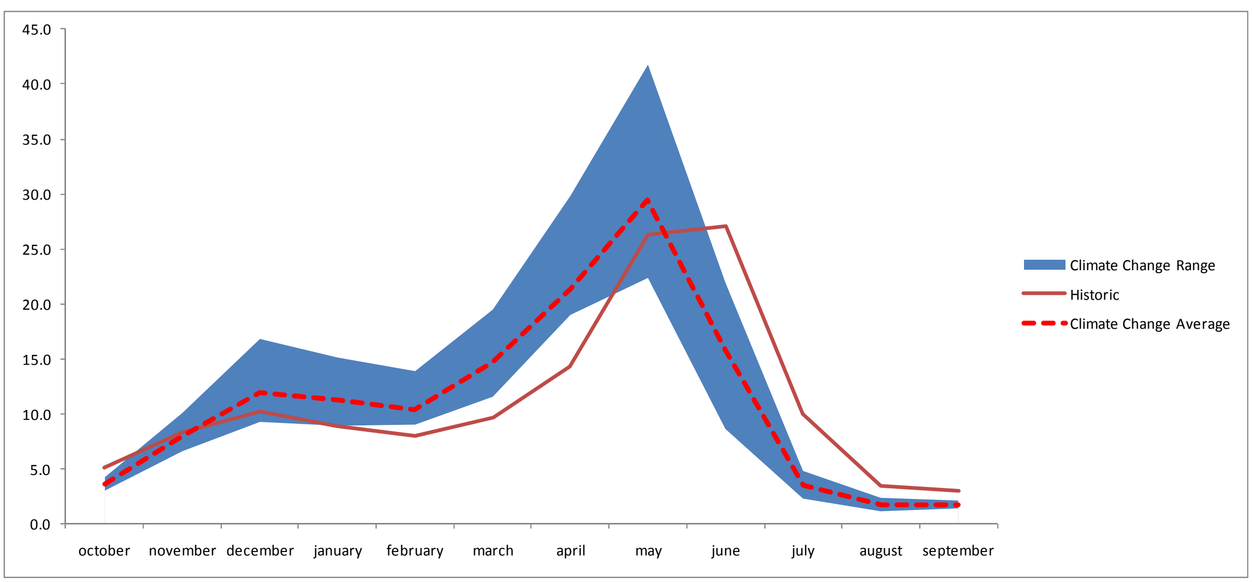


Figure 28 Average Monthly Streamflow for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

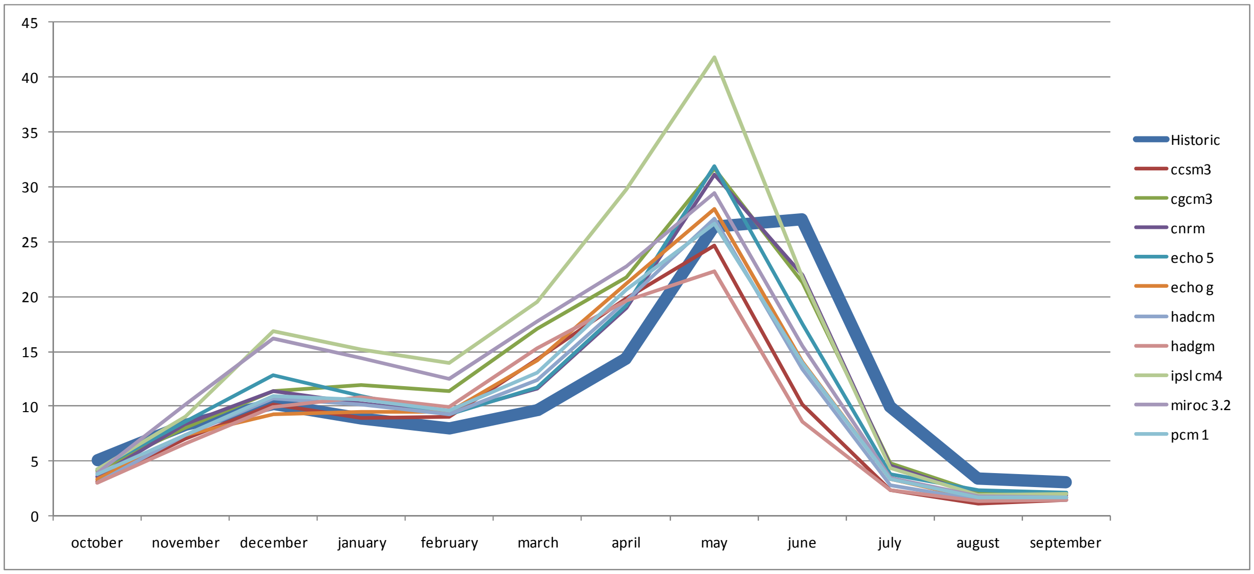


Table 6 Average Monthly Streamflow for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	5.13	3.11	4.15	3.56	4.29	3.38	3.06	3.08	4.22	3.97	3.79
November	8.33	7.03	8.04	8.37	8.61	7.33	7.33	6.63	9.07	10.12	7.42
December	10.27	10.14	11.38	11.35	12.8	9.27	10.73	9.93	16.83	16.19	10.89
January	8.93	8.93	11.97	10.22	10.91	9.47	10.12	10.86	15.15	14.4	10.62
February	7.95	9.03	11.35	9.41	9.29	9.48	9.23	9.99	13.91	12.5	9.64
March	9.71	14.29	17.1	11.56	11.67	14.16	12.37	15.23	19.5	17.75	13.08
April	14.36	19.86	21.75	18.96	19.22	21.15	19.59	19.66	29.82	22.79	20.66
May	26.32	24.67	31.68	31.11	31.93	27.98	27.07	22.31	41.75	29.42	26.66
June	27.07	10.11	21.34	21.96	17.48	14.02	13.38	8.64	21.77	15.46	13.91
July	9.95	2.33	4.85	4.57	3.86	3.34	2.81	2.39	4.41	3.47	3.39
August	3.47	1.18	2.17	1.91	2.41	1.63	1.43	1.41	1.94	1.83	1.69
September	3.07	1.5	2.04	1.92	2.16	1.67	1.52	1.45	2	1.7	1.71

Extreme Values

Figure 29 Quantiles for extreme flood during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

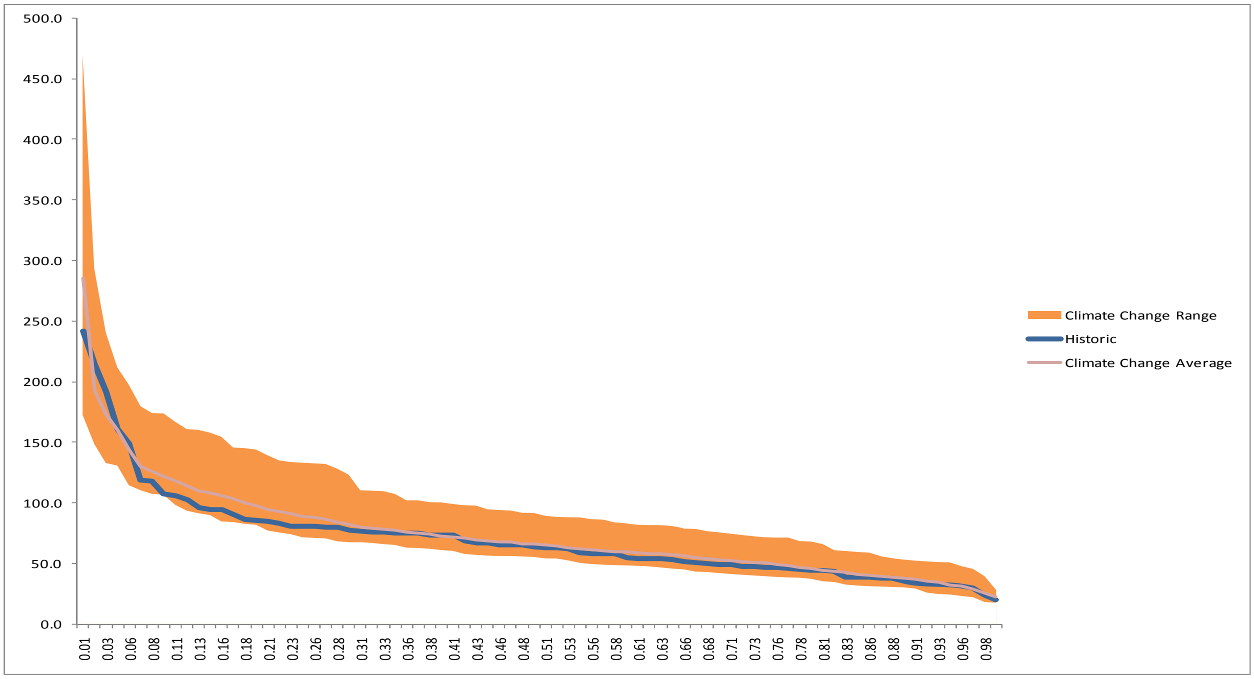


Figure 30 Quantiles for extreme flood during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

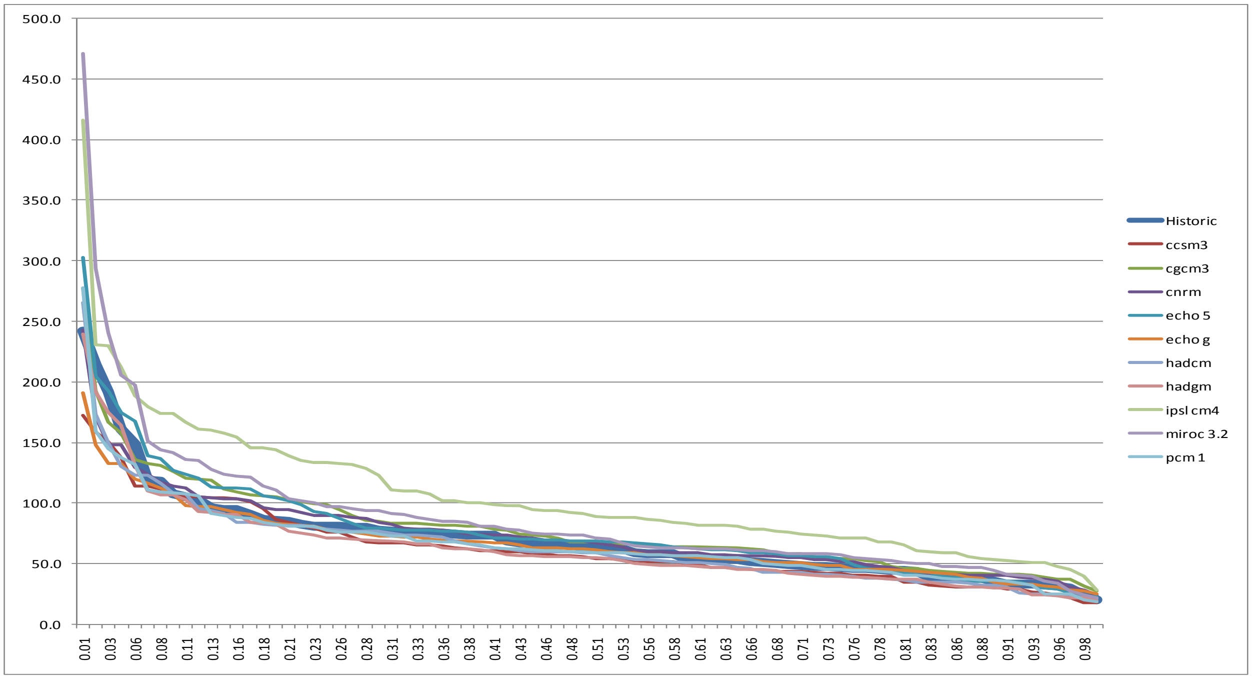


Figure 31 Quantiles for extreme low streamflow during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

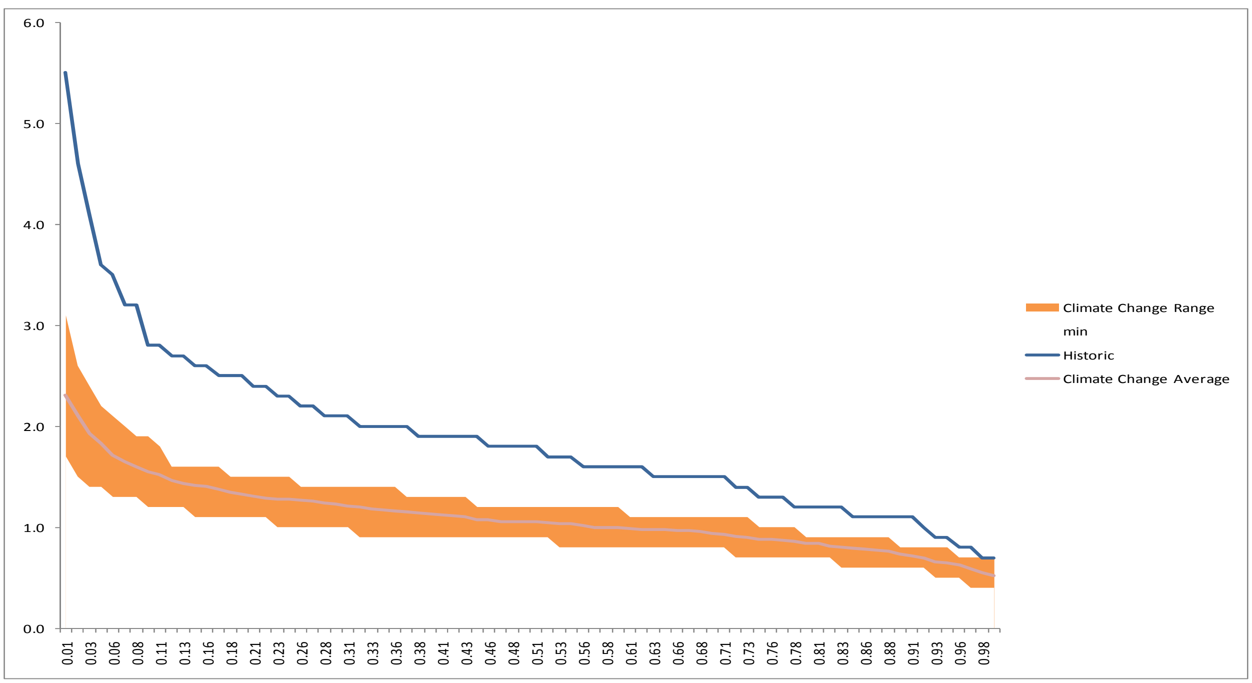


Figure 32 Quantiles for extreme low streamflow during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

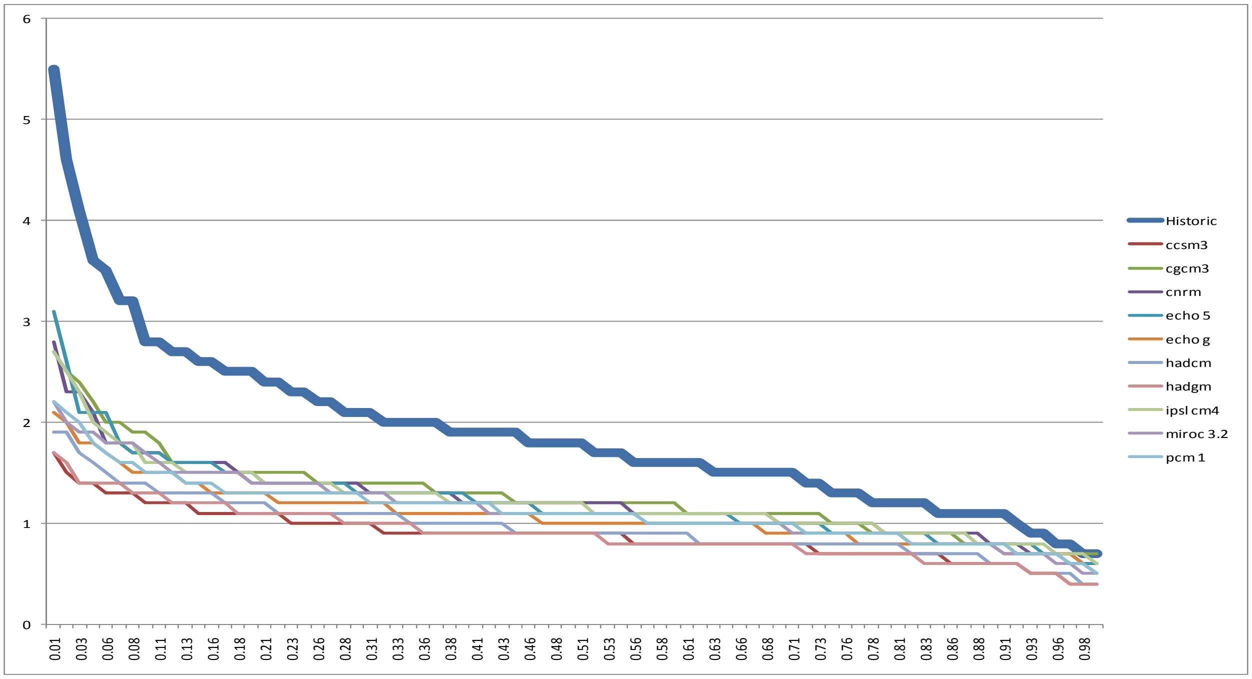
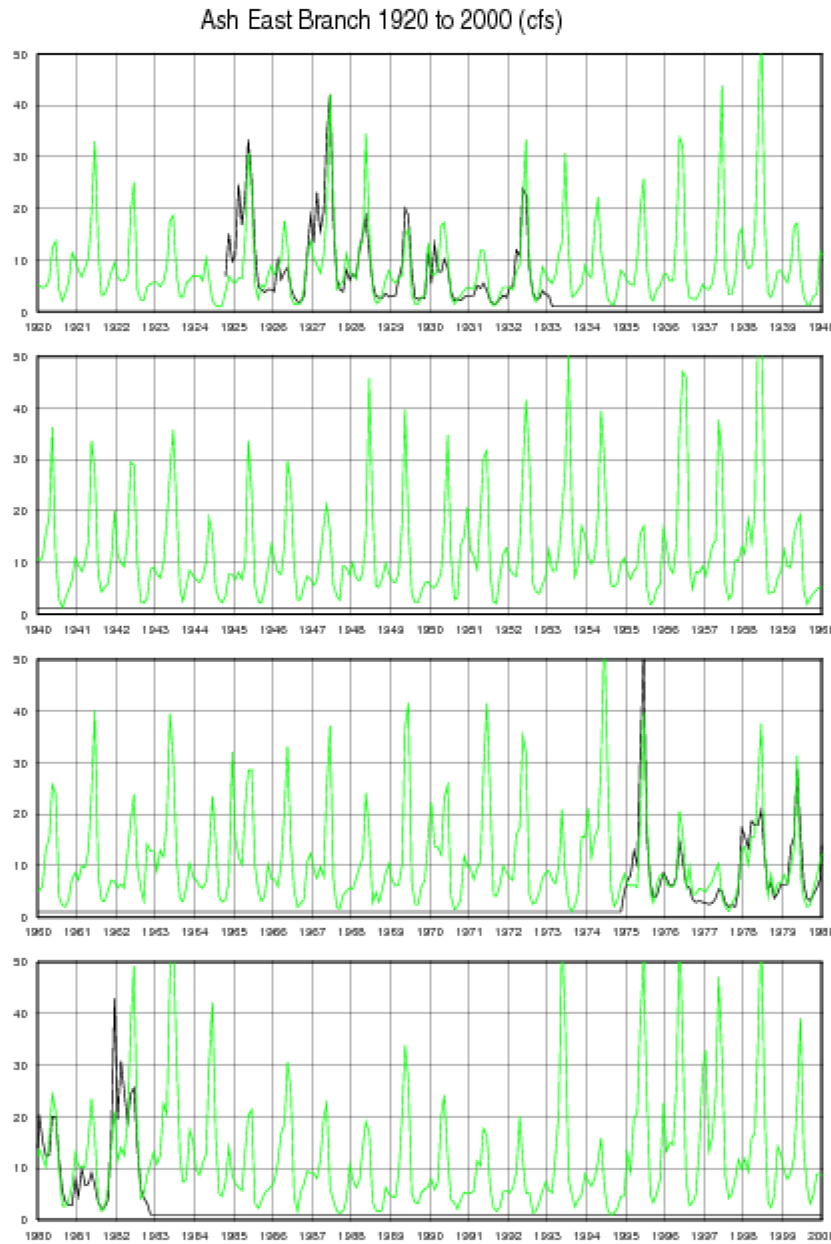


Figure 33 Monthly Average Streamflow in cfs, black line represent observed values.



West Fork

Snow Water Equivalent

Figure 34 Mean Snow Water Equivalent for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

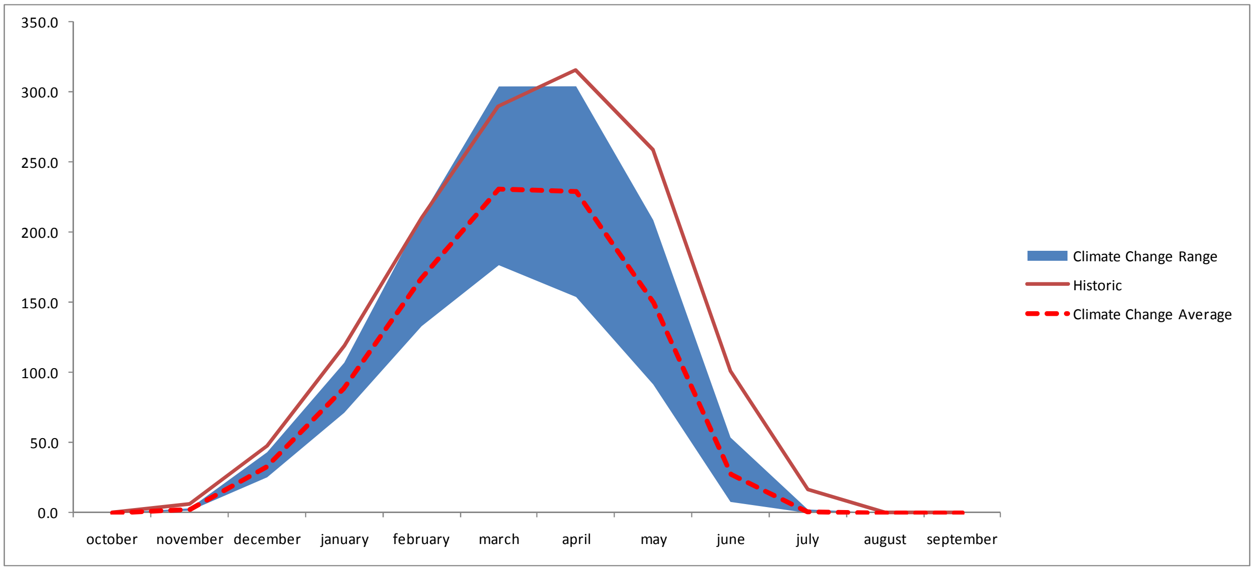


Figure 35 Mean Snow Water Equivalent for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

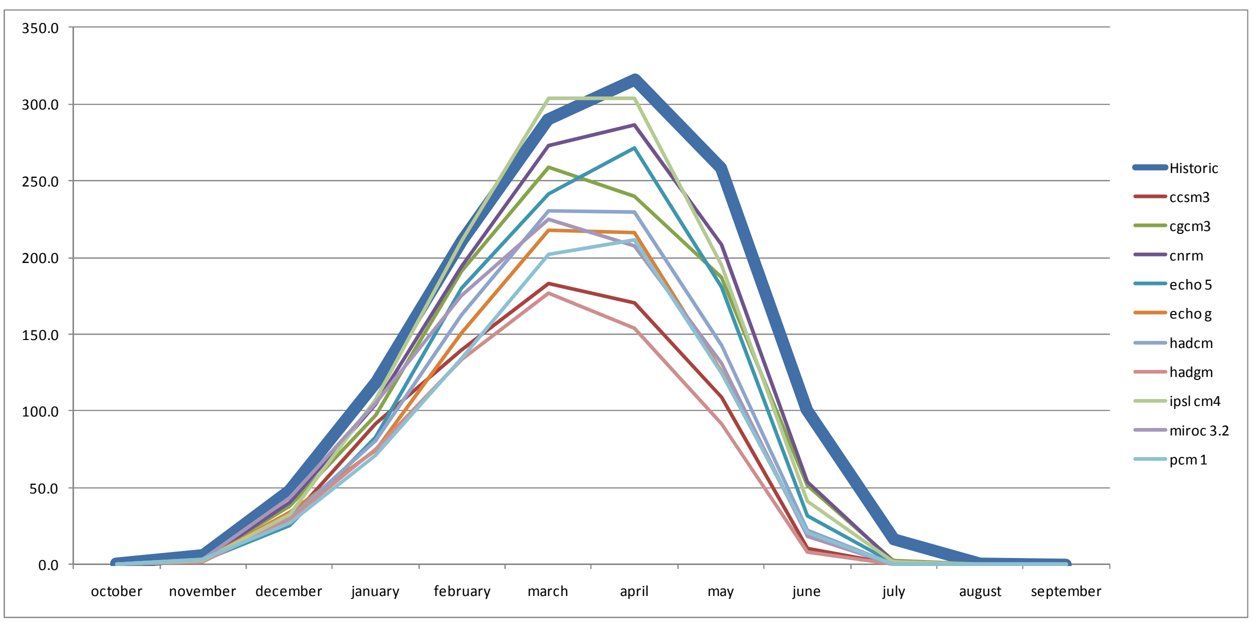


Table 7 Mean Monthly Snow Water Equivalent for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	0.4	0.10	0.08	0.07	0.10	0.05	0.04	0.04	0.08	0.06	0.07
November	6.1	2.49	3.30	2.39	2.86	2.25	1.65	1.92	2.83	3.07	3.09
December	47.8	29.62	38.11	40.26	25.42	33.76	29.86	29.09	32.57	43.31	27.20
January	119.2	91.35	96.82	103.99	82.99	74.51	80.23	75.24	107.05	105.14	71.48
February	210.8	139.96	190.78	194.37	179.55	150.79	162.23	133.15	210.94	175.01	133.92
March	289.8	183.39	258.67	273.15	241.58	217.54	230.17	176.67	303.72	224.65	201.63
April	316.1	170.08	239.97	286.33	271.70	216.08	229.57	154.03	303.85	207.71	211.18
May	258.5	108.93	186.65	208.60	180.59	125.53	142.91	91.64	194.70	130.99	124.51
June	101.0	10.24	51.09	53.81	31.77	19.78	21.88	7.92	41.35	18.49	20.82
July	16.3	0.03	2.54	1.83	1.03	0.42	0.42	0.05	1.47	0.35	0.39
August	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September	0.0	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01

Table 8 Snow Statistics for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059, Julian Day of 10% accumulation (JD 10% SWE) , Julian Day of maximum accumulation (JD MAX SWE), Julian Day of 90% melting of the accumulated snow (JD 90% MELT SWE), Maximum Snow Water Equivalent (MAX SWE) , Days Between 10% of accumulation to 90 % of melting (DAYS 10% - 90%)

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
JD 10% SWE	58.2	58.3	58.8	60.3	65.7	58.2	62.8	59.3	63.9	54.9	63.4
JD MAX SWE	181.7	165.9	167.4	178.2	178.4	170.1	172.2	159.4	171.4	163.4	173.9
JD 90% MELT SWE	254.6	229.5	245.6	244.7	239.9	237.3	234.4	227.4	241.7	234.6	235.2
MAX SWE	343.2	209.3	282.3	312.0	287.4	244.5	256.1	196.4	335.8	245.3	234.3
DAYS 10% - 90%	196.4	171.2	186.8	184.4	174.2	179.1	171.7	168.1	177.8	179.7	171.8

Evapotranspiration

Figure 36 Accumulated Monthly Evapotranspiration for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

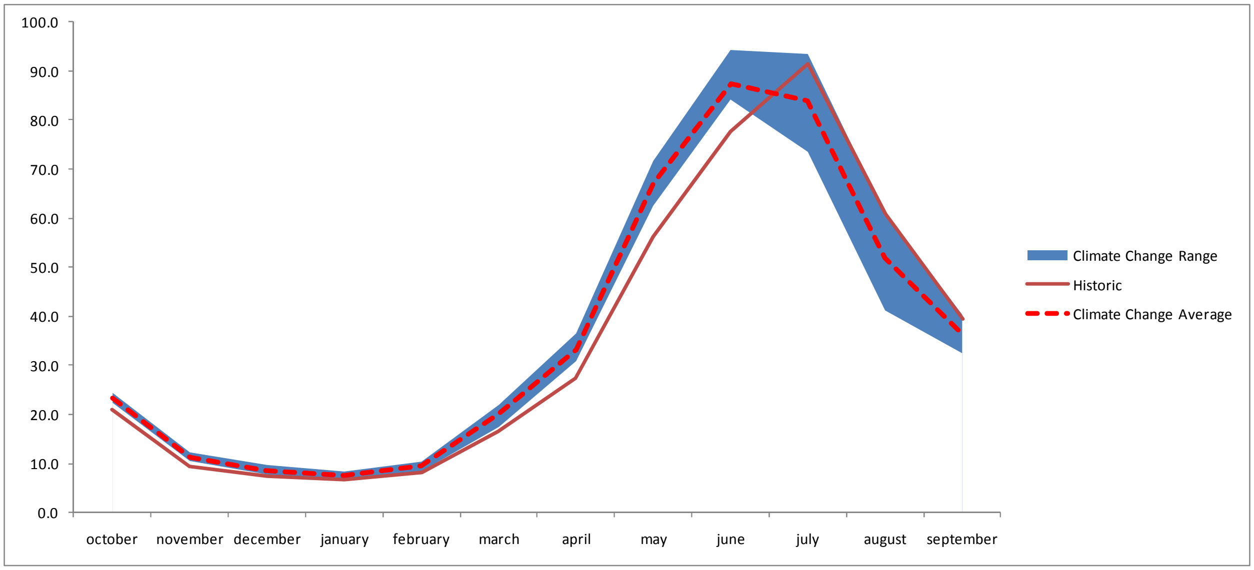


Figure 37 Accumulated Monthly Evapotranspiration for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

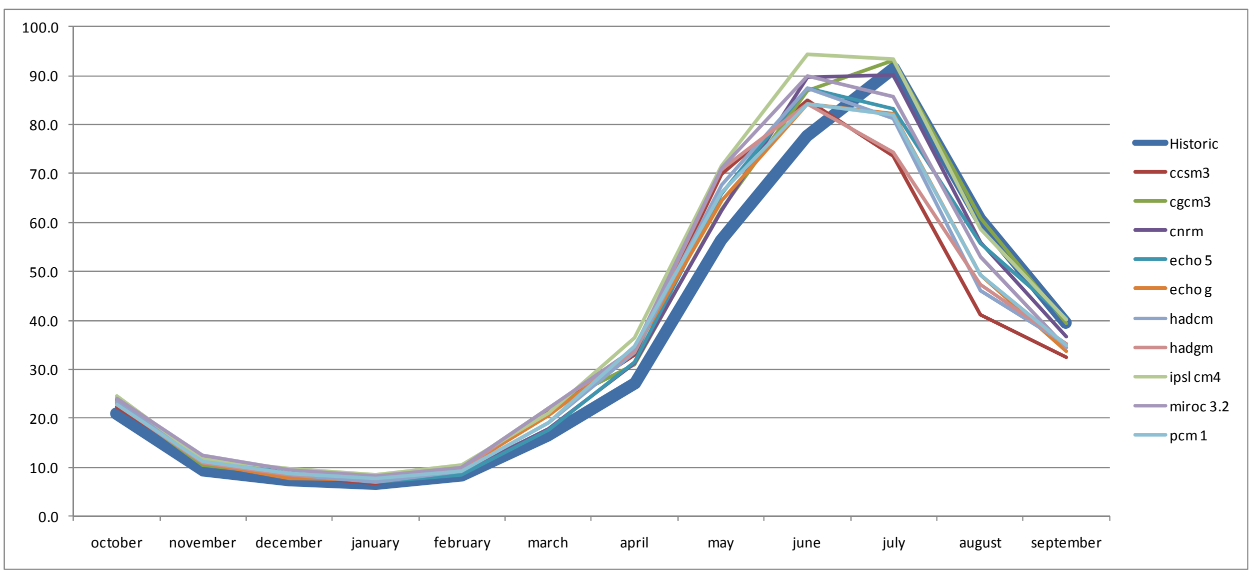


Table 9 Accumulated Monthly Evapotranspiration for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	21.1	22.4	23.3	23.0	23.9	23.5	23.2	22.8	24.5	24.0	22.9
November	9.3	11.3	10.6	11.2	11.9	11.0	11.4	10.9	11.6	12.3	11.3
December	7.4	8.2	8.5	8.3	8.8	7.8	8.5	8.5	9.8	9.5	8.7
January	6.7	6.8	8.2	7.3	7.1	7.5	7.1	8.4	8.4	8.1	7.7
February	8.3	9.6	10.0	8.8	8.5	9.8	9.1	9.5	10.5	10.0	9.2
March	16.6	21.3	22.0	17.9	17.5	20.5	19.1	22.0	21.0	22.0	19.1
April	27.3	32.9	30.9	31.3	31.5	33.6	33.5	33.7	36.5	34.2	34.8
May	56.3	69.9	62.6	62.6	65.9	64.3	67.7	70.9	71.7	71.0	66.1
June	77.7	84.9	86.9	89.6	87.5	84.2	87.5	84.2	94.3	90.0	84.4
July	91.5	73.5	93.3	90.2	83.3	82.1	81.3	74.4	93.4	85.8	81.9
August	60.9	41.3	60.9	55.9	55.7	49.4	46.1	47.4	58.8	53.0	49.4
September	39.5	32.5	39.3	36.7	40.4	33.8	35.2	35.2	40.1	34.5	35.0

Stream Flow

Figure 38 Average Monthly Streamflow for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

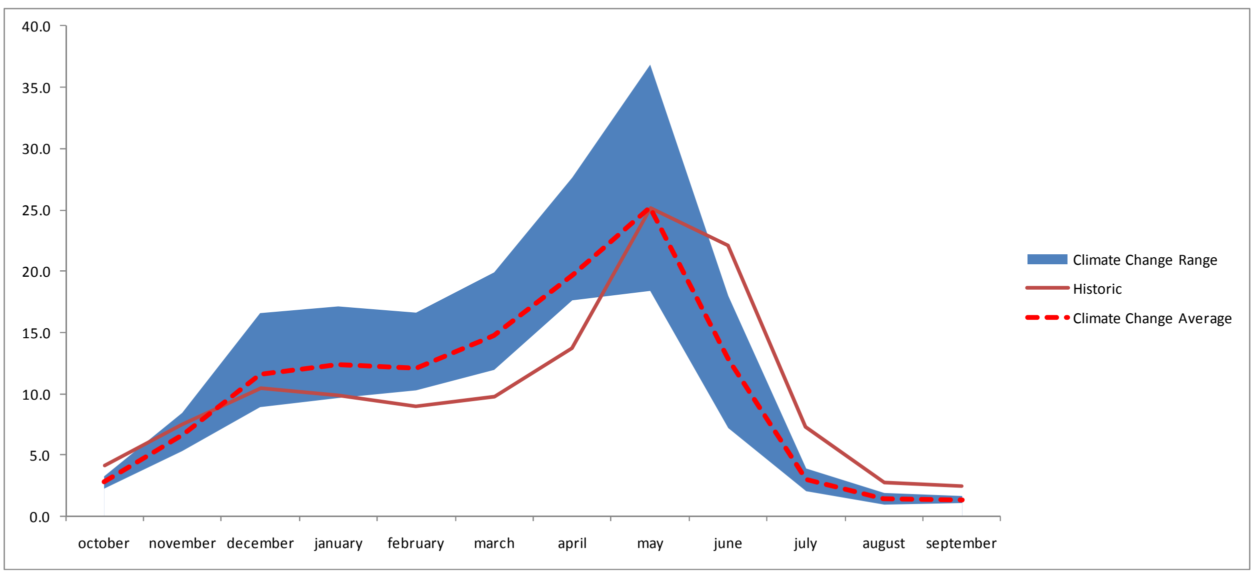


Figure 39 Average Monthly Streamflow for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

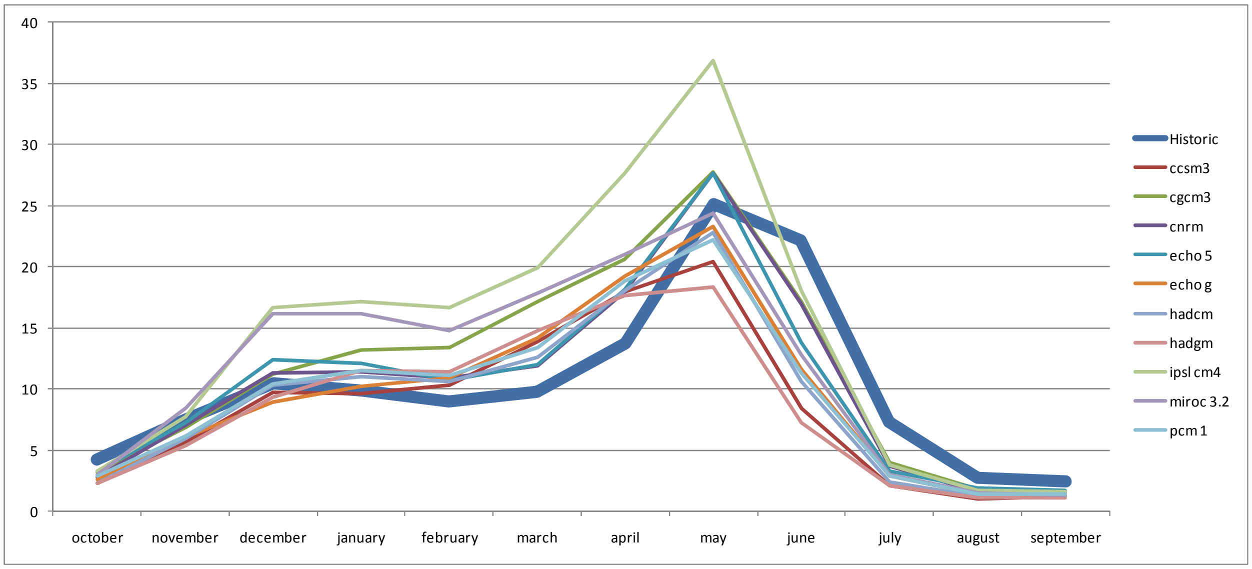


Table 10 Average Monthly Streamflow for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	4.2	2.34	3.23	2.77	3.31	2.58	2.32	2.3	3.28	2.99	2.89
November	7.5	5.69	6.89	7.06	7.23	6.06	5.97	5.35	7.74	8.48	6.15
December	10.43	9.74	11.23	11.31	12.44	8.92	10.32	9.37	16.62	16.12	10.38
January	9.83	9.66	13.24	11.39	12.1	10.22	11.02	11.51	17.17	16.19	11.47
February	8.96	10.29	13.35	10.93	10.74	10.91	10.63	11.37	16.65	14.8	11.15
March	9.81	13.89	17.13	11.95	12.05	14.17	12.56	14.75	19.94	17.88	13.38
April	13.73	17.93	20.58	17.99	18.19	19.25	18.09	17.6	27.67	20.98	18.83
May	25.16	20.44	27.75	27.65	27.66	23.34	22.82	18.37	36.87	24.4	22.25
June	22.11	8.46	17.19	16.94	13.81	11.63	10.58	7.22	18.03	12.76	11.32
July	7.33	2.09	3.94	3.69	3.27	2.93	2.41	2.09	3.76	3.02	2.94
August	2.78	1	1.81	1.61	1.95	1.38	1.19	1.15	1.67	1.53	1.43
September	2.49	1.16	1.62	1.53	1.7	1.33	1.19	1.12	1.6	1.35	1.36

Extreme Values

Figure 40 Quantiles for extreme flood during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

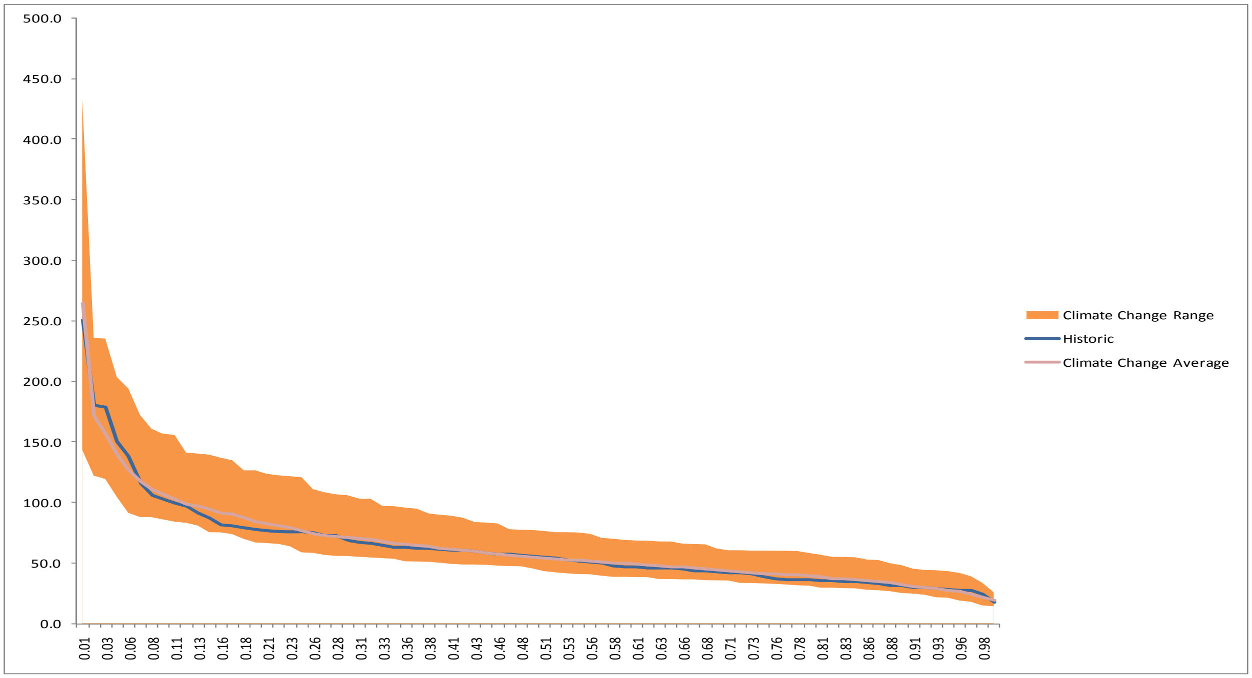


Figure 41 Quantiles for extreme flood during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

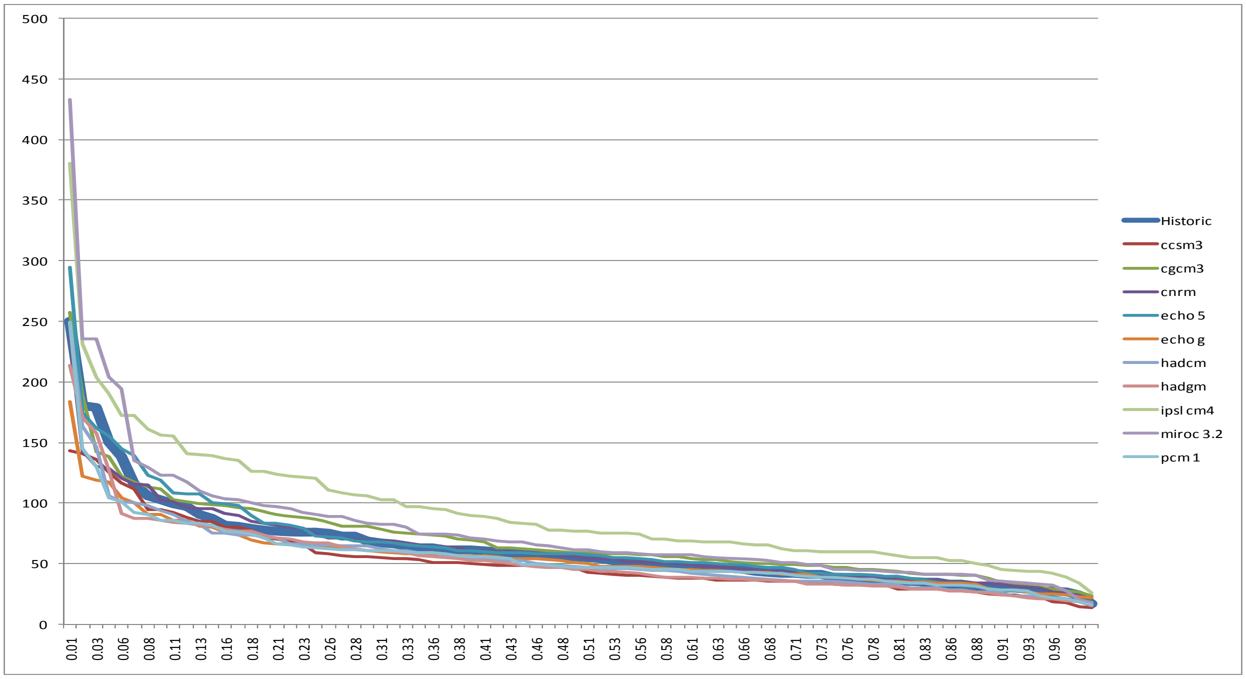


Figure 42 Quantiles for extreme low streamflow during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

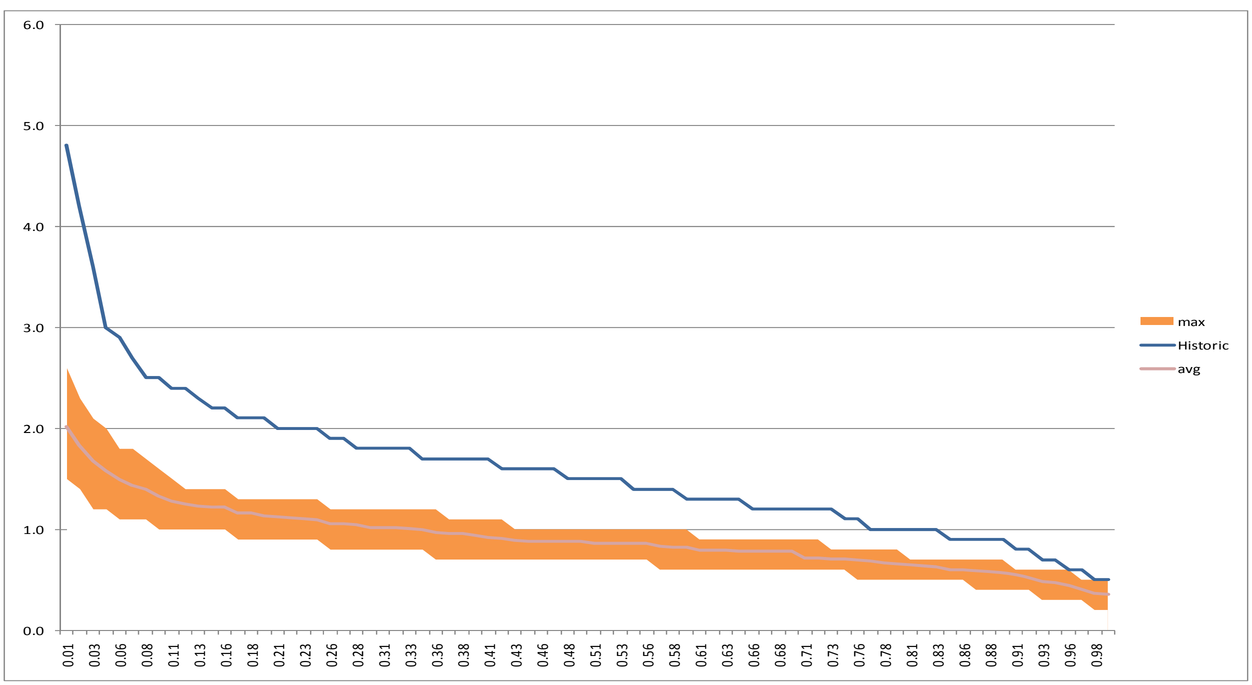


Figure 43 Quantiles for extreme low streamflow during the historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

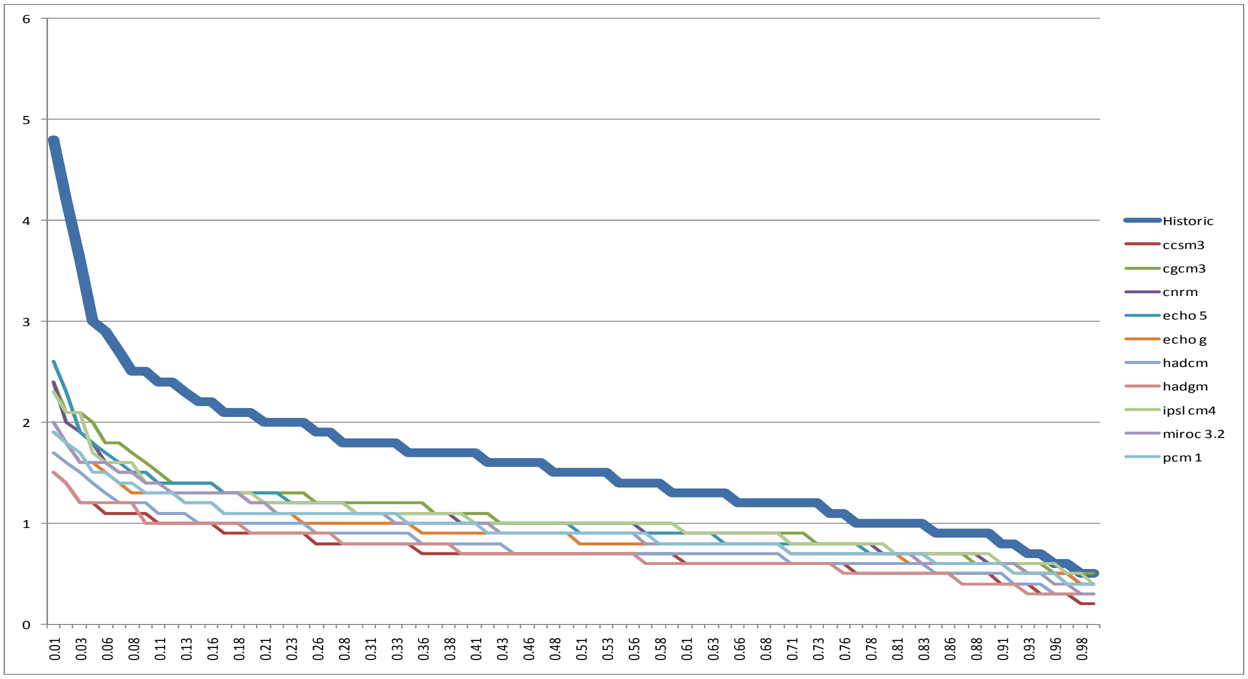
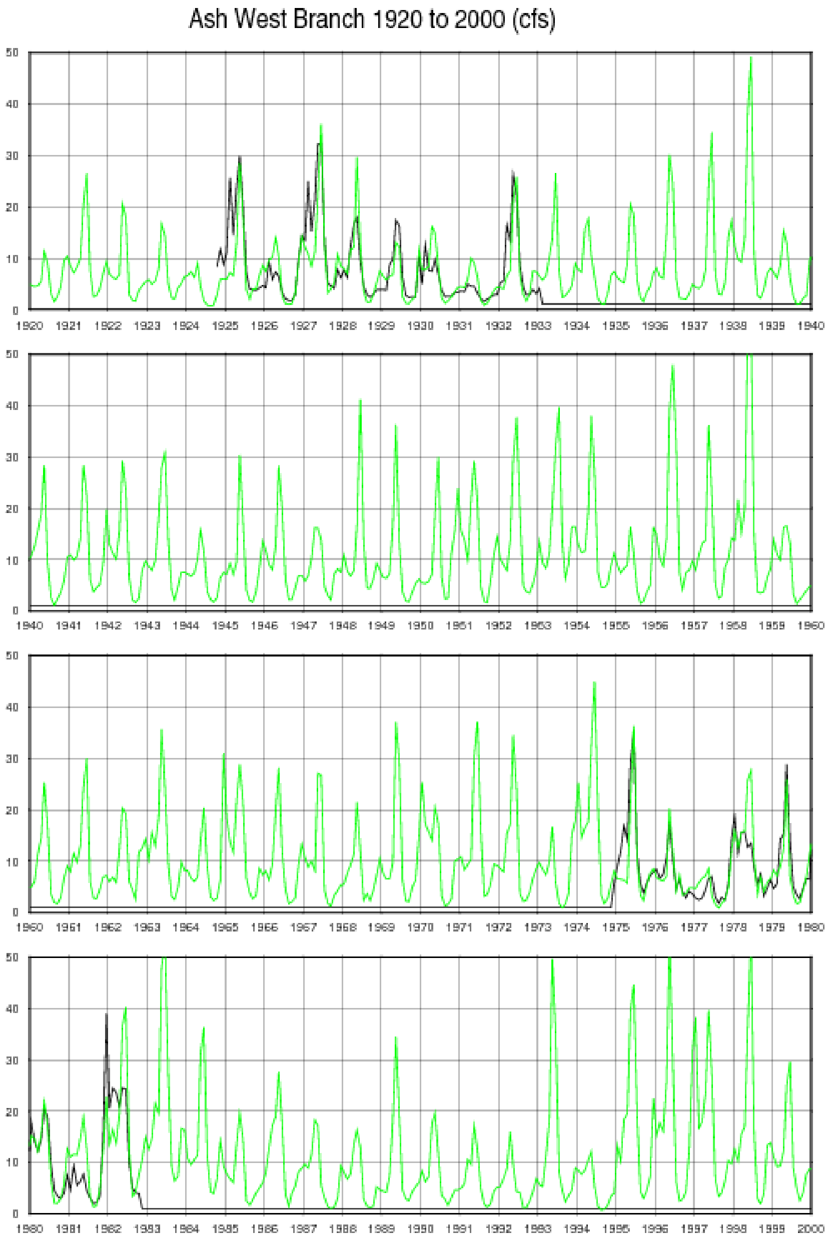


Figure 44 Monthly Average Streamflow in cfs, black line represent observed values.



Combined Streamflow

Figure 45 Combined Monthly Streamflow of the West and East Branches for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

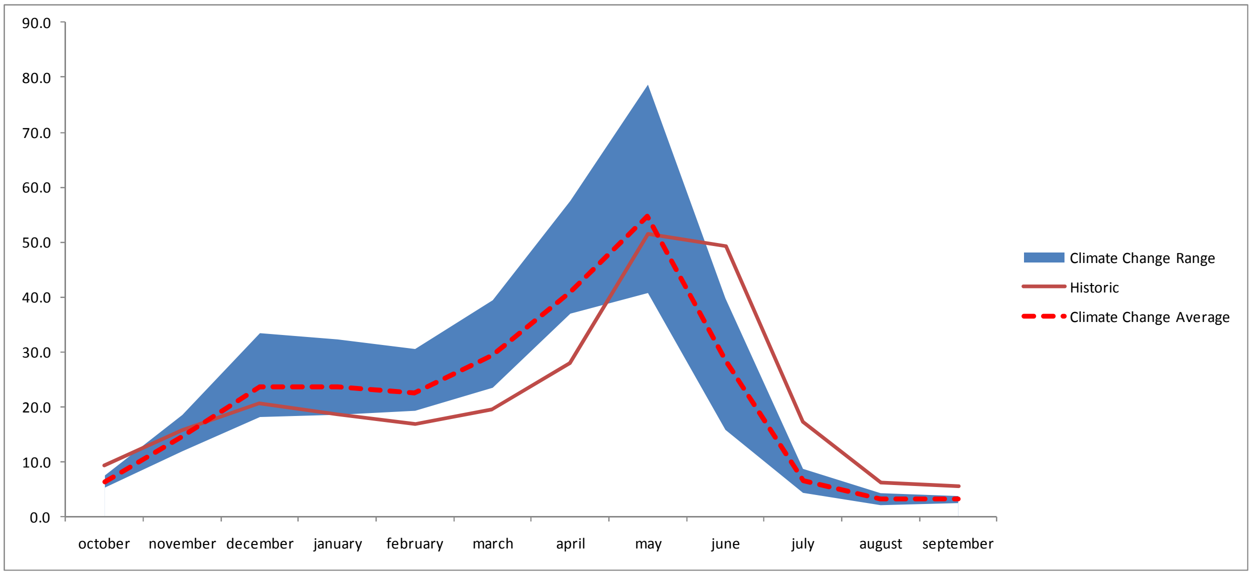


Figure 46 Combined Monthly Streamflow of the West and East Branches for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

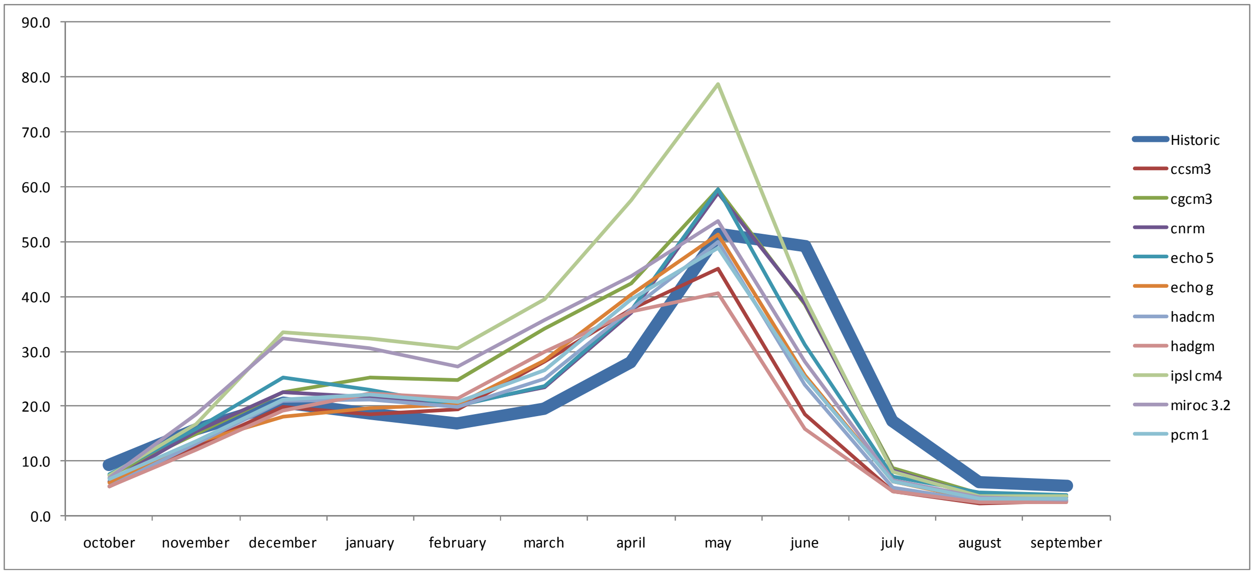


Table 11 Combined Monthly Streamflow of the West and East Branches for the period historic period 1920 to 2000 and climate change scenarios from 2030 to 2059

	Historic	ccsm3	cgcm3	cnrm	echo 5	echo g	hadcm	hadgm	ipsl cm4	miroc 3.2	pcm 1
October	9.3	5.5	7.4	6.3	7.6	6.0	5.4	5.4	7.5	7.0	6.7
November	15.8	12.7	14.9	15.4	15.8	13.4	13.3	12.0	16.8	18.6	13.6
December	20.7	19.9	22.6	22.7	25.2	18.2	21.1	19.3	33.5	32.3	21.3
January	18.8	18.6	25.2	21.6	23.0	19.7	21.1	22.4	32.3	30.6	22.1
February	16.9	19.3	24.7	20.3	20.0	20.4	19.9	21.4	30.6	27.3	20.8
March	19.5	28.2	34.2	23.5	23.7	28.3	24.9	30.0	39.4	35.6	26.5
April	28.1	37.8	42.3	37.0	37.4	40.4	37.7	37.3	57.5	43.8	39.5
May	51.5	45.1	59.4	58.8	59.6	51.3	49.9	40.7	78.6	53.8	48.9
June	49.2	18.6	38.5	38.9	31.3	25.7	24.0	15.9	39.8	28.2	25.2
July	17.3	4.4	8.8	8.3	7.1	6.3	5.2	4.5	8.2	6.5	6.3
August	6.3	2.2	4.0	3.5	4.4	3.0	2.6	2.6	3.6	3.4	3.1
September	5.6	2.7	3.7	3.5	3.9	3.0	2.7	2.6	3.6	3.1	3.1

FTP DATA

All the information is available in a FTP site ,The address is:

http://www.hydro.washington.edu/pub/pcarrasco/

There are 2 subdirectories one for the east and one for the west

Inside each of these subdirectories there are directories for each scenario

Aggregated.Values Basin	Average Values of the internal Variables
mouth_east.asheast_calXX.ps	Graph of Monthly Streamflow
mouth_east.asheast_cal4XXHD.ps	Hydrograph of the scenario and Observed Data
mouth_east.mon_cfs	Monthly Average Streamflow at the Mouth starting 1916
mouth_east.day	Daily Average Streamflow at the Mouth in CFS starting 1920
mouth_east.year_avg_cfs	Yearly Average Streamflow at the Mouth
mouth_east.dly_cfs	Daily Average Streamflow at the Mouth in CFS starting 1916
Streamflow.Only	Streamflow in all the segments of the stream network
Mass.Balance	Internal Mass Balance Components
Stream.Temp	Stream Temperature Data
Stream.Flow	Streamflow Balance
Streamtemp.Only	Stream Temperature in all the segments of the stream network

The Files ***mouth_east.dly_cfs and mouth_west.dly_cfs*** contains the simulated streamflow at the USGS gages, years from 1916 to 1919 must not be used since contain spin up data. If information at others parts of the creek is needed the Stream.Flow file can be utilized.

Aggregated Values

Id Name Long name Units File label

1. Evap.ETot Evapotranspiration (Total) m/timestep Total amount of evapotranspiration
2. Evap.EPot Potential Evapotranspiration m/timestep Potential evaporation/transpiration
3. Evap.EInt Interception Evaporation m/timestep Evaporation from interception
4. Evap.ESoil Not implemented yet m/timestep Not implemented yet
5. Evap.EAct Evaporation m/timestep Actual evaporation/transpiration
6. Precip Precipitation m/timestep Precipitation
7. Precip.IntRain Interception Storage (liquid) m Interception storage (liquid)
8. Precip.IntSnow Interception Storage (frozen) m Interception storage (frozen)
9. Rad.Beam Incoming Direct Radiation W/m^2 Direct beam solar radiation
10. Rad.Diffuse Incoming Diffuse Radiation W/m^2 Diffuse solar radiation

11. Snow.HasSnow Snow Presence/Absence - Snow cover flag
12. Snow.SnowCoverOver Overstory Snow Flag - Flag overstory can be covered
13. Snow.LastSnow Last Snowfall days Days since last snowfall
14. Snow.Swq Snow Water Equivalent m Snow water equivalent
15. Snow.Melt Snow Melt m/timestep Snow Melt
16. Snow.PackWater Liquid Water Content (Deep Layer) m Liquid water content of snow
17. Snow.TPack Snow Temperature (Deep Layer) °C Temperature of snow pack
18. Snow.SurfWater Liquid Water Content (Surface Layer) m Liquid water content of surface
19. Snow.TSurf Snow Temperature (Surface Layer) °C Temperature of snow pack surface
20. Snow.ColdContent Snow Cold Content J Cold content of snow pack
21. Soil.Moist Soil Moisture Content - Soil moisture for layer %d
22. Soil.Perc Percolation m/timestep Percolation
23. Soil.TableDepth Water Table Depth m below surface Depth of water table
24. Soil.NetFlux Net Water Flux m/timestep Net flux of water
25. Soil.TSurf Surface Temperature °C Soil surface temperature
26. Soil.Qnet Net Radiation W/m^2 Net radiation exchange at surface
27. Soil.Qs Sensible Heat Flux W/m^2 Sensible heat exchange
28. Soil.Qe Latent Heat Flux W/m^2 Latent heat exchange
29. Soil.Qg Ground Heat Flux W/m2 Ground heat exchange
30. Soil.Qst Ground Heat Storage W/m^2/td> Ground heat storage

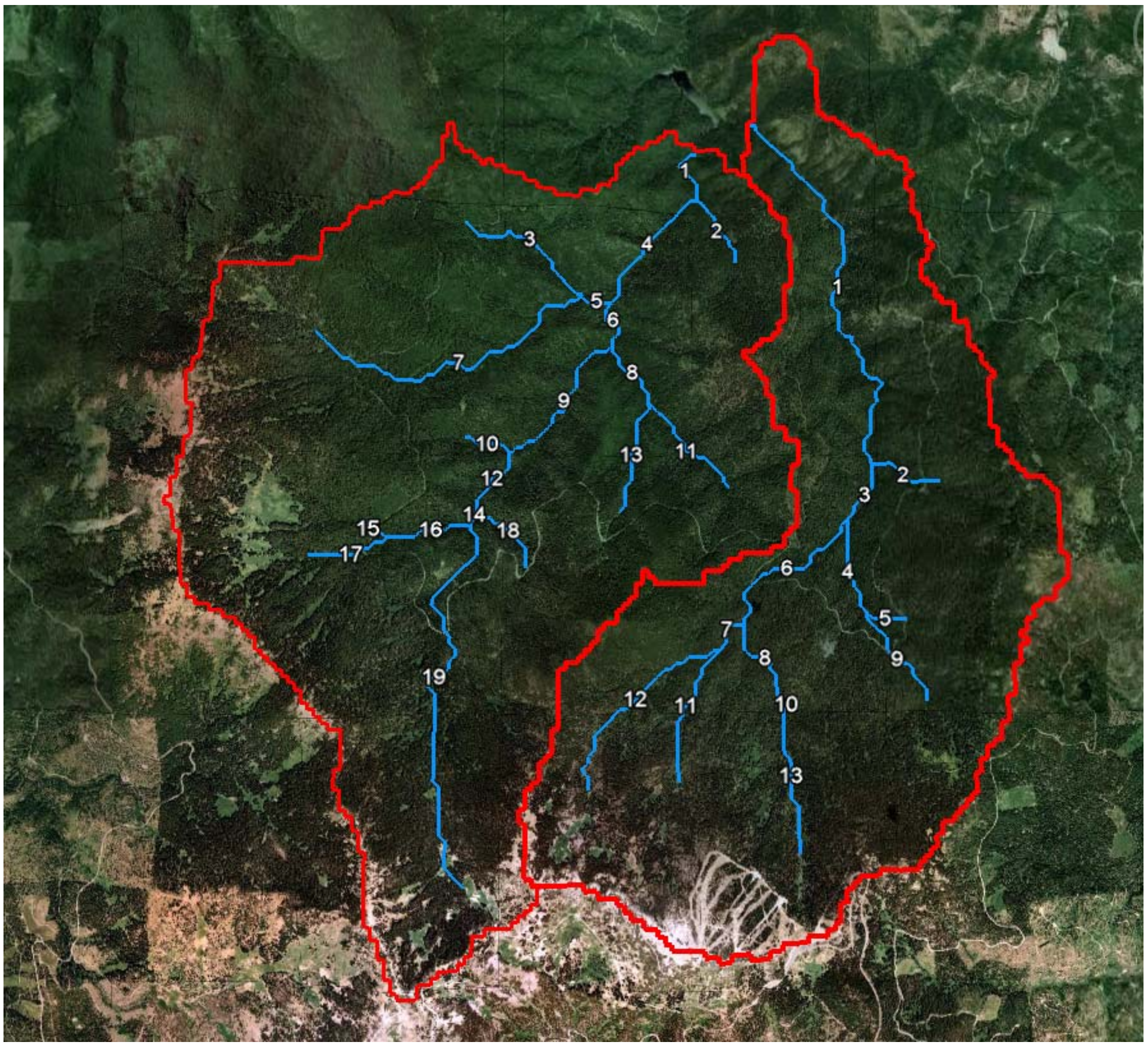
Mass Balance File

1. Total runoff
2. Total amount of water in the canopy
3. Total amount of water in the soil
4. Total amount of snow water equivalent
5. Total amount of saturated subsurface flow
6. Total amount of water intercepted by channels
7. Total amount of water intercepted by roads
8. Total amount of water returned by culverts to the land surface
9. Total amount of evapotranspiration
10. Total amount of precipitation
11. Total amount of sublimation from snow on the ground
12. Total amount of sublimation from snow in the canopy
13. Total amount of water during the previous time step
14. Total amount of flow from culverts to the channel
15. Total amount of surface flow to the channel
16. Total mass balance error for the current time step

Stream.Flow

The file Stream.Flow contains the volume of water for each time step for each segment of the stream network the unit are m3/3hrs. Column 4 contains the inflow in the segment and column 5 contains the outflow of the segment. For information about segment ID check the following figure.

Figure 47 Stream Segment ID



1 string Simulation time stamp of the form MM/DD/YYYY-HH

2 integer Segment identifier, as specified in the stream/road network file; zero for the "Totals" lines

3 real inflow, m^3/timestep, to the segment from upstream segments; not printed for the "Totals" lines

4 real lateral inflow, m^3/timestep, to the segment, or entire network in "Totals" lines

5 real outflow, m^3/timestep, from the segment, or entire network in "Totals" lines If the line is for a single segment the remaining fields are as follows:

6 real Change in segment storage, m^3, occurring within the previous routing time step. 7 "string" Segment title specified in the stream/road network file If the line is for the entire network (i.e. "Totals" line) the remaining fields are as follows: 6 real Total network storage, m^3, for the previous routing time step.

7 real Change in entire network storage, m^3, occurring within the previous routing time step.

8 real Estimate of the mass balance error for the time step

9 "Totals" identifier for "Totals" lines

Coordinated Water Rights Management and Water Sharing Plan

A strategic approach to water management

September 30, 2021

Water is a precious but limited resource in Southern Oregon. Because of this, the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent—collectively referred to as the Partner Cities—and the Medford Water Commission have come together to protect and ensure access to this vital resource.

Why is this partnership needed?

The Partner Cities hold numerous water rights that authorize the diversion of water at the Medford Water Commission's Duff Water Treatment Plant (WTP). Because of the complications associated with managing multiple water rights at a single point of diversion, the Partner Cities and Medford Water must work together to manage these water rights to ensure they are protected.

This alliance also allows for the sharing of water supplies. Water sharing eliminates the need for some Partner Cities to obtain new water rights, which would only further complicate water rights management. Ultimately, the partnership's efforts will help diversify the region's water supply portfolio, increase the long-term reliability of the water supplies, and provide additional tools for managing through water shortages and drought.

What is the background of the partnership?

The Partner Cities and Medford Water entered into a cooperative agreement for developing a water rights strategy in 2019, and in February 2020, identified a recommended approach. The recommended approach includes two elements (1) water rights certification coordination, and (2) a water-sharing plan.

How does water sharing work?

Under the water-sharing plan framework, the Partner Cities would retain ownership and control of their water rights, and continue to use water under their own water rights from May 1 through September 30 each year. At the end of each year, Medford Water would compare each city's water use to the volume of water authorized by its water rights. Any Partner Cities that used more water than authorized by their water rights would provide compensation to the other Partner Cities for use of water under their rights.

What are the next steps?

Staff from Medford Water and the Partner Cities have been meeting to develop an Intergovernmental Agreement (IGA) for establishing the Coordinated Water Rights Management and Water Sharing Plan. Staff will continue to keep their Boards and Councils updated and in the near future will bring the IGA to decision makers for their review.

INTERGOVERNMENTAL AGREEMENT FOR

A COORDINATED WATER RIGHTS MANAGEMENT AND WATER SHARING PLAN

I. Parties

This Intergovernmental Agreement (IGA) is between the Medford Water Commission (MEDFORD WATER) and the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent, hereinafter PARTNERS when referred to collectively, and MEDFORD WATER, ASHLAND, CENTRAL POINT, EAGLE POINT, JACKSONVILLE, PHOENIX, and TALENT when referred to individually, and PARTNER CITIES when referring to ASHLAND, CENTRAL POINT, EAGLE POINT, JACKSONVILLE, PHOENIX, and TALENT.

II. Recitals

A. The PARTNERS all own and operate water systems that supply water to their respective customers;

B. The PARTNERS recognize the vital importance of providing a reliable source of water to all their respective customers for public health, safety, and welfare and for sustaining economic development;

C. The PARTNERS recognize the importance of water conservation, and each take actions to conserve their water supply.

D. The PARTNERS have invested in and each hold water right(s) that are diverted and treated at the Duff Water Treatment Plant (WTP) located on the Rogue River, and understand the importance of strategically managing those water rights;

E. The Duff WTP, owned by MEDFORD WATER, provides treated water to the PARTNERS and is a critical regional water supply facility.

F. The PARTNER CITIES receive water treated at the Duff WTP under Treat and Transport contracts with MEDFORD WATER. These contracts include rates of water that the PARTNER CITIES can receive from the MEDFORD WATER's water supply system during identified time periods.

G. The PARTNERS value the important role each utility plays in meeting the water supply needs of the Rogue Valley Region;

H. The PARTNERS entered into a cooperative agreement for developing a water rights strategy in 2019, which resulted in development of a Final Report entitled WATER RIGHTS STRATEGY FOR PARTNER WATER PROVIDERS (February 2020). The cooperative agreement and report executive summary are included in **Attachment 1**;

I. The WATER RIGHTS STRATEGY FOR PARTNER WATER PROVIDERS recommends Phase I of the Coordinated Water Rights Management and Sharing Plan, which includes a coordinated water rights certification strategy for water rights diverted at the Duff WTP and a PARTNER CITIES water sharing framework;

J. The WATER RIGHTS STRATEGY FOR PARTNER WATER PROVIDERS recommends a Phase II of the Coordinated Water Rights Management and Sharing Plan to continue the water rights certification strategy for water rights diverted at the Duff

WTP and a PARTNER CITIES and MEDFORD WATER water sharing framework. A separate IGA will need to be developed and approved for Phase II;

K. The PARTNERS recognize that this IGA is related to Phase I of the Coordinated Water Rights Management and Sharing Plan; and
L. The PARTNERS enter this agreement in a spirit of good will and mutual cooperation, understanding that entering this IGA for Phase I of a Cooperative Water Rights Management and Water Sharing Plan is intended to improve the current and long-term reliability of individual and collective water supplies and is in the highest public interest.

III. Scope and Purpose

To develop, refine and implement Phase I of a Coordinated Water Rights Management and Water Sharing Plan that includes a coordinated water rights certification strategy for water rights diverted at the Duff WTP and a PARTNER CITIES water sharing framework. This IGA does not address Phase II of a Coordinated Water Rights Management and Water Sharing Plan, which would be established in a separate IGA. Being a signatory to this IGA does not require a PARTNER to become a signatory to an IGA developed for Phase II.

IV. Retention of Asset Ownership

A. Each Partner will retain ownership of its water right(s). Nothing in this IGA will have the effect of conveying a water right to any other entity.
B. MEDFORD WATER will retain ownership of the Duff WTP, the associated intake on the Rogue River, and all related infrastructure. Nothing in this IGA will have the effect of conveying any of MEDFORD WATER's water system to any other entity.

V. Water Right Certification Coordination

A. The PARTNERS developed a strategy for managing the timing of certification of their existing water use permits and transfers, which is described in the Water Rights Certification Strategy Table provided in **Attachment 2**. The table identifies the water rights that have been or can be certificated at the current Duff WTP capacity (70 cfs), and the permits and transfers to be certificated at each subsequent WTP capacity (100 cfs, 131 cfs, 162 cfs and 193 cfs). Except as provided in subsection D of this section, only the portion of the Water Rights Certification Strategy Table for the Duff WTP's existing capacity of 70 cfs is applicable to this IGA for Phase I of the Water Rights Management and Water Sharing Plan.
B. The PARTNERS agree to submit claims of beneficial use (COBUs) and requests for water right certificates to the Oregon Water Resources Department (OWRD) only at times consistent with the portion of the Water Rights Certification Strategy Table for the Duff WTP's existing capacity of 70 cfs, except as provided in subsection D of this section.
C. At least 14 days prior to submitting a COBU and request for water right certificate to OWRD, PARTNERS agree to provide the Managing Agency with written notice of their intention to file a COBU.

D. The Water Rights Certification Strategy Table will be reviewed by the PARTNERS annually as described in Section VIII, and will be updated to reflect the issuance of water right certificates consistent with Water Rights Certification Strategy.

E. Each PARTNER will continue to be responsible for maintaining its own water rights, which will include but is not limited to filing water use reports with OWRD, developing claims of beneficial use and requesting water right certificates, and developing water management and conservation plans.

VI. Water Sharing

A. Consistent with the PARTNER CITIES' contracts with MEDFORD WATER, each PARTNER CITY will use water under its individual water rights beginning May 1 of each year and ending September 30 of each year.

B. By November 15 of each year, MEDFORD WATER will calculate the total volume of water used by each PARTNER CITY during the period of May 1 through September 30 based on meter readings for each city, referred to as each city's "Annual Metered Volume." The meters used to determine each PARTNER CITY'S "Annual Metered Volume" are listed in **Attachment 3**.

1. The owner of each meter will ensure its meter(s) are calibrated to manufacturer standards.
2. If a meter breaks or malfunctions the PARTNERS will use the best practicable information available to estimate water use.

C. MEDFORD WATER will compare each PARTNER CITY'S Annual Metered Volume to the total volume of water authorized by each PARTNER CITY'S water rights (referred to as each PARTNER CITY'S "Total Authorized Water Volume") as shown in **Attachment 4.**

~~C.~~D. The PARTNER CITIES will notify MEDFORD WATER of any changes to their Total Authorized Water Volume that occur during the May 1 through September 30 period.

~~D.~~E. If a PARTNER CITY'S Annual Metered Volume exceeds its Authorized Water Volume, as provided in VI. C., MEDFORD WATER will subtract the Authorized Water Volume from the Annual Metered Volume to obtain that PARTNER CITY'S "Volume of Excess Use" for the year.

~~E.~~F. If a PARTNER CITY'S Annual Metered Volume is less than that city's Authorized Water Volume, as provided in VI. C., MEDFORD WATER will subtract the Annual Metered Volume from the Authorized Water Volume to obtain that PARTNER CITY'S "Excess Water Right Volume" for the year.

~~F.~~G. For each PARTNER CITY with a Volume of Excess Use, MEDFORD WATER will allocate the Volume of Excess Use equally among all PARTNER CITIES with an

Excess Water Right Volume for that year. MEDFORD WATER will allocate the Volume of Excess Use equally up to, but not in excess of, the PARTNER CITIES' Authorized Water Volumes. If equal allocation of a PARTNER CITY'S Volume of Excess Use would exceed one or more PARTNER CITY'S Authorized Water Volume, the Volume of Excess Use will be allocated equally among the PARTNER CITIES in the amount of the smallest Excess Water Right Volume. The remaining Volume of Excess Use will then be allocated equally among the remaining PARTNER CITIES with Excess Water Right Volume. This process will be repeated until the PARTNER CITY'S entire Volume of Excess Use has been allocated to other PARTNER CITIES. **Attachment 5** provides an example of the intended process.

~~G.~~H. Any PARTNER CITY with a Volume of Excess Use will provide compensation to PARTNER CITIES with Excess Water Right Volume according to the volume of water allocated to that PARTNER CITY, and the Method of Cost Allocation provided in Section VII.

VII. Method of Cost Allocation

A. By March 1 of each year, each PARTNER CITY will provide to MEDFORD WATER a copy of any Statement of Account or other invoices from the U.S. Army Corps of Engineers, or annual assessment from the Medford Irrigation District and/or Rogue River Irrigation District the PARTNER CITY received in the previous year related to their water rights associated with the Duff Water Treatment Plant as described in Attachment 2.

B. Based on the information provided in subsection A., MEDFORD WATER will calculate the following total annual costs. An example of the calculations is provided in **Attachment 6**.

1. The Total Annual Operation and Maintenance (O&M) Costs for storage space for Lost Creek Reservoir will be calculated by adding together the annual O&M costs for Ashland, Jacksonville, Phoenix, and Talent. This cost is associated with 3,892 AF of storage space in the reservoir, as shown in Table 1 of Attachment 6;
2. The Total Annual Repair Replacement and Rehabilitation (RR&R) Costs for storage space for Lost Creek Reservoir will be calculated by adding together any annual RR&R costs for Ashland, Jacksonville, Phoenix, and Talent. This cost is associated with the 3,892 AF of storage space, as shown in Table 2 of Attachment 6.
3. The 5-year Rolling Average RR&R Cost for storage space for Lost Creek Reservoir will be calculated by adding together the Total Annual RR&R Costs for the preceding five years and dividing by 5. This calculation is shown in Table 3 in Attachment 6.
4. The Total Annual Assessment Costs will be calculated by adding together the annual costs charged to Central Point and Eagle Point by Medford Irrigation District and Rogue River Irrigation District. This cost is associated with the

3,123.7 AF for which the irrigation districts charge assessments, as shown in Table 4 of Attachment 6.

5. The Total Water Volume Associated with the Costs is 7,015.7 AF, which is calculated by adding 3,892 AF associated with storage space plus 3,123.7 AF associated with the irrigation districts, as shown in Table 5 of Attachment 6.

C. The Average Annual Cost Per Acre Foot will be calculated as follows.

1. Calculate the Total Annual Cost by adding together the Total Annual O&M Cost for storage space, the Five-Year Rolling Average RR&R Cost, and the Total Annual Assessment Cost.
2. Calculate the Annual Average Cost Per Acre Foot by dividing the Total Annual Cost by the Total Water Volume Associated with the Costs (7,015.7 AF), as shown in Table 5 of Attachment 6.

D. MEDFORD WATER will provide the PARTNER CITIES with the Average Annual Cost Per Acre Foot by March 30 of each year.

E. Each year after completing the calculations described in Section VI., for each PARTNER CITY with a Volume of Excess Use, MEDFORD WATER will multiply the Volume of Excess Use allocated to each PARTNER CITY (determined according to Section VI. D.) by the Average Annual Cost Per Acre Foot to obtain the "Annual Cost for Excess Use" owed to each PARTNER CITY.

F. By December 15 of each year, MEDFORD WATER will provide the PARTNER CITIES an Annual Summary Report of Water Sharing that includes the following information for the previous May through September:

1. Each PARTNER CITY'S Annual Metered Volume;
2. Each PARTNER CITY'S Authorized Water Volume;
3. Each PARTNER CITY'S Excess Water Right Volume, or Volume of Excess Use for the year; and
4. For each PARTNER CITY with a Volume of Excess Use, the volume of water allocated to each PARTNER CITY with an Excess Water Right Volume, and the associated Annual Cost for Excess Use. An example Annual Summary Report of Water Sharing is provided in **Attachment 7**.

G. By January 15 of each year, the PARTNERS will meet to review the Annual Summary Report of Water Sharing, and will work in good faith to resolve any discrepancies raised by a PARTNER CITY.

H. By February 15 of each year, each PARTNER CITY with a Volume of Excess Use shall pay the Annual Cost for Excess Use to other PARTNER CITIES as provided in the Annual Summary Report of Water Sharing.

VIII. Annual Meeting

A. Medford Water will schedule an annual meeting with the PARTNERS during the month of April each year at a time and location agreeable to the PARTNERS.

B. Each PARTNER will, to the extent possible, have at least one representative at the annual meeting.

C. Agenda items will include, but are not limited to, the following:
   1. An explanation of the processes established by this IGA, as necessary.
   2. Estimations provided by each PARTNER CITY of the amount of water it expects to use during the upcoming period of May 1 through September 30.
   3. Any available estimations of water supply expected to be available during the upcoming period of May 1 through September 30
   4. A review of the Water Rights Certification Strategy Table (the current version is provided in Attachment 2), and a discussion of any updates to the table that are needed or any plans to certificate a water right included in the table.
   5. Coordination of any other activities regarding the Water Rights so that all Partners are apprised of actions by a Partner that may affect them.
   6. Any amendments needed to this IGA. The process for adoption of amendments is provided in Section XIV.

IX. Designation, Tasks and Powers of Managing Agency

A. Medford Water shall perform the duties of the Managing Agency hereunder including but not limited to:
   1. Coordinating use of the Partners' Rogue River water rights at the Duff Water Treatment Plant in accordance with the terms and conditions of this Agreement.
   2. Schedule and convene meetings with the Partners in accordance with the terms of this Agreement and as necessary to meet the requirements of this Agreement, maintain public records in accordance with the Oregon Public Records Law and rules, policies and procedures of Medford Water, and provide administrative support.
   3. Provide public communications and outreach, including response to public information, media or records requests in coordination with the Partner Cities.
   4. Retain consultants, attorneys, auditors, accountants and other professional services to assist the Managing Agency in accordance with Managing Agency contracting rules.
   5. Provide the Partners and their agents with reasonable access to books and records maintained by the Managing Agency specifically related to administration of this Agreement.
   6. Perform ministerial and administrative tasks to implement this Agreement.

B. The General Manager of Medford Water shall be the person authorized to act for the Managing Agency, unless the Medford Water Commission specifies otherwise.

X. Governance

A. Each Partner shall appoint a representative, elected or staff member, to receive notices, attend meetings as called and act as a liaison to the Partner's governing body. A

Partner's representative shall serve at the discretion of the Partner's governing body, or the City Manager or City Administrator.

B. The Representatives shall meet in accordance with the terms of this Agreement and as deemed necessary by the Managing Agency upon reasonable notice to carry out the terms and conditions of this Agreement.

XI. Failure to Perform/Breach/Remedies

A. If a Partner fails to perform any obligation or term of this Agreement, (Defaulting Partner) the Managing Agency will notify the Defaulting Partner in writing and request performance and cure. If the Defaulting Partner cures the default within 30 days of notice or commences to diligently cure a default within 30 days and completes cure within a mutually agreed time, then the matter will be deemed resolved.

B. If the default continues after notice and opportunity to cure, the Managing Agency and the Representative of the Defaulting Partner shall meet within 45 days to discuss and resolve. Other Partners (Remaining Partners) shall be apprised and may attend.

C. If no satisfactory resolution is reached, the parties agree to mediate any disputes under ORS Chapter 36.

XII. Termination and Withdrawal

A. A Partner may elect to withdraw from this Agreement (Withdrawing Partner) by providing written notice to the Managing Agency no later than October 1 of each year. If timely notice is given, the withdrawal shall be effective on the following May 1.

B. The Managing Agency will provide the Remaining Partners with timely notice of the withdrawal notice.

C. Withdrawal from this Agreement will terminate the obligation to participate in water sharing under this agreement but will not affect any pre-existing agreements that may be operative. Withdrawal shall not relieve the Withdrawing Partner of any outstanding obligations remaining unpaid.

D. Upon withdrawal, the Managing Agency will cause the Attachments to this Agreement affected by such Partner's withdrawal to be revised and adjusted as necessary to remove the Withdrawing Partner and its water rights, Authorized Water Volumes, and associated costs identified in the Attachments. The Managing Agency may create a new Attachment for addition to this Agreement to account for change in membership to identify the Partners, and their water rights, Authorized Water Volumes, and associated costs.

E. The Managing Agency shall provide the Partner Cities with timely copies of the new or revised Attachment(s).

F. This Agreement shall continue after withdrawal of a Partner unless dissolved as provided in Section XV, below.

XIII. Representations

By execution of this Agreement, each Partner represents to the others that the Agreement has been approved by the governing body and that the person executing the Agreement has full authority to do so and the Agreement is binding on the Partner. Further the designated Representative of the Partner is vested with authority to act on behalf of the Partner except for those decisions that require specific governing body approval: amendment and dissolution.

XIV. Amendment

A. A Partner seeking an amendment to the Agreement shall provide a notice to all other Partners that specifies the section(s) of the Agreement that the Partner seeks to amend, and the nature of the requested amendment.
B. The proposed amendment shall be included in the agenda for the next annual meeting.
C. This Agreement may be amended only by mutual written agreement of all the Partners, and the amended agreement will become effective on the next October 1 or as otherwise mutually agreed upon by the Partners.

XV. Term, Dissolution and Winding Up

A. This Agreement shall become effective on October 1, 2022, (effective date) and will continue for five years from the effective date or until the remaining Partners mutually agree to terminate or there is only one Partner remaining, whichever is sooner.
B. This Agreement will automatically renew every five years on October 1 (fifth year anniversary date) without further action.
C. If this Agreement is amended as provided in Section XIV, the amended agreement will automatically renew every five years from the effective date of the amended agreement without further action.

XVI. Notices

Any notice required to be given shall be sufficient if given electronically, personal delivery or regular U.S. Mail to the following. A Partner may change the recipient by written notice to the others.

If to Medford Water:	Medford Water Attn: General Manager 200 S. Ivy St. – Room 177 Medford, Oregon 97501
If to Ashland:	City of Ashland Attn: City Manager 20 East Main Street Ashland, OR 97520

If to Central Point:

If to Eagle Point:

If to Jacksonville:

If to Phoenix:

If to Talent: Jordan Rooklyn
PO Box 445
110 E Main St
Talent, OR 97540

Attachment 1

Cooperative Agreement and Report Executive Summary

Intergovernmental Agreement for a Coordinated Water Rights Management and Water Sharing Plan

COOPERATIVE AGREEMENT FOR DEVELOPING A WATER RIGHT STRATEGY FOR ACCESS TO WATER AMONG MEDFORD WATER COMMISSION, CITY OF ASHLAND, CITY OF CENTRAL POINT, CITY OF EAGLE POINT, CITY OF JACKSONVILLE, CITY OF PHOENIX, AND CITY OF TALENT

This cooperative agreement (hereinafter "Agreement") is by and among Medford Water Commission and the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent, hereinafter PARTNERS when referred to collectively and MWC, ASHLAND, CENTRAL POINT, EAGLE POINT, JACKSONVILLE, PHOENIX, and TALENT when referred to individually.

RECITALS

A. The PARTNERS all own and operate water systems that supply water to their respective customers;
B. The PARTNERS recognize the vital importance of providing a reliable source of water to all their respective customers for public health, safety, and welfare and for sustaining economic development;
C. The PARTNERS value the important role each utility plays in meeting the water supply needs of the Rogue Valley Region (RVR);
D. The PARTNERS enter this agreement in a spirit of good will and mutual cooperation, with the understanding that coordinating a Water Right Strategy (WRS) will improve the current and long-term reliability of individual and collective water supplies and is in the highest public interest;
E. The PARTNERS understand that the WRS will document the current understanding of the water rights held by the jurisdictions in the RVR, and provide options to the PARTNERS on how to move forward with securing and allocating water supplies for the RVR that may be in the best interests of the Region as a whole, but it will not bind PARTNERS to any particular direction or action; and
F. The PARTNERS recognize that developing a WRS is the first step and that a second step of adopting a WRS would require a second IGA that would then guide the adoption, implementation, and management of the WRS moving forward. It is understood that a second step may not be possible if there is not agreement on how to move forward with the WRS.
G. The PARTNERS are willing to fund development of a WRS.

AGREEMENT

The PARTNERS agree to the following:

I. RECITALS/PURPOSE

The above recitals are true and correct and are specifically adopted and incorporated herein as the purpose of this Agreement.

II. DEFINITIONS

A. ASHLAND means City of Ashland.

B. CENTRAL POINT means City of Central Point.

C. EAGLE POINT means City of Eagle Point.

D. JACKSONVILLE means City of Jacksonville.

E. MWC means Medford Water Commission.

F. OWRD means the Oregon Water Resources Department.

G. PARTNERS means collectively the Medford Water Commission and the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent.

H. PHOENIX means City of Phoenix.

I. RVR is an abbreviation for Rogue Valley Region.

J. STEERING COMMITTEE means a group comprised of at least a single voting representative from each of the PARTNERS. The Steering Committee function will be to oversee the implementation of this Agreement, to facilitate changes to it necessary to ensure its continued effectiveness in meeting the needs of the PARTNERS and to settle differences in interpretation of its provisions and execution.

K. TALENT means City of Talent.

L. WRS is an abbreviation for Water Right Strategy.

III. RESPONSIBILITIES

A. The PARTNERS:

1. Agree to form a STEERING COMMITTEE.
2. Agree not to move forward with any actions to certificate water rights at the MWC Duff Water Treatment Plant intake, except as provided in III.C, until a WRS is completed, or the term of this Agreement ends.
3. Agree to pay the identified, pro-rata costs of the development of a WRS as provided in Section IV (B) of this Agreement.

B. MWC:

1. Agrees to award and administer a contract with GSI Water Solutions to develop a WRS as described in Section IV (A) of this Agreement.
2. Agrees to pay monthly invoices to GSI Water Solutions on behalf of the PARTNERS.

C. PHOENIX:

1. Agrees not to request expedited processing of its claim of beneficial use under OWRD's Reimbursement Authority Program for Permit S-47672 until a WRS is completed, or the term of this agreement ends, whichever occurs first.
2. Agrees to notify the PARTNERS within a reasonable period of time in the event that OWRD begins review of its pending claim of beneficial use for Permit S-47672.

IV. WATER RIGHT STUDY SCOPE AND COST

A. The draft outline of the scope of work to develop a WRS is included as Exhibit A. The PARTNERS intend to collaboratively develop and establish a final scope of work after this agreement is executed.

B. The PARTNERS agree to share the cost of the WRS on a pro rata basis in proportion to their populations based on Portland State University's 2015 population data, as shown in Exhibit B. Exhibit B indicates preliminary costs. The total cost of the WRS is expected to be less than $80,000. Final pro-rata cost share will be determined at the time the contract with the consultant is signed. Payments by PARTNERS will be due quarterly and must be remitted to MWC within 30 days of invoice.

V. DECISION MAKING PROCESS

A. All decisions made under this Agreement, and during the course of the development of the WRS, shall be made through negotiations among the PARTNERS.
B. The WRS does not bind any PARTNER(S) to any future action or direction proposed by the WRS.

VI. LIABILITY, INDEMNITY AND HOLD HARMLESS

A. INDEMNIFICATION. To the extent allowed by the Oregon Constitution and the Oregon Revised Statutes, and not to exceed monetary limits of the Oregon Tort Claim Act, the PARTNERS agree to defend, indemnify, and hold harmless each other from claims, liability or damages, including attorney fees, arising out of error, omission or act of negligence on the part of the indemnifying party, its officers, agents, or employees in the performance of this Agreement.

B. STATUS. In providing the services specified in this Agreement (and any associated services) the PARTNERS are public bodies and maintain their public body status as specified in ORS 30.260. The PARTNERS understand and acknowledge that each retains all immunities and privileges granted them by the Oregon Tort Claims Act and any and all other statutory rights granted as a result of their status as local public bodies.

VII. TERM AND TERMINATION

The term of the Agreement is twelve months from the last date of execution, unless the STEERING COMMITTEE members unanimously agree in writing to extend that date. Any PARTNER may agree to terminate its participation in the Agreement at any time with 15-day written notice to the other PARTNERS, provided, however, that once a contract with the selected consultant has been signed, the terminating PARTNER agrees to pay its full pro-rata share of the cost of the consultant contract to MWC.

In WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed by their proper officers on the dates noted below.

Brad Taylor
Brad Taylor (Jan 25, 2019) Jan 25, 2019

Brad Taylor DATE
General Manager
Medford Water Commission

christopher clayton
christopher clayton (Jan 25, 2019) Jan 25, 2019

Chris Clayton DATE
City Manager
City of Central Point

Kelly Madding
Kelly Madding (Feb 22, 2019) Feb 22, 2019

Kelly Madding DATE
City Administrator
City of Ashland

Henry Lawrence
Henry Lawrence (Feb 22, 2019) Feb 22, 2019

Henry Lawrence DATE
City Administrator
City of Eagle Point

Jeff Alvis
Jeff Alvis (Feb 25, 2019) Feb 25, 2019

Jeff Alvis DATE
City Administrator
City of Jacksonville

Aaron Prunty
Aaron Prunty (Mar 18, 2019) Mar 18, 2019

Aaron Prunty DATE
City Manager
City of Phoenix

Sandra Spelliscy
Sandra Spelliscy (Mar 18, 2019) Mar 18, 2019

Sandra Spelliscy DATE
City Manager
City of Talent

February 7, 2020

Executive Summary

Water Rights Strategy for Partner Water Providers

I. Introduction

GSI Water Solutions, Inc. (GSI) is assisting the Partner Water Providers (Partners) to develop a water rights strategy. The Partners include the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent (jointly the Partner Cities) and Medford Water Commission (MWC).[1] In early 2019, the Partners signed a Cooperative Agreement to develop the strategy recognizing the benefits of mutual cooperation and the vital importance of providing source water to their respective customers for public health, safety and welfare, and for sustaining economic development.

The water rights strategy focuses on the Partners' water rights and water supply associated with the MWC Duff Water Treatment Plant (Duff WTP) on the Rogue River. During the months of May through September (peak season), much of the MWC's water supply and all of the Partner Cities' water supply is treated at the Duff WTP. During this peak season period, the Partner Cities currently rely on water rights they have obtained and hold Treat and Transport agreements with the MWC.

As the Partners plan for their long-term water supply needs, it is important that they have a full understanding of the status of their water rights and develop a common strategy to protect and secure them. The water rights strategy is intended to meet those needs.

II. Process

To develop the water rights strategy, GSI initially prepared a comprehensive water rights summary, which enabled the Partners to develop a shared understanding of the water rights at the Duff WTP. Next, GSI developed a consolidated water demand projection for each of the Partners, which included the maximum anticipated demands for the years 2030, 2040 and 2070. GSI then compared the Partners' individual and collective demands with their water rights. This evaluation showed that some of the Partners' water rights will likely provide them with sufficient supply past the year 2070, while other Partners' water rights do not provide sufficient water supply to meet current demands. The evaluation also showed that if the Partners shared their water supplies, they would have sufficient supply to meet all of their demands through 2070.

[1] MWC's customers include customers within the City of Medford, White City, Elk City and Charlotte Ann Water Districts, as well as other customers served by MWC outside of its service area (Outside Customers).

III. Goals, Interests and Priorities for Water Rights Strategy

The above-described differences between the Partners' water rights and projected water demands demonstrate the value of a strategy related to the Partner water rights at the Duff WTP. The strategy is intended to meet the following goals, interests, and priorities:

- Ensure that the water rights at the Duff WTP are strategically managed.
- Secure a long-term water supply for all Partners.
- Eliminate the need for Partners to unnecessarily purchase additional water rights.
- Retain each Partners' ownership of its existing water rights and create opportunities to obtain value for the water rights.
- Treat White City, Elk City and Charlotte Ann Water Districts, and other customers served by MWC outside of its service area (Outside Customers) equitably.

IV. Strategic Management of **Partners' Existing** Water Rights

A. Reasons for Developing Coordinated Approach to Water Rights and Water Use

GSI recommends that the Partners consider developing a coordinated approach to managing their water rights and water supply. This coordination could include not only coordinated management of the water rights at the Duff WTP, but also creation of an opportunity for the Partners to share their combined water supplies. Coordination will also be necessary to strategically secure the 20 existing water rights at the Duff WTP. Additionally, if the Partners established a combined water supply, it could address the imbalances between water rights and projected water demands that have been previously described, and eliminate the need for the purchase of additional water rights to meet their individual needs. Further, establishing a combined water supply could provide the Partners with some level of supply redundancy; that is, the arrangement could enable each Partner to obtain water from more than one source of supply.

B. Conceptual Framework for Water Supply Sharing

GSI and the Partners considered multiple approaches to sharing water supply. Based on GSI's understanding of the Partners' goals, interests, and priorities, as well as the Partners' water supplies and demands, GSI recommended an approach that provides an opportunity to meet the Partners' near-term and long-term goals without jeopardizing any of the Partners' water rights. In addition, the Partners would pool their water rights to establish a diverse water rights portfolio.

Under the recommended option, the Partner Cities and MWC would enter into an intergovernmental agreement (IGA) to work together on regional water supply. The IGA would describe how the water rights and water supply would be shared, which would occur in two phases. Until the Duff WTP capacity was expanded to 100 cfs in approximately 2028, the Partner Cities and the Outside Customers would share their water supplies. MWC could track each entity's water use and compare that with the entity's individual water rights to determine whether any compensation was required for use of another entity's water rights. Additionally, the Partners would follow an agreed-upon strategy to request water right certificates for their water rights.

In the second phase of this option, the MWC would modify its agreements with the Partner Cities and Outside Customers and would begin to provide them with surplus water. The water rights held by the MWC and the Partner Cities would be placed into a regional water supply pool, which would be managed by the MWC. This would result in the Partners having a diverse water supply portfolio. The Partner Cities would retain ownership of their water rights, and the IGA would include a mechanism by which any of the Partner Cities could withdraw from the group.

The MWC would compensate the Partner Cities for any Operation and Management (O&M) costs it incurred associated with contracts for stored water that was being used by the Partners. The MWC would also provide Partner Cities with compensation (based on negotiations between each Partner City and the MWC) for water rights used by the Partners. The rate the Partner Cities pay to the MWC would reflect these expenses.

V. Summary of Recommended Option

The option recommended by GSI provides an approach to meeting the Partners' near-term and long-term water supply goals without jeopardizing any of the Partners' collective water rights. In the near term, the recommended option provides a method for the Partner Cities and MWC on behalf of the Outside Customers to initiate a shared water supply strategy. It then changes relatively quickly to reset the relationship with the MWC, which would then provide surplus water supply to the Partner Cities and Outside Customers. In addition, the Partners would pool their water rights to establish a diverse water rights portfolio. Finally, this option minimizes water rights transactions, such as extensions of time for permits and transfers, and decreases the risks associated with these transactions.

VI. Next Steps

Establishing a water sharing agreement will require completing a series of steps or actions. The following is a brief summary of some of the actions that will be required:

- The Partners' staff communicate with their councils/boards, and seek approval to develop a scope of work to develop an IGA.
- Staff develop the scope of work for drafting the IGA, and take the scope of work to city councils/ board for approval.
- Staff develop a draft IGA.
- Staff take the draft IGA to their city councils/board for review and approval.

Attachment 2

Water Rights Certification Strategy Table

Intergovernmental Agreement for a Coordinated Water Rights Management and Water Sharing Plan

Water Rights Certification Strategy Table

Action	Rate (cfs)	Development Deadline	Total Rate in Water Right Certificate Status (cfs)
Duff WTP - Existing Capacity – 70 cfs			
Current Status - Existing Certificates and Pending COBUs			
Central Point's Certificate 93754	1.13	N/A	65.26
Central Point's Certificate 93755	1.13	N/A	
Eagle Point's Certificate 88552	0.90	N/A	
Eagle Point's Certificate 89864	1.25	N/A	
Jacksonville's Certificate 87360	*No rate* (400 AF)	N/A	
MWC's Certificate 86832	60.85	N/A	
Talent's Certificate 91134	*No rate* (533 AF)	N/A	
Ashland's Certificate 96166	*No rate* (550.6 AF)	N/A	
Central Point's Transfer T-10465	1.20	10/1/2014	66.46
Eagle Point's Transfer T-10527	0.50	10/1/2013	66.96
*Phoenix's Permit S-47672 (COBU on hold)**	*5.0*	*10/1/2001*	*(71.96)*
Transactions			
Certificate Central Point's Transfer T-9900	1.846	10/1/2030	68.806
Certificate Eagle Point's Transfer T-10614	1.15	10/1/2030	69.956
~~Certificate Ashland's Permit S-54337*~~	~~*No rate* (1,000 AF)~~	~~9/7/2021~~	~~69.956~~
Total at this capacity			**69.956 cfs**
Duff WTP Capacity – 100 cfs in approximately 2028			
Certificate Jacksonville's Permit S-54974*	*No rate* (200 AF)	11/19/2035	69.956 cfs
Certificate Talent's Permit S-53898*	*No rate* (759 AF)	10/1/2065	69.956 cfs
Certificate Ashland's Permit S-54337*	*No rate* (449.4 AF)	9/7/2021	69.956
Certificate Phoenix's Permit S-47672	5.0	10/1/2001	74.956
Certificate Eagle Point's Transfer T-10960	1.77	10/1/2030	76.726
Certificate Eagle Point's Transfer T-12221	0.7	10/1/2030	77.426
Certificate Phoenix's Permit S-52650	3.1	10/1/2030	80.526
Partially certificate MWC's Permit S-54935 (estimated rate)	19.474	10/1/2056	100
Total at this capacity			**100 cfs**
Duff WTP Capacity – 131 cfs in approximately 2036			
Partially certificate MWC's Permit S-23210	31	10/1/2050	131
Total at this capacity			**131 cfs**
Duff WTP Capacity – 162 cfs (TBD)			
Partially certificate remainder of MWC's Permit S-23210	8.15	10/1/2050	139.15
Partially certificate MWC's Permit S-54935 (estimated rate)	22.85	10/1/2056	162.0
Extend MWC's Permit S-54935 as needed		10/1/2056	
Total at this capacity			**162.0 cfs**
Duff WTP Capacity – 193 cfs (TBD)			
Certificate remainder of MWC's Permit S-54935 (estimated rate)	7.676	10/1/2056	169.676
Total at this capacity			**169.676 cfs**

Notes

* These steps assume that certificating the "volume-only" water rights would not negatively impact the ability to certificate the other Partner water rights, and all elements of seeking a certificate can be met.

AF: acre-feet — cfs: cubic feet per second

COBU: claim of beneficial use — MWC: Medford Water Commission

Attachment 3

Water Meters

Intergovernmental Agreement for a Coordinated Water Rights Management and Water Sharing Plan

Meters and Information Source Documentation

Water User	Meter Description	Source of Information	Notes:
Central Point	BEALL MASTER	MWC Data Export	
Central Point	HOPKINS	MWC Data Export	
Central Point	VILAS MASTER 10"	MWC Data Export	
Eagle Point	AVENUE G NORTH 8"	MWC Data Export	
Eagle Point	AVENUE G SOUTH 6"	MWC Data Export	
Eagle Point	STEVENS & RILEY 4"	MWC Data Export	
Eagle Point	VISTA POINTE #1	MWC Data Export	
Eagle Point	VISTA POINTE #2	MWC Data Export	
Jacksonville	MADRONE/OAKGROVE 6"	MWC Data Export	
Phoenix MWC	Garfield St and Kings Avenue Meter	MWC Data Export	Phoenix has two connections to the MWC system, one direct connection at Garfield and Kings and the connection via TAP. This is the direct connection.
Phoenix TAP	TAP Master Meter on Samike Drive *less* Talent Meter	RVCOG Monthly Utility Billing Data	Phoenix TAP usage is the equal to the total from the TAP master meter at Samike, *less* what is measured at the Talent Meter on the TAP line.
Talent	Talent Meter at intersection Bear Creek Drive and Main Street in Phoenix *less* Ashland usage	RVCOG Monthly Utility Billing Data	Talent usage is the total of the Talent meter, *less* measured Ashland usage.
Ashland	Creel Road and Highway 97	RVCOG Monthly Utility Billing Data	

Attachment 4

Participating Partner Cities' Authorized Water Volumes

Intergovernmental Agreement for a Coordinated Water Rights Management and Water Sharing Plan

Partner Cities' Authorized Water Volumes

Water Right	Authorized Water Volume				
	From Water Right (acre-feet)	Calculated from Rate (acre-feet)	Total Water Right (acre-feet)	Limitations[1]	Total Authorized Water Volume[2] (acre-feet)
Ashland					
Permit S-54337	449.4~~1,000~~				
Certificate 96166	550.6				
Total	1,000		**1,000**		~~**1,000**~~
Central Point					
Transfer T-9900	666.0				
Certificate 93754		412.4			
Certificate 93755		412.4			
Transfer T-10465	438.0				
Total	**1,104.0**	**824.8**	**1,928.8**		~~**1,928.8**~~
Eagle Point					
Certificate 88552	321.3				
Transfer T-10527	181.5				
Transfer T-10614	273.7				
Transfer T-10960	520.3				
Certificate 89864	356.94				
Transfer T-12221	207.2				
Total	**1,860.94**		**1,860.94**		~~**1,860.94**~~
Jacksonville					
Certificate 87360	400.0				
Permit S-54974	200.0				
Total	**600**		**600**		~~**600**~~
Phoenix					
Permit S-47672~~3~~	400				
Permit S-52650	600				
Total	**1,000**		**1,000**		~~**1,000**~~
Talent					
Permit S-53898	759.0				
Certificate 91134	533.0				
Total	**1,292**		**1,292**		~~**1,292**~~
Partner Cities' Authorized Water Volumes	**6,856.94**	**824.8**	**7,681.74**		~~**7,681.74**~~

[1] Limitations on a Partner City's authorized volume of water could include regulation of their water right by the OWRD watermaster, or limitations on use provided in a final order approving their water management and conservation plan.

[2] Total Authorized Water Volume equals the total water right minus limitations.

Attachment 5

Example Allocation of Excess Water Use

Intergovernmental Agreement for a Coordinated Water Rights Management and Water Sharing Plan

Example Allocation of Excess Water Use:

- Four cities hold water rights and use water as follows. Medford Water would calculate excess water use and unused water rights as shown in the column labeled "difference"

City	Water Rights (AF)	Water Use (AF)	Difference (AF)
City A	500	1,490	-990 (excess water use)
City B	1,000	750	250 (unused water rights)
City C	1,500	1,000	500 (unused water rights)
City D	2,000	1,000	1,000 (unused water rights)

- Medford Water would calculate the compensation that City A (the only City with excess water use) would need to provide to Cities B, C and D (who had unused water rights) as follows:
  - Total excess use - 990 AF
  - Cities B, C, D – each compensated for 250 AF (up to maximum of City B's water rights), which accounts for 750 AF
  - Remaining excess use - 240 AF
  - Cities C and D – each compensated for 120 AF (for a total of 370 AF each)

Attachment 6

Example Calculation of Average Annual Cost per Acre-Foot

Table 1: Example Calculation of Total Annual O&M Costs for Storage Space (See VII.B.1. in IGA)

Name	Application	Permit	Contracted Storage Space (AF)	Total O&M Cost (2020)
Ashland	S-85733	S-54377	1000	$9,653.00
Jacksonville	S-80641	S-53445	400	$14,479.50
Jacksonville	S-88088	S-54974	200	$9,653.00
Phoenix	S-60890	S-47672	400	$24,132.50
Phoenix	S-71996	S-52650	600	$31,179.19
Talent	S-84029	S-53898	759	$4,826.50
		Totals	3,892	**$93,923.69**

Table 2: Example Calculation of Total RR&R Costs for Storage Space (See VII.B.2. in IGA)

Name	Application	Permit	Contracted Storage Space (AF)	Total RR&R Cost (2020)
Ashland	S-85733	S-54377	1000	$0
Jacksonville	S-80641	S-53445	400	$0
Jacksonville	S-88088	S-54974	200	$0
Phoenix	S-60890	S-47672	400	$0
Phoenix	S-71996	S-52650	600	$0
Talent	S-84029	S-53898	759	$0
		Totals	3,892	**$0**

Table 3: Example Calculation of 5-year Rolling Average RR&R Cost (See VII.B.3. in IGA)

Year	RR&R Cost
2016	$0.00
2017	$0.00
2018	$0.00
2019	$0.00
2020	$0.00
Total	**$0.00**
5-year Rolling Average (Divide Total by 5)	**$0.00**

Table 4: Example Calculation of Total Annual Assessment Costs (See VII.B.4. in IGA)

Holder	Type of Right	Certificate /Transfer	Maximum Rate (cfs)	Maximum Volume (AF)	Period of Use		Volume Associated with Irrigation Districts (AF)	Annual Assessment Costs (2020)
Central Point	Non-District	T-9900	1.846	666	1-Apr	1-Nov	N/A - Non-District Water Right	N/A - Non-District Water Right
Central Point	Non-District							
Central Point	Non-District							
Central Point	Non-District							
Central Point	District	93754	1.13		1-Apr	1-Oct	412.4	$30,677.22
Central Point	District	93755	1.13		1-Apr	1-Oct	412.4	
Central Point	District	T-10465	1.2	447.6	1-Apr	1-Oct	438.0	
Central Point	District							
Central Point	District							
Central Point	District							
Central Point	District							
Eagle Point	District	88552	0.9	321.3	1-Apr	31-Oct	321.3	$40,800.00
Eagle Point	District	T-10527	0.5	181.5	1-Apr	31-Oct	181.5	
Eagle Point	District	T-10614	1.15	273.7	1-Apr	31-Oct	273.7	
Eagle Point	District	T-10960	1.77	520.3	1-Apr	1-Oct	520.3	
Eagle Point	District				1-Apr	31-Oct		
Eagle Point	District	89864	1.25	356.94	1-Apr	31-Oct	356.94	
Eagle Point	District	T-12221	0.7	207.2	1-Apr	1-Oct	207.2	
Eagle Point	District				1-Apr	31-Oct		
						Totals	3,123.7	**$71,477.22**

Table 5: Example Calculation of Average Annual Cost Per Acre Foot (See VII.B.5. and VII.C. in IGA)

	Annual Costs (2020)	Water Volumes Associated with the Costs (AF)
Total Annual O&M Cost For Storage Space	$93,923.69	3,892
5-Year Rolling Average RR&R Cost for Storage Space	$0.00	
Total Annual Assessment Cost from Irrigation Districts	$71,477.22	3,123.7
Totals	**$165,400.91**	**7,015.70**
Annual Average Cost Per Acre Foot: (Divide Total Annual Cost by the Total Water Volume Associated with the Costs)		**$23.58**

Attachment 7

Example Annual Summary Report of Water Sharing Agreement

Intergovernmental Agreement for a Coordinated Water Rights Management and Water Sharing Plan

Table 1: Example - Volume of Water Use, Water Purchased, and Water Sold

Partner City	Authorized Water Volume (AF/season)	Annual Metered Volume (AF)	Volume of Excess Use/ Excess Water Right Volume (AF)	Water Volume Purchased (AF)	Water Volume Sold (AF)	Authorized Water Volume Remaining After Purchase/Sale (AF)
Central Point	1928.8	2023.1	-94.4	94.4	0.0	0.0
Eagle Point	1860.9	1050.5	810.5	0.0	18.9	791.6
Ashland	1000.0	0.0	1000.0	0.0	18.9	981.1
Jacksonville	600.0	529.4	70.6	0.0	18.9	51.7
Phoenix	1000.0	540.5	459.5	0.0	18.9	440.7
Talent	1292.0	559.3	732.7	0.0	18.9	713.9

Table 2: Example - Total Cost Paid and Received by each Partner City

	Average Annual Cost ($/AF)	Water Volume Purchased (AF)	Total Paid ($)	Water Volume Sold (AF)	Total Received ($)
Central Point	$23.58	94.4	$2,225.13	0.0	$0.00
Eagle Point	$23.58	0.0	$0.00	18.9	$445.03
Ashland	$23.58	0.0	$0.00	18.9	$445.03
Jacksonville	$23.58	0.0	$0.00	18.9	$445.03
Phoenix	$23.58	0.0	$0.00	18.9	$445.03
Talent	$23.58	0.0	$0.00	18.9	$445.03
Total		**94.4**	**$2,225.13**	**94.4**	**$2,225.13**

Table 3: Example - Matrix of Costs Paid by and to Each Partner City

		Receives						
		Central Point	Eagle Point	Ashland	Jacksonville	Phoenix	Talent	Total Paid
Pays	Central Point		$445.03	$445.03	$445.03	$445.03	$445.03	$2,225.13
	Eagle Point	$0.00		$0.00	$0.00	$0.00	$0.00	$0.00
	Ashland	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
	Jacksonville	$0.00	$0.00	$0.00		$0.00	$0.00	$0.00
	Phoenix	$0.00	$0.00	$0.00	$0.00		$0.00	$0.00
	Talent	$0.00	$0.00	$0.00	$0.00	$0.00		$0.00
	Total Received	$0.00	$445.03	$445.03	$445.03	$445.03	$445.03	