COLUMBIA RIVER FORECAST GROUP

2020

ANNUAL

REPORT

CHAIRMAN: KYLE DITTMER, CRITFC
VICE-CHAIRMAN: ERIK PYTLAK, BPA

3 JUNE 2021

COLUMBIA RIVER FORECAST GROUP

2020 ANNUAL REPORT

SUMMARY

The Columbia River Forecast Group (CRFG) was created in 2009 to promote and support the advancement of water resource forecasting, products, and techniques in the Columbia River Basin. The primary group objective is to refine and improve Basin reservoir operations for the benefit of the region's water supply consistent with the Columbia Basin Fish Accords and 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp), Reasonable and Prudent Alternative (#7) as shown below.

> ***RPA Action 7 – Forecasting and Climate Change/Variability:*** *The Action Agencies will hold annual forecast performance reviews looking at in-place tools for seasonal volume forecasts and to report on the effectiveness of experimental or developing/emerging technologies and procedures. As new procedures and techniques become available and are identified to have significant potential to reduce forecast error and improve the reliability of a forecast, the Action Agencies will discuss the implementation possibilities with regional interests. The purpose is to improve upon achieving upper rule curve elevations by reducing forecast errors and thereby providing for improved spring flows…* [1]

The Action Agencies and Fish Accord partners collaborated to form the Columbia River Forecast Group (CRFG) to implement this RPA action and to meet Accord principles. To address these needs, the CRFG provided an open forum for sharing, discussing, evaluating, comparing and potentially implementing new forecasting techniques, supporting procedures, and information into the planning and operation of the Columbia River Basin reservoir system. The term "forecasting" refers to both water supply forecasting and streamflow forecasting.

The CRFG developed a charter, organizational structure, expectations, and strategies in 2009. Under the terms of the charter, the CRFG is open for participation from any Basin representative of a governmental organization, academic institution, or invited guests of the CRFG who are willing to contribute to the effectiveness and success of the group.

1: With the issuance of the 2020 Biological Opinion, RPA 7 from the 2008 BiOp has expired. However, the CRFG will update its charter in 2021 to reflect this change.

The CRFG conducted four business meetings in 2020. CRITFC hosted the February meeting but the rest were by video-call due to the Covid-19 pandemic. Each meeting provided a forum to review the current runoff forecasts (or performance), discuss topics of common interest, and to hear speakers on topics related to water supply forecasting. Meetings were attended by staff from BC Hydro, Bonneville Power Administration (BPA), Columbia River Inter-Tribal Fish Commission (CRITFC), Colville Tribes, Corps of Engineers (COE), Fish Passage Center (FPC), Idaho Power Company (IPC), National Oceanic and Atmospheric Administration (NOAA) Fisheries, Natural Resources Conservation Service (NRCS), NOAA/NWS-Northwest River Forecast Center (NWRFC), Northwest Power Conservation Council (NWPCC), Portland Community College (PCC), U.S Bureau of Reclamation (USBR), and Washington Dept. of Ecology.

TOPICS FOR DISCUSSION

Topics and discussion covered a wide range of interests and included:

- Review and discussion of current forecasts with a focus on potential forecast errors and challenges; summaries of snow and precipitation patterns
- The finalization of the major 2020 Modified Flows project effort
- Discussion of Salmon Manager concerns (via the FPAC and TMT forums) in the Columbia River Basin as they relate to water and weather forecasts
- Northwest River Forecast Center's new/updated products and forecasting tools
- The impacts of fire-burn on SNOTEL sites – datasets, climate characteristics, etc.
- Discussed patterns of extreme weather and Atmospheric River events
- The 2020 wrap-up and review of seasonal runoff forecasts, comparison of results, discussion of challenges, and lessons learned; and
- Discussion of possible 2021 CRFG activities and work elements

Water Year 2020 was a *see-saw* year for the hydrometeorological response: dry autumn followed by a middle-of-the-road winter, then a wet-cool spring followed by a dry-warm summer. WY2020 finished up with surpluses of moisture in the Washington Cascades, western Montana and the Upper Columbia, the drainages of northeast Oregon and southeast Washington, and the Upper Snake. Layered atop this back-and-forth pattern were widespread (and in some cases historic) late summer wildfires in Oregon and Washington greatly affecting millions of citizens <u>and</u> the unusual situation of a global pandemic forcing workers to move operational computers to a home-office setting.

The basin saw a fair number of Atmospheric River events, which was a topic for discussion at every meeting. We also noted the timing for the delivery of late-season moisture was pronounced this year as this effect has occurred many times in recent years.

Water Year Basin runoff: the Upper Columbia had 105-110% of normal, Snake River at Lower Granite Dam saw 90%, Columbia River at The Dalles had 96%. These values are good considering the rocky start of the water year and the high variability of the weather.

PRESENTATION HIGHLIGHTS

Various guest speaker presentations were well received and appreciated by the group:

- Erik Pytlak, BPA, *2020 Modified Flows Update*: Erik solicited comments from Group agency members on the semi-final dataset. The USACE, IPCo, and CRITFC technical staff gave critical review and comments. The draft modified flow datasets were finalized by October 2020. ☺

- Danny Tappa, NRCS-Boise, *Fire and SNOTEL Data*: Danny illustrated his talk with examples from the Idaho SNOTEL network. It was fascinating to see the contrast of the burned areas in Idaho vs. the Cascades and may help explain why there are such large fires burning in Oregon right now and not in Idaho. One big take-home message: the change at each site is very site dependent and we need to analyze the climate impacts on a site-by-site basis.

- Kyle Dittmer, CRITFC, *City of Portland Climate Change Mitigation Projects*: A virtual field trip of sites in southeast Portland showed how wetland/river habitat restoration work can also help in carbon sequestration and local flood control and water quality enhancement. Some of these projects are being replicated elsewhere.

- Jeremy Giovando, USACE-CRRL, Boulder, CO, *SNOTEL Sites and Disturbance Impacts*: The project uses SNOTEL network data with the purpose of determining changes and patterns to SWE, temperature, precipitation, and soil moisture pre- and post-fire. Jeremy showed fire trends in different eco-zones throughout the northwest. Regarding the annual peak SWE, most sites saw a decrease in peak SWE but the response was mixed (i.e., increases and decreases) depending on aspect, location of site, etc. He said that the ultimate goal would be to develop guidance for use by operations staff to use to understand how watershed will change after a fire and how such information can be added into their modeling.

ACCOMPLISHMENTS

CRFG work accomplishments and ongoing studies or issues that will continue to be addressed in 2020 and beyond:

- 2020 Modified Flows. Frequent updates helped inform members of the progress. The final BPA results can be accessed here: https://www.bpa.gov/p/Power-Products/Historical-Streamflow-Data/Pages/Historical-Streamflow-Data.aspx

- The issue of fire-burn and the loss of SNOTEL stations or degradation/alteration of long-term climate data was a major issue for the CRFG. Two different but complementary and thought-provoking presentations led to much discussion.

- The stabilization of staff and resources of the NRCS's National Water and Climate Center, Portland, means that their staff can participate more fully in CRFG meetings and discussions. A CRFG group letter sent out in 2019 in support of such an effort may have played a role with this good outcome.

- Continuing to closely monitor both statistical and ESP water supply forecasts for possible refinements including continued discussions regarding the volume forecast periods to account for earlier than normal runoff.

- There is a need to make some modifications to the intro-page of this annual report given the new 2020 Biological Opinion. An internal discussion has started among the Principals and a legal/policy review.

- Current relevant articles via BAMS and other journals were shared in regard to new work on forecasting, ARs, and water resources.

- We reminisced at the 40-year anniversary of the eruption of Mt. St. Helens and its hydro/weather impacts with a slide-show by a retired NWRFC Senior Hydrologist.

- Tribute to George Miller, retired MIC, NOAA/NWS Portland-WSFO. George was among many PNW NWS station managers who help spin up the Oregon NWS offices in preparation for the NWS Modernization-and-Restructuring effort of the 1990s. He was also a major player in the Oregon AMS Chapter. His obituary: https://obits.oregonlive.com/obituaries/oregon/obituary.aspx?pid=196220392

- Development of draft CRFG outreach materials…a continued work-in-progress.

A P P E N D I X A

Columbia River Forecast Group (CRFG)

The following pages document the CRFG Charter approved on July 21, 2009.

CRFG CHARTER

I. Purpose

The Columbia River Forecast Group will work to promote and support the advancement of forecasting skill, products, and techniques in the Columbia River Basin for the purpose of improving reservoir operations for the benefit of the region and as prescribed and documented in the Columbia Basin Fish Accords and 2008 FCRPS Biological Opinion, Reasonable and Prudent Alternative (#7). It will also provide an open forum for sharing, discussing, evaluating and potentially implementing new forecasting techniques, supporting procedures, and information into the planning and operation of the Columbia River Basin system. The term forecasting will refer to both water supply forecasting and streamflow forecasting.

II. Composition

The CRFG will be composed of technical representatives from the "Action Agencies" (i.e., AAs), namely the BPA, the USACE, and the USBR, as well as the parties to the Fish Accords. The CRFG will also be open for participation from any representative of a governmental organization, academic institution or invited guests of the CRFG, who are willing to contribute to the effectiveness and success of the group.

The Chair of the CRFG will be a representative from the three AAs or Fish Accord Tribes. The Chair position will rotate annually among these four representative organizations or groups following the Autumn Workshop.

III. Meetings and Workshops

A general business meeting will occur no less than quarterly but more frequently if workload and projects require it. Meetings and workshops will be called at the discretion of the Chair.

In addition to business meetings, there will be an Annual CRFG Meeting in the fall to review the performance of various operational and experimental forecast procedures over the previous water year, to report on any new approved procedures being implemented in the next year, and to plan committee work for the coming year.

IV. Functions

1. Facilitate the sharing of information and research pertinent to the improvement of forecasting for the Columbia River Basin, namely in the areas of water supply forecasting, operational streamflow forecasting, data quality and availability, weather forecasting (as it pertains to improving water supply and streamflow forecasting), and climate change.

2. Track and review the performance of current forecasting procedures and techniques, as well as sharing, discussing, and investigating the potential of new forecasting techniques and modeling.

3. When promising research or techniques are discovered and introduced for consideration, the CRFG will develop a strategy for either investigating the potential improvement with available technical staff within the CRFG or provide recommendations or proposals to the AAs for possible funding and support for further research and development.

4. The group will participate in the evaluation of proposed new forecast procedures, models, and techniques and provide recommendations on the incorporation of new procedures into the planning and operation of the Columbia River system.

5. Facilitate the sharing of data, where possible, and the monitoring of the data network and systems which enhance and support the forecasting capabilities of the region. When necessary, the group will provide recommendations on improvements and enhancements to the network.

6. When necessary, the group will plan and facilitate workshops with presenters speaking on current research and forecast projects. The group will also have a role in educating users on forecasting products and on specific focus areas, providing the technical expertise and platform for conducting seminars and workshops on various topics pertinent to the group's purpose.

V. <u>Reporting</u>

1. The CRFG will produce minutes of each official meeting for distribution to the group and for the purpose of summarizing the group's activities and achievements at the end of the year.

2. The CRFG will produce an annual summary of the group's activities, achievements, and recommendations no later than four months after the end of the water year. This report will be the basis for annual reporting required for the Biological Opinion and Fish Accord records.

3. The organization chairing the CRFG will be responsible for meeting notes and annual reporting at the end of the water year.

A P P E N D I X B

Columbia River Forecast Group - 2020 Meetings

The following meetings took place for the CRFG. Note: due to the Covid-19 pandemic the June, September, and November meetings were virtual.

12 February 2020
18 June 2020
17 September 2020
12 November 2020 (Annual Review)

Reviewed and finalized Meeting notes are as follows:

February 12, 2020

Meeting time: 8:30 am – 1:00 pm PST
Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)**
Columbia Room (12th Floor)
700 NE Multnomah Street, Portland

Web Meeting: https://usace.webex.com/meet/NWSRCC
Room ID: 966 350 725
Join by phone:
1-877-873-8018 Call-in toll-free number (ATT Audio Conference)
1-636-651-3182 Call-in number (ATT Audio Conference)
8238307 Access Code
1111 Security Code

Contact Info: Kyle Dittmer, CRITFC (503) 731-1314
Erik Pytlak, BPA (503) 230-5335

8:30 am **Welcome and Introductions** (Kyle)

8:35 **Approval of December Minutes** (all) **and 2019 Annual Report** (Peter)

8:45 **2020 Water Year updates (~ 15 minutes each)**

NWS-NWRFC:	Ryan Lucas and Amy Burke (systemwide)
NRCS:	???
USACE:	Mike Warner (LIB)
	Alfredo Rodriguez/Jonathan Roberts (DWR)
US B-Reclamation:	Peter Cooper (HGH, HEII)

10:00-10:15 **<< BREAK >>**

10:15-11:00 **2020 Water Year updates…continued**

BC Hydro:	Georg Jost (not confirmed)
CRITFC:	Kyle Dittmer (TDA)
Idaho Power:	John Hildreth (BRN)
Others?	

11:00-11:45 **Guest Speaker** (*invited*) **– John Saltenberger (former NWS) – Fire Weather and Impacts**

11:45-12:10 **Weather Discussion – January wet pattern; Extreme weather – region trend** (all).

12:10-12:15 **"The Sampler" Salmon Manager Topics** – AMS article – AR classification; other topics? (Kyle and others)

12:15-12:30 **Other Topics** (all) – updates to CRFG Contact List, info/outreach materials, NRCS fire-burn issue – recruiting a guest speaker (Danny Tappa?) and other items (?).

12:30-12:30 **Set next Meeting and Adjourn**

Meeting Minutes

Columbia River Forecast Group – Winter 2020 Meeting: February 12, 2020
Columbia Inter-Tribal Fish Commission (CRITFC), Columbia Room (12th Floor)
700 NE Multnomah Street, Portland

Introductions:
Chairman Kyle Dittmer welcomed the group and started the meeting at 8:40 am. The attendees introduced themselves.

Approval of Minutes:
Chairman Dittmer asked the members to approve the minutes from the December 2019 Meeting. It was so moved by Erik Pytlak and was seconded by Peter Cooper and they were approved as final.

The draft 2019 Annual Report was then discussed. No comments from the group were noted with the exception that the Contact List should be updated to the most current version and the draft December 2019 meeting minutes should be replaced with the final version approved at this meeting. Peter will incorporate those changes and the document will be presented for approved at the next CRFG meeting.

2020 Water Year Updates:
Systemwide – Ryan Lucas, NWS-NWRFC
Ryan gave a summary of the Columbia River basin conditions. A dry start to the water year was followed by a wet January and start of February. Volume forecasts are near normal with exception of below normal forecasts for eastern Oregon. Snowpacks had dramatic improvement from early January. Runoff signals right now indicate fairly normal timing. The 3-4 week NOAA/CPC outlook indicates cold and dry upcoming conditions. Erik was curious how the very dry fall will affect spring runoff. The volume forecasts are coming in lower than the raw snowpack would indicate. Soil moisture states are well below normal. Erik also mentioned that at this year's annual American Meteorological Society (AMS) conference it was discussed that the GFS model has a cold bias, i.e. the model predicts snow but rain actually occurs, or Arctic outbreaks pushed too far south.

Systemwide – NRCS, Julie Koeberle:
Julie gave an update on NRCS staffing conditions and let the group know that for the first time in many years the forecasting group is fully staffed! Julie indicated that Dave Garen's position has been filled by Dr. Sean Flemming who came to the agency from Oregon State University. Sean has been working on developing machine learning forecasting models. Julie also noted that there are some key positions in the IT department that are currently vacant and they are doing their best to keep the websites up and running. Erik asked if there are plans to incorporate Canadian SWE data into the interactive map? Julie indicated that there is a way to toggle those on and she will look into it and will follow up with the group next time. Pete asked about Montana forecasts and Julie indicated that in Montana they begin preparing forecasts starting in March.

Libby – Mike Warner, USACE Seattle
Snowpack is above normal in the Kootenai basin both stateside and in Canada. The Libby forecast has been volatile this year because big storms have hit right at end of the months, which has had the impact of increasing forecasts. The April-August forecast is 109% of average which matches well with NWRFC. This is up significantly from the January forecasts. Mike gave an update to the new forecast development. They expect to have a new regression forecast by the beginning of next water year. They did get ESP hindcasts from the NWRFC and are assessing how to potentially incorporate that into future forecasts. Seattle District has been very busy with west side

flooding events since the end of December. Erik asked: When does fall precipitation weighting diminish in the statistical forecast? Mike indicated that the forecast consists of primarily precipitation early on, but then in January it starts to use SNOTEL stations, so precipitation naturally diminishes starting in January. Erik indicated his question was related to the record dry fall and how that might affect spring runoff. Mike noted that he will look deeper into it.

Dworshak –USACE Walla Walla
USACE Walla Walla was not present at the meeting and did not give a presentation.

Hungry Horse and Upper Snake – Peter Cooper, Reclamation
Peter started with Hungry Horse, and indicated the snowpack is above normal, precipitation is near normal, and it has been a warmer than normal winter for the most part. The February forecast came in at 106% of normal for the February through July period and 105% of normal for the May-September time period. The NWRFC and NRCS forecasts came in a slightly higher in the 110-115% range. In the Upper Snake, the snowpack is near normal and precipitation is slightly below normal. The February-July forecast for Snake near Heise came in at 100% of normal. Most forecasts were very close with the exception of NRCS which came in around 90% of normal. Soil moisture in the Hungry Horse and Upper Snake basins is better than last year, likely due to the wet conditions in September.

Mica, Arrow and Duncan - BC Hydro
BC Hydro was not present at the meeting and did not give a presentation.

The Dalles - Kyle Dittmer, CRITFC
Kyle showed the results of The Dalles MEI forecast. The January-July, April-July and April-August forecasts all came in at 95% of normal. Kyle then discussed that the ONI historical dataset was recently updated, so he needs to look into why that occurred. The ONI forecast was not shown due to this issue. Kyle indicated that the marine heatwave is breaking up, which is good news for salmon survival in the north Pacific Ocean.

Brownlee - Idaho Power Company
Idaho Power Company was not present at the meeting and did not give a presentation.

Guest Speak – John Saltenberger – Fire Weather and Impacts
A guest speaker, John Saltenberger, was scheduled to talk at the meeting, but fell ill and was unable to attend. Kyle will work to reschedule John to speak at a future meeting.

Weather Discussion – January wet pattern; Extreme weather – region trend
With recent extreme events in the Umatilla and Walla Walla River basins, the group thought it was timely to discuss if there is meaning to the extreme events on a regional scale level. Kyle began the discussion by remembering back in the 90s that winter flooding on the east side seemed to be rare. Mike said that it is not unusual to break records. Records are broken fairly normally and it may be more perception than reality, however, it is not to discount trends. Pete said that he came to the same conclusion that it may be more perception just through a simple review of record events throughout history on the NRCS SNOTEL map – records were being broken all the time as far back as the data goes. Amy mentioned that it is necessary to think about timescale when talking about records and also how much the records were broken. Erik stated that we are in the jetstream often, so we see a lot of volatility. Records don't equal climate change and we have to look at trends. For example, when you do look at the trends for places like Utqiaġvik (Barrow), Alaska, there hasn't been a record low since 2005, but has had dozens of record highs. Mike stated that temperature is a much more stable indicator and precipitation is much trickier. We can look at statistics but it is important to put a physical mechanism to it as well. When physical

mechanisms line up then it is a much more convincing story. Correlation is not causation. Kyle did share with the group an e-mail from Kate Ely, staff Hydrologist with the Confederated Tribes of the Umatilla Indian Reservation, which described the early February 2020 flooding event on the Umatilla River as potentially a 200-500 year recurrence interval event.

(Photo by Charlie Quaempts, CRITFC staff)

2020 Modified Flows Update – Erik Pytlak, BPA
Erik gave a brief update and let the group know that draft results of the 2020 Modified Flows would be available by June 2020 for comment and review. He will present the results when we meet in June.

"The Sampler" Salmon Manager Topics – Kyle Dittmer, CRITFC
Kyle shared with the group an article from the February 2019 issue of the Bulletin of the American Meteorological Society (AMS) on Atmospheric River (AR) classification. The full paper can be accessed here: (https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-18-0023.1). The classification would work similar to the Hurricane (Saffir–Simpson) scale and would include Category 1-5 ratings based on the hazard or benefit. Ryan indicated the NWRFC is using the product as guidance. Mike added that this has been in development over the last few years and that they are using it at SCRIPPS (Institute of Oceanography). Mike attended a talk at AMS and gave a brief synopsis. The scale attempts to give an indication of how hazardous events can be. The scale changes with duration and intensity of the event. Kyle indicated that AR's are a concern for the Tribes.

Kyle then switched topics and focused on the USGS gage on the Grande Ronde River at Troy, Oregon. This gage is very important to the Tribes and is only funded through April 1, 2020. The site is operated in cooperation with USACE. Mike said he will look into this, likely discussing with Walla Walla as a first step. Kyle is very interested in keeping the gage funded and asked the group to think about ways they may be able to help. Ryan remembered from the September meeting that Steve Hall did say the gage would only be funded during flood season from now on due to budgetary constraints.

Other Topics - all
Kyle has updated the CRFG Contact List. He will send out the new version to be incorporated into the 2019 Annual Report.

Kyle presented some educational outreach materials, particularly an info-flyer that he developed to help spread the word of the CRFG. So far the group has been mostly word of mouth, but he would like to spread the word farther.

Kyle continues to think about the field trip and is thinking about possibly September would be a good time to try and catch good weather. We could do one or two local trips this year.

The group is still interested in learning more about impacts to NRCS SNOTEL sites from fires. Danny Tappa with the NRCS Idaho Snow Survey has been researching the effects of burned area on runoff and he may be willing to come talk to the group about his efforts. Kyle will reach out to him. Julie said she would also touch base with Gus as he may be working on something as well.

Kyle mentioned to the group that the first draft of his hydro paper is finished. He will be trying to publish soon.

Adjournment:
The next CRFG meeting will be scheduled, TBD, by Kyle Dittmer and information will be sent out to the CRFG. Possible dates are June 4 or June 18, 2020. The meeting was then adjourned by Kyle at 11:00 am.

****

Attendance:
In person
Benner, Dave – FPC (Portland)
Burke, Amy - NOAA/NWS/NWRFC (Portland)
Cooper, Peter – USBR (Boise)
Dittmer, Kyle – CRITFC (Portland)
Koeberle, Julie – NRCS (Portland)
Lucas, Ryan – NOAA/NWS/NWRFC (Portland)
Pytlak, Erik – BPA (Portland)

On the phone:
Warner, Mike – COE (Seattle)

****
Note Taker: Peter Cooper, U.S. Bureau of Reclamation, Boise, Idaho

Revised April 13, 2020

June 18, 2020

Meeting time: 9 am – 12:30 pm PDT
Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)**
Satellite Office – Mt. Sylvania, Portland, Oregon …via webinar

Web Meeting:
https://usace.webex.com/meet/NWSRCC
1-877-873-8018 Call-in toll-free number (ATT Audio Conference)
1-636-651-3182 Call-in number (ATT Audio Conference)
Access Code: 8238307
Security Code: 1111

Contact Info: Kyle Dittmer, CRITFC (503) 731-1314 (call-forward)
Erik Pytlak, BPA (503) 230-5335

8:55 am **Dial-in time**

9:00 am **Welcome and Introductions** (Kyle)

9:05 **Approval of February Minutes; Status update - 2019 Annual CRFG Report**

9:10 **2020 Water Year updates (~ 15 minutes each)**

NWS-NWRFC:	Ryan Lucas (systemwide)
NRCS:	Julie Koeberle or Gus Goodbody
USACE:	Mike Warner (LIB)
	Alfredo Rodriguez/Jonathan Roberts (DWR)
USB Reclamation:	Peter Cooper (HGH, HEII)

10:15-10:30 **<< BREAK >>**

10:30-11:00 **2020 Water Year updates…continued**

BC Hydro:	Georg Jost (not confirmed)
CRITFC:	Kyle Dittmer (TDA)
Idaho Power:	John Hildreth (BRN)

11:00-11:50 **2020 Modified Flows Update** (Erik)

11:50-12:00 **"The Sampler" Salmon Manager Topics** – topics? (Kyle, Claire, and others)

12:00-12:10 **Mt. St. Helens 40-year anniversary – a hydro/weather review** (Kyle)

12:10 -12:20 **CRFG Outreach draft info-flyers** (Kyle)

12:20–12:30 **Tribute to George Miller, retired MIC, NOAA/NWS-Portland-WSFO** (Kyle)

12:30-12:30 **Thoughts on next meeting…set next Meeting and Adjourn**

Meeting Minutes

Columbia River Forecast Group – Spring 2020 Meeting: June 18, 2020

Introductions:

Chairman Kyle Dittmer welcomed the group and started the meeting at 9:00 am. The attendees introduced themselves. The meeting was held via WebEx webinar.

Approval of Minutes:

Kyle asked for any additional edits from the February minutes. No changes were suggested. Peter motioned to approve the minutes...Mike seconded. Motion carried. Special thanks to Peter for standing in for Erik at the February 2020 CRFG meeting.

There has been a request from Bill Proctor (COE – NW Division) to make an update to the 2019 Annual Report to reword the report to edit references to the 2008 RPA language. The team then discussed the merits given the upcoming 2020 Biological Opinion, and decided that while it is a great CRFG agenda item topic in future meetings, the request is out-of-scope for last year's report. Erik motioned to approve the report as amended. Alfredo seconded...motion carried.

2020 Water Year Updates:

Systemwide – Ryan Lucas, NWS-NWRFC

The current water supply situation is generally near average, but above average across the northern half of the basin, and below average in the south half. Below average temperatures in the northern half of the basin helped preserve snowpack, despite a rather dry March and April. Precipitation was above average in May and June.

Systemwide – NRCS, Julie Koeberle

NRCS is seeing similar water supply trends across the basin, with notably low water supplies in the Lost and Wood River Basins in south central Idaho. Snow water equivalents on the US side of the international border peaked nearly on schedule. Some NRCS snow courses were not measured in 2020 due to COVID-19 restrictions on physical distancing (it usually takes two people to completes snow courses). Summer SNOTEL maintenance, though, will proceed with additional safety measures in place. Erik mentioned that there appears to have been a strong rain shadowing pattern this winter/spring, where leeward slopes started to slip into drought, while core water supply regions have significant snowpack and water supplies. Sheri indicated that was indeed the case across the Colville Tribal lands.

Libby – Mike Warner, USACE Seattle

Libby water supplies were near average with the Corps forecast slightly lower than NWRFC with quite a bit of snow remaining in the Canadian Kootenay basin. The average water supply allowed a normal sturgeon pulse to occur. They are in the process of making a more thorough update to their water supply forecast options, rather than making another, basic update to remove Akamina Pass (which had a wildfire in the area). Data gathering has begun. COE is planning to roll out in 2022. Erik asked if the Corps intended to explore options beyond statistical methods. Mike replied that they intend to stick with statistical methods, but to adopt a more flexible approach like Reclamation uses for their upstream projects.

Dworshak – Alfredo Rodriquez, USACE Walla Walla

Total annual inflows have actually been well below normal so far in 2020, and closer to 2010 and 2015, even though snowpack was near average. The very dry start to the water year was the main cause with below average precipitation since October 1. Despite the challenging conditions, they were able to accommodate two special fish operations in March and April, did not need to spill, and have refilled on schedule. They intend to start temperature control drafts after the 4th of July.

The Corps is about to reinitiate a review of the PCA water supply forecast, not just for Dworshak, but also in eastern Oregon and in the Boise basin.

Hungry Horse and Upper Snake – Peter Cooper, Bureau of Reclamation
They are seeing similar trends with well above average water supplies for Hungry Horse (about 130% of normal), and near average water supplies for the Snake River at Heise. The Flathead River crested near flood stage around June 1 with Reclamation providing critical flood control at Hungry Horse. Above Palisades, the Jackson Hole summit webcam (10,300 feet) still showed some snow remaining as of June 15. The spring melt occurred on schedule above Palisades with an above average peak in late May-early June. In the Boise basin, snowpacks were below average, but spring rains have helped extend the runoff.

Mica, Arrow and Duncan - BC Hydro
BC Hydro was not present at the meeting and did not give a presentation.

The Dalles - Kyle Dittmer, CRITFC
Kyle showed the results of The Dalles MEI forecast, updated as of June. The January-July, April-July and April-August forecasts all came in at 96% of normal, and little changed for much of the winter and spring. The MEI is currently drifting lower from ENSO-neutral toward *La Niña* criteria.

Brownlee - Idaho Power Company
John reported that the Brownlee forecast remained well below average. They drafted earlier and deeper than usual, but were able to refill on schedule thanks to higher spring flows.

2020 Modified Flows Update – Erik Pytlak, BPA
Erik gave an overview of the preliminary 2020 Modified Flows dataset. It is available for review and comment through July 31 at: https://www.bpa.gov/p/Power-Products/Historical-Streamflow-Data/Pages/Historical-Streamflow-Data.aspx. The final set will be published this fall and will become the new dataset used for a wide variety of planning purposes for the FCRPS, the Columbia River Treaty, Biological Opinions and other purposes.

Washington State University simultaneously published their irrigation depletion modernization work and results across the basin. In general, there was a very slight decrease in irrigation withdrawals across the basin, which were most pronounced in the lower Columbia and lower Snake Basins. Because of this trend and the including of four very wet years between 2011-2018 overall volumes are very slightly higher between the 80-year and 90-year datasets. The draft documentation also includes a brief assessment of non-stationarity trends in the dataset, including statistically significant trends which were foretold in the RMJOC-II climate change study: higher winter flows, lower summer flows, and a slightly earlier shift in peak flow timing are indicated across large portions of the basin.

"The Sampler" Salmon Manager Topics:
Kyle reported that the March 2020 Bulletin of AMS had a summary article that showed north Pacific/Aleutian lows can impact downstream, long range forecasts during the spring and summer, and connection with next winter's ENSO signal. The full article can be accessed here: https://journals.ametsoc.org/jcli/article/33/8/3061/345082/Potential-Impact-of-Preceding-Aleutian-Low

No updates from TMT or FPAC. Kyle reported there was a last-minute effort to provide funding for the USGS basin for the Grande Ronde at Troy. BLM is providing stop-gap funding until Oct. 1, 2020.

Erik asked the team how their operations are faring during the COVID-19 Pandemic. All CRFG members are mostly working from home on telework or alternate facilities until further notice. Work groups who do have to go in for graphics-intensive forecasting have been doing so, but at skeleton levels. There are some efforts to slowly return/reconstitute to offices as staff safety and local conditions allow, but the members are generally expecting to continue working remotely for the next several weeks or months. Fortunately, there have been virtually no operational forecasting impacts, and in some cases staff found themselves being more productive.

Mt. St. Helens 40-year anniversary – a hydro/weather review
Kyle gave a brief overview and presentation by Phil Pasteris (former NWRFC Senior Hydrologist) of the weather and hydrology conditions associated with the Mt. St. Helens eruption on May 18, 1980. That slideshow can be accessed here:
https://docs.google.com/presentation/d/e/2PACX-1vS4S0VKbuOT946S0Nwj9ZJK7BVd51_t3qSrjTzmlH9WcrBOh82v_Yd-kqegpyyMDH7BRKd3poOo7d-R/pub?start=true&loop=true&delayms=15000#slide=id.g780da53db8_1_78

NWRFC update: Cameron Bracken, previously at BPA's short-term planning group, is a new Senior Hydrologist at NWRFC.

CRFG Outreach draft info-flyers:
Kyle has developed an information flyer and pamphlet on what the CRFG does. There was some concern expressed that the CRFG is not an open-member group as the flyers imply. However, it would be a good idea for CRFG to elevate its profile as new Biological Opinions are developed. Kyle will work with the group on making corrections to the info-flyers.

Tribute to George Miller, retired MIC, NOAA/NWS-Portland-WSFO
Kyle offered a nice tribute to the former Portland MIC who passed away on May 14, 2020. His obituary was just posted in *The Oregonian*:
https://obits.oregonlive.com/obituaries/oregon/obituary.aspx?pid=196220392

Adjournment:
The next CRFG meeting will be virtual and scheduled for September. Some suggested topics: CRFG Annual Report – intro page draft wording (to reflect the new Biologic Opinion), SNOTEL site fire burn area and climate characteristics (Danny Tappa, John Saltenberger), virtual field trip (climate mitigation projects – City of Portland), other topics? Kyle will send out a Doodle-poll to narrow to possible dates. The meeting was then adjourned by Kyle at 12:40 pm.

****

Attendance:
Leslie Bach – NW Council (Portland)
Peter Cooper – USBR (Boise)
Kyle Dittmer – CRITFC (Portland)
Angela Duren – COE NW Division
John Hildreth – Idaho Power (Boise)
Julie Koeberle – NRCS (Portland)
Ryan Lucas – NOAA/NWS/NWRFC (Portland)
John Moen – COE Seattle District
Erik Pytlak – BPA (Portland)
Michael Warner – COE (Seattle)
Alfredo Rodriquez – COE (Walla Walla)

Henry Pai – NOAA/NWS/NWRFC (Portland)
Sheri Sears – Colville Tribe
Janak Timilsena – Idaho Power (Boise)

****

Note Taker/Vice-Chairman: Erik Pytlak, BPA Portland, OR

Revised July 13, 2020

September 17, 2020

Meeting time: 8:30 am – 12:00 pm PDT
Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)**
Satellite Office – Mt. Sylvania, Portland, Oregon …via webinar

Web Meeting (hosted by Alfredo R., COE-Walla Walla):
https://usace.webex.com/usace/j.php?MTID=m2274f05adf72e9b23473b80c7582b1c9
1-877-848-7030 Call-in toll-free number (ATT Audio Conference)
1-404-443-2170 Call-in number (ATT Audio Conference)
Meeting #: 146 295 4885; Access Code: 835 173 6; Security Code: 1234

Contact Info: Kyle Dittmer, CRITFC (503) 731-1314 (call-forward)
Erik Pytlak, BPA (503) 230-5335

8:20 am **Dial-in time**

8:30 **Welcome and Introductions…Introduction of New member** (Kyle)

8:35 **Approval of June meeting Minutes** (all)

8:40 **Updates on Forecasting Methods…Changes for WY 2021 (~10 minutes each)**

NWS-NWRFC:	Ryan Lucas (systemwide)
NRCS:	Julie Koeberle (or Gus Goodbody)
USACE:	Mike Warner (LIB)
	Alfredo Rodriguez/Jonathan Roberts (DWR)
USBR:	Peter Cooper (HGH, HEII)
BC Hydro:	Georg Jost (not confirmed)
CRITFC:	Kyle Dittmer (TDA)
Idaho Power Co.:	John Hildreth (BRN)

9:30 - 9:50 **2020 Modified Flows Update** (Erik)

9:50 - 10:00 **<< BREAK >>**

10:00 - 10:15 **"The Sampler" Salmon Manager Topics** – BiOp target flows (Kyle & Claire)

10:15 - 10:50 **SNOTEL site fire-burn area and climate characteristics** (Danny Tappa, NRCS)

10:50 - 11:30 **CRFG Annual Report – intro page draft re-wording** (all; Christine G. - CRITFC)

11:30 – 11:50 **Virtual Field Trip – Climate Change mitigation projects – City of Portland** (Kyle)

11:50 - 12:00 **Thoughts on next meeting (Annual Review)…set next Meeting and Adjourn**

Meeting Minutes

Columbia River Forecast Group – Summer 2020 Meeting: September 17, 2020

Introductions:

Chairman Kyle Dittmer welcomed the group and started the meeting at 8:34 am. The attendees introduced themselves. Kyle also introduced a new CRITFC staffer, Sanjeev, Hydrologist/Climate Scientist. Due to COVID-19, the meeting was held virtually by Alfredo (COE-WW) using the WebEx platform.

Approval of Minutes:

Chairman Dittmer asked the members to approve the minutes from the June 2020 Meeting. It was so moved by Peter Cooper and was seconded by Alfredo Rodriguez and they were approved as final.

Updates on Forecasting Methods and Changes for 2021:

Systemwide – Ryan Lucas, NWS-NWRFC

Ryan highlighted a number of changes and additional products available on the NWRFC website including: Highlighting suspect data, weather forecast evolution for past 10 days (available back to 2011), and updating the river stage threshold colors to be consistent with other RFCs and AHPS. Also, NWRFC is upgrading the HEFS forcings from GEFS v.10 to v.12. The increase in model skill was not as much as hoped, but HEFS forcings will now be updated four-times per day instead of two- times per day, which may result in short term forecasts being produced two- times per day. Long range ESP forecasts will still be updated once per day at 12z. West-side calibrations will also be completed this year using the 1981-2010 period for calibration and the 2011-2020 period for validation.

Systemwide –Julie Koeberle, NRCS:

The NRCS forecasting team is working on recalibrating their forecast models using the 1991-2020 period and also rebuilding any models that are over five-years old. They will also be looking at including SNOTEL sites that now have a long enough record to be viable for forecasting. In addition, they will be looking at potentially excluding any sites that may have been disturbed (fire, clear cutting, fire-burns, etc.).

Soldier Ranger Station SNOTEL site in Idaho was lost this year due to fire. Two other sites (Diamond Lake and Little Meadows) may have also been lost in the recent fires in Oregon. This will be confirmed in the coming weeks. Julie mentioned that NRCS has compiled a disturbed SNOTEL site list, and will make that available to the group.

Libby – Mike Warner, USACE Seattle

The Libby basin experienced a dry April after the forecast came out, so the actual runoff ended up about 0.5 MAF lower than forecast. USACE is working on updating the Libby forecast, and they have gathered data from sites in the region. They will be using data up through WY2020 for the training period. They will be looking at regression analysis along with potentially including ESP or other ensemble methods. They are currently in the process of filling in data gaps and anticipate having something close to final by spring meeting 2021. The updated forecast is anticipated to be implemented in WY2022.

Dworshak – Alfredo Rodriguez, USACE Walla Walla

This year they have completed conversion of their forecasting platform from MS Excel to a GUI application. They will be testing both methodologies in parallel this season. The Excel version will be maintained for training purposes but operationally they will switch to GUI.

Alfredo mentioned that Senator Wyden's (D-OR) office has been working with the USACE to pursue additional funding to be used for additional data collection in Oregon. As part of that process, Alfredo worked with Pete (Reclamation) to identify aerial marker/snow course stations that could be converted to provide additional real-time data that will aid in forecasting and reservoir operations in eastern Oregon (e.g., Malheur, Powder, Burnt River Basins).

Hungry Horse and Upper Snake – Peter Cooper, US Bureau of Reclamation
Reclamation produces runoff volume forecasts for 34 locations in the Columbia River basin, and will be working over the next few years to update all of those forecasts, and potentially add additional forecast locations that will aid with operations. This fall Reclamation will examine and QC (quality control) potential predictor data sources and will begin the process of forecast updates. The process will focus on five locations to start with (Snake River near Heise, S. Fork Flathead River at Hungry Horse, Boise River at Lucky Peak, Yakima River near Parker, and Owyhee River near Owyhee Dam). Additional information will be provided at future CRFG meetings as they work through the forecast update process.

Mica, Arrow and Duncan - BC Hydro
No representative from BC Hydro was present at the meeting.

The Dalles - Kyle Dittmer, CRITFC
Kyle will be pulling in the previous year's observed data and will be updating his forecasts. Kyle mentioned that the R^2 values for his forecast have increased each year. No major changes to his methodology are planned. Kyle will also be examining the ONI dataset more in depth. Something has changed with the ONI data and he will work with NOAA staff to understand the change.

Brownlee – Jennifer Cuhaciyan, Idaho Power Company
IPCo uses the FEWS platform for forecasting. They are working on expediting the transition to Version 2019-02 as soon as it is available in North America, and are anticipating its use for the 2021 forecasting season.

Other Topics – Kyle Dittmer, CRITFC
Kyle shared some BAMS articles with the group and mentioned that access to BAMS articles is free through September 30, 2020 as part of BAMS COVID-19 response. BAMS can be found on the web here, https://journals.ametsoc.org/bams, and links to the articles Kyle shared are below:

June 2020 issue:
Merryfield & co-authors, Current and Emerging Developments in Subseasonal to Decadal Prediction
https://journals.ametsoc.org/bams/article/101/6/E869/345572/Current-and-Emerging-Developments-in-Subseasonal

O'Brien & co-authors, Detection Uncertainty Matters for Understanding Atmospheric Rivers
https://journals.ametsoc.org/bams/article/101/6/E790/345615/Detection-Uncertainty-Matters-for-Understanding

July 2020 issue:
Gourley & co-authors, Predicting the Floods that Follow the Flames
https://journals.ametsoc.org/bams/article/101/7/E1101/345968/Predicting-the-Floods-that-Follow-the-Flames

August 2020 issue:

Ralph & co-authors, West Coast Forecast Challenges and Development of Atmospheric River Reconnaissance
https://journals.ametsoc.org/bams/article/101/8/E1357/347613/West-Coast-Forecast-Challenges-and-Development-of

2020 Modified Flows Update – Erik Pytlak, BPA

All comments are back from the draft posting in June. Erik gave special credit and thanks to USACE, IPCo, and CRITFC (David Graves). Their comments in particular helped to identify locations in the document that required additional detail. Some of the differences are attributed to Reclamation and BPA updating their models. The second set of flows has been generated and they are in the process data QC right now. Erik anticipates publishing of the 2020 Modified Flows around October 1, 2020.

"The Sampler" Salmon Manager Topics

Biological Opinion target flows - Kyle Dittmer, CRITFC; Claire McGrath, NOAA Fisheries

Kyle shared a table showing the frequency that BiOp target flows are met at LWG, PRD, MCN for two time periods: Spring and Summer. The table showed that the BiOp flows are often met in the spring, but have been met less of the time in the summer, potentially indicating a shift in timing of runoff. Claire added that objective analysis will continue to be needed to understand what does data like this mean, how do we adjust, and what are the effects on salmon migration and survival.

Pete provided one observation that Reclamation flow augmentation shifted earlier in the season (into May and June instead of July and August) starting in 2008 at NOAA's request. To understand a shift in timing, it would be necessary to look at unregulated flows so water management changes don't skew the results.

Kyle asked group to do some more thinking on this data. Kyle will follow up and work with NOAA-Fisheries staff for their input and insight.

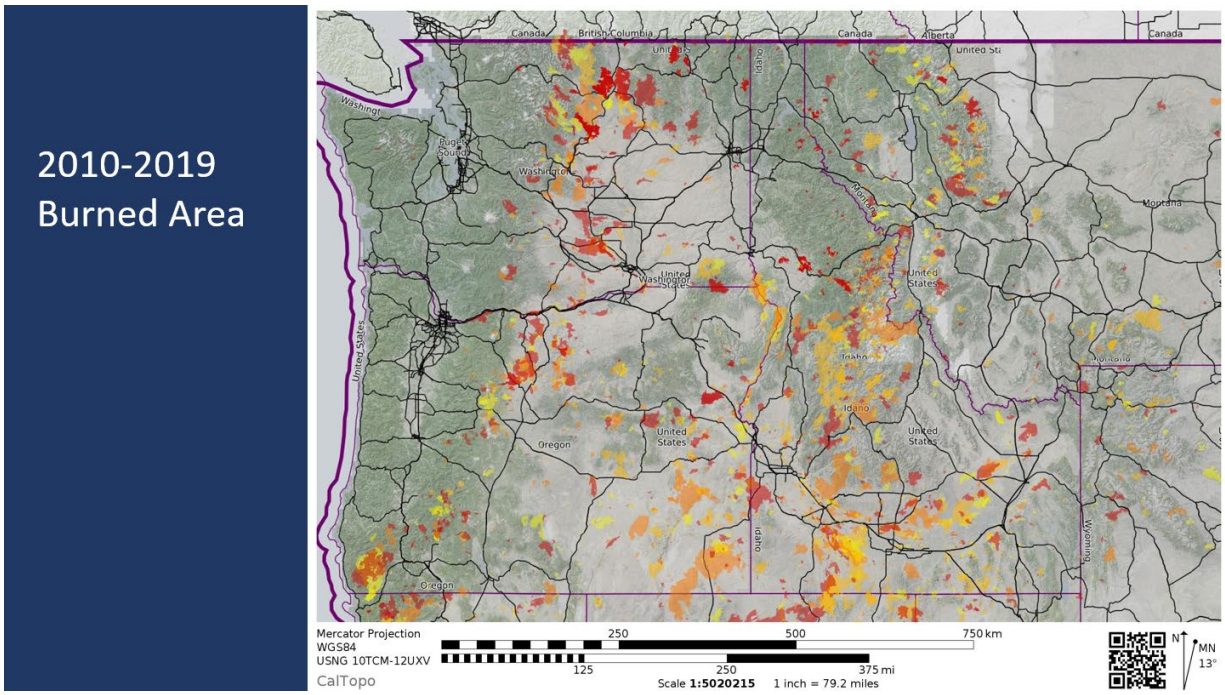
Guest Speaker – Danny Tappa, NRCS Idaho Snow Survey – Fire and SNOTEL Data

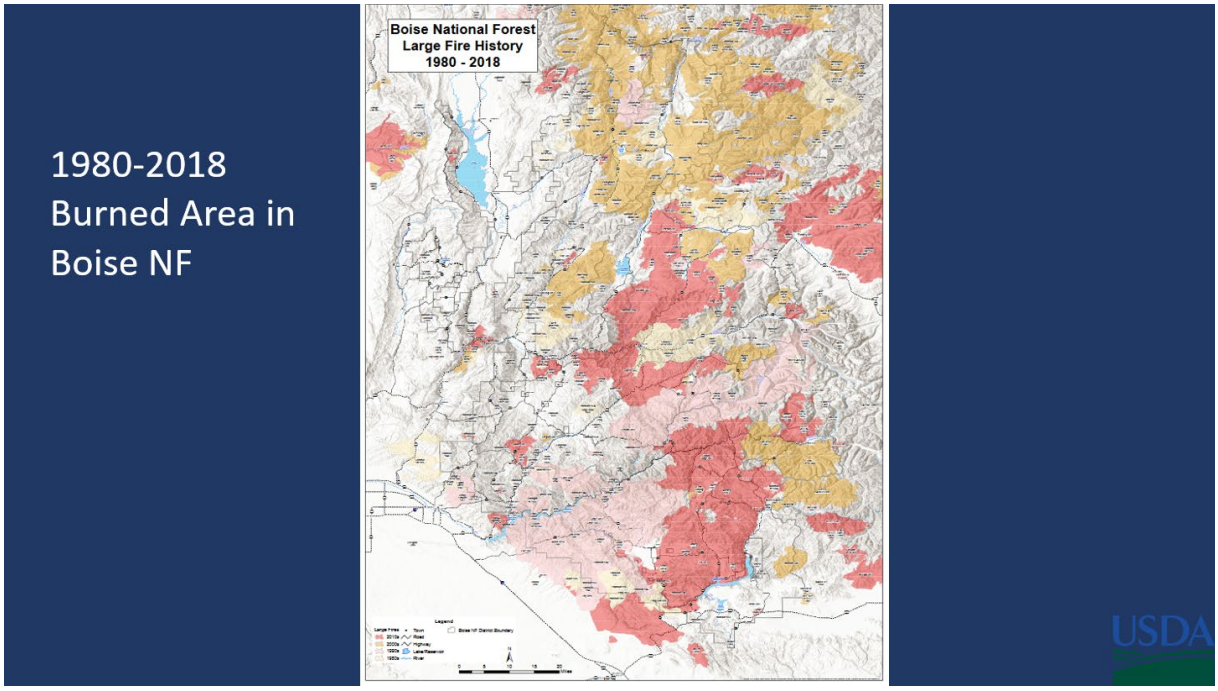
Danny focused on the Idaho SNOTEL network since that is where he is located. He started by showing statistics from site disturbances. The Idaho SNOTEL network has nearly 100 SNOTEL sites and most with nearly a 40-year record. This means that there are 4,000 years of combined SNOTEL data. During that period of record, there have only been 23 documented site disturbances, which means there have only been 0.5% disturbance events per data year. On top of that, there have only been 10 sites disturbed by fire in that period of record, meaning, there is only a 0.25% chance each year that a site will be disturbed by fire.

Danny presented a case study of the Atlanta Summit SNOTEL in the Boise Basin. This site has a good period of record before and after the site was burned by fire in 2004, so it is possible to do some statistical analysis to look at how a fire can change a SNOTEL site. Danny and his team did a double-mass balance study with surrounding SNOTEL sites and found no change to the cumulative peak SWE relationship. However, a change in the peak SWE deviation relationship was observed, but only after a number of years after the fire had passed. Danny needs to do more analysis to understand why. Amy Burke (NWRFC) commented that relationship looks a lot like relationships she was seeing with beetle kill in Montana, where it took many years for the trees to die and eventually fall. Danny also showed that melt timing has shifted ~11 days earlier than it historically did because of the higher solar radiation on the snowpack because the tree canopy was burned. Danny showed a second case study of Mores Creek Summit SNOTEL (also in the Boise basin), however this was a more recent burn and does not have as long of a period of record. Once again, no change to the peak SWE accumulation relationship to nearby sites was found.

Next Danny showed a map of the Pacific Northwest overlaid with areas burned during the 2010-2019 time period. It was striking how much has burned in Idaho vs. the Cascades and helps to explain why there are such large fires burning in Oregon right now and not in Idaho (i.e. there is a lot of fuel in Oregon, but in Idaho a lot of the fuel has already been burned). Danny then showed a map zoomed in on the Boise River basin with burned areas from 1980-2018. Essentially the majority of the basin has burned sometime during the last 40 years. This is evident when you fly over the basin. Danny posed the question: If a SNOTEL hasn't burned in the Boise Basin, is it really reflective of the basin conditions? The basin has changed more than the SNOTEL representation.

Gus Goodbody provided some good comments for the group to think about. Overall, the change at each site is very site dependent and we need to analyze on site-by-site basis. Fires can influence immediate site location so it is hard to generalize. There is stationarity at the site level (i.e. data collection), then there is stationarity at the basin scale. If what happens at the site is similar to the watershed, maybe it is less impactful. Gus stated this is very hard to evaluate.





CRFG Annual Report – Intro Page Draft Re-Wording - All

The group discussed concerns raised earlier in the year regarding wording of the first-page of the Annual Report which references the 2008 Biological Opinion. The concern was that a new Biological Opinion will be issued soon. Claire described the timeline of the Biological Opinion (final version was issued July 24 and will be implemented when the Record-of-Decision (ROD) is signed by the action agencies – anticipated end of September 2020). Claire also mentioned that one of main themes of the 2020 Biological Opinion is the very strong role of monitoring and adaptive management. It is clear throughout the document that continued improvement of forecasting is critical to the operation of the system. Per Claire, there is more than enough justification in the new Biological Opinion for the continued existence of CRFG.

After discussion, the group did not see a need to completely re-invent the CRFG Charter. Rather, Claire offered to help the four CRFG sovereigns (CRITFC, USACE, BPA, and Reclamation) craft new language to update the Charter with references to the 2020 Biological Opinion. The goal will be to have a draft of new language for consideration at the next CRFG meeting.

The 2020 Biological Opinion can be found here:

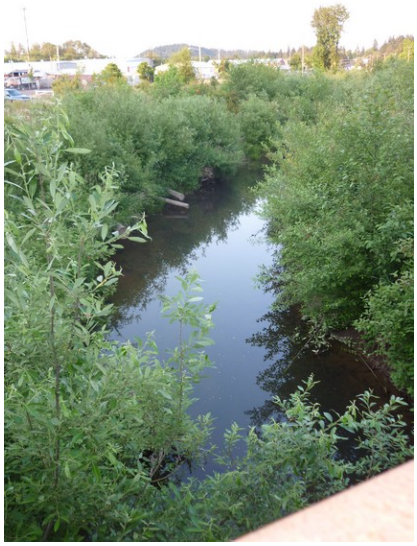
https://s3.amazonaws.com/media.fisheries.noaa.gov/dam-migration/2020_crs_biological_opinion.pdf

Virtual Field Trip – Climate Change mitigation projects – City of Portland

Kyle presented a virtual field trip of climate change mitigation projects throughout the City of Portland. Stops included Crystal Springs, Reed Lake and Canyon (Reed College), and Johnson Creek Natural Area. The main take-home message was that wetland/river habitat restoration work can also help in carbon sequestration and local flood control and water quality enhancement. The group appreciated the insight as a number of attendees either live near or have visited some of these sites. A partial slide-show, as follows:

Crystal Springs city park area (East Morland neighborhood, Portland)


Reed Lake and Reed Canyon at Reed College (headwaters of Crystal Springs), southeast Portland

Johnson Creek/Foster Road Natural Area after restoration (2007) and later (2015)

Adjournment:
The next CRFG meeting (Annual Review) will likely occur sometime in mid-November. Kyle will send a Doodle-poll to the CRFG membership to determine the final date. Due to many factors, Kyle suggested that we all agree to have another virtual meeting. The meeting was then adjourned at 11:35 am.

****

Attendance:
In person: none – meeting conducted virtually due to COVID-19

On the phone:
Alfredo Rodriguez – USACE
Amy Burke – NWRFC
Angela Duren – USACE
Brian Stevens – USBR
Claire McGrath – NOAA
Danny Tappa – NRCS
Erik Pytlak – BPA
Gus Goodbody – NRCS
Jen Cuhaciyan – IPCo
Jeremy Dalling – USBR
Joel Fenolio – USBR
John Moen – USACE
Jolyne Lea – NRCS
Julie Koeberle – NRCS
Kyle Dittmer – CRITFC
Leslie Bach – NWPPP
Mike Warner – USACE
Peter Cooper - USBR
Ryan Lucas – NWRFC
Sanjeev Joshi – CRITFC
Sean Flemming – NRCS
Sherri Sears – Colville Tribes

****
Note Taker: Peter Cooper, U.S. Bureau of Reclamation, Boise, Idaho

Revised October 26, 2020

November 12th, 2020

Meeting time: **8**:30 am – 12:30 pm PST
Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)**
CRITFC satellite office, Mount Sylvania, Portland, Oregon … via webinar

Web/video-call Meeting (hosted by D. Alfredo Rodriguez, COE-Walla Walla):
https://usace.webex.com/webappng/sites/usace/meeting/info/7b129f8e987d49bf9f015a4f89a69bb5?MTID=m7309acb623c2300ba95c4a22c1bb2b82
1-877-848-7030 Call-in toll-free number (ATT Audio Conference)
1-404-443-2170 Call-in number (ATT Audio Conference)
Meeting #: 146 380 5869; Access Code: 835 173 6; Security Code: 1234

Contact Info: Kyle Dittmer, CRITFC (503) 731-1314 (call-forward)
Erik Pytlak, BPA (503) 230-5335

8:30 am **Dial-in time (8:25 am)**…**Welcome and Introductions** (Kyle)

8:35 – 8:40 **Approval of September meeting Minutes** (all)

8:40 – 8:45 **CRFG Contact List – updates?** (all)

8:40 - 8:45 **"The Sampler" Salmon Manager Topics** (Kyle)

8:45 - 8:55 **BAMS research weather/climate articles…Upcoming conferences** (Kyle)

8:55 - 9:00 **CRFG Annual Report – Intro-page re-wording – update on process** (Kyle)

9:00 **Water Year 2020 Review (~15 minutes each)**

NWS-NWRFC:	Ryan Lucas (systemwide)
NRCS:	Julie Koeberle (or Gus Goodbody)
USACE:	Mike Warner (LIB)
	Alfredo Rodriguez/Jonathan Roberts (DWR)
USBR:	Peter Cooper (HGH, HEII)

10:00 - 10:15 **<< BREAK >>**

10:15 - 11:00 **Water Year 2020 Review … continues**

BC Hydro:	Georg Jost (*not confirmed*)
CRITFC:	Kyle Dittmer (TDA)
Idaho Power Co.:	John Hildreth (BRN)

11:00 - 11:30 **WY2021 Forecasted Columbia Basin Weather/WSF** (NWRFC, Kyle, others)

11:30 - 12:00 **SNOTEL sites and disturbance impacts** (Jeremy Giovando, COE)

12:00 - 12:20 **Transition leadership** (Erik Pytlak to Chairman, Michael or Alfredo to Vice-Chairman)

Goals for 2021 – make a wish list
Set next meeting (Kyle)
Adjournment

Meeting Minutes

Columbia River Forecast Group – 2020 Annual Review Meeting: November 12, 2020

Introductions:

Chairman Kyle Dittmer welcomed the group and started the meeting at 8:34 am. The attendees introduced themselves. Due to COVID-19, the meeting was held virtually using the WebEx platform (and hosted by Alfredo Rodriguez, COE-Walla Walla).

Approval of Minutes:

Chairman Dittmer asked the members to approve the minutes from the September 2020 Meeting. It was so moved by Mike Warner and seconded by Kyle Dittmer. Notes were approved as final.

CRFG Contact List:

The current CRFG contact list was displayed for the group to review. A few changes were made. The updated contact list will be sent to the Group for additional edits.

"The Sampler" Salmon Manager Topics:

Kyle noted that he had checked in with the Salmon Managers but there were no new topics for discussion at CRFG. It is possible that new issues will become known at the TMT Year-End-Review on Dec. 2.

BAMS research weather/climate articles…Upcoming conferences/trainings:

Kyle provided links to two articles that he thought may be of interest to the group:

The first article is titled "Emerging Developments in Subseasonal to Decadal Prediction" and was published in the Bulletin of the American Meteorological Society. The article can be found at the following link:

https://journals.ametsoc.org/bams/article/101/6/E869/345572/Current-and-Emerging-Developments-in-Subseasonal

The second article is titled "The Physics of River Prediction" and was published in Physics Today. The article can be found at the following link:

https://physicstoday.scitation.org/doi/full/10.1063/PT.3.4523

The group then discussed past and upcoming conferences. Mike mentioned that he attended the International Atmospheric River (AR) Conference. More than 300 people from around the world participated with more than 100 talks. The research into ARs has dramatically increased in the last decade. Kyle mentioned that the American Institute of Hydrology has a Nov. 18 training on forecast informed reservoir operations upcoming. The conference is open to both members and non-members of AIH. More information can be found here:

https://www.aihydrology.org/

CRFG Annual Report – Intro-page re-wording – update on process:

Kyle sent information regarding this topic to Claire McGrath (NOAA-Fisheries) and Christine Golightly (CRITFC attorney), but has not had a full discussion with them yet. Kyle sees this as a two-pronged action. First being the CRFG Annual Report into-page and the second being the CRFG charter. Erik mentioned that his thought is to keep much of the wording in the CRFG Annual Report intro-page the same since actions this year occurred under the previous Biological

Opinion, but add a footnote to describe that the language will be updated to reflect the new Opinion. That way it doesn't hold up the finalization of the 2020 CRFG Annual Report. Erik thinks it is more appropriate to update the Charter first and get it ready for 2021 and then work on the intro-page. The Group agreed. The path moving forward will be for Erik to take the lead on this project as he is will be the CRFG Chairman in 2021.

Water Year 2020 Review:

Systemwide – Ryan Lucas, NWS-NWRFC

Overall the trend for the 2020 water year was a wet September, followed by a dry fall, then precipitation in the January-March time frame helped to bring the snowpack back up to near normal locations in many areas. May and June were quite wet followed by a dry summer. Overall, the water year precipitation ended up fairly close to normal in most locations except for central and southwest Oregon. The northern and eastern portion of the basin had wetter conditions than the southern and western portion of the basin.

Kyle asked if Ryan had noticed any trends with late season ARs increasing. Ryan said that he had not noticed any trends and thought perhaps some of the perception may be due to the increased awareness of ARs. Erik described that what struck him about last year was that temperatures were favorable during the late season storms to build snowpack, which is different than what has been seen in the last few years. Mike mentioned that from his AR research: what he found was that the majority of the change has been in the early season in months like October.

Systemwide –Julie Koeberle, NRCS:

Julie started by letting the Group know that her group will be working on keeping the disturbed SNOTEL site list updated. NRCS is looking at publishing that list on their website.

Julie then reviewed the NRCS forecasts for WY2020. Generally, the forecasts were above normal in the northern and eastern portion of the basin, below normal in the southern and western portion. Julie then focused in on the Pend Oreille forecast to show the variability in that basin last year. Particularly, September precipitation wetted up the soils, but is not included in the NRCS forecast. Additionally, spring precipitation after April is not included in the April 1 forecasts. The wet conditions in May and June helped with an efficient runoff in spring.

Erik asked about Canadian snow pillow data, and how that is incorporated into the NRCS basin condition maps. Julie said that NRCS is working on new normal calculations, which includes the Canadian basins, so the Canadian data will get better. The current rule is a site needs 25-years for it to be included. Erik described that BPA is also recalculating their 30-year normals right now. They will only be using 15 years' worth of temperature (2005-2019) to calibrate their models in order to capture warming better but this needs to be done very carefully to not cause problems.

Libby – Mike Warner, USACE Seattle

Mike described that the dry first part of WY2020 impacted the water year precipitation. Overall the forecast bounced around but came in close to observed in the March and April time frame. The Kootenai basin generally experienced below normal precipitation for the season. So far for WY2021, conditions have been wet up north and dry down south.

Dworshak – Alfredo Rodriguez, USACE Walla Walla

Alfredo described that at the start of the water year they thought it would be very dry, but then the snowpack improved with storms starting in January. Their January forecast was low because the forecast was made before the snow events arrived. By March the forecast had increased up to near normal. Overall operations went well. Mike commented that it is impressive how you can go in

thinking it is going to be very dry and it changes so quickly. Kyle mentioned the Nez Perce Tribe was happy with operations to keep river water cool below Dworshak for summer operations.

Hungry Horse and Upper Snake – Peter Cooper, US Bureau of Reclamation
Peter briefly mentioned similar weather conditions as other presenters had before. Overall this caused the forecasts at both Hungry Horse and Heise to be low early in the season, but by March and April, the forecasts came in line with the actual observed runoff. Peter mentioned that he appreciated NRCS being fully staffed and providing full season forecasts as Reclamation does look at those forecasts during the season. For the Heise forecast, there was quite a bit of variability between the MLR and PCA. Peter thinks this was caused by the wet September which is not included in the forecast equation, and the dry conditions in October through December, which are included. Fortunately, Reclamation has the ability to look at a number of different forecasts, and overall ended up with forecasts near the observed. John Hildreth asked if Reclamation's new forecast software, Pycast, was used in WY2020. Peter responded that no, it was not used to make operational forecasts in WY2020, and that the software is still in development. Reclamation hopes to be using it to develop forecast equations soon. Kyle mentioned he was amazed to see a pretty normal shape on the Hungry Horse and Heise hydrographs, as that has not been the normal in recent years.

Mica, Arrow and Duncan - BC Hydro
No representative from BC Hydro was present at the meeting.

The Dalles - Kyle Dittmer, CRITFC
Kyle showed the results from his MEI forecast. The ONI forecast is not being used currently as that dataset was changed and Kyle needs to work with NOAA staff to understand the changes. Kyle described that his forecast continues to improve with each new year of data. Originally Kyle developed his MEI method as a pre-season forecast tool. Last October's forecast turned out to be the best forecast for the season. Kyle has added RMSE now. Kyle described the advantages of his method as being a good pre-season tool, fast to make a forecast, and minimizes forecast flip-flop. The disadvantages are that it is not statistically robust and more data is needed for improved operational use. Kyle will look at ONI dataset and hopes to be running ONI and MEI next year.

Brownlee – John Hildreth, Idaho Power Company
John gave an overview of the Idaho Power system which serves over 570,000 customers. John described that the Hells Canyon Complex is the big work horse of their system. Milner is important for them, and is where they spend the majority of their effort. Every drop of water that makes is past Milner goes through the rest of their system, so it is very important. John mentioned the managed aquifer recharge program and how that has been an important piece of their forecasts. John mentioned that they are seeing increases in reach gains during the spring due to the recharge activities. The Brownlee April-July water supply forecast was shown. Observed came in very close to median. Brownlee came in ~20 feet below the end of April FRM (Flood Risk Management) requirements to minimize spill in the system. Ryan asked if Idaho Power does any groundwater modeling to get a better understanding of recharge effects? John said that Idaho Power does have response functions built in to get expected response, and those are updated once per year.

<u>WY2021 Forecasted Columbia Basin Weather/WSF – Ryan Lucas and Kyle Dittmer</u>
Ryan presented on the WY2021 outlook with the caveat that it is still very early in water year and there is a lot of winter left to come. October followed a similar pattern to WY2020 with wet conditions up north and dry conditions down south. There is a big storm in the 10-day forecast right now and that could change basin conditions fairly dramatically. The CPC outlooks mimic a *La Niña* pattern, with colder and wetter conditions shown for the Pacific Northwest. Outlooks show the *La Niña* pattern persisting through winter and lasting into spring. Ryan showed a

number of correlations between climatic indices and runoff. The correlations generally show quite a bit of variance. Erik gave kudos to the NWRFC for displaying this type of information on their website as it is very helpful in discussions with stakeholders. Mike also echoed that these are great tools but really anything can happen as shown by the large variance. Mike asked when NWRFC will switch to the 1991-2020 30-year normal? Ryan's impression is that it will happen later in the calendar year 2021. Mike said that they have noticed some pretty big differences between the 1981-2010 and the 1991-2020 normals with the 1981-2010 normals being quite a bit lower.

Kyle then presented his outlook for WY2021. Kyle uses a holistic approach including sunspots, MEI, SST, and other information. Kyle says pattern recognition is key in his method. For WY2021, he has chosen 80% *La Niña* years, and 9 of the 20 years chosen were close to solar minimums, which is the current condition we are in. Kyle's prediction is for 115 MAF (±19) for TDA runoff (Jan.-July). Kyle then gave specific outlooks for a number of locations. For all of his CRITFC-based forecast locations (Hagerman, Hood River, Government Camp, and Portland), Kyle is predicting near normal temperatures to start with and trending towards cooler in mid-to-late winter. He expects above normal precipitation for most of the winter. Kyle expects five snow events in Portland this winter: 2 moderate (2-3 inch), 3 minor (0.5 inch), 6-inches seasonal total.

Kyle mentioned two upcoming meetings that may be of interest to the Group:

OMSI/OR-AMS Winter Weather Meeting presentations, more information can be found here: https://oregonams.wordpress.com/2020/11/06/presentations-28th-annual-winter-weather-conference/

2021 AMS Annual Meeting (January 10-15, 2021)
https://annual.ametsoc.org/index.cfm/2021/

Guest Speaker Jeremy Giovando, USACE CRELL - SNOTEL Sites and Disturbance Impacts:

Jeremy presented on his work with analyzing burned SNOTEL sites. Jeremy first gave thanks to the snow survey data collection offices. He is happy to report he is going to be able to do more work than originally anticipated. Jeremy's work is related to the USACE's post-wildfire R&D to improve hydrologic models, and developing a better understanding of how post fire hydrology and hydraulics work. Key component is getting data. The project uses data from the SNOTEL network with the purpose of determining changes and patterns to SWE, temperature, precipitation, and soil moisture pre and post fire. Jeremy showed fire trends in different eco-zones throughout the northwest (through 2017 – hasn't included 2020 yet). What we see is lots of variability in number of fires and a shift in the lower threshold on size of fires. Jeremy expects that trend to continue into the future. There are quite a few SNOTEL sites that have been impacted by fire. When you look at that list of impacted sites, you can look at variables collected there and do some differencing since fire occurred. For daily temperatures, in general there is a higher temperature at the site post-fire (roughly +0 to +10%). When annual peak SWE is examined, Jeremy saw the majority of sites see a decrease in peak SWE but there is a mix of increases and decreases. A lot is dependent on aspect, location of site, etc. Jeremy caveated that this is a raw analysis and hasn't been controlled for other factors. In general, Jeremy found peak SWE in dry years increases while peak SWE in wet years decreases. Finally, when soil moisture was examined, Jeremy found a pattern where soil moisture tended to be higher post-fire than pre-fire. Mike commented that this is opposite of what he would think: what is happening? Jeremy once again mentioned that the data needs to be checked and controlled, but anecdotally a couple of things could be happening: 1) If a heavily forested area pre-fire, and post-fire the canopy is no longer present, this can cause

differences in interception, and 2) If water-loving vegetation was there pre-fire, perhaps the new ground cover post-fire is using less water.

Jeremy described his future efforts, which includes adding fire impacted SNOTELs through year 2020, evaluating changes in soil moisture while controlling for precipitation, and ultimately looking at how infiltration changes pre- and post-fire. We then opened the discussion up for questions.

Erik asked how Jeremy sees this applying in an operational sense. Jeremy said that the ultimate goal would be to develop guidance for use by operations staff to use to understand how watershed will change after a fire and then that information can be added into their modeling. Jeremy added that in the future, he would like to see impacted SNOTEL sites rebuilt with enhanced sensors to continue to add data to the system.

Leadership Transition and Goals for 2021

The Group thanked Kyle for his leadership during this interesting time of COVID-19: Kyle did a fantastic job. The Chairmanship was then transitioned to Erik Pytlak. The Vice-Chairmanship was transitioned to the USACE. Mike Warner and Alfredo Rodriguez will (likely) split the duties.

Adjournment:

The next CRFG meeting will likely occur sometime in late-January/early-February. Erik will send an invite once the final date has been established. Whether the meeting will be in person or virtual will depend on Covid-19 status at that time. Regardless, virtual meetings are likely to be a part of the future of CRFG. The meeting was then adjourned at 12:15 pm.

****

Attendance:

In person: none – meeting conducted virtually due to Covid-19

On the phone:

Alfredo Rodriguez – USACE-NWW
Erik Pytlak – BPA
Jeremy Giovando – USACE-CRREL
John Hildreth – Idaho Power Co.
Julie Koeberle – NRCS
Kyle Dittmer – CRITFC
Mike Warner – USACE-NWS
Peter Cooper - USBR
Ryan Lucas – NWRFC
Tom Iverson – Yakama Nation Fisheries

****

Note Taker: Peter Cooper, U.S. Bureau of Reclamation, Boise, Idaho

Revised November 30, 2020

Appendix C

Historical forecast results

Columbia River Forecast Group 2020

In 2012, the official Water Supply Forecasts used for FCRPS operations for Grand Coulee, Brownlee, Lower Granite, and The Dalles changed to the NWRFC ESP median issued on certain days of the month, and based on different lead times on future precipitation as follows:

2012: 4th working day of the month, 10 days of future precipitation
2013: 5th working day of the month, 3 days of future precipitation
2015: 5th working day of the month, 5 days of future precipitation
2016: 5th working day of the month, 5 days of future precipitation
2017: 3rd working day of the month, 5 days of future precipitation
2018: 3rd working day of the month, 5 days of future precipitation
2019: 3rd working day of the month, 5 days of future precipitation
2020: 3rd working day of the month, 10 days of future precipitation (note: 5 day future precipitation forecast flavor was discontinued and 10 day future precipitation forecast was adopted as the official)

The following process is used to retrieve annual data that is used to append the historical forecast versus observed tables found in this Appendix. The tables are produced from an Excel file named: "CRFG_Forecast-vs-Obs-Flow_Report-Tables YYYY.xlsx" which is housed in the CRFG archive.

Step 1: Retrieve official historic forecast results for all locations (EXCEPT for Lower Granite (Jan-Jul) and The Dalles (Jan-Jul)) from the COE's published monthly "Flood Risk Management" reports.

a. Browse to https://www.nwd-wc.usace.army.mil/report/flood_risk/
b. Select the "May" report for the appropriate water year.
c. Table 2 can be used to retrieve all necessary forecasts.

Flood Risk Management Requirements

WY 2021	Dec	Jan	Feb	Mar	Apr	May	Jun	
WY 2020	Dec	Jan	Feb	Mar 6 Mar 12	Apr 7 Apr 29	May	Jun 5 Jun 22	Jul
	Dec	Jan	Feb	Mar	Apr 8	May 8	Jun 6	Jul

Table 2. Water Supply Forecasts (Kaf)

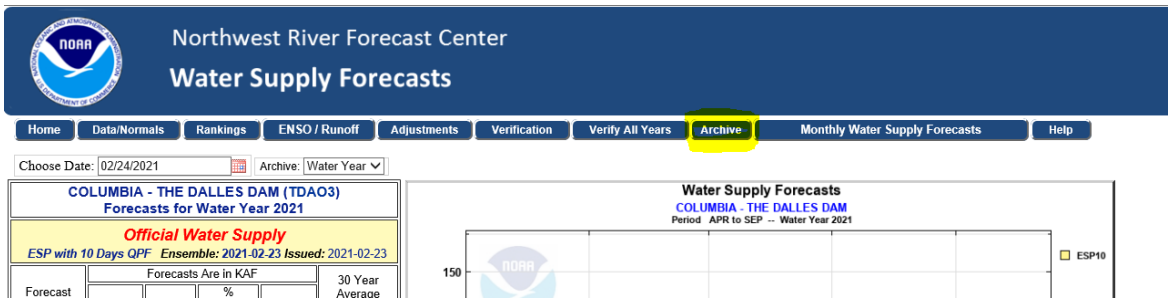
Project	Forecast Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Current Month Forecast % of Normal	Residual Runoff[2] (%)
MCDB	Apr-Aug	11179	11598	11579	11793	11308			103	95
ARDB	Apr-Aug	22621	23898	23744	23858	23162			105	94
DCDB	Apr-Aug	1998	2227	2214	2233	2178			108	93
LIB	Apr-Aug	5481	6386	6349	6324	5759			98	91
HGH	May-Sep	1582	1778	1830	1890	1970			116	93
SKQ[1]	Apr-Jul	6378	6653	6405	5889	6263			108	84
ALF[1]	Apr-Jul	11926	13167	12295	11347	12169			103	81
GCL[1]	Apr-Aug	58483	63023	61265	58666	60098			106	88
BRN[1]	Apr-Jul	5414	5105	4028	3875	3848			70	67
DWR	Apr-Jul	1532	2095	2355	2333	1960			81	64
TDA[1]	Apr-Aug	86909	92647	87043	84445	87323			100	84

Notes:

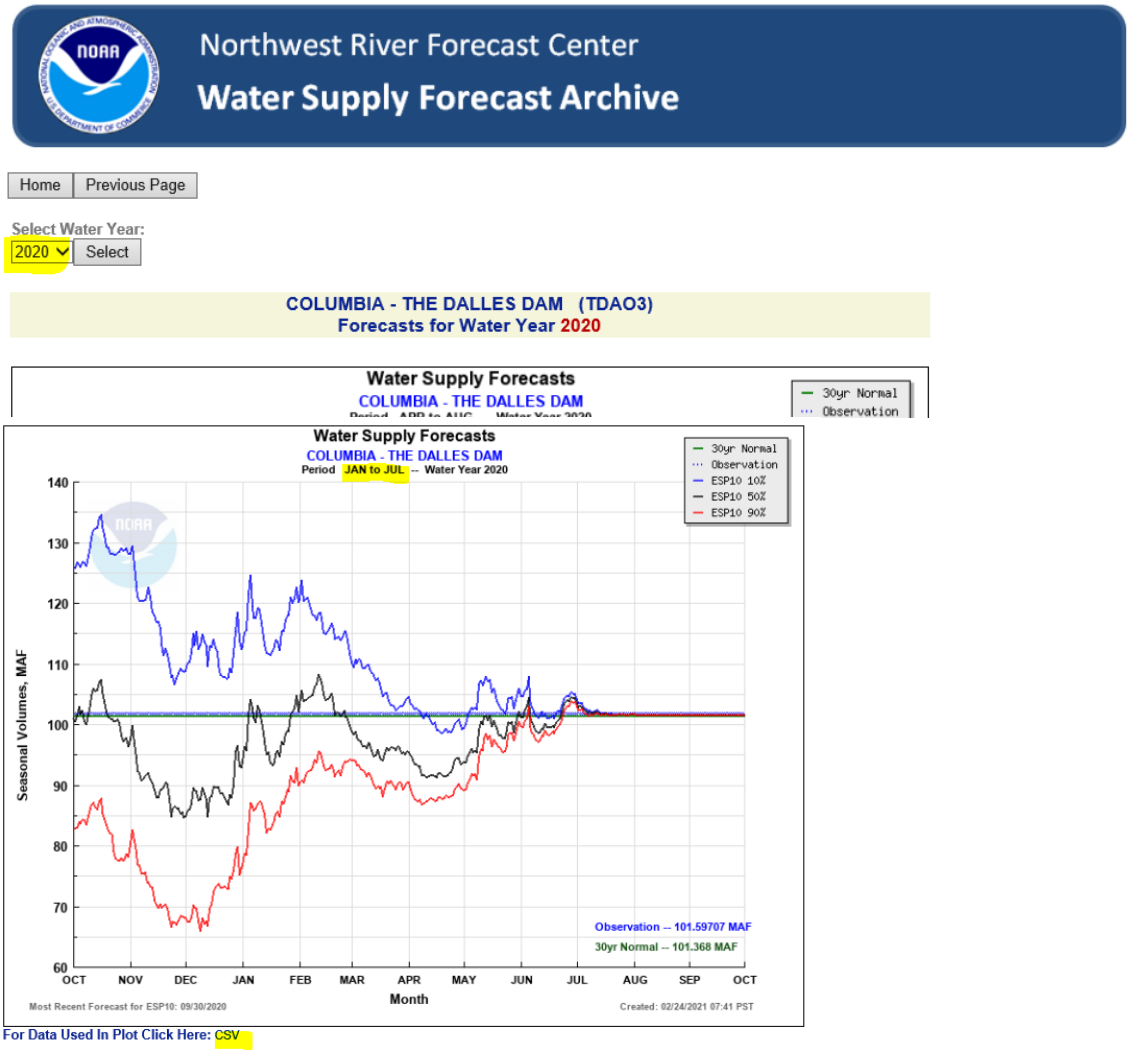
1. Official water supply forecasts for SKQ, ALF, GCL, BRN and TDA are the ESP 10-day-QPF median values published by the NWRFC on the following days for 2020: Jan 6, Feb 5, Mar 4, Apr 3, May 5, Jun 3, and Jul 7.
2. Residual runoff is the percentage of the current month's seasonal volume forecast that has yet to runoff.

Step 2: Retrieve historic Jan-Jul forecasts for Lower Granite and The Dalles from the NWRFC website.

a. Browse to https://www.nwrfc.noaa.gov/ws/
b. Click on the appropriate forecast point (i.e. either Lower Granite or The Dalles)
c. Click on the "Archive" button



d. Choose the appropriate water year from the drop down box and scroll to the Jan-Jul graph. Click on "csv" at the bottom of the graph.



e. Table 2 of the COE report lists the "official" forecast dates in the "Notes" section. In the NWRFC "csv" link, scroll to the appropriate dates and pick off the "50% FCST" for each.

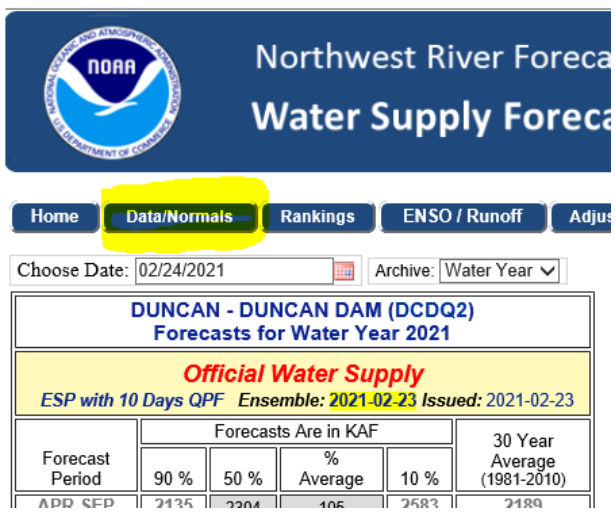
```
# Water Supply Forecast for COLUMBIA - THE DALLES DAM (TDAO3)
# Ensemble Model: with ESP10 day QPF
ID,Ensemble Date,Issuance Date,Start Month,End Month,Min FCST,90% FCST,75% FCST,50% FCST,25% FCST,10% FCST,Max FCST
TDAO3,2020-09-30,2020-09-30,JAN,JUL,101547,101547,101547,101547,101547,101547,101547
TDAO3,2020-09-29,2020-09-29,JAN,JUL,101547,101547,101547,101547,101547,101547,101547
TDAO3,2020-09-28,2020-09-28,JAN,JUL,101547,101547,101547,101547,101547,101547,101547
TDAO3,2020-09-27,2020-09-27,JAN,JUL,101547,101547,101547,101547,101547,101547,101547
TDAO3,2020-09-26,2020-09-26,JAN,JUL,101547,101547,101547,101547,101547,101547,101547
TDAO3,2020-09-25,2020-09-25,JAN,JUL,101547,101547,101547,101547,101547,101547,101547
```

For example, for the official January The Dalles Jan-Jul forecast for WY2020, scroll to January 6, 2020 in the csv file, and pick off the 4th value in the row to align with the 50% FCST entry:

```
TDAO3,2020-01-08,2020-01-08,JAN,JUL,78811.37,86065.47,90413.67,100335.47,110665.27,117505.27,129809.27
TDAO3,2020-01-07,2020-01-07,JAN,JUL,79299.77,85867.07,89915.87,101137.37,109749.37,117460.37,131680.37
TDAO3,2020-01-06,2020-01-06,JAN,JUL,79678.58,86518.88,91532.08,102656.68,111281.68,119518.68,132100.68
TDAO3,2020-01-05,2020-01-05,JAN,JUL,80453.84,87146.34,92596.24,104070.44,111965.44,124586.44,133063.44
TDAO3,2020-01-04,2020-01-04,JAN,JUL,77878.8,82769.5,90001.2,101407.1,108368.1,121550.1,129619.1
TDAO3,2020-01-03,2020-01-03,JAN,JUL,72712.41,78576.41,85231.21,95759.31,103537.11,115456.11,125230.11
```

Step 3: Retrieve observed runoff values for the appropriate periods for all locations (EXCEPT for Hungry Horse), as reported on the NWRFC website.

a. Browse to https://www.nwrfc.noaa.gov/ws/
b. Click on the appropriate point location.
c. Click on the "Data/Normals" tab



d. Add up the observed monthly data for the appropriate period (for example for Duncan, add up the monthly values for April through August).

2019	56.20	26.00	34.33	151.02	416.72	466.34	462.61	266.34	249.50	166.16	69.73	76.26
2020	*86.62*	*48.31*	*33.44*	*118.83*	*468.38*	*673.17*	*551.68*	*345.78*	*181.16*	*135.36*	*97.70*	*71.63*
2021	*61.52*	*28.34**										
30-Year Normal 1981-2010	**55.17**	**35.40**	**46.07**	**120.03**	**405.20**	**591.40**	**545.50**	**345.47**	**181.23**	**108.93**	**79.53**	**61.53**
Previous 30-Year Normal 1971-2000	**53.83**	**36.40**	**45.73**	**114.97**	**396.53**	**595.97**	**562.87**	**373.50**	**185.27**	**102.77**	**75.73**	**62.50**

* Partial Monthly Total
** Estimated from available years
Provisional data beyond WY 2010

Step 4: Retrieve the observed runoff for Hungry Horse from the Bureau of Reclamation.

a. Contact the Bureau of Reclamation CRFG representative for this information.

Duncan: (Apr-Aug)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	2003	109%	2013	110%	1972	108%	1968	107%	1876	102%	1834
2006	1839	87%	1906	90%	1946	92%	1922	91%	1932	91%	2120
2007	2087	88%	2122	90%	2096	88%	2221	94%	2257	95%	2370
2008	2202	113%	2091	107%	2091	107%	2059	105%	1985	101%	1957
2009	2003	123%	1945	120%	1866	115%	1859	114%	1787	110%	1627
2010	2030	125%	1962	121%	1825	113%	1817	112%	1813	112%	1621
2011	1846	82%	1942	86%	1912	85%	1997	89%	2057	91%	2251
2012	1987	77%	2039	79%	2015	78%	2138	83%	2227	87%	2571
2013	2283	105%	2079	96%	1975	91%	2061	95%	2094	96%	2172
2014	1785	86%	1728	83%	1761	85%	1891	91%	1903	91%	2081
2015	2148	122%	2061	117%	1995	113%	1958	111%	1912	108%	1766
2016	2063	106%	1978	101%	1961	101%	1972	101%	2063	106%	1951
2017	2010	91%	1954	89%	1942	88%	2036	93%	2103	96%	2198
2018	1995	96%	2061	99%	2174	105%	2208	106%	2167	104%	2079
2019	1956	110%	2030	114%	2007	112%	1893	106%	1771	99%	1786
2020	1998	93%	2227	103%	2214	103%	2233	103%	2178	101%	2158

Libby: (Apr-Aug)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	5786	104%	5630	101%	5371	97%	5401	97%	5096	92%	5564
2006	5487	83%	6186	93%	6350	96%	6076	92%	6179	93%	6629
2007	6955	102%	6582	96%	6516	96%	6847	100%	6990	102%	6822
2008	6282	113%	6498	117%	6435	116%	6387	115%	6166	111%	5539
2009	5526	125%	5436	123%	5296	120%	5672	128%	5209	118%	4425
2010	5682	126%	5478	121%	5084	113%	5103	113%	4887	108%	4517
2011	5610	73%	6656	86%	7111	92%	7191	93%	8165	106%	7729
2012	5524	60%	5714	62%	5635	61%	6872	75%	7159	78%	9185
2013	6898	96%	6384	89%	6315	88%	6189	86%	6535	91%	7173
2014	5432	81%	5192	78%	5505	82%	6868	103%	6996	105%	6673
2015	6297	148%	5523	130%	5683	134%	5808	137%	4826	114%	4250
2016	6249	115%	6318	117%	6472	120%	6681	123%	5831	108%	5414
2017	6861	98%	5583	80%	6783	97%	7654	109%	8190	117%	7016
2018	6645	107%	6765	109%	7205	116%	7189	116%	7356	119%	6195
2019	5639	126%	5318	119%	5478	123%	4752	106%	4983	112%	4463
2020	5481	87%	6386	101%	6349	100%	6324	100%	5759	91%	6320

Hungry Horse: (May-Sep)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	1647	129%	1418	111%	1144	90%	1217	95%	1173	92%	1275
2006	1826	99%	2024	110%	1958	106%	1912	104%	1824	99%	1841
2007	1823	137%	1803	136%	1786	134%	1495	112%	1425	107%	1330
2008	1840	76%	1859	77%	1876	78%	1913	79%	2131	89%	2408
2009	1809	114%	1864	117%	1697	107%	1817	114%	1816	114%	1589
2010	1654	103%	1429	89%	1284	80%	1305	81%	1345	84%	1606
2011	1944	61%	2139	67%	2222	69%	2357	73%	2798	87%	3213
2012	1691	81%	1781	86%	1739	84%	1906	92%	1680	81%	2078
2013	1968	107%	1877	102%	1743	95%	1750	95%	1789	98%	1833
2014	1787	73%	1819	75%	2142	88%	2204	90%	2400	98%	2439
2015	1977	213%	1927	208%	1678	181%	1496	162%	1499	162%	926
2016	1629	135%	1531	127%	1573	131%	1556	129%	1251	104%	1204
2017	1828	101%	1489	82%	1691	93%	1769	97%	2018	111%	1818
2018	1964	77%	2062	80%	2302	90%	2395	93%	2500	98%	2563
2019	1533	121%	1500	118%	1580	124%	1400	110%	1460	115%	1270
2020	1582	76%	1778	85%	1830	88%	1890	91%	1970	95%	2084

Grand Coulee: (Apr-Aug)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	54863	112%	53657	110%	45820	94%	47628	98%	47628	98%	48807
2006	55466	91%	58480	96%	57877	95%	57275	94%	58500	96%	61189
2007	60000	105%	61600	107%	61200	107%	61600	107%	61000	106%	57350
2008	59300	99%	59200	99%	61300	103%	61600	103%	60000	100%	59739
2009	55800	116%	54600	113%	53100	110%	55400	115%	54000	112%	48186
2010	54000	113%	49100	103%	45800	96%	44900	94%	45300	95%	47711
2011	56500	75%	61400	82%	62200	83%	64700	86%	70800	94%	75107
2012	44509	56%	56788	71%	60853	76%	68525	86%	72812	91%	79874
2013	58230	89%	54536	84%	54020	83%	55882	86%	57373	88%	65121
2014	54683	87%	48197	77%	57818	92%	60382	96%	64683	103%	62620
2015	56539	134%	55845	133%	49419	117%	51165	121%	45498	108%	42145
2016	52783	102%	54491	105%	56411	109%	57009	110%	56763	110%	51836
2017	54930	84%	53656	82%	57336	87%	64955	99%	68159	104%	65575
2018	55852	85%	64817	98%	65870	100%	68335	104%	71449	108%	66018
2019	55941	116%	51352	107%	48998	102%	47853	100%	48664	101%	48084
2020	58483	94%	63023	101%	61265	98%	58666	94%	60098	96%	62386

Brownlee: (Apr-Jul)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	3170	88%	2590	72%	1740	48%	2180	60%	2440	68%	3612
2006	6690	75%	8016	89%	6940	77%	8380	93%	9020	101%	8975
2007	5200	185%	3630	129%	3760	134%	3300	118%	3040	108%	2807
2008	4390	101%	5260	120%	5500	126%	5400	124%	4860	111%	4368
2009	4260	76%	4020	72%	3350	60%	4970	89%	5000	90%	5575
2010	3300	72%	3020	66%	2470	54%	2590	56%	2780	61%	4586
2011	7230	69%	6280	60%	5690	54%	7510	71%	9060	86%	10549
2012	4783	86%	4986	90%	5211	94%	6388	115%	6162	111%	5535
2013	4650	178%	4229	162%	3744	144%	3478	133%	2673	102%	2609
2014	3723	108%	3246	94%	3861	112%	3934	114%	3519	102%	3436
2015	4831	197%	4665	190%	3738	153%	3052	125%	2289	93%	2449
2016	4693	118%	4689	118%	4623	116%	4767	120%	4373	110%	3969
2017	4801	48%	5327	53%	7560	75%	10845	108%	11277	113%	10019
2018	5690	99%	5509	96%	5665	98%	6436	112%	5889	102%	5753
2019	4383	62%	4160	59%	5863	83%	5450	77%	7275	103%	7040
2020	5414	125%	5105	118%	4028	93%	3875	89%	3848	89%	4342

Dworshak: (Apr-Jul)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	1914	116%	1642	100%	1423	87%	1321	80%	1344	82%	1643
2006	2601	97%	2707	101%	2612	98%	2593	97%	2626	98%	2677
2007	2905	161%	2126	118%	2192	122%	1982	110%	1868	104%	1799
2008	2717	79%	2738	80%	2810	82%	3010	88%	3003	87%	3434
2009	3075	121%	2681	106%	2461	97%	2662	105%	2631	104%	2539
2010	2174	114%	1742	91%	1571	82%	1398	73%	1526	80%	1906
2011	3340	83%	3142	78%	3329	82%	3387	84%	3772	93%	4042
2012	2473	74%	2504	75%	2585	77%	2966	89%	3226	97%	3343
2013	2587	123%	2202	105%	2128	101%	2036	97%	2296	109%	2105
2014	2296	78%	2274	77%	2701	92%	3111	106%	3183	108%	2943
2015	2136	198%	1922	178%	1815	168%	1709	158%	1325	123%	1081
2016	1913	93%	1986	96%	2025	98%	2308	112%	2090	101%	2068
2017	3055	105%	2541	88%	2867	99%	2984	103%	2941	102%	2896
2018	2941	98%	2849	95%	3093	103%	3040	101%	3032	101%	3001
2019	2239	93%	1951	81%	2142	89%	1964	81%	2438	101%	2418
2020	1532	65%	2095	89%	2355	100%	2333	99%	1960	83%	2357

Lower Granite: (Jan-Jul)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	20700	114%	18000	99%	14600	81%	15700	87%	16500	91%	18134
2006	31600	98%	34500	107%	31900	99%	33200	103%	34900	108%	32194
2007	28200	149%	23000	122%	23500	124%	21400	113%	20600	109%	18887
2008	27200	99%	29500	107%	29200	106%	28000	102%	26500	96%	27522
2009	25700	89%	25100	87%	22400	78%	26400	91%	26900	93%	28899
2010	22400	100%	19300	86%	17000	76%	16600	74%	17000	76%	22460
2011	31253	75%	30439	73%	30676	74%	32924	79%	36291	87%	41610
2012	23497	79%	25598	86%	26022	87%	29996	100%	30266	101%	29893
2013	27769	147%	24052	127%	21683	114%	20774	110%	19130	101%	18948
2014	23024	85%	23286	86%	27967	104%	29328	109%	28629	106%	26942
2015	27621	146%	28729	152%	23125	122%	21906	116%	18856	100%	18882
2016	24286	101%	25579	106%	25886	107%	26440	110%	25401	105%	24116
2017	25181	60%	26766	64%	34589	83%	41579	99%	42323	101%	41883
2018	27399	86%	30472	96%	30462	96%	31817	100%	31592	100%	31676
2019	23116	79%	22562	77%	24780	85%	24586	84%	29050	100%	29162
2020	25336	101%	27225	108%	22635	90%	21843	87%	22486	89%	25173

The Dalles: (Jan-Jul)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	85600	105%	82400	101%	70700	87%	73800	91%	74700	92%	81349
2006	101000	88%	111000	97%	107000	93%	107000	93%	110000	96%	114672
2007	105000	110%	101000	105%	100000	104%	100000	104%	99100	104%	95738
2008	102000	103%	103000	104%	103000	104%	101000	102%	97300	98%	99209
2009	94700	105%	92900	103%	86200	96%	92000	102%	91100	101%	90244
2010	88500	104%	79200	93%	71800	85%	69700	82%	70900	84%	84718
2011	99041	69%	105851	74%	111213	78%	119785	84%	126943	89%	142616
2012	86041	66%	93781	72%	98799	76%	114135	88%	120043	93%	129441
2013	102470	105%	92040	94%	89674	92%	90972	93%	92870	95%	97709
2014	90334	84%	79222	73%	95865	89%	105424	98%	105513	98%	108082
2015	102646	123%	103786	124%	91678	110%	96005	115%	86396	103%	83668
2016	94084	96%	95160	97%	102918	105%	104709	107%	104704	107%	97605
2017	96575	70%	93398	68%	108782	79%	130774	95%	136944	100%	137111
2018	99282	84%	111454	94%	113994	96%	117562	99%	122145	103%	118708
2019	93497	104%	85011	94%	84495	94%	84126	93%	91430	101%	90237
2020	102657	101%	104294	103%	97882	96%	94192	93%	95961	94%	101597

The Dalles: (Apr-Aug)

	Jan		Feb		Mar		Apr		May		Observed
Year	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF
2005	74300	109%	69200	101%	57200	84%	60800	89%	61900	90%	68452
2006	87500	90%	94300	97%	91200	93%	92700	95%	95600	98%	97541
2007	91300	116%	88200	112%	88300	112%	85200	108%	84200	107%	78939
2008	88200	95%	91800	98%	94300	101%	94700	102%	90900	98%	93198
2009	82100	102%	79700	99%	74800	93%	82400	102%	81400	101%	80771
2010	76700	99%	68500	88%	62100	80%	60900	79%	62200	80%	77410
2011	90600	71%	92500	73%	92300	72%	101000	79%	113000	89%	127378
2012	77041	65%	84454	71%	90604	76%	103726	87%	110762	93%	119127
2013	92030	106%	81863	94%	80372	92%	81811	94%	82502	95%	87052
2014	84888	90%	72458	77%	88832	94%	92057	97%	96741	102%	94548
2015	87324	149%	83108	142%	71784	123%	72233	124%	62398	107%	58449
2016	82621	105%	83221	106%	86527	110%	86867	111%	86841	111%	78329
2017	84945	78%	82821	76%	92337	85%	102039	93%	111123	102%	109275
2018	87282	86%	94748	93%	98132	97%	103337	102%	106883	105%	101488
2019	83322	103%	75301	93%	76636	95%	75577	93%	82415	102%	81019
2020	86909	95%	92647	101%	87043	95%	84445	92%	87323	95%	91841

CRFG Roster -- 2020

Revised December 4, 2020

Name	Agency	Phone	E-mail	Position
PRINCIPAL SOVEREIGNS				
RED	Primary agency representative			
BLUE	Agency/Branch Director/Manager			
Erik Pytlak	BPA - Weather and Streamflow Forecasting	503-230-5335	espytlak@bpa.gov	Manager, Meteorologist
Ann McManamon	BPA- Weather and Streamflow Forecasting		amcmanamon@bpa.gov	
Rick van der Zweep	BPA- Weather and Streamflow Forecasting		ravanderzweep@bpa.gov	
Kyle Dittmer	CRITFC - Fish Management Dept.	503-731-1314	DITK@critfc.org	Hydrologist-Meteorlogist
Sanjeev Joshi	CRITFC - Watershed Dept.		sjoshi@critfc.org	Climate Scientist/Hydrologist
Laura Gephart	CRITFC - Watershed Dept.		gepl@critfc.org	Watershed Programs Coordinator
Bob Heinith	CRITFC - Contractor		bheinith@comcast.net	
Steve Barton	USACE - NW Division	503-808-3930	steven.b.barton@usace.army.mil	
William Proctor	USACE - NW Division	503-808-3954	william.d.proctor@usace.army.mil	Chief, Hydrologic Engr/Power Branch
Angela Duren	USACE - NW Division		Angela.M.Duren@usace.army.mil	
Kasi Whorley	USACE - NW Division		kasi.a.rodgers@usace.army.mil	
Mike Warner, Ph.D.	USACE - Seattle District	206-764-3278	Michael.D.Warner@usace.army.mil	Meteorologist/Climate Scientist
Chris Frans, Ph.D.	USACE - Seattle District	206-764-6701	chris.d.frans@usace.army.mil	Civil Engineer
Jonathan Moen	USACE - Seattle District	206-764-3561	Jonathan.C.Moen@usace.army.mil	Senior Water Manager, Eastside
Kristian Mickelson	USACE - Seattle District	206-764-6927	Kristian.E.Mickelson@usace.army.mil	Civil Engineer
Kevin Shaffer	USACE - Seattle District	206-764-3660	Kevin.P.Shaffer@usace.army.mil	Hydraulic Engineer
Alfredo Rodriguez	USACE - Walla Walla District	509-527-7532	daniel.a.rodriguez@usace.army.mil	Civil Engineer (Hydraulics)
Stephen Hall	USACE - Walla Walla District	509-527-7550	stephen.c.hall@usace.army.mil	
Evan Heisman	USACE - Walla Walla District	509 527 7534	evan.a.heisman@usace.army.mil	
Jonathan Roberts	USACE - Walla Walla District		Jonathan.M.Roberts@usace.army.mil	
Jeremy Giovando, Ph.D.	USACE - Cold Research Lab, Boulder, CO		Jeremy.j.Giovando@usace.army.mil	
Keith Duffy	USACE - Portland District	503-808-4969	Keith.B.Duffy@usace.army.mil	
Peter Cooper	USBR - Boise, CPN Region Water Management	208-378-5037	pcooper@usbr.gov	Operations - Engineer
Joel Fenolio	USBR - Boise, CPN Region Water Management	208-378-5118	jfenolio@usbr.gov	Operations - Team Supervisor
John Roache	USBR - Boise, CPN Region Water Management	208-378-5215	jroache@usbr.gov	Program Manager
Jon Rocha	USBR - Boise, CPN Region Water Management	208-378-6213	jrocha@usbr.gov	Operations - Engineer
Eric Rothwell	USBR - Boise, CPN Region Water Management	208-378-5370	erothwell@usbr.gov	Columbia River Hydro-Coordinator
Ken Nowak	USBR - Denver	303-445-2197	knowak@usbr.gov	TSC - R&D Engineer
Jeremy Dalling	USBR - Heyburn, USFO - Water Management	208-678-0461 x25	jdalling@usbr.gov	Operations - Hydrologist
Brian Stevens	USBR - Heyburn, USFO - Water Management	208-678-0461 x46	bstevens@usbr.gov	Operations - Supervisor
Regular CRFG member agencies:				
Georg Jost	BC Hydro		Georg.Jost@bchydro.com	
Stephanie Smith	BC Hydro	604-528-2219	Stephanie.Smith@bchydro.com	Manager, Hydrology Branch
Sheri Sears	CCT - Confederated Colville Tribes	509-634-2118	sheri.sears@colvilletribes.com	Biologist/Policy Analyst
Tom Iverson	Yakama Nation - Consultant	971-221-8561	t.k.iverson@comcast.net	
David Benner	Fish Passage Center (FPC)	503-833-3900	dbenner@fpc.org	Data Analyst/Fishery Biologist
Brandon Chockley	Fish Passage Center (FPC)	503-833-3907	bchockley@fpc.org	Data Analyst/Fishery Biologist
John Hildreth	Idaho Power Co.		jhildreth@idahopower.com	
Kresta Davis-Butts	Idaho Power Co.	208-388-2602	kdavisbutts@idahopower.com	Operations Hydrology Leader
Frank Gariglio	Idaho Power Co.	208-388-5387	fgariglio@idahopower.com	
Claire McGrath	NOAA- Fisheries	503-230-5433	claire.mcgrath@noaa.gov	Columbia Hydropower Branch
Ryan Lucas	NOAA- NWS-NWRFC	503-326-7291	nwrfc.watersupply@noaa.gov	Hydrometeorologist
Joe Intermill	NOAA- NWS-NWRFC	503-326-7291	Joe.Intermill@noaa.gov	Hydrologist-In-Charge
Amy Burke	NOAA- NWS-NWRFC	503-326-7291	nwrfc.watersupply@noaa.gov	Hydrologist
Geoffrey Walters	NOAA- NWS-NWRFC	503-326-7291	nwrfc.watersupply@noaa.gov	Senior Hydrologist
Steve King	NOAA- NWS-NWRFC	503-326-7291	nwrfc.watersupply@noaa.gov	Service Coordination Hydrologist
Julie Koeberle	NRCS - National Water and Climate Center	503-414-3035	julie.koeberle@usda.gov	Hydrologist
Michael Strobel	NRCS - Dir., Nat. Water & Climate Center	503-414-3055	michael.strobel@usda.gov	
Angus Goodbody	NRCS - National Water and Climate Center	503-414-3033	angus.goodbody@usda.gov	Senior Hydrologist
Sean Fleming	NRCS - National Water and Climate Center	503-310-8114	Sean.Fleming@usda.gov	Applied R&D Technical Lead
Jolyne Lea	NRCS - National Water and Climate Center	503-414-3040	jolyne.lea@usda.gov	Hydrologist
Cara McCarrthy	NRCS - National Water and Climate Center	503-414-3088	cara.s.mccarthy@usda.gov	
Lexi Landers	NRCS - National Water and Climate Center	406-587-6874	lexi.landers@usda.gov	Missouri basin forecaster
Danny Tappa	NRCS - Idaho Snow Survey, Boise	208-378-5740	daniel.tappa@usda.gov	Supervisory Hydrologist
Leslie Bach	NW Power and Conservation Council	503-222-5161	lbach@nwcouncil.org	Senior Program Manager
John Fazio	NW Power and Conservation Council	503-222-5161	jfazio@nwcouncil.org	Senior Power Systems Analyst
Dan Hua	NW Power and Conservation Council	503-222-5161	dhua@nwcouncil.org	Power Systems Analyst
Matt Glazewski	PCC-Cascade	503-568-1350	matt.glazewski@pcc.edu	Instructor, Meteorologist
Oriana Chegwidden	University of Washington	206-616-0901	orianac@uw.edu	Research Scientist
Prof. Bart Nijssen	University of Washington, Hydro Program	206-616-0901	nijssen@uw.edu	
John Saltenberger	USFWS		jsaltenb@comcast.net	Meteorologist, Fire-weather specialist
Cynthia Barton	USGS - Director WAWSC	252-552-1600	dc_wa@usgs.gov	
Kyle Blasch	USGS - Boise	208-387-1300	dc_id@usgs.gov	
James Crammond	USGS - Portland	503-251-3200	dc_or@usgs.gov	
Adam Stonewall	USGS		stonewal@usgs.gov	
Tyler Roberts	WA Dept. of Ecology- Columbia River		tyro461@ECY.WA.GOV	