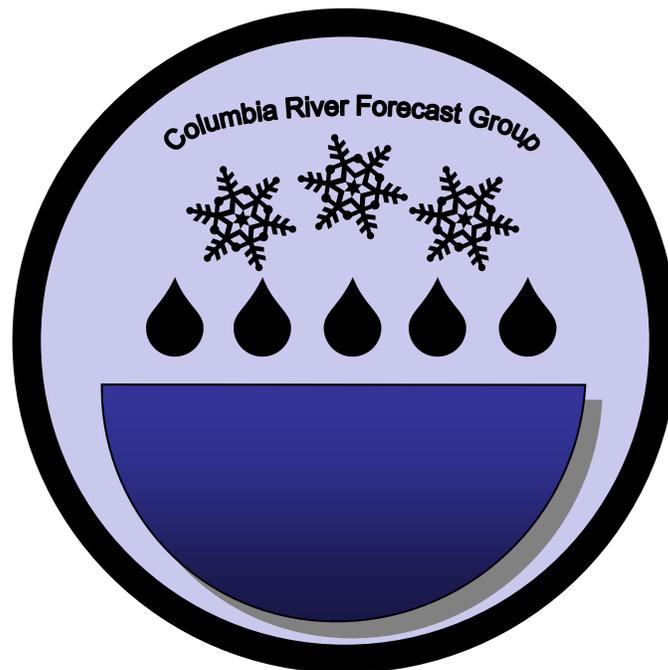


COLUMBIA RIVER FORECAST GROUP

2019

ANNUAL

REPORT



CHAIRMAN: PETER COOPER, USBR
VICE-CHAIRMAN: KYLE DITTMER, CRITFC

18 JUNE 2020

COLUMBIA RIVER FORECAST GROUP

2019 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...

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.

The CRFG conducted four business meetings in 2019, all of which were hosted by CRITFC: 12 March, 20 June, 24 September, and the annual review on 10 December. 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
- Current status of the RMJOC-II Climate Change study
- Discussion of Salmon Manager concerns in the Columbia River Basin as they relate to forecasts
- Northwest River Forecast Center's addition of the Hydrologic Ensemble Forecast System (HEFS) into their suite of forecasting tools
- Discussion of support for the NRCS Snow Survey Program
- Discussion of discontinuities in SNOTEL data caused by logging, fires, etc.
- The 2019 wrap-up and review of runoff forecasts, comparison of results, discussion of challenges, and lessons learned; and
- Discussion of possible 2020 CRFG activities and work elements

Water Year 2019 once again saw a water supply north-south dipole along a dividing line that ran roughly along the Washington-Oregon border. However, this year it was the northern basins that saw below normal conditions while the southern basins saw near to above normal conditions. The entire Columbia River basin started the water year dry, but a pattern change in February brought cold temperatures and heavy precipitation to the Snake River basins, allowing a massive snowpack to build. At the same time, the Upper Columbia River basin remained dry. By April, Oregon and Southern Idaho had accumulated well above normal snowpack, while areas to the north had well below normal snowpack. Precipitation on top of the snowpack in Eastern Oregon and southern Idaho resulted in localized flood operations in those basins. Runoff in the Upper Columbia basin ended up below normal, while runoff in the Snake Basin ended up above normal. As a whole, the Columbia River at The Dalles saw slightly below normal runoff for the season.

While there was no dedicated keynote speaker for the year, various guest speakers presented to the group throughout the year. Brief summaries of those presentations can be found in the "Presentation Highlights" section below. Of particular note, the Northwest River Forecast Center presented on a number of changes to their ensemble forecast products and services. The major change being the retirement of the ESP5 forecast which is being replaced with the Hydrologic Ensemble Forecast System (HEFS). This method takes advantage of a 15-day weather forecast ensemble. The ESP10 (NWS Official) and ESP0 will still be available.

The CRFG also continued to be quite concerned with the possibility of losing valuable publicly available products from the NRCS Snow Survey due to staffing shortages at that agency. Continued support for the NRCS Snow Survey will continue to be important in the future.

P R E S E N T A T I O N H I G H L I G H T S

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

- ❖ Erik Pytlak, BPA, *RMJOC-II Climate Change Study Updates*: In the June meeting, Erik discussed the progress being made on the 19 RCP 8.5 scenarios identified in Part 1 of the RMJOC-II report for hydropower regulation studies and vetted by CRFG in 2017-2018. The team hoped to be done by summer of 2019. The unregulated dataset was completed in 2018 and the COE plans to regulate all 160 scenarios.
- ❖ Erik Pytlak, BPA, *2020 Modified Flows Update*: In the June meeting, Erik described that the PNCA and CRT require that the modified flow data-set (starting 1928) be updated every 10-years by BPA technical staff. BPA has contracted with Washington State University to calculate the irrigation depletions across the basin, using a much better GIS and CorpSys modeling framework. The draft modified flows dataset should be ready to review by PNCA, NWPCC, and CRITFC by June 2020, with the final dataset published by November 2020.
- ❖ Angela Duren, COE, *RMJOC II Columbia River Basin Hydrology Effort*: In the June meeting, Angela talked about the COE effort to develop a baseline of hydro data and models of 758 sub-basins for CRT, Flood Risk Management, and other purposes. The project is in year 2 of a 5-10 year effort.
- ❖ Jeremy Giovando, USACE, CRRL, and Chris Brown, NRCS, *SNOTEL Historical Temperature Data*: During the September meeting, Jeremy and Chris presented data related to changes to the NRCS SNOTEL temperature sensors in the 1990s that produced a bias in many of the archived records. The use of this biased SNOTEL archived data has resulted in skewed model results, with an example being modeled melt-rates being higher than observed. Work is ongoing to determine how to resolve the biases.
- ❖ Taylor Dixon, NWRFC, *Summary of Enhancements – Operational Products/Services WY2020*: At the September meeting, Taylor described new additions to the NWRFC suite of forecasting tools. The motivation for the upgrades is to spend less time on data-prep and more time on analysis to improve the forecasts. The additions include the Hydrologic Ensemble Forecast System (HEFS), advanced model calibration techniques, reducing the calibration period to start in 1981, and the use of the National Blend of Models (NBM). In addition, the ESP 5-day is retiring in favor of HEFS and ESPs informed by 10 days of forecasted precipitation.

ACCOMPLISHMENTS

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

- RMJOC-II. Part 2 of the project are the hydro-regulation studies and these remain underway. Part 1 of the study was completed this year and posted to BPA's website. The CRFG will continue to serve as a technical body to guide the best use of these datasets.
- Climate change continues to be a topic of great interest for the CRFG. The recent comprehensive RMJOC-II dataset, in addition to the publication of 2020 Modified Flows, provides opportunity for studies throughout the region.
- Ongoing discussion continues around the loss of SNOTEL stations contained in current water supply forecasts, and the potential for future losses of SNOTEL data due to more active fire years.
- Continued support for the NRCS snow survey as important partners in providing information critical to water supply forecasting. The CRFG letter of support was well received, and positions are now being advertised and filled at NRCS.
- 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.

APPENDIX 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. Reporting

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 - 2019 Meetings

The following meetings took place for the CRFG.

12 March 2019

20 June 2019

24 September 2019

10 December 2019 (Annual Review)

Reviewed and finalized Meeting notes are as follows:

March 12th, 2019

Meeting time: 8:30 am – 12:00 pm PST

Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)**
Columbia Room (12th Floor)
700 NE Multnomah Street, Portland

Telecon Info: USA Toll-Free: (415) 527-5035
ACCESS CODE: 905 280 837

Web Meeting:

<https://borpn.webex.com/borpn/j.php?MTID=mae782e84c28ac337657e509bb23c2e9f>

Meeting number (access code): 905 280 837

Meeting Password: Mar12@2019

Contact Info: Peter Cooper, Bureau of Reclamation (208-378-5037)
Kyle Dittmer, CRITFC (503) 731-1314

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

8:35 **Approval of December Minutes and 2018 Annual Report** (all)

8:45 **2019 Water Year to date (~ 15 minutes each)**
NWS-NWRFC: Kevin Berghoff (systemwide)
NRCS: Gus Goodbody (systemwide)
USACE: Mike Warner (LIB)
Steve Hall (DWR)

9:45-10:00 << **BREAK** >>

10:00-11:00 **2019 Water Year to date, Continued**
Reclamation: Peter Cooper (HGH, HEII)
BC Hydro: Georg Jost
CRITFC: Kyle Dittmer (TDA)
Idaho Power: John Hildreth (BRN)
Others?

11:00-11:15 **“The Sampler” Salmon Manager Topics (NOAA/Kyle)**

11:15-12:00 **Other topics**
Presidential Memo 19 October 2018
NRCS Letter Update
USBR Forecast Update Project
2018 National Climate Assessment
Wildfire impacted SNOTEL sites
CRFG Roster
Other?

12:00pm **Set next Meeting and Adjourn**

Columbia River Forecast Group– Winter Meeting, CRITFC, Portland; March 12, 2019

Introductions:

Chairman [Peter Cooper](#) welcomed everyone at 8:30 am. The attendees introduced themselves.

Draft 2018 CRFG Annual Report, Mike Warner (COE); Approval of December 2018 Minutes:

The report is a work-in-progress. The December draft minutes were reviewed by the group for any final corrections. None were offered. Erik moved, seconded by Mike, to approve – done.

Review and Discussion of the 2019 Forecast Season:

NWS-NWRFC (Kevin Berghoff)...November-January was very warm and dry across the basin. Then, February was abruptly very cold and very wet as was March 1-10, especially in the Upper Columbia. The latest NOAA/CPC forecast (8-14 days) says warm and dry. The Upper Columbia is 73-83% of normal seasonal precipitation – Mica is at 90%. SWE vs. elevation – there is more snow in the lower areas than higher elevation areas at this time. The October 1 – March 10 runoff (Columbia River at The Dalles) is 87% of normal. Other sites: LWG is 95% (+9% from February), Mica 98% (+5% increase), GCL 87% (-2% drop), DWR 94%, JCK 106% (+20% increase). The soil-moisture deficit (SMD) was high in October, hence less runoff will occur this spring. That parameter is hard to quantify. Real-time options for the SMD are being explored. Paul – snowmelt timing? Kevin – an early warm pattern could alter the whole melt sequence. The timing also plays a big role as to how much snowmelt is absorbed by the soil.

NRCS (Gus Goodbody)...We run statistical based models, but do not track soil moisture. There is a consistent difference of ESP vs. statistical model results. Kevin – it is good to use a variety of models to bracket the range of forecast results. Gus also said, due to staffing shortages, that the January and June forecasts would be eliminated for now, just have February-May forecasts.

COE – Seattle (Michael Warner)...Libby update: 90% SWE (March 8) for the Kootenai basin (5000-6500 feet elevation). Forecast is at 5.5 MAF (April-August) or 93% of normal. The pre-season (Oct. 1 – Jan. 31) precipitation was only 50-90% before the deep freeze. February was way above normal. The new NOAA/CPC forecast calls for warmer than normal, above normal precipitation for April-May-June. Akamina Pass – a new forecast method may be delayed beyond 2020. Gus – forecast agencies should move back to operational coordination to benefit multi-model ensemble forecast results. Kevin – the NWRFC updates the snow states on Tuesdays and more often when needed.

COE – Walla Walla (Alfredo Rodriguez)...Dworshak update: 2200 KAF (April-July) or 88%. Analog: 2016 (near normal year). We are expecting to refill DWR by late June. The peak inflow is likely to occur in mid-May. The NRCS did a helicopter flyer-over. COE typically does their snow survey flyover in early June. SNOTEL site Shanghai Summit (low elev. 4600 feet) is back online after needed repairs. Gus – the 2016 clear-cut is still an issue for the site.

USBR (Peter Cooper)...The Snake at Heise forecast changed from 80-90% in January to 100-110% in March with the biggest increases in snowpack west of the Wyoming border. The Upper Snake had avalanche danger in early March. The HGH forecast: 1790 KAF (March-July), 91%. During February, atmospheric river (AR) paths did hit southern Idaho often and most of the Southwest. This was a pattern similar to 2005. Erik – ARs are an active area of research these days, especially at the synoptic scale. What are the implications for water supply forecast patterns? This winter seems like an *El Niño* response (partially, anyway). Michael – SIO is doing AR research – recon flights out in the Pacific Ocean, synoptic sampling, etc. This is a classic *El Niño* signal this winter. There was no convective activity in the central Pacific. Kyle – we saw both ENSO-neutral (early season) and *El Niño* weather patterns giving us highly variable weather patterns.

BC Hydro...no report.

CRITFC (Kyle Dittmer)...The Multivariable ENSO Index (MEI) has not been updated since December 2018, as its custodian, Dr. Klaus Wolter, just retired from NOAA/ESRL/PSD. Kyle has been looking at the ONI index and eye-balling the trend to make an estimated value for the MEI. Columbia River at The Dalles MEI forecasts: Jan.-July, 96 MAF (94%); April-July, 76 MAF (95%); April-Aug., 83 MAF (95%). ONI forecasts: Jan.-July, 103 MAF (101%); April-July, 82 MAF (103%); April-Aug., 90 MAF (103%).

IPCo (Frank)...Brownlee saw a sharp increase in its forecast in February: 127%. The SWE for the BRN basin is 23-inches. The NWRFC forecasts suggest near normal pool elevations (2041 feet) vs. COE flood control (2083 feet). The Snake at Murphey saw a big jump in flow. IDWR stated that managed recharge greatly increased in February.

“The Sampler” – Salmon Manager Topics

Paul Wagner (NOAA-Fisheries) had related to Kyle earlier in the week, at the FPAC meeting, that the Salmon Managers appreciated seeing the increased snowpack. Things (i.e., hydro-system) were looking kinda scary earlier in the season.

Other Topics:

- 1) President Trump memo, 19-Oct-2018 (sec. 3) – USBR is actively updating its forecasts; COE said that Columbia River Treaty group is examining the memo.
- 2) NRCS Letter (staffing issues) – a draft version was circulated. We took real-time edits. Letter will have signatures of the technical representatives (four CRFG Principals). Content will have statement of impacts and uses of data in order to show support for the SNOTEL program. The letter was finalized, signed, and sent to NRCS Water Center Director Mike Strobel.
- 3) USBR Forecast Update Project – statistical water supply, PYCAST software development, for all 34 forecast sites. Expect to conduct test runs on five basins this summer.

4) 2018 National Climate Assessment – Erik did a review: he says that the PNW was *not* lumped in with "the West". Climate change impacts between the Northwest and Southwest were separated. The climate change projections for the Pacific Northwest were generally consistent with RMJOC-II: warming nearly certain and precipitation increases likely (although those projections are more uncertain compared to temperature). Kyle suggested that CRFG members review the document before our next meeting, so we can have further discussion.

5) Wildfire Impacted SNOTEL Sites – where do we stand with getting an expert speaker invited? What about recently retired Dave Garen (NRCS)? Michael – we need help given the operational impacts. Gus – mitigation issues (e.g., double-mass analysis), use of info? Michael – we need to continue long-term sites but do we dump an affected site due to too much change? Any discontinuities in the observed change data? Kevin – besides thinking about an expert from the NRCS National Water Center, what about someone from the PRISM group (OSU)? Michael – consider the UW for speakers on hydro, atmospheric science.

6) CRFG member roster – some edits were sent in. More real-time edits were given. Peter will clean up the list and send it out soon for members to review.

7) Forecast verification – Gus said that multi-year statistics and hindcasting are ongoing. Do we see trends?

8) At the next meeting, Erik wants to talk about the new upcoming 90-year modified flow data-sets and the restarted effort on the soon-to-be ready 19 RMJOC-II data-sets.

Our next meeting will be June 20th (Thursday) at CRITFC's Columbia Room. Peter adjourned the meeting at 12:10 pm and thanked all for coming and participating.

Attendance:

Berghoff, Kevin – NWS/NWRFC (Portland)
Cooper, Peter – USBR (Boise)
Dittmer, Kyle – CRITFC (Portland)
Gariglio, Frank – IPCo
Goodbody, Gus – NRCS (Portland)
Rocha, Jon – USBR (Boise)
Rodriguez, Alfredo – COE (Walla Walla)
Stevens, Brian – USBR (Boise)
Wagner, Paul – NOAA-Fisheries (Portland)
Warner, Mike – COE (Seattle)

On the phone:

Carr, Ben – Washington Dept. of Ecology
Hall, Steve – COE (Walla Walla)
Pytlak, Erik – BPA (Portland)
Sears, Sheri – Colville Tribe
Zimmerman, Logan – COE (Seattle)

Note-taker: Kyle Dittmer, Columbia River Inter-Tribal Fish Commission, Portland,
Oregon

Revised June 20, 2019

June 20th, 2019

Meeting time: 8:30 am – 12:30 pm PDT

Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)**
Columbia Room (12th Floor)
700 NE Multnomah Street, Portland

Telecon Info: USA Toll-Free: (415) 527-5035
ACCESS CODE: 909 108 053

Web Meeting:

<https://borpn.webex.com/borpn/j.php?MTID=me2c05ec8157c73d3a33d8fd213717c2e>

Meeting number (access code): 909 108 053

Meeting Password: Jun20@2019

Contact Info: Peter Cooper, Bureau of Reclamation (208-378-5037)
Kyle Dittmer, CRITFC (503) 731-1314

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

8:35 **Approval of March Minutes and 2018 Annual Report** (all)

8:45 **2019 Water Year to date (~ 15 minutes each)**
NWS-NWRFC: Kevin Berghoff (systemwide)
NRCS: Gus Goodbody (systemwide)
USACE: Mike Warner (LIB)
Steve Hall (DWR)
Reclamation: Peter Cooper (HGH, HEII)

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

10:15-11:00 **2019 Water Year to date, Continued**
BC Hydro: Georg Jost
CRITFC: Kyle Dittmer (TDA)
Idaho Power: John Hildreth (BRN)
Others?

11:00-11:15 **“The Sampler” Salmon Manager Topics** (NOAA/Kyle)
West Africa natural resource/water managers conference report (Kyle)

11:15-11:30 **2020 Modified Flow Update** (Erik Pytlak)

11:30-11:45 **RMJOC-II Climate Change Study Update** (Erik Pytlak)

11:45-12:30 **Other Topics**
NRCS Letter of Support Update (Peter Cooper)
USBR Forecast Update Project (Peter Cooper)
2018 National Climate Assessment – General Check-In (Kyle Dittmer, Laura
Gephart): <https://nca2018.globalchange.gov/chapter/1/>

SNOTEL site record discontinuity – group findings on possible speaker (all)

SNOTEL site record discontinuity inventory update – (Gus Goodbody)
SNOTEL historical temperature corrections – (Gus Goodbody, Jeremy Giovando)
Columbia River Basin Hydrology Effort – (Angela Duren)
Other Topics (all)

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

Columbia River Forecast Group– Spring Meeting, CRITFC, Portland; June 20, 2019

Introductions:

Chairman Peter Cooper welcomed everyone at 8:30 am. The attendees introduced themselves.

Draft 2018 CRFG Annual Report, Mike Warner (COE); Approval of March 2019 Minutes:

The report is a work-in-progress. The March draft minutes were reviewed for any final corrections. One typo was seen/corrected. Erik moved, seconded by Kyle, to approve – done.

Review and Discussion of the 2019 Forecast Season:

NWS-NWRFC (Kevin Berghoff)...The NOAA/CPC forecast (8-14 days) says warm but near normal precipitation (except higher in southern Idaho). Overview: very good precipitation in the Upper Snake and earlier runoff in most tributaries. Temperature departures: warm January, April, May but very cold February-March. Precipitation departures: a very wet February countered dry December-January. Spring was dry, though. Seasonal precipitation: 90-130% Upper Snake; 50-90% Upper Columbia. Runoff: 78-98% Upper Columbia, 94-111% Snake and 96% Columbia at The Dalles. Erik noted that we really need to start the runoff counter in March and not April given the persistent trend of having earlier snow-melt runoff in recent years (and expected to continue). Current Water Supply Forecasts: 110-175% NE Oregon, Upper Snake; 50-90% Upper Columbia. The DWR forecast was in very good agreement with NWS, COE, and NRCS forecasts. Near term: wet air-flow with the Upper Columbia to be the biggest beneficiary (1-5 inch 10-day QPF). Kyle asked how busy were spring operations? Kevin – spotty, at best, with some borderline flood events, but April was the biggest single event.

NRCS...no report.

COE – Seattle (Michael Warner)...Libby update: June forecast is 4676 KAF (April-August) or 96% of normal (it declined through spring). The Sturgeon pulse: 0.8 MAF (7 kcfs summer outflows). Akamina Pass station – got burned in 2018 so we're using proxy data for forecast procedure. A new forecast method may be ready by 2021. Erik – expressed deep concern about using the same method in 2020 which clearly did not verify well in 2019 and suggested COE Division closely monitor the situation and prepare to use the deviation request process, as needed. He also reported that BC Hydro is seriously thinking of permanent use of ESP forecasts for their projects. Both issues are being actively discussed by the CRT Hydromet Committee.

COE – Walla Walla (Alfredo Rodriguez)...Dworshak update: reservoir filled on June 16 and now passing inflow. Summer fish operation drawdown will commence after the Fourth-of-July weekend. The NRCS flyover was on June 3. The Hemlock Butte SNOTEL site (5810 feet) was visited. The snow-covered area (SCA) was only at 2% for the Clearwater basin. If the SCA is greater than 10% then spill at DWR needs to be considered to push out more water before the end of June. This was an uneventful spring

– spill occurred only for nine-days (late May). Spring forecasts: 2000 – 2500 KAF (April-July). Water temperature modeling was done.

USBR (Peter Cooper)...Heise forecast: normal accumulation (but dry early in the season). We're now at slightly above normal. Disturbed SNOTEL sites (i.e., early runoff and/or rapid recession): Gros Ventre Summit (8750 feet), East Rim Divide (7930 feet) vs. undisturbed Lewis Lake Divide (7850 feet). NRCS-Boise will look at the burned areas and runoff pattern. June forecast: 1090 KAF, 109%, five-peaks so far. Soil moisture is dry (70-90%) but very dry in Montana, Washington, and Upper Columbia. The June forecast had higher variability: 135% MLR vs. 97% NWRFC.

HGH update: disturbed SNOTEL sites: Pike Creek (5930 feet), burned in 2008, and Badger Pass (6900 feet), burned in 2018, vs. undisturbed Noisy Basin (6040 feet). June forecast: 680 KAF (June-July), 79%, three peaks – very dry soil moisture. Spring forecasts were 80-90%.

BC Hydro...no report.

CRITFC (Kyle Dittmer)...Multivariable ENSO Index (MEI) is computed a little different now: 6-parameters now use 5-parameters. Sky Cover is now using Outgoing Long-Wave radiation. A regression analysis of each month of MEI old vs. new gives $R^2 = 0.82 - 0.98$ with the months of interest (summer/autumn) at the higher end. All forecasts declined from October: MEI method had a 5-6 MAF drop, ONI a 4-MAF drop. The April forecast for Columbia River at The Dalles: MEI method 95 MAF (Jan.-July) 94%, 75 MAF (April-July) 94%, 83 MAF (April-Aug.) 94%; ONI method 96 MAF (Jan.-July) 95%, 76 MAF (April-July) 96%, 84 MAF (April-Aug.) 96%.

IPCo (John)...Highly variable operations occurred this spring. Owyhee Dam filled unexpectedly. Brownlee forecast: 7 MAF (April-July), 130%, and will fill soon. The annual flow augmentation operation starts June 21. Flow recharge is hard to model and forecast. We have a summer intern project looking at monthly and seasonal forecast verification. Erik – will you be able to share your project findings with us? John – will run the idea by management.

“The Sampler” – Salmon Manager Topics:

- (1) Kyle: CRITFC hosted a delegation of 11 water/natural resource managers from west Africa on April 18. We covered tribal culture and foods, climate change, and water quality. Kyle noted that the guests know that climate change is a big problem but don't have baseline data to run any studies. They asked their elders for stories for a baseline. Since some of these countries were former colonies of France and England there may be existing long-term weather station data from which to build a climate data-set. Funding is problematic.
- (2) Claire shared that the new Flex-Spill agreement was being implemented this spring.
- (3) Kyle noted that the lower Columbia/Snake saw a triple-peak freshet – largest peak in April. Erik noted that seven years since 2010 had flows on the Snake peaking a full month earlier than at Grand Coulee.

2020 Modified Flow Update (Erik):

The PNCA and CRT require that the modified flow data-set (starting 1928) be updated every 10-years by BPA technical staff. BPA has contracted with Washington State University to calculate the irrigation depletions across the basin, using a much better GIS and CorpSys modeling framework. Angela is the new POC for the COE's effort. Modified Flows are computed for 112 locations (65 Columbia basin, 47 western Oregon and Washington). The Modified Flows are not the same as natural flows. USDA Crop Census data is the key input into the process and has just recently become available. Timeline: BC Hydro will provide their flows contribution (June 30), Reclamation will provide theirs for the Yakima, Deschutes and upper Snake Basins by late November (but hopefully sooner). BPA is planning to finalize Adjusted Routed Flows by December 31. The draft modified flows dataset should be ready to review by PNCA, NWPC, and CRITFC (May 1, 2020), with final dataset published by November 2020 (or by September if possible). BPA is doing quality-control (QC) checking of data using its CHPS streamflow forecasting system but coordinating the QC with each PNCA party.

RMJOC-II Climate Change Study Update (Erik):

"Good progress" is being made on the 19 RCP8.5 scenarios identified in Part I of the RMJOC-II report for hydropower regulation studies and vetted by CRFG in 2017-18. The team hopes to be done late this summer. Internal QC is just now getting started. How and what to release is being actively discussed since once data is released, it is very difficult to pull back if major issues are found. The unregulated dataset was completed last year, with COE planning to hydro-regulate all 160 scenarios.

Other Topics:

- 1) NRCS Letter (staffing/resource issues) – the final letter went to NRCS Water Center Director Mike Strobel. He sent us a good reply (Peter read portions of the email) – the letter went to senior management at NRCS and USDA in Washington DC. NRCS now can hire two more hydrologists and has more IT support. Kudos to Steve Hall (COE-WW) for starting this letter.
- 2) USBR Forecast Update Project (Jon Rocha) – we're in active development. Software was demonstrated recently with test basins (including the Boise basin). July 25 meeting in Portland will discuss work results to date. John (IPC) asked: "Operational in 2020?" Hard to say as it is in beta-test mode now. Current forecast procedures will run in parallel with test basins.
- 3) 2018 National Climate Assessment (Kyle) – Erik noted the Indigenous Section – new climate zones vs. existence of tribes (land-based) – how will that change? He noted the expected trends in temperature, precipitation, and Sea-Level Rise (SLR) which will impact estuary management. Kyle noted that observed Greenland (more so) and Antarctica glacial melt is occurring fast than model prediction and will impact SLR sooner. Peter noted variable impacts for the PNW: wildfires, electricity and irrigation demand, extreme rain events, snowpack changes. Laura said that tribal concerns are treaty rights (and obligations) and food security (source and timing). Kyle suggested that more CRFG members review the document for further discussion.
- 4) SNOTEL sites record discontinuity. Kyle suggested that a map be compiled: logged and burned areas vs. SNOTEL locations. Will a pattern emerge? We hope that Gus

Goodbody (NRCS) and Jeremy Giovando (COE-WW) will have updates on record inventory and corrections by the next meeting.

5) Columbia River Basin Hydrology Effort (Angela). Goal is to have a baseline of hydro data and models of 758 sub-basins for CRT, Flood Risk Management, etc. We're in year-2 of a 5-10 year effort. Effort is being guided by a 10-Tasks list. For more info/data, contact Angela Duren: Angela.M.Duren@usace.army.mil.

6) OSU PNW Water Research Symposium (Kyle). This free April 8-9 event was great – current research by OSU researchers was show-cased. Event covered a wide variety of practical and theoretical issues. Kyle will ensure CRFG members are invited to 2020 event. For more info:

<https://hydrophilesresearchsymposium.org/symposium-2019-0>

7) PNW Climate Science Conference (UW-CIG). October 8-10 in Portland. For more info:

<https://www.pdx.edu/sustainability/news/nw-climate-conference-returns-portland-10th-year>

Our next meeting will be mid-to-late September at CRITFC's Columbia Room. Peter adjourned the meeting at 12:30 pm and thanked all for coming and participating.

Attendance:

Bach, Leslie – NPCC (Portland)
Barton, Diane – CRITFC (Portland)
Berghoff, Kevin – NWS/NWRFC (Portland)
Cooper, Peter – USBR (Boise)
Dittmer, Kyle – CRITFC (Portland)
Duren, Angela – COE, NW Division (Portland)
Gephart, Laura – CRITFC (Portland)
Graves, David – CRITFC (Portland)
Lucas, Ryan – NWS/NWRFC (Portland)
McGrath, Claire – NOAA-Fisheries (Portland)
Pytlak, Erik – BPA (Portland)
Rocha, Jon – USBR (Boise)
Rodriguez, Alfredo – COE (Walla Walla)
Warner, Mike – COE (Seattle)

On the phone:

Hildreth, John – IPCo (Boise)
Sears, Sheri – Colville Tribe (Nespelem, WA)

Note-taker: Kyle Dittmer, Columbia River Inter-Tribal Fish Commission, Portland, Oregon

Revised August 29, 2019

September 24, 2019

Meeting time: 8:30 am – 12:30 pm PDT
Location: **State of Oregon Building**
Room 1C
700 NE Oregon Street
Portland, OR

Telecon Info: USA Toll-Free: (415) 527-5035
ACCESS CODE: 900 471 901

Web Meeting:

<https://borpn.webex.com/webappng/sites/borpn/meeting/info/133885156255620621?MTID=m24cffdff92193b3e13dbda9494a56573>

Meeting number (access code): 900 471 901

Meeting Password: Sep09@2019

Contact Info: Peter Cooper, Bureau of Reclamation (208-378-5037)
Kyle Dittmer, CRITFC (503) 731-1314

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

8:35 **Approval of June Minutes and 2018 Annual Report** (all)

8:45 **Forecasting Methods News/Changes for 2020**

NWS-NWRFC: Kevin Berghoff (systemwide) – HEFS and ESP Period of Record

NRCS: Gus Goodbody (systemwide)

USACE: Mike Warner (LIB)

Steve Hall (DWR)

Reclamation: Peter Cooper (HGH, HEII)

BC Hydro: Georg Jost

CRITFC: Kyle Dittmer (TDA)

Idaho Power: John Hildreth (BRN)

Others?

10:30-10:45 << **BREAK** >>

10:45-11:00 **“The Sampler” Salmon Manager Topics** (NOAA/Kyle)

11:00-11:15 **Modified Flows Update** (Rick van der Zweep – BPA)

11:15-12:00 **SNOTEL Historical Temperature Data** (Jeremy Giovando/Gus Goodbody)

12:00-12:30 **Other Topics** (all)

12:30pm **Set next Meeting Agenda and Adjourn**

Columbia River Forecast Group – Summer Meeting, CRITFC (hosted at the State of Oregon Building), Portland; Sept. 24, 2019

Introductions:

Chairman [Peter Cooper](#) welcomed everyone at 8:30 am. The attendees introduced themselves.

Draft 2018 CRFG Annual Report; Approval of June 2019 Minutes:

The June draft meeting minutes were reviewed – a few edits came in recently. Michael moved, seconded by Kyle, to approve – done. The Annual Report received a few more recent edits. No additional comments were offered. Peter moved, seconded by Bill, to approve the 2018 Annual Report – done.

Forecasting Methods – Changes to 2020 Forecast Season:

NWS-NWRFC (Taylor Dixon)...”Summary of Enhancements – Operational Products/Services WY 2020.” The motivation for the upgrades is to spend less time on data-prep and more on analysis to improve the forecast and its communication venues. (1) *Next generation hydro ensemble models – HEFS* (Hydrologic Ensemble Forecast System): will use a domain-wide advanced model and calibration. HEFS will build on top of ESP. More uncertainty will be incorporated to benefit short-term weather “intelligence.” Bill – is there a background report or white-paper? Yes, there is, including baseline validation work and hindcasting. John – date of the ESP traces? A new tool will compute the 1-14 day error then ESP historical traces kick in on day-15 onward. (2) *Advanced model calibration*: Analysis of Record for Calibration – uses hourly gridded data from 1981 onward, instead of 1948 onward, to better capture more representative recent years. The results will better match up with real-time data and modeling. Process will enhance the physical basis and adaptability of the models, products, and services. The ensemble members will better align with next generation models. The ESP 5-day is retiring in favor of HEFS. National Blend of Models (NBM) – an ensemble of 150+ members to benefit the ESP 10-day with lower RMSE. Spin up time: 30-60 days. Steve – any improvement of radar to high-elevation areas? Yes...and we can now include SNOTEL and RAWS sites.

NRCS...Julie Koeberle (new staffer) and Chris Brown introduced themselves. They said the National Water Climate Office is adding more staff, finally, and hopes to be fully staffed soon. A new paper was just published about their new forecast system (URL link?).

COE – Seattle (Michael Warner)...Libby update: the 2018 fires at Akamina Pass station has complicated data collection, analyses, and our forecast process. A graph of COE vs. NWRFC forecast performance (ESP 5-day) shows a 500 KAF higher bias for the COE than the NWRFC data for key months in the Spring. PyCast is a new statistical forecast development tool currently being developed by Reclamation and will be verified by Jeremy Giovando (COE). VIPER was used to update the forecast without the Akamina Pass site and are using this updated system for their current forecast.

COE – Walla Walla (Steve Hall)...Dworshak June forecast was 2.4 MAF or near normal. Shanghi Summit SNOTEL had a forest-fire burn and clear-cut. The Hemlock Butte SNOTEL site is not representative anymore of local conditions due to dead trees and forest-fire burn. Taylor – have you run a Double-Mass analyses? No, not yet, but COE staff intends to. You folks need to get out of the office and see these sites to better appreciate their role in the forecast. With sadness it was announced that there will be reduced data collection due to a 10-15% budget cut impacting stream gages, weather stations, etc. COE needs more partner share funding, now. The point was made by Julie at the NRCS that SNOTEL stations are not necessarily sited to ensure complete basin representativeness, but for other reasons. Mike at the COE argued that, for our regression forecasts, it is more important to understand what the year to year variability is and to ensure that the record is consistent (i.e., site doesn't move, burn, get clear cut, etc.). Inconsistency or discontinuities in the record can negatively impact our ability to forecast with our current regression techniques

USBR (Peter Cooper)...Peter re-iterated that Reclamation is currently developing the PyCast statistical forecast development program as mentioned by Mike Warner. We intend to begin updating Reclamation's forecast equations (with priority being Hungry Horse and Heise) over the next year to two years.

BC Hydro (Georg Jost)...We have run statistical and ESP models over the years. We've been recalibrating basins since 2017. The error bands have increased. The short-range ESP is dynamic with a 0-30 day window using the North American Ensemble Forecast System (42 members). Hydrographs can now visually separate out the various components: surface water, groundwater, glacial-melt. New tool – the super ensemble forecast using multi-month steps. The Columbia River Treaty – technical participants are debating a statistical vs. ESP approach.

CRITFC (Kyle Dittmer)...The new Multivariable ENSO Index (MEI), using 5-parameters, will be used after the data is run through a regression of the old values vs. new data for each specified month period. The ONI-based forecasts will continue and may serve as a check to the MEI.

IPCo (John Hildreth)...New River-Ware software is being implemented for Upper Snake operations. Work has yet to be done for the Boise and Payette basins. A neural-network is being devised for groundwater forecasts and good results have been reported so far.

BPA (Rick)...Will change our datasets to a start year of 1981 (instead of 1948). This move will help our ESP runs and be consistent with the development work of the NWS/NWRFC.

“The Sampler” – Salmon Manager Topics:

- (1) Kyle: CRITFC hosted a delegation of 10 water/natural resource managers from southeast Asia (Mekong river basin) on September 5. We covered tribal culture and foods, hydro operations, climate change, and water quality. Presentations were well-received.
- (2) The 10th Annual Pacific Northwest Climate Conference will be Oct. 8-10. Many

good sessions are expected. Come join us! More info:

<https://www.nwclimateconference.org/>

- (3) Kyle noted a new BAMS article (June 2019) about a study of hydromet variability and WSF for the Lake Tahoe Truckee/Carson River system and interfacing with user groups. Top adaptation strategies: data collection, monitor for climate impacts, revise water management strategies, collaboration and coordination. Full article accessible here: <https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-18-0031.1>

2020 Modified Flow Update (Rick vanDer Zweep):

The re-computation of flow data-sets with irrigation withdrawals is 90% done. BPA technical staff are waiting on BC Hydro, Pacific Corps, and USBR for some sites. The work on Irrigation-Depletion calculations is being sub-contracted to WSU-Pullman. Initial work has been done for the Upper Columbia, Willamette, Pend O'reille, and Spokane basins. Work is being reviewed and quality-control checked. Some issues have been spotted – like timing and irrigation areas. We will use a CHPs platform and not EXCEL spreadsheets for 111 forecast sites, 1928-2018. We hope to have the reviewed and quality-control data ready for release by late 2020.

SNOTEL Historical Temperature Data (Jeremy Giovando and Chris Brown):

Jeremy: Changes to the temperature sensors in the 1990s has produced a bias in many of the archived records. Issue – conversion voltage and a new algorithm. For T_{min} , a positive anomaly was found after the upgrade year (a strong red-flag). For T_{max} , the anomaly was up and down. The big problem is the use of this bad SNOTEL archived data for other agency purposes and products (e.g., TopoWx, PRISM, etc.) and higher melt-rates are occurring. The fix – identify problem years and adjust, compile a list of products that use this data, pair-wise homogeneous USHCN data, compare SNOTEL data with other spatial products. Discussion – should the SNOTEL temperature bias be evaluated? Should a consistent process be used?

Chris: Linear line analyses had been used for the voltage calibration. We now know that a polynomial fit (5th power) is a better fit. Kevin – does the correction apply to real-time data? Good question – unknown...ideas are being discussed. NWRFC will do independent evaluation.

Other Topics:

- 1) Idaho NRCS (Peter) – the office is in the process of analyzing the extents of burn-areas in detail and how it might affect the hydrology within basins. Is this the “new normal”?
- 2) NWRFC – Kevin will retire in December. He represented the NWRFC at most meetings. His experience and sharing of info were appreciated. Kevin will be missed by CRFG members.

Our next meeting will be the Annual Review either December 3rd or 5th at CRITFC's Columbia Room and piggy-back on to the TMT Year-End-Review (Dec. 4th). Peter adjourned the meeting at 11:40 am and thanked all for coming and participating.

Attendance:

Berghoff, Kevin – NWS/NWRFC (Portland)

Brown, Chris – NRCS (Portland)
Cooper, Peter – USBR (Boise)
Dittmer, Kyle – CRITFC (Portland)
Dixon, Taylor – NWS/NWRFC (Portland)
Hall, Steve – COE (Walla Walla)
Hildreth, John – IPCo (Boise)
Intermill, Joe – NWS/NWRFC (Portland)
Jost, Georg – BC Hydro (Burnaby, BC)
Koeberle, Julie – NRCS (Portland)
Lea, Jolyne – NRCS (Portland)
Lucas, Ryan – NWS/NWRFC (Portland)
Osgood-Zimmerman, Logan – COE (Seattle)
Proctor, William – COE, NW Division (Portland)
vanDer Zweep, Rick (BPA)
Warner, Mike – COE (Seattle)

On the phone:

Chow, Eric – COE, NW Division (Portland)
Dalling, Jeremy – USBR (Heyburn)
Duren, Angela – COE, NW Division (Portland)
Fenolio, Joel – USBR (Boise)
Giovando, Jeremy – COE-CRREL
Runyan, Chris – USBR (Boise)
Stevens, Brian – USBR (Heyburn)

Note-taker: Kyle Dittmer, Columbia River Inter-Tribal Fish Commission, Portland,
Oregon

Revised December 2, 2019

December 10th, 2019

Meeting time: 8:30 am – 2:00 pm PST

Location: **Columbia River Inter-Tribal Fish Commission (CRITFC)
Celilo Room (5th Floor)
700 NE Multnomah Street, Portland**

Telecon Info: USA Toll-Free: (415) 527-5035
ACCESS CODE: 906 939 073

Web Meeting:

<https://borpn.webex.com/webappng/sites/borpn/meeting/info/702cd58e4d784544b6ee69b92e9e60ad?siteurl=borpn&MTID=m5072f3b1fa3b8eff910f6be6d1b5a7ab>

Meeting number (access code): 906 939 073

Meeting Password: Dec10@2019

Contact Info: Peter Cooper, Bureau of Reclamation (208-378-5037)
Kyle Dittmer, CRITFC (503) 731-1314

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

8:35 **Approval of September Minutes** (all)

8:45 **2019 Water Year Review (~ 15 minutes each)**

NWS-NWRFC: Kevin Berghoff (systemwide)

NRCS: NRCS Unavailable

USACE: Mike Warner (LIB)

Alfredo Rodriguez (DWR)

Reclamation: Peter Cooper (HGH, HEIL)

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

10:15-11:00 **2019 Water Year Review, Continued**

BC Hydro: Georg Jost (not confirmed)

CRITFC: Kyle Dittmer (TDA)

Idaho Power: John Hildreth (BRN)

Others?

11:00-11:45 **WY2020 Basin Conditions** (NWRFC, Dittmer)

11:30-11:45 **HEFS Update** (NWRFC)

11:45-12:15 **“The Sampler” Salmon Manager Topics** (NOAA/Kyle)

12:15-12:45 **Lunch Break (Catered Sandwich Bar - \$5 anticipated cost – Please RSVP to pcooper@usbr.gov no later than Wednesday December 4th)**

12:45-1:00 **Modified Flows Update** (Rick van der Zweep – BPA)

1:00-1:30 **Other Topics** (all)

1:30-2:00

Transition leadership (Kyle Dittmer to Chairman, Erik Pytlak to Vice-Chairman)
Goals for 2020
Special Recognition – Kevin Berghoff
Set next meeting

Columbia River Forecast Group – Annual Review Meeting, CRITFC – Celilo Room, Portland; December 10, 2019

Introductions:

Chairman [Peter Cooper](#) welcomed everyone at 8:35 am. The attendees introduced themselves.

Approval of September 2019 Minutes:

The September draft meeting minutes were reviewed. Kyle moved, seconded by Steve, to approve the notes – done.

The 2019 Water Year Review:

NWS-NWRFC (Kevin Berghoff)... In general, runoff was down in the north and up in the south. It was a year of extreme contrasts with very heavy rains in February (and really cold February-April) but a very warm, dry May-June then an unexpected very wet September. Precipitation: GCL 76%, IHR 88%, TDA 81% (and a highly checkered spatial pattern). Snow-packs were high in northeast Oregon, Oregon Cascades (but poor in the Washington Cascades). Runoff: MCD 99%, GCL 87%, LWG 116%, TDA 94%.

NRCS (Gus Goodbody *via email*). Here is a link to the first of a series of papers that will be published describing recent efforts and future directions in NRCS forecasting: https://www.wcc.nrcs.usda.gov/ftpref/downloads/factpub/wsf/FlemingAndGoodbody_IEEEAccess_2019.pdf

COE – Seattle (Michael Warner)...Libby update: similar to the NWRFC forecast, the 2019 USACE forecast was generally above the final observed value, but tracked downward as the season progressed. Later in the season, the NWRFC forecast oscillated around the final value, while the USACE forecast remained above. The final observed APR-AUG inflow volume into Lake Koocanusa behind Libby Dam was 4463 KAF, whereas, the June forecast was 4676 KAF. Only October and February were above normal for precipitation – every other month was below. In a correction from a prior meeting, a review of forecasts using actual Akamina Pass data versus estimated Akamina Pass analysis, shows closer agreement in forecast results, where previously we had presented a fairly large difference (primarily in the May forecast). There was an error found in code used to calculate these values and that error has been removed.

The 2020 outlook: dry initial conditions at 70% normal precipitation for the Libby basin. The pre-season forecasts: NWRFC 5128 KAF (April-August), COE 5050 KAF. Kyle noted that September-October delivered highly variable rain. Mike noted persistent patterns of rain and dry-spells in October-November. Peter – how is Akamina Pass station being estimated? We continue to use a regression analysis with four surrounding SNOTEL stations.

COE – Walla Walla (Steve Hall)...Dworshak forecast stayed close to 2000 MAF or 99%. The Z-score forecast did slightly better (and less SOI-influence). We are looking for more cooperative agreements for snow work (north Idaho) – more labor service and less on cost-sharing. COE is also doing in-house discussion about revising the forecast

method: date (Jan. 1 onward) to July 15 in order to better capture winter runoff events due to climate change drivers.

USBR (Peter Cooper)...Peter toured the HGH and Upper Snake projects. The April forecast for HGH was 1515 KAF vs. 1505 KAF observed. March weather drove down the forecast then only to rebound in April but not fully recovered due to dry conditions during the summer. Due to the dry conditions, the peak and shape of the runoff was early. Snake R. at Heise (HEII): Forecasts started below average but jumped up (driven by wet February conditions) and runoff ended near normal. The April forecast for HEII was 3,369 KAF vs. 3,200 KAF observed. The adopted forecasts were coordinated with the COE which helped to moderate the individual forecast performances.

The 2020 outlook: NOAA/CPC shows ENSO-neutral with ONI running 0 – 0.5. November was dry (Snake basin above Palisades received 42% of normal precipitation in November) but overall the snowpack is near normal; HGH snowpack is also near normal.

BC Hydro...not available.

CRITFC (Kyle Dittmer)...The MEI forecast methodology was reviewed. MEI was neutral but did move into El Niño for a short time. The 2019 MEI performance: Jan.-July 0%, April-July -1%, April-Aug. 1%. October 2018 was the best forecast for the Jan.-July and April-Aug. periods. November 2018 was the best forecast for the April-July period. The Nov-Dec-Jan MEI average gives the best R2 for the Jan.-July forecast. The Aug-Sept-Oct MEI average gives the best R2 for the April-July forecast. In the last two years, the ONI index was used in parallel with MEI. The 2019 ONI performance: Jan.-July -5%, April-July -3%, April-Aug. -3%. The 12-year (2008-2019) performance of these indices is most encouraging: for MEI Jan.-July 1.8%, April-July 1.6%, April-Aug. 0.4%; for ONI Jan.-July 1.5%, April-July 2.6%, April-Aug. 3.5%. A paper will soon be written for publication. Michael offered *J. Hydrometeorology* as a possibility.

IPCo (John Hildreth)...Aquifer recharge was 300 KAF (vs. 250 KAF average). The 2017, 2018 recharge values were also high. Milner was zero last winter – first time ever. Snake at Swan Falls had two peaks. Brownlee saw a sharp increase in March. The TDA forecast had less influence on Hells Canyon flood control operations this year than previous years. The Eastern-Snake Plain model – a possible guide to future management practices?

The 2020 Basin Pre-season Forecasts:

NWS-NWRFC (Kevin Berghoff)...the NOAA/CPC 1-mon. and 3-mon. forecasts suggest a warm, wet pattern. ONI is at 0.3 (ENSO-neutral). Ensemble modeling suggests that we will stay at ENSO-neutral through spring 2020. We have very dry, warm initial conditions although the Upper Columbia is near normal (ESP-10 results). Jan. 9, 2020 – the first WSF briefing webinar. New services: new HEFS, recalibration effort, aligning ensemble model with next generation models, and improve short-term deterministic forecasts (day 1-10). NWRFC website gives a summary of the expected changes.

“The Sampler” – Salmon Manager Topics:

- (1) Kyle: The 10th Annual Pacific Northwest Climate Conference was a good event – many good sessions. Matt said that insurance folks came and shared risk management concerns. Abstracts:
<https://sites.google.com/pdx.edu/nwcc2019agenda/home>
- (2) The 2020 PNW Climate Conference – hosted by UW and Tulalip tribe (Marysville).
- (3) At a recent FPAC meeting Claire (NOAA-Fisheries) asked about GCL inflow forecasts and the drum-gate maintenance schedule. Peter explained that it is the TDA February forecast, not the GCL forecast, that drives the determination of work due to lead-time required to procure materials. For more information on the triggers, please see the Water Management Plan Section 6.5.4 that can be located on the TMT website. The hard-constraint is maintenance needs to be completed once per 3-year window, two times per 5-year window, and three times per 7-year window. Drum-gate maintenance was completed in water years 2015, 2016, 2017, and 2018, but was not completed in 2019. Paul reiterated that improved forecast helps NOAA-Fisheries implement its Biological Opinion hydro operations.

HEFS update (Brad Gillies):

HEFS is a hydrologic (stream flow) ensemble initialized with precipitation from members of the GEFS v.10 (Global Ensemble Prediction System) and other inputs and is being used in place of the now discontinued ESP-5 forecasts. An ensemble of temperature and precipitation datasets serve as the inputs for day1-5 forecasts. A meta-Gaussian model generates the ensemble members. One strength is more forecast skill than ESP-5. The HEFS WSF info (and traces) are available on the NWRFC webpage in the same spot as the 0-day, 10-day info. Experimental work will continue on HEFS.

Lunch break (12-noon to 12:30 pm) – we decided to have an in-house burger/appetizer food bar in order to keep us on time. Kyle did the shopping and set-up (with help from staff, Vivian).

2020 Modified Flow Update (Rick vanDer Zweep):

We are updating the last 10-years of data and adjusting it to current irrigation levels. We're working on quality-control and waiting on Environment Canada for their data. The depletion analysis will be conducted by WSU-Vancouver (Willamette, Upper Columbia, Yakima – done). Target deadline Jan. 31, 2020. Draft modified flows will be sent to PNCA, NWPPC, and CRITFC by May 1, 2020. The Pend O'reille, Spokane, and Lower Snake basins are being reviewed right now. The final version should be done by Nov. 30, 2020. Kevin – how were the return flows developed? WSU used the VIC model to create return flows (estimated) dataset.

Other Topics:

- 1) CRFG Contact-List (Peter) – he asked members to check the printed list for updates.
- 2) AMS National Conference – Kyle asked Matt to elaborate. The Jan. 12-16, 2020 event will be the big 100-year anniversary meeting. For info:

<https://annual.ametsoc.org/index.cfm/2020/>

Leadership Transition:

Peter handed off the Chairmanship over to Kyle. Erik Pytlak assumes the Vice-Chairman. Kyle thanked Peter for his leadership role in 2019. Peter noted that the letter to the NRCS management, for supporting the SNOTEL program, was one of the group's best efforts during his time as Chairman.

2020 CRFG Goals:

- 1) Data issues (continuing from 2019). We would really like a specialist to come out as a guest speaker. Peter recommends Danny Tappas – Idaho Snow Survey.
- 2) Field-trips. Kyle led a trip to Condit Dam in Oct. 2012. He is offering two possible trips: (1) A SNOTEL site (appropriate for our data-issue talks) like Mt. Hood Test Site, (2) East Portland climate-hydrology mitigation and restoration projects. We will check with member later on.
- 3) Info/educational Outreach. Kyle wants to explore having a website for the CRFG (other than a repository for the annual reports) and maybe an info-pamphlet that can be handed out.

Special Recognition – Kevin Berghoff:

We celebrated the NOAA/ NWS career of Kevin – 20-years of service to the NWRFC. Kyle presented a customized signed retirement card, two 6-pack beverages, McMenamins gift-card and Passport. Kevin reminisced on his time as a RFC forecaster and thanked everyone.

Our next meeting will be the winter-term meeting at CRITFC's Columbia Room – maybe mid-February? Kyle adjourned the meeting at 1:15 pm and thanked all for coming and participating.

Attendance:

Benner, Dave – FPC (Portland)
Berghoff, Kevin – NOAA/NWS/NWRFC (Portland)
Cooper, Peter – USBR (Boise)
Dittmer, Kyle – CRITFC (Portland)
Duren, Angela – COE, NW Division (Portland)
Fenolio, Joel – USBR (Boise)
Gariglio, Frank – IPCo (Boise)
Gillies, Brad – NOAA/NWS/NWRFC (Portland)
Glazewski, Matt – PCC-Cascade, Clackamas County (Oregon) Enviro. Services
Hall, Steve – COE (Walla Walla)
Hildreth, John – IPCo (Boise)
Osgood-Zimmerman, Logan – COE (Seattle)
Roberts, Jon – COE (Walla Walla)
vanDer Zweep, Rick (BPA)
Warner, Mike – COE (Seattle)
Walters, Geoffrey – NOAA/NWS/NWRFC (Portland)

On the phone:

Sears, Sheri – Colville Tribes

Wagner, Paul – NOAA Fisheries

Note-taker: Kyle Dittmer, Columbia River Inter-Tribal Fish Commission, Portland,
Oregon

Revised January 23, 2020

Appendix C

Historical forecast results

Columbia River Forecast Group 2019

Historic forecast results: http://www.nwd-wc.usace.army.mil/report/flood_risk

Historical Jan-Jul Results for The Dalles and Lower Granite and Observed KAF:

<http://www.nwrfc.noaa.gov/ws>

1. Use the interactive map at the web address above.
2. Go to the forecasting map for TDA and LWG or the runoff map for Observed results.
3. Click on the dam needed and for TDA and LWG, look up the appropriate archive data. For the observed runoff, click on the dam needed and add up the observed for the months stated in the tables below.
4. 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:

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

Duncan: (Apr-Aug)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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

Libby: (Apr-Aug)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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	69%	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

Hungry Horse: (May-Sep)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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	120%	1500	118%	1580	124%	1400	110%	1460	115%	1273

Grand Coulee: (Apr-Aug)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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

Brownlee: (Apr-Jul)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	
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

Dworshak: (Apr-Jul)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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	69%	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

Lower Granite: (Jan-Jul)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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

The Dalles: (Jan-Jul)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS									
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	71%	105851	73%	111213	72%	119785	79%	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	87%	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

The Dalles: (Apr-Aug)

Year	Jan		Feb		Mar		Apr		May		Observed KAF
	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	KAF	% of OBS	
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	105%	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

CRFG Roster -- 2020

Revised Feb. 11, 2020			
Name	Agency	Phone	E-mail
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BLUE	Agency/Branch Director/Manager		
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Jeremy Giovando	USACE - Walla Walla District	509-527-7053	Jeremy.i.Giovando@usace.army.mil
Keith Duffy	USACE - Portland District	503-808-4969	Keith.B.Duffy@usace.army.mil
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