StreamNet 2020
Annual Report

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II.   Executive Summary

StreamNet serves as a regional coordination body to support data management and facilitate cooperation across organizational boundaries. The Pacific States Marine Fisheries Commission (PSMFC) hosts the StreamNet project and its databases, which provide access to regional fish and fish-related data by maintaining a coordinated, standardized, web-based distributed information network. The need for regionally coordinated and readily accessible data has been identified by the Bonneville Power Administration (BPA), the National Oceanic and Atmospheric Administration Fisheries Program (NOAA), and the Northwest Power and Conservation Council (NPCC). To ensure access to these data, StreamNet supports technical staff within the agencies (data stewards) who compile and submit these data in standardized, publicly accessible, regional data repositories. StreamNet also collaboratively leads and coordinates a number of initiatives to assure a regional approach to data management among federal, state, and tribal fish and wildlife agencies.

This annual report summarizes the work performed during calendar year 2020, which spans fiscal years 2019 and 2020. During calendar year 2020 StreamNet continued to implement the Coordinated Assessments Partnership (CAP) with the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) and engaged in collaborative efforts with all partners to advance the quality of shared data. Below is a brief highlight of these 2020 accomplishments:
- StreamNet continued to acquire fish data from our partners resulting in a total of 13,953 records submitted to the Fish High Level Indicator (HLI) Coordinated Assessments Data Exchange (CAX) system, and a total of 189,902 records in the Fish Monitoring Data (trends system), by the end of calendar year 2020. During 2020, the Nez Perce Tribe (NPT) started submitting their data directly to the CAX system and the Yakama Nation's (YN) STAR data system has increased YN data submittal as well.
- Some specific accomplishments achieved by the individual StreamNet subprojects related to development or improvement of their organizations' data storage systems includes:
  o The Colville Tribes' development of software to improve the efficiency and quality of the calculations of juvenile population estimates.
  o Idaho Department of Fish and Game's success in achieving upload of data directly from their system in a single step in order to simplify standardization of the data and speed submission to the StreamNet database, saving significant time.
  o Montana Fish Wildlife & Park's progress in converting data files residing with individual biologists to file types that can be uploaded into the centralized database, eliminating the need for biologists or technicians to spend their time hand entering historic data into the system.
  o Oregon Department of Fish and Wildlife's new web application for Coordinated Assessments data, which enables data to be entered directly into the ODFW SQL server database and automates the processes for validation and submission to the StreamNet API. The Coordinated Assessments Validation, Evaluation and Submission (CAVES) web application, was completed and became fully operational for all-natural-origin high-level indicator tables in 2020.
  o Washington Department of Fish and Wildlife's progress in working with agency headquarters staff to implement mobile data collection platforms, staging databases and automated transfer mechanisms for sport and commercial, adult survey, and juvenile data systems, which ultimately inform the Fish HLI (CAX system) as well as other consumers.
- The new Fish Monitoring Data tabular query was designed so that users can quickly find and access the data they are looking for by using filters, and can choose to download these data into an Excel Spreadsheet file or copy the URL to easily reference and share these data with others. The Fish Monitoring Data tabular query pulls data using an API and was designed to better integrate with the StreamNet website.
- StreamNet provided funding to contribute to advancing tribal data management and sharing capacity to YN, the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO), and Shoshone Bannock Tribes.
- Progress was made in consolidating PSMFC-StreamNet server/system and virtual deployment within the PSMFC virtual environment to simplify maintenance tasks and backups.

- PNAMP and StreamNet co-organized the Emerging Technology Information Session (ETIS) Webinar Series. Participation in the ETIS webinar series ranged from 30 to over 100 attendees and included individuals from across the USA and other countries.

Recommendations to the Executive Committee:
- Support expanding data flow from agency/tribal data systems to StreamNet data systems that contribute to informing the NPCC 2020 Addendum (goals, objectives and indicators); and BPA and U.S. Fish and Wildlife Service (USFWS) bull trout and sturgeon needs.
- Support implementation of the Five-Year Plan for Coordinated Assessments Partnership by strongly encouraging BPA, NPCC, and USFWS to build on StreamNet/CAP successes for improving access to bull trout data.
- Assist in securing short-term funding to support CAP co-leads to perform outreach with potential data providers outside of the Columbia River Basin to better support the reporting needs of NOAA and USFWS.
- Support implementation of the manual CAP Fish HLI Qulaoty C procedure once finalized in CY2021 by StreamNet funded partners by providing BPA funding for this task.
- Support participation, either by providing in-kind or BPA funding, by all data providers and data consumers in discussions to refine existing data categories or develop new data categories and exchange standards in PNAMP FWMG/StreamNet task groups to address issues that require input from a broader group of experts including biologists, fisheries managers, and CBF&W librarian.
- Advance implementation of improved metadata documentation within agencies' and tribes' data systems, especially for data of regional importance.
- Encourage NPCC, in addition to BPA, to officially recognize PSMFC StreamNet GIS and the StreamNet database systems (Fish HLI and Fish Monitoring Data) as the system of record for the Program.
- Encourage BPA to consider providing and/or increasing funding for data stewards, especially with Tribal partners.
- Continue to encourage and invite other data providers, including CRITFC member tribes, Northwest Indian Fisheries Commission (NWIFC) member tribes, Shoshone Bannock Tribes (SBT), and others to participate in and/or become members on both the Executive Committee and Steering Committee.
- Encourage and support BPA and NPCC decisions to maintain or increase the StreamNet FY2021 base funding ($2,145,483, not including ODFW portfolio funding), to facilitate meeting the needs of BPA and NPCC.
- Facilitate discussions among BPA, NPCC, NOAA, and USFWS on funding avenues that could be secured to address new tasks, and to reduce the budget shortfall associated with decline in the purchasing power of the budget (i.e., the budget will effectively decline as costs increase).
- Support efforts by StreamNet and PNAMP to secure alternative sources of funding to complement BPA funding such as EPA grants by providing letters of support and exploring synergies among federal agencies and multi-state compacts that consume StreamNet data.

Lessons Learned:
- Ensuring the integrity of data flow and quality requires ongoing maintenance and updates, including adopting advances in data management and reporting technology (open source and proprietary programs and tools) to improve efficiencies across the entire data life cycle. Several of the data providers are adopting a more automated data flow from field data collection to StreamNet's data systems, which would be beneficial to all data providers.
- Improving access of data maintained by StreamNet to audiences with different technical knowledge will increase the value and use of these data by the public and for informing decisions.
- Proper documentation for data integrity is critical to ensure that these valuable data, funded by the public and ratepayers, remain accessible to inform critical uncertainties and decisions into the future.
- Documentation of the StreamNet Program groups and processes is necessary to ensure successful successor planning and coverage when needed.

III.   Introduction

The need for effective and timely access of information to inform regional decision-making continues to be prominent in the Columbia River basin (CRB) and the Pacific Northwest as a whole. Specifically, the Bonneville Power Administration (BPA), the National Oceanic and Atmospheric Administration Fisheries Program (NOAA), and the Northwest Power and Conservation Council (NPCC) have all identified an ongoing need for regionally coordinated, securely stored, and readily accessible data to inform their reporting and decision-making processes. Furthermore, the Northwest Power Act, which established the NPCC, calls for decisions to be made using the best available science, which requires the best available information. StreamNet provides regional standardization and access to data throughout the Columbia River basin through development and maintenance of regional data repositories for fish and habitat.

A. Project Background

StreamNet is a collaborative data sharing project that works among the federal, state and tribal agencies to locate, assemble, and share, in a standardized manner, specific data and indicators from the local scale to inform regional needs. StreamNet also has an important role in archiving data sets and providing access to historical information, especially those that support policy decisions such as the NPCC's Protected Areas, system and subbasin planning data, wildlife Habitat Evaluation Procedure (HEP), and US Congress funded Hatchery Reform Group and Hatchery Scientific Reform Group (HSRG) reports and data sets. Data submitted to StreamNet have been recently focused on the Columbia Basin but began as region-wide coverage and may soon find themselves evolving back to the region-wide coverage through the CA. To properly address regional reporting and decision-making processes there is an ongoing need to include information from other areas of the Pacific States, such as for the NPCC's Protected Areas and NOAA 5-year status reviews for listed salmonids. Information from outside the basin is also submitted to StreamNet when it is more efficient during the data submittal process because the geographic coverage for many of StreamNet's partners overlap the CRB but extends well beyond its boundaries. The overarching goal of StreamNet is to make river-related information collected in the Pacific States, with an emphasis on the Columbia River basin, standardized and accessible, in order to inform management questions and strategies (Figure 1). The data disseminated represent primary fish-related data, regardless of the funding sources responsible for supporting the work of field collection. Thus, all data of a given type are included, both those paid for under the BPA-funded Fish and Wildlife Program and similar data that are obtained based on other funding. This is important because in order to conduct assessments or monitor population status and trends, all data relevant to each population must be used, regardless of funding source or agency collecting the data.

Figure 1: StreamNet focuses its data sharing efforts on data within the Columbia River basin. However, data from other Pacific States are included as well to better support partners' information needs such as the NPCC Protected Areas and NOAA's 5-year salmon and steelhead status assessments.

The genesis of StreamNet was the call for standardized information to support the NPCC's 1984 Columbia River Basin Fish and Wildlife Program (Program) and 1983 Northwest Conservation and Electric Power Plan (Plan) Hydro Assessment Study (HAS) to document the environmental health and energy potential of the basin's rivers. At that time, when StreamNet began in 1983 albeit under a different name, it was intended to be the region's Rivers Information System. The HAS was a cooperative regional effort by the BPA, the NPCC, the four Northwest states, the region's Indian tribes, and Federal land management agencies. The goal of this effort was to assess the significance of the region's rivers in a standardized fashion with the public's input, and to document those results. The HAS consisted of three distinct, coordinated efforts. For one, BPA, the NPCC, and the U.S. Army Corps of Engineers cooperated to develop the Pacific Northwest Hydropower Data Base and Analysis System (NWHS). For another, the NPCC led the effort to design the region's first anadromous fish data system called the Coordinated Information System (CIS; 1987 Program states needed database content and 1992 Program section 7.6 describes CIS). For the third, BPA began coordinating the inventory and analysis work on the remaining environmental categories, called the Pacific Northwest Rivers Study (PNWRS). Data generated by these efforts covered all four states (comprehensive) and contained the same data elements for each state (consistent structure and content). The HAS efforts resulted in detailed natural resource data sets for the region and the technical and administrative infrastructure to ensure the maintenance and use of the information housed in the Northwest Environmental Database (NED) and in the Coordinated Information System (CIS). These cooperative data collection efforts spanned across agency and state lines with information updates transmitted from the states to the regional system biannually. Source data were maintained at the state level to ensure accuracy and ties to other state data collection efforts.

StreamNet originated following the integration of the Coordinated Information System (CIS) and the Northwest Environmental Database (NED). The NED had previously integrated data from the Hydro Assessment Study (HAS), specifically data from the Northwest Hydropower Data Base and Analysis System (NWHS) and Pacific Northwest Rivers

Study (PNWRS). Over time the original StreamNet project evolved to adopt technology that facilitated data sharing and to respond to information needs from regional decision-making efforts (Figure 2).
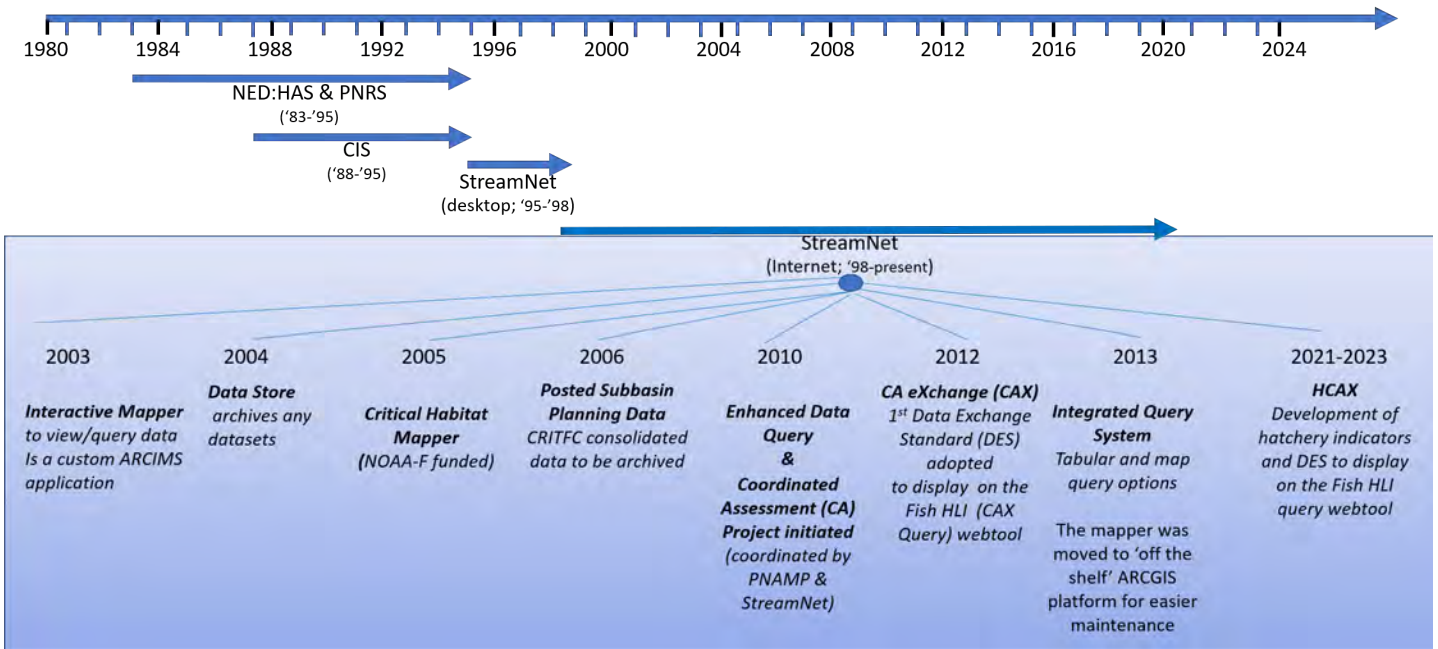

Figure 2: Timeline showing the merging of CIS and NED in 1995 to form the StreamNet project and its subsequent evolution to current day StreamNet data sharing project.

During its most recent significant evolution, following the 2012/2013 NPCC programmatic recommendations for Regional Data Management Projects[i] and those specific to the StreamNet project, as well as the NPCC recommendations generated from the follow-on Program Evaluation & Reporting Committee (PERC) process[ii], the StreamNet project:

- Established an Executive Committee with representatives of NPCC, BPA and fish and wildlife managers to direct data management direction and priority (Figure 3),
- Prioritized efforts on making synthesized information, such as population estimates, accessible through StreamNet with emphasis on the high-level indicators (HLIs) identified through the Coordinated Assessments (co-led by Pacific Northwest Aquatic Partnership (PNAMP) and StreamNet),
- Continued to evolve towards a more accessible platform for various users and optimize webservices to facilitate coordinated data-sharing and data depiction, including updating its main website and developing an application programming interface (API) that allows different systems to talk to one another and exchange data,
- Expanded its participants to include additional managers and data collecting entities that are not directly funded through the StreamNet project,
- Focused its BPA funds on providing data needed for BPA and NPCC reporting needs such as NPCC HLI reports and BPA Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) reports for priority populations.

The most recent NPCC recommendation, the August 2019 programmatic and project recommendations[iii], continues to support the StreamNet project and further recommended that StreamNet continue its effort to expand its steering committee membership to agencies managing fish data and to initiate work on other priority NPCC program indicators including hatchery indicators. To this end StreamNet continues to seek opportunities for expanding the CAP HLIs to other categories and fish species. StreamNet's prioritization of work continues to be informed by the Five-Year Work Plan for the Coordinated Assessments Partnership (CAP).

Figure 3: StreamNet is hosted by PSMFC and largely funded by BPA to promote efficient data sharing from member agencies and tribes in support of the NPCC Columbia River Basin Fish and Wildlife Program. StreamNet committees' members currently include the four states, Colville Tribes, CRITFC and CRITFC CBF&W Library.

B. Coordinated Assessments Partnership

The Coordinated Assessments Partnership's (CAP) goal is to develop efficient, consistent, and transparent data sharing among the co-managers (fish and wildlife agencies and Tribes) and regulatory/funding agencies (BPA, NOAA, and US Fish and Wildlife Service) of the CRB for fish-related data. The CAP was designed (in part) to assist and streamline state and tribal data contributions to regional decision-making processes (e.g., NOAA 5-yr status assessments) and reports (e.g., NPCC Program Tracker; BPA FCRPS BiOp reports). The project has been coordinated by PNAMP and the PSMFC StreamNet project since its inception in 2010 (see: https://www.pnamp.org/project/coordinated-assessments-for-salmon-and-steelhead). The development of the CAX was partially funded by a 2015 EPA Exchange Network grant (Salmon Coordinated Assessments Data Exchange project #83546401, closed). Close contact with HLI users (BPA, NPCC, NOAA, others) and with regional fish and wildlife managers is maintained and is crucial to the success of the project.

The project is focused on sharing standardized regional high-level indicators (HLIs) for the health of fish populations. CAP is a collaborative effort amongst many partners and its scope, both jurisdictionally and species topics, remains flexible to address emerging regional data and reporting needs. The intent is for the CAP to be a collaborative, consensus-based effort. Parties involved in the CAP remain flexible so that participants with the required expertise (e.g., resident fish managers, habitat managers, etc.) will be recruited as needed, as CAP moves to additional indicators. Since 2010, the agencies and tribes within the CRB participating in the CAP have successfully developed the Coordinated Assessments Data Exchange (CAX). The CAX's Fish HLI query has effectively communicated and made accessible natural-origin salmon and steelhead population HLIs to decision-makers and other interested parties. The Fish HLI query is valuable in providing timely access to CRB HLIs used in federal reports and research, as well as reporting needs of the Washington State Governor's Salmon Recovery Office, NPCC, and BPA (see Appendix C for crosswalk between NPCC populations and CAX populations). Funding has been the limiting factor for expanding the Fish HLI query (CAX data system) beyond natural origin HLIs.

The second five-year plan for the CAP was discussed in June 2019 by the StreamNet Executive Committee and adopted in August 2019[iv]. The plan is revisited annually to ensure alignment with regional priorities and changes as needed if regional priorities change, and a revised version was adopted September 2, 2020, by the StreamNet Executive Committee. The five-year plan for the Coordinated Assessments Partnership guides the implementation of this project

by prioritizing data for contribution from partners. The CAP plan currently focuses on natural origin salmon and steelhead populations in the CRB with emphases on BPA priority populations. The primary data types contained in and disseminated through the CAP that relate to abundance and Viable Salmon Population (VSP) parameters are five VSP indicators including population scale estimates of natural spawner abundance, smolt to adult ratio, adult recruits per spawner (spawner to spawner ratio), smolt outmigrants, and presmolt abundance. In addition to high level indicator data, related data (aka Trends) is also curated by StreamNet, including spawner counts, juvenile counts, redd counts, and dam and weir counts. These trends data relate to the population scale estimates of VSP parameters, summarized to annual totals. The CAP Plan also indicates other fish species, e.g., sturgeon, and category of data, e.g., hatchery indicators, as priorities, and these will be explored as additional funding and resources become available. Implementation of the plan will require resources from a diversity of sources to provide access to the data approved by the Executive Committee. To this end the CAP members secured a USEPA Exchange Network grant in 2015 that was focused on sharing natural origin salmon and steelhead HLIs, and in 2020 the CAP Core Team was awarded an EPA Exchange Network Grant that will fund developing and flow of a small subset of hatchery fish HLI with work occurring during 2020-2023.

C. Policy Guidance

The StreamNet project is implemented following the guidance provided in the [2021-2026 StreamNet Vision and Strategic Plan](#) [v] (adopted September 2, 2020) and through the collaboratively developed Five-Year Plan for the Coordinated Assessments Partnership, which is adopted by the StreamNet Executive Committee. The CAP Plan is updated annually, while considering a 5-year implementation period. The direction provided by the CAP Plan considers guidance from NPCC Program and Project Recommendations, which in turn stipulate a need for StreamNet to address the reporting needs of NPCC and BPA. Below are excerpts of the current NPCC Program and related NPCC and BPA data priorities that inform the CAP Plan and work implemented by StreamNet.

1. Data Management Principles and Measures

StreamNet follows the 2014 NPCC Fish and Wildlife Program's guidance for data management ([Program Part Four](#) and its [draft 2020 Addendum Part 1B](#)) by making information accessible to the public and for decision-making at a regional-scale. The Program guidance implemented by StreamNet includes:

- Manage data in a manner that is searchable and usable by interested parties.
- Properly document metadata associated with data are ensure these are accessible through web links or attached documentation when data are accessed.
- Provide access to categories of data, such as fish abundance, through a single centralized website.
- Produce derived estimates and indicators (e.g., population estimates) from preliminary data collection (e.g., redd counts) and made publicly accessible along with supporting data.
- Work collaboratively to refine indicators that can be used consistently to inform decisions and reporting needs, providing these data in regionally consistent formats to all interested parties in a timely manner, and preserving these data beyond the longevity of a project.
- Facilitate collaboration among agencies, tribes, and tribal consortia, as well as with other monitoring entities in the Basin, which contribute and consume data to inform decisions. To effectively support the Program indicators and objectives, which include hatchery, anadromous and resident fish, it is essential to prioritize which information needs to be addressed first, based on the Program's guidance.
- Refine content of the data management system to align with partners' reporting needs including the NPCC.
- Maintain data and products supporting the NPCC FW Program, both historical and current, in a structured manner that facilitates public access such as information related to Protected Areas information, habitat evaluation procedures, and GIS layers.

2. Priority Populations

BPA's Environment & Fish and Wildlife division, in 2016, identified priority populations that were associated with data needs for the FCRPS BiOp. These were categorized by BPA as either Tier 1 (18 highest priority populations) or Tier 2 (51

next highest priority populations). BPA requested that StreamNet, including all StreamNet partners, focus efforts on obtaining as much data as possible for these priority populations[vi]. StreamNet continues implementing this guidance and it is reflected in the CAP Plan.

3. High Level Indicator Priority Categories

The priority high level indicators (HLIs), which have guided the work of the CAP since its inception, were focused on providing derived indicators to address the Viable Salmon Population (VSP) data needs for NOAA's 5-year status reviews. These also aligned with the specific indicators and metrics for reporting progress on implementation of the reasonable and prudent alternatives (RPAs) identified in the 2008 FCRPS BiOp[vii] and related documents. These HLIs, as well as others identified in the CAP Plan, continue to be a priority.

4. Trend Data Set Priorities

The 2014 NPCC Fish and Wildlife Program provides guidance on the information needed to track the status of the basin's fish and wildlife resources (Part Two, section V), report on the program's approved high-level indicators (see 2014 Program Appendix E), and assess progress towards Program goals, objectives and indicators (see 2014 Program Appendix D and its draft 2020 Addendum Part 1A). During 2018, the Executive Committee directed the StreamNet project to resume updating selected, high priority traditional data sets, such as long-term sets that support CAP indicators and those that are used to maintain the NPCC dashboards. This continues to be a priority for StreamNet as available resources allow.

5. GIS Data Layers Priorities

PSMFC's GIS Center supports the management and publication of StreamNet's spatial data layers related to fish populations, monitoring sites, fish facilities, and stream survey reaches associated with time-series data stored in the StreamNet database. This centralized GIS provides a comprehensive location referencing system for finding and accessing Columbia River basin fisheries information compiled by the StreamNet partnership. It enables discovery and display of the CAX HLI at the population scale and drives the web-based mapping components of the CAX Query system and StreamNet Query systems. StreamNet's core GIS data layers are recognized as BPA's system of record for mapping fish facilities (e.g., hatchery, weirs) and fish distribution within the basin. PSMFC's centralized GIS also supports the Columbia Basin PIT Tag Information System (PTAGIS) and the Regional Mark Processing Center (RMPC), providing consistency and synergy across projects.

D. Budget Considerations

In FY21 BPA reinstated the StreamNet Program to the FY2017 amount as recommended by the NPCC in its 2019 project recommendation[viii] for StreamNet (Figure 4). The FY21 budget contributed to fully supporting the remaining three PSMFC StreamNet staff and reinstating support of some PSMFC GIS staff time which had not been possible since FY13. This budget level, in additional to additional funding secured by PSMFC StreamNet, allowed StreamNet to support the Shoshone Bannock Tribes in developing their data management and sharing capacity, and allowed PSMFC StreamNet to subcontract with independent contractors, who are highly knowledgeable of StreamNet and CAP, to complement the limited PSMFC StreamNet FTE and assist in making progress on several BPA priority tasks during FY21. The partner agencies did not receive any increase during FY21.

To alleviate the financial constraints experienced by StreamNet partners, PSMFC StreamNet staff are continuously seeking alternative funding sources, in most cases translating in reduced PSMFC staff time allocated to the to the StreamNet Project to reallocate those funds to partners. Similarly, the CAP Core Team seeks funding from alternative sources as feasible. For instance, in 2015 the CAP benefited from a multi-year grant received by WDFW from the EPA. StreamNet was a sub-contractor under that grant. The purpose of the grant was to automate data flow on the key VSP indicators across the region and foster collaboration. The CAP Core Team and StreamNet Steering Committee also submitted a proposal to advance hatchery indicators in 2020. This proposal was selected for funding by EPA and the Hatchery Coordinated Assessments Data Exchange (HCAX) work was initiated late in 2020 and will continue to late 2023. This proposal was by Washington State Recreation and Conservation Office / Governor's Salmon Recovery Office with

WDFW, The Colville Tribes, PNAMP and StreamNet as sub-awardees, and with Idaho Department of Fish and Game (IDFG) and Oregon Department of Fish and Wildlife (ODFW) being funded through subcontracts from this funding.

The StreamNet budget does constrain the ability of PSMFC staff and partners to address the information and tasks requested by BPA in the time frame desired. BPA's inability to adjust budgets to address increases in cost of living and expenses compounds this constraint over time as shown in Figure 4, which depicts the decrease in the budget's nominal and real value since 2004. As rates and fees increase over time, the resources available, the ability of PSMFC StreamNet and partners to maintain and recruit staff with the required data management expertise to make up for lost FTE by employing independent subcontractors, and to support data management needs of Tribes not funded through the StreamNet Program will be further reduced.

E. StreamNet Data Sharing Partners – Providers and Consumers

Current partner agencies funded through this project are: The Confederated Tribes of the Colville Reservation (Colville Tribes); Idaho Department of Fish and Game (IDFG); Montana Fish, Wildlife& Parks (MFWP); ODFW; and Washington Department of Fish and Wildlife (WDFW). Colville Tribes joined in 2013 when they began receiving funding through StreamNet.

Other partner agencies that are not funded directly through StreamNet include: US Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), Columbia River Inter-Tribal Fish Commission (CRITFC) and its member tribes, Columbia Basin Fish & Wildlife Library (previously the StreamNet Library), and Pacific Northwest Aquatic Monitoring Partnership (PNAMP). During CY2020, Yakama Nation (YN) and CRITFC completed their subcontracted tasks for improving data management and sharing capacity, and the Shoshone Bannock Tribes subcontract was extended and increased to further assist them with data sharing that informs the CAX database. Up until 2017, the USFWS was funded through StreamNet, but no longer receives funding through StreamNet. In calendar year 2018 BPA and the USFWS reached agreement on funding these activities through a direct contract focused on integrating USFWS hatchery databases.
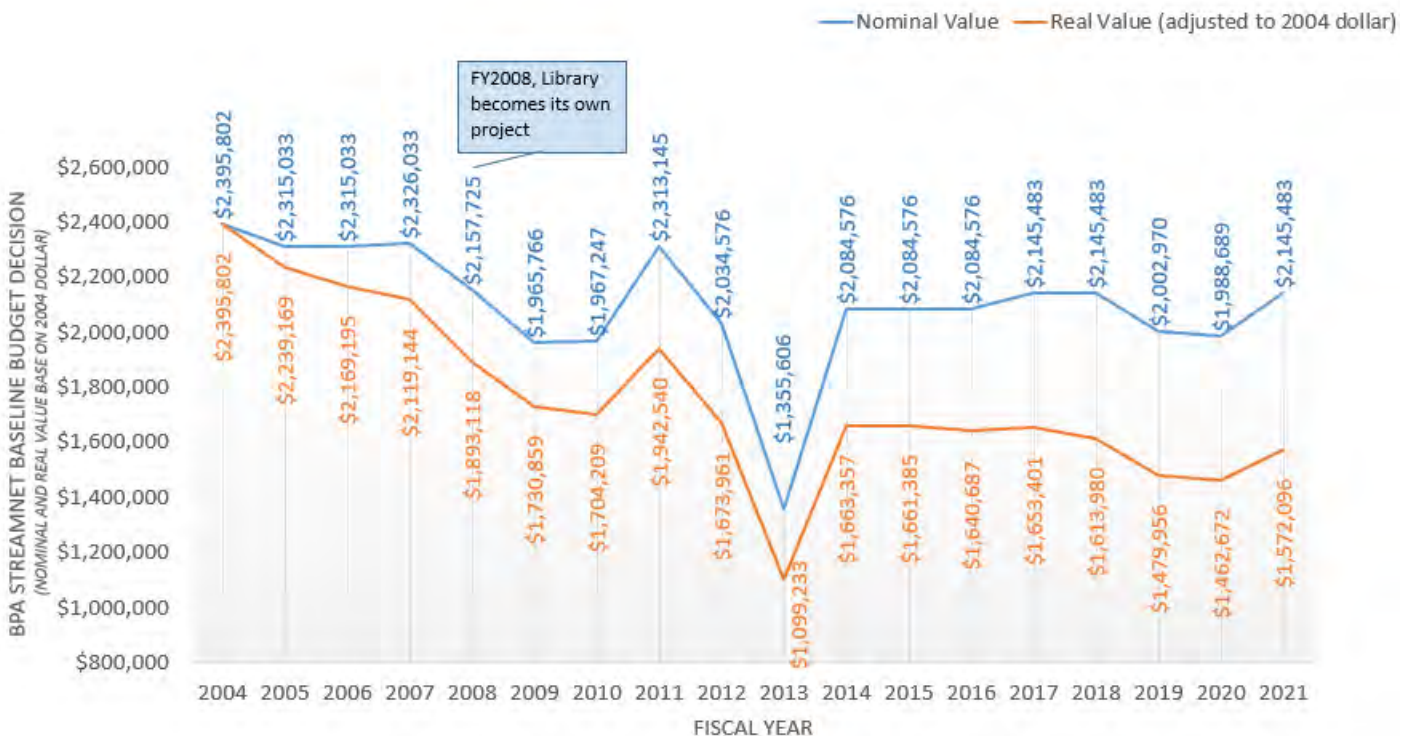
Figure 4: BPA annual budget decision for the StreamNet project between FY2004 and FY2021. In 2008 the Library was split from the StreamNet project and assigned its own project number and budget (BPA project # 2008-505-00). The sharp decrease in FY2013 arose from the percent cut made by BPA across all projects to address a BPA financial crisis. The cut in FY2013 resulted in substantial PSMFC staff time being reallocated to other PSMFC projects until the budget was readjusted to a higher amount in FY2014. Additionally, the FY2013 cut resulted in all PSMFC GIS support no longer being funded through the StreamNet budget from FY2013 to FY2020. The 2019-2020 decrease in the budget reflects the reduction agreed to by the Executive Committee in 2018 to assist BPA with another budget issue. In FY2021 BPA reinstated the StreamNet baseline (excluding ODFW portfolio funds) budget to $2,145,483 as recommended by the NPCC in 2019. When comparing the nominal budget value to the real budget value this further highlights the StreamNet budgetary constraints. The real budget value is adjusted to the 2004-dollar value considering inflation and calculated using https://www.usinflationcalculator.com/

IV.   Approach and Methodology

StreamNet[ix] supports a regional approach to data management, coordination, and standardization by increasing partner capacity and by improving access to fish data (Figure 5). The majority of fish-related data originate with the region's state, tribal and federal fisheries agency fish monitoring programs. StreamNet participates in or leads a variety of teams of data management professionals from states, tribes, and agencies that coordinate regional data sharing. Data flow has been streamlined through the implementation of application programming interfaces (APIs) for various data types.

StreamNet facilitates submittal of data and high-level indicators to its regional databases at PSMFC by supporting technical staff inside these agencies to help increase the capacity of these partners with managing, standardizing, and geo-referencing these data to the regional stream network (hydrography). PSMFC and StreamNet funded agency employees and subcontractors locate data, standardize data reporting through the cooperative development of protocols, complete Quality Assurance/Quality Control (QA/QC), and then assure the flow of data from state, tribal, or agency repositories to and through StreamNet. StreamNet supports individual agencies and tribes to work collaboratively to improve regional decision making.
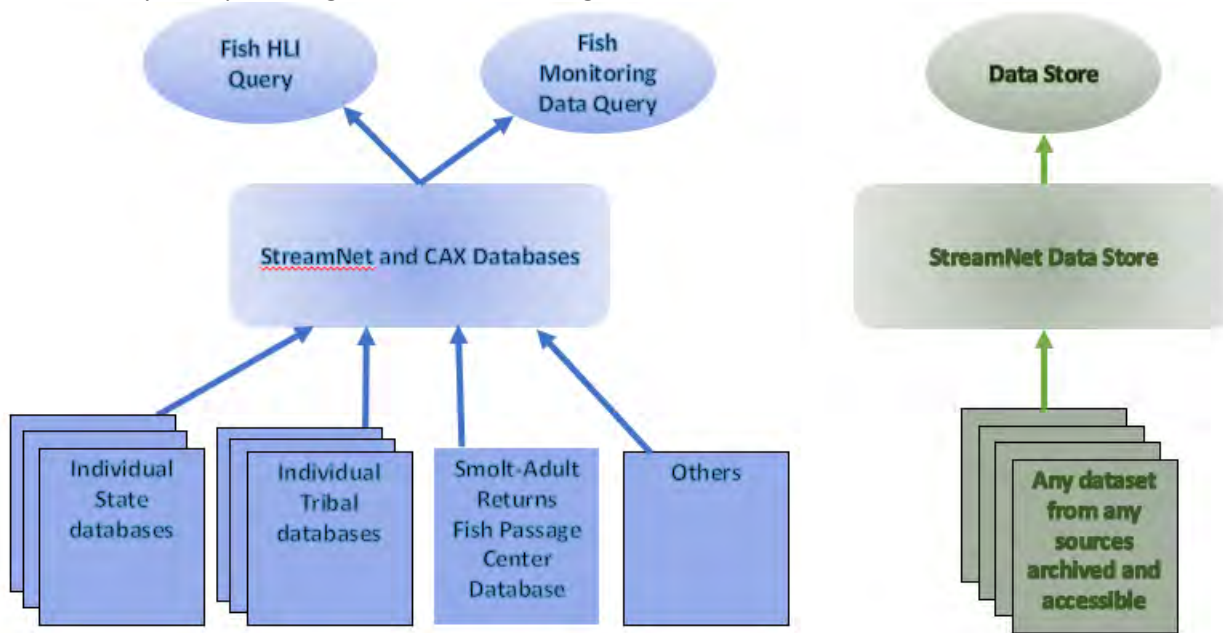
Figure 5: Flow of data from StreamNet members' agency/tribal databases, sub-regional databases, and other sources to the StreamNet database and Data Store and the StreamNet online data access tools.

Work Elements:	C. 189 CAP Data Coordination
	I. 189: Coordination

There are several committees and teams that contribute to the implementation of StreamNet, including an Executive Committee and a Steering Committee, and supporting teams (Figure 6). The Coordinated Assessments co-implemented by StreamNet and PNAMP involves a broader set of partners than the StreamNet project alone, and provides a broader jurisdictional engagement to address partners' Pacific Northwest information needs.

There are specific teams and workgroups associated with StreamNet to provide guidance and coordination for the CA. The Coordinated Assessments and StreamNet are both discussed and considered by the StreamNet Executive Committee when developing the annual work plan and the Five-Year Plan for Coordinated Assessments to inform data priorities.
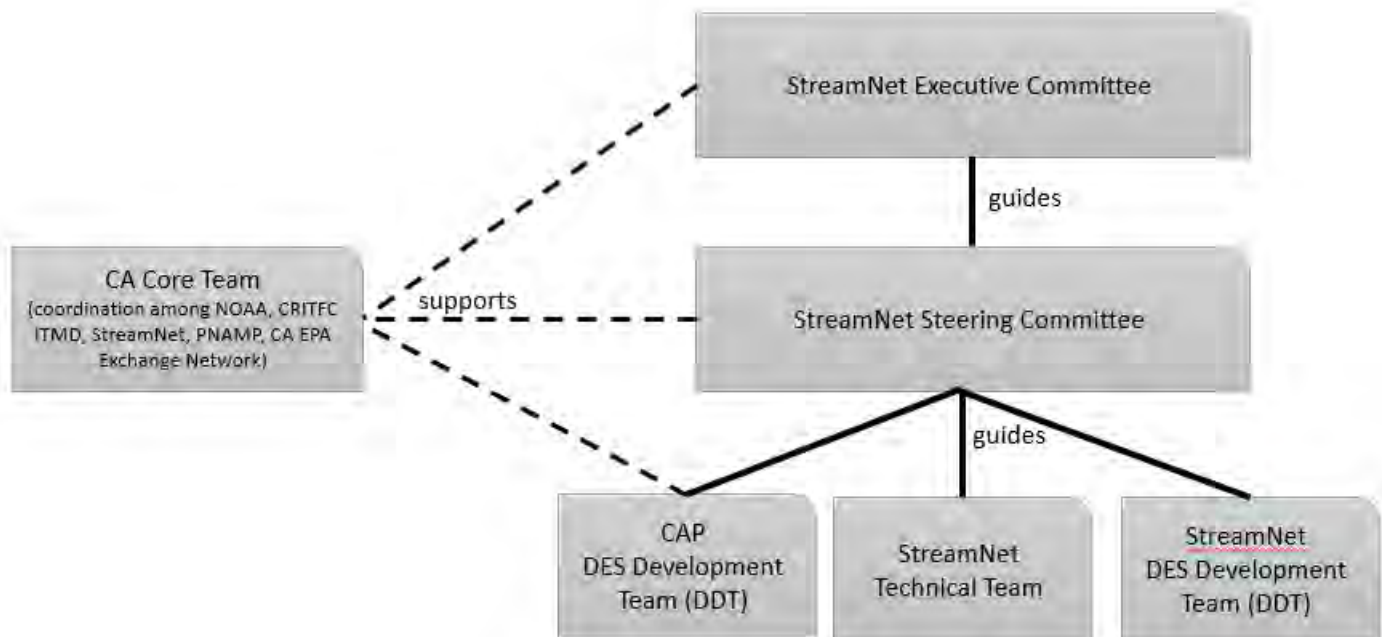
Figure 6: Relationship among the StreamNet Committees and Teams and their connection to the Coordinated Assessments work.

1. StreamNet Executive Committee

As part of the effort to improve coordination, in 2014 StreamNet instituted an Executive Committee. This committee is made up of policy staff and project leaders from the StreamNet partner agencies as well as other related organizations involved in managing and using fisheries data, primarily in the Columbia Basin (Table 1). The chair is the PSMFC Executive Director who is represented by the StreamNet Program Manager. This group provides the high-level guidance and decision-making for StreamNet and the Coordinated Assessments Partnership. This guidance includes review of the high-level goals and products of the Coordinated Assessments Partnership, Fish HLI query (CAX data system), time series (trends) data set trends for the StreamNet Fish Monitoring Data Query, and making decisions on species, populations, indicators, and priorities on a long-term and an annual basis. The Executive Committee reviews and annually approves the Five-Year Plan for Coordinated Assessments Partnership to ensure that the regional data priorities are being addressed through the Coordinated Assessments Partnership CAX and StreamNet databases.

Table 1: Calendar Year 2020 members of the StreamNet Executive Committee

Current Members	Affiliation
Randy Fisher (Chair) and Stan Allen	PSMFC
Zachery (Zach) Penney	CRITFC
Patty O'Toole	NPCC
Jody Lando and Rodrigo George	BPA
Greg Sieglitz	NOAA-Fisheries
Tom Stahl and Art Martin	ODFW
Dan Rawding	WDFW
Lance Hebdon	IDFG
Don Skaar	MFWP
John Arterburn	Colville Tribes
John Netto	USFWS

2. StreamNet Steering Committee

The Steering Committee helps to implement the decisions of the StreamNet Executive Committee, particularly as it relates to the content of the StreamNet databases and the queries it supports: StreamNet Fish Monitoring Data (trends) Query and Fish HLI Query (CAX). This committee includes active participation by StreamNet and non-StreamNet members at the data manager level (Table 2). This includes NOAA, BPA, NPCC, state agencies, and some tribal representatives. The committee is made up of technical project leaders from the StreamNet partner agencies as well as other related organizations involved in managing fisheries data, primarily in the Columbia Basin. The chair is the PSMFC StreamNet Program Manager.

Table 2: Calendar Year 2020 members of the StreamNet Steering Committee

Current Members	Affiliation
Nancy Leonard (Chair)	PSMFC
Denise Kelsey and Tami Wilkerson *(Denise Kelsey replaced Colleen Roe in Feb. 2020)*	CRITFC
Mark Fritsch	NPCC
Tom Pansky, Russell Scranton, and Matt Schwartz	BPA
Mari Williams	NOAA-Fisheries
April Brenden-Locke (replaced Cedric Cooney in November 2020)	ODFW
Brodie Cox	WDFW
Angie Schmidt and Evan Brown	IDFG
Dawn Anderson	MFWP
George Batten	Sitka Tech representing Colville Tribes
Doug Threloff	USFWS
Jen Bayer	PNAMP

3. StreamNet Technical Committee

The Technical Committee is composed primarily of PSMFC and state and tribal agency staff from StreamNet partners that implement data management actions (Table 3). The chair is one of the PSMFC StreamNet staff, with the staff assigned depending on the team's current task. This team has the responsibilities dealing with the programming details necessary to adequately flow data from partner data systems to the StreamNet database and associated Fish HLI (CAX) and StreamNet Fish Monitoring Data queries.

Table 3: Calendar Year 2020 members of the StreamNet Technical Team

Current Members	Affiliation
Greg Wilke and Mike Banach	PSMFC-StreamNet
Van Hare	PSMFC-GIS Center
Denise Kelsey, Tami Wilkerson (*Colleen Roe served until Feb. 2020*)	CRITFC
Jon Bowers, Peter Robinson, Jake Chambers, Nadine Craft, and Kasey Bliesner	ODFW
Michelle Groesbeck, Greg Lippert, and Leslie Sikora	WDFW
Chris Harrington, Randy Walsh, Evan Brown, and Rebecca (Bekki) Waskovich	IDFG
Ace Riverman (*replaced Ryan Alger during 2019*)	MFWP
Todd Gilmore and David Hines	USFWS
George Batten (Sitka Tech consultant)	Colville Tribes

4. CAP Data Exchange Standard Development Team (DDT)

The CAP Data Exchange Standard (DES) Development Team (DDT) meets as necessary to maintain existing data tables and develop new indicator tables. This team consists of both data technicians and biologists that are responsible for calculating indicators. The DDT determines DES content and import/export guidelines. Actual team membership is fluid and depends on the species/indicators/geography of the data (Table 4). New teams may form as the CAP effort moves to other data categories, such as Bull Trout or hatcheries. The chair of the DDT is the PSMFC StreamNet biologist.

Table 4: Calendar Year 2020 members of the DDT

Current Members	Affiliation
Mike Banach (Chair) and Nancy Leonard	PSMFC
Denise Kelsey	CRITFC
Russell Scranton and Jeffery Stier	BPA
Mari Williams, Monica Diaz and Craig Busack	NOAA-Fisheries
Ace Riverman	MFWP
Jake Chambers, Nadine Craft, Jim Ruzycki, and Kasey Bliesner	ODFW
Brodie Cox, Andrew Murdoch, Dan Rawding, and Michelle Groesbeck	WDFW
Evan Brown, Rebecca Waskovich, and Lance Hebdon	IDFG
George Batten (Sitka Tech consultant)	Colville Tribes
Jay Hesse and Ryan Kinzer	Nez Perce Tribe
Bill Bosch	Yakama Nation
Jen Bayer	PNAMP
Brandon Chockley	Fish Passage Center

5. Coordinated Assessments Partnership (CAP) Core Team

The CAP Core Team meets regularly to coordinate CAP amongst several BPA-funded projects. The Core Team is made up of representatives from BPA, PNAMP, StreamNet, a StreamNet partner agency/ EPA Exchange Network representative, and the CRITFC Inter-Tribal Monitoring Data project representative. A NOAA representative was added in 2019 to this team. The CAP Team are important leaders in ensuring that CAP produces results (Table 5). The Core team facilitates discussion amongst projects, directs requests for work to the appropriate CAP level (as needed), and generally serves to maintain forward momentum. The team manages and implements periodic CAP Workshops.

Table 5: Calendar Year 2019 members of the CAP Core Team

Current Members	Affiliation
Nancy Leonard	PSMFC
Colleen Roe *(Denise Kelsey replaced Colleen in Feb 2020)*	CRITFC
Russell Scranton and Matt Schwartz	BPA
Mari Williams	NOAA-Fisheries
Brodie Cox	StreamNet partner representative (WDFW)
Jen Bayer	PNAMP
Tom Iverson	StreamNet Tribal Outreach
John Arterburn *(added in 2020 for HCAX coordination)*	Colville Tribes
Michelle Steg-Geltner *(added in 2020 for HCAX coordination)*	Yakama Nation
Keith Dublanica *(added in 2020 for HCAX coordination)*	WA GSRO

B. StreamNet Data Specialists within Agencies

Work Elements:	B 159: Support transfer of data into secure and accessible repositories D. 160 CAP Data – DES and database E. 159: CAP Data – compile data F.160: CAP Data -automated data exchange H. 159 Compile high priority traditional StreamNet data J. 160 Enhance data efficiency – system development

The StreamNet project uses subcontracts to support data stewards inside StreamNet member agencies. These data stewards operate within the agency or tribe for which they work, and coordinate with biologists across that organization to identify and collect data of interest to StreamNet.

These data stewards locate and acquire data, convert these to the DES adopted by StreamNet, perform Quality Assurance/Quality Control (QA/QC), add geo-referencing to tie the data to the stream network (hydrography), and assist with development and utilization of database systems within agencies to streamline the data flow process. Once these data are properly formatted and validated, these data are then submitted to the StreamNet database at PSMFC, where they are quality checked and managed so they become available to the StreamNet online data query systems. These data are then made publicly available for viewing and download in standardized format through the project website, www.streamnet.org. The data submitted by these data stewards may also include data from other agencies and tribes, because state agencies often collect data from partners to calculate estimates, metrics, or indicators that are reporting on the Fish HLI query (CAX data system).

C. Data Store - Archiving Data Sets and Information

Work Elements:	B 159: Support transfer of data into secure and accessible repositories
	G. 161: Data - dissemination

StreamNet staff continues to maintain public access to structured information for the NPCC FW Program including the Data Store, Subbasin Plans, Protected Areas, HEP, and the HSRG. StreamNet's Data Store, the online searchable data archive, continues to provide access to historical and recent data collected by BPA-funded projects as well as other data sets from partners and the CRB.

Data Store – StreamNet maintains the Data Store archive service[x]. The Data Store is a secure location for data storage for projects throughout the region and provides access to non-standardized data. The StreamNet Data Store is a searchable archive of data sets related to fish and other aquatic resources. These data sets come from many different sources and are provided for download in their original formats. StreamNet facilitates data submittal to the Data Store by providing a data publishing service that guides the data submitter in how to describe their data set and submit it. The Data Publishing Service is for submittal of data sets. Those who want to archive a report with summary graphs and tables are directed to the Columbia Basin Fish & Wildlife Library[xi] hosted by CRITFC. Because the Data Store is a data set archive, data sets housed there are generally not updated after the first version is submitted.

Subbasin Plans – StreamNet maintains documents and data sets[xii] used in the NPCC subbasin planning process. The NPCC (formerly the Northwest Power Planning Council) led the 2001-2004 effort to develop comprehensive subbasin plans throughout the Columbia River basin. StreamNet both provided data to support subbasin planning and also received and distributed compilations of the data used in the plans. After the plans were completed, StreamNet, the Technical Outreach and Assistance to Subbasins Team (TOAST), the CRITFC, and the Northwest Habitat Institute captured new data that were developed for use in the aquatic portion of each subbasin plan. Resources archived by StreamNet include the spreadsheets, maps, GIS layers, subbasin planning modeling input and results, tools, and databases developed for subbasin planning. Included is a large majority of the Ecosystem Diagnosis and Treatment (EDT) and Qualitative Habitat Assessment (QHA) modeling information used in subbasin planning, as well as GIS layers that define the EDT/QHA reach codes.

Protected Areas – StreamNet maintains access to the NPCC Fish and Wildlife Program's documentation of the river reaches designated as areas protected from hydroelectricity development[xiii]. This protection was assigned by the NPCC FW Program based on the determination from extensive Pacific Northwest river studies conducted during the 1980s that these areas are to be protected to avoid the unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat. To this end the NPPC FW Program states that the Federal Energy Regulatory Commission (FERC) cannot license a new hydroelectric development in a Protected Area, and 2) calls on BPA not to acquire the power from such a project should one be licensed by FERC, nor to allow access to the Pacific Northwest-Pacific Southwest Intertie (the "power grid") in a way that would undermine the Protected Areas policy. The last update to the Protected Areas list was promulgated in 1992, and it remains in effect through the current NPPC FW Program.

HEP – StreamNet also maintains the NPCC's Columbia River Basin Fish and Wildlife Program's (Program) Wildlife Habitat Evaluation Procedures (HEP) documents and data[xiv]. The NPCC FW Program policy guiding wildlife mitigation to compensate for hydrosystem development relies on the HEP data to support the mitigated habitat unit, where this tool was applied. HEP was used to quantify the impacts of development, protection, and restoration on terrestrial and aquatic habitats by assessing changes, both negative and positive, in habitat quality and quantity. The HEP informed the NPCC FW Program's progress in BPA's mitigation for lost habitat units related to the construction and operations of the hydrosystem dams. StreamNet maintains access to this critical information for the NPCC FW Program and BPA. The

NPCC FW Program also relies on settlement agreements between BPA and partners for mitigating for lost habitat and these are tracked by the NPCC.

HSRG – StreamNet staff has begun integrating the content of the Hatchery Reform Project website[xv] to ensure that its content, including the Hatchery Scientific Reform Group's (HSRG) documents remain accessible to the public through the refreshed StreamNet website that will be released during 2021. The NPCC FW Program policy guidance for its *Fish Propagation including hatchery programs*[xvi] strategy includes in its rationale the HSRG outcomes, and the Program guidance encourages the application of these HSRG recommendations for FW Program-funded hatcheries, thus maintenance of the HSRG website and documents[xvii] is needed to inform implementation of this policy guidance.

D. Fish Monitoring Data (time series trends)

Work Elements:	B 159: Support transfer of data into secure and accessible repositories
	D. 160 CAP Data – DES and database
	E. 159: CAP Data – compile data
	G. 161: Data - dissemination
	F.160: CAP Data -automated data exchange
	H. 159 Compile high priority traditional StreamNet data

StreamNet Fish Monitoring Data query system[xviii] provides access to all time series (trends) data sets submitted to the StreamNet database (excluding content from the Data Store). These data are also georeferenced. The StreamNet Fish Monitoring Data query system was refreshed in CY2020 to better integrate with the StreamNet website and supports a simpler filter-based query in a tabular format. During CY2021-2022 a map-based query version will be developed. This existing tabular query allows the user to filter data in different ways to suit their needs and download the resulting data or share a URL to the filtered content. The content of StreamNet's Fish Monitoring Data query system includes fish abundance estimates and indexes at the local scales for native and non-native species, many of which are focal species for the 2014 FW Program, as well as information on hatchery returns, redd counts, and harvest. Data sets relating to monitoring activities such as redd counts and dam counts are generally updated annually.

For current data types that are included in the StreamNet Data Exchange Standard (DES) for Fish Monitoring Data (time series data sets), content is updated annually or less frequently as needed. The StreamNet Program expects needing to expand the StreamNet DES in future years to accommodate the data needs for the NPCC 2020 Addendum.

The StreamNet Application Programming Interface (API) requires that users request access and get issued a unique programming key to interact with Fish Monitoring Data via this method. This is a case of programming best practice rather than limiting data access.

E. Maintenance and Access to GIS Layers

Work Elements: B 159: Support transfer of data into secure and
                       accessible repositories
                       D. 160 CAP Data – DES and database
                       E. 159: CAP Data – compile data
                       G. 161: Data - dissemination
                       F.160: CAP Data -automated data exchange

There are three mappers associated with StreamNet[xix]. The first, the StreamNet mapper, allows exploration of regional fish distribution and stream referenced survey data. The second, the Protected Areas mapper, displays streams protected from hydroelectric development by the NPCC. The third, the Fish Facilities mapper, shows the location and some descriptive information about fish facilities located in the Columbia Basin that submit fish data to PSMFC's data projects, including StreamNet. Facilities that are not linked to data housed at PSMFC currently are not included on this map although the need to support these other facilities is being discussed given the information needs of NPCC and BPA.

StreamNet's interactive mapping applications are useful resources for Fish and Wildlife Program-sponsored projects and related watershed and stream-specific projects. The applications enable users to: 1) explore baseline information on fish abundance and distribution, 2) identify the location of surveyed stream reaches and important fish facilities (e.g., dams, hatcheries, weirs, traps, etc.), 3) create custom data and map products, and 4) summarize data by subbasins and areas of interest.

PSMFC's GIS Center staff maintain and update StreamNet's core GIS layers as new data becomes available from partners. In general, the GIS Center staff checks about twice a year for available updates from partner agencies.

F. Fish HLIs – Coordinated Assessments Partnership

Work Elements: B 159: Support transfer of data into secure and
                       accessible repositories
                       G. 161: Data - dissemination

Fish HLIs and associated Fish Monitoring Data time series data sets (trends) for population level estimates are available through the Fish HLI map query (CAX data system[xx]). Development of the Fish HLI map query (renamed in 2020-2021, formerly named Coordinated Assessments Indicators of Fish Population Health or CAX Query) was initiated in 2016 with the intent of providing access to HLIs and associated trends. The Fish HLI query provides access to these data by having the user select a species and run and complements the tabular data with a dynamic map that displays the geographic population distribution and summary information in a pop-up box.

StreamNet coordinates closely with PNAMP in providing technical guidance to the CAP which follows the Five-year Plan for CAP. This technical guidance includes development and modifications to the Data Exchange Standard (DES) document which is needed for submitting standardized data that will be displayed on the CAP Query. The DES document specifically identifies the data elements that are to be shared for each indicator, along with definitions, formats, and business rules for each element. The DES document is used to guide the organization of data to be shared via any specific medium, whether by spreadsheet, CSV file, database file, or web service. The data elements are hosted by the originating agency, and exchanged following the DESs using the StreamNet Application Programming Interface (API).

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As part of the CAP, staff at PSMFC and subcontracting agencies coordinated with state, federal and tribal agencies in support of increasing data flow in the region and to encourage increased use of information technology to improve the efficiency of data sharing. The StreamNet API facilitates submittal and access of Fish HLIs through the CAX data system. The Fish HLI and supporting time series data sets in the Fish Monitoring Data query are updated at a minimum of once a year, but as automation advances, more partners are submitting more frequently such as on a daily basis by the source agency.

To access the information on the Fish HLI query (CAX data system), users are asked to agree to an End User License Agreement which reflects the data sharing agreement conditions agreed to by parties providing data to StreamNet for the CAX data system. The data sharing agreement is presented for agreement as data are uploaded and shared. The purpose of these data sharing agreements are to articulate how data that are shared are to be interpreted, analyzed, and attributed correctly. Furthermore, if users use the StreamNet Application Programming Interface (API) to access the CAX data, the API requires that users request access to be issued a unique programming key to interact with data via this method. Additionally, if a user accesses the Fish HLI query content from the EPA Exchange Network (EN), the EN requires that users register before accessing any data sets. This is a requirement imposed by the EPA and not StreamNet. The EPA Exchange Network for the CAX Node is accessible at http://www.exchangenetwork.net/data-exchange/columbia-river-basin-coordinated-assessment/

G. Validation Process for Data and HLIs Submitted to the StreamNet Database

Work Elements:	B 159: Support transfer of data into secure and accessible repositories
	E. 159: CAP Data – compile data
	F.160: CAP Data -automated data exchange
	H. 159 Compile high priority traditional StreamNet data
	K. 160 Infrastructure and base operations

Data exchange standards, a data sharing agreement, and rigorous QA/QC protocols are all part of the data compilation and reporting process. Data, including reference documents, in the StreamNet database must conform to StreamNet DES document, which precisely defines the data elements, their organization in tables, and required formats. This document serves as the common denominator for the specific data types contained in the database. Adherence to the DES document assures that data can be loaded into the database, can be queried accurately, and are equivalent for further analysis by users. Conversion of agency data to the DES document and assuring that they conform before submission is the responsibility of the project's data stewards/compilers in the data source agencies. Additions or changes to the DES are made following a formal documented procedure adopted by the Steering Committee, which are currently being revised for implementation later in CY2021. See past version at ftp://ftp.streamnet.org/pub/streamnet/Projman_files/ExchangeFormat/CurrentDraft/DES-Change-Process.pdf .

QA procedures are applied at the agency data steward level. An automated data validation and loading system has been implemented at StreamNet. This system provides real-time feedback on the success (or not) of data validation. Data are submitted to the StreamNet database one record at a time, and real-time data validation is run on them at two levels (with a third level planned). First, each field has its own set of rules. Examples include ensuring numeric fields do not contain text, ensuring codes fall within the group of allowable values, and ensuring text strings are within acceptable length ranges. The second level of validation ensures that values in the different fields within a table are compatible. For example, if a record appears that says it is for "spring run coho salmon," the record is rejected because there is no such run. The third level of validation, once implemented, will look for data problems between rows of data within a table. This will primarily be to find and flag duplicate data. A useful feature of the automated validation routines is that

the data may be run against the validation rules and an error report obtained without actually submitting the data for inclusion in the database. This feature allows data submitters to check entire sets of data, fix all errors, and then submit an entire data set after it is known it will pass validation. The interface used for data submittals allows for new records, for changing existing records, and for deleting existing records.

H. Enhanced Metadata Documentation by Connecting to Complementary Data Systems

Work Elements:	B 159: Support transfer of data into secure and accessible repositories
	K. 160 Infrastructure and base operations

Documentation of metadata for information submitted to the GIS Database, Data Store, and StreamNet database has always been a priority to StreamNet as this ensures the appropriate use of these data outside of the original project that created these data.

GIS – Metadata for the GIS data comply with the Federal Geographic Data Committee (FGDC) International Organization for Standardization (ISO) standard and are packaged in ArcGIS file geodatabase format for use with desktop GIS software.

Data Store – Metadata for data sets in the Data Store are provided by the entity that uploads the data set. The BPA Data Management Strategy directs StreamNet to store links to associated protocols and designs to ensure data downloaded and used by third parties can be understood and properly used. The Data Store process requests the user to provide a BPA Project number if relevant. When a BPA project number is provided the Data Store provides the user with options from the BPA www.cbfish.org and the PNAMP www.monitoringresources.org to facilitate connecting the data set to contact information and documented protocols and methods.

StreamNet Database for Fish Monitoring Data – Preferably metadata for the tabular data should meet the requirements of the FGDC Biological Extension, but we often lack the required level of detail from the source agency, as many agencies have not placed high priority on creating metadata. Depending on the data being submitted, different levels of metadata are captured.

For CAP Fish HLI and related Fish Monitoring Data time series (trend) data sets submitted to the StreamNet database to be displayed on the Fish HLI query, some metadata components are required from the data source agencies as part of the DES. Specifically, information on 'calculation method' used is requested in the DES, and this information is presented with all data displays and in data downloads. There is also information captured by the DES related to general categories or types of methods, rather than detailed descriptions. Additionally, StreamNet now also captures URL information to link to www.monitoringresources.org for the specific method used for a particular component of data related to population-scale HLIs.

For the data submitted to the StreamNet Fish Monitoring Data (trends) database that are not related to the Fish HLI Query, there is frequently a lack of formal metadata from the data source agencies. To compensate for the lack of formal metadata, StreamNet obtains source documents for all data entered into the database, which are subsequently stored in the Columbia Basin Fish & Wildlife Library. Links to these source documents are presented with all views of the data and with all data downloads. Many source documents contain methods sections that provide the detail about how the data were collected. When viewed online, there are links to the Library's online catalog record for the document, which include a link to the digitized version of the document. In 2019 the Library began a reconciliation project to ensure the accuracy and accessibility of its links to StreamNet source documents. Over 2,000 documents have been

reconciled thus far and the projected completion date is December 2022. During 2020 StreamNet PSMFC staff assisted the Library in identifying the documents requiring a stable Library URL and began working on a process to facilitate the Library uploading these new URLs into the StreamNet data system.

At a minimum, StreamNet has gathered the source document or report that detailed the protocols used to collect these data and, working in collaboration with Library staff, have made these accessible through the Library. With the regional recognition that protocols and methods described in reports are not always sufficient for fully understanding the origin and uses of the data, a tool to support full description of methods and protocols was developed through PNAMP (BPA project #2004-002-00) with support from BPA. StreamNet has established a link between PNAMP's tool and information on the CAX data system. In the absence of metadata provided by the Library and/or MonitoringResources.org, the StreamNet database will at a minimum point to the originating agency as the source.

StreamNet data and metadata are provided online as web services, allowing users to locate and obtain data through automated means such as national or regional clearinghouses, and in fact, the StreamNet database harvests our own web services as part of the new, more efficient approach to querying our data.

1. PNAMP MonitoringResources.org

In 2008, PNAMP began efforts that lead to the development of MonitoringResources.org. PNAMP leveraged work by National Park Service and USDA Forest Service that developed a tool for documenting protocols[xxi]. The further development of this tool aimed to provide detailed information about protocols, methods, study design, and metric documentation to inform the NPCC's project review process, and BPA's Research, Monitoring and Evaluation (RM&E) needs and for project tracking[xxii]. The current version of MonitoringResources.org promotes transparency and greater understanding of monitoring through a standard process of documentation and information management, which is facilitated through online tools that provide guidance and support design and documentation of monitoring projects from beginning to end[xxiii].

The StreamNet database contains a field associated with the CAX data to allow the submitter to include a URL link to metadata. This can include providing a link to the protocols and methods documented in monitoringresources.org.

2. Columbia Basin Fish & Wildlife Library

The Columbia Basin Fish & Wildlife Library (Library) was founded in 1995, to support the StreamNet Project which originated with the consolidation of two projects, NED and CIS. Originally the Library was part of the StreamNet project and was named the StreamNet Library. In 2008 the Library was separated into its own project and is now hosted by the Columbia River Inter-Tribal Fish Commission (CRITFC; project #2008-505-00). The Library serves as a centralized repository for the information created by tribal, federal, state and local agencies, private and contract researchers, and advocacy groups on Columbia Basin fish and wildlife projects and issues. The StreamNet project continues to rely on the Library to provide access to documents that provide details related to the data submitted to the StreamNet database. In turn, a primary objective of the Library continues to be making StreamNet source and data reference documents in print and digital format, as well as those related to data for the Coordinated Assessments, accessible. StreamNet and Library staff work together to ensure that all StreamNet references have complete and accessible digital records.

I. Data Backup Systems

| Work Elements: | B 159: Support transfer of data into secure and accessible repositories |
| | K. 160 Infrastructure and base operations |

The StreamNet databases are backed up on the PSMFC organization-wide system, which entails sending backup copies to the Kennewick PSMFC office.

The StreamNet staff also make backup copies on DVD media monthly and store these offsite. Additionally, StreamNet staff send a differential backup to the cloud on a daily basis.

J. StreamNet Relationship with Mainstem and Sub-regional Data Projects

Work Elements: B 159: Support transfer of data into secure and accessible repositories
C. 189: CAP Data -coordination
G. 161: Data -dissemination
I. 189: Coordination

StreamNet collaborates with existing mainstem/sub-regional data management projects to further enhance the flow of information needed to inform decision-making and reporting. These types of projects are tasked with compiling information from a subset of the CRB, in some cases to support collaborative analysis. StreamNet works with these data management projects to access relevant information needed to inform HLIs. This coordination reduces the workload placed on individual biologists and data stewards by not requiring them to resubmit these data to the StreamNet database.

1. CRITFC Inter Tribal Monitoring Data Project

StreamNet continues to work with CRITFC tribes and specifically with the CRITFC Inter-Tribal Monitoring Data (ITMD) project (BPA Project #2008-507-00) to integrate these two projects, along with the Columbia Basin Fish & Wildlife Library (BPA Project # 2008-505-00), to maximize data sharing. Much of the tribal data flow during 2020 was through the respective StreamNet member state agency. Starting in late 2019 and early 2020 more data began to be submitted from the Nez Perce Tribe (NPT) and the YN, and it is expected that other CRITFC tribes will be providing their data directly to StreamNet, as several of the tribes have built the capability to share data with regional repositories.

The ITMD staff, similar to the work done through the StreamNet project, coordinate with its member tribes and the data stewards who are partially funded by the ITMD and positioned at each tribe. Coordination occurs through monthly conference calls, quarterly webinars, and an annual workshop. Many of the IT tribal staff and the ITMD data stewards attend many of the regional coordination meetings for data management and sharing within the Basin. If they are not able to attend, the ITMD Project staff coordinates with tribal staff to distribute information they need from the meetings and responds to questions or concerns they may have on data management requirements and deliverables. The ITMD Project staff also attend many of the regional coordination meetings for data management and sharing in the Columbia Basin including Coordinated Assessments Workshops and Working Groups, StreamNet Executive Committee, StreamNet Steering Committee, CAP Core Team, StreamNet Technical Team, and CAP DDT.

2. Fish Passage Center's Comparative Survival Study Database

The Fish Passage Center (FPC, 1994-033-00) provides technical analysis, data summaries, and graphic representations for the state, federal and tribal fishery managers' use in developing their recommendations for fish passage management to the federal operators and regulators. One of the FPC's responsibilities includes management, implementation, and assistance in the analysis of the Comparative Survival Study (CSS; Project 1996-202-00) as directed by the Comparative Survival Study Oversight Committee. StreamNet leverages the FPC database to populate the Smolt to Adult Returns (SARs) population high level indicators in the CAX database and provides the URL to the supporting documentation describing the monitoring and analytical methods. StreamNet staff and FPC staff collaborate to ensure that the CSS data

are appropriately assigned to the correct CAX populations because this involves deconstructing the annual CSS fish groups and aggregates back to the individual populations.

CRITFC staff worked with StreamNet staff to identify populations so that the CSS SARs for Chinook and steelhead can be submitted to the CAX. To work out an acceptable way to submit these to the StreamNet/CAX system, StreamNet staff has defined 'superpopulations', which are aggregates of populations. These SARs are now updated annually by StreamNet staff who access the FPC database, convert the FPC data into CAP format, and upload these into the CAX.

3. US. Fish and Wildlife Service Database

The USFWS used to receive funds from the StreamNet Project prior to 2018. In calendar year 2018, BPA and the USFWS reached agreement on funding the USFWS's previous StreamNet activities directly. USFWS has active members of the StreamNet Steering Committee and Executive Committee.

USFWS staff with the Fish and Aquatic Conservation Program in Oregon, Washington, and Idaho collect data at 14 National Fish Hatcheries (NFHs). Those data are currently stored in three databases that include the Columbia River Information System, Fish Inventory System (FINS), and Fisheries Resource Evaluation Database. Because those databases possess different structures, the ability to aggregate and distribute data in those databases is time consuming and inefficient. USFWS staff in the Pacific Northwest are in the process of identifying a strategy that will improve the efficiency of managing those data in Oregon and Washington state, lead to the standardization of those data, and substantially improve the ability to share USFWS NFH data with StreamNet partners in a more timely fashion. The NFHs in Idaho will continue to use the FINS database, and the Oregon and Washington NFHs will use a different system for managing their data.

V.   Results – Improved Data Sharing and Access

Work Elements:	159: Support transfer of data into secure and accessible repositories 161: Data – dissemination 189: Coordination

StreamNet continued to acquire fish data from our four partner state fish and wildlife agencies (ODFW, WDFW, IDFG, and MFWP), our tribal partner (Colville Tribes), one federal agency (USFWS for data from the national fish hatcheries), a tribal consortium (CRITFC[1]), and the Fish passage Center (FPC). StreamNet continues to work with other tribes to access population-level indicator data for the CAP effort. These data have been created through a variety of funding processes and sources, only some of which are through BPA or other federal programs. As a regional data coordinator, StreamNet strives to provide access to all data of a given type from all sources. Consult Appendix D to view work-element specific results from IDFG, MFWP, ODFW, PSMFC-StreamNet, Colville Tribes, and WDFW.

Data acquired by StreamNet are available through multiple web-based data query tools (tabular and map based) as well as multiple data download formats and through specialized categories of downloadable data. All data are available to the public, either directly from the web tools or after requesting access through the StreamNet API as recommended by programming best practices. Some sensitive data, such as specific spawning locations, may be obscured by the submitting agency to protect the resource. In such cases, the agency will typically generalize locations to a larger map

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[1] CRITFC member tribes consists of Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakama Nation.

section (show a large stream section rather than a point). Users accessing data through the CAX query system are also required to agree to the End User Agreement (EULA) at the request of data submitting agencies.

Use of the StreamNet website consistently remains highest with the general public/rate-payers. This is to be expected as most of the agencies accessing StreamNet database for their reporting are using the more efficient APIs (Figure 7; see Appendix A for previous years).
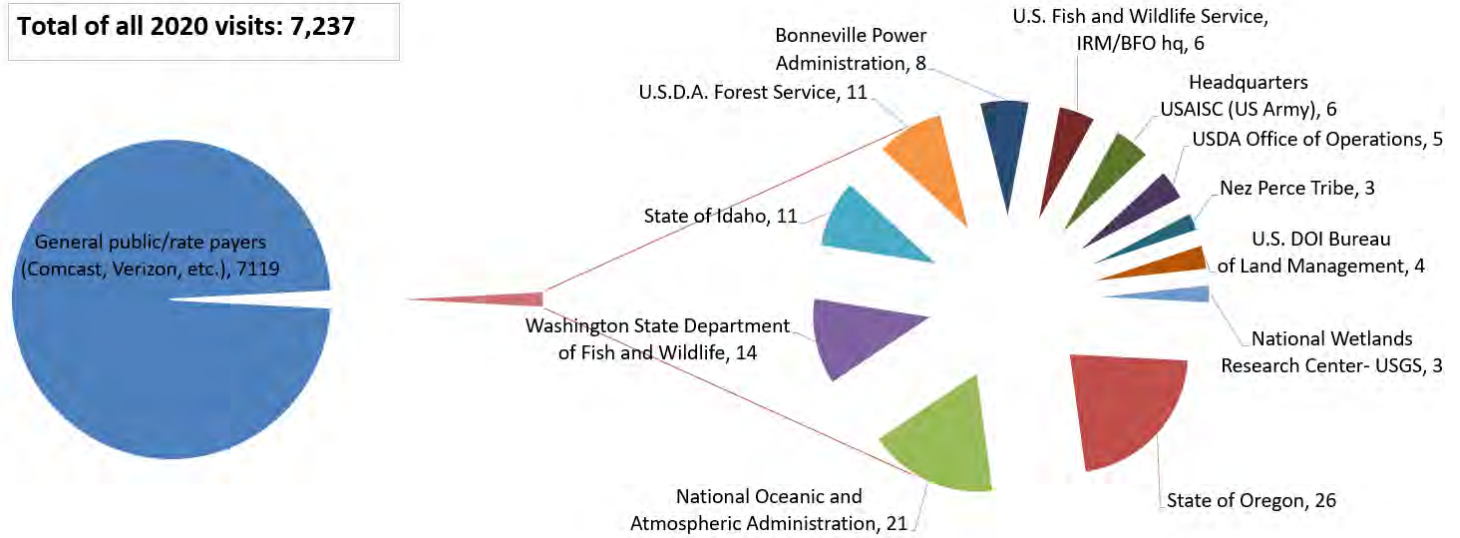
Figure 7: Users accessing the StreamNet website during calendar year 2020 for a total count of 7,237 unique website visits. Identification of user groups/entities was made using the IP addresses.

Use of the API to submit and access data on the StreamNet database has increased since the API became available in 2014. Recent improvements to the API have led to more partners using the API instead of the StreamNet website. One recent improvement to the API that was completed in 2018 allows data submitters to self-validate their data during the submittal process instead of using the website to download and verify their data. Thus, as the API has increased in use, there has been a decrease in StreamNet website user visits, because the API is addressing more of the data submitters'/users' needs. (Figure 8; see Appendix A for previous years).

Annual use of the StreamNet Website and Queries

Legend: Unique Visitors ☐ SN Query and CAX Query data (hits/usage) ■
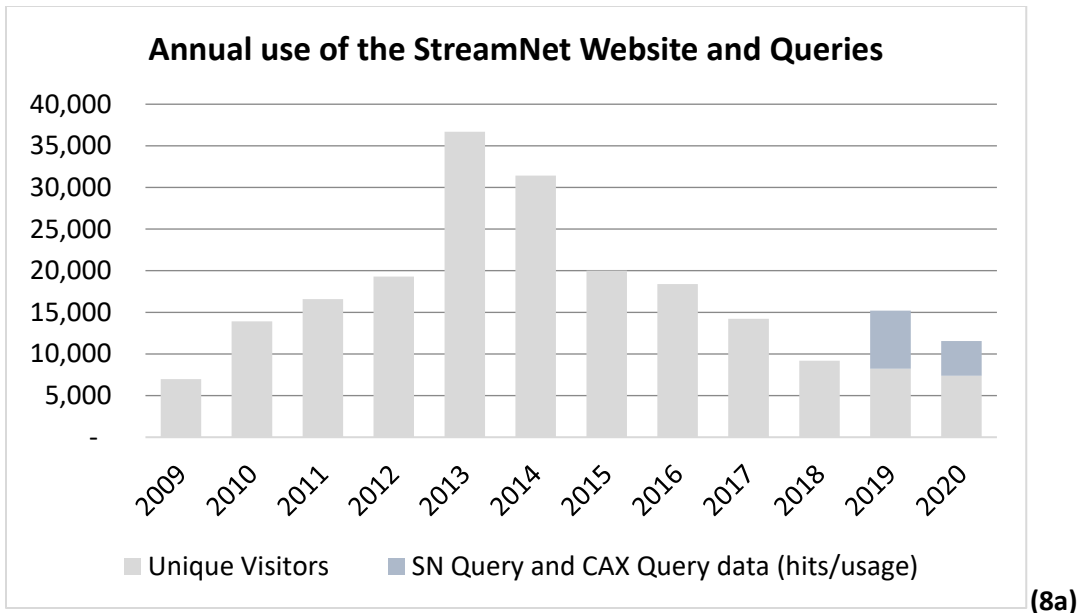
(8a)

Note: data for the SNQ and CAX query system usage are only available for 2020

Figure 8a: *illustrates the number of times during 2020 that StreamNet's Fish Monitoring Data query (trends) and the Fish HLI query (CAX) systems were used to access data (no pre-2019 data available) as well as the total number of unique visitors to the StreamNet website.*

Data API Usage (hits/usage)

Legend: ■ Data API Usage (hits/usage)
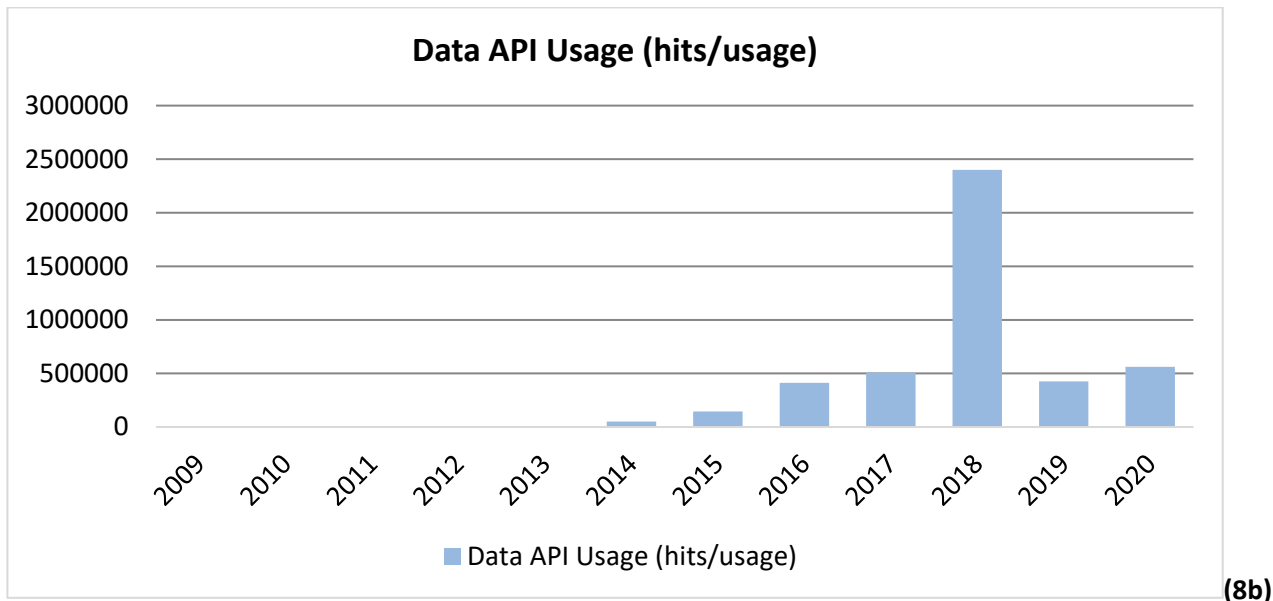
(8b)

Note: The increase in API usage show for 2018 corresponds to new partners beginning to use the API as well as a new version of the API being released that allowed individual agencies/tribes to self-validate their data submission using the API prior to submitting their data to the StreamNet database. The self-validation function of the new version of the API in 2018 improved the quality of data submitted to the database. In 2020 the API use is reflective of a more normal level of use.

Figure 8b: *shows the annual count of times the API was used to submit/use data (2014-2020). Although the y-axis scale differs between 8(a) and (b) one can see that as the use of StreamNet API (8a) increased over time there was a corresponding decrease in the query systems (8b).*

StreamNet GIS data are published as downloadable spatial data and as publicly accessible web map services. Those who download StreamNet's GIS data are primarily academics, agency staff, non-profits, private consultants, and the general public (Figure 9). Use of StreamNet's interactive mapping applications has gradually increased over time, with the StreamNet Mapper proving to be the most frequently used (Figure 10).

2020 StreamNet GIS Downloads by User Type

- Federal Agency 13%
- State Agency 5%
- Tribal Agency 4%
- Regional Agency 4%
- Municipal Agency 1%
- Non-profit 6%
- General Public 5%
- Anonymous 1%
- Private consultant 18%
- University/Academic Institution 43%

534 StreamNet GIS data sets were downloaded by these 8 user groups
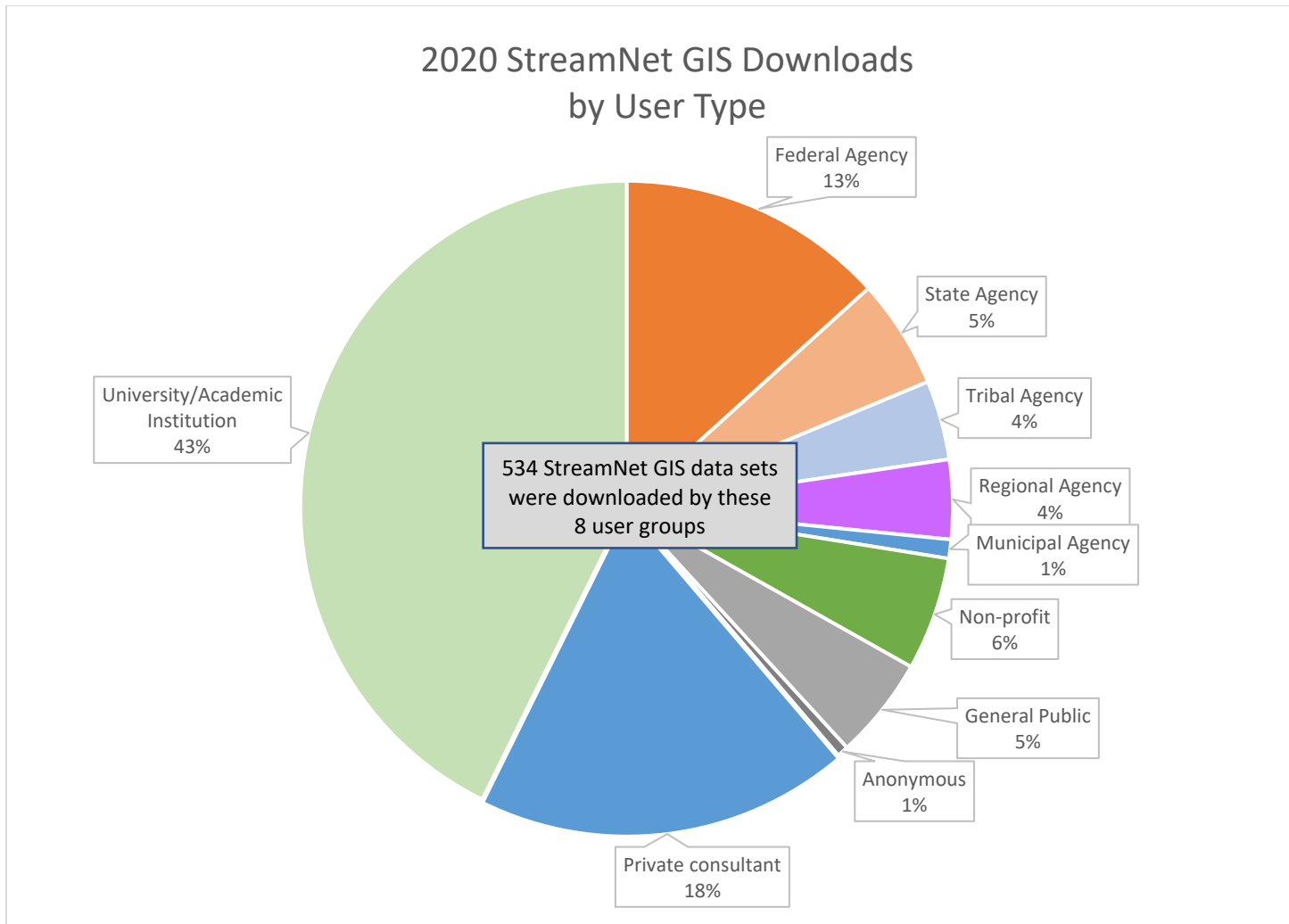
Figure 8 StreamNet's GIS Data sets were downloaded in 2020 by 10 different external user groups. The user group that downloaded the largest percentage of the 534 GIS data sets was the University/Academic Institution user group, which downloaded 43% of the 534 GIS data sets.

StreamNet Mapping Applications
Usage trend 2015-2020

Unique daily user sessions

7,000
6,000
5,000
4,000
3,000
2,000
1,000
0

2015   2016   2017   2018   2019   2020

Mapping application

■ StreamNet Mapper   ■ PNW Protected Areas/Streams Mapper   ■ Columbia Basin Fish Facilities Mapper
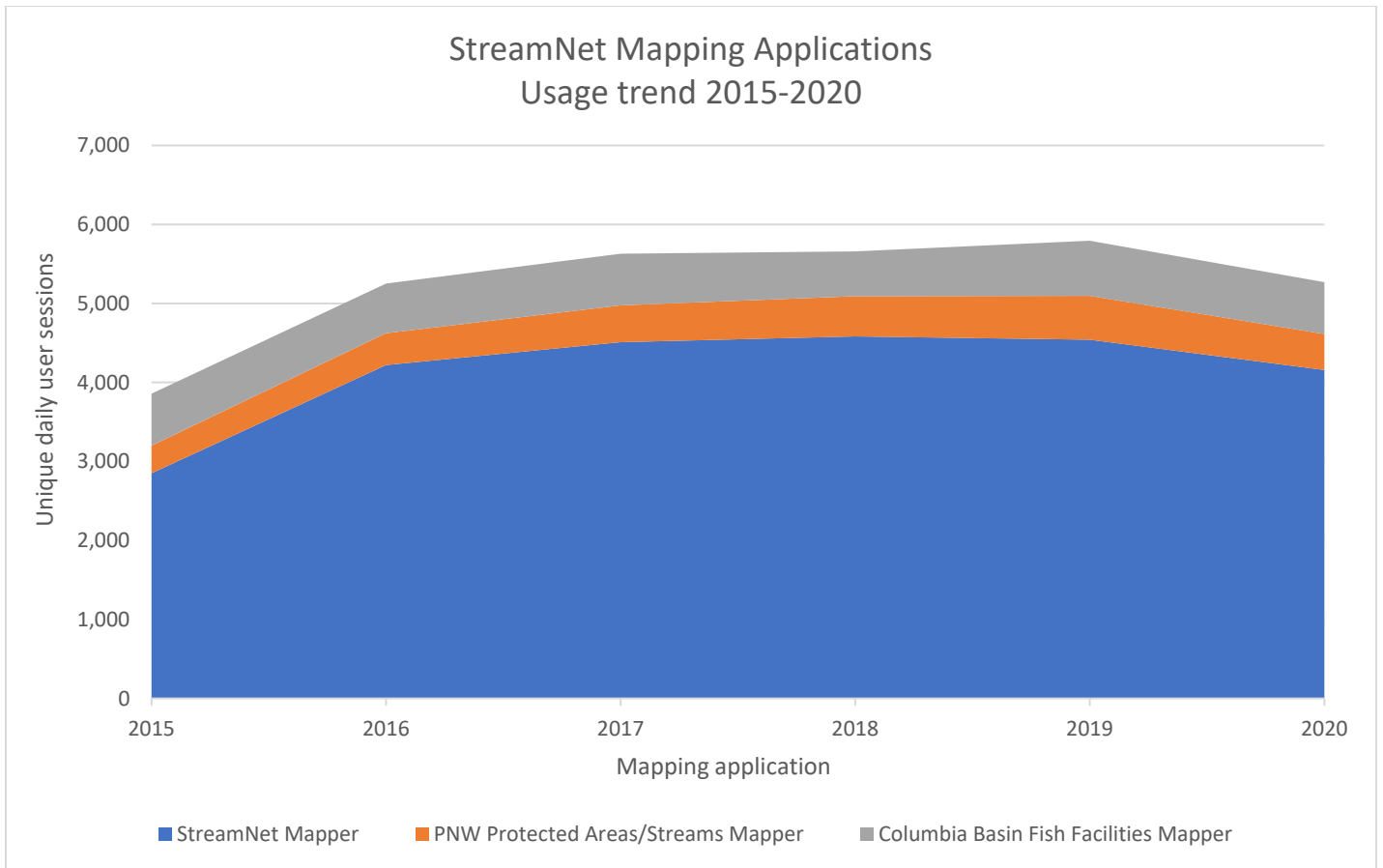
Figure 9: Use of StreamNet's online mapping applications has gradually increased over time, with the total annual unique daily user sessions increasing between 2015 and 2019 and a small decrease observed in 2020. A unique daily visit is sometimes referred to as a 'session' in web analytics terms. All StreamNet web mapping applications that are currently in use were published on the ArcGIS platform as of 3/1/2015, and thus the data during the 2015 to 2020 period uses comparable web analytics for reporting unique users. Web analytics for prior applications are different in nature and are not comparable. Note that usage reports generated from ArcGIS Online, 2015 statistics are not for the entire year (3/1/2015 - 12/31/2015).

A. StreamNet Data Specialists within Agencies – Enhancing Data Access

Work Elements:	159: Support transfer of data into secure and accessible repositories 160 CAP Data – DES and database 159: CAP Data – compile data 160: CAP Data -automated data exchange 159 Compile high priority traditional StreamNet data 160 Enhance data efficiency – system development

StreamNet continued to coordinate within partner agencies to build systems with regional data sharing capability. StreamNet supports data flow and management within the data source agencies through assistance in development of database systems and approaches for improving data management efficiency and data dissemination. StreamNet-funded staff provide significant technical database and data transfer support services to state fish and wildlife agencies.

This includes database system development, data translation, serving external data requests, and data capture routine development. The goal is to make it possible to harvest data directly for loading into StreamNet through automated means. When implemented, this will significantly speed the process of obtaining annual data updates, and allow our data stewards to expand to the acquisition of additional priority data types.

During CY2020 StreamNet provided funding to contribute to advancing tribal data management and sharing capacity to YN, the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO), and Shoshone Bannock Tribes. Additional funding to the Shoshone Bannock Tribes was also provided at the end of CY2020 with the start of FY21. With additional funding provide to the Shoshone Bannock Tribes during FY21, it is expected that direct flow of data to the Fish HLI (CAX data system) will begin during CY2021.

The StreamNet subprojects in the state agencies and tribes all contributed to development or improvement of their organizations' data storage systems in 2020. Focus continued to be on increasing the speed and efficiency of data conversion to the regional standard StreamNet DES, and then submission to the StreamNet database. The long-term goal is to develop the capacity for the agencies and tribes to host data in the regional standard and share them via web services and/or to transfer data to StreamNet via web services. Because each partner uses different approaches to their data management, actions taken by the subprojects differ accordingly.

1. The Confederated Tribes of the Colville Reservation

In 2020 the Data Steward maintained and updated the Okanogan Basin Monitoring and Evaluation Program (OBMEP) database, and developed software to improve the efficiency and quality of the calculations of juvenile population estimates.

2. Idaho Department of Fish and Game

The IDFG StreamNet subproject continued assistance with development of the Idaho Fish and Wildlife Information System (IFWIS), and was able to upload data directly from the system in a single step in order to simplify standardization of the data and speed submission to the StreamNet database, saving significant time from the previous approach.

IDFG StreamNet staff assisted BPA project biologists to identify and prioritize data available for entry into IFWIS, or an alternative accessible, backed up information system. IDFG StreamNet staff participated in meetings of the CA planning and development groups. They provided input prioritizing indicators, metrics, and metadata. They coordinated with development between the proposed DES, the prototype database and application, and the web service data exchange. Multiple sources of CA data were consolidated into complete, standardized workbooks on a secure and backed up network drive. SQL queries were written to extract and transform those data into the draft DES for natural origin spawner abundance (NOSA), natural origin juvenile abundance (presmolt abundance), and recruits per spawner. IDFG staff wrote web service routines to enable the transfer of CA data to PSMFC and NOAA databases. Those services were successfully tested and the results shared with the CA Exchange Team. After appending into the IFWIS CA database, those data were then transferred to the PSMFC CA database. IDFG StreamNet staff compiled and submitted hatchery return data for Chinook, steelhead, sockeye, and Chinook index redd counts.

3. Montana Department of Fish, Wildlife & Parks

StreamNet staff continued to assist in converting data files residing with individual biologists to file types that can be uploaded into the centralized database. This has eliminated the need for biologists or technicians to spend their time hand entering historic data into the system. StreamNet staff are also continuing to be a resource to biologists as well as advocates of biologists entering their data into the system. The database currently houses over 4.9 million raw fish records statewide. In 2020, 863 fish survey locations were added in the Columbia Basin resulting in 171,168 individual fish records. Statewide, 1648 new survey locations were added resulting in 747,848 individual raw fish records being added to the database. In the Columbia Basin 1160 redd counts at 121 locations were added to the database during 2020. All relevant data were submitted to StreamNet databases or the Data Store.

MFWP StreamNet staff continued to be involved in the Yellowstone Cutthroat Trout range-wide assessment. During the past calendar year MFWP staff coordinated updates to the database with biologists throughout the subspecies' native range. Discussions were held related to integrating the Yellowstone Cutthroat Trout native trout assessment into the Inland Cutthroat Protocol (ICP) data system. An estimate to reintegrate the data was obtained from the contractor (Wyoming GIS Center) though the work could not be completed in the necessary timeframe. The MFWP native species coordinator retired in the summer of 2019, leaving the status of this project in a state of uncertainty. There is potential to revive this project though it is dependent on the priorities of the fisheries division.

Large agency projects have been consuming MFWP's Application Development and Projects Bureau staff time. These staff are not funded with StreamNet dollars. This resulted in no opportunity for new development work on the internal database during 2020. Given these large agency priorities there has been a decrease in the amount of staff resources available for additional project work. This halt on new work impacted the ability hire a subcontractor for development work due to the close working relationship required between a subcontractor and agency application development and database administrator staff.

4. Oregon Department of Fish and Wildlife

ODFW StreamNet performed routine maintenance and updates on existing core databases. In addition, efforts to improve overall agency data storage and flow from the field continued by ongoing development and maintenance of data management and sharing systems. Once created, ODFW's new resource information system will significantly advance the agency in these areas of data management and increase data flow and sharing efficiency. In the meantime, we continue to encourage the implementation of data management best practices related to standards in field and file names, metadata, folder organization, data sharing and non-disclosure agreements, and data management plans, as time and resources allow, particularly as they relate to priority CA and Recovery Planning efforts.

StreamNet staff spent considerable time designing and testing the new web application for Coordinated Assessments data to be entered directly into the ODFW SQL server database and to automate the processes for validation and submission to the StreamNet API. The Coordinated Assessments Validation, Evaluation and Submission (CAVES) web application was completed and became fully operational for all-natural origin high-level indicator tables in 2020.

The ODFW Data Clearinghouse (DC), which makes Oregon's natural resource information more secure and accessible by providing a centralized storage and distribution service, was maintained and updated. During the year, 423 new and existing DC records were created and updated. In 2020, using partial funding from other sources, we continued an effort to improve the accuracy of and migrate 39,000 records from the old ODFW Library electronic bibliography into the DC in order to preserve this historic record of ODFW documents and provide access to digital copies of these documents.

Other internal and external websites were updated and maintained throughout the year including updating URLs and web content and adding new projects to the NRIMP data resources and information pages.

Oregon StreamNet staff continued a partnership with ODFW Recovery Planning staff throughout the year to coordinate data standardization, DES updates, flow configuration and data sharing documents, metadata and efficient exchange of CA and Recovery data to StreamNet and the ODFW Salmon & Steelhead Recovery Tracker. In 2020, with other funding, Oregon updated and submitted coastal coho natural origin spawner abundance and adult recruits per spawner estimates to StreamNet. Recovery populations in the Lower Columbia, Middle Columbia, Snake River and Coast coho (other funding) data were also processed and uploaded to the ODFW Recovery Tracker public website (http://odfwrecoverytracker.org/).

StreamNet supported the proposal to develop the Oregon Salmon Recovery Tracker website from its inception in 2010, and took over hosting the system upon its completion. Oregon StreamNet continues to maintain the system, which allows users to explore and download information related to salmon conservation and recovery in Oregon. This system

was targeted to undergo major technical updates in 2020, but was postponed until 2021; therefore, the public website may be unavailable at times throughout the year.

Users tested the Fish Habitat Distribution (FHD) Data Change Request form developed by ODFW Natural Resource Information Management Program GIS staff. This form will enable FHD stakeholders to submit proposed changes to the FHD data and to improve upon its accuracy and completeness. Keeping this information updated is crucial to the quality of Oregon FHD data submitted to StreamNet.

Staff participated in, and contributed to, the development of the ODFW Take, Hold, Release, and Observation (THRO) standards effort and resulting draft document. This effort is a crucial part of the future ODFW resource information system that will significantly advance the agency in areas of data management and increase data flow and sharing efficiency. The standard is expected to be finalized in late 2021.

Oregon StreamNet's server infrastructure was upgraded to support the new web application for submitting Coordinated Assessments data. In addition, it continued to be monitored and upgraded where necessary for long-term support. Software tools used for development were upgraded to their most recent versions. Capacity of the infrastructure continued to be monitored and is currently adequate at least through 2022. Licensing for Microsoft SQL Server was extended through mid-2023.

5. Washington Department of Fish and Wildlife

The WDFW StreamNet subproject coordinated with the Biological Data Systems Program in WDFW on ongoing development of the EPA funded Juvenile Migrant Exchange and the Adult Fish Exchange data delivery system, and developing services which will serve data to StreamNet in the future. WDFW also secured a new EPA Exchange Network grant to facilitate sharing of hatchery and harvest data between tribes and WDFW.

WDFW continued development of an internal CA reporting database and participated in all DES development and technical meetings. Particular attention was paid to integrating new NOSA and SAR data where existing and we began integration of Puget Sound NOSA and escapement data at NOAA's request. In addition to CA systems development, WDFW StreamNet worked with agency HQ staff to implement mobile data collection platforms, staging databases and automated transfer mechanisms for sport and commercial, adult survey, and juvenile data systems. Ultimately these inform the CA exchange as well as other consumers like WA Governors Salmon Recovery Office and tribal co-managers. WDFW continued hydrography mapping to NHD framework. Final adoption of WDFW's draft new stream layer has repeatedly been delayed. When it is adopted, the StreamNet funded Location Manager will fully scope the layer and draft a proposal to integrate mixed scale hydro (MSH) with the new line work.

WDFW continues to communicate with project sponsors, review data storage, and offer assistance in submitting data sets to secure accessible repositories. StreamNet's request to submit geometry instead of event data also prompted work to make basic location data more integral and available to CA and traditional StreamNet data compilers.

B. Data Store - Archived Data Sets and Information

Work Elements:	159: Support transfer of data into secure and accessible repositories 161: Data - dissemination

The StreamNet Data Store serves as the default database for numerous fish population metrics such as fish habitat, and abundance. As recommended in the 2013 BPA Data Management Strategy[2] the Data Store can function as the interim data storage location during the development of databases for new data sets, such as fish species genetics, blood work, and enzyme analysis. The Data Store also supports the Data Management principles of the 2014 Columbia River Basin Fish and Wildlife Program's Adaptive Management[3]. PSMFC also physically hosts other data storage repositories as a cooperator with state and tribal agencies.

Data Store – StreamNet staff continued to provide support by phone and email for data contributors to the Data Store, including BPA and non-BPA funded contributors. As described in the 2013 BPA Data Management Strategy, the StreamNet Data Store is a repository for any BPA projects where a BPA recognized environmental data repository is not available. BPA relies on the StreamNet Data Store as a core data repository to secure public access to data where not provided in an alternative, publicly accessible system. When a BPA project data set is uploaded to the Data Store, the project number allows pre-populating project attributes housed in the BPA database system (cbfish.org) such as contact information.

Subbasin Plans – Documents and data continued to be archived at StreamNet and remain accessible to the public on StreamNet's website.

Protected Areas – Documents and data continued to be archived at StreamNet and remain accessible to the public on StreamNet's website and on the Protected Areas mapper.

HEP – Data and other resources from the HEP project are archived on StreamNet, at the request of BPA and the NPCC. The data and associated materials from this past program remain accessible for regional use[xxiv].

HSRG – StreamNet staff began consolidation and integration of the Hatchery Reform Project website content, tools and documents. The Columbia River Basin Fish and Wildlife Library is assisting in the organization and access of documents to ensure copyright rules are followed. During CY2021 the Hatchery Reform website will be taken offline and the StreamNet Website will maintain access to the content in a similar fashion as done for HEP, Protected Areas, and Subbasin Plans. The NPCC 2014 Program refers to the HSRG recommendations and thus keeping this content publicly accessible supports the Program's implementation. NOAA's Hatchery Genetic Management Plan (HGMP) development was informed by the HSRG effort, thus maintenance of the HSRG website and documents is needed to provide the details and rationale used in developing the HGMP[xxv].

During CY2020 there were 20 data sets uploaded to the Data Store. These 20 data sets consisted of 19 new data sets, and 1 update to existing data sets. The BPA funded CHaMP project data sets have begun to be submitted to the Data Store. The aggregated CHaMP data based on "Channel Units" (Polygon) and "Site" (Point) summary metrics are now available at the DataStore link for 2011-2017. The export of the CHaMP topographic data sets, temperature data, and photos are still pending a BPA decision on how to manage those data files into the future.

In general, StreamNet partners encourage BPA project sponsors to secure data in repositories, including the Data Store.

1. The Confederated Tribes of the Colville Reservation

The Colville Tribes continues to communicate with Project Sponsors, inventory data storage and aid in securing data in accessible repositories.

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[2] Bonneville Power Administration. 2013. A Framework for the Fish and Wildlife Program Data Management: Issues and Policy Direction for Development of a Data Management Strategy and Action Plan. Bonneville Power Administration, Fish and Wildlife Policy and Planning Division, June 04, 2013.

[3] Northwest Power and Conservation Council. 2014.2014/2020 Columbia River Basin Fish and Wildlife Program. Council Document 2014-12, revised 2020. Portland, Oregon. https://www.nwcouncil.org/sites/default/files/2014-12_1.pdf

2. Idaho Department of Fish and Game

IDFG StreamNet supported state and tribal project sponsors in the transfer of data to secure and accessible repositories.

3. Montana Department of Fish, Wildlife & Parks

MFWP StreamNet continued to communicate with and support sponsors in the transfer of data to secure and accessible repositories. In addition, staff submitted data types without a formal DES such as the Yellowstone Cutthroat Trout Range-Wide assessment, population surveys, and genetic sample information, to the StreamNet Data Store as independent data sets.

4. Oregon Department of Fish and Wildlife

ODFW StreamNet staff continued to assist and encourage BPA funded, ODFW, and local project sponsors to manage or locate their data within secure and accessible data repositories.

5. Washington Department of Fish and Wildlife

WDFW continued to communicate with project sponsors, review data storage and offer assistance to secure accessible repositories.

C. Fish Monitoring Data (time series trends)

Work Elements:	B 159: Support transfer of data into secure and accessible repositories G. 161: Data - dissemination H. 159 Compile high priority traditional StreamNet data

StreamNet's Fish Monitoring Data new tabular query is designed so that users can quickly find and access the data they are looking for by using filters. Once located the users can view the table of data along with metadata and a map of the monitoring location. The user can also choose to download these data into an Excel Spreadsheet file or copy the URL to easy reference and share these data with others. The Fish Monitoring Data tabular query pulls data using the API and was designed to better integrate with the StreamNet website. We are currently looking at adding several georeferencing filters to the Fish Monitoring Data query.

Updating trend data sets was prioritized by the StreamNet Executive Committee in 2018, with emphasis on trends supporting CAX HLIs and NPCC tools. With the recently adopted 2020 Addendum to the Columbia River Basin Fish and Wildlife Program, it is anticipated that the Fish Monitoring Data query will be supporting specific data needs for the NPCC's Program Tracker. The StreamNet DES, which contains data submission standards for Fish Monitoring Data system, was updated in 2020. Validation rules were updated to implement those changes. As a failsafe, tables were added in CY2020 to back up records that are deleted or modified in the main data tables. Triggers were added or modified on all main data tables to archive deleted/modified records. A summary of the Fish Monitoring Data trends data sets updated in CY2020 is provided in the below table (Table 6) along with a highlight of the number of records associated with a Coordinated Assessments Partnership population in the Fish HLI map query (Table 7).

Table 6: Summary of the number of Fish Monitoring data time series (trends) data sets by data category, representing a total of 18,160 trends consisting of 189,902 records; and 32,997 Protected Areas records in the StreamNet database as of December 31, 2020. This summary represents all data submitted by the end of calendar year 2020 from any geographic areas in Montana, Idaho, Washington, and Oregon (not limited to the Columbia River basin). The number of Protected Areas records has been stable since the NPCC last amended the Protected Areas in 1992. Note: beginning in 2018 fish distribution, barriers, dams, and hatcheries are being managed as GIS layers rather than as tables in a database.

Data Category	Available Data	Years	Records
Redd counts	4,970 Trends	1901 - 2020	54,536
Fish counts	438 Trends	1956 - 2019	2,331
Spawner counts	5,153 Trends	1944 - 2019	40,151
Spawning population estimates	3,173 Trends	1901 - 2020	22,134
Dam / weir counts	508 Trends	1926 - 2020	14,184
Fish abundance estimates	128 Trends	1976 - 2019	549
Hatchery returns	1,082 Trends	1906 - 2020	10,355
Freshwater harvest	2,708 Trends	1894 - 2015	45,662
Protected Areas	32,997 Records	n/a	n/a

Table 7: Summary of Coordinated Assessments Partnership populations with associated time series data sets in the Fish Monitoring Data (trends). First column is population grouping; second column is the type of data; third column is number of populations with associated time series data sets in the Fish Monitoring Data (trends) for the population group and data category indicated; fourth column is the year range for the trends; fifth column is the number of records of data in the group. Fish Monitoring Data time series data (Trends) data are generally at a smaller geographic scale than populations and are generally indexes of abundance.

Population Group*	Data Category	Pops	Years	Records
BPA Priority	Redd counts	40	1949 - 2020	12,611
	Fish counts	13	1994 - 2019	836
	Spawner counts	14	1985 – 2019	4,533
	Spawning population estimates	8	1954 – 2019	1,220
	Dam / weir counts	8	1963 - 2020	405
	Fish abundance estimates	10	1996 - 2019	284
	Hatchery returns	13	1978 - 2020	266
	Freshwater harvest	1	1992 - 2011	57
Columbia River Basin	Redd counts	74	1949 - 2020	17,716
	Fish counts	20	1994 - 2019	1,583
	Spawner counts	48	1948 - 2019	10,336
	Spawning population estimates	41	1944 - 2019	3,197
	Dam / weir counts	26	1950 - 2020	2,110
	Fish abundance estimates	13	1996 - 2019	384
	Hatchery returns	31	1942 - 2020	537
	Freshwater harvest	9	1961 - 2011	222
Oregon Coast	Dam / weir counts	1	1946 - 2018	118
Puget Sound	Spawner counts	22	1965 - 2019	1,774
	Spawning population estimates	25	1952 - 2020	1,556
	Dam / weir counts	1	1978 - 2019	64
	Fish abundance estimates	1	1985 - 2017	39

*BPA Priority = The 68 BPA Tier 1 and Tier 2 priority populations.
Columbia River Basin = All population within the Columbia Basin, including the Priority populations.
Oregon Coast = Populations in Oregon coast river systems draining directly into the Pacific Ocean. These are outside the Columbia River Basin.*

Puget Sound = Populations in Washington draining into Puget Sound / Strait of Juan de Fuca. These are outside the Columbia River Basin.

1. The Confederated Tribes of the Colville Reservation

No significant work on HLI-related trend data during 2020.

2. Idaho Department of Fish and Game

Idaho compiled and delivered fish data to StreamNet as time and staffing allowed. All metric data used to derive HLIs for CAX were uploaded to the StreamNet database (e.g., redd counts, hatchery returns, weir counts). The Chinook, steelhead, and sockeye salmon redd counts, weir counts, and hatchery returns were all updated.

3. Montana Department of Fish, Wildlife & Parks

MFWP compiled traditional StreamNet data throughout the year and exchanged trend data consisting of 1160 redd counts at 121 locations in the Columbia Basin. In addition, 33 references were added and fish population and genetic data were submitted to the StreamNet Data Store as independent data sets. Fish distribution was submitted as a spatial data set and the submission included all fish distribution records in the MFWP dataset to ensure StreamNet had a comprehensive and current dataset.

4. Oregon Department of Fish and Wildlife

Oregon exchanged 51 new and updated 235 existing traditional trends (including updating and adding 1,190 records for escapement data only) via the StreamNet API, originating from BPA-funded projects, NPCC dashboards, opportunistic connections to CAP data, priority populations within the Columbia Basin, and QC information from StreamNet staff. Staff submitted new trends for populations of Umatilla River steelhead juvenile fish counts at Three Mile Falls Dam, juvenile counts and migrants in Birch Creek (tributary to Umatilla River), North Fork John Day summer steelhead redd counts, and Upper Willamette spring Chinook redd and carcass counts.

5. Washington Department of Fish and Wildlife

WDFW updated Columbia Basin trend data in 2020. Specifically, for the following categories of trends: 69 redd counts, 35 carcass counts, and 36 escapement or spawning abundance. In 2020 the previously uploaded 5 harvest trends were removed.

D. GIS Layers Updated Content and Access

PSMFC's GIS Center continues to support an integrated Columbia Basin fish facilities GIS data set. This effort eliminates multiple data sets with varying degrees of accuracy for location information, and establishes a common layer which is now shared between programs. This integrated GIS data set approach continued to support StreamNet and CAP during 2020.

PSMFC StreamNet (Regional) also provides links to barrier data sets that partner agencies publish publicly. These barriers data are not currently being compiled and standardized regionally. The status of this information reflects that this data category has not been identified as a priority for standardized compilation and distribution at the regional level. However, StreamNet partners are often involved in maintaining these datasets to meet internal state mandates and to inform the fish distribution dataset

During CY2020, BPA reinstated funding with the StreamNet FY2021 budget to support GIS tasks. The PSMFC GIS Center staff-initiated planning in CY2020 for specific tasks to advance the BPA priorities including, creating and improving access to population polygons and PSMFC standardized names informed by managers, working with PNAMP MonitoringResources.org staff to facilitate use of PSMFC GIS layers, and discussing the development of a prototype visualization tool to display screw trap locations with related data and metadata.

PSMFC's GIS Center also worked with StreamNet staff in CY2020 to explore how GIS data sets and layers can more easily be integrated into the StreamNet Website to facilitate access. This task is ongoing during CY2021 and will be completed by the time the refreshed StreamNet website is released during the summer of CY2021. It is noteworthy to point out that although PSMFC's GIS Center receives new stream routes from partner agencies, StreamNet is no longer funded to maintain a coordinated regional hydrography layer.

1. The Confederated Tribes of the Colville Reservation

GIS-related tasks are not included in the StreamNet scope of work for the Colville Tribes, though information on the layout of the research (assessment units, reaches, sites) and location of fish facilities is available in an interactive map on the site okanoganmonitoring.org.

2. Idaho Department of Fish and Game

The generalized fish distribution layer was updated per new stream and lake survey data via direct GIS Exchange with StreamNet.

3. Montana Department of Fish, Wildlife & Parks

MFWP StreamNet staff manage the agency's fisheries spatial data and post GIS layers to the MFWP Open Data site where they are available for viewing and download. Spatial data sets include fish distribution, fish survey locations, genetic sample locations and hatchery locations. StreamNet staff under the guidance of PSMFC have begun to submit some data sets as spatial data sets rather than tabular.

In addition to managing StreamNet data sets as GIS layers, MFWP staff outside of StreamNet also make further fisheries GIS layers and products available to the public and partners such as aquatic invasive species information, fish stocking data, disease information and interactive maps and Story Maps.

4. Oregon Department of Fish and Wildlife

Within Oregon, routine GIS coordination occurred during 2020, as well as maintaining hydrography data (whole stream routes) to support mapping trend data.

ODFW staff added records to the Oregon Fish Passage Barrier database, and updated Oregon Fish Habitat Distribution Database records in the Columbia Basin as necessary. Associated references were also developed and submitted.

5. Washington Department of Fish and Wildlife

WDFW StreamNet GIS staff continued updates of WA NHD hydro databases and supporting GIS needs to ensure the flow of StreamNet trend, fish distribution and CA data. In 2020 the GIS work continued focusing on fish distribution, population geometry reviews and supercode, linework and dataflow tools. We added Hatchery location ID and verification for upcoming HCAX work and synching Columbia Basin geometry for SGS (our historic Spawner Ground Survey database) and WALOCS (our internal database supporting Hatchery collections and RMIS submissions). We submitted new trends and relevant supercodes to coordinate better with CA data.

E. Fish HLIs – Coordinated Assessments Partnership

Work Elements:	159: Support transfer of data into secure and accessible repositories 161: Data - dissemination

The CAP Coordinated Data Partnership aims to build automated HLI sharing capability in all the data source agencies. StreamNet works with the agencies to develop procedures for internal conversion of the data to regional standards

defined in the Coordinated Assessments Data Exchange Standards, and during 2020 has contributed to the coordination and standardization of monitoring data throughout the basin in 2020.

This past year has been very active for the Coordinated Assessments Partnership (CAP) co-lead by PNAMP and StreamNet. During 2020, the Nez Perce Tribe started submitting their data directly to the Coordinated Assessments Data Exchange (CAX) system and the Yakama Nation's STAR data system has increased their data submittal as well. We also saw improvements in the data sharing capacity of other tribes, some of who benefited from the small StreamNet subcontracts received in 2020, and we expect to see additional tribes start flowing data into the CAX during 2021. StreamNet staff and members continue to actively support improving data sharing capabilities in the region through the CAP, and since 2012 StreamNet staff maintains an API and supports an automated means of feeding indicators and metrics from the CAP to the NOAA Salmon Population Summary (SPS) database. In 2020, StreamNet staff also continued to support NOAA staff accessing data directly from the CAX and from the web-based Fish HLI map query.

During the calendar year 2020 the CAP partners continued to maintain and publish new records to the CAX resulting in a total of 13,953 records by the end of calendar year 2020 (Tables 8 and 9). The Fish HLI mapping query system displays HLIs in the CAX and related Fish Monitoring Data time series stored in the StreamNet database.

Table 8: Number of records of data, by high level indicator and StreamNet partner, as of 12/31/2019 and 12/31/2020.

High Level Indicator	Partner*	12/31/2019	12/31/2020
Natural Origin Spawner Abundance (NOSA)	Colville Tribes	14	14
	YN	272	280
	IDFG	1,254	1,441
	NPT	0	389
	ODFW	2,445	2,499
	USFWS	33	23
	WDFW	2,142	2,305
Presmolt Abundance	Colville Tribes	49	49
	ODFW	89	89
	PSMFC	1	1
	Terraqua Inc.	23	23
Juvenile Outmigrants	Biomark	31	31
	Colville Tribes	12	12
	IDFG	741	548
	NPT	0	157
	ODFW	315	321
	WDFW	358	450
Smolt to Adult Return Rate (SAR)	Colville Tribes	10	10
	FPC**	759	955
	ODFW	246	273
	USFWS	16	16
	WDFW	44	47
Recruits per Spawner (R/S)	Colville Tribes	10	10
	IDFG	984	1,200
	ODFW	2,232	2,323
	USFWS	13	13
	WDFW	302	310
	Colville Tribes	0	15
Proportionate Natural Influence (PNI)	WDFW	146	149
Total number of records	**All combined**	**12,541**	**13,953**

*Biomark = Biomark, Inc.; Colville Tribes = Confederated Tribes of the Colville Reservation;
YN = Confederated Tribes and Bands of the Yakama Indian Nation; FPC = Fish Passage Center
IDFG = Idaho Department of Fish and Game; NPT = Nez Perce Tribe; ODFW = Oregon Department of Fish and Wildlife;
PSMFC = Pacific States Marine Fisheries Commission; USFWS = U.S. Fish and Wildlife Service; WDFW = Washington
Department of Fish and Wildlife.

Table 9: Summary of populations represented in the data as of 12/31/2020, by population group and high-level indicator. Groups reported are the combination of the first two columns. First column is population grouping; second column is high level indicator; third column is number of populations represented in the group; fourth column is the number of populations that are represented only as part of one or more superpopulations rather than as data specific to only a single population; fifth column is the number of records of data in the group; sixth column is the year range of the group. The third column minus the fourth column is the number of populations that were represented by data specific to only a single population (i.e., not represented only by superpopulations).

Population Group[*]	High Level Indicator	Pops	Superpops Only	Records	Year Range
BPA Priority	Natural Origin Spawner Abundance (NOSA)	66	1	2,735	1949 - 2020
	Presmolt Abundance	8	0	162	1993 - 2018
	Juvenile Outmigrants	43	0	936	1987 - 2019
	Smolt to Adult Return Rate (SAR)	58	41	304	1985 - 2017
	Recruits per Spawner (R/S)	51	12	2,145	1949 - 2017
	Proportionate Natural Influence (PNI)	4	0	136	1985 - 2019
Columbia River Basin	Natural Origin Spawner Abundance (NOSA)	175	1	6,362	1938 - 2020
	Presmolt Abundance	8	0	162	1993 - 2018
	Juvenile Outmigrants	70	4	1,355	1978 - 2020
	Smolt to Adult Return Rate (SAR)	99	75	1,177	1985 - 2018
	Recruits per Spawner (R/S)	83	14	3,141	1949 - 2018
	Proportionate Natural Influence (PNI)	5	0	164	1985 - 2019
Oregon Coast	Natural Origin Spawner Abundance (NOSA)	56	35	589	1994 - 2019
	Juvenile Outmigrants	7	0	132	1997 - 2017
	Smolt to Adult Return Rate (SAR)	7	0	124	1997 - 2016
	Recruits per Spawner (R/S)	21	0	715	1994 - 2016
Puget Sound	Juvenile Outmigrants	2	0	32	1999 - 2019

[*]BPA Priority = The 69 BPA Tier 1 and Tier 2 priority ESA-listed populations.
Columbia River Basin = All population within the Columbia Basin, including the BPA priority populations.
Oregon Coast = Populations in Oregon coast river systems draining directly into the Pacific Ocean. These are outside the Columbia River basin and are compiled using alternative funding.
The database held no data for Puget Sound populations.
Puget Sound = Populations in Washington draining into Puget Sound / Strait of Juan de Fuca. These are outside the Columbia River Basin.

1. The Confederated Tribes of the Colville Reservation

The Colville Tribes' HLIs are housed in the OBMEP database, and a Python script syncs these data with the CAX database.

2. Idaho Department of Fish and Game

The IDFG StreamNet subproject can currently accomplish nearly automated submittal of data consistent with the DES through their IFWIS database and APIs, which the Idaho StreamNet project helped to initiate and partially supports.

IDFG StreamNet expanded streamlined data flows for CAX HLI data to include new species, populations, and life stages.

3. Montana Department of Fish, Wildlife & Parks

CAP HLIs and DESs have not been developed for resident fish species. MFWP staff have been staying aware of work being done for the CAP project and will be prepared as work begins to develop metrics and indicators for resident species.

4. Oregon Department of Fish and Wildlife

In 2020, ODFW StreamNet staff completed development of a new internal web application that allows Coordinated Assessments Partnership data to be entered directly into the ODFW Coordinated Assessment SQL server database and automates the processes for validation and submission to the StreamNet API. A production and test application for all-natural origin high-level indicator tables was developed and is currently in operation. The new application has increased efficiency, reduced errors and eliminated previous DES data transfers and transformations between staff. Data stewards with specific familiarity with a population and project conduct direct data entry into the new system.

ODFW StreamNet acquired new and maintained existing data sets for population estimates from various contributors in the Columbia Basin. This resulted in the submission in Coordinated Assessments DES format of all BPA priority populations in the Lower Columbia, Middle Columbia and Snake River that ODFW committed to in 2020. ODFW submitted new RperS indicator data for Hood River winter steelhead and made changes to in-house data and databases to conform to the new DES approval of flagging NOSA estimates as natural origin spawner or escapement estimates. Updates and edits were conducted to follow validation rules of the DES and to standardize metadata to be more consistent among similar records and populations.

Collaborating with East Region Fish Research (ERFR), StreamNet staff co-authored and finalized the Snake River Spring Chinook Viable Salmonid Population (VSP) Compendium. The VSP Compendium is a detailed field and analysis methods document for CAP indicators and metrics. The document is uploaded to the ODFW Data Clearinghouse and the Columbia Basin Fish & Wildlife Library for added discoverability and included as metadata with high-level indicator DES records.

Staff coordinated internally and externally to ensure priority CA and recovery-related efforts were addressed. ODFW regional coordination focused on NOAA Technical Recovery Team (TRT) recovery population changes, regional information gathering requests, data exchange standards, traditional data category definitions, and StreamNet's Fish Monitoring Data query system. Oregon spent significant time participating in the development, update and maintenance of the CA and StreamNet DESs throughout the year.

5. Washington Department of Fish and Wildlife

WDFW is in the process of modifying their Salmon Population Indicator data base to carry CA indicator data and deliver them to the Coordinated Assessments Data Exchange (CAX) database using the StreamNet API.

WDFW StreamNet staff loaded the WDFW CAX database with NOSA (2019-2020) and SAR (2010+) data through the API. Although the test was successful, these data were not published as, at that time, the PopFit and TRTmethod columns in the data tables needed to be documented further to accurately reflect the data. The Upper Columbia Data Steward conducted a regional WDFW review to identify CA metric data and associated time series for CAX data in the upper Columbia Basin. These data were identified and compiled for future integration into the CAX database. All StreamNet

staff contributed and continue to contribute to the new design of the TWS (Traps, Weirs, Surveys) restructure and to ensure all measurements were being collected to support metrics needed to create focal indicators.

6. CAP Co-Lead Update (PNAMP and StreamNet)

With an increasing number of new organizations submitting data to the Coordinated Assessments Data Exchange (CAX) system, most of whom were not engaged when CAP began in 2011, the need to tighten up CAP processes, improve documentation, and CAP communication became evident. One area of focus was improving how StreamNet and PNAMP can leverage their areas of expertise and membership to benefit CAP. In 2020 we formalized how the PNAMP Fish Monitoring Work Group (FMWG) can assist developing new HLIs identified by the StreamNet Executive Committee by bringing together the relevant fish and habitat experts, and how the FMWG can also assist the CAP DDT by participating in CAP DDT ad hoc workgroups as needed. The other area of focus was to address the need for better documentation and communication. In response to this need, the CAP co-leads Jen Bayer and Nancy Leonard, worked with the CAP Core Group that is facilitated by Jen (PNAMP) to update existing descriptive materials and to develop new materials where needed. These 2020 products have included:

- First CAP newsletter produced in November 2020
- Adoption of the first CAP logo that was included in the CAP newsletter
- Revised CAP workgroup roles and responsibilities document to clarify existing groups and how the revitalized FMWG will support CAP HLI development and refinement process.
- Updated Five-Year Plan for Coordinated Assessments Partnership, adopted by the StreamNet Executive Committee in September 2020.
- Talking points to inform WDFW discussions with NWIFC and Puget Sound tribes
- Draft CAP partners and participants definitions to clarify expectations for organizations that engage with different levels in CAP.
- Updates to the PNAMP webpage for the CAP project

This effort to improve documentation and communication about CAP has also resulted in improved diagrams to describe relationships among groups. These diagrams were used in presentations to CRITFC ITMD, StreamNet committees, and PNAMP Steering Committee (e.g., see Executive Committee slides). This work also helped inform the StreamNet Vision and Strategic Plan adopted in September 2020 to ensure alignment in how overlap StreamNet-CAP groups and tasks are described. Ongoing work includes development of short fact sheets for the CAP and the new HCAX effort starting in 2021, and a refined Data Exchange Standard procedure and CAP DDT charter that is being developed by StreamNet staff.

In addition to improving documentation and communication, efforts in 2020 also continued to focus on improving the quality of data accessible through the CAX, which is an ongoing goal for the CAP. This summer, StreamNet staff with assistance from PNAMP worked with a subgroup of the CAP DDT to rapidly address the need to distinguish between NOSA and escapement over a short time period (a few months this summer). This modification was vetted by a small workgroup of experts and successfully implemented, addressing a critical need to improve the quality of the data identified by BPA and NOAA.

During this year the CAP Core Team also invested time to develop a proposal to advance a new category of HLIs that have been on the Five-Year Plan for CAP for several years. The proposal submitted by CAP was successful in securing an award from the EPA Exchange Network FY2020 for the HCAX project. The HCAX will advance development and flow of standardized hatchery indicators to inform regional needs including the NPCC FW Program. This work will leverage existing CAP groups and processes to develop standardized indicators and the structured data exchange standard that will inform how these data will flow from partners to the CAX. This is an exciting project as it will show the applicability of the CAP approach to a new data category and engage a different group of individuals that will include hatchery managers.

The StreamNet Program also submitted a proposal to receive NOAA Interjurisdictional Fisheries Act (IJFA) through PSMFC to support further CAP activities. This proposal was funded for FY21 and includes funding for PNAMP to collaborate with StreamNet in conducting outreach to Puget Sound tribes in collaboration with NOAA and WDFW. Some

of the funding secured is also going to improving access to super/subpopulation HLI data and supporting the Colville Tribes in developing HLIs and submitting these to the CAX for a new population of interest to NOAA.

Since 2011, PNAMP and the PSMFC StreamNet program have collaborated to manage the Coordinated Assessments Partnership (CAP). Over time, much has been refined and improved to continue to make progress towards the CAP's overarching goal of improving the timeliness, reliability, flow, and transparency of data necessary for regional assessments and management decisions for improved environmental effectiveness. PNAMP staff work with StreamNet and Bonneville Power Administration to support the CAP. PNAMP facilitates the Coordinated Assessments Core Team meetings and related workshops as requested. PNAMP also supports StreamNet staff's leadership of the DES Development Team (DDT), which maintains and provides updates to the DES. Participants in the CAP represent four states, six tribes, an inter-tribal consortium, and multiple federal regulatory agencies; all with an interest in collaboratively sharing fish population data for informing decision-making and reporting for fish populations in the Pacific Northwest. This work benefits from the existing facilitation framework provided by StreamNet, PNAMP, and the substantial cost share contributions from the Bonneville Power Administration. In addition, the project has benefited from multi-year grants from EPA to support HLI development and data sharing.

F. DES and Validation Process for Data and HLIs Submitted to the StreamNet Database

Work Elements:	159: Support transfer of data into secure and accessible repositories 159: CAP Data – compile data 160: CAP Data -automated data exchange 159 Compile high priority traditional StreamNet data 160 Infrastructure and base operations

StreamNet maintains a thorough data validation system as detailed in the approach/methodology section. During CY2020, StreamNet PSMFC staff updated the DES and the related validation rules for both the CAP HLIs and for the fish monitoring data (StreamNet trends).

CAP DDT members and StreamNet DDT members (including data stewards) engaged in development of the DESs and validation process.

In CY2020 several new initiatives were begun to improve the functions of the DDTs. First, a draft charter was created for each DDT. These draft charters specify the roles of DDT members, and outline the general approaches used to develop/update a DES. Second, a draft was created to update the formal DES change process that was first created in 2003. The DES change process lists specific steps in the development of new/changed DESs. As part of the new DES process envisioned, we hope to gain assistance from experts across the Northwest as needed. To do so, StreamNet worked with PNAMP to re-initiate the PNAMP Fish Monitoring Work Group. We intend to ask assistance via that group in cases when DES questions arise.

1. The Confederated Tribes of the Colville Reservation
The Colville Tribes staff participated in the DES development meetings during 2020.

2. Idaho Department of Fish and Game
IDFG StreamNet staff continued to support the development and maintenance of Coordinated Assessments DES and CAX database. They coordinated with development between the proposed DES, the prototype database and

application, and the web service data exchange. IDFG StreamNet staff completed, corrected, and standardized data source workbooks for natural origin HLI data.

IDFG StreamNet staff collaborated with PSMFC staff to update validation rules and used web services to exchange data between IDFG, StreamNet, and the CAX databases. They also helped regional staff test updates to DES and validation.

3. Montana Fish, Wildlife & Parks
MFWP staff are ready to engage when CAP indicators and DES are developed for resident fish.

4. Oregon Department of Fish and Wildlife
ODFW staff contributed input to CA DES discussions, various forums and email correspondences throughout the year, including significant participation in the proposals and discussions for adding Escapement as an estimate type in the NOSA DES. The DES Development Team (DDT) accepted the proposed modifications, and they were implemented at PSMFC and ODFW StreamNet.

5. Washington Department of Fish and Wildlife
WDFW participated in CA DES development discussions and meetings with the CA DES Development Team (DDT). WDFW SN Staff continued to map the CA DES to ETL processes in our own internal corporate systems for the three primary CA indicators in 2020.

G. Metadata Documentation

Work Elements:	159: Support transfer of data into secure and accessible repositories 160 Infrastructure and base operations

During 2020, metadata continued to be captured for new data sets submitted to the Data Store. These metadata are provided by the entity that uploads the data set. The Data Store online upload process requires that descriptive information be completed before the data set is accepted. For data from projects funded under the Fish and Wildlife Program, the application pre-fills some project-related metadata fields directly from the BPA Cbfish.org database. All metadata are included whenever users download data sets. The amount of detail regarding sampling methodology and other key aspects is dependent on the entity uploading the data. The Data Store metadata constitute an extension to the FGDC Biological Profile metadata standard.

During 2020, metadata also continued to be captured for data submitted to the StreamNet databases. The metadata captured differed depending on whether the data were submitted to the Fish HLI (CAX data system) or the Fish Monitoring Data (StreamNet Trends data system), as described in Section IV.H. The documentation of metadata could be further improved and discussions to address this need were initiated in CY2020 with PNAMP and by initiating a quality control (QC) review of the Fish HLI to inform a QC Procedure to be implemented starting FY2022.

The metadata requested by the StreamNet data systems is summarized below for each system:

- Fish Monitoring Data
  Due to the very large volume of individual records of fish monitoring data, each independent of all the others, metadata provided, by necessity, are limited.

  Each time series ("trend") has the following time series-level metadata:

- associated hatchery, if any;
- associated dam, if any;
- whether all known historical data are included;
- whether the time series in continuing to be added to the StreamNet database, and if not then why;
- organization that created the time series and is responsible for updates;
- comments associated with a time series;
- date and time the time series record was last updated.

Each record of data for annual counts/estimates contains the following record-level metadata:
- general approach to field methods and calculation methods;
- comments associated with each individual annual record;
- organization that created the record and is responsible for updates;
- whether a regularly-scheduled annual measurement is unavailable, and why;
- a citation for a reference document where the data come from;
- date and time the record was last updated.

In addition, when a fish monitoring data set is obtained from the StreamNet online query system it is given a time stamp to indicate the time at which the data set was created.

- Fish HLI
  Each record of data for fish HLI estimates contains the following record-level metadata:
  - comments associated with each individual annual record;
  - organization and contact person information for questions about the record;
  - whether the value of that record is considered the providing organization's best available estimate (when multiple reasonable estimates are provided by that organization);
  - protocols used to produce the HLI estimate (provided as name(s), URL(s), or document citation(s);
  - whether the protocols cited were adjusted when making this estimate;
  - complete list of organizations that contributed to the estimate;
  - whether a regularly-scheduled annual estimate in a time series is unavailable, and why;
  - status of the data provided (draft, reviewed, or final);
  - location where the source HLI is available;
  - location(s) where "metrics" used to calculate the HLI are available;
  - location(s) where field measurement data used to calculate the metrics are available;
  - a citation for a reference document where the data come from;
  - date and time the record was last updated.
  In addition, when a fish HLI data set is obtained from the CAX online query system it is given a time stamp to indicate the time at which the data set was created.

- Data Store
  The StreamNet Data Store uses and enforces the federal FGDC metadata standard, modified for Pacific Northwest fish data sets that are assumed to not have a GIS component.

1. The Confederated Tribes of the Colville Reservation.
The metadata related to the compilation of filed data used for the HLI are housed in MonitoringResources.org.

2. Idaho Department of Fish and Game
IDFG continued to create and update metadata for all data submitted to SN and CAX per the DES. Sampling and analysis protocols, and links to data sources were updated.

3. Montana Department of Fish, Wildlife & Parks

MFWP StreamNet staff created and updated metadata for all spatial data sets submitted to StreamNet or posted to the MFWP Open Data site. Metadata were completed for all data submissions to the StreamNet Data Store.

4. Oregon Department of Fish and Wildlife

Collaborating with East Region Fish Research (ERFR), StreamNet staff co-authored and finalized the Snake River Spring Chinook Viable Salmonid Population (VSP) Compendium. The VSP Compendium is a detailed field and analysis methods document for CA indicators and metrics. The document is uploaded to the ODFW Data Clearinghouse and Columbia Basin Fish & Wildlife Library for added discoverability and included as metadata with high-level indicator DES records submitted to the CAX for display on the Fish HLI map query.

Staff also regularly updated and created metadata for in-house datasets used to calculate and report high-level indicators.

5. Washington Department of Fish and Wildlife

WDFW StreamNet staff continued to work with contributing biologists to document methodologies and update them within our corporate reporting systems. The development of formal metadata for CAP data and beyond will greatly aid efforts to document data origin, protocols used to collect the data, and uses of the data.

H. Data Backup Systems

Work Elements:	159: Support transfer of data into secure and accessible repositories
	160 Infrastructure and base operations

In 2020 we retired several older stand-alone server computers and continued our server/system consolidation and virtual deployment within the PSMFC virtual environment. Virtual deployment simplifies maintenance tasks and backups.

The StreamNet staff continued to maintain and implement the data backup approach described in Section IV-I above. No material changes in data backup systems were made in 2020. Annual testing of database restore function was initiated and tested. Previously, this was done intermittently.

I. Supported Reporting and Decision-Making Processes

Work Elements: 185 Produce PISCES Status Report
161: Data Dissemination
119: Manage project activities
132: Produce annual reports

StreamNet Staff manages all project activities and ensures that StreamNet project quarterly status reports, annual report and BiOp RPA report to BPA are submitted on time to BPA. During CY2020 regular meetings were held for ExCom and SN SC. Agendas were formulated, issues discussed and resolved where possible, and priorities were set. Reporting and posting of notes and decisions were facilitated via the StreamNet website. Subcontracts were executed and invoices tracked. New SOW and budgets were developed and provided to BPA. An inventory list and cost share report were also developed and provided to BPA. All reports were submitted to BPA as requested during calendar year 2020.

All StreamNet funded partners contributed to the successful management and implementation of project activities, as follows:

- Colville Tribes
  - Participated in StreamNet Technical and Steering committee meetings as well as the DES Development Team. Budgets effectively tracked and managed.
  - Provided input that informed the quarterly status review, the Annual Report and Cost Share report.
- IDFG
  - IDFG StreamNet staff, budgets, and resources were effectively managed to meet all program objectives.
  - Provided input that informed the quarterly status review, the Annual Report and Cost Share report.
- MFWP
  - MFWP StreamNet staff participated in project management, StreamNet Technical and Steering committee meetings. Budgets were effectively tracked and managed. Staff participated in all relevant budget and Statement of Work discussions and provided input to the SOW and budget.
  - Provided input that informed the quarterly status review, the Annual Report and Cost Share report.
- ODFW
  - ODFW StreamNet staff participated in project management, StreamNet Technical/DES, Steering Committee, and Executive Committee meetings. Staff were effectively supervised, and budgets were tracked and managed throughout the year. ODFW StreamNet staff provided input to Statement of Work and budget discussions, and submitted updated inventory reports to Regional StreamNet.
  - ODFW StreamNet staff summarized activities in preparation for completing the 2020 Annual Progress Report. Staff provided input for the Annual Report on schedule and participated in editing efforts. Staff also provided input that informed the quarterly status review and Cost Share report.
- WDFW
  - WDFW StreamNet staff participated in project management, StreamNet Technical and Steering Committee meetings. Staff were supervised, budgets were tracked and managed throughout the year. Staff provided input to the SOW and budget.
  - Provided input that informed the quarterly status review, the Annual Report and Cost Share report.

During 2020, StreamNet continued to support regional information needs with a focus on BPA, NOAA and NPCC (Figure 11). StreamNet supported BPA's mandate to have data sets collected using rate payer funding be publicly accessible in a web-based data repository by facilitating submittal of data sets to the StreamNet Data Store. The availability of Fish HLI estimates through the CAX has facilitated BPA's "One Fish Two Fish" tool to pull information from the CAX database as well as other data sources to display these on an interactive web-tool that communicates the status of ESA-listed salmon

and steelhead populations (http://www.onefishtwofish.net/sps/SPS3.html). BPA also manages a web-based project contracting tool, CBFish.org, which contains annual reports of BPA funded projects, several of which submit their data to the StreamNet Data Store, to the CAX as derived metrics estimates and Fish HLIs, and/or as a time-series (trends) data set to the Fish Monitoring Data StreamNet database.

NOAA staff involved in the data compilation to inform the 5-year status review of CRB salmon and steelhead populations continue to participate in the CAP and StreamNet committees and teams to inform the content of the CAX to support their data needs. NOAA Fisheries uses the natural origin CRB salmon and steelhead indicators currently reported through the Fish HLI map query (e.g., adult spawner abundance and productivity) to inform their status reviews and delisting decisions. The CAP's Fish HLI (CAX data system) have greatly reduced the time and effort required by NOAA Fisheries staff to obtain and process data for their CRB ESA status assessments. StreamNet staff continued to assist NOAA staff and respond to their requests during 2020.

StreamNet Staff continued to provide support in 2020 to NPCC staff and their Program Tracker contractors. NPCC staff continued throughout 2020 to use and rely on the Protected Areas mapper and associated database and documentation to inform their decisions related to whether proposed new hydroelectricity development is consistent with the NPCC FW Program policy. Furthermore, StreamNet databases and maps supports the NPCC FW Program reporting needs related to tracking the status of the basin's fish and wildlife resources (2014 FW Program Part Two, section V), reporting on the program's approved high-level indicators (2014 FW Program Appendix E), and tracking progress towards Program goals, objectives and indicators (2014 FW Program Appendix D and its draft 2020 Addendum Part 1A). NPCC also has several online reporting tools that relies on StreamNet's Fish Monitoring Data query and the Fish HLI query including:

- NPCC high-level indicators and Program Tracker to track the status of species, progress of fish and wildlife efforts in the Columbia Basin, and with the adoption of the 2020 Program addendum, will assess progress towards NPCC FW Program objectives and performance Indicators. The CAX and StreamNet's Integrated Query traditional trends data feed information to these reporting tools.
- NPCC Fish Objectives Mapper and Query Tool displays in real-time the CAX population estimates to provide context to the adult salmon and steelhead goals and objectives from CRB management and policy documents.
- NPCC subbasin plan "dashboards" show extracts of subbasin plans and related links. StreamNet data are widely used in support of dashboards. In particular StreamNet partners have made the underlying "Trend" data sets that support these dashboards an update priority through StreamNet.

StreamNet maintains an API that allows NPCC to retrieve, in an automated way, specific sets of detailed Fish Monitoring Data "trend" for use in NPCC online reporting tools.
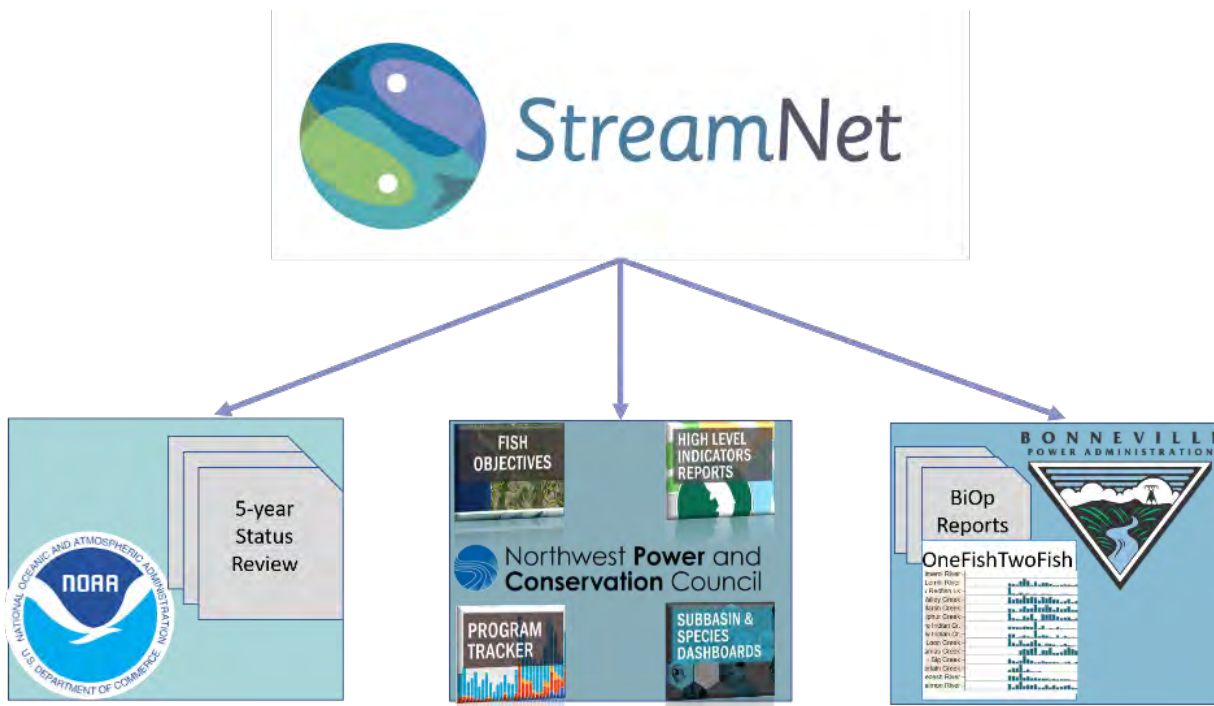
Figure 10: StreamNet provides information to several regional reporting tools and decision-making processes.

During 2020, StreamNet co-organized with the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) the Emerging Technology Information Session [Webinar Series](). The webinar series was held from October 2020 to the end of February 2021 and covered various topics related to emerging technologies for monitoring and data management, with each of the four months focusing on one topic and including three or four virtual sessions with expert speakers from the field. The topics and expert speakers were identified by the ETIS Planning Group members, consisting of StreamNet staff (Mike Banach, Nancy Leonard, Greg Wilke), PNAMP staff (Jen Bayer, Sam Cimino, Amy Puls, Becca Scully), BPA staff (Russell Scranton), CBF&W Library staff (Tami Wilkerson), Oregon State University staff (Erik Suring), OWEB staff (Ken Fetcho), US BOR staff (Mitch Mumma), and USGS staff (David Pilliod). Participation in the ETIS webinar series ranged from 30 to over 100 attendees and included individuals from across the USA and other countries. Each of the sessions was recorded and posted to [PNAMP's YouTube Channel]() to support broader access, and included the below presentation and speakers:

- **October 2020: Aerial Monitoring of Aquatic Systems**

    Tuesday, Oct 6, 1:00-2:30pm Pacific ([learn more]() | [watch recording]())
    Richie Carmichael (Biomark): *Drone Assisted Stream Habitat (DASH) Protocol: Establishing consistency and compatibility between UAS monitoring programs*
    Sarah Hoffmann (Biomark): *Machine learning applications for conservation*

    Tuesday, Oct 13, 1:00-2:30pm Pacific ([learn more]() | [watch recording]())
    Kain Kutz (USFS): *Mapping riparian habitat and geomorphology monitoring applications within the United States Forest Service (USFS) using unmanned aerial systems (UAS) acquired imagery*
    Lauren Burns (CRITFC): *Integrating unmanned aerial vehicles into large-scale habitat monitoring in the Columbia River Basin*

    Tuesday, Oct 20, 1:00-2:30pm Pacific ([learn more]() | [watch recording]())
    Mischa Hey (Quantum Spatial): *Characterizing riverine fish habitat with bathymetric LiDAR*

Phil Roni (Cramer Fish Sciences): *Review of remote sensing and emerging technologies for use in evaluating floodplain and riparian projects*

- **November 2020: eDNA**

  Tuesday, Nov 3, 1:00-2:30pm Pacific (learn more | watch recording)
  David Pilliod and Matthew Laramie (USGS): *eDNA 101: Overview of sampling and extraction methods for environmental DNA*

  Tuesday, Nov 10, 1:00-2:30pm Pacific (learn more | watch recording)
  Carl Ostberg (USGS): *eDNA 201: Using environmental DNA for single-species assessments*

  Tuesday, Nov 17, 1:00-2:30pm Pacific (learn more | watch recording)
  Taylor Wilcox (National Genomics Center for Wildlife and Fish Conservation): *eDNA 301: Multi-species and biodiversity assessments, focusing on laboratory procedures and interpretation of results including challenges and future directions*

- **January 2021: Fish Monitoring and Assessment**

  Thursday, Jan 7, 1:00-2:30pm Pacific (watch recording)
  Chris Harrington (IDFG), Justin L Welty (USGS), Michelle Steg-Geltner (YN), and Samantha Smith (NPT): *Latest applications for handheld devices for field data collection*

  Thursday, Jan 14, 1:00-2:30pm Pacific (watch recording)
  Thomas Delomas (PSMFC/IDFG): *Measuring ploidy with non-lethal tissue samples and amplicon sequencing.*
  John Hargrove (PSMFC/IDFG): *Parentage-based tagging improves escapement estimates for ESA-listed adult Chinook Salmon and Steelhead in the Snake River basin.*

  Thursday, Jan 21, 1:00-2:30pm Pacific (watch recording)
  Gabriel Brooks and Benjamin Sandford (NOAA) : *Advances in PIT tag technology and what this can mean for assessments.*

  Thursday, Jan 28, 1:00-2:30pm Pacific (watch recording)
  Ryan Kinzer (NPT): *A streamlined data flow for improved decision making: data collection to analysis and all the gunk in between.*
  Dan Isaak (USFS): *The Fish Data Analysis Tool: Applying spatial stream network models with standardized databases to provide information for decision making.*

- **February 2021: Data Management**

  Thursday, Feb 11, 1:00-2:30pm Pacific (watch recording)
  Amanda Whitmire (Stanford University): *The basics of data management plans for research*
  Stacy Schumacher (Confederated Tribes of the Umatilla Indian Reservation) : *The Centralized Data Management System used by the Confederated Tribes of the Umatilla Indian Reservation for the storage of fisheries data*

  Thursday, Feb 18, 1:00-2:30pm Pacific (watch recording)
  Kevin D. Henry and Jeff Peters (USGS): *Data visualization tools and frameworks for hazards and risk research*
  Brendan Ward (Astute Spruce, LLC): *Using open-source technologies to build spatial web apps*

Thursday, Feb 25, 1:00-2:30pm Pacific ([watch recording](#))
Tami Wilkerson (Columbia Basin Fish & Wildlife Library/CRITFC): *Tools and best practices for data sharing and reuse to advance research*
Patricia Soranno (Michigan State University): *The ethics of data sharing in the environmental sciences*

StreamNet staff are also serving on the PNAMP Fish Monitoring Work Group (FMWG) Core Team, assisting PNAMP in the organization and identification of topics for the [FMWG](#). StreamNet staff engagement and assistance focuses on the tasks that aim to support the Coordinated Assessments Partnership and StreamNet by providing a venue for discussion of topics to inform tasks with appropriate subject matter experts (e.g., fisheries biologists, program managers, etc.). Some specific topics identified to date to improve how CAP and StreamNet supports reporting and decision-making include: improving access to fish population polygons and agreed upon names used by PSMFC by adding more species; improving how Fish HLI are displayed for superpopulations and subpopulations; determining how to display (or not) salmon and steelhead populations that currently do not have data in the Fish HLI, and refining the Coordinated Assessments DES. During CY2020 work focused on planning for the first FMWG meeting held on February 11, 2020.

1. The Confederated Tribes of the Colville Reservation

Tribal data management advancements supported in part by StreamNet data stewards have also contributed data informing the Colville Tribes Okanogan Monitoring and Evaluation Program Report Card[xxvi] which informs decisions related to habitat action implementation.

2. Idaho Department of Fish and Game

IFWIS and StreamNet data compilation and access tools were used by IDFG and other organizations for research and management purposes. Researchers and policy makers used the data to answer research questions in journal manuscripts, annual reports, fishery management plans, updates to status assessments, and ESA compliance.

3. Montana Department of Fish, Wildlife & Parks

MFWP data and information websites have advanced their capacity for providing access and sharing data for resident fish species important to the NPCC FW Program. These include:

-   The Fisheries Inventory System (FIS) FIS is available through the agency internal website and holds survey data, individual fish information, distribution, tagging data and hatchery data to name a few. FIS also contains sophisticated analysis tools which incorporate the use of R statistical code. This application puts the data entry, analysis and reporting in the hands of biologists. Data are continually updated, and sources include FWP, US Forest Service (USFS), USFWS, Bureau of Land Management (BLM) and tribal fisheries biologists and supplemented with information provided in technical documents and reports.

-   FishMT is a public facing web application that provides users with access to vast amount of fish and fishing information. Through FishMT the public can get information related to fish stocking records, survey data, species distribution, reports, publications and more. In addition, users can find fishing opportunities, report catching tagged fish, link to the regulations and buy licenses http://fwp.mt.gov/fish/

4. Oregon Department of Fish and Wildlife

In 2017, ODFW initiated Phase 1 efforts to pilot a comprehensive, resource information system which once fully implemented will greatly improve ODFW data management and sharing efficiency. Such a system was also called for in the ODFW 2018 Strategic Plan. With the establishment of an Enterprise Governance Committee in 2018, agency data management was deemed to be an enterprise level project under their purview. Discussions are ongoing to determine the best data management and sharing approach for the agency.

Staff participated in, and contributed to, the development of the ODFW Take, Hold, Release, and Observation (THRO) standards effort and resulting document. This effort is a crucial part of the future ODFW resource information system that will significantly advance the agency in areas of data management and increase data flow and sharing efficiency. The standard is expected to be finalized in late 2021.

In 2017, the Oregon Legislature passed several mandates around state agencies' management, use and sharing of data. The state has launched an Open Data Portal (data.oregon.gov) and published an Open Data Standard, which requires agencies to maintain an inventory of agency information resources, identify publishable data and publish "publishable" data to the Open Data Portal. ODFW has initiated an Open Data project to meet these requirements. In addition, the project will produce a detailed natural resources agency dataset inventory and mature data governance structures in the agency.

Currently, ODFW provides access to salmon and steelhead information and data through several websites:
- Data Clearinghouse (https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=1) stores natural resource information, including reports, data files, databases, GIS files, maps and pictures from natural resource projects. This includes agency projects that provide CA data for recovery populations, and Oregon Watershed Council projects funded by the Oregon Watershed Enhancement Board, and other partners implementing the Oregon Plan for Salmon and Watersheds.
- Oregon Salmon and Steelhead Recovery Tracker website (http://www.odfwrecoverytracker.org/) allows exploring and downloading information related to salmon conservation and recovery in Oregon.
- Centralized Oregon Mapping Products and Analysis Support System (Compass, http://www.dfw.state.or.us/maps/compass/). This online fish and wildlife habitat map provides coarse-scale, non-regulatory fish and wildlife information, and crucial habitat layers emphasizing areas documented as containing important natural resources. Compass is intended to support early planning for large-scale land-use, development or conservation projects, helping users make informed decisions related to fish and wildlife habitats as energy, transportation, conservation and other large projects are planned.
- Fish Habitat Distribution and Barrier Data Viewer (https://nrimp.dfw.state.or.us/FHD_FPB_Viewer/index.html) facilitates access to ODFW stewarded data sets for fish habitat distribution and fish passage barriers.

5. Washington Department of Fish and Wildlife

Washington Department of Fish and Wildlife (WDFW) manages multiple data resources which provides up-to-date information on populations and provides context for the efforts WDFW and its partners are taking in the arenas of habitat, hatcheries, and harvest to protect and conserve salmon and steelhead in Washington. These databases have benefited from advances funded through StreamNet and include:

- **SCoRe Interactive Map** [xxvii] allows the user to explore salmon and steelhead hatchery and population data and related information by salmon recovery region, county, lead entities, and by water resource inventory area (WRIA).
- **SalmonScape** [xxviii] delivers the science that helps recovery planners identify and prioritize the restoration and protection activities that offer the greatest benefit to fish. SalmonScape merges fish and habitat data collected by state, federal, tribal and local biologists and presents them in an integrated system that can be readily accessed by other agencies and citizens. SalmonScape is an interactive mapping application designed to display and report a wide range of data related to salmon distribution, status, and habitats.
- The **Spawning Ground Survey**[xxix] (SGS) database was designed as a repository for unexpanded data collected during spawning ground surveys and from adult traps. It is intended to provide a common framework for the collection, storage, retrieval, and dissemination of data collected by public and private entities. It includes status and trends of Coastal, Puget Sound, and Columbia Basin salmonid stocks.
- **CWT Recovery Database** live updates posted to Data.WA.Gov website.

J. Coordination with Partners and Responding to Data and Information Requests

Work Elements:	189: Coordination
	161. Disseminate Raw/Summary Data and Results

During CY2020 PSMFC StreamNet staff were invited to present during CRITFC ITMD annual Tribal Data Workshop in April 2020 and at a group monthly coordination meeting in November 2020. The purpose of these presentations focused on communicating the purpose and services provided by StreamNet and its data systems, as well as seeking feedback on what StreamNet could do to facilitate engagement by tribal data stewards and better support direct data submittal by CRITFC member tribes. PSMFC StreamNet staff look forward to having more regular engagement with the CRITFC ITMD participants and facilitate discussions.

During CY2020 PSMFC StreamNet secured IJFA funding to support StreamNet and PNAMP, the CAP co-leads to engage with NOAA, WDFW, and Northwest Indian Fisheries Commission staff working with Puget Sound salmon and steelhead data. The purpose of this interaction was to conduct outreach about the CAP and to gain a better understand of the level of interest in participating in CAP and what, if any, obstacles there may exist. This interaction continued into CY2021.

PSMFC StreamNet continued to engaged in the CAP Core Team which serves to coordinate among StreamNet, CRITFC-ITMD, NOAA, BPA and states. PSMFC StreamNet continued to organize and chair the StreamNet Steering Committee meetings and update the StreamNet Executive Committee. PSMFC staff continue to collaborate with and assist with partners submitting data to the StreamNet and CAX databases to improve data flow to the CAX and access to Fish HLI and related data submitted to the Fish Monitoring Data (trends data system). PSMFC staff continue to convene and chair StreamNet Technical Team that supports the API and other foundation content, and StreamNet DES Development Team (DDT) and CAP DDT meetings to inform DES development and refinements. PSMFC StreamNet also regularly engages, on an individual basis, with USFWS, NOAA, BPA, CRITFC, PNAMP and NPCC staff to be informed about each entity's needs and how coordination can be enhanced.

Direct requests for information or help have become less frequent over the years, as the StreamNet web site has been more stable, our online services more robust, and our priority shift to population-scale data has meant that our traditional data are not updated as frequently. Only 11 non-trivial direct requests were received by PSMFC StreamNet staff in 2020. All were promptly and satisfactorily addressed.

1. The Confederated Tribes of the Colville Reservation

The Colville Tribes Data Steward participated on the CAP Core Team and the DES Development Team, and provided feedback on the DES.

The Colville Tribes' anadromous division coordinated with other separately funded Colville Tribes programs such as the Chief Joseph Hatchery and the Resident Fish Department to keep them informed of the efforts and data structure the Colville Tribes was using for the Coordinated Assessments Partnership.

The Colville Tribes continued to respond to data requests this year, which were either met by directing users to appropriate data sources, or by running specific queries in the OBMEP database to fulfill the request.

2. Idaho Department of Fish and Game

IDFG StreamNet staff participated in the Steering Committee and Technical Committee, and supported development of DES and streamlined data flows. They provided input prioritizing indicators, metrics, and metadata.

Staff coordinated data management and analyses with tribal collaborators. Staff also updated and improved the sockeye data source workbook in cooperation with research and hatchery staff.

IDFG StreamNet staff responded to data requests coming from internal and external partners, and the general public. The number of data requests continues to decrease as the number of IFWIS users increases, and people find data for themselves.

3. Montana Department of Fish, Wildlife & Parks

Staff participated in Western Association of Fish and Wildlife Agencies efforts which relate directly to the use of StreamNet data.

MFWP StreamNet staff responded to all data and map requests coming from internal staff, partners and the public. Many external data requesters are being referred to the FishMT web query system or the MFWP Open Data site to meet their needs. Internal requests consist of data queries and map requests that internal staff cannot complete themselves. A new request/ticketing system was implemented in 2020 resulting in requests residing in two systems. MFWP GIS staff received approximately 45 map or data requests during the calendar year and all requests were fully satisfied.

4. Oregon Department of Fish and Wildlife

ODFW participated in the CAP DES Development Team, and StreamNet Technical and Steering Committee meetings, along with state and other regional discussions, workshops and planning efforts related to trend data development and CAP CAX data flow. Focused attention was given to completing the proposal to add new fields in the NOSA table to describe estimates more closely related to escapement and improvements to the design and functionality of the StreamNet and CAX websites. Staff continued contributions to BPA regarding priority population commitments and responding to requests from StreamNet partners.

Oregon StreamNet staff responded to data requests coming from internal and external partners, and the general public, with GIS, data and tech support requests being the most frequent. Agency staff are also utilizing StreamNet funded staff as a resource for assistance with developing data standards and responding to data requests that come to them.

Staff participated in the East Region Fish Research Program meeting and gave a presentation that promoted and explained the Coordinated Assessments and StreamNet projects. The overall meeting purpose was to discuss long-term data needs, various project efforts and results, potential for method standardization, and how data collected feeds into the CAP.

StreamNet staff participated in the Lower Columbia chum salmon reintroduction meeting to outline the next steps for distribution to data sharing systems, including Coordinated Assessments and the ODFW Recovery Tracker websites. West Region StreamNet staff have initiated work with chum project biologists to compile, calculate and analyze various datasets aimed at sharing fish monitoring data and the potential for high-level indicators.

ODFW StreamNet staff reviewed the StreamNet website to assess issues with data visualization and display of Fish HLI and Fish Monitoring Data. Detailed suggestions were submitted to SN staff.

Staff participated in user testing of Monitoring Resources.org and provided comments to PNAMP staff to streamline navigation and functionality of the website.

5. Washington Department of Fish and Wildlife

WDFW StreamNet continued this year to participate in the CAP process. Attention was given to DES development efforts, working with other agencies on overlapping populations, and continued development of data flow. Staff developed the code and processes to update CAP tables with final products.

In 2019 and 2020, WDFW collaborated with CAP partners to develop and submit a hatchery CAX grant proposal and preliminary scoping.

WDFW StreamNet staff responded to data requests coming from internal and external partners, and the general public, with GIS, data, and tech support requests being the most frequent.

VI.   Discussion – Recommendations and Lessons Learned

StreamNet serves as a regional coordination body to support data management and facilitate cooperation across organizational boundaries. StreamNet supports coordination through establishing and implementing regional data exchange standards for a specific suite of fish monitoring data (time series trends) and fish HLIs, including abundance, distribution, and productivity, with a long-term goal of extending coverage to additional metrics of regional importance. These data have traditionally been created and managed internally by the region's state, tribal, and federal fish management agencies or programs, and the StreamNet data systems provide access to these data in a consistent format as agreed upon by the data providers.

The success of StreamNet relies on its staff, and partner and member organizations' ability to learn, adapt, and adjust to regional information needs. The dynamic arena of data management and technology provides challenges and opportunities that StreamNet must tackle to be responsive to data providers' and consumers' needs. These needs include improving processes and tools to both enhance access to quality data and, strenghten proper use and attribution of data, while lessening the burden on data providers. Below we highlight some lessons learned and recommendations to further strengthen the StreamNet Program and its value to regional reporting and decision-making processes.

A. Recommendation for Supporting a Broader Group of Data Categories to Support Regional Information Needs

The diversity of data maintained by StreamNet addresses the different regional needs ranging from providing access to publicly funded data (such as via BPA ratepayers) to providing a common source of manager-approved data sets to inform regional decisions. In recent years these regional needs have become clearer and the approach used by StreamNet and CAP recognized as highly effective. The time is ripe for the Executive Committee to expand their guidance to StreamNet to improve data access for BPA, NOAA, NPCC and USFWS assessments and reporting needs, and to assist StreamNet, CAP, and its participants in securing funding to advance this work, whether through short-term grants or contracts or longer commitments (e.g. multi-year agreements or project funding).

Recommendations to the Executive Committee members:
- Support expanding data flow from agency/tribal data systems to StreamNet data systems that contribute to informing the NPCC 2020 Addendum (goals, objectives, and indicators); and BPA and USFWS bull trout and sturgeon needs. For instance, some bull trout and resident fish time-series data are submitted to StreamNet's Fish Monitoring Data (trends) system; this could be expanded to be comprehensive and better support BPA, NPCC and USFWS. Furthermore, NPCC intends to have their contracted data stewards (QW Consulting) work with StreamNet during CY2021-2022 to assess how data compiled for the NPCC Program Tracker can be provided through the Fish Monitoring Data (StreamNet Trends data system) and the Fish HLI (CAX data system). We expect that this will be an iterative process, building on data located and manually compiled through the Fish Data Product (FDP) Technical Contract work to illustrate what data are sought and organized in what

manner, with data providers flowing these data as feasible, and through discussions with fish managers about leveraging the FDP work for time-series data categories that are currently only in static documents.

- Support participation, either by providing in-kind or BPA funding, in PNAMP Fish Monitoring Work Group (FMWG)/StreamNet joint task groups to ensure proper representation by state and tribal natural resources experts to work on tasks that contribute to improving expanding data managed by StreamNet. For example, there are four tasks that will be initiated in CY2021 through the FMWG that will be led by StreamNet supported staff: (1) providing expert guidance on informing non-ESA population polygons and fish population (or other scale) names to be used by StreamNet and PSMFC; (2) determining how to display populations and their data availability for those populations that don't have HLIs in the Fish HLI Query; (3) determining how to properly display HLIs and metrics corresponding to superpopulations or subpopulations; and (4) clarifying the definition for smolt-equivalent for the CAP DES to improve data quality.
- Support implementation of the Five-Year Plan for Coordinated Assessments Partnership by strongly encouraging BPA, NPCC and USFWS to build on StreamNet/CAP successes for improving access to bull trout data. StreamNet Manager has initiated communications with Bull Trout leads at BPA and USFWS, and would benefit from clearer guidance and support from the Executive Committee members for this endeavor to succeed.
- Assist in securing short-term funding to support CAP co-leads to perform outreach with potential data providers outside of the Columbia River Basin to better support NOAA and USFWS. For example, WDFW began efforts in 2020 to facilitate submittal of NWIFC member tribes' data to the Fish HLI; however, the tribes wanted more information and discussions before supporting the flow of their data to the Fish HLI (CAX system). StreamNet secured NOAA IJFA funding in September 2020 to support some initial outreach by StreamNet and PNAMP (CAP co-leads) with NWIFC in coordination with WDFW and NOAA. WDFW is continuing discussions with the NWIFC member tribes, however the CAP co-leads are restricted in their ability to assist by the one-year IJFA funding.

B. Recommendation to Enhance and Maintain Access to High Quality Data

The Fish HLI (CAX data system) has been flowing data since 2015. The increase in users accessing these data to inform their assessments and reporting, including BPA, NOAA, and NPCC, has raised awareness of needed improvements, including an on-going quality control procedure to ensure data integrity over-time. The time is ripe to take a close look at what needs to be strengthened before we begin flowing hatchery indicators that will be developed through the HCAX during 2021-2023. StreamNet PSMFC staff have initiated an effort, with the support of a consultant, to inform the development of a quality control procedure that will assesses whether the Fish HLI content in the CAX meets expectations to support proper use and attribution of these data.

During CY2021, StreamNet anticipates identifying aspects of the QC procedure that could be addressed by StreamNet-funded data stewards. Depending on the effort needed some additional funding may be needed to support this new task. StreamNet also expects that some issues identified will require more in-depth work to properly address the problems, and may require working closely with biologists through the PNAMP FMWG, PNAMP MonitoringResources.org staff, and the CBF&W Library staff. This work will likely require additional funding, and StreamNet will be attempting to secure funding for this work once it is better defined.

Recommendations to the Executive Committee:
- Support implementation of the CAP Fish HLI QC procedure once finalized in CY2021 by StreamNet funded partners by providing BPA funding for this task.
- Support participation, either by providing in-kind or BPA funding, by all data providers and data consumers in discussions to refine or develop new data categories and exchange standards in PNAMP FWMG/StreamNet task groups to address issues that require input from a broader group of experts including biologists, fisheries managers, and CBF&W librarian.
- Advance implementation of improved metadata documentation within agencies' and tribes' data systems, especially for data of regional importance. For instance, this could include documenting data set progress and procedures in accessible documents or project management applications like Asana (asana.com). This

documentation not only benefits the data quality but is critical to maintaining the integrity and stability of projects and workflows during periods of high personnel turnover.

C. Recommendation to Establish StreamNet as System of Record for BPA/NPCC Program

BPA recognizes the PSMFC StreamNet GIS data layers for GIS locations related to fish populations and sites associated with data submitted to the StreamNet database as the system of record for fish facilities (e.g., hatchery, weirs) and for fish distribution. Establishing StreamNet as the system of record for these GIS data layers provides a comprehensive location for Columbia River basin information that is collaboratively informed by partners and facilitates consistency across users.

Recommendation:
- Encourage NPCC, in addition to BPA, to officially recognize PSMFC StreamNet GIS and the StreamNet database systems (Fish HLI and Fish Monitoring Data) as the system of record for the Program. This would ensure that the underlying information informing BPA and NPCC assessments and reporting tools are based on the same information, thus reducing the potential for inconsistent information and confusion. This would also allow for a common set of information used among StreamNet, BPA, and NPCC GIS-based tools to ensure consistency of what is displayed (e.g. hatchery facilities location and cross-walk of non-standardized names) across BPA and NPCC as well as other partners.

D. Recommendation to Adequately Support State and Tribal Data Stewards and Participation in StreamNet

A critical component of StreamNet is being able to financially support data management staff within data-providing states and tribes. This tight connection between PSMFC-StreamNet and funded partners is instrumental in ensuring that relevant BPA-funded data are submitted on a regular basis to the StreamNet database in the agreed upon format. At the same time, integrating data stewards within agencies and tribes allows for implementation of more efficient data flow to decision makers, as there is a collaborative approach and common vision about how to make the desired information accessible. The existing committee and team structure of StreamNet further facilitates this shared effort as all levels are informed through the same flow of information, from the Executive and Steering Committees to the DES Development Teams and Technical Team. The success of this approach is reflected in the increase in data submitted by the Colville Tribes since becoming a funded partner, and is also observed when StreamNet has the financial ability to fund small subcontracts with CRITFC ITMD project, CRITFC member tribes, and the SBT.

Recommendations:
- Encourage BPA and NPCC to consider providing and/or increasing funding for data stewards, especially with Tribal partners. This funding could be managed through the StreamNet project to facilitate coordination and engagement of all data providers submitting to the StreamNet data systems. This funding should complement, and not reduce, existing funding provided through individual projects and or through data management projects including the CRITFC ITMD (2005-507-00) project that partially supports data stewards, and the Intermountain Province / Pend Oreille Subbasin Data Management Project (2011-020-00).
- The Executive Committee should continue to encourage and invite other data providers, including CRITFC member tribes, NWIFC member tribes, SBT, and others to participate in and/or become members on both the Executive Committee and Steering Committee. Based on past discussions, funding may be required to secure the participation of tribes in StreamNet and CAP.

E. Recommendation to BPA and NPCC About StreamNet Budget

BPA funding of the StreamNet project was reinstated in October 2020 (FY 2021) to $2,145,483 as recommended by the NPCC in 2019 (Figure 4 in Section III.D). The reinstated BPA funding allowed StreamNet to continue to fund StreamNet partners (Colville Tribes, IDFG, ODFW, MFWP, and WDFW) to the same level as during FY2020 while also fully funding

StreamNet PSMFC staff, and funding some time to PSMFC GIS Center staff. Having the StreamNet PSMFC staff fully funded has allowed significant progress in improving the data queries and process informing data submittal. StreamNet PSMFC staff also secured additional funding from NOAA IJFA (September 2020-August 2021) and EPA Exchange Network Grant (December 2020 – September 2023) which, together with the reinstated BPA funding, has allowed StreamNet to make significance advances during FY2021. The combined funding from BPA, EPA, and HCAX has also allowed StreamNet to further support data management and sharing capacity of the Shoshone Bannock Tribes; support the Colville Tribes to work on developing and submitting HLI for a new population; coordinate with PNAMP to conduct outreach with Northwest Indian Fisheries Commission about the CAP; and given the small StreamNet PSMFC staff, allowed StreamNet to employ independent contractors to advance several priority tasks including improving the StreamNet website to enhance access and facilitate site maintenance; and initiating an effort to inform a sustainable quality control procedure for the Fish HLI data; initiating a stronger collaboration with PNAMP FMWG to engage fish biologists and managers in developing recommendations for improving the Coordinated Assessments DES and display of fish information including fish polygons, fish names, fish without HLIs, and HLIs for super/sub populations. The work initiated at the end of CY2020, which overlaps with the start of FY2021, shows the ability of StreamNet to respond to priority tasks when appropriately funded.

Recommendation:
- Encourage and support BPA and NPCC decisions to maintain or increase the StreamNet FY2021 base funding ($2,145,483, not including ODFW portfolio funding), to facilitate meeting the needs of BPA and NPCC.
- Facilitate discussions among BPA, NPCC, NOAA, and USFWS on funding avenues that could be secured to address new tasks, and to reduce the budget shortfall associated with decline in the purchasing power of the budget (i.e., the budget will effectively decline as costs increase).
- The Executive Committee should support efforts by StreamNet and PNAMP to secure alternative sources of funding to complement BPA funding such as EPA grants by providing letters of support and exploring synergies among federal agencies and multi-state compacts that consume StreamNet data.

F. Lessons Learned about the Benefits of Streamlining Internal Data Submission for Direct Staff Data Submittal to CAP and StreamNet

Ensuring the integrity of data flow and quality requires ongoing maintenance and updates, including adopting advances in data management and reporting technology (open source and proprietary programs and tools) to improve efficiencies across the entire data life cycle. Several of the data providers are adopting a more automated data flow from field data collection to StreamNet's data systems. This is evolving the roles within an organization as to who ultimately submits the data to regional data systems, including delegating the decision to submit data into the CAX to the staff responsible for that data set. Approaches in place and underdevelopment differ in their specific approach, however, the development of similarly purposed applications for submitting fish data to Fish HLI (CAX) and to Fish Monitoring Data (SN Trends) would be beneficial to all StreamNet data providers. Some examples of approaches currently in use by StreamNet funded partners are described below.

In 2020 the Colville Tribes developed software to automatically calculate pre-smolt abundance estimates in Okanogan River tributaries. Estimates are determined using mark-recapture techniques with field data recorded in PTAGIS P4 files. Prior to 2020, population estimates were determined by aggregating and performing all calculations manually (using spreadsheets) – a time-consuming process. Now P4 files are loaded directly into the OBMEP database where the calculations are run. The Colville Tribes are currently exploring similar efficiencies for other HLIs.

ODFW's new Coordinated Assessments (CAVES) web application has enabled ODFW staff responsible for specific data to enter this data directly into ODFW's Coordinated Assessments SQL database for validation and submission to the StreamNet API. The new functionality has made ODFW's internal submission process much more efficient and allows the staff member responsible to receive real-time data validation. ODFW expects to launch a similar application to submit fish monitoring data (trends) in 2021.

G. Lessons Learned about the Importance of Improving Access to Data Consumers

StreamNet staff have been working on facilitating access to StreamNet data by different audience groups ranging in their technical expertise. To this end, StreamNet staff have developed a filterable API that better meets the custom data requests from the diversity of users accessing the StreamNet data system. This improved API also supports the improved Fish Monitoring Data query system released in CY2020 and will be supporting a new Fish HLI tabular query system that will complement the existing Fish HLI map query. To ensure ease of access to these queries and information on using the API, the refreshed StreamNet website planned for a summer 2021 release is focusing on facilitating locating these tools on the website. Improving access of data maintained by StreamNet to audiences with different technical knowledge will increase the value and use of these data by the public and for informing decisions.

H. Lessons Learned about the Importance of Documentation for Data Integrity and Succession Planning

Proper documentation for data integrity is critical to ensure that these valuable data, funded by the public and rate-payers, remain accessible to inform critical uncertainties and decisions into the future. This applies both for data managed within an organization and for data submitted to regional data systems. Projects such as StreamNet serve a key role in ensuring that this documentation and the data needed to inform the assessment process are accessible and stable during any upcoming transition, such as retirement of core biologists with significant institutional knowledge about the data methods and analysis conducted. Some of the StreamNet partners have acknowledged that they also need better overall documentation of field collection and analysis to improve the quality of their data submissions to the Fish HLI (CAX system) and are exploring how this can be accomplished, including utilizing PNAMP's MonitoringResources.org. StreamNet and PNAMP, with BPA support, continue to work on improving how to facilitate the connection between data submitted to StreamNet data systems and metadata submitted to MonitoringResources.org to reduce the burden on the data provider. The ongoing priority of proper metadata documentation (data source, definitions, and monitoring and analytical methods) resulted in StreamNet initiating in CY2020 an effort that will continue past CY2021 to inform the development of a quality control procedure. The procedure includes assessing metadata in the Fish HLI and increasing discussions with PNAMP and CBF&W Library to determine what is needed to strengthen metadata while minimizing the burden on project sponsors of submitting the same metadata in multiple data systems (e.g., how to connect StreamNet, PNAMP and the Library's data systems).

Documentation of the StreamNet Program groups and processes is also necessary to ensure successful successor planning and coverage when needed both within PSMFC-StreamNet and among its partners and members. The StreamNet Program has matured in its committees' and teams' organization, including the CAP team, and how they function. To facilitate understanding of the roles of these groups and processes guiding the work implemented by StreamNet PSMFC staff, members and partners, it is important to clearly document this information and make it publicly accessible. During 2020, PSMFC StreamNet staff took the lead in drafting this content and requesting review by members and partners, including basic organizational hierarchy, description of group roles and responsibilities, and team charters. The refreshed StreamNet website to be launched in 2021 will also include new webpages aimed at transparently conveying information about the existing committees and teams and the CAP.

VII.   Appendix A: User Statistics for PSMFC-StreamNet Project Information Tools

Table 7: Summary of the number of visitors to the StreamNet website including the number of page-views, average page viewed, and average time on the website. Last two columns on the far right summarizes the combined usage (hits) of the StreamNet Query (SNQ) and the Coordinated Assessments Exchange (CAX), as well as the usage of the API (hits).

Calendar Year:	Total Visits	Unique Visitors	Page Views	Ave. Page Views	Ave. Time on Site (min)	SNQ / CAX data (hits/usage)	Data API Usage (hits/usage)	Map applications Unique Visitors
2020	10,723	7,373	20,338	2	1	4,181	561,707	5,270
2019	11,774	8,232	23,458	2	1	6,968	425,710	5,794
2018	13,371	9,197	34,551	3	2		2,399,444*	5,659
2017	22,630	14,228	54,677	2	1		508,123	5,630
2016	29,708	18,399	83,182	3	3		412,504	5,252
2015	32,590	20,014	63,880	3	3		144,698	n/a
2014	39,171	31,424	75,112	2	1		51,358	n/a
2013	44,798	36,683	89,681	2	1.11		n/a	n/a
2012	27,163	19,291	66,686	2.46	1.38		n/a	n/a
2011	25,169	16,586	63,186	2.51	1.58		n/a	n/a
2010	23,029	13,924	49,725	2.16	2.06		n/a	n/a
2009	11,578	6,983	26,261	2.27	2.11		n/a	n/a

* New API feature allowing internal AGENCY/TRIBAL validation before data submission and new partners starting to use API resulted in the large increase of API usage in 2018 before returning to more stable amount in 2019.

Table 8: Summary of the number of visits per year by entities/groups visiting the StreamNet website based on their IP addresses. The sharp decline in the non-public entities is likely a reflection of the move to remote work from home due to the COVID-19 restrictions.

Calendar Year:	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009
General Public/Rate Payers (Comcast, Verizon, Etc.)	7,119	7,417	6,170	9,621	10,906	9,241	17,862	17,711	12,515	4,200	8,369	2,530
State of Oregon	26	438	203	380	948	776	640	600	961	881	974	594
National Oceanic and Atmospheric Administration	21	216	115	251	540	574	349	309	385	144	572	306
Washington State Department of Fish and Wildlife	14	154	64	111	220	194	165	89	156	36	584	261
State of Idaho	11	142	52	134	270	158	118	120	132	63	166	128
U.S.D.A. Forest Service	11	90	172	218	308	347	241	393	443	0	593	339
Bonneville Power Administration	8	235	91	173	536	448	213	220	258	141	296	150
U.S. Fish and Wildlife Service, IRM/BFO Hq	6	160	86	208	388	256	201	109	182	111	262	185
Headquarters USAISC (Us Army)	6	98	72	120	198	394	360	462	342	96	515	277
USDA Office Of Operations	5	74	50	78	129	126	122	148	130	58	244	201
U.S. DOI Bureau Of Land Management	4	47	38	83	125	176	122	139	186	81	155	95
Nez Perce Tribe	3	66	36	37	80	99						
National Wetlands Research Center-USGS	3	34										
Oregon State University		79	77	146	175	187	158	186	152	40	148	64
University of Washington		69	65	17	141	167	114	91	109	24	169	70
Portland State University		47	81	40	103	146	70	73	88	0	55	39
State of Washington		35										
Total		**9,401**	**7,372**	**11,617**	**15,067**	**13,289**	**20,735**	**20,650**	**16,039**	**5,875**	**13,102**	**5,239**

VIII. Appendix B: NPCC FW Program Focal Species and other Fish Species included in StreamNet Query System

NPCC Focal Species	SN Query Trend data
Chinook salmon	Yes
Chum salmon	Yes
Coho salmon	Yes
Green sturgeon	Yes
Pacific lamprey	Yes
Sockeye salmon	Yes
Steelhead	Yes
American shad	Yes
Black crappie	Yes
Bluegill	Yes
Brook trout	Yes
Brown trout	Yes
Bull trout	Yes
Burbot	Yes
Channel catfish	Yes
Coastal cutthroat trout	Yes
Cutthroat trout	Yes
Kokanee	Yes
Lahontan cutthroat trout	Yes
Lake trout	Yes
Largemouth bass	Yes
Mountain whitefish	Yes
Northern pike	Yes
Northern pikeminnow	Yes
Rainbow trout	Yes
Rainbow trout X Cutthroat trout hybrid	Yes
Redband trout	Yes
Sculpins	Yes
Smallmouth bass	Yes
Walleye	Yes
Western brook lamprey	Yes
Westslope cutthroat trout	Yes
White crappie	Yes
White sturgeon	Yes
Yellow perch	Yes
Yellowstone cutthroat trout	Yes
Oregon Chub	No

IX. Appendix C: NPCC FW Program Draft 2020 Addendum Salmon and Steelhead Groupings Cross-walked to StreamNet/CAX Query Systems

Below we provide a preliminary crosswalk between the populations with data within the CAX and the grouping of populations used by NPCC and Marine Fisheries Advisory Committee's (MAFAC) Columbia Basin Partnership Task Force (CBPTF). For populations not linked to data in the CAX we need to verify with managers if there are available data.

Table 9: Preliminary crosswalk between the NPCC/MAFAC salmon and steelhead groups with content of the CAX query system.

NPCC 2020 Addendum and MAFAC-CBPTF Group	pop with HLI and/or Trend	total pop in group	% covered
CBPTF Lower Columbia Chum group	4	17	24%
CBPTF Lower Columbia Coho group	23	25	92%
CBPTF Lower Columbia Fall Chinook (tules) group	20	21	95%
CBPTF Lower Columbia Late Fall Chinook (bright) group	2	2	100%
CBPTF Lower Columbia Spring Chinook group	6	9	67%
CBPTF Lower Columbia Steelhead group	22	30	73%
CBPTF Mid-Columbia (upriver) Coho group	0	14	0
CBPTF Mid-Columbia Sockeye group	0	1	0
CBPTF Mid-Columbia Spring Chinook Group	0	14	0
CBPTF Mid-Columbia Steelhead group	17	20	85%
CBPTF Mid-Columbia Summer/Fall Chinook group	0	1	0%
CBPTF Snake River Fall Chinook group	1	2	50%
CBPTF Snake River Sockeye group	1	6	17%
CBPTF Snake River Spring/Summer Chinook group	35	54	65%
CBPTF Snake River Summer Steelhead group	5	26	19%
CBPTF Upper Columbia Fall Chinook group	0	1	0%
CBPTF Upper Columbia Sockeye group	0	2	0%
CBPTF Upper Columbia Spring Chinook group	3	5	60%
CBPTF Upper Columbia Summer Chinook group	2	4	50%
CBPTF Upper Columbia Summer Steelhead group	4	5	80%
CBPTF Willamette River Spring Chinook group	6	7	86%
CBPTF Willamette River Winter Steelhead group	4	4	100%

X.   Appendix D: Status Summary of Work Elements

Details of the work conducted for each work element is described in the appropriate section of the report

Work Element	Entity	Milestone Title	End Data	Milestone Status ☺ will complete by end date; ☺ may not complete ☺ will not complete; √ completed				
				Jan-Mar	Apr-June	Jul-Sept	Oct-Dec	Comments
159. Transfer/Consolidate Regionally Standardized Data Support transfer of data into secure and accessible repositories	Colville	C. The Colville Tribes StreamNet will assist tribal project sponsors transfer of data to secure and accessible repositories	9/30/2021	☺	☺	☺	☺	
	IDFG	D. IDFG Assist project sponsors transfer of data to secure and accessible repositories	9/30/2021	☺	☺	☺	☺	
	MFWP	E. MFWP Assist project sponsors transfer of data to secure and accessible repositories	9/30/2021	☺	☺	☺	☺	
	ODFW	F. ODFW Assist project sponsors transfer of data to secure and accessible repositories	9/30/2021	☺	☺	☺	☺	
	WDFW	G. WDFW Assist project sponsors transfer of data to secure and accessible repositories	9/30/2021	☺	☺	☺	☺	
	PSMFC	A. PSMFC Assist project sponsors transfer of data to secure and accessible repositories	9/30/2021	☺	☺	☺	☺	

	Agency	Deliverable	Date	Q1	Q2	Q3	Q4	
	PSMFC	B. PSMFC StreamNet will continue to manage and improve the StreamNet Data Store as a repository for unstructured data.	9/30/2021	☺	☺	☺	☺	
	PSMFC	h. **Deliverable:** Support transfer of data into secure & accessible repositories	9/30/2021	☺	☺	☺	☺	
189. Coordination-Columbia Basinwide CAP Data - coordination	Colville	B. CTCR Coordinate and support the Coordinated Assessments project	9/30/2021	☺	☺	☺	☺	
	IDFG	C. IDFG Coordinate and support the Coordinated Assessments project	9/30/2021	☺	☺	☺	☺	
	ODFW	D. ODFW Coordinate and support the Coordinated Assessments project	9/30/2021	☺	☺	☺	☺	
	PSMFC	A. PSMFC Coordinate and support the Coordinated Assessments project	9/30/2021	☺	☺	☺	☺	
	WDFW	E. WDFW Coordinate and support the Coordinated Assessments project	9/30/2021	☺	☺	☺	☺	
	PSMFC	g. **Deliverable:** Coordinated Assessment Leadership	9/30/2021	☺	☺	☺	☺	
160. Create/Manage/Maintain Database CAP Data - DES and database	PSMFC	a. **PSMFC Lead development of database**	9/30/2021	☺	☺	☺	☺	
	PSMFC	b. **PSMFC Lead development of DES**	9/30/2021	☺	☺	☺	☺	
	Colville	C. CTCR Development and maintenance of CAP data exchange standards and database	9/30/2021	☺	☺	☺	☺	
	IDFG	D. IDFG Development and maintenance of CAP data exchange standards and database	9/30/2021	☺	☺	☺	☺	

	WDFW	F. WDFW Development and maintenance of CAP data exchange standards and database	9/30/2021	☺	☺	☺	☺
	PSMFC	A. PSMFC Lead development of database	9/30/2021	☺	☺	☺	☺
	PSMFC	B. PSMFC Lead development of DES	9/30/2021	☺	☺	☺	☺
	MFWP	G. MFWP Development and maintenance of CAP data exchange standards and database	9/30/2021	☺	☺	☺	☺
	PSMFC	h. **Deliverable:** The CAP DES is maintained and updated	9/30/2021	☺	☺	☺	☺
159. Transfer/Consolidate Regionally Standardized Data CAP Data - compile data	Colville	B. CTCR compile data relevant to Coordinated Assessments indicators and metrics	9/30/2021	☺	☺	☺	☺
	IDFG	C. IDFG Compile data relevant to Coordinated Assessments	9/30/2021	☺	☺	☺	☺
	ODFW	D. ODFW Compile data relevant to Coordinated Assessments	9/30/2021	☺	☺	☺	☺
	PSMFC	A. PSMFC will ensure that annual work plan includes measurable goals and objectives for data comp	9/30/2021	☺	☺	☺	☺
	WDFW	E. WDFW: Compile data relevant to Coordinated Assessments	9/30/2021	☺	☺	☺	☺
	PSMFC	g. **Deliverable:** CAP indicators and metrics are compiled	9/30/2021	☺	☺	☺	☺
160. Create/Manage/Maintain Database CAP Data - automated data exchange	Colville	C. CTCR Improve systems to manage data feeding CAP indicators	9/30/2021	☺	☺	☺	☺
	IDFG	B. IDFG : Improve systems to manage data feeding CAP indicators	9/30/2021	☺	☺	☺	☺

	ODFW	F. ODFW Improve systems to manage data feeding CAP indicators	9/30/2021	☺	☺		☺	☺
	PSMFC	A. PSMFC Improve systems to manage data feeding CAP indicators	9/30/2021	☺	☺		☺	☺
	WDFW	E. WDFW Improve systems to manage data feeding CAP indicators	9/30/2021	☺	☺		☺	☺
	PSMFC	g. **Deliverable**: Automated feeds of CAP data to the CAP database are implemented and evaluated	9/30/2021	☺	☺		☺	☺
161. Disseminate Raw/Summary Data and Results Data - dissemination	PSMFC	A. PSMFC disseminate the CAP indicators and metrics	9/30/2021	☺	☺		☺	☺
	PSMFC	b. PSMFC StreamNet staff will participate with PNAMP and others to help implement MonitoringResources.org	9/30/2021	☺	☺		☺	☺
	PSMFC	c. PSMFC implements Data Sharing Agreements	9/30/2021	☺	☺		☺	☺
	PSMFC	d. PSMFC assures CAP Website and Database Maintenance	9/30/2021	☺	☺		☺	☺
	PSMFC	E. PSMFC responds to and tracks data/information requests	9/30/2021	☺	☺		☺	☺
	Colville	F. CTCR responds to and tracks data/information requests	9/30/2021	☺	☺		☺	☺
	IDFG	G. IDFG responds to and tracks data/information requests	9/30/2021	☺	☺		☺	☺

	MFWP	H. MFWP responds to and tracks data/information requests	9/30/2021	☺	☺	☺	☺	
	ODFW	I. ODFW responds to and tracks data/information requests	9/30/2021	☺	☺	☺	☺	
	WDFW	J. WDFW responds to and tracks data/information requests	9/30/2021	☺	☺	☺	☺	
	PSMFC	k. **Deliverable:** CAP indicators, metrics and metadata are available	9/30/2021	☺	☺	☺	☺	
159. Transfer/Consolidate Regionally Standardized Data Compile high priority traditional StreamNet data	PSMFC	A. PSMFC Compile and deliver fish data to StreamNet databases.	9/30/2021	☺	☺	☺	☺	
	Colville	B. CTCR Compile and deliver fish data to StreamNet databases.	9/30/2021	☺	☺	☺	☺	
	IDFG	C. IDFG Compile and deliver fish data to StreamNet databases.	9/30/2021	☺	☺	☺	☺	
	WDFW	D. WDFW Compile and deliver fish data to StreamNet databases.	9/30/2021	☺	☺	☺	☺	
	ODFW	E. ODFW Compile and deliver fish data to StreamNet databases.	9/30/2021	☺	☺	☺	☺	
	MFWP	F. MFWP Compile and deliver fish data to StreamNet databases.	9/30/2021	☺	☺	☺	☺	
	PSMFC	h. Deliverable: Specific high priority data sets are updated and maintained	9/30/2021	☺	☺	☺	☺	
189. Coordination-Columbia Basinwide	PSMFC	A. Coordination with data source agencies inside and outside the Fish & Wildlife Program	9/30/2021	☺	☺	☺	☺	

Coordination	Colville	B. CTCR StreamNet coordinate to support the Fish & Wildlife Program	9/30/2021	☺	☺	☺	☺	
	IDFG	C. IDFG coordination with the Fish and Wildlife Program	9/30/2021	☺	☺	☺	☺	
	ODFW	D. ODFW provide support to F&W Program development activities	9/30/2021	☺	☺	☺	☺	
	MFWP	E. MFWP provide support to F&W Program development activities	9/30/2021	☺	☺	☺	☺	
	WDFW	F. WDFW provide support to Fish and Wildlife Program development activities	9/30/2021	☺	☺	☺	☺	
	All	G. StreamNet partners promote the project through technical and professional organizations	9/30/2021	☺	☺	☺	☺	
	PSMFC	H. Support and maintain regionally significant datasets and processes	9/30/2021	☺	☺	☺	☺	
	PSMFC	I. Support documentation of monitoring protocols	9/30/2021	☺	☺	☺	☺	
	PSMFC	J. PSMFC supports implementation of BPA data management strategy	9/30/2021	☺	☺	☺	☺	
	PSMFC	K. **Deliverable:** StreamNet coordinates to improve data sharing, data	9/30/2021	☺	☺	☺	☺	

		standards, and automated data flow						
160. Create/Manage/Maintain Database Enhance data efficiency	PSMFC	a. PSMFC Develop automated data flow to central StreamNet database	**9/30/2021**	☺	☺	☺	☺	
	CCT	b. The Colville Tribe Develop automated data flow to central StreamNet database	**9/30/2021**	☺	☺	☺	☺	
	IDFG	c. IDFG Develop automated data flow to central StreamNet database	**9/30/2021**	☺	☺	☺	☺	
	MFWP	d. MFWP Develop automated data flow to central StreamNet database	**9/30/2021**	☺	☺	☺	☺	
	ODFW	e. ODFW Develop automated data flow to central StreamNet database	**9/30/2021**	☺	☺	☺	☺	
	WDFW	f. WDFW Develop automated data flow to central StreamNet	**9/30/2021**	☺	☺	☺	☺	
	PSMFC	g. Coordinate regional review and discussion of field data capture devices and software	**9/30/2021**	☺	☺	☺	☺	

	PSMFC	h. **Deliverable:** Enhanced agency database procedures and systems	**9/30/2021**	☺	☺	☺	☺	
160. Create/Manage/Maintain Database Infrastructure and base operations	PSMFC	a. PSMFC Infrastructure maintenance and base operations	9/30/2021	☺	☺	☺	☺	
	Colville	B. CTCR infrastructure maintenance and base operations	9/30/2021	☺	☺	☺	☺	
	IDFG	C. IDFG infrastructure maintenance and base operations	9/30/2021	☺	☺	☺	☺	
	MFWP	D. MFWP infrastructure maintenance and base operations	9/30/2021	☺	☺	☺	☺	
	ODFW	E. ODFW infrastructure maintenance and base operations	9/30/2021	☺	☺	☺	☺	
	WDFW	F. WDFW infrastructure maintenance and base operations	9/30/2021	☺	☺	☺	☺	
	PSMFC	g. **Deliverable:** Project infrastructure and databases are maintained	9/30/2021	☺	☺	☺	☺	
119. Manage and Administer Projects Manage project activities	PSMFC	a. Submit physical inventory record	9/30/2021	☺	☺	☺	☺	
	PSMFC	b. Error-check & update actual WE budget spending w/in 4 months (reflect contract close-out value)	9/30/2021* Corrected end date of 1/31/2022 *	☺	☺	☺	☺	end date should be 4 months after

							9/30/21 ... so 1/31/22 •
PSMFC	C. Submit contract renewal package (SOW, Excel budget, property inventory) to BPA COTR	9/30/2021	☺ * *will complete earlier than 9/30/21	☺		☺	☺	*Corrected end date to be July 1, so that it is 4 months prior to end of current 2-yr contract
PSMFC	D. Address comments and revise SOW, LIB, and PI as needed to get BPA manager approval	9/30/2021	☺	☺		☺	☺	
PSMFC	E. Return signed contract to BPA's Contracting Officer within 30 days	9/30/2021	☺	☺		☺	☺	
PSMFC	F. Submit final invoice for prior contract within 90 days to facilitate contract closeout	9/30/2021	☺	☺		☺	☺	
PSMFC	H. Facilitate inputting Cost Share information into Pisces at the Project level	11/15/2020	☺	☺		☺	√ 11/15/2020	
PSMFC	I. Comply with all applicable federal, state, tribal and local safety requirements, including reporting	9/30/2021	☺	☺		☺	☺	
WDFW	J. WDFW Effective program management will be maintained	9/30/2021	☺	☺		☺	☺	
ODFW	K. ODFW Effective program management will be maintained	9/30/2021	☺	☺		☺	☺	

	Agency	Element	End date					Notes
	MFWP	L. MFWP Effective program management will be maintained	9/30/2021	☺	☺	☺	☺	
	IDFG	M. IDFG Effective program management will be maintained	9/30/2021	☺	☺	☺	☺	
	Colville	O. CTCR Effective program management will be maintained	9/30/2021	☺	☺	☺	☺	
	PSMFC	P. PSMFC Project oversight and guidance: Project management Executive and Steering Committees	9/30/2021	☺	☺	☺	☺	
	PSMFC	q. **Deliverable:** Project is successfully administered	9/30/2021	☺	☺	☺	☺	
132. Produce (Annual) Progress Report for **2019** calendar year	PSMFC	A. Non-Technical: Prepare for non-technical Progress Report. Review most recent guidance and template.	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	√ completed 2/14/2020	☺	☺		A separate technical report was not required this CY, so the non-technical report fulfills the contract requirement
	PSMFC	B. Non-Technical: Write Non-technical Progress Report	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	√ completed 3/6/2020	☺	☺		
	PSMFC	C. Non-Technical: Upload Non-Technical Progress Report in Pisces	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	☺	√ completed 4/1/2020	☺		

	PSMFC	g. Distribute Progress Report for Internal Contractor Review	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	√ completed 3/6/2020				
	PSMFC	h. Distribute Progress Report for External Review to [Insert external review entity]	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	√ completed 3/6/2020				
	Partners	I to N, partners produce annual report	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	√ completed 3/31/2020				
	PSMFC	O. Deliverable: Annual report submitted to BPA	9/30/2021 * Note incorrect end-date should be prior to 4/1/2020	☺	√ completed 4/1/2020			
132. Produce (Annual) Progress Report for **2020 calendar year**	PSMFC	A. Non-Technical: Prepare for non-technical Progress Report. Review most recent guidance and template.	9/30/2021 * Note incorrect end-date should be prior to 4/1/2021	☺	☺	☺	☺	
	PSMFC	B. Non-Technical: Write Non-technical Progress Report	9/30/2021 * Note incorrect end-date should be prior to 4/1/2021	☺	☺	☺	☺	
	PSMFC	C. Non-Technical: Upload Non-Technical Progress Report in Pisces	9/30/2021 * Note incorrect end-date should	☺	☺	☺	☺	

				☺	☺	☺	☺	
			be prior to 4/1/2021					
	PSMFC	g. Distribute Progress Report for Internal Contractor Review	9/30/2021 * Note incorrect end-date should be prior to 4/1/2021	☺	☺	☺	☺	
	PSMFC	h. Distribute Progress Report for External Review to [Insert external review entity]	9/30/2021 * Note incorrect end-date should be prior to 4/1/2021	☺	☺	☺	☺	
	Partners	I to N, partners produce annual report	9/30/2021 * Note incorrect end-date should be prior to 4/1/2021	☺	☺	☺	☺	
	PSMFC	O. Deliverable: Annual report submitted to BPA	9/30/2021 * Note incorrect end-date should be prior to 4/1/2021	☺	☺	☺	☺	

XI. References / Endnotes

[i] NPCC 2012/2013 Decision Memorandum: Council recommendations on Resident Fish, Data Management and Regional Coordination Category Reviews – projects and associated programmatic issues https://www.nwcouncil.org/sites/default/files/CouncilDecision_0.pdf

[ii] NPCC 2012 Program Evaluation and Reporting Committee https://www.nwcouncil.org/fw/program/perc and the November 2012 Council recommendations based on the PERC https://www.nwcouncil.org/sites/default/files/2012_1106_1.pdf

[iii] NPCC 2019, Committee Recommendations on mainstem and Program Support Project Review: Project Implementation and Programmatic Issues https://www.nwcouncil.org/sites/default/files/2019_0716_f1.pdf; Council recommendations from August 2019 are similar https://www.nwcouncil.org/fish-and-wildlife/fish-and-wildlife-program/project-reviews-and-recommendations/mainstem-review

[iv] 2019 version of the Five-Year Plan for Coordinated Assessments, revised September 2, 2020 https://www.streamnet.org/wp-content/uploads/2020/10/Five-Year-Plan-for-Coordinated-Assessments-rev20200902-Final.doc

[v] 2021-2026 StreamNet Vision and Strategic Plan, September 2, 2020, https://www.streamnet.org/wp-content/uploads/2020/10/StreamNet-Vision-Strategic-Plan-Final-Adopted20200902.doc

[vi] Tier 1 and Tier 2 populations as identified by BPA at the end of 2015 https://www.streamnet.org/ca-priority-data/

[vii] NOAA Fisheries Biological Opinion for operation and maintenance of the Columbia River System Operations and related documents https://www.salmonrecovery.gov/BiologicalOpinions/FCRPSBiOp/2008FCRPSBiOp.aspx

[viii] NPCC July 2019 Committee Recommendations on mainstem and Program Support Project Review: Project Implementation and Programmatic Issues https://www.nwcouncil.org/sites/default/files/2019_0716_f1.pdf; Council recommendations from August 2019 are similar https://www.nwcouncil.org/fish-and-wildlife/fish-and-wildlife-program/project-reviews-and-recommendations/mainstem-review

[ix] For more details see the Project Summary: https://www.cbfish.org/Project.mvc/Display/1988-108-04 and past and current Contract Summary: https://www.cbfish.org/Contract.mvc/Summary/66435

[x] StreamNet Data Store https://app.streamnet.org/datastore_search_classic.cfm

[xi] Columbia Basin Fish & Wildlife Library hosted by CRITFC https://www.streamnetlibrary.org/

[xii] StreamNet subbasin plans and achieved datasets used during the NPCC2001-2004 subbasin planning effort https://www.streamnet.org/services/technical-assistance-to-agencies-and-tribes/subbasin-plans-archived-datasets/

[xiii] NPCC FW Program Protected Areas documentation, river reach, and online Protected Areas database and interactive map https://www.streamnet.org/data/protected-areas/

[xiv] Habitat Evaluation Procedures (HEP) https://www.streamnet.org/hep

[xvxv] Hatchery Reform Project http://hatcheryreform.us/

[xvi] NPCC FW Program Strategy for *Fish Propagation including hatchery programs* https://www.nwcouncil.org/reports/2014-columbia-river-basin-fish-and-wildlife-program/b-fish-propagation-including-hatchery-programs

[xvii] Hatchery scientific review group's products resulting from the hatchery reform project http://hatcheryreform.us/

[xviii] StreamNet Fish Monitoring Data (replaces the previous StreamNet Query – Abundance Estimates and Indexes at Local Scales) https://www.streamnet.org/data/trends/

[xix] GIS Data & Mapping Applications
https://www.streamnet.org/data/interactive-maps-and-gis-data/

[xx] StreamNet Fish HLI query https://cax.streamnet.org

[xxi] PNAMP 2009 annual report https://www.cbfish.org/Document.mvc/Viewer/P115609

[xxii] PNAMP 2010 annual report https://www.cbfish.org/Document.mvc/Viewer/P120754

[xxiii] PNAMP 2018 annual report https://www.cbfish.org/Document.mvc/Viewer/P167990

[xxiv] HEP archived data and documents http://www.streamnet.org/hep.

[xxv] NOAA and USFWS engagement in the hatchery reform project and the hatchery scientific review group https://www.nwfsc.noaa.gov/research/divisions/efs/hatchery/review.cfm ; products produced by the hatchery scientific review group for the hatchery reform project
http://hatcheryreform.us/

[xxvi] The Okanogan Subbasin Report Card online tool
https://ecosystems.azurewebsites.net/reportcards/okanogan/

[xxvii] SCoRE https://fortress.wa.gov/dfw/score/score/

[xxviii] SalmonScape http://apps.wdfw.wa.gov/salmonscape/

[xxix] Spawning Ground Survey (SGS) https://wdfw.wa.gov/fishing/management/sgs-data