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Chair
Idaho

W. Bill Booth
Idaho

Guy Norman
Washington

Tom Karier
Washington



Northwest Power and Conservation Council

Jennifer Anders
Vice Chair
Montana

Tim Baker
Montana

Ted Ferrioli
Oregon

Richard Devlin
Oregon

Council Meeting October 9 and 10, 2018 Wenatchee, Washington

Tuesday, October 9, 2018

Council Chair Jim Yost brought the meeting to order at 1:30 p.m. All Members were in attendance.

Reports from Fish and Wildlife, Power and Public Affairs Committees

Fish and Wildlife Committee

Council Member and Fish and Wildlife Committee Chair Guy Norman reported on eight items:

1. Patty O'Toole, staff program implementation manager, provided a review of the program framework and some of its history. This will be an ongoing part of the Fish and Wildlife Committee agenda as we move through the Amendment Process.
2. Lynn Palensky, staff program development manager, summarized the status of the research project review. There are 25 projects reviewed by the ISRP, they're on the website, and public comments are open until October 24. The idea is to wrap these up by December with Council recommendations.
3. Palensky informed the committee that 2019 is the International Year of the Salmon. It's jointly sponsored by North Pacific Anadromous Fish Commission and the North Atlantic Salmon Conservation Organization. The themes are outreach and research, sharing information about salmon, its resilience and looking at its future. The North Pacific Anadromous Fish Commission is meeting next May in Portland, providing an opportunity for interaction with scientists throughout the world.
4. Nancy Leonard, fish, wildlife and ecosystem M&E report manager, gave an overview of the objectives for anadromous and resident fish. A story map tool is being

developed so people can look at that information. In mid-November, a draft of that tool will be brought to the committee.

5. The committee heard from the Yakama Nation on sharing fish and habitat data. They've been doing it for seven years. The idea is to develop reporting tools that are fit for a variety of audiences.
6. Dr. Kellie Carim, National Genomics Center for Wildlife and Fish Conservation, presented a genetic study of northern pike in Lake Roosevelt to determine their source. The committee got a look at the origin of the species west of the Rockies. An interesting finding using eDNA suggests that the predator fish were transported and introduced from Medical and Cave lakes. Some could have drifted downstream from Pend Oreille.
7. Cody Gillin, with Trout Unlimited, and Julie Nelson, Methow Beaver Project, made a presentation on using beavers as an ecosystem conservation tool.
8. Bryan Mercier, of Bonneville Power, and Tony Grover, Fish and Wildlife Division director, spoke on the agency's budget cuts and policy implications. They focused on first quarter activities. Bryan is leaving BPA to become the regional director for the Bureau of Indian Affairs.

Power Committee

Council Member and Power Committee Chair Tim Baker reported on five items:

1. The committee heard about the final draft of the Midterm Assessment, which is a check-in on the Seventh Power Plan. There's a motion on the Council's business agenda tomorrow to release the document for public comment.
2. There was a presentation by Seattle City Light on its integrated resource plan. Owned by the City of Seattle, the utility has its own resources in addition to being a BPA customer. The utility is carbon neutral and has surplus power. It plans to join EIM, and has initiatives on environmental and social justice.
3. There was a presentation on a western region gas and electric interface study. The grid has become more reliant on natural gas generation. In light of the woes in California over storage, there was interest in looking at the interface between gas and electricity in terms of reliability and disruptions to the gas system. The good news is we have a resilient system in the Northwest and can stand disruptions, with multiple pipelines, connections and storage. The region also has other resources such as hydro. It's not the same as looking at Southern California and the desert southwest.
4. There was a report on an Agricultural Energy Efficiency Potential Study, which looked at the energy-efficiency potential of the agricultural sector. The committee also got into the Eighth Power Plan. It was a technical review. There are 87 MW of

potential. It includes dairy, irrigation, lighting, motors and pumps. These assumptions will be given to the RTF for review and then put into Eighth Power Plan process.

5. The committee heard from staff on the draft NEEA business plan. They're facing slight budget constraints. NEEA's work is important to the region, and important to conservation and energy efficiency. The Council wanted to weigh in, express support and raise areas of concerns to take into consideration. That will come to the Council for action.

Public Affairs

Council Member and Public Affairs Committee Chair Bill Booth reported that the committee didn't have a meeting. They will meet next month to discuss formulating recommendations for Council sponsorship budget for the remainder of Fiscal Year 2019.

John Harrison, information officer, has continued his work with our with Canadian counterparts and the Canadian Basin Trust on the 2019 Transboundary Conference set for September 2019.

Staff completed a pocket guide brochure with facts about the Columbia Basin power system. Harrison and Eric Schrepel, technical and web data specialist, completed a story for the Council's website on northern pike, and are working on a story about sea lions.

1. Presentation by Snohomish PUD on new small hydroelectric projects

Gillian Charles, energy policy analyst, introduced Scott Spahr, Snohomish PUD's (SnoPUD) general engineering manager and thanked SnoPUD for hosting a tour of hydroelectric projects.

Spahr has worked for SnoPUD for 10 years, where he wears a lot of hats. Since last February, he has worked on licensing and construction of small hydro.

In 2007, SnoPUD had a climate change initiative to meet all load through carbon neutral resources. In western Washington, it's difficult to develop wind, solar is not well-suited and that leaves hydro. He outlined the Hancock and Calligan projects' history and layout, and detailed their licensing background. We found that there's the legacy hydro, but there's still a lot of territory to explore, Spahr said. In a four-county region, they identified 145 different sites. He said they ended up with 10 sites they could develop. In 2010, they started licensing. The projects looked at were upstream of Snoqualmie Falls, so there were no anadromous fish up there.

The key to finding a site is finding one without fish issues, he said. Both sites had very low population densities of rainbow trout. They still monitored and assisted trout there. They tried to reduce other environmental impacts. Spahr discussed the construction steps and timeline. Forest fires, followed by record rainfalls, impacted construction, but they still met their timeline. They completed the intake in December 2017 and began their commercial operation in February.

Spahr shared the following facts and figures:

- Hancock Creek, Calligan Creek, and Youngs Creek are the first new run-of-river hydroelectric projects built in Washington in last 20 years. This is what makes it interesting.
- They operate about nine months per year (typically shutdown July through September due to low flows).
- It took 680 calendar days of construction — about two years to build.
- 14,100 feet of pipe were installed.
- 4,460 cubic yards of concrete were poured.
- 280,000 cubic yards of earth were moved.
- 56 PUD employees charged 5,500 hours to project.
- Calligan Creek production ~ 20.7 GWh average annually.
- Hancock Creek production ~22.1 GWh average annually.
- \$60 million cost, LCOE \$77 to 88/MWh.

Spahr said SnoPUD could have purchased wind, but the utility wanted long-term assets.

Spahr talked about SnoPUD's historical growth, from 250,000 people to 800,000. Our retail load is strongly correlated with that increase until about 10 years ago, he said. Then it plateaued due to conservation. PUD budgeted \$20 million into conservation programs and averages 9 aMW of savings per year.

According to the 2017 IRP analysis, the utility is using cost-effective conservation as its primary tool to meet load growth. Still, they forecast the need for capacity resources during extended cold-weather periods and during the late summer in the late 2020s.

Member Richard Devlin said when they started planning this process, the commission estimated that the cost would be comparable to long-term wind or solar. Did it end up being your levelized cost? It depends on the discount rate and the terms you assume, Spahr replied. They funded them through 30-year bonds, so it depends on the lifecycle you assume. They stayed on a mid 70 to mid 80 figure.

Member Devlin asked, how did the board make that decision, was there some kind of business case? Was it about the certainty of having the asset for the long term? Spahr said it boiled down to the board creating their own policy on climate change and deciding to make sure they had their own renewables. There were echoes of being deeply hurt by Enron situation and having control of our own destiny, he explained.

Member Ted Ferrioli expressed appreciation for the generous time given to us on the tour.

Member Norman asked if there were any other projects on the horizon. Not at this time, Spahr replied.

2. Presentation on invasive northern pike and lessons from the Pend Oreille

Tony Grover introduced Joe Maroney, of the Kalispel Tribe, one of the leading researchers on invasive species. Maroney discussed the geographic spread of northern pike. It's also in Coeur d'Alene waters. The spread looks like chicken pox. It showed up in Pend Oreille in 2004, and it has been in Coeur d'Alene much longer than that, he said. His presentation

focused on work being done in Pend Oreille. He said the Kalispel project area is where they started doing the first northern pike suppression. Pike are a problem, not an opportunity. They developed management goals to minimize the impact to native species and to reduce the spread of pike to other waters, including the Columbia River. They also are working to reduce their numbers in Box Canyon Reservoir. Northern pike is native to two-thirds of Alaska. It's having a huge impact. Colorado, Utah, and California have had northern pike invade and have actively managed them. In Washington, northern pike was listed as prohibitive species, but it's also listed as a game fish. We need to remove the game fish designation, Maroney said. Then the tribe could go after them.

Maroney provided an invasion/action timeline:

- 2004: Northern pike first detected
- 2005: Northern pike studies initiated
- 2010: First annual SPIN survey in Box Canyon Reservoir
- 2011: Pilot suppression project
- 2012: Full-blown northern pike suppression project
- 2016: Spin survey in Boundary Reservoir, suppression pilot
- 2017: Full suppression initiated in Boundary Reservoir

He talked about suppression in Box Canyon Reservoir, explaining that they need a minimum three years of suppression to see reductions. 2017 was our bonus year with 32 pike, he said. This year, it's 214. But it's not the thousands they used to get. Between 2012 and 2018, 17,500 northern pike have been removed from Box Canyon Reservoir.

He cited Boundary Reservoir figures, where they reduced the population by 83 percent in one year in 2017.

To date, they have removed more than 18,000 northern pike. reduced relative abundance by more than 98 percent in Box Canyon, and by more than 80 percent in Boundary. This demonstrates that it can be done in a large, complex system.

He said the program is consistent with the strategies of the 2014 Fish and Wildlife Program. It's a substrategy of managing predator fish: to improve the survival of salmon, steelhead and other native focal fish species by managing and controlling predation rates.

Maroney sits on Washington's invasive species council. Northern pike is among the top 50 invasive species in Washington and is the top invasive aquatic animal. If Quagga mussels were in Washington, they'd rank higher, he said.

There's increased awareness of northern pike. The Salmon Recovery Funding Board presentation on northern pike was well received. Letters were written to Washington Governor Inslee, the Council and PUDs. Former Council Member Phil Rockefeller gave an impassioned address on the topic. The Okanogan River is susceptible and it would be devastating to the sockeye fishery in Lake Washington.

Maroney discussed the invasion curve and why action is needed early. If you can eradicate northern pike early, the chance of success at a lower cost is likely. The higher you get on the curve, it becomes exceedingly difficult to eradicate.

Member Ferrioli asked about the Canadian response to the letters. Maroney said they are very concerned that a lot of pike are moving upstream. There's no ranking in British Columbia for invasives, but they're very concerned.

Ferrioli asked if there's a tendency to want to declare victory after the Box Canyon effort and not do maintenance. Time will tell if we're in a maintenance mode and for how long, Maroney replied. The effort used to be about two months, now it's down to two weeks. It might end up not being every year, and do it every other year instead. They tried to get a good snapshot this year on the Pend Oreille, but because of high flows they couldn't get out on the water at all. They have plans to get the snapshot next year.

Member Booth complimented Maroney's success and for getting on it so early. He asked what are northern pike eating in Box Canyon? If you have soft fins and you're shiny, you go first, Maroney said. We saw our mountain white fish going first. There aren't many trout species there. Then you see a reduction in everything else except small mouth bass, northern pike and tench.

Member Booth said that based on Dr. Carim's presentation on genetics in the Fish and Wildlife Committee meeting, it was interesting that the Lake Roosevelt population of pike principally came from a bucket transplant — perhaps in an effort to start a pike fishery. Do you agree with that?

Maroney said they've been dealing with genetics. The data supports that. It may be too early to tell. We need to get more samples and data. The fish in Lake Roosevelt came from Box Canyon. "That's not what her data shows," Member Booth said. Maroney clarified that the Lake Pend Oreille came from somewhere else. How many come down in the flush, we don't know.

Member Booth said this points out that we need to spend time telling fishermen not to transport species. What's your annual budget and where does the money come from? It comes from BPA and Avista, Maroney replied. The first investment was \$450,000. You need to invest in boats and gear. From there, it tapers down. Because the Box Canyon license was negotiated, there's no FERC money in it. But within the reservoir downstream, they were able to write language into those license articles for pike suppression.

Member Booth asked what is the annual budget currently and how much comes from BPA? I know it's less than \$100,000 annually, Maroney said, but he didn't know what percentage comes from Bonneville. Member Booth said if that's all it is, he hopes they can continue that maintenance effort.

Member Tom Karier asked what are penalties for transplanting fish? Are we doing enough on Lake Roosevelt? You have to ask the comanagers on Lake Roosevelt, Maroney said. I'm sure they wish they had more effort and funding from BPA. Oregon and the lower river tribes are concerned. Time is of the essence. There's no need to study them or have an ISRP review, just remove them. They're a prohibited species.

Member Norman congratulated Maroney on removing 17,000 pike in seven years. He asked about an uptick on the chart in 2018 and if that's a rebound. Maroney replied that it was an uptick in one age class, and they hope to have it tick down again in 2019.

3. Presentation by Mid-Columbia Public Utilities on predator management efforts

Tony Grover introduced the panel: Lance Keller, Chelan PUD senior fisheries biologist; Tom Kahler, Douglas PUD fisheries biologist; and Tom Dresser, Grant PUD fish, wildlife, water quality manager.

Kahler described efforts at Wells Dam, the last project on the river with fish passage. He talked about the resident fish study performed in 2014. Predators weren't very abundant except for the Okanogan River, which is "predator central." Northern pike had declined, but then rebounded. Large-mouth bass and yellow perch have increased. The bass are only in the Okanogan. Burbot and pikeminnow studies also were performed. They determined that pikeminnow is the primary predator in the Mid-Columbia reservoirs. They implemented a removal program and found that the fish were too mobile to come up with a good population estimate. In 1997, they stopped their removal program and started a pikeminnow telemetry study. They tagged 41 individual pikeminnow to study and found that they're highly mobile. They found a major spawning location at the mouth of the Chelan River. Kahler discussed pikeminnow movements and provided catch data per location. It is diminishing in size and numbers over time. Ladder counts are lower too.

The bird hazing program was discussed. Bird deterrent wires were erected around the dam.

They are monitoring northern pike to see when they'll show up. A gillnet survey in 2017 had no northern pike. They're waiting for environmental DNA sampling results. Public outreach is important. The Cassimer Bar Cormorant/Heron Rookery was discussed and the detection of sturgeon, salmon and steelhead PIT tags.

Member Norman asked what percent are PIT tagged? Kahler said they just developed a systematic sampling to quantify tags. They plan to go to the tagging rates.

Keller talked about Rocky Reach and Rock Island projects. Spill is used for juvenile fish passage at Rock Island. Habitat conservation plans call for no net impact on chinook according to a 50-year agreement signed in 2002. The tools used to achieve survival standards remain in place.

They have a three-pronged approach to reaching no-net impact: 7 percent hatchery production, 91 percent combined adult/juvenile survival and 2 percent tributary projects. They talked about survival statistics at the two projects. The standards are being met.

Keller talked about northern pikeminnow and removal statistics. Since 1994, they have removed nearly 1.3 million fish. Chelan PUD also is supporting suppression above Grand Coulee.

Chelan PUD has achieved no-net impact for spring plan species. Its predation control program supports no-net impact achievement and a 10-year check-in study. They have a

robust pikeminnow removal program and piscivorous bird monitoring. Chelan PUD providing regional support to northern pike removal efforts.

Dresser said Grant PUD implements 51 different programs. It conducts extensive consultation with the Priest Rapids Coordinating Committee (PRCC). Members of PRCC include NMFS, USFWS, WDFW, Yakama Nation, Confederated Tribes of the Colville Reservation, Confederated Tribes of the Umatilla Indian Reservation (via Columbia River Intertribal Fish Commission), the Wanapum and Grant PUD. It's important to note that the PRCC (and other required committees) decision-making process requires 100 percent consensus.

They have a three-pronged approach to reaching no-net impact: 7 percent hatchery production, 91 percent combined adult and juvenile survival, and 2 percent habitat contributions.

They have found a large number of northern pikeminnow in their service area and have implemented an assortment of removal technologies.

More than 533,500 pikeminnow are removed annually from the Priest Rapids Project (PRP) (based on 2012-2017 data). The removal effort targets all life stages (young of-year, juvenile, sub-adult, and adult pikeminnow). Over 830 different locations within the PRP are sampled annually. The average cost of the program (O&M and labor) is approximately \$477,000 per year. They do the work inhouse.

Dresser said it's extremely difficult to assess the number of smolts saved. Grant is getting away from research and sticking to a removal strategy. They are increasing their focus on the removal of non-native fish predators and monitoring for the presence of northern pike.

Daytime electrofishing and angling were used (2016 and 2017) to remove a total of 1,453 non-native fish predators (smallmouth bass, walleye and channel catfish). No northern pike have been sampled within the PRP to date. Dresser listed activities underway to detect the presence/absence of non-native fish predators.

An effective avian predation control program is in place to deter gulls in the immediate vicinity of the Wanapum and Priest Rapids dams, and they have seen some decreases in the tern population.

Funding provided by the PRCC (via the NNI Fund) has greatly contributed to the knowledge base and resulted in positive efforts to reduce tern predation on juvenile salmonids migrating through the Columbia River plateau. Federal action agencies need to continue to play a major role in addressing the long-term management avian predation issues and non-native fish predators basinwide.

Dresser said that as a region, we need to be proactive. The federal agencies need to work with the PUDs to face the predation issues we have. They're not going away; they're cyclic. The tern population is a good-news story for now. Grant has some survival studies coming up in 2025-26, and that's a bar we'll have to cross. We need to start thinking as a region how to be prepared for that, he said. Northern Pike aren't in anadromous waters yet, but it's only a matter of time before they show up and we're faced with very expensive programs.

Member Karier said that the Council's science panel did a report on metrics for predators. Smolts saved is useful and evidence of compensatory affects is another. We haven't developed those as standard reporting yet. Would you be able to get better population numbers if you worked together? Are you aware of any studies about the compensatory effects of predation in the Columbia?

Dresser replied that it's difficult because it's an open system. There is a large amount of spawning in the project area, and they spent a lot of time, effort and money trying to come up with a population estimate. So we migrated to a removal program. On the Lower Granite, we spent 5–10 years coming up with population estimates.

Keller said Chelan has also switched tactics.

Member Jennifer Anders asked if there's an effort to prioritize predation, such as non-native over native predators. Or are they all treated equally?

Dresser replied that for Grant, it started as pikeminnow removal. But since we're out there and are encountering small mouth bass and walleye in certain areas, we don't prioritize one over another.

4. Panel on transportation electrification

Steve Simmons, senior economic analyst, introduced Jim White, Chelan County PUD; and Richard DeRock, LinkTransit general manager

Transportation accounts for 28 percent of the energy consumption in the U.S. and 92 percent of that is petroleum-based.

DeRock talked about LinkTransit's history of electrification, including its first models. The bus batteries had to be charged daily and failed very quickly. He talked about the upgrade to more trouble-free China Aviation Lithium Batteries. He reviewed the fast-charging and slow-charging and robotic charging stations. These are the first robotic charging stations in the world. They had to pull the Trolley Fast Charge buses out of services because of reliability issues.

DeRock talked about the issues with the robotic chargers:

- Exceedingly complicated design
- Many moving parts needing constant maintenance — a maintenance nightmare.
- Time required for deployment and retraction limits charger functionality
- Charger is a strike hazard
- Very moisture sensitive

Electric bus challenges:

- Poor reliability – weekly circuit board failures
- Fragile suspension – inadequate durability
- Unique buses and chargers
- Temperature challenges

The generation two BYD bus is surprisingly reliable. But they operate in a different environment in the west. The vehicle range is 145 miles, but our system requires more than 200 miles, DeRock said. Plus, the batteries and chargers were impacted by temperature.

In Wenatchee, they have installed the MD charger, the first high-powered charger in the world, with a 95-97 percent efficiency of power transfer.

LinkTransit has ordered a new generation of buses with temperature and performance improvements. They will be delivered in winter 2019. They are looking at chargers in different communities for longer-distance buses to Leavenworth.

"We didn't get into this for environmental reasons, it was cost," DeRock said. It costs \$285 per month for electricity versus \$1,381 per month for diesel.

Member Karier said that's one of the reasons is to get the bugs out. Do you feel you're getting to that now? DeRock replied that he's hopeful, but he's not sure the board is. It's been a rough number of years. Manufacturers said the vehicles could do a lot more than they're doing. Short routes work best in warmer climates. The cold issues are significant. They have experienced good reliability with the two remaining buses in the last two months. But they just don't get the range. When someone says it's proven technology, I push back pretty hard.

Jim White said Chelan has installed five electric power stations. How much are they going to be used? Monitoring at their headquarters, they're used 1.4 times per day. He said that range solves a lot of problems with electric vehicles. As range improves, so will usage. He discussed an increase in adoption in the area, including some Tesla chargers in Leavenworth.

Member Karier asked who's charging in Leavenworth. Mostly people from Seattle, White replied. The electric highway structure from Mexico to Canada has a station every 55 miles. He said that additional load from electric vehicles is the opposite of conservation. We're removing generation capacity, but now it's being consumed instead of conserved and exported. The benefits are O&M savings, come carbon benefits and money coming into the region. He added that it costs 27 cents per equivalent gallon to run a car on electricity.

In addition, the overall ratepayer impact is low. In Chelan County, because we sell power so low, the life of the electric vehicle adds a cost to our bottom line of \$1,100 per vehicle, White said. The average ratepayer impact is positive in the Pacific Northwest. Plus, there's a benefit of \$2,200 for customers having electric vehicles and \$1.4 billion benefit to the region.

Member Devlin asked DeRock about getting funding when it was such a new technology. Public entities are reluctant to invest until it's proven. Then they want to make sure they get the right entry. What's the future given the past problems? DeRock said the market has moved dramatically. He listed recipients of grants and all had issues with technologies. Others in California don't have the temperature issues we do, he said. I believe this will work quite well. Demand charges in California make it 60 cents per kwh, so diesel's

cheaper, but they're not allowed to operate diesel. Another advantage is the reduction of ambient noise.

5. Presentation by the Independent Scientific Review Panel on Research Project Progress

Erik Merrill, manager of the Independent Scientific Review Program, said the purpose of the ISRP research status review was to look at the progress of addressing the critical uncertainties identified in the Council's 2017 Research Plan. He then introduced ISRP Chair Dr. Steve Schroder, who reported that the research going on in the Columbia River Basin is terrific. The ISRP reviewed 25 projects in 2018. The last review was in 2010. They have found a lot of collaboration. The Research Plan looked at 14 topic areas. Research plans addressed 13. The one not addressed was public outreach. Ten met scientific review. Four had been completed and 11 met criteria with some improvements.

There were three categories: fish and wildlife populations, habitat, and fish propagation.

Looking at the results, PIT tags have been used for years to track adults and juveniles. There's been a decline in the detection systems in the mainstem. Why? As we increase spill, the fish were going over the spillways, Schroder said. There's no way to detect those, except on Granite Dam. Some spillway PIT tag detector arrays are going to be installed for use this spring. Also, there are detection challenges in broad, deep rivers. They are now testing vertical detection arrays.

Schroder said another black box is the ocean. NOAA surveys found that ocean conditions are the overwhelming driver of salmon survival. It doesn't matter how they do in fresh water if they end up in poor ocean conditions. The size of the ocean plume is another factor.

There has been tremendous advancement in genetic diversity studies. They've been using them to estimate the arrival time and abundance of anadromous fish as they go over the dam. They have collected data on white sturgeon and lamprey too.

Looking at habitat and effectiveness of restoration actions, there are three questions:

- What factors limit habitat capacity and salmonid productivity by life stage?
- What is the effectiveness of individual projects at the site/reach scale?
- What is the combined effectiveness of restoration actions across watersheds/subbasins?

These are questions that the Council has wanted answered for a long time, he said. At Grande Ronde and Catherine Creek, they did structural equation monitoring and found three limiting factors: too few large pools, mean August water temperatures, and the stream power is erosive, or too high. Using models, they could predict what would happen with restoration actions. It helped them prioritize their money and projects.

Schroder listed the products and key assessment tools produced by the CHaMP/ISEMP projects.

Looking at fish propagation, he outlined the effectiveness of hatcheries as conservation tools. There are 10 projects: four steelhead and six spring chinook. The general conclusions were that hatchery-origin fish didn't do as well, as they were impacted by genetic and environmental factors. Steelhead seemed to be much more impacted than spring chinook.

How could they raise reproductive success? The Johnson Creek and Upper Yakima studies look at rearing environments to reduce genetic selection for surface orientation and aggression in steelhead, for example. He described some of the approaches to improve fish culture methods.

Going forward, Schroder hopes the Council will support surveys of basin hatcheries, and to implement and evaluate fish cultural changes. You and BPA should be proud you're supporting this work, he said. It's the best in the world.

Member Karier said what he liked about this is to tell us what's been discovered and why it's important to the region, and your efforts toward that are commendable. He wondered if the Council should come up with criteria of what we're looking for in a successful project. Are these projects effective? Are there other things we should be doing that we're not doing. You hit on both in this presentation.

Chair Yost recessed the meeting at 5:15 p.m.

Wednesday October 10, 2018

Chair Yost brought the meeting to order at 8:02 a.m.

6. Council decision on approval of 2019 Regional Technical Forum Work Plan and Budget; and Council decision on 2019-2021 RTF Members

Regional Technical Forum Manager Jennifer Light outlined the RTF's work plan. The RTF was formed in 1999 from BPA shifting programs to utilities. It has helped tailor programs to utilities and to better assess energy efficiency. It also tracks progress in the region against the Council's targets.

The RTF's current charter has five elements:

1. Develop and maintain measure library with savings, lifetime costs, and estimated value to power system.
2. Establish a process for updating list of resources and an appeals process for demonstration of different values.
3. Develop set of protocols by which savings and system value should be estimated.
4. Assist the Council in assessing measures, technology development trends, and effect of trends on future performance and availability of resources.
5. Track regional progress toward meeting Council targets annually.

Light listed the RTF's values:

- Leverages the work across the region to reduce the individual burden on any one utility;
- Brings together 30, unbiased, technical experts to analyze the data and provide recommendations;
- Uses a public process to bring transparency, as well as additional ideas and expertise, to the analysis; and
- Removes some of the friction between utilities and regulators when estimating and claiming savings.

She said these values help add credibility to numbers. They have put the work plan together through an open process. They received a set of comments from BPA. Member Baker can talk about the work of the RTF Advisory Committee.

The proposed budget subtotal is \$1.875 million. It is funded by BPA, the Energy Trust of Oregon and IOUs. The Council members and staff have provided strong support for the RTF. Light reviewed the budget compared to prior years. The budget has a slight increase for inflation. 2019 is the last year of the agreement. They will be starting conversations about 2020 and beyond since there is no agreement yet.

Eighty-three percent of the budget is tied to energy savings. The budget includes room for new measures. Measure collaboration is core to getting work done. The standardization of technical analysis is key to making sure the work is consistent and meets guidelines. Also having membership and meeting support boosts participation and transparency.

Light said there's a big shift toward tools. There will be a bit of a ramp up because next year the RTF will be working on the Council's Eighth Power Plan. Fifteen percent of the budget is in the tools category, building simulation models and coming up with estimates.

Other management items include the website RCP and the regional conservation survey.

Demand response is another category. They are looking at an assessment of up to six demand response technologies for estimating the potential per-unit savings and technical cost.

What is the RTF offsetting? The budget was first built without demand response. Adding it required a reallocation from Eighth Plan support and saving shape development.

Member Baker said that as RTF Advisory Committee co-chair, the work plan and budget has gone through a robust process. It has involved key stakeholders and constituencies. Jennifer does a fantastic job in shepherding the process and allowing input, he said.

Northwest Power and Conservation Council Motion to Approve the 2019 Regional Technical Forum Work Plan, Budget of \$1,875,200, and Business Plan as Recommended by the Regional Technical Forum Policy Advisory Committee

Member Anders moved that the Council approve the 2019 Regional Technical Forum Work Plan, Business Plan and Budget in the amount of \$1,875,200, as presented by staff and recommended by the Regional Technical Forum Policy Advisory Committee.

Member Baker second.

The motion was approved unanimously.

Northwest Power and Conservation Council Motion to Approve the Staff Recommendations for the 2019-2020 Regional Technical Forum Membership, Including the Reappointment of Jennifer Light as RTF Chair, and Charlie Grist as Vice-Chair

Member Anders moved at the Council approve the staff recommendations for the 2019-2020 Regional Technical Forum membership, including the reappointment of Jennifer Light as RTF Chair and Charlie Grist as Vice-Chair, as presented by staff.

Member Karier second

The motion was approved unanimously.

7. Briefing on Bonneville's Columbia Basin Fish Accord Extensions

Tony Grover introduced Peter Cogswell, BPA's acting vice-president of environment fish and wildlife; and Bryan Mercier, BPA's former executive manager of fish and wildlife, briefed Council Members on the agreement. Grover noted it will be Mercier's last appearance before the Council as a BPA representative.

Cogswell said an agreement was reached between the Action Agencies, numerous tribes, Idaho and Montana to extend the Columbia Basin Fish Accords until 2022. They will be signed today and the extension will be announced tomorrow. They will last through 2022. The first Accords lasted 10 years. He said they went through a 30-day public comment and many issues are addressed in the Record of Decision (ROD).

Mercier walked through specific revisions. He started at BPA when these were put together. He said it's impressive to see the results that the sovereign parties have achieved. There's a commitment on both sides. He listed the Accord extension partners, which includes everyone except the Kalispell tribe, which has their own Accord. They are still having conversations on a memorandum of understanding with the State of Washington.

Regarding the financial commitment of BPA to the partners: It's complicated, Mercier said. Each agreement has an attachment. The takeaway is that the suite of projects is at a reduced level from Bonneville's perspective. If you were to sum up the 10-year Accords with compounded inflation, the next four years is a \$3.3 annual decrease from those previous 10 years. There is also a substantial reduction on the capital side of the equation. It was \$220 million over the first 10 years. Over the next four years, it's \$24 million, so it's a substantial reduction in capital commitment. Mercier said it helps BPA move in the right direction to get on a more sustainable financial path, while still leveraging these great projects and good efficiencies with these partners.

Member Karier asked what's the total number? The Accord is \$448.5 million over four years, capital and expense. The challenge is the number appears greater. The nuance is Montana and Idaho had narrowly focused Accords the first 10 years. When we did these, we didn't know what we were getting into, but we've built trust over the years, Mercier said.

Member Karier asked if it includes the carry forward and expense of capital? No, it does not, those are separate, Mercier replied.

Mercier said, looking at the future, what's different? There's more trust, and the language reflects that. It aligns us with our 2018 Strategic Plan to keep rates below rate of inflation, he explained. It has language for greater flexibility. There is continued BPA and Council review for science, project scope and implementation. There is collaboration across parallel processes to increase alignment (for BiOp, hydro ops, etc.).

They received comments from 14 stakeholders, which are addressed in the ROD or in changes to the final, signed agreements. Comments ranged from customers concerned about the financial commitment, to fish advocates questioning the need for the Accords.

Member Karier asked about budget totals and carryover money. A significant amount of capital money was not spent due to permitting problems, which could be spent in next four years. Looking at level and carry forward, could more money be spent on these projects? Or will it be a decrease in Bonneville's overall costs? Mercier answered that on capital side it's difficult to know when their hatchery commitments will hit. What we do is establish what our likely needs will be. For fiscal year 2019 and 2020-21, we set those rates, estimating what that carryforward in expense and capital money will be needed. There is risk. Then, we'll have to work with partners to sequence the work to remain within the budget we have. We have reduced our budgets in 2020-21. There is risk, but it's managed.

Member Devlin said there are clear positives to the Accords. Still there are outstanding questions. There's a benefit to the partners of the longer-term funding of projects. The number of dollars available from ratepayers to pay for the fish and wildlife program is finite. I'm concerned about language that would impede feedback to the Council as we go through the Amendment process. This short window is the time to hear about various partners' concerns and anything that impedes that process is problematic. Another concern is a lot of things in the Accords are from a standpoint of this is what we're doing and going to do. Many of Bonneville's programs aren't going to change substantially. There's an underlying impression that you're trying to impact a program and keep it static. In my time on Council, new issues arise every couple of months, and a program can't be static. Ocean conditions are getting worse. All this emphasis to putting the program into a box is a little naïve. It will need to have input.

Mercier replied that he disagrees with the characterization that there's any impediment. The partners signed with their eyes wide open. There's an off-ramp should the status of a species change dramatically. My assessment of why most sovereigns signed is it's a forum of compromise to work together with a certainty of funding. Ten years ago, we didn't realize how effectively we'd complete our work. We had use-or-lose funding. It was a band-aid approach. This is a more effective way. I don't think the Accords impede anyone's ability to provide input and offramps.

Member Devlin said he understands that the parties to the agreement aren't giving up their sovereignty, but anything that impedes that process for bringing issues before the Council should be considered as part of the Amendment process. I don't think the Accords intend to do that, Mercier said. We want our partners to have full, unlimited expression of what's in the environmental impact statement. The Accords still provide for that opportunity for dialogue and feedback.

Member Norman asked Mercier to reflect on the Accords and the 10-year window. Is this four-year agreement a continuation of certainty, or a launching pad for the next 10 years? Mercier said he would characterize it as an extension of the first 10. But with a longer-term perspective, they can really address issues.

Member Norman said with the NEPA process, there's an opportunity to look forward for the next 10 years.

Member Baker said looking at the ROD, there's a discussion over the Council's plan and process. Answer was "virtually all" of the projects have been reviewed by the ISRP. In today's world, I'm not comforted by virtually: It could mean none. I'm curious on your view on the work on extensions in the future fits with the Council processes and reviews. Mercier replied that there are one or two new projects that will have to undergo scientific and Council review, so they didn't make a blanket statement. One is a law enforcement project. Most of projects are longstanding projects, from the 1980s and 1990s that have evolved over time, and have regular check-ins with the Council. They have that certainty to evolve and become more efficient.

Member Anders said the Accords are two-pronged. One is a stream of funding. The other is a commitment and alignment in terms of policy decisions, which are in flux. I look forward to a time when the dynamics might be resolved and Accords exist to provide the funding. It's a good mid-step. Mercier said he wishes for the same, to have regional alignment and not fight as much about how we get there. The Accords try to create some space to compromise.

Member Baker asked about the intersection on what the Council does and extensions. We've been wrestling with metrics of performance. As we move forward, we think about how to better assess results and become more efficient. Do the extensions allow for that feathering in of Council review?

Absolutely, Mercier replied. As we moved through the programmatic reductions, we looked at efficiencies. That will continue. While the funding is firm, how we spend those funds should be as efficient as possible.

8. Council decision on Asset Management Strategic Plan

Mark Fritsch, project implementation manager, presented the Asset Management Strategic Plan for a Council decision. Bryan Mercier was an essential partner and collaborator with this. We've been at this effort for 37 years, Fritsch said. Long-term maintenance is the

highest priority in the 2014 program emerging priorities. This plan provides the ability to address non-recurring needs such as hatcheries, screens and lands.

Fritsch discussed the four-phase asset management strategy. He listed who they worked with: the Asset Management Subcommittee, IEAB, FSOC, hatchery managers and consultants (HDR Engineering, Inc./McMillen Jacobs Associates; and QW Consulting, LLC).

He read the guiding issues and principles and showed a map of program hatcheries, screens and lands.

He outlined the annual process and future assessments: \$500,000 will be needed annually after 2020.

- \$250,000 through securing cost savings from program projects that have decreased expenditures; and
- \$250,000 from the Budget Oversight Group placeholder.

He read a list of funding tools. There is funding for 2019 and 2020, but the Fish and Wildlife Committee will want to confirm the approach monetarily and details before 2021 actions. There's still an interest to pursue discussions on a regional level on the endowment.

Fritsch reviewed the actions accomplished for hatcheries in 2017 and 2018. 2018 is the first year for screens.

Mercier said it's a business approach going forward. Member Booth pushed us, and I didn't think it would take four years, but we got there, he said.

Member Ferrioli said he appreciates the inclusion of the endowment fund. He has seen serious meltdowns at other state agencies. We shouldn't kid ourselves into seeing a transfer of money as cost savings. It's just a transfer of funds. The budget oversight group is one of the most important functions we have: to keep rechecking and identify where the dollars might be piling up.

Member Karier said this is an important and good piece of work. It does exactly what you said: it makes sure we don't defer maintenance costs. I want to emphasize that this funding does not come at expense of the \$30 million you'll save in fish and wildlife. Is that correct? Mercier replied these funds are from the savings identified by Member Anders' Cost Savings Workgroup.

Member Karier noted it said to capitalize when possible. BPA used to capitalize everything it could but then it went into debt. It seems that the bullet should be qualified.

Member Norman said this particular project was first thing he was involved in when he became a member. He praised the leadership of Member Booth and Fritsch's work. With the five-year review, what's the vision of how that could be conducted? Would we still need an outside consultant? Fritsch said they envision an abbreviated version of what was done before. He said we'll need to hire an independent consultant, but they could do most of it over the phone with some site visits. There will be a cost that will have to be captured in the budget.

Northwest Power and Conservation Council Motion to Support the Implementation of the Asset Management Strategic Plan

Member Anders moved that the Council approve the implementation of the Asset Management Strategic Plan with a placeholder fund of \$500,000 and with the conditions that the Asset Management Committee provide annual updates to the Council; confirm implementation of the plan prior to 2021; and work on establishing an endowment fund to support implementation, as presented by staff and recommended by the Fish and Wildlife Committee.

Member Baker second. He encouraged everyone to vote for it.
The motion was approved unanimously.

Member Booth said was a fulfilling period of his life to successfully complete this before I hang up my spurs. He praised Mercier and others at BPA. He thanked Terry Morlan at IEAB and the state staff who attended the committee meetings. He thanked Members Norman and Anders, and singled out the efforts of Mark Fritsch.

9. Council decision on release of Draft Mid-Term Assessment for public comment

Ben Kujala, Power Division director, reminded Council members that they went through the content and detail of the draft at the last meeting. They received good comments from Member Karier. Council approval of the draft for public comment is recommended by Member Baker, who remarked that there was great work by the staff.

Northwest Power and Conservation Council Motion to Approve the Release of the Draft Mid-Term Assessment of the Seventh Plan for Release with 60 Days of Public Comment

Member Anders moved that the Council approve the release of the Draft Mid-Term Assessment of the Seventh Plan for public comment for a period of 60 days, as presented by staff and recommended by the Power Committee.

Member Devlin second
The motion was approved unanimously.

10. Council decision on comments for Draft Northwest Energy Efficiency Alliance Business Plan

Charlie Grist, conservation resources manager, updated the Council on NEEA's funding cycle and its draft business plan.

Member Devlin said there was a robust discussion in the Power Committee. One item was dropped, an assessment for multifamily housing, and the Council is recommending that be restored. He said it's especially curious that it was dropped at this time given the Council's recent emphasis on hard-to-serve markets, where multifamily was highlighted. Plus,

conservation is becoming more difficult, so we'd like to break that barrier. We're just asking that NEEA look closer at what its priorities are, given the needs of the region and the Council to do the work we're supposed to do.

Kujala, said that clearly, NEEA has some budget constraints. We're trying to recognize that while still pointing out areas where we'll have difficulty. Grist suggested NEEA could assemble a panel of subject matter experts to get coverage on multi-family, and hopes to find a solution that works for everyone.

Northwest Power and Conservation Council Motion to Approve Comments to Northwest Energy Efficiency Alliance on its 2018 Business Plan

Anders moved that the Council approve comments to the Northwest Energy Efficiency Alliance on its 2018 business plan, as presented by staff and recommended by the Power Committee.

Member Karier second.

The motion was approved unanimously.

11. Briefing by representatives from Chelan Public Utility District regarding innovative developments in hydro research and dam safety

Elizabeth Osborne, senior energy policy analyst, introduced Chelan Public Utility District's Kirk Hudson, managing director of generation and transmission and dam safety (working on the Hydropower Research Institute); and Bill Christman, chief engineer, dam safety/natural resources.

Hudson talked about how to remain competitive on the wholesale energy market. Advancements have been made on the machine and design side in hydro. But the new frontier in hydro industry improvements is digital transformation. We can't affect wholesale energy prices, but we can impact the production costs, the workmanship and the quality of materials going into hydro projects, he said. They established the Hydropower Research Institute (HRI) to work with other hydropower owners to try and get their arms around all the instrumentation data that's being produced. Each hydro owner is doing their own thing with their own systems. Owners are collecting different kinds of data. To address this, they established HRI to gather operational data. It was incorporated on July 17 as a separate nonprofit headquartered in Wenatchee.

Hudson said there's a tremendous value associated with data. They need to address the culture. They used to have to limit the data because of the cost of storage. That's no longer an issue, he said. It's a conservative industry, but it needs to move forward with the technology available. He discussed how to participate in HRI, both for people who can provide data (contributors) and those who want it (subscribers).

The Kaplan shaft failure is an example of a case study undertaken by HRI. They spent \$150,000 on modifications and spent over \$1 million to fix it. If you compare operational data, others can learn from it.

Hudson talked about HRI's governance. It is guided by technical steering committee made up of Kirk Hudson, Chelan PUD; Lisa Martindale, Alabama Power/Southern Company; and Daniel Rabon, USACE Hydropower Business Line. They have a commitment from USACE to represent operational data from 110 hydropower plants and 489 units. The goal by end of the year is to have data from Chelan, Southern and USACE – representing 30 percent of hydro in the U.S. Then they will be ready to accept new contributors in Q1 2019. One of the concerns they've heard from other hydro owners surround security privacy and market concerns. There's less of a desire to see whose unit it is than to see how it responds to an energy imbalance market. So all the data that's going to be in the system is going to be anonymized. The data will lag by a month as well. For security, the data will be pushed to the cloud, not allowing access to control systems.

Member Karier remarked that it's a timely idea. Are there other categories of topics to focus on, or is it primarily repair, maintenance and those kinds of issues?

The main issue is reducing the downtime of units, Hudson said. There's value in standardizing the data being collected. Another category is the aviation industry. Jet engines have thousands of sensors on them. We see opportunities to spur development in the hydro industry. But the main value is on the O&M side.

Member Karier said hydro is being asked to do different things, such as integrating wind and ramping. Hudson said it's a huge area, such as comparing data to others who are seeing big swings they haven't seen before. We can see that hydro can respond to these different things, but what is it doing to the useful life of the unit? The more data we have the more we can understand these kinds of patterns.

Member Devlin said he expects this will be membership-based organization and doubts if federal entities would participate directly. He knows the Army Corps of Engineers has done a lot of this kind of data collection work. He asked if there's been any interaction with the Corp and the Bureau of Reclamation. Hudson replied there has been a lot of interaction with both entities. They have been doing this kind of work and there's an opportunity to share across the industry. Because this is governed by hydropower owners, there's more of an inclination to share.

Member Yost asked if he has talked to IOUs such as Idaho Power and Avista? Hudson said they have had a couple of workshops. Both have participated in those. They haven't committed yet, but they're interested — Northwestern Energy as well.

Christman talked about the seismic potential for hydropower — or the chance that we might experience earthquake on one of our projects. The entire Northwest has seismic potential, which could adversely affect hydro projects. With different tools, we can observe there are fractures in the earth's crust that have shown significant change since the last ice age. Earthquakes don't happen very often, however.

He reviewed the Yakima Fault Belt and areas around Wenatchee recognized as having seismic forces. It probably won't happen, but it might, so we're interested in them, Cristman said.

He discussed the different levels of earthquake potential. He talked about the possible impact of the Columbia Subduction Zone event on Chelan's facilities. It's important to protect the public and assets from ground-shaking events.

Looking at the potential risk of facilities, the Rocky Reach and Rock Island dams in Washington are low downstream hazards, while the Lower San Fernando Dam in Los Angeles is a high downstream hazard. Chelan Powerhouse and Switchyard is a low hazard as well.

Reading from slides, Christman said Chelan has evaluated its water retaining structures for the 10,000-year ground motion as a first step in the risk-assessment process. It also has evaluated the water retaining structures for the maximum credible earthquake. They haven't finalized the analysis for transformers and switchyards.

An ongoing second step in their risk assessment looks at things that would be important for maintaining control of the hydroprojects; areas where project robustness can likely benefit the most. Examples include control room resiliency and enhanced operator response training. This ensures that essential hydro control systems remain functional.

Chelan PUD's three hydroelectric projects' water-retaining structures are resilient for rare seismic loads. For the most part, they meet the standard for not having a release of water. There are some things they could do to update structures to make them more robust at a modest cost.

Other risk-informed, decision-making is ongoing because our projects are subject to a variety of risks (such as the effects of aging, changes in anticipated flood flows, and security breaches), Christman said.

Member Karier commented that when Washington had an earthquake a decade ago, there was a crack in Olympia rotunda. What if a dam above you is impacted? How does it affect you? Shouldn't it be a system study?

Dome structures are like an egg, Christman replied. Our dams are concrete gravity dams. Upstream, they have a lot of reinforcing. But they can crack. But there's no indication they'll mobilize enough to fail. Cracking is something I'm confident we'll address. It might make gates difficult to remove, but it could occur over a long planning cycle. It would take a rare earthquake. They do regular exercises with the Corps, the Bureau and BC Hydro to practice in the event that occurred.

Member Baker said that if you're on the coast, it's mostly movement of water, not the effect of shaking. Is that something here you have to be concerned about, with how the water moves? Yes, Christman said, there's that surge tank at Chelan. Water creates a lot of momentum. That's what could make a structure fail. It's amenable to cracking or failure because of how water moves at different cycles. Coastal areas could have wave action from a subduction event. However, in the long, narrow reservoirs in Lake Chelan, there isn't a straight enough corridor for a wave to impact a dam site.

Member Yost asked if Chelan has a budget for dam safety. We have a long-range plan, Christman said. I think about our budget on a one- to two-year basis. There's no structural modification in the next year or two, but there's money for studies.

Member Yost asked if there's a budget amount for regular maintenance. No, but we will have one in the near future, Christman believes. I haven't conceptualized how to address transformers and accumulator tanks, he said. Most of what we come up with will be easy to do and will be programmed into regular work cycles. We do have an annual O&M budget for dam safety. Projects presented here go through our financial forecasts and are justified through business cases.

12. Council decision on scope of science and economic predation review: Delayed to the November meeting

Special briefing on natural gas pipeline explosion in Prince George, British Columbia.

Steve Simmons, senior economic analyst, told Council members that Enbridge Inc reported a pipeline rupture on the Westcoast/BC natural gas pipeline in a rural area north of Prince George, B.C. There were no injuries and some evacuations. Puget Sound Energy and FortisBC has asked customers to conserve gas and electricity following the rupture. It's pretty serious, Simmons said.

There is currently no gas flowing across the Canadian/Washington border at Sumas, Washington to the I-5 corridor. Williams Northwest Pipeline has declared force majeure. Member Booth asked what percent of the pipeline's gas goes into Seattle. There are other alternatives, Simmons said. Williams also connects to Alberta, the Rockies and storage from Jackson Prairie in Washington. This is what that modeling (discussed in the Power Committee meeting) was all about.

Member Karier said the study was a possibility. Simmons said to remember it's a computer model, not the real thing, but it is serious. Member Karier asked if others should reduce gas or electric use. Will it spill into other markets for price and supply? Too early to tell, Simmons said. Kujala said they'll look at prices and see if they see a spike.

Member Norman asked, what if this occurred in January? Simmons said that's what the modeling looked at: an event in December. It looked at a worst-case scenario. This time of year is typically when we have injection for storage. Williams has contacted shippers.

13. Council Business

Northwest Power and Conservation Council Motion to Approve the Minutes of the September 11-12, 2018, Council Meeting

Member Anders moved that the Council approve for the signature of the Vice-Chair the minutes of the September 11-12, 2018, Council Meeting held in Eugene, Oregon.

Member Karier second

The motion was approved unanimously.

Northwest Power and Conservation Council Motion to Recommend to the Independent Scientific Advisory Board the Appointment of Thomas Quinn to the Independent Scientific Review Board

Erik Merrill provided background on Thomas Quinn, who is an expert in predator and prey interactions.

Member Anders moved that the Council recommend that the Chair, in his capacity as a member of the ISAB Administrative Oversight Panel, support the appointment of Thomas Quinn to the Independent Scientific Advisory Board, as recommended by staff.

Member Baker second

The motion was approved unanimously.

Northwest Power and Conservation Council Motion to Authorize the Staff to Enter into a Regional Portfolio Model Software Support Contract in an Amount not to Exceed \$50,000 for Fiscal Year 2019, as Recommended by the staff

Member Anders moved that the Council authorize the staff to enter into a Regional Portfolio Model software support contract in FY 2019 in an amount not to exceed \$50,000, as recommended by the staff.

Member Baker second.

Member Yost said as we have gone through the development of the models and contracts for websites, staff needs to present to the Council what contracting it has for web services and models. I'd like to have a picture of a year or two out of what that may be in our budget and what we can anticipate — what we could do in-house and what we have to contract for. I'm not really concerned, but we've spent a lot in the last few years. The model work has been excellent.

Kujala will follow up with the division budget for contracting.

The motion was approved unanimously.

There was no public comment.

Chair Yost adjourned the meeting at 11:01 a.m.

Approved November ____, 2018.

Vice-Chair