Columbia River Basin Collaborative Data Sharing Strategy:
Salmon and Steelhead Population Abundance and Productivity Indicators

Final DRAFT

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Recommendations of the

Coordinated Assessments Workgroup

Co-Sponsored By:
Columbia Basin Fish and Wildlife Authority
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List of Acronyms Used in Report

AMIP	FCRPS BiOp Adaptive Management Implementation Plan
ASMS	NPCC Anadromous Salmonid Monitoring Strategy
BiOp	FCRPS Biological Opinion
BPA	Bonneville Power Administration
CA	Coordinated Assessments Project
CBFWA	Columbia Basin Fish and Wildlife Authority
CRB	Columbia River Basin
CRITFC	Columbia River Inter-Tribal Fish Commission
CWA	Clean Water Act
DAFD	Data Analysis Flow Diagram
DET	Data Exchange Template
DPS	NOAA Distinct Population Segment
ESA	Endangered Species Act
ESU	NOAA Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
HLI	High Level Indicator
LSRCP	Lower Snake River Compensation Plan
MERR	NPCC Monitoring, Evaluation, Research, and Reporting Plan
NED	Northwest Environmental Data network
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPA	Northwest Power Act
NPCC	Northwest Power and Conservation Council
NWFSC	NMFS Northwest Fisheries Science Center
OWEB	Oregon Watershed Enhancement Board
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
RIOG	Action Agency Regional Implementation Oversight Group
RME	Research, Monitoring and Evaluation
RPA	Reasonable and Prudent Alternative
SOTR	CBFWA Status of the Resource Report
SPS	NOAA Salmon Population Summary database
TRT	NOAA Technical Recovery Team
VSP	NOAA Viable Salmonid Population

Executive Summary

The Coordinated Assessments Project was started in 2010 with the goal of improving the timeliness, reliability and transparency of the data necessary for regional assessments and management decisions. This Columbia River Basin Collaborative Data Sharing Strategy concludes the first two phases of the Coordinated Assessments project and identifies specific actions and activities for sharing three Viable Salmonid Population (VSP) indicators in the Columbia River Basin. Once progress has been achieved on these three indicators, the project will be expanded to include additional salmon and steelhead indicators as well as habitat and hatchery data.

Data consumers and providers have acknowledged the need for improved access to data to support high level indicators for salmon and steelhead. The targeted consumers for this effort include the Northwest Power and Conservation Council (NPCC), NOAA Fisheries, Bonneville Power Administration (BPA), Lower Snake River Compensation Plan, Columbia Basin Fish and Wildlife Authority, and the state and tribal fishery co-managers.

The agencies and tribes that collect salmon and steelhead data intend to improve the accessibility, quality, comparability and administrative efficiency of their data management and sharing practices. This Strategy presents the first in a series of incremental steps towards a data exchange network which would support participating agencies and tribes in developing and using more advanced and automated data sharing tools. These steps will range from developing internal agency/tribal data systems, to shared hosting of indicators and/or supporting metrics, to publishing data and metadata via 'web services' on the Internet. This will ultimately allow the regional data consumers - those conducting assessments and assembling the various high level reports - to exchange the needed data.

The objectives of this Strategy are:

- Promote discussion and understanding at the policy-level within the agencies and tribes on how to support timely, reliable, and transparent data management and prioritize data that support basin-wide salmon and steelhead assessments.

- Inform the Council's Category Review for Data Management and Regional Coordination projects. The agencies and tribes acknowledge that BPA funding for data management may require re-prioritization of work elements within existing data management projects, alignment of data management tasks within monitoring projects, and in-kind contributions from the agencies and tribes.

- Inform NOAA funding to support recovery monitoring and align data management funding necessary for status assessments, as well as inform other funding processes, in order to better align these efforts with BPA funding for data management within the Columbia River Basin.

- Realize a sustained flow of high quality anadromous fish abundance and productivity data to efficiently generate reliable and transparent high level indicators sufficient to evaluate restoration success.

In order to achieve the goal of improved management decisions based on improved sharing of information, the agencies and tribes will:

1) Support local control and management of key primary data, while ensuring consistency with basin-wide assessment and reporting needs,
2) Exchange indicators and agreed-upon supporting metrics in a common format regardless of original format or coding, and regardless of sampling methodologies,
3) Prioritize timely sharing of the data necessary to support basin-wide assessments and reporting,
4) Provide enough information about the data to support understanding and replication of the derivation of indicators for secondary applications and assessment needs, and
5) Develop enterprise database systems which store data across projects on behalf of the entire agency or tribe and with the ability to automate internal data flow, which will increase speed and efficiency of external data sharing and reduce individual work load.

During 2009 federal, state, and tribal fish and wildlife managers collaborated through a series of sub-regional and regional workshops, collectively referred to as the 2009 Columbia Basin Coordinated Anadromous Monitoring Workshop. A regional workshop was convened by BPA, CBFWA, NOAA and NPCC during October 20-21, 2009 and November 3-5, 2009 in Skamania Washington to develop the coordinated Anadromous Salmonid Monitoring Strategy (ASMS). The purpose of the Regional Workshop was to reach agreement among participants on an efficient and effective framework and project specific implementation strategy for anadromous salmon and steelhead monitoring to assess (1) VSP criteria, (2) habitat effectiveness and (3) hatchery effectiveness in the Columbia Basin. The agreed-upon framework and strategy addresses the needs of the NPCC's Fish and Wildlife Program, meets the needs of the FCRPS BiOp and AMIP (at a minimum), and contributes to the monitoring needs of ESA recovery planning and other regional fisheries management needs. The outcome of this collaboration was the ASMS which was used by the NPCC during their Monitoring and Evaluation Projects Category Review to prioritize and coordinate BPA funded monitoring projects.

In 2010, the agencies and tribes created the Coordinated Assessments Project in order coordinate the data being collected through the BPA funded monitoring projects. They completed Gaps, Needs, and Priorities assessments in relation to three selected VSP population level indicators for salmon and steelhead in order to develop Individual Data Management and Sharing Strategies. These strategies provide a detailed analysis for each of the agencies and tribes and they are found in Appendices C through L to this report.

The data sharing gaps identified by the agencies and tribes were very similar across the Basin, regardless of where along the spectrum their data management capabilities fell. Most of the existing data systems were developed to support local, sub-regional (within the agency or tribe) decisions. Although they may be construed as archaic or clunky by the outside observer, they have been adequate to support the appropriate level of decision making within the agency or tribe for which the projects were intended. The gaps arise when the systems are evaluated on the capability to provide data and metadata for higher level analyses and decision support systems. When viewed under this lens, the systems are generally outdated and need significant upgrades. To address the regional or basin-wide data sharing needs, the local sub-regional data management infrastructure has to be improved.

Currently the agencies and tribes do not regularly calculate VSP indicators at the population scale needed by NOAA to conduct ESA status assessments. Several agencies intend to prioritize that activity in order to provide the derived indicators on a regular basis to NOAA, while other agencies and tribes

are content to provide the metric data and metadata necessary to allow those calculations to be performed by NOAA. Re-alignment of staff to perform the analyses necessary to generate the indicators that are needed for higher level analyses will take time and resources. The agencies and tribes will need to invest in staff to perform the calculations and report high level indicators within their management areas. Funding will come from internal realignment of personnel, existing BPA funding within monitoring projects or from NOAA Fisheries where appropriate. It is important to note, indicators are generated from the same metric level data for different areas of inference; therefore, exchanging indicator information will require some level of metric level data and metadata exchange.

The needs or funding opportunities within the agencies and tribes to improve data management and sharing fell generally within six categories: Data Management Assessments and Planning Support, Updated Data Management Policies, Hardware and Software Infrastructure, IT Support (programmer, web manager, etc.), Data Stewards (internal and external coordination), and Coordination Forums for Standardized Protocols.

The Strategy presents the following recommendations:

A) Improve Infrastructure. The agencies and tribes should maintain up-to-date, secure, web accessible databases that utilize standardized performance measures. The agencies and tribes will prioritize and adopt data management business practices that support internal data sharing and will invest in data management infrastructure to manage measurement-, metric- and indicator-level data in consistent and transparent systems.

B) Encourage a Network of Data Stewards. Invest in data professionals placed within the agencies and tribes who can bridge the gap between biologists and the technical side of data management. These professionals should support internal data coordination and infrastructure development and coordinate externally to ensure basin-wide data sharing needs are met.

C) Continue Coordination. Continue to use the Coordinated Assessments Planning Group (CAPG) for oversight and guidance of the Coordinated Assessment effort, including implementation of this Strategy. The CAPG will establish sub-committees using existing forums (e.g., PNAMP and expanded StreamNet) whenever possible.

The CAPG will:

- Provide coordination between basin-wide level data consumers and data collectors
- Establish a DET development subcommittee to:
    - Identify content to be shared through the use of a basin-wide Data Exchange Template – which includes what information is needed, in what format, and on what schedule
    - Include participation of former TRT members and equivalent level biologists from each of the agencies and tribes and their designated basin-wide data professionals
    - Ensure participation by NOAA Salmon Population Summary database staff
- Oversee the work of the technical sub-committee (defined below)
- Meet face-to-face to discuss recommendations as necessary and continue to use annual workshops to communicate and update the Coordinated Assessments Workgroup participants

The expanded StreamNet Steering Committee should serve as a technical forum and sub-committee of the CAPG. Responsibilities of the technical sub-committee include:

- Coordination between data providers to agree on data exchange format implementation standards and methodologies
- Developing a data dictionary of technical terms to unify terminology
- Overseeing the development of tools to facilitate basin-wide data exchange
- Participate in CAPG to provide technical guidance and realities

D) Develop Tools. Continue to support PNAMP, for investigating new approaches and exploring alternative strategies for basin-wide data sharing. This work has been conducted through the PNAMP Data Management Leadership Team which continues to help develop and evaluate tools for improving data sharing.

Budget Exercise

Representatives from the states and tribes, BPA, CRITFC and StreamNet agreed to develop prioritized budget targets for use in guiding BPA funding for data management through the NPCC's FY13-15 Data Management Category Review Process. The objectives of the budget exercise were to: 1) Demonstrate due diligence in review of BPA funded data management and monitoring projects for redundancy and priority of data management tasks, 2) Optimize available BPA funding to address the Strategy recommendations, 3) Identify synergy and efficiencies that can maximize the value of BPA data management investments, and 4) Identify the agencies' and tribes' specific gaps and needs, with the benefit of providing a list of prioritized unfunded projects to submit to alternative funding processes.

The intent of the effort was to keep focused on the work necessary to implement a 5-year work plan and develop a budget based on agency/tribe Data Management Plans (Appendices). A list of specific agency and tribal needs, and the results of the budget exercise are provided in Appendix M.

The Taurus portfolio list of Data Management projects for the NPCC's review process includes several projects that are not directly related to the Coordinated Assessments project, and therefore, were not discussed in detail at the budget exercise meeting. These include Habitat and Biodiversity Information System, Kalispel Tribe Data Management Project, Columbia Pit Tag Information, Fish Passage Center, and Data Access in Real Time. The StreamNet, Tribal Data Network, and Regional Data Management Support and Coordination ($500k FCRPS BiOp Data Management Placeholder) projects were the primary focus of discussion for implementation of the Data Sharing Strategy during the budget exercise. The StreamNet Library project may also be reviewed in this context, but those conversations will occur between BPA and CRITFC.

It is recommended that funds from the Placeholder be used to augment the StreamNet and Tribal Data Network projects to support data coordinators within each of the tribes that manage salmon and steelhead data. These were considered Tier 1 needs. The purpose of implementing these new tasks within these two projects meets two objectives. First, the Category Review process does not allow for new projects to be developed and submitted; therefore using the StreamNet and Tribal Data Network projects facilitates proposing new tasks into the process. Second, it is important that these tasks (new data coordinators for each tribe) are well coordinated in the regional processes, and implementing these tasks through the data manage coordination projects will ensure focus of the data coordinators on priorities identified within this strategy.

The Tier 2 projects primarily focus on Improving Infrastructure within the agencies and tribes to better support regional sharing of data and information. Funding for these tasks will be pursued through other funding sources such as NOAA Fisheries, internal funding within the agencies and tribes, or other sources. These are important, priority tasks and implementation of them will be required to eventually obtain the data exchange network envisioned as the ultimate objective of the Coordinated Assessments project.

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Introduction

The purpose of the Columbia River Basin Collaborative Data Sharing Strategy (Strategy) is to identify and recommend priority actions and investments to support data management business practices and infrastructures that allow for timely, reliable, and transparent data sharing of basin-wide population level indicators for salmon and steelhead. The Strategy is intentionally limited to three Viable Salmonid Population (VSP) abundance and productivity indicators; recognizing indicators for additional VSP parameters, hatchery and habitat effectiveness, other anadromous fish, resident fish and wildlife data sharing needs will be added as warranted. Many of the technologies and processes for sharing data that this Strategy supports will easily transfer to other indicators, as well as whole other sectors of information.

The Strategy is a collaborative effort by the Columbia River Basin salmon and steelhead fishery co-managers through the Coordinated Assessments Project and provides the logical next step for data sharing within the Basin. The Strategy provides a framework to support data sharing across distinct systems from the local level to the regional level; and, enables a process for sharing comparable data from different contributing sources which can be combined to facilitate basin-wide assessments. This effort builds upon past efforts for data sharing in the Columbia River Basin. In part it is intended to fulfill the need identified in the October 2, 2007 Northwest Summit briefing paper "Sharing Information to Improve Decisions," that "*there is a need for a clear statement of purpose and goals before we'll [executive level deputies] commit resources to a regional data sharing effort*."[1]

This Strategy presents a clear statement of purpose for sharing salmon and steelhead data and provides guidance for how best to support a regional data sharing effort. The Strategy includes two main components: 1) A basin-wide data sharing strategy that identifies and references priority data needs and identifies gaps and recommendations for improving data sharing in the Columbia River Basin, and 2) Individual agency and tribal data management plans that identify specific infrastructure needs to support basin-wide data sharing of specific salmon and steelhead data. These documents describe the essential elements for advancing data management and sharing including a commitment by all parties to share their data, invest in the technical and human infrastructure to support each individual entity's capacity to capture (or centralize) and manage their data, planning for performing the analyses necessary to generate the indicators that are relevant at the basin-wide scale, and both internal and external coordination to ensure consistency and transparency in data sharing systems.

It should be noted that members of the Coordinated Assessment Planning Group felt it was impractical to try to address the entire range of data sharing needs in one step; therefore, they designed this pilot project focusing on improving data sharing of a subset of the VSP data (natural origin abundance and two indicators of productivity – adult-to-adult return rates and smolt-to-adult return rates). Many of the lessons learned in this pilot effort also apply to sharing of other data types. However, this study and its conclusions and recommendations should not be viewed as a complete solution to data sharing problems in the Columbia Basin. We expect that some additional problems, gaps and needs will be encountered as the region addresses the full range of data sharing needs.

[1] See all briefing materials for the Executive Summit at http://www.pnamp.org/event/2476.

Background

Complying with the Endangered Species Act poses one of the most complex set of legal and technical requirements for resource managers, involving multiple jurisdictions, larger amounts of data, and new types and combinations of analyses. This will require new and larger data management activities than present systems in the Columbia River Basin were designed to handle.

Through the Columbia River Basin Anadromous Salmonid Monitoring Strategy (ASMS)[2], the Federal Columbia River Power System (FCRPS) Action Agencies and Fishery Co-Managers agreed to the necessary monitoring to collect data needed to answer key management questions related to VSP parameters. The next step is to share that data in a manner that supports basin-wide assessments and calculation of high level indicators that address important management questions. The discussion to identify key habitat and hatchery effectiveness assessment indicators is ongoing. Performing these assessments and reporting answers to these management questions on an ongoing basis is critical to assure: 1) effective evaluation of the actions under the FCRPS Biological Opinion (BiOp)[3], 2) progress toward the recovery of anadromous salmonids listed under the Endangered Species Act (ESA)[4], 3) effective implementation of the anadromous salmonid elements of the Northwest Power and Conservation Council's (NPCC) Columbia River Basin Fish and Wildlife Program[5], and 4) informed fishery co-manager decisions and actions[6].

Currently salmon and steelhead goals and objectives are expressed in adult abundance and productivity values, yet in many cases the agencies and tribes only report status in terms of measurements and metrics such as redd count trends, dam counts, carcass surveys, weir counts, etc. Run reconstruction analyses to calculate abundance and productivity at the population scale is not performed on a routine basis except for harvest management, hatchery supplementation evaluations, and episodic status evaluations by regulatory agencies and/or recovery teams.

Monitoring budgets among the fisheries co-managers are steady, at best, or decreasing while the demand for summarized high level indicators to support decision making is increasing. Agencies can respond by reducing monitoring efforts or by improving the efficiency of data systems. The second choice is the better choice, and by enhancing data management they can ensure access to the best available science necessary for regional decision making.

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[2] July Draft Anadromous Salmonid Monitoring Strategy: Viable Salmonid Population Criteria and Subset of Tributary Habitat and Hatchery Effectiveness. See http://www.cbfwa.org/ams/files/Anadromous%20Salmonid%20Monitoring%20SubFramework-July%206%202010.pdf.

[3] FCRPS Adaptive Management Implementation Plan. See http://www.salmonrecovery.gov/Files/BiologicalOpinions/AMIP_09%2010%2009.pdf.

[4] Guidance for Monitoring Recovery of Pacific Northwest Salmon & Steelhead listed under the Federal Endangered Species Act. See http://www.nwr.noaa.gov/Salmon-Recovery-Planning/upload/RME-Guidance.pdf.

[5] NPCC Draft Monitoring, Evaluation, Research, and Reporting Plann. See http://www.nwcouncil.org/fw/merr/Default.asp.

[6] As examples, the Columbia Basin Fish Accords and Agencies and Tribes' recommendations to amend the 2000 Fish and Wildlife Program. See http://www.salmonrecovery.gov/ColumbiaBasinFishAccords.aspx and http://www.cbfwa.org/Committees/Members/meetings/2008_0404/2008_Apr4_FWMGRS_CBFWAsubmittal_FINAL.pdf.

Salmon cross jurisdictional boundaries (both internal and external to any particular agency) and effective salmon management depends upon the ability of the agencies, tribes and stakeholders to coordinate data collection, analysis, and reporting activities. Coordination is essential for managing salmon populations and can be enhanced through the use of agreed upon data dictionaries, data protocols and delivery mechanisms for sharing key data.

Resource managers must comply with many and diverse legal requirements. Decisions must be based upon and supported by credible information and analyses. Well organized and consistent data make it easier to respond to these legal requirements. Impacts of unforeseen events (e.g., climate change) will create new and unexpected challenges to resource managers. Integrating the data required to respond to these challenges with existing systems, distilling it to create new knowledge, and using that knowledge to develop response strategies will require significantly enhanced data management and analysis systems.

For these reasons, the fishery co-managers, NOAA, BPA and NPCC have supported this effort to:

- Improve the efficiency and effectiveness of sharing an initial set of salmon and steelhead information,
- Agree to common standards and definitions for information exchange,
- Support ESA implementation and status updates, as well as other fish management requirements, and
- Help all parties be better able to respond to known fish management challenges and emerging issues.

In early 2010, the Columbia Basin Fish and Wildlife Authority (CBFWA), NOAA Fisheries (NOAA), Bonneville Power Administration (BPA), Pacific Northwest Aquatic Monitoring Partnership (PNAMP), and StreamNet merged their efforts to create the Coordinated Assessments Project. The Coordinated Assessment Project was developed to address the need for the fishery management agencies and tribes collecting salmon and steelhead data in the Columbia River Basin to be involved in the management and use of their data for calculation of population level metrics and indicators in support of regional scale reporting and population assessments. In addition, there was wide recognition that data management and sharing is essential for extracting meaningful basin-scale information from basin-wide monitoring activities. The activities of the Coordinated Assessments project that resulted in this Strategy are described in Appendix A.

Goals and Objectives

Goals

The long term goal of the Coordinated Assessments Project is to develop a basin-wide approach to data management that allows efficient and reliable calculation and sharing of a broad range of data including abundance, productivity, habitat, and hatchery data which will improve access to the best available science to support decision making. To meet this goal, the agencies and tribes have begun a series of incremental steps towards developing and participating in a data exchange network based on advanced and automated data transport options. These steps include developing agency/tribal data management systems, shared hosting of indicators and/or supporting metrics, and publishing data and metadata in

standardized formats via 'web services' on the Internet. Where appropriate, this also includes automation of some processes now conducted manually. This approach will allow those conducting basin-wide assessments and assembling the various high level reports to directly access the needed data. In the near-term population level assessments will require an ad-hoc approach based on existing data sharing capabilities within the participating agencies/tribes.

The goal of the Columbia River Basin Collaborative Data Sharing Strategy is to take the first incremental step towards the larger CA Project goal. The Strategy identifies and focuses on three VSP high level indicators and uses these indicators to align data management processes, projects and funding. The participating agencies and tribes intend to improve accessibility, quality, comparability and administrative efficiency of their data management and sharing practices. The Strategy is also intended to inform and aid agency and tribal requests to multiple funding sources for financial support in implementing basin-wide business practices and infrastructures, and to assist in setting priorities for BPA data management funding.

Objectives

The objectives of this Strategy and its related products are:

Objective 1: Promote discussion and understanding at the policy-level within the agencies and tribes on how to support timely, reliable, and transparent data management and prioritize data that support basin-wide salmon and steelhead assessments.

> **Product:** Coordinated, consistent, individual data management plans for each salmon and steelhead management entity that can guide development of up-to-date, secure, web accessible databases that utilize consistent data management implementation standards and methodologies.

Objective 2: Inform the Council's Category Review for Data Management and Regional Coordination projects.

> **Product:** Use of this strategy for prioritization of BPA funding in the NPCC's data management category review as it relates to salmon and steelhead information. The agencies and tribes acknowledge that BPA funding for data management may require re-prioritization of work elements within existing data management projects, alignment of data management tasks within monitoring projects, and in-kind contributions from the agencies and tribes.

Objective 3: Inform NOAA funding to support recovery monitoring and align data management funding necessary for status assessments, as well as inform other funding processes, in order to better align these efforts with BPA funding for data management within the Columbia River Basin.

> **Product:** Develop an ongoing list of unfunded tasks necessary for full implementation of the Strategy.

Objective 4: Realize a sustained flow of high quality anadromous fish abundance and productivity data to efficiently generate reliable and transparent high level indicators sufficient to evaluate restoration success.

Product: A data exchange network for salmon and steelhead metric and indicator data for the Columbia River Basin.

Guiding Principles and Assumptions

In order to achieve the goal of improved management decisions based on improved sharing of information, the agencies and tribes will:

1) Support local control and management of key primary data, while ensuring consistency with basin-wide assessment and reporting needs,
2) Exchange indicators and agreed-upon supporting metrics in a common format regardless of original format or coding, and regardless of sampling methodologies,
3) Prioritize timely sharing of the data necessary to support basin-wide assessments and reporting,
4) Provide enough information about the data to support understanding and replication of the derivation of indicators for secondary applications and assessment needs, and
5) Develop enterprise database systems which store data across projects on behalf of the entire agency or tribe and with the ability to automate internal data flow, which will increase speed and efficiency of external data sharing and reduce individual work load.

Data Management is Key for M&E

Data management is an often overlooked component of monitoring and evaluation and adaptive management. Evaluations cannot occur without an explicit effort to accumulate appropriate information to support analysis and decision making. For this reason agencies and tribes have a fundamental need for investment in data management and improved data sharing.

This Strategy endorses the guidelines described in a StreamNet white paper titled 'Considerations for Regional Data Collection, Sharing and Exchange' (Appendix B) as part of a comprehensive approach to data management and data sharing:

1. Standardize sampling to the degree possible,
2. Agree to a common set of data management guidance documents,
3. Automate data capture and management, to the degree possible,
4. Use common coding and formatting and describe in a data dictionary,
5. Describe data so that others can understand and use them,
6. Publish the metadata,
7. Assure control over data quality,
8. Prepare a data management plan,
9. Prepare a data analysis plan,
10. Plan to share data,
11. Establish data sharing priorities and policies.

Effective data sharing involves the entire data stream

Data sharing involves actions at all levels of data management including: data capture by field biologists, consolidation and management of data within projects and agencies, policy decisions on what data to

share and how to share it, and support from funding agencies that require data for project and program reporting.

Data management and sharing requires diverse funding sources

In order for data systems to satisfy multiple user groups or diverse purposes, funding will be necessary from a variety of sources. The intent for this Strategy is to use internal agency data management funding as efficiently as possible and rely on external funding as a catalyst to improve data management that supports data sharing for regional demands for information. The intent is also to create a common basin-wide approach to data management and sharing that will inform both internal and external funding to the agencies and tribes, and will support the data needs of the funding agents. In order to prioritize funding from external sources, the data consumers need to clearly identify the measurements, metrics, or indicators they need at a basin-wide or regional scale.

Measurements, Metrics, and Indicators

Definitions are important and this Strategy relies on the following definitions for data available at www.monitoringmethods.org.

Measurement - A value resulting from a data collection event at a specific site and temporal period. Measurements can be used to produce metrics using a response design. A measurement is the source of the original data value.

Metric - A value resulting from the reduction or processing of measurements taken at a site and temporal unit at one or more times during the study period based on the procedures defined by the response design. Metrics can be used to estimate an indicator using an inference design. Note that a variety of metrics can be derived from original measurements.

Indicator - A value resulting from the data reduction of metrics across sites and temporal periods based on applying the procedures in the inference design. A reported value used to indicate the status, condition, or trend of a resource or ecological process.

Salmon and Steelhead Data Sharing Landscape in the Columbia River Basin

Basin Level Data Consumers

There are many basin-wide data consumers who have identified the need for data to support high level indicators for salmon and steelhead. Implementation of this Strategy will lead to routine reporting of abundance and productivity indicators or data to support their calculation, by the following entities, and by future reporting groups that may not be identified here. This partial list of data consumers and their reporting needs identifies what specific abundance and productivity data needs to be shared, and

emphasizes the importance of building the necessary local infrastructure to support reporting of this data.

Northwest Power and Conservation Council (NPCC)

The NPCC is developing a Monitoring, Evaluation, Research and Reporting Plan (MERR), in draft version currently, that will guide their reporting activities including tracking of the status and trends of priority species. The NPCC also annually reports on high level indicators including abundance and return rates of ESA listed salmon and steelhead in the Columbia River Basin. See: http://www.nwcouncil.org/fw/merr/ and http://www.nwcouncil.org/fw/program/hli/2009_10.htm.

NOAA Fisheries

Beginning in 2010, NOAA is conducting 5-year reviews of ESA-listed salmon and steelhead. The Salmonid Population Summary (SPS) database is the primary repository of data for these analyses. In addition, NOAA would like to have adult abundance and percent natural origin spawner data for all populations on an annual basis. See http://www.nwr.noaa.gov/Salmon-Recovery-Planning/upload/RME-Guidance.pdf.

Federal Columbia River Power System (FCRPS)

The Columbia River Action Agencies – Bonneville Power Administration, Bureau of Reclamation, and the U.S. Army Corps of Engineers – are required to produce an annual progress report on their implementation and progress toward the Reasonable and Prudent Alternative (RPA) actions described in the 2008 FCRPS Biological Opinion and in the Adaptive Management Implementation Plan (AMIP) developed to implement the RPA's. See https://pcts.nmfs.noaa.gov/pls/pcts-pub/pcts_upload.summary_list_biop?p_id=27149 (the BiOp), http://www.salmonrecovery.gov/Files/BiologicalOpinions/AMIP_09%2010%2009.pdf), (the AMIP), and http://www.cbfish.org/FcrpsBiOp.mvc/index (the RPA's).

Other basin-wide data consumers that require Basin-scale abundance and productivity data are the Columbia Basin Fish and Wildlife Authority (CBFWA) for their annual Status of the Resources Report (SOTR); Washington State's State of the Salmon in Watersheds Report; Washington Salmon Recovery Funding Board reporting; the Lower Snake River Compensation Plan (LSRCP) partners, the Columbia River Fish Accord partners for reporting against their performance measures, and the state and tribal fishery co-managers for effective decision making.

Basin Level Data Management Priorities

These reporting needs can only be met with the appropriate data management business practices, infrastructure, and resources that support data sharing. The various data reporting plans identified above also call for specific improvements and provide guidelines for addressing gaps in effective data management and sharing systems and processes. Following are some specific considerations identified by the data consumers:

The NPCC's Monitoring, Evaluation, Research, and Reporting (MERR) plan states that project data *will be made accessible, in an agreed upon format, and with accompanying metadata*.

NOAA makes specific recommendations to support data management and sharing in their 'Guidance for Monitoring Recovery of Pacific Northwest Salmon & Steelhead listed under the Federal Endangered Species Act.[7]:'

- *The regional environmental databases should be coordinated such that a common set of metadata and common data dictionaries are used,*
- *The natural resource agencies and tribes should develop automated internal infrastructure to assess and evaluate their data such that all methods and calculations are transparent and repeatable to all interested parties,*
- *All recovery entities should strive to have the elements of the Pacific Coast Salmon Recovery Fund (PCSRF) database dictionary within their databases and/or adequate data mapping to be able to provide data to the database when NOAA is conducting a status review, and*
- *The regional salmon recovery partners should build a distributed data system that can communicate between the various agencies and tribes involved in natural resources and report to the public progress in salmon recovery.*

The 2008 FCRPS Biological Opinion contains several RPA's that address data management and sharing priorities. With relationship to data management, RPA 51 states that the Action Agencies *will enhance existing fish populations status monitoring performed by fish management agencies through the following annual collaboration commitments:*

- *Support the coordination, data management, and annual synthesis of fish population metrics through Regional Data Repositories and reports, and*
- *Provide cost-shared funding support and staff participation in regional coordination forums … advance regional standards and coordination for more efficient and robust monitoring and information management.*

RPA 71 states that the Action Agencies *will coordinate RM&E activities with other Federal, State and Tribal agencies on an ongoing annual basis, including, in part:*

- *Working with regional monitoring agencies to develop, cooperatively fund, and implement standard metrics, business practices, and information collection and reporting tools needed to cooperatively track and report on the status of regional fish improvement and fish monitoring projects.*

RPA 72 states that the Action Agencies *will ensure that the information obtained under the auspices of the FCRPS RM&E Program is archived in appropriate data management systems. Actions include, in part:*

- *Continue to work with regional, Federal, State and Tribal agencies to establish a coordinated and standardized information system network to support the RM&E program and related performance assessments. The coordination of this development will occur primarily through leadership, participation, and joint funding support in regional coordination forums ….*
- *Contribute funding for data system components that support the information management needs of individual Hydro system, Tributary Habitat, Estuary/Ocean, Harvest, Hatchery, and Predation RM&E. (Initiate in FY2007-2009 Projects)*
- *Participate in Northwest regional coordination and collaboration efforts ….to develop and implement a regional management strategy for water, fish and habitat data*

[7] http://www.nwr.noaa.gov/Salmon-Recovery-Planning/upload/RME-Guidance.pdf

These guidelines, and others not cited here, contain common themes that set priorities for effective basin-wide data sharing and without strategic action they will continue to be gaps. In summary the biggest gaps for data consumers are:

- The need for data accessibility through automated internal infrastructures at the agency and tribal level that can interact in a standardized manner with regional repositories,
- The need for agreed upon data content and formatting (data dictionaries and/or data templates),
- The need for metadata to accompany datasets, and
- The need for coordination of a network of data sharing entities and the fostering of collaboration and communication through regional forums.

Salmon and Steelhead Data Collectors

Many federal, state, and tribal programs monitor anadromous salmonids in the Basin. During 2009 federal, state, and tribal fish and wildlife managers collaborated through a series of sub-regional and regional workshops, collectively referred to as the 2009 Columbia Basin Coordinated Anadromous Monitoring Workshop. A regional workshop was convened by BPA, CBFWA, NOAA and NPCC during October 20-21, 2009 and November 3-5, 2009 in Skamania Washington to develop the coordinated ASMS[8]. The purpose of the Regional Workshop was to reach agreement among participants on an efficient and effective framework and project specific implementation strategy for anadromous salmon and steelhead monitoring to assess (1) VSP criteria, (2) habitat effectiveness and (3) hatchery effectiveness in the Columbia Basin. The agreed-upon framework and strategy addresses the needs of the NPCC's Fish and Wildlife Program, meets the needs of the FCRPS BiOp (at a minimum), and contributes to the monitoring needs of ESA recovery planning and other regional fisheries management needs. The outcome of this collaboration was the ASMS which was used by the NPCC during their Monitoring and Evaluation Projects Category Review to prioritize and coordinate BPA funded monitoring projects. The full list of monitoring projects can be viewed at http://www.nwcouncil.org/library/report.asp?docid=286. While the ASMS identified gaps in monitoring projects, the effort did not address how the data would eventually be shared and reported.

The primary agencies and tribes collecting salmon and steelhead data are listed in the Gaps section of this report.

Assessment of Gaps and Needs

As part of the Coordinated Assessments Project, the agencies and tribes completed Gaps, Needs, and Priorities assessments in relation to sharing three selected VSP population level indicators for salmon and steelhead in order to develop initial Individual Data Management and Sharing Strategies. The detailed analysis for each of the agencies and tribes is found in Appendices C through L to this report. The summaries provided here form the basis for data management recommendations on a basinwide scale.

[8] See http://www.cbfwa.org/ams/files/Anadromous%20Salmonid%20Monitoring%20SubFramework-July%206%202010.pdf.

The data sharing gaps identified by the agencies and tribes were very similar across the Basin, regardless of where along the spectrum their data management capabilities fell. Most of the existing data systems were developed to support local, sub-regional (within the agency or tribe) decisions. Although they may be construed as archaic or clunky by the outside observer, they have been adequate to support the appropriate level of decision making within the agency or tribe for which the projects were intended. The gaps arise when the systems are evaluated on the capability to provide data and metadata for higher level analyses and decision support systems. When viewed under this lens, the systems are generally outdated and need significant upgrades. To address the regional or basin-wide data sharing needs, the local and sub-regional data management infrastructure has to be improved.

Gaps

Data management systems within the Basin range from data managed on desktop computers according to project level needs, to enterprise data systems that support statewide data bases according to regional standards. Even with this broad range of capabilities, the data management gaps and needs fit into a few specific categories.

Following is a brief description of the data management status and Gaps identified for each agency and tribe:

Columbia River Inter-Tribal Fish Commission (CRITFC):
CRITFC currently manages and provides some data to its member tribes. They have a backlog of field data to summarize which can support calculation of indicators. This legacy data needs to be entered into new databases to make it useful for regional analyses. The Tribal Data Network project, and funding through other projects, provides data management applications and services to its member tribes. They also host an annual Data Workshop to identify needs and coordinate data management efforts of their members. CRITFC lacks the programmer time necessary to develop the requested tribal data management applications for its member tribes. They also need partial funding for a web manager to publish the data that is available to the Internet.

Colville Confederated Tribes (CCT):
The CCT currently has a data management plan and is implementing it through their Okanogan Basin Monitoring and Evaluation Program (OBMEP, BPA Project Number 200302200). The CCT does not have a dedicated staff person to coordinated data management external to the tribe. As the CCT continues to build their data system, they are looking for regional guidance on data dictionaries, metadata guidance, basin-wide data priorities, etc. They have secured ½ FTE to address data management and sharing needs through a data steward, but require the other ½ FTE to fund the position.

Confederated Tribes of the Umatilla Indian Reservation (CTUIR):
The CTUIR have a comprehensive data management policy in place and are developing an enterprise data system for the fisheries department. The CTUIR are using tasks within BPA monitoring project(s) to cobble together funding for a fisheries data coordinator to implement their data management plan. The CTUIR are working on standardizing data collection and reporting protocols to better facilitate data sharing within the tribe.

Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO):
Within the CTWSRO data is currently managed by project leaders to support individual projects within the tribe. Although CRITIFC is providing some level of data management support, the CTWSRO lacks an agency-wide data management plan that addresses the priorities identified by the Coordinated Assessments Project. The CTWSRO is in the early stages of developing a centralized database for storage and retrieval of fisheries data, but would benefit from an overall data management assessment and planning effort to define a comprehensive roadmap for their development of data management systems. The tribe needs a full-time Data Coordinator to develop internal data management and sharing programs.

Idaho Department of Fish and Game (IDFG):
IDFG has an enterprise data system that contains much of the metric data necessary to calculate the three indicators (Idaho Fish and Wildlife Information System, IFWIS); however, IDFG does not currently calculate these indicators at this scale on a routine basis and does not include these indicators in the IFWIS portal. IDFG does not have adequate staff to coordinate internally among biologists collecting the data, and externally with regional entities.

Nez Perce Tribe (NPT):
The Nez Perce Tribe Department of Fisheries Resources Management is participating in multiple regional efforts to standardized and share data generated by the Department. To date these efforts have improved standardization and demonstrated our commitment to collaborative data storage, maintenance, analysis, and reporting relationships within the region. The NPT is primarily limited by lack of adequate staffing to fully participate in regional data management forums and implement data management practices identified in their data management plan. Gaps in NPT staffing include a data steward, data technician, and QA/QC technician. In addition, staffing to support historical data entry and development a QA/QC protocol document is needed. Gaps in NPT infrastructure are minor, but include two additional file servers and upgrades to existing file server hard drives. Finally, the NPT needs funding support for half a FTE web developer.

Oregon Department of Fish and Wildlife (ODFW):
ODFW has recently developed the Salmon Recovery Tracker (www.odfwrecoverytracker.org) for sharing population level data; however, only data for Oregon Coast Coho ESU populations are currently available. ODFW's current data sharing capabilities are overly complex, inefficient, and non-standardized. Data is primarily stored in local computers and individual data systems. ODFW has a plan to systematically enter data into the Salmon Recovery Tracker tool, as funds become available, and is currently requesting temporary reprioritization of StreamNet funds for development of systems to organize data and feed them to StreamNet and the Salmon Recovery Tracker. Initial efforts are starting with populations in the lower- and mid- Columbia River and working upstream.

Shoshone-Bannock Tribe (SBT):
Within SBT, data is currently managed by project leaders to support individual decision processes within the Tribe. The SBT contributes and relies somewhat on the IFWIS portals to manage some of their data. The SBT lacks an agency-wide data management plan and data back-up strategy. The SBT collects and stores much of the data necessary to calculate the indicators, but only currently performs the analyses for certain Tribal programs.

Washington Department of Fish and Wildlife (WDFW):

WDFW manages their population data at a different scale than the TRT defined populations through the SaSI Database (http://wdfw.wa.gov/conservation/fisheries/sasi/sasi_2002_introduction.html). For many populations, WDFW has sufficient data but lacks staff necessary to calculate the indicators. WDFW has corporate data bases for some of the elements used for calculating the indicators, but several elements require development and maintenance of new data bases. WDFW envisions sharing the data elements necessary to support calculation of the VSP Indicators through automated data sharing tools such as exchange templates, web services, etc.

Yakama Nation (YN):
The YN has employed data managers for the Yakima and Klickitat Basins and has made a lot of progress including automating many data capture processes, compiling and organizing a substantial amount of existing data for all species in both subbasins, and development of a report detailing the status of VSP monitoring indicators for Yakima spring Chinook. In other portions of the YN ceded area, data management has generally been taken on by project biologists. The primary focus of existing data management activities has been to support internal project and program priorities within specific basins. The YN has also worked to share existing data with co-managers, other agencies, and the public, but many existing project data and information are still only available via project reports (available through the PISCES and TAURUS web sites) or via e-mail contacts with data managers or project biologists. The YN would benefit from an overall data management assessment and strategic planning effort to guide the design of a comprehensive, integrated agency-wide enterprise data system. The YN lacks the dedicated IT support and funding necessary to develop this system.

Needs

Currently the agencies and tribes generally do not directly calculate VSP indicators used for NOAA status assessments. Several agencies expressed an interest in prioritizing that activity in order to provide NOAA Fisheries the derived indicators, while other agencies and tribes are content to provide NOAA Fisheries the metric data and metadata necessary to allow those calculations to be performed at NOAA. Re-alignment of staff to perform the analyses necessary to generate the indicators that are relevant at the basin-wide scale will take time. The agencies and tribes will need to invest in staff to perform the calculations and report high level indicators within their management authority where appropriate. Funding will come from internal realignment of personnel, existing BPA funding within monitoring projects or from NOAA Fisheries where appropriate. It is important to note, indicators are generated from the same metric-level data for different areas of inference; therefore, exchanging indicator information will require some level of metric-level data exchange, as well.

The needs or funding opportunities within the agencies and tribes to improve data management and sharing fell generally within six categories (Table 1):

1) Data Management Assessments and Planning Support

Several entities currently manage their salmon and steelhead data on essentially a project by project basis. While some of their data are entered into enterprise data systems, or into their own developing systems, or some summarized field data are available through StreamNet, access to the data often requires contacting the project leader and/or accessing annual reports. As data management plans were developed by each of the agencies and tribes, it became apparent that several of the tribes would benefit from having a professional consultant assist them with performing an overall data management

assessment and develop a long term plan for managing and sharing their salmon and steelhead data consistent with regional guidance and needs. This is a task that could be completed with FY2012 BPA funding from the Regional Data Management Support and Coordination project. Discussion of this work is ongoing in the PNAMP Data Management Leadership Team and will likely be implemented through the StreamNet or CRITFC Tribal Data Network projects within the next fiscal year.

2) Updated Data Management Policies

Several of the agencies and tribes referenced the need to update their existing data management systems with current data dictionaries, metadata standards, and other regional guidance information that is now available. While funding is not necessarily needed to implement new policies within the agencies or tribes, this effort could be considered a "cost-share" by the agencies and tribes as they adjust their data management systems to address a more clearly defined need by regional data consumers. The costs for implementing new policies consist of investments in hardware, software, and IT personnel necessary to make needed changes to adapt their systems to regional needs.

3) Hardware and Software Infrastructure

The agencies and tribes require hardware and software infrastructure in order to support reliable data management systems. Most of the systems in place are adequate to support the local and project level decision making that is required by the agencies and tribes. To support basin-wide data needs, in a timely manner, this infrastructure will have to be updated and improved to automate data transport to enterprise data systems. Automation will reduce compilation errors, provide more standardized data entry and formats, improve and facilitate metadata documentation and use, and provide reliability and accessibility for measurement and metric level data needed for calculation of indicators. For this reason, it may be appropriate for basin-wide data consumers to help fund infrastructure improvements within the agencies and tribes to satisfy data access requirements for meeting report obligations.

4) IT Support (programmer, web manager, etc.)

Many of the agencies and tribes rely on project level staff to support data management needs for their data, in addition to their normal duties. In order to move some of the agencies and tribes towards modern integrated enterprise data systems, some level of IT support will be required. This activity is different from a data coordinator in that special programming skills are required. IT support will help with standardization, integration, and construction of the additional infrastructure necessary to integrate the agency or tribal data systems.

5) Data Stewards (internal and external coordination)

Effective data management requires data professionals that can bridge the gap between the biologists and the technical side of data management. Hiring data stewards will ensure that data content priorities are set by the biologists in a way to guide the data technicians to be most efficient and effective in managing data bases. The provision of temporary data coordinators through the Coordinated Assessments Project helped the agencies and tribes realize the value of having a data coordinator to help guide IT development and interactions with biologists. This is a likely role for BPA funding as this requires flexibility in job specifications and the ability to operate across various projects or regional offices. These professionals should support internal data coordination and infrastructure development and coordinate externally to ensure basin-wide data sharing needs and requirements are

met. A model for this type of implementation is currently provided by state agencies through the StreamNet project for specific types of data with good success, but the specific tasks of this project will have to be refocused to support salmon and steelhead indicator data.

6) Coordination Forums for Standardized Protocols

The Coordinated Assessments Project relies on two levels of coordination for its success – coordination with lead field biologists and coordination with agency and tribal data managers. It is proposed that the Coordinated Assessments Planning Group (CAPG) continue this coordination. Facilitation of the CAPG is provided through the Columbia Basin Fish and Wildlife Foundation (CBFWF) and PNAMP, with support from the StreamNet project.

The CAPG will identify the content priorities for basin-wide data sharing and coordinate between basin-wide level data consumers and field level data collectors. The CAPG will also establish the specific content to be shared through development of basin-wide Data Exchange Templates (DET) in order to determine what information is needed and on what schedule.

The CAPG will form a technical sub-committee to define data management mechanisms and formats to support data sharing. Membership in this sub-committee would largely be data professionals; however, data coordinator attendance at both the technical forum and at the CAPG will be encouraged to ensure overlap between the two groups. The technical forum will facilitate discussion between data providers to agree on data exchange template implementation standards and methodologies. This forum will also oversee the development of tools to facilitate basin-wide data exchange and through StreamNet, provide data web hosting to support the initial stages of data exchange network.

Coordination needs are ongoing for development of common data collection methods and investigating improved sampling methods and data capture. Efforts should continue through PNAMP to evaluate tools and methodologies that can be tested on a pilot scale prior to implementation across the Basin.

Table 1. Summary needs by agency and tribe for sharing three abundance and productivity indicators for salmon and steelhead.

Agency/Tribe	1) Data Management Assessments and Planning Support	2) Updated Data Management Policies	3) Hardware and Software Infrastructure	4) IT Support (programmer, web manager, etc.)	5) Data Steward (internal and external coordination)	6) Coordination Forums for Standardized Protocols
Columbia River Inter-Tribal Fish Commission (CRITFC)		X		X	X	X
Colville Confederated Tribes (CCT)					X	X
Confederated Tribes of the Umatilla Indian Reservation (CTUIR)					X	X
Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO)	X	X	X	X	X	X
Idaho Department of Fish and Game (IDFG)		X			X	X
Nez Perce Tribe (NPT)			X	X	X	X
Oregon Department of Fish and Wildlife (ODFW)		X	X	X	X	X
Shoshone-Bannock Tribe (SBT)	X	X	X	X	X	X
Washington Department of Fish and Wildlife (WDFW)		X	X	X	X	X
Yakama Nation (YN)		X	X	X	X	X

Recommendations

With the completion of the Skamania workshops and the development of the ASMS, the agencies and tribes of the Columbia River agreed to data collection in support of regional decision making. While the target indicators are not calculated consistently across the Basin, salmon and steelhead data are being collected and metrics supporting the indicators are calculated on a regular basis. An important step in the collection of these data and calculation of metrics is making them available to those who need them to perform additional calculations and analyses for regional applications such as calculation of VSP indicators or other high level indicators.

While this Strategy's primary intention is to build an approach that can access many funding sources, the NPCC's Data Management Category Review of BPA funded data management projects is currently underway. The objective of the data management review is to improve the value of the raw and derived data that is collected, maintained, and analyzed under the Program to evaluate program effectiveness and also improve the interconnectivity, usability, accessibility, and dissemination of that data for the region. The category review will focus on existing projects and will entertain proposals for restructuring or expansion to fill gaps. Therefore, some specific recommendations for BPA funding are contained in this Strategy and explicitly in Table 2.

The following recommendations should move the co-managers and their partners towards improved data sharing to support local and regional decision making.

A) **Improve Infrastructure.** The agencies and tribes should maintain up-to-date, secure, web accessible databases that utilize consistent data management implementation standards and methodologies. The agencies and tribes will prioritize and adopt data management business practices that support internal data sharing and will invest in data management infrastructure to manage measurement-, metric- and indicator-level data in consistent and transparent systems. Key to this infrastructure is the planning and development of enterprise data systems that manage data on behalf of the entire agency or tribe rather than on a project by project basis. Building agency-wide databases will help establish internal standardized data sharing protocols and collaborating with partner agencies and tribes will occur to ensure consistency between data bases. Funding will likely come from internal prioritization of agency and tribal investments, use of hardware replacement/upgrade budgets to build toward enterprise systems, existing monitoring projects that rely on data support from the agencies and tribes (realignment of existing project level funds), or other appropriate sources to purchase hardware and software necessary to meet the demand for the data. This may be an important area of investment for NOAA Fisheries as a driver for improved infrastructure is to provide the agencies and tribes with the capability to provide necessary data for basin-wide status assessments of listed anadromous fish.

B) **Encourage a Network of Data Stewards.** Invest in data professionals placed within the agencies and tribes who can bridge the gap between biologists and the technical side of data management. These professionals should support internal data coordination and infrastructure development and coordinate externally to ensure basin-wide data sharing needs are met. This will make sure that data content priorities are set by the biologists in a way to guide the data technicians to be most efficient and effective in managing data bases. This is a likely role for BPA funding as this requires flexibility in job specifications and the ability to operate among

various projects or regional offices. This funding model has been successfully implemented through the StreamNet project in the past, but may need to be expanded, in collaboration with the CRITIFC Tribal Data Network project, to support all of the agencies and tribes.

C) Continue Coordination. Continue to use the CAPG for oversight and guidance of the Coordinated Assessment effort, including implementation of this Strategy. Where needed (e.g., development of the DET and the identification of data transport mechanisms), establish sub-committees using existing forums (e.g., expanded StreamNet) wherever possible. The current Membership of the CAPG and Core Team is provided in the Acknowledgements section of this report; however, specific membership will vary based on need and priority. The CAPG will:

- Provide coordination between basin-wide level data consumers and data collectors
- Establish a DET development subcommittee to:
  - Identify content to be shared through the use of a basin-wide Data Exchange Template – which includes what information is needed, in what format, and on what schedule
  - Include participation of former TRT members and equivalent level biologists from each of the agencies and tribes and their designated basin-wide data professionals
  - Ensure participation by NOAA Salmon Population Summary database staff
- Oversee the work of the technical sub-committee (defined below)
- Meet face-to-face to discuss recommendations as necessary and continue to use annual workshops to communicate and update the Coordinated Assessments Workgroup participants

A sub-committee of the CAPG will be required in the beginning of this process to develop the working draft of the DET, which will require extensive effort for several months. Coordination of the CAPG and associated sub-committees should be funded by BPA through the CAPG core team and quarterly teleconferences would likely be sufficient after initial efforts (See Table 2). The CAPG has adopted a Phase III Workplan to guide this effort.

The expanded StreamNet Steering Committee should serve as a technical forum and sub-committee of the CAPG. Responsibilities of the technical sub-committee include:

- Coordination between data providers to agree on data exchange format implementation standards and methodologies
- Developing a data dictionary of technical terms to unify terminology
- Overseeing the development of tools to facilitate basin-wide data exchange
- Participate in CAPG to provide technical guidance and realities

In the long-term, an exchange network approach is envisioned, where data can be directly requested and accessed from individual partners as needed. In the interim, StreamNet will provide data web hosting for agencies and tribes that do not yet have that capability.

D) Develop Tools. Continue to support PNAMP, for investigating new approaches and exploring alternative strategies for basin-wide data sharing. This work has been conducted through the PNAMP Data Management Leadership Team which continues to help develop and evaluate tools for improving data sharing. Examples include the ISTM project, Metadata Guidance, and Monitoring Methods.org. This forum operates at a level above the Columbia River Basin and links activities within the Basin to a larger network of data management groups.

Table 2. BPA funded data management projects and suggested modifications for FY13-15 funding cycle.

Number	Title	Proponent Orgs	FY 13-15 Comments	BiOp Action	Draft Budget
1988-108-04	StreamNet - Coordinated Information System (CIS)/ Northwest Environmental Database (NED)	Pacific States Marine Fisheries Commission (PSMFC)	Shift focus from facilitating data compilation within State data bases, to supporting development of corporate databases within the states that support direct data entry and eliminates the need for data compilers for anadromous and resident fish data bases (could take a couple years to complete transition). Facilitate communication between state and tribal data bases to ensure consistent data exchange formats and efficient data sharing (Technical Coordination Forum). Add 1-2 FTE to support participation and data management for SBT and CCT. Manage interim central data base for high level indicators for salmon and steelhead.	RPA 51 Collaboration Regarding Fish Population Status Monitoring, RPA 71 Coordination, RPA 72 Data Management	$2,169,576
1996-019-00	Data Access in Real Time (DART)	University of Washington	Ensure consistency with DETs for appropriate data sharing. This project will likely benefit from the basin-wide data sharing strategy, as a second tier database, but will not necessarily be a major driver in developing the DET or facilitating data exchange.	RPA 72 Data Management	$ 293,938
2003-072-00	Habitat and Biodiversity Information System for Columbia River	Northwest Habitat Institute	See Draft Wildlife Monitoring Strategy	RPA 71 Coordination	$ 165,821

Number	Title	Proponent Orgs	FY 13-15 Comments	BiOp Action	Draft Budget
	Basin				
2008-505-00	StreamNet Library	Columbia River Inter-Tribal Fish Commission (CRITFC)	Capture and provide access to materials analyzing and interpreting data relevant to restoration of fish and wildlife resources in the Columbia Basin. Catalog, manage and update the reference portions of the StreamNet databases. Serve as an "Institutional Memory" for activities and decisions affecting natural resources in the Columbia Basin and provide context for decision making processes. Increase the availability of Library holdings through the Internet as well as providing access to other collections of relevant materials (requires an additional FTE). Increase the Library user base and services available remotely (e.g. access to Journals and inter-library loan, etc.).	RPA 51 Collaboration Regarding Fish Population Status Monitoring, RPA 71 Coordination, RPA 72 Data Management	$ 462,833
2008-507-00	Tribal Data Network	Columbia River Inter-Tribal Fish Commission (CRITFC)	Participate at the science and technical forums for guiding the next phases of Coordinated Assessments project. Provide a liaison to the member tribes' for helping coordinate their biologist/IT interface where they need help (this will require 2 additional FTE to serve as	RPA 51 Collaboration Regarding Fish Population Status Monitoring, RPA 56 Monitor and Evaluate Tributary Habitat Conditions and Limiting Factors, RPA 57	$ 701,903

Number	Title	Proponent Orgs	FY 13-15 Comments	BiOp Action	Draft Budget
			Data Coordinators at Member tribes). Support an IT team that can adapt new technology to data management, write software and provide infrastructure support for helping CRITFC and its member tribes with obstacles to housing and sharing their data from tribal databases (creation of metric level data bases, data entry tools, data extraction software, web services, etc. (this will require 1 FTE programmer and partial funding for a web programmer). Create and maintain mainstem and ocean metric level data bases.	Evaluate the Effectiveness of Tributary Habitat Actions, RPA 59 Monitor and Evaluate Migration Characteristics and Estuary/Ocean Conditions, RPA 71 Coordination, RPA 72 Data Management	
1989-062-01	Regional Coordination Facilitation Services	Columbia Basin Fish and Wildlife Foundation	Co-facilitate Coordinated Assessments Planning Group and participate in CAPG Core Team to support fishery co-managers participation in guiding data management for sharing high level indicators.		TBD in Regional Coordination Review
2004-002-00	Pacific Northwest Aquatic Monitoring Program (PNAMP) Coordination	US Geological Survey (USGS)	Co-facilitate Coordinated Assessments Planning Group and participate in CAPG Core Team to support PNAMP member participation in guiding data management and sharing high level indicators. Facilitate PNW regional forum for data sharing (Data Management Leadership Team).	RPA 51 Collaboration Regarding Fish Population Status Monitoring, RPA 56 Monitor and Evaluate Tributary Habitat Conditions and Limiting Factors, RPA 57 Evaluate the Effectiveness of Tributary	TBD in Regional Coordination Review

Number	Title	Proponent Orgs	FY 13-15 Comments	BiOp Action	Draft Budget
			Facilitate development of tools and pilot projects for data management and sharing (R&D for data management and sharing with cost share from appropriate entities). State management agencies and tribes will continue to require coordination funding to maintain their capacity to participate.	Habitat Actions, RPA 59 Monitor and Evaluate Migration Characteristics and Estuary/Ocean Conditions, RPA 71 Coordination, RPA 72 Data Management	

Budget Exercise

Representatives from the states and tribes, BPA, CRITFC and StreamNet agreed to develop prioritized budget targets for use in guiding BPA funding for data management through the NPCC's FY13-15 Data Management Category Review Process. The objectives of the budget exercise were to: 1) Demonstrate due diligence in review of BPA funded data management and monitoring projects for redundancy and priority of data management tasks, 2) Optimize available BPA funding to address the Strategy recommendations, 3) Identify synergy and efficiencies that can maximize the value of BPA data management investments, and 4) Identify the agencies' and tribes' specific gaps and needs, with the benefit of providing a list of prioritized unfunded projects to submit to alternative funding processes.

The intent of the effort was to keep focused on the work necessary to implement a 5-year work plan and develop a budget based on agency/tribe Data Management Plans (Appendices) according to the following principles:

- Task based – group work into discrete tasks so that funding for one element does not require funding for another within the same FY.
- Sequential – if funding for one element depends on funding for another, phase the costs over successive years.
- Reasonable rate of implementation – be conscious of limited funding availability, pace implementation accordingly, identify priorities as Tier 1, 2, or 3 (adjusted to Tier 1 and 2).
- Products/results – be clear what will be accomplished with each task/phase in terms of supporting VSP indicators.

- Align tasks with Strategy recommendations; identify which recommendation(s) each task is addressing.
- Project associations – identify other agency projects that are coordinated under the Data Management Plan, or other relevant data management tasks funded by BPA. Review tasks within monitoring and evaluation projects, and confirm that those tasks can or cannot contribute to the larger data management effort within the agency.
- Identify additional funding sources and cost share opportunities.

The agency and tribe representatives reviewed 136 individual work elements within 55 BPA funded projects to determine if efficiencies could be obtained within existing monitoring projects, to support the Coordinated Assessment effort. A few of the projects were not monitoring or reporting anadromous fish data. Most of the work elements directly supported the deliverables for the project and could not be redirected to regional efforts without compromising the scientific integrity of the project. Many of the work elements currently support a basin-wide effort indirectly, by facilitating the reporting of project level data into existing enterprise data systems. Several of the projects identified the possibility of contributing to the larger data sharing effort, but efforts to accomplish reprioritization and alignment of the M&E projects with the regional data management efforts will require additional time and internal discussions and negotiations. There was general agreement to continue exploring these options in parallel with proposing data management tasks for the current Category Review Process.

The budget exercise was neither a project review nor a decision making process. The group reviewed tasks proposed by the individual participants in order to set them in context to the larger data sharing effort conducted through the Coordinated Assessments Project. Each of the tasks that will eventually be proposed for funding will be required to complete a proposal form and proceed through the funding process consistent with all other projects. Funding will be determined based on the scientific and technical merit of each project. Questions raised during the budget exercise should be fully addressed within the project proposal. This process was narrowly focused on funding for FY2013 through 2015.

A list of specific agency and tribal needs, and the results of the budget exercise are provided in Appendix M. The Taurus portfolio list of Data Management projects for the NPCC's review process includes several projects that are not directly related to the Coordinated Assessments project, and therefore, were not discussed in detail at the budget exercise meeting. These include Habitat and Biodiversity Information System, Kalispel Tribe Data Management Project, Columbia Pit Tag Information, Fish Passage Center, and Data Access in Real Time. It is assumed that those projects will likely remain level funded for FY2013-15, but their proposed needs will guide that discussion during the project review process.

The StreamNet, Tribal Data Network, and Regional Data Management Support and Coordination (Placeholder) projects were the primary focus of discussion for implementation of the Data Sharing Strategy during the budget exercise. The StreamNet Library project may also be reviewed in this context, but those conversations will occur between BPA and CRITFC. Funds from the Placeholder will be used to augment the StreamNet and Tribal Data Network projects to support data coordinators

within each of the tribes that manage salmon and steelhead data. These were considered Tier 1 needs. The purpose of implementing these new tasks within these two projects meets two objectives. First, the Category Review process does not allow for new projects to be developed and submitted; therefore using the StreamNet and Tribal Data Network projects facilitates proposing new tasks into the process. Second, it is important that these tasks (new data coordinators for each tribe) are well coordinated in the regional processes, and implementing these tasks through the data manage coordination projects will ensure focus of the data coordinators on priorities identified within this strategy.

Discussion will occur between BPA and their Fish Accord partners to ensure that the tasks identified in the Tier 1 category are truly lower priority tasks than those currently being funded within the Fish Accords; and therefore merit additional new funding. If they are a higher priority than existing work within the accords, funding may be re-allocated to support this newly identified work. The BPA proposed budget appears to be adequate to support a network of data stewards to facilitate development and sharing of relevant VSP data to support BiOp and Program reporting consistent with the Strategy; however, significant tasks will remain unfunded.

The Tier 2 projects primarily focus on Improving Infrastructure within the agencies and tribes to better support regional sharing of data and information. Funding for these tasks will be pursued through other funding sources such as NOAA Fisheries, internal funding within the agencies and tribes, or other sources. These are important, priority tasks and implementation of them will be required to eventually obtain the data exchange network envisioned as the ultimate objective of the Coordinated Assessments project.

List of Appendices

DRAFT

The Coordinated Assessments Project

Summary of progress to date

August 22, 2011

Introduction

The Coordinated Assessment (CA) project was developed to address the need for the fishery management agencies and tribes collecting salmon and steelhead data in the Columbia River Basin to be involved in the management and use of their data for calculation of population level metrics and indicators in support of regional scale reporting and population assessments. The focus was on the ability to support sharing of viable salmonid population (VSP), habitat action effectiveness, and salmonid hatchery effectiveness indicators. The fishery co-managers purposely limited the initial focus of the project to three salmon and steelhead indicators to increase the likelihood of success. Additional salmon and steelhead indicators, as well as habitat effectiveness, hatchery effectiveness and resident fish and wildlife data sharing strategies, will be added as the project progresses. This approach was chosen because many of the technologies and processes for sharing data will easily transfer to other indicators, as well as whole other sectors of information. Each phase of the project has led to the development of a work plan to address the next steps.

The Columbia Basin Fish and Wildlife Authority (CBFWA) and the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), with support from the StreamNet project, took the lead in organizing the CA project and their respective staff representatives comprise the CA Core Team. Project planning and implementation is guided by the CA Planning Group (CAPG) consisting of the Core Team and Federal (NOAA Fisheries and Bonneville Power Administration), State (Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, and Idaho Department of Fish and Wildlife) and Tribal (Columbia Inter-Tribal Fish Commission and Nez Perce Tribe) representatives. Participation in the project workshops consisted of most of the parties working with salmon and steelhead data in the Columbia River Basin. All supporting information is provided on the PNAMP website at: http://www.pnamp.org/project/3129.

Phase 1

Phase I of the CA effort began in the Spring of 2010 and concluded in January 2011. In this phase the initial project goals were established, support for the project was developed within the state fisheries agencies and tribes, and the basic approach was defined and implemented.

Initial efforts by the CAPG were focused on determining the appropriate approach to sharing the test indicators, how to stipulate the specific data elements to be shared, and how to understand how each state and tribe approached managing the relevant data within their agency. The CAPG selected three primary components for use or consideration in the CA project: a Data Exchange Network as a long term goal for sharing data in the future, a Data Exchange Template (DET) to specify the data elements to be shared, including definitions of each data element and specific formats for sharing the data, and Data Analysis Flow Diagrams (DAFD) for describing how data flow within the agencies.

Exchange networks

Initially the CAPG looked at a sophisticated mechanism of data sharing developed by EPA, commonly referred to as a Data Exchange Network. Developed initially for sharing water quality data, the exchange network approach is now being applied more widely and allows data to be exchanged automatically from source agency database systems using web services in XML format through a central data access application. Such successful data sharing was made possible by having: 1) a precise listing of the data to be shared, 2) clear definitions of the elements that are included in these data sets, and 3) detailed descriptions of the required formatting of the data elements described in a DET. In order for an exchange network to function, the requisite data must be stored in the required DET format in a database system accessible via XML on the Internet. Currently, the state and tribal agencies have not yet deployed database systems with this capability.

Rather than decide initially what technological mechanism would be best for data sharing in the Columbia River Basin, the CAPG decided to first focus on the building blocks of successful data sharing. If the content and format of what is to be shared is clearly defined, a variety of means to actually share the data are possible and would suffice to get the data sharing effort started. Selecting and gearing up for a more robust approach will be addressed later in the project.

Data Exchange Template

A DET is a standardized format that identifies the types of information required or allowed in a particular document or exchange. Data exchange templates contain no data but instead define the format for exchange according to standards and trading partner agreements. The planning group chose to use a DET to provide a framework and technical tool to support data sharing between the agencies and tribes by clearly defining what was to be shared. Employing a DET eliminates duplication of effort to take data from different sources and convert them into a common format. While a DET is simply a list defining the data elements to be shared and their respective definitions and formats, for the Phase II trial, the DET was used in an Excel spreadsheet format that allowed both the definition and actual capture of data. A longer term data sharing approach would be unlikely to use this exploratory tool as an ongoing sharing mechanism.

The DET was used to test the data sharing capabilities and capacities of the agencies and tribes that currently manage salmon and steelhead data. The draft DET was developed using an independent contractor with experience working with data exchange networks. For convenience, the DET was formatted as an Excel spreadsheet, combining the functions of describing the data to be shared with acquiring representative data in that format. During its initial development it was vetted by the CAPG and was distributed to four agencies [WDFW, ODFW, IDFG and NPT] for initial testing and subsequent refinement. It is hoped that the adoption of the DET will be a catalyst to improve the status and functionality of agency information systems.

Data Analysis Flow Diagram

As an aid for data specialists to locate the required indicators and metrics, the CA project developed diagrams of how the data for each indicator in each population flow from field

collection to calculation of the indicator and other analyses. These diagrams were developed in Visio, with common symbology to describe the data pathways. These diagrams were useful in determining where the final estimates and their component parts were located, proved useful to agency staff in developing their data sharing strategies, and will be useful as the agencies move toward developing and enhancing their data management infrastructure.

The Phase I effort began by focusing its efforts on a subset of possible indicators, hoping to demonstrate success within a smaller effort and then expand to additional VSP, habitat effectiveness and hatchery effectiveness indicators at a later time. The initial data selected for sharing were three VSP indicators for salmon and steelhead: Natural Origin Spawner Abundance, Smolt to Adult Return, and Recruits per Spawner, along with certain derived metrics that support the calculation of the three indicators and descriptive information (metadata). These and the associated metadata constituted the content of the DET so that it was clear to all participants precisely what data elements were being requested.

Phase I concluded with a Basin-wide workshop held October 6, 2010 in Portland, Oregon. The CA Core Team presented the work plan for the Coordinated Assessments project which described the goals of the entire project and objectives for the near-term (Phase I), medium-term (Phase II), and long-term (Phase III). The participating state agencies and tribes were provided background on the draft DET and information on their cooperation in the wider testing and use of the draft DET during Phase II. Planning for Basin-wide data sharing gaps, needs, and priorities assessments was described in support of developing partner capacity, shared technical infrastructure, and the management and governance needed to promote the use of a common data template for these three VSP indicators.

Phase 2

Phase II began in February of 2011 and will conclude with the September 21-22, 2011 Coordinated Assessments Workshop. Phase II consisted of an extensive assessment of data flow and availability within the participating state and tribal fisheries agencies, application of the DET to acquire data from a representative year for each indicator, assessment of data sharing needs, evaluation and synthesis of Phase II products, and will culminate in development of a Columbia River Basin-wide data sharing strategy.

The Phase II Goals included: 1) Develop individual and regional data sharing strategies that identify the capacities and business practices necessary for integrated data sharing of three specific VSP indicators in the Basin; and, 2) Refine and promote the sharing of data in the DET format among the fisheries co-managers as a business practice.

Key products developed during Phase II of the project included: 1) Determination of the availability of the Indicator estimates and supporting metrics, described by population with DAFDs; 2) Acquisition of a representative year's estimates for each Indicator, with supporting metrics and metadata, in a DET spreadsheet for as many salmon and steelhead populations as feasible within the available time; 3) A Gaps, Needs, and Priorities (GNP) assessment used to identify the capacity needs of state and tribal fisheries agencies to manage and share data, and; 4) Individual Data Sharing Strategies for each agency and tribe addressing plans regarding capacity, infrastructure, procedures, and management and governance. From these products a draft basin-wide data sharing strategy was developed to address common strategies, needs for common infrastructure, and long term management and governance.

Ten data technicians were hired through StreamNet to work with participants to locate and capture data into the draft DET (v0.9) spreadsheet for the salmonid populations for which the participating agency calculated any of the three indicators and assist with development of the other key products. Nine different state and tribal fisheries agencies participated in this effort (Confederated Tribes of the Colville, Confederated Tribes of the Umatilla , Confederated Tribes of Warm Springs, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife (Corvallis and LaGrande), Nez Perce Tribe, Shoshone-Bannock Tribes, Washington Department of Fish and Wildlife (Wenatchee and Vancouver), and the Yakama Nation).

A workshop was held April 21, 2011, in Portland, Oregon that gathered together the data team, participating agencies and tribes, and the CA Core Team and CAPG for a mid-course check of progress. At that workshop participating agencies and tribes were asked to fill a Gaps, Needs, and Priorities (GNP) Assessment and to develop individual data sharing strategies. The data technicians initiated the GNP assessment for the populations at each location and provided this information to their agency's biologists and/or management to roll into an overall assessment of the agency's data sharing gaps, needs, and priorities. A more detailed Phase II work plan was also presented at the workshop.

Phase 3

Phase III of the Coordinated Assessments Project will begin at the September 2011 Workshop. Topics for the workshop will include finalizing a basin-wide data sharing strategy and adopting a Phase III work plan that describes the path forward for continuing development of the data sharing process for salmon and steelhead data in the Columbia River Basin. It is expected that future work on this project will include: 1) definition of population level abundance and productivity indicators that will be shared across the Basin, both initially and expanding in the future, 2) development of a functioning DET for use in sharing the initial three indicators into a central data base, 3) adoption of longer range data sharing approaches, and, 4) continued coordination through facilitated forums.

Coordinated Assessment Results and Findings to Date

The Coordinated Assessments project facilitated 10 temporary workers within the 9 agencies and tribes responsible for salmon and steelhead data within the Columbia River Basin for 5 months. The technicians employed DETs and DAFDs to assess the current data sharing capacities and capabilities within each of their designated agencies and assisted with development of the Gaps, Needs and Priorities assessments and individual agency data sharing strategies.

Products from Phase II included DET spreadsheets for 164 populations/agencies (Table 1), X completed DAFDs for use within the agencies and tribes, Gaps, Needs and Priorities Assessment by population and for each participating state or tribal fisheries agency, individual data sharing strategies for agency and tribe, and a draft basin-wide data sharing strategy. The DET spreadsheets were compiled into a dataset for later summary analysis and preliminary evaluation. The individual data sharing strategies are included with this report (Appendix C-L). The DAFDs and GNP assessments were used by the CAPG to supplement their evaluation of data sharing needs and identification of lessons learned.

The 164 completed DETs represent roughly 150 populations (some were reported by multiple agencies) out of 274 populations in the Columbia River Basin as defined by CBFWA (including listed and non-listed populations) during the 2009 NPCC Program Amendment process. It was not the intent for the data

technicians to develop DETs for every population, only to develop DETs for a representative sample to enable evaluation of current data management processes within each of the state agencies and tribes. Natural origin spawner abundance was currently available for approximately 58% of those populations where a DET was completed (Table 2); Smolt to Adult return rate was available for approximately 29% of those populations, and Recruits per Spawner was calculated for approximately 46% of those populations. It should be noted that these three indicators were calculated for all populations where data were available and sufficient during the NOAA Fisheries 5-year status assessments performed for the 2010 check-in (http://www.nwr.noaa.gov/ESA-Salmon-Listings/5-yr-sums.cfm). Those calculations are not currently conducted annually; however.

Natural origin spawner abundance was the most available indicator, but only 52% of the estimates obtained were representative of the entire defined population (Table 2). Furthermore, it was discovered that the geographic coverage of a given population in some cases differed from the geographic coverage of the population as defined by the relevant Technical Recovery Team (TRT). Another key finding was that only 4% of the spawner abundance estimates included calculation of a confidence interval. Therefore it is very important that the full context of these indicators be captured the data exchange templates through inclusion of metrics and metadata, so that the assumptions for confidence, expansion factors, etc. can be fully understood.

Following are the primary findings and lessons learned from the Phase II efforts:

1) The three indicators chosen for this project are primary components of population assessments used by NOAA Fisheries for status determination under the ESA (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm). Aside from locations where NOAA or a TRT's calculates these VSP indicators, the three selected indicators are currently calculated by the state agencies and Tribes for all populations in their purview. Where indicators are calculated for purposes other than TRT evaluation, there are significant variations within and between state agencies and Tribes in how populations are defined and how indicators are calculated or derived. It is critical that the metric level data that support calculation of population level indicators (regardless of the population's geographic definition) be managed in a way to support calculation of multiple indicators for various purposes.

2) Currently much of the data necessary to calculate the productivity and abundance indicators are collected and stored only on individual computers on a project by project basis. Often, these data are not managed in a way that they are easily transferred to the analysts within an agency, or those external to the agency, who calculate productivity and abundance indicators, including the NOAA calculation of the VSP indicators. Calculation of these productivity and abundance indicators to support basin-wide decision making has not always been a high priority for the state agencies and tribes, sometimes making such calculations more difficult and time consuming than they need to be simply due to the difficulties in assembling the requisite data sets.

3) Improving the data management capacity of the individual state agencies and tribes is the most important step that can be taken towards improving regional data sharing. These improvements can be supported by targeted individual and shared infrastructure investments. These improvements include development of more formal "corporate" data systems to store measurement, metric and indicator data, as well as tools such as field data entry systems that feed data directly to corporate systems. Important gaps identified by agency and tribes in local data management capacity were:

a. Lack of senior management attention/prioritization of data management: From the perspective of senior fisheries managers, the existing data management infrastructure appears to be working. The data necessary for local and agency decision making generally are provided in a timely manner. However, the inefficiencies of the current data systems may be not be apparent to administrators and the inability to share the data beyond the primary decision process has often not been a priority.
b. Lack of dedicated data management staffing: Generally, where data are managed on individual computers or in regional offices on self-contained systems, data management is an add-on task to the biological or information technology personnel within those offices. A lack of investment in data management limits the use of common data dictionaries, methods and protocols when handling the data and makes integration of the data with other systems complicated and difficult.
c. Regional data sharing has been perceived as an unfunded mandate: In most cases data management to support local or agency level decision making has been adequate, but the addition of data management to support regional or Basin-wide decision making may have been viewed as additional work for the state agencies and tribes for the benefit of others.
d. Even though local data management within the agencies has largely been sufficient to meet local and agency management needs, there is a growing interest in improving the efficiency and effectiveness of data management within the agencies.

4) There are inconsistencies in definitions and methodologies applied across the Basin. Inconsistencies in field methodology is not the purview of data management but should be addressed through other forums focused on monitoring. At a minimum, field methods need to be well documented in the metadata accompanying shared indicators to provide context. Methods can be described through www.monitoringmethods.org and then referenced in the metadata. Inconsistencies in terminology should be addressed through widespread adoption and use of a common glossary of terms.

5) There is an ongoing need for coordination and management of regional data sharing issues at two levels: science (content) and technical (information technology). The CA planning group is partially supporting both these roles on an ad hoc basis now. The regional data needs are currently coordinated through NOAA and former TRT members within their own agencies and tribes. Ongoing coordination to support regional data sharing should occur in a more formal way to ensure that all the appropriate entities participate and that regional content is clearly identified. Once the needed content is identified, the data specialists should work together to ensure that data are shared in the most efficient manner.

6) In general, the representatives of the agencies and tribes have been very welcoming to the concept of improved data management to support improved local and basin-wide data sharing. The agencies and tribes identify and understand that improved data management will help them meet their local reporting efforts as well as support their participation in regional or basin-wide reporting needs.

Data Sharing Guidance

Planning and conduct of this CA effort to share VSP indicators drew on recommendations and general guidance contained in 'Considerations for Regional Data Collection, Sharing and Exchange' (Appendix B),

also known as the 'Data Sharing Guide'. The eleven general recommendations proved helpful in developing and implementing the initial effort to share the three VSP indicators.

Roles and Responsibilities:

Because data sharing involves actions at several levels, including data capture by field biologists, management of data within agencies, policy decisions on what data to share and internal data management priorities, and support from funding agencies, the Coordinated Assessments Planning Group was established to include representation from biologists, data management specialists, regional scale data users, and funding entities. Direction was also sought from the CBFWA anadromous fish managers and Members Advisory Group. This was all done to assure that all aspects were considered and the various needs were addressed.

Recommended Actions from the Data Sharing Guide and how they were applied to this effort:

1. Standardize sampling to the degree possible. The actual sampling to collect monitoring data was addressed by a series of workshops that culminated in the Skamania workshop, and is also addressed in the MERR plan. These formed the basis for this initial attempt to share three VSP indicators.
2. Follow existing data management guidance documents. This general advice was not directly relevant to this data sharing effort, but should be considered as agencies move toward development of internal data management capacities.
3. Automate data capture and management, to the degree possible. While this data sharing effort did not address capture of sampling data in the field, this should be considered as an initial step in developing comprehensive approaches to data management within the state and tribal fisheries programs.
4. Use common coding and formatting and describe in a data dictionary. The primary intent of this data sharing effort was to share data so that they can be combined across agencies to address entire populations, regardless of jurisdictions. That required that the indicators and supporting metrics adhere to consistent definitions and formats. A 'Data Exchange Template' (DET) served as a data dictionary to define the variables to be shared and their formats for sharing. This was a key component of this effort, and is an essential part of developing an Exchange Network or any other formalized data sharing strategy where interoperable data are desired.
5. Describe your data so that others can understand and use them. A key aspect of sharing indicators and supporting data is to assure that others who need the data can find them and understand how to use them correctly. This is done through creation of metadata, descriptive information that describes what data are in the data set, how they were collected, what they mean, how they should be used, and how to obtain them. This project included various metadata fields in the DET along with the indicators and metrics.
6. Publish the metadata. A key aspect of sharing indicators and supporting data is to assure that others who need the data can find them and understand how to use them correctly. This is done through creation of metadata: descriptive information that describes what data are in the data set, how they were collected, what they mean, how they should be used, and how to obtain them. This project included various metadata fields along with the indicators and metrics. The ultimate goal of this data sharing effort is to make the metadata and the data available through an Exchange Network or other consistent sharing mechanism. Publishing the metadata where others can find them is a key aspect of enabling people to locate needed data. For the Coordinated Assessment effort, if the resulting indicators and metrics, along with metadata, are shared via the Internet, the initial intent is to share among specific agencies, not to the general public.

7. Assure control over data quality. The CA project advocates that agencies address data quality control through development of their internal data management systems. The initial data sharing effort itself attempted to assure data quality by asking for review by the biologists involved before finalizing the data sharing templates.
8. Prepare a data management plan, and
9. Prepare a data analysis plan. These recommendations were incorporated in this data sharing effort in several ways. One aspect was to work with agency biological staff to create Data Analysis Flow Diagrams that clearly describe how the data are moved through the agency from capture in the field to data analysis. Then, each agency developed data sharing strategies to plan how they would share these indicators and metrics routinely in the future. These strategies can serve as starting points for development of more specific data management plans. In addition, this basin-wide data sharing strategy also constitutes a basic plan for sharing these indicators at a regional scale.
10. Plan to share data. This entire project was based on the need to share indicators and supporting metrics to support basin-wide reporting. The need to share data collected with public funding was clearly recognized as part of this effort.
11. Establish data sharing priorities and policies. While this initial data sharing effort does not constitute a regional data sharing policy, it did establish priorities for the initial data to address in establishing a regionally consistent approach to sharing indicators and metrics in support of regional reporting needs. This represents a first step that should be helpful for the Columbia Basin's fisheries agencies in establishing a consistent approach toward setting priorities and policies for sharing data in the future. As a result of the CA effort, one key recommendation is the formation of a regional science (content) forum and a regional technical (information technology) forum among the participating entities, which would provide the means of addressing data sharing priorities and policies.

Table 1. Populations with filled out DETs from the Coordinated Assessments project, Phase II

164 Populations Assessed 20110801		
Population Name	**Coordinated Assessment Filename**	**CA#**
"East Fork SR, Lemhi, Marsh Creek, Pahsimeroi, MF Clearwater, SF Clearwater, and Upper Salmon Mainstem "	Snake_River_SAR_SpSuC_IDFG_DET_v1.xlsx	88
"John Day River (includes CBFWA John Day Basin Summer Steelhead populations: Upper, Lower, South Fork, Middle Fork, North Fork John Day Summer Steelhead)"	U-JohnDayBasin-ShS-ODFW-2010-DET-A-v1.xlsx	120
"Klickitat River Summer Steelhead, Klickitat River Winter Steelhead "	R_KlickitatR_ShSW_YNFP_2010_DET_V3.xlsx	37
"Snake River Sockeye (Stanley, Petit, Alturas, other lakes)"	R_SnakeRiver_Sockeye_ShoBan_DET_1.xlsx	50
"This John Day Subbasin population aggregate is unlisted. It includes CBFWA John Day Basin Summer Steelhead populations: Upper, Lower, South Fork, Middle Fork, North Fork John Day Summer Steelhead."	U-JohnDayRiverBasin-ChS-ODFW-2010-DET-A-v1.xlsx	121
American River Spring Chinook	R_AmericanR_ChS_YNFP_2009_DET_V3.xlsx	27
Bear Valley	Bear Valley_Cr_SpSuChinook_IDFG_DET_1.xlsx	1
Bear Valley Creek Spring/Summer Chinook	R_BearValleyCreek_Ch_ShoBan_DET_V1.xlsx	28
Big Creek	Big Creek_SpSuC_IDFG_DET_v1.xlsx	2
Big Creek Winter Steelhead	R_Big_Creek_SthdW_DET_ODFW_2008_A_v1.xlsx	157
Camas Creek	Camas Creek_SpSuC_IDFG_DET_1.xlsx	3
Camas Creek Spring/Summer Chinook	R_CamasCreek_ChSS_ShoBan_DET_1.xlsx	29
Catherine Creek Spring Chinook	R_Catherine_Creek_Spring_Chinook_CTUIR_2011_HDET_ApproachA_V1.xlsx	30
Catherine Creek Spring Chinook	R_Catherine_Creek_Spring_Chinook_CTUIR_2011_NDET_ApproachA_V2.xlsx	31
Catherine Creek Spring Chinook	U_CatherineCreek-ChSS-DET-4.xls	93
Chamberlain Creek	Chamberlain_SpSuC_IDFG_DET_1.xlsx	5
Chewach River Spring Chinook	R2-Chewuch-ChSp-WDFW-DET.xlsx	141
Chiwawa Spring Chinook	R2-Chiwawa-ChSp-WDFW-DET.xlsx	142
Clackamas River Coho	U_Clackamas_Coho_DET_ODFW_2008_A_v1-In.xlsx	163
Clatskanie River Fall Chinook	U_Clatskanie_ChF_ODFW_2006_DET_A_v1-In.xlsx	164
Clearwater River Lower Mainstem Summer Steelhead	Lower Clearwater_STH_IDFG_DET_v2.xlsx	18
Columbia Estuary_Clatskanie Winter Steelhead (Late)	R_Clatskanie_SthdW_DET_ODFW_2008_A_v2.xlsx	158
Columbia Gorge Tributaries Winter Steelhead	U_UC_Gorge_Tribs_WSH_DET_ODFW_A_v1-In.xlsx	170
Deschutes River Fall Chinook	U-DeschutesRiver-ChF-CTWSRO-2010-DET-A-v1.xlsx	107
Deschutes River Westside Tributaries Summer Steelhead	U-DeschutesTributariesWestside-ShS-CTWSRO-2010-DET-a-v1.xlsx	108
Deschutes Westside Tributaries Summer Steelhead	U-DeschutesTributariesWestside-ShS-ODFW-MidC-2009-DET-a-v1.xlsx	109
East Fork Salmon River	East Fork Salmon_SpSuC_IDFG_DET_v2.xlsx	6
East Fork Salmon River	R_EFSR_STH_IDFG_DET_v2.xlsx	34
East Fork Salmon River Spring Chinook	R_EastForkSalmon_ChSS_ShoBan_DET_1.xlsx	33
Entiat River Late-Run Chinook	R-Entiat-ChSu-USFWS-DET.xlsx	155
Entiat River Spring Chinook	R-Entiat-ChSp-USFWS-DET.xlsx	154
Entiat Summer Steelhead	R-Entiat-ShSu-USFWS-DET.xlsx	156
Fifteenmile Subbasin Winter Steelhead	U_Fifteenmile-ShW-ODFW-DET-V2.xls	94
Granite Creek Spring Chinook	U-JohnDayRiverGC-ChS-ODFW-2010-DET-A-v1.xlsx	122
Hood River Coho	U-HoodRiver-Co-CTWSRO-2010-DET-A-v2.xlsx	114
Hood River Coho	U-HoodRiver-Co-ODFW-2009-DET-A-v2.xlsx	115
Hood River Fall Chinook	U-HoodRiver-ChF-CTWSRO-2010-DET-A-v2.xlsx	110

164 Populations Assessed 20110801		
Population Name	**Coordinated Assessment Filename**	**CA#**
Hood River Fall Chinook	U-HoodRiver-ChF-ODFW-2009-DET-A-v2.xlsx	111
Hood River Spring Chinook	U-HoodRiver-ChS-CTWSRO-2010-DET-A-v2.xlsx	112
Hood River Spring Chinook	U-HoodRiver-ChS-ODFW-2009-DET-A-v2.xlsx	113
Hood River Summer Steelhead	U-HoodRiver-ShS-CTWSRO-2010-DET-A-v2.xlsx	116
Hood River Summer Steelhead	U-HoodRiver-ShS-ODFW-2009-DET-A-v2.xlsx	117
Hood River Winter Steelhead	U-HoodRiver-ShW-CTWSRO-2010-DET-A-v2.xlsx	118
Hood River Winter Steelhead	U-HoodRiver-ShW-ODFW-2010-DET-A-v2.xlsx	119
Imnaha River Mainstem Spring/Summer Chinook	U_Imnaha-ChSS-DET-ODFW-v3.xls	95
Imnaha River Summer Steelhead	R-ImnahaCowCreek-ShS-2011-NPT-DET-v2.xlsx	71
Imnaha River Summer Steelhead	R-ImnahaHorseCreek-ShS-2011-NPT-DET-v2.xlsx	72
Imnaha River Summer Steelhead	R-ImnahaLightningCreek-ShS-2011-NPT-DET-v2.xlsx	73
Joseph Creek Summer Steelhead	R-JosephCrk-ShS-NPT-DET-v1.xlsx	74
Joseph Creek Summer Steelhead	U_JosephCk-ShSS-ODFW-DET-2.xls	96
Klickitat River Spring Chinook	R_KlickitatR_ChS_YNFP_2010_DET_A_Total_V4.xlsx	35
Klickitat River Spring Chinook	R_KlickitatR_ChS_YNFP_2010_DET_A_Wild_V4.xlsx	36
Lawyer Creek	LawyerCreek_(ClearCreek)_SpSuC_IDFG_DET_3.xlsx	7
Lemhi Creek	Lemhi_SpSuC_IDFG_DET_v2.xlsx	8
Lemhi River Summer Steelhead	R_Lemhi_STH_IDFG_DET_v2.xlsx	38
Little Salmon	Little-Salmon_SpSuC_IDFG_DET_v_1.xlsx	10
Little Salmon and Rapid Rivers Steelhead	Little_Salmon_STH_IDFG_DET_v3.xlsx	9
Little Wenatchee Spring Chinook	R2-Little Wenatchee-ChSp-WDFW-DET.xlsx	144
Lochsa River	Lochsa_(CrookedForkCreek)_SpSuC_IDFG_DET_V3.xlsx	12
Lochsa Steelhead	Lochsa_STH_IDFG_DET_v3.xlsx	13
Lolo Creek Spring Chinook	R-LoloCrk-ChSS-2010-NPT-DET-v2.xlsx	75
Lolo Creek Summer Steelhead	R-LoloCrk-ShS-2011-NPT-DET-v1.xlsx	76
Lookingglass creek spring Chinook	Lookingglass_Creek_Spring_Chinook_CTUIR_2011_HDET_ApproachA_V1.xlsx	15
Lookingglass creek spring Chinook	Lookingglass_Creek_Spring_Chinook_CTUIR_2011_NDET_ApproachA_V1.xlsx	16
Loon Creek	Loon Creek_SpSuC_IDFG_DET_1.xlsx	17
Loon Creek Spring/Summer Chinook	R_LoonCreek_ChSS_ShoBan_DET_1.xlsx	39
Lower John Day River Summer Steelhead	U-JohnDayRiverL-ShS-ODFW-Mid-C-2010-DET-B-v1.xlsx	124
Lower Middle Fork Salmon River Summer Steelhead	LMFSR_STH_IDFG_DET_v2.xlsx	11
Lower Middle Fork Salmon River Summer Steelhead	R-SalmonLowerMF-ShS-2011-NPT-DET-v1.xlsx	78
Lower North Fork Clearwater	Lower-North-Fork-SpSuC-IDFG-DET_v_1.xlsx	20
Lower Salmon Mainstem below Redfish Lake	Lower Salmon Mainstem_SpSuC_IDFG_DET_1.xlsx	19
Lower Yakima River Fall Chinook	R_YakimaL_ChF_YNFP_2009_DET_V3.xlsx	64
Mainstem above Indian Creek	Mainstem-AboveIndianCreek_SpSuC_IDFG_DET_v2.xlsx	21
Marsh Creek SpSu Chinook	Marsh_Creek_SpSuC_IDFG_DET_V2.xlsx	23
Meadow Creek Spring/Summer Chinook	R-MeadowCrk-ChSS-2011-NPT-DET-v1.xlsx	77
Methow Mainstem River Spring Chinook	R2-Mainstem-Methow-ChSp-WDFW-DET.xlsx	145
Methow River Summer/Fall Chinook	R2-Methow-ChSu-WDFW-DET.xlsx	146
Methow Summer Steelhead	R2-Methow-ShSu-WDFW-DET.xlsx	147
Middle Fork John Day River Spring Chinook	U-JohnDayRiverMF-ChS-ODFW-2010-DET-A-v1.xlsx	125
Middle Fork John Day River Summer Steelhead	U-JohnDayRiverMF-ShS-ODFW-2010-DET-A-v1.xlsx	126
Middle Fork John Day River Summer Steelhead	U-JohnDayRiverMF-ShS-ODFW-Mid-C-2010-DET-B-v1.xlsx	127
Minam River Spring Chinook	U_Minam-ChSp-ODFW-DET-A1-V2.xls	97
Naches River Spring Chinook	R_NachesR_ChS_YNFP_2009_DET_V3.xlsx	40
Nason Spring Chinook	R2-Nason-ChSp-WDFW-DET.xlsx	148
North Fork John Day River Spring Chinook	U-JohnDayRiverNF-ChS-ODFW-2010-DET-A-v1.xlsx	128

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Population Name	**Coordinated Assessment Filename**	**CA#**
North Fork John Day River Summer Steelhead	U-JohnDayRiverNF-ShS-ODFW-2010-DET-A-v1.xlsx	129
North Fork John Day River Summer Steelhead	U-JohnDayRiverNF-ShS-ODFW-Mid-C-2010-DET-B-v1.xlsx	130
North Fork Salmon River	North-Fork-Salmon_SpSuC_IDFG_DET_v1.xlsx	24
North Fork Salmon River	R_NFSalmonR_STH_IDFG_DET_v2.xlsx	41
Okanogan River Sockeye	R_Okanogan_S_NSA_CCT_2010_DET_A_V2.xlsx	44
Okanogan River Spring Chinook	R_Okanogan_ChSp_NSA_CCT_2008_DET_A_V3.xlsx	43
Okanogan River Summer Steelhead	R_Okanogan_ShS_CCT_2010_DET_2.xlsx	45
Okanogan River Summer/Fall Chinook	R_Okanogan_ChSF_NSA_CCT_2008_DET_A_V3.xlsx	42
Okanogan Summer Steelhead	Okanogan-ShSu-WDFW-DET.xlsx	138
Okanogan Summer/Fall Chinook	R2-Okanogan-ChSu-Bioanalysts-DET.xlsx	149
Pahsimeroi	Pahsimeroi_SpSuC_IDFG_DET_v2.xlsx	25
Pahsimeroi River Summer Steelhead	R_Pahsimeroi_STH_IDFG_DET_v1.xlsx	46
Panther Creek Chinook Spring/Summer	R_PantherCreek_ChSS_ShoBan_DET_2010.xlsx	47
Potlatch River	Potlatch_SpSuC_IDFG_DET_v_1.xlsx	26
Salmon River Upper Mainstem above Redfish Lake Spring/Summer Chinook	R_UpperSalmon_ChSS_ShoBan_DET_1.xlsx	61
Sandy Fall Chinook (Late)	U_Sandy_ChF__DET_ODFW_2006_A_1-In.xlsx	166
Sandy Fall Chinook (Late)	U_Sandy_ChF_DET_ODFW_2004_A_v1-In.xlsx	167
Sandy River Spring Chinook	U_Sandy_ChS_DET_ODFW_2008_A_v1-In.xlsx	168
Sandy River Winter Steelhead	U_Sandy_SthdW_DET_ODFW_2008_A_v1-In.xlsx	169
Scappoose Creek Winter Steelhead	R_Scappoose_SthdW_DET_ODFW_2008_A_v2.xlsx	159
Secesh River Spring/Summer Chinook	R-Secesh-ChSS-2010-NPT-DET-v1.xlsx	81
Secesh River Summer Steelhead	R-Secesh-ShS-2011-NPT-DET-v1.xlsx	82
Shitike Creek Spring Chinook	U-ShitikeCreek-ChS-CTWSRO-2010-DET-A-v2.xlsx	136
Snake River Sockeye	Snake_River_Sockeye_IDFG_DET_v2.xlsx	89
South Fork Clearwater	SF Clearwater_Crooked River_SpSuC_IDFG_DET_v3.xlsx	86
South Fork Clearwater	SF Clearwater_Red River_SpSuC_IDFG_DET_3.xlsx	87
South Fork Clearwater River Summer Steelhead	R-ClearwaterSF-ShS-2011-NPT-DET-v1.xlsx	69
South Fork Clearwater Summer Steelhead	R_SFClearwater_STH_IDFG_DET_v2.xlsx	48
South Fork John Day River Summer Steelhead	U-JohnDayRiverSF-ShS-ODFW-2010-DET-A-v1.xlsx	131
South Fork John Day River Summer Steelhead	U-JohnDayRiverSF-ShS-ODFW-Mid-C-2010-DET-B-v1.xlsx	132
South Fork Salmon	South Fork Salmon_SpSuC_IDFG_DET.xlsx	90
South Fork Salmon River Spring/Summer Chinook	R-SalmonSFMain-ChSS-2010-NPT-DET-v2.xlsx	79
South Fork Salmon River Summer Steelhead	R_SFSalmon_STH_IDFG_DET_v2.xlsx	49
South Fork Salmon River Summer Steelhead	R-SalmonSF-ShS-2011-NPT-DET-v1.xlsx	80
Sulphur Creek	Sulphur_Creek_SpSuC_IDFG_DET_1.xlsx	91
Touchet River Summer Steelhead	Touchet_River_Summer_Steelhead_CTUIR_2011_DET_ApproachA_V1.xlsx	92
Twisp River Spring Chinook	R1-Twisp-ChSp-WDFW-DET.xlsx	139
Umatilla River Coho	R_Umatilla_Coho_CTUIR-ODFW_2011_DET_ApproachA_V3.xlsx	51
Umatilla River Fall Chinook	R_Umatilla_Fall_Chinook_CTUIR-ODFW_2011_NDET_ApproachA_V2.xlsx	53
Umatilla River Spring Chinook	R_Umatilla_Spring_Chinook_CTUIR-ODFW_2011_HDET_ApproachA_V1.xlsx	54
Umatilla River Spring Chinook	R_Umatilla_Spring_Chinook_CTUIR-ODFW_2011_NDET_ApproachA_V2.xlsx	55
Umatilla River Summer Steelhead	R_Umatilla_Summer_Steelhead_CTUIR-ODFW_2011_HDET_ApproachA_V1.xlsx	56
Umatilla River Summer Steelhead	R_Umatilla_Summer_Steelhead_CTUIR-ODFW_2011_NDET_ApproachA_V2.xlsx	57
Upper Grande Ronde Spring Chinook	R_Upper_Grande_Ronde_Spring_Chinook_CTUIR_2011_HDET_ApproachA_V1.xlsx	58
Upper Grande Ronde Spring Chinook	R_Upper_Grande_Ronde_Spring_Chinook_CTUIR_2011_NDET_ApproachA_V2.xlsx	59
Upper Grande Ronde Spring Chinook	R_UpperGrandeRonde_ChSS_ODFW_DET_V4.xls	60
Upper Grande Ronde Summer Steelhead	Catherine_Creek_Summer_Steelhead_CTUIR_2011_DET_ApproachA_V3.xlsx	4

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Population Name	**Coordinated Assessment Filename**	**CA#**
Upper Grande Ronde Summer Steelhead	U_UpperGrandeRonde-ShSS-ODFW-DET-4.xls	98
Upper Grande Ronde Summer Steelhead	Upper_Grande_Ronde_Summer_Steelhead_CTUIR_2011_DET_ApproachA_V3.xlsx	101
Upper John Day River Summer Steelhead	U-JohnDayRiverL-ShS-ODFW-2010-DET-A-v1.xlsx	123
Upper John Day River Summer Steelhead	U-JohnDayRiverU-ShS-ODFW-2010-DET-A-v1.xlsx	134
Upper John Day River Summer Steelhead	U-JohnDayRiverU-ShS-ODFW-Mid-C-2010-DET-B-v1.xlsx	135
Upper Mainstem John Day River Spring Chinook	U-JohnDayRiverU-ChS-ODFW-2010-DET-A-v1.xlsx	133
Upper North Fork Clearwater	Upper-NF-Clearwater_SpSuC_IDFG_DET_v-1.xlsx	102
Upper Salmon Mainstem	R_USRMA_STH_IDFG_DET_v2.xlsx	62
Upper Salmon Mainstem above Redfish Lake	Upper Salmon Mainstem_SpSuC_IDFG_DET_v2.xlsx	100
Upper Selway	Selway_SpSuC_IDFG_DET_v_1.xlsx	85
Upper South Fork Clearwater River Spring/Summer Chinook	R-ClearwaterUpperSF-ChSS-2010-NPT-DET-v2.xlsx	70
Upper Yakima River Spring Chinook	R_YakimaU_ChS_YNFP_2009_DET_SAR2_V4.xlsx	65
Upper Yakima River Spring Chinook	R_YakimaU_ChS_YNFP_2009_DET_V4.xlsx	66
Valley Creek	Valley_Creek_SpSuC_DET_v_1.xlsx	103
Valley Creek Spring/Summer Chinook	R_ValleyCreek_ChSS_ShoBan_DET_1.xlsx	63
Walla Walla River Sumer Steelhead	Walla_Walla_Summer_Steelhead_CTUIR_2011_DET_ApproachA_V4.xlsx	105
Walla Walla Spring Chinook	Walla_Walla_Spring_Chinook_CTUIR_2011_DET_ApproachA_V3.xlsx	104
Wallowa - Lostine River Spring Chinook	R_DET_WallowaLostine_ChSS_ODFW_V4.xls	32
Wallowa River Summer Steelhead	R-Wallowa-ShS-NPT-DET-v1.xlsx	84
Wallowa-Lostine River Spring/Summer Chinook	R-WallowaLostine-ChSS-2009-NPT-DET-v2.xlsx	83
Warm Springs River Spring Chinook	U-WarmSpringsRiver-ChS-CTWSRO-2010-DET-A-v2.xlsx	137
Wenaha River Spring/Summer Chinook	U_Wenaha-ChSS-ODFW-DET-v4.xls	99
Wenatchee River Late-Run Chinook	R2-Wenatchee-ChSu-WDFW-DET.xlsx	151
Wenatchee River Sockeye	R2-Wenatchee-Sock-WDFW-DET.xlsx	152
Wenatchee River Spring Chinook	R2-Upper Wenatchee-ChSp-WDFW-DET.xlsx	150
Wenatchee River Summer Steelhead	R1-Wenatchee-ShSu-WDFW-DET.xlsx	140
Wenatchee Spring Chinook (Leavenworth NFH)-Hatchery	R2-Icicle-ChSp-WDFW-DET.xlsx	143
White River Spring Chinook	R2-White-ChSp-WDFW-DET.xlsx	153
Yakima River Group Summer Steelhead Aggregate	R_YakimaU_Naches_Status_Toppenish_ShS_YNFP_2009_DET_V3.xlsx	67
Yankee Fork	Yankee Fork_SpSuC_IDFG_DET_1.xlsx	106
Yankee Fork Spring/Summer Chinook	R_YankeeFork_ChSS_ShoBan_DET_1.xlsx	68
Youngs Bay Winter Steelhead	R_Youngs_Bay_SthdW_DET_ODFW_2008_A_v2.xlsx	160

Table 2. Summary of DET statistics from the Coordinated Assessments Phase II.

Statistic	Value
Number of populations reviewed & documented & DETs loaded into database (2 did not load: U_Clackamas_ChS 2008 A&B)	164
Number of extinct populations reviewed & documented. These were not included in the 164 loaded	8
Number (percent of 164) of populations that provided an indicator estimate for: Natural origin spawner abundance [2-E10] [#18 had two values but counted here as one] Smolt to adult ratio [3-E10] [#81 had value of "1,191"] Recruits per spawner[4-E10] [#150 had value of 0.00, 14 were negative, 6 values included %sign while 69 did not]	 95 (58 %) 48 (29 %) 75 (46 %)
Percentage of NOSA indicators representing the complete population [2-A6] [85 Yes, 36 No and 46 Null values]	52%
Of populations having indicator estimates, the percentage that have a confidence interval: a. Natural origin spawner abundance [2-E13][7 ranges, 12 "Unknown if calc.", 59 "Not Calc.", 4 "range", 1 "total census"] b. Smolt to adult ratio [3-E13]: (1 %) [2 had standard error values, 2 indicated in process of calc., 8 included comments] c. Recruits per spawner[4-E14]: (0 %) [10 unknown if calc., 48 not calculated, rest NULL]	 4% 1% 0%
Number (percentage) of populations where smolt abundance was given [3-E20]	62 (38 %)
Number (percentage) of populations where any of the Methods included at least one reference to www.monitoringmethods.org [3 made over 15 references, 15 made 2 to 7 references and 11 made a single reference]	29 (18 %)

Appendix B

WHITE PAPER

Considerations for Regional Data Collection, Sharing and Exchange

Bruce Schmidt, StreamNet Program Manager
and
The StreamNet Steering Committee

June 1, 2009

BACKGROUND and PURPOSE

The need to share environmental data has grown significantly due to multi-agency programs like ESA recovery and shared management responsibilities. Agencies and projects collect data for their specific needs, but wider scale programs often require shared data from multiple sources. Data should be maintained and accessible for long term use and not lost when a project ends or staff changes. Achieving these ends will require action at various levels from the field to policy.

Environmental data are time consuming and expensive to collect, and should be utilized to the greatest advantage in managing and enhancing resources. To accomplish that goal, data need to be available for wider use beyond their initial local purpose. Public funding of sampling further emphasizes the need to make the resulting data available to others and the public. This guide outlines basic actions needed by various entities from data collection in the field to agency programs, funding programs, and policy levels to facilitate wide scale sharing and use of data. These recommendations are also summarized as checklists in Appendix C.

This is a general guide, independent of the purpose or use of the data, intended as a "nuts and bolts" description of the steps needed to establish a comprehensive approach to data sharing. The focus is more on the container than the contents. It is intended to provide a checklist of all aspects of data creation and use, even though many agencies and projects may already be adept at various aspects of it. It can inform development of new data management approaches and systems, or allow comparison of existing systems to these recommended components. The guide does not prescribe specific actions but attempts to list the issues and discuss the various paths available for addressing them. It relates to data sharing approaches as they currently are.

Ideally, in the future data sharing will become a routine part of wide-scale, multi-agency monitoring programs rather than the current more *ad hoc* sampling.

ROLES AND RESPONSIBILITIES

Various entities have roles and responsibilities in effective data sharing. Executives at the regional policy level need to make basic decisions about priorities (which data should be shared) and provide specific policy guidance. Funding entities, including regional and federal agencies, can negotiate the specifics of data creation, management and sharing and enforce them in contracts. Agencies that conduct data creation in the field are responsible for meeting their statutory mandates and providing guidance and resources to their field staff for applying agency and regional policy and funding entity guidance. Individual field samplers are responsible for implementing that guidance as data are created. The individual sampler and data creating agency roles are closely aligned. And, regional scale database management projects can provide technical services and perform many required data sharing functions.

- Agencies and field samplers.

Many agencies and programs collect environmental data in support of their missions and mandates, including state, tribal and federal fish and wildlife agencies and programs, state and federal environmental quality agencies, state and federal land management agencies, etc. The sampling is done in the field by various agency staff, project staff or consultants. Many of the sampling and data management recommendations discussed here are influenced by agency policies, support capabilities and internal requirements. Agency policy should also provide guidance to their respective sampling projects in order to implement these guidelines.

Due to different purposes, different environments, and historic data, it will not always be possible to standardize sampling and data management among agencies, even though that would simplify data consolidation and sharing. There may be several ways for agencies to implement these recommendations. Therefore these recommendations are intended to urge samplers and agencies toward maximizing standardization to the degree practicable, but to managing the data to facilitate consolidation and sharing when standardization is not feasible or possible. Where preexisting requirements (agency, funder or legal) are in effect, they should take precedence over this general guidance. This guide is intended to provide recommendations to fill the gap where no specific requirements are currently in place or being followed. It may also be used by organizations that currently have data management systems and guidance in place as a means to compare and evaluate existing practices, and to potentially supplement or streamline processes.

- Funding entities

Various agencies and entities fund field sampling to create environmental data. For this guide, funder recommendations relate to entities that provide contract funds to others to do work, such as the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program funded by the Bonneville Power Administration (BPA), state programs (Oregon Watershed Enhancement Board (OWEB), Washington Salmon Recovery Fund Board (SRFB), etc.), federal programs (Pacific Coast Salmon Recovery Fund (PCSRF)) and individual federal agencies that fund work outside their agency (e.g., Environmental Protection Agency (EPA), U.S. Forest

Service (FS), Bureau of Land Management (BLM), etc.) Work done within these agencies by agency staff would be considered under the Agencies and Field Samplers sections.
All entities that fund environmental sampling have the ability to negotiate or establish specific requirements. These may relate to agency mandates, policies, legislation, and technical considerations. In some cases it may be appropriate to negotiate sampling methodology to meet each party's data needs. Funding entities may wish to specify data management requirements in contract language to assure that data are maintained and shared appropriately and not lost at the end of a project. Such language could apply to all projects to assure compliance with national programs (such as feeding water quality data to a national database), or be project specific. Language could be original, or could reference one or more published documents. Contracts could include relevant recommendations from this guidance document, with recognition that there may be multiple means to accomplishing these objectives, and different procedures may be appropriate for different kinds of environmental data or agencies.

- Policy level

Policy level guidance relates to decisions made at the executive level by the heads of involved state, tribal, federal and regional entities. Since a goal is to establish regional consensus on monitoring programs and data sharing, a collaborative approach to establishing formal data management and sharing guidance is important. Any policy level collaborative group should include the agencies and organizations that create environmental data, use data collected by others, and fund monitoring and data management activities. Policy level issues may include setting priorities for which kinds of data to be shared and addressing other policy level questions, including those posed later in this guide.

- Database management projects

A number of regional scale database management projects are available to provide advice and data management services (see Table 1 for a partial list). These usually specialize in specific kinds of data or meeting specific program needs. In some cases, these projects can perform data management and sharing tasks for other projects and agencies, and can be consulted to take advantage of their technical expertise. Incremental costs for these services may often be lower than developing similar expertise or capability in house.

RECOMMENDED ACTIONS

The following actions represent a series of recommendations or steps to consider as part of a comprehensive approach to data management and data sharing. Many actions can have several suitable approaches or options. In some cases, one approach may be identified as best or ideal, but final decisions may depend on the specific needs or capabilities of a given agency or project. The various entities often have different rolls within each recommended action.

1. Standardize sampling to the degree possible

Many different agencies and projects collect similar kinds of data, but often with different objectives, approaches or methods. This reflects the longstanding nature of many monitoring programs, individual agency mandates, different purposes for sampling (addressing different questions), and the need to function effectively in local conditions. At the same time, broad scale issues like ESA recovery, subbasin planning and multi-jurisdictional management are best served when relevant data from all sources can be combined and analyzed seamlessly.

There is growing regional interest in employing common sampling methods among agencies to facilitate comparability and sharing of like kinds of data, but adopting field methods that adhere to regionally recommended protocols may require altering existing, sometimes longstanding sampling approaches. Agencies need to decide whether to ask their field staff to adopt regionally recommended sampling methods or to maintain existing practices.

Complete standardization is difficult to achieve due to variability in the purposes for sampling and the environments being sampled. Also, absolute adherence to standards can stifle innovation or improvement of methods. However, actions to limit the number of acceptable sampling protocols, both within and between agencies, and fully describing the sampling protocols used would significantly ease compilation of data sets from multiple sources and enhance data compatibility for broader scale use. The recommended approach is to participate in appropriate wide scale collaborative efforts to establish agreements on a limited number of sampling methodologies. Alternatively, field sampling could be consolidated into regionally agreed upon coordinated monitoring programs, also developed through a collaborative process. Collaborative efforts will require participation by all interested parties, including the agencies that conduct field sampling and the entities that utilize data from multiple sources,

- Agency actions:
    - To maximize data comparability, sampling agencies should utilize consistent sampling methodology to the greatest degree practicable. Ideally, methods should at least be standardized within each agency. The goal should be to provide the most consistent and useful information at an agency and a regional scale.
    - If agencies can not or choose not to adopt regionally recommended standard sampling protocols, they should make that decision known so that regional emphasis can shift to focus on means to consolidate the data produced by different methodologies.
    - Provide agency perspective and expertise by participating in collaborative regional efforts to recommend standard sampling protocols or create coordinated monitoring programs. Collaborative efforts should serve to select a limited set of recommended appropriate methodologies.

- Field sampler actions:
    - Follow agency guidance and adhere to established sampling protocols and methods as much as possible. Avoid developing new sampling approaches independently. If this is unavoidable, then modified or newly created protocols should be described and provided to regional collaborative bodies for review and evaluation.
    - Describe and document the specific sampling protocols or method manuals you followed in all publications and data descriptions. Prototype tools are being developed at the PNW regional scale that should simplify this task (e.g., PNAMP

Protocol Manager). If sampling is done consistently, then describing the method is a one-time effort.
    - Record any adjustments to or deviations from established sampling protocols. Many things can affect actual sampling, such as weather, equipment malfunction, flow, changes, etc., and any resultant changes to standard approaches must be recorded so that subsequent users of the data can understand the context.

- Funder actions:
    - If project data are to be shared, funders should negotiate with project sponsors to ensure sampling methodology meets funder and sponsor needs and is appropriate for the sampling environment. Contract language can be used to assure agreed methods are used.

2. Follow existing data management guidance documents

Data management standards relate to how data are defined, coded, error-checked, documented, recorded, published and shared. Consistent use of established standards simplifies and improves the ability to combine and share data. Currently available guidance includes "Best Practices" documents for reporting location and time information (http://www.nwcouncil.org/ned/time.pdf), for creating a data dictionary (http://www.nwcouncil.org/ned/DataDictionary.pdf), and for developing a data management plan (http://www.nwcouncil.org/ned/Checklist.pdf). Participation in collaborative groups to create additional guidelines and standards is encouraged. These standards relate to common types of information that describe or qualify the sampling effort. They do not dictate the specific environmental metrics to be measured.

- Agency actions
    - Adopt specific Best Practices recommendations as standard procedure for agency staff.

- Funder actions
    - If adherence to specific Best Practices is important to the project, contract language can be used to specify required practices.

- Field sampler actions
    - Follow the Best Practices for managing data as specified by agency and funder.

3. Automate data capture and management, to the degree possible

Computerized data capture and management is becoming cheaper and more effective, reliable, and efficient. Ideally, data should be entered into electronic format in the field or immediately afterward, and then flow into an agency-wide data system. Such systems provide multiple benefits at all levels: immediate and accurate data entry; data validation on entry; automatic generation of metadata; local control over data management and updates; canned analyses or standard outputs to analysis programs, canned reports at the field and agency levels; automatic data consolidation agency-wide; support for comprehensive analysis at the agency level; and automatic translation and output into regional data sharing formats.

Costs for developing systematic approaches to data management are decreasing, and often the largest challenge isn't expense but expanding the data management focus to an agency-wide perspective. Concepts (and sometimes computer code) can be obtained from agencies already using the technology and adapt it for use. Assistance from regional database projects is often available to organizations planning and developing data management systems.

- Agency actions
  - Work toward developing comprehensive data management systems for the high priority types of data for the agency. These can include field data entry devices, data validation routines, agency wide databases, etc. An iterative, modular approach by data type would be least expensive and is recommended.
  - Adopt a partnership approach between biological staff and IT specialists to design and construct agency wide data systems and other tools.

- Field sampler actions
  - Field test data input devices at the field level, as they become available. Participate in system development as opportunities arise. Field level input is critical to ultimate system success. Provide feedback early in system development and testing.
  - Adopt use of tools to input data in the field or immediately after collection.

- Funder actions
  - Support agency efforts to deploy field data collection tools and develop consolidated data systems, since these will be critically important and are prerequisites to feeding data into any regional scale data sharing approach.

- Database project actions
  - Develop field data capture applications on request of agencies.
  - Assist agencies with design and programming of agency database systems and tools.

4. Use common coding and formatting, and describe in a data dictionary

Many agencies have established code lists for common sampling elements (for example, species) that may be mandatory. There are few code lists adopted among agencies, however. In the absence of agreed-upon region-wide coding systems, some database projects have developed systems to support combining and storing data from multiple sources for dissemination. Examples include StreamNet's (www.streamnet.org) "Data Exchange Format" and the Pacific Northwest Water Quality Data Exchange's (http://www.ecy.wa.gov/pnwdx/pnwdx_main.htm) "Data Exchange Template," and there are specific standards for managing coded wire tag and PIT tag data established by the Regional Mark Processing Center (http://www.rmpc.org/) and the PIT Tag Information System (http://www.ptagis.org/), respectively.

For new sampling programs collecting data elements that are already included in a regional exchange format or regional database system, we recommend use of that coding and format system. For sampling efforts already using other formats, project sponsors should work with the appropriate database project (Table 1) to ensure that the data can be output in a common

exchange format for data sharing. For data types without adopted regional scale formats, participation in collaborative efforts to develop common coding and formats is encouraged. It is important that data are defined consistently within and among agencies, and this is simplified by utilization of agency-wide data systems. Some apparently similar data types can be incompatible if defined differently, for example, using different length and diameter definitions of what constitutes "Large Woody Debris." To maintain efficiency, it would be helpful to prioritize which attributes are most important to standardize for sharing on a wide-scale perspective. If at all possible, new coding systems and data definitions should not be created, but should be adopted from existing efforts.

Most critically, all data definitions and codes should be described in a data dictionary for each data set. This is simplified if each type of data is standardized within the agency, requiring only one dictionary for each type of sampling. A data dictionary is a critical component for describing a data set and making it understandable to others. The dictionary needs to include definitions of all data elements plus information on units of measure, format, field sizes, acceptable values; data coding and lookup tables; and information about the table structure and relationships if in a relational database. Additional information about developing data dictionaries can be obtained from *Best Practices for Data Dictionary Definitions and Usage* (http://www.nwcouncil.org/ned/DataDictionary.pdf) or a regional database project.

- Agency actions
    - Utilize standard code lists for common data elements within the agency.
    - Develop agency wide code lists and data dictionaries, by type of sampling.
    - When adopting new code lists, work with other agencies to adopt a common set of codes that are consistent among agencies. Try not to create any new, individual data coding systems.

- Field sampler actions
    - Adhere to standard code lists as established by your agency.
    - When developing new code lists, work with others to adopt a regionally consistent set of codes. Try not to create any new individual data coding systems.
    - Follow the appropriate agency data dictionaries, or if there aren't appropriate ones for your type of sampling, develop a data dictionary for each data set.
    - Provide a copy of (or link to) the data dictionary in the metadata (Recommended Action 5).

- Database project actions
    - Provide agencies and projects with existing data definition and code lists, as requested.
    - Assist agencies and projects with development of data dictionaries, as requested and within the scope of the data types addressed by the database project.

- Funder actions
    - Address any need for specific data coding and a data dictionary through negotiation with the project sponsor. Specific needs can be included in contract language related to metadata (Recommended Action 5).

5. Describe your data so that others can understand and use them

For every data set there should be a set of descriptive information that allows others to fully understand the data and how to use them. Such descriptive information, or data about the data, is referred to as "metadata." This is a technical requirement of all approaches to automate data transfer. Metadata includes information about who collected the data, what data were collected, how the data were collected, how the data elements are defined and coded, what purpose they serve, where and when they were collected, and where the data reside and can be accessed.

For geographic data for use in a GIS, the data should adhere to the minimum metadata standards as prescribed by the Federal Geographic Data Committee (FGDC, www.fgdc.gov/metadata), which should be familiar to all GIS professionals. Tabular biological data should be described following the FGDC Biological Data Profile. Descriptions of various metadata creation tools are available through National Biological Information Infrastructure (NBII) of USGS at http://metadata.nbii.gov/portal/community/Communities/Toolkit/Metadata/FGDC_Metadata/Tools/

These standards indicate that only a small portion of potential metadata is absolutely required, but minimal required data often don't provide sufficient information. We recommend a somewhat larger set of minimal metadata (Appendix A). Full metadata would be even more useful and would minimize subsequent requests for additional information about a data set, but full metadata is not required by FGDC. The amount of metadata required could be scaled based on regional priorities for sharing specific kinds of data. Assistance with developing metadata is available from NBII at http://www.nbii.gov/portal/community/Communities/Toolkit/Metadata/ and from regional database projects for specific types of data (Table 1). Agency-wide data systems would be useful in automating creation of metadata.

- Agency actions
    - Adopt as agency standard practice that all data sets should be accompanied by descriptive information (metadata).
    - Phase in the requirement for metadata. The task of creating metadata only appears daunting at first. Once a few data sets have been described it becomes much simpler to create metadata for additional data sets because the majority of descriptive fields can simply be copied over from existing metadata.
    - Metadata for existing or historic datasets can be developed sequentially over time. Note that much of the metadata can be cut and pasted from previous sets of metadata, making the job easier over time, as only the differences need to be newly described.

- Field sampler actions
    - Include a set of descriptive information with all data sets. Note that after one data set has been described, it is often possible to simply copy the descriptions for additional data sets, with only a few basic pieces of information like location or species changing. Updating descriptive information in subsequent years is often simply a matter of adjusting dates and describing any unusual events for the subsequent year.

- Funder actions
    - Contract language can be used to require that metadata be prepared and supplied with data sets created and supplied under the contract.

- Database project actions
    - Share expertise with projects and agencies regarding metadata creation, as requested.

6. Publish the metadata

Not only should metadata be included with every dataset, metadata for every data set that will be shared should also be publicly available so that the metadata and data can be found by online searches. Posting the metadata on the Internet (ideally as Extensible Markup Language – XML) is a prerequisite for being able to locate the data through online clearinghouses or portals. There should be a long term commitment to keeping the metadata updated along with the data over time unless it is a completely static data set. Several approaches to publishing metadata are available.

a. Publish the metadata as a web service. This is the preferred approach for ongoing projects, since it results in only a single copy of the metadata being made available. The web service is registered with the desired clearinghouses (e.g., NBII) and/or portals (e.g., the NED Portal at http://gis.bpa.gov/Portal/, Geospatial One Stop at http://gos2.geodata.gov/wps/portal/gos, etc.) which then simply point to the original metadata, resulting in only one copy of the metadata to keep current. Assistance with establishing a web service can be obtained from agency GIS programs, agency IT departments, regional database projects, etc.

b. Use an intermediary project to host metadata as a web service. Regional database projects (Table 1) that work with the kinds of data being developed by your project (such as StreamNet for fish abundance data, PNW Water Quality Data Exchange for water quality data, etc.) can often host metadata as a web service for clients. This can be useful if the project does not have the necessary technology or staff, or is not a long term project. Regional database projects may be able to provide long term maintenance for the metadata, and serve as the single place to contact to update the metadata.

c. Publish the metadata on a clearinghouse or portal. This approach can be expeditious if a project does not have the necessary technology available to host its own web service. For example, the NED Portal has an online tool to create and post metadata. Be aware that other portals often harvest and republish metadata, resulting in duplicate copies, creating a burden to locate and update all duplicates as changes are made to the data set and metadata.

- Agency actions
    - Decide which data sets will be made available for sharing.
    - Establish an agency approach to publishing metadata, including decisions on how the metadata will be published (by the agency or through an intermediary database project) and promote the plan within the agency.

- Provide metadata creation and validation tools, preferably a single agency-wide application. There are several of these on the Internet that are available for free download and use (see Recommended Action 5).

- Field sampler actions
  - Follow agency policy regarding publication of metadata.
  - Update the online metadata as data sets are updated.

- Funder actions
  - Contract language can be used to specify how metadata are to be made available under the contract after negotiation with the sponsor.

- Database project actions
  - If within project capabilities and area of project responsibility, host metadata and post as a web service on request of partner agencies. Capability and data type focus varies by project.

7. Assure control over data quality

Specific attention needs to be paid to quality control to assure that data are accurate and appropriate for their intended use. A variety of specific actions are needed at every step of the data cycle, from initial collection through ultimate use of the data. Quality Control procedures should be incorporated in the data collection process from the very beginning. In general the following suggested QC procedures and steps should be adopted to the degree possible:

- The sampling design should be reviewed by a statistician to insure that representative measurements can be made with appropriate accuracy and precision to minimize error within a desired level of confidence.
- Employ sampling methodology suitable for the intended purpose and for the environment being sampled.
- Follow a prescribed sampling protocol, and record any specific differences or deviations.
- Statistical techniques should be employed early during data collection to monitor the performance of the methods to successfully address issues of variation and repeatability and enhance the probabilities of obtaining accurate and precise measurements.
- Plan sampling and data coding to minimize the opportunity for data translation errors.
- Competent, well trained personnel should be used for sampling. Provide them with training and sampling manuals.
- Enter data into electronic format as quickly as possible (see Recommended Action 3). Potential actions could include:
  - Use handheld or other data entry tools in the field for original data recording, if possible.
  - Use redundant data capture, such as voice recordings along with direct electronic entry, to provide a back up when entering data directly in the field.
  - Use double entry to validate accuracy when entering data from forms.
  - Automate data entry to the degree possible (pull-down lists, pre-populated fields where possible, required formats, etc.)

    - Automate data validation to the degree possible, with built in range checks, required formats, review of summary statistics, etc.
- Back up data immediately; archive a copy in a safe, preferably different location.
- Review the data at the end of each sampling session for obvious errors.
- Errors discovered in the field or at any later review should be shared back to the data originators for correction in all versions of the data.
- Maintain close control of versioning of the data set. Document any changes made to base records
- Keep the data flow pathway as short as possible from collection to storage and ultimate use. For example, have a single official data set and send people to it rather than passing data sets from person to person.
- Limit the number of data processing steps to only once for each stage of treatment.
- Check for all data entry and other errors before reports are generated or the data are placed in permanent storage.
- Record all QA/QC steps and procedures used and include that information in the reports and metadata associated with the data. Include the Quality Assurance Project Plan if one was required by a funding entity.

Overall, data quality control can best be provided by those people most familiar with the data.

- Agency actions
    - Develop an agency wide Quality Assurance program and require compliance.

- Field sampler actions
    - Follow the principles and procedures in the above recommended QA steps and as contained in your agency's QC process.

- Funder actions
    - Contract language can be used to require that QA steps be clearly articulated and described in the data management plan (Recommended Action 8).

8. Prepare a data management plan

All projects that collect data should prepare a data management plan prior to data collection. Such a plan could be made a requirement for funding in contract language. Such a plan does not need to be lengthy, but it should clearly describe how data are going to be collected, stored, managed, quality assured and shared. Issues of sensitive data, timeliness of delivery, ultimate disposition of data, etc. should be detailed in the plan. Developing a plan assures that all steps in creating, managing and sharing the data are considered. One suggested approach to developing a data management plan is outlined in Appendix B. The *Checklist for Organizing Field Data Collection and Management of Data* (http://www.nwcouncil.org/ned/Checklist.pdf) may also be useful in developing a data management plan. The data management plan, or a link to it, should be included in the metadata describing the data set(s).

- Agency actions
    - Require that sampling projects develop a data management plan before initiating data sampling in the field. For ongoing monitoring that does not yet have a plan, request development of a plan prior to the next round of sampling. The plan should cover specific kinds of sampling, and apply to all such field efforts across the agency.

- Field sampler actions
    - Develop a data management plan for sampling activities, or use an agency plan.

    - Follow the steps outlined in the data management plan when collecting and managing data.

- Funder actions
    - Contract language could require that a data management plan be submitted to the funder prior to initiation of sampling. Any specific needed approaches to data sharing and management should be negotiated with the sponsor and included in the plan.

9. Prepare a data analysis plan

If the project will create summarized or analyzed data, the analysis approach used should be described in a separate Data Analysis Plan (for detailed analysis) or described specifically in the Data Management Plan (for data summarization or simple analysis). The data analysis plan, or a link to it, should be included in the metadata describing the data set(s). This plan may also be useful in the Methods section of any reports or publications that result.

- Agency actions
    - Assure that data summarization or analysis steps are described in a data analysis plan or in a section of the data management plan.

- Field sampler actions
    - Develop a data analysis plan or include information on the analysis procedure used in a section of the data management plan.
    - Follow the steps outlined in the data analysis plan when analyzing or summarizing data.

- Funder actions
    - Contract language could be used to require a data analysis plan or to include analysis procedures in the data management plan, depending on the needs of the funder or through negotiations with the project sponsor.

10. Plan to share data

There are several options for making data available so that others can obtain and use them for wider scale analysis. Which approach is chosen can be influenced by agency policies, available agency or project IT capacity, funder requirements, available assistance and support, and/or commitment to long term maintenance. At a minimum, the contents, location, availability, and

methods used to collect and analyze the data should be described in the metadata, which should be made publicly available (Recommended Action 5).

The preferred means of sharing data is via the Internet. At a minimum, the data should be posted in a machine readable format to allow subsequent data use, such as in a relational database or spreadsheet application, GIS files, or if as text, in a delimited file format (ASCII). Data provided in .pdf format or summarized in project reports are not sufficient for sharing data. Ideally, the data, or a link to request the data, would be available at all times.

Data files may be made available in various ways, including File Transfer Protocol (.ftp), links on a web page, an online database and data query system, an Internet Map System, a Distributed Data Base Management System (DDBMS) or some combination of all of the above. In all cases, the existence of the data and the means to acquire the data should be included in the metadata, in project reports, and, ideally, also described on a web page. For very large data sets too large for direct download, or subject to specific requirements for use, the means to obtain the data, along with any limitations, should be publicized on the project website and in the metadata.

Project sponsors have essentially two options for managing and posting data for sharing: 1) posting and maintaining the data directly themselves, or 2) posting the data through an intermediary. The preferred approach will depend on a number of factors including the needs of the project, the type of data being collected, the longevity of the project, available IT infrastructure, and the sponsor's desire to maintain the data and update them as necessary.

a. Posting data directly on the Internet

   A minimum data management infrastructure sufficient to support a project website and a commitment to maintaining project databases are required before a project or agency can post and maintain its data directly via the Internet. Data can be posted in database or spreadsheet format for direct download from a project website, through file transfer protocol (.ftp)or as XML. For larger or more complex data sets, the data owner may need to provide additional tools to query the database so that users can locate specific data within the overall database. The data owner also must be prepared to continually maintain and update the data and metadata as necessary. This would be simplified by utilizing an agency wide data system (see recommendation 3).

   Large data sets that require more extensive database management systems and more complex approaches to serving data, such as on-line data query tools and/or Internet Map Services require more specialized expertise and capabilities. These resources may be beyond the purpose and available level of support for some projects. Some projects may be short term or not sufficiently staffed to manage databases and data distribution functions into the future. In such cases, it could be more efficient and effective to utilize an intermediary to post the data.

b. Posting data through an intermediary

   Where field samplers or agencies do not have the time, resources or interest in maintaining data on the Internet over an indefinite time period, a number of options are available. Some

commercial sites, e.g., Google, will host simple spreadsheets or database files for low or no cost, and the URL for the data set can be publicized on a project website.

Another, more focused approach is to work through regional scale database projects to have the data posted and maintained on the Internet. A number of database projects consolidate, standardize and disseminate specific subsets of environmental data in the Pacific Northwest (a partial list is contained in Table 1). Some, like the Pacific Northwest Water Quality Data Exchange (PNWQDX) and StreamNet provide data hosting services for the kinds of data they specialize in, either directly or through their partner agencies. StreamNet also has an archive program (the Data Store, http://www.streamnet.org/online-data/datastore.html) that can accept and post any kind of data, and the StreamNet Library (http://www.fishlib.org/) will archive any natural resource related documents. A data hosting service makes the data available over the Internet and also publishes the metadata to make the data findable through portals.

In cases where there is a regional database project that specializes in the type of data being collected, the data, or a URL to the data, should be provided to the database project, even if the archiving function isn't needed. This assures that all data of the particular type are consolidated across agencies for maximal value to the broader region.

Individual database projects have different procedures for handling data, so project sponsors should contact the appropriate database project(s) early in their planning to discuss requirements, procedures and data formats (Table 1). For example, fish related data in the StreamNet database are usually managed by StreamNet project staff in the partner fish and wildlife agencies or are sent directly to the regional database at PSMFC if they are data that do not conform to the StreamNet data exchange format. Water quality data in PNWQDX are submitted through and maintained within databases in the state environmental quality agencies, and data can be housed in a host database for partners unable to serve data on the Internet.

- Agency actions
    - Decide on an agency approach to sharing data sets. Actions could include hosting data sets on the web directly, using an intermediary database project to host data, or some combination.
    - Contact the database project appropriate to the kind of data to determine the details of how to submit data.
    - Update data sets as appropriate for the type of data, either internally or at the database project.
    - Even if a regional database project is not used to host data, the database projects appropriate for the type of data should be notified of available data and updates so that they can point their users to the data.

- Field sampler actions
    - Follow agency directives regarding sharing data on the Internet. Complete QA procedures and post your data set on the Internet, transmit data to your agency for posting, or provide it to the relevant database project for them to post.

- If not covered under an agency policy, field sampling projects should contact the database project appropriate to the type of data to explore data hosting and to provide data and updates.

- Funder actions
  - Contract language should specify how data are to be shared, based on negotiations with the project sponsor.
  - The approach for long term management and update of the data should be negotiated with the project sponsor.
  - Negotiate with project sponsors to assure that the details of data sharing are included in the data management plan.

- Database management project actions
  - For database projects with these capabilities and within the scope of data types they address, host agency data sets and make them available on the Web, as requested. Incorporate data in project data systems, if appropriate, or host as independent data.
  - Negotiate with agencies, projects or funders for large efforts that might require additional resources.

11. Establish data sharing priorities and policies

A number of policy issues related to data collection, management and sharing need to be agreed upon collaboratively at a regional scale. Data collected or developed with public funds should be considered public data and should be made readily available to others. Within that premise, specific policy guidance is needed to address issues that cross agency authorities. Consensus on policy needs to be reached among all involved entities, including field agencies that collect data, agencies that use data from multiple sources, and funding entities. A collaborative approach is recommended. While there may be numerous policy issues in need of resolution, the following topics are of immediate importance.

a. Data sharing priorities

Agencies and projects collect data of many types for many purposes, but not all data sets are needed for regional scale sharing. Regional consensus on which specific types of data are highest priority for wide sharing would allow focusing efforts initially on those data sets of greatest wide-scale utility.

b. Timeliness of sharing data

Regional scale entities often need data quickly, while the data originators are busy and may need time to consolidate and quality check data or to fully analyze their data and complete manuscripts and management recommendations, leading to concern over early release of the data. A regional policy is needed to promote rapid sharing of data but protect the interests of the data originator. Timeliness standards will need to be flexible depending on various circumstances, such as whether the data are from annual monitoring or are part of a multi-year sampling design. Policy could indicate, as a general rule, that data from annual

monitoring should be made available prior to the subsequent round of sampling. But, there may be reasonable concerns over premature release of partial data from multi-year sampling designs, and a release schedule for such data may need to be negotiated. Absent regional policy, negotiations between project sponsors and funding entities will be needed as part of a process to develop required schedules for data availability. At a minimum, data release schedules should be addressed as part of the data management plan and in the metadata. Regional policy should indicate general timelines for sharing various kinds of data.

c. Right to first use of data

Related to timely release of data, the originators of data may be reluctant to release data before they have had the opportunity to publish results based on the data. A regional data use policy could allow for conditional release of data with a provision that limits subsequent publication or sharing of the data set until a specified date or after publication by the originator. Such a limitation could be enforced by requiring a signed data sharing agreement prior to data release, and the FGDC Biological Data Profile contains a field to specifically record such a requirement in the metadata.

d. Release of sensitive information

Handling sensitive data is another important consideration that would benefit from a regional policy. Any proposed policy should recognize legal and agency constraints, but should facilitate sharing of data to responsible parties. Policy decisions should include defining what constitutes "sensitive" information, and allowing restricting release of sensitive information only to agencies or entities with recognized need, or specifying that information may be released with sensitive information generalized, such as to protect individual site locations. The policy should also require that any restrictions on use of sensitive data be specified in the data plan and in associated metadata.

e. Regional approach to building a data sharing system.

There has been interest expressed in developing a regional (Columbia Basin to Pacific Northwest scale) data delivery system as a means of making environmental monitoring data widely available. While the technical aspects of how to create such a system are technical IT, not policy level, questions, there is a need to establish policy on what such a system should be tasked to do if undertaken, what data types should be included, comparability of data from different sources (data standardization or interoperability), and agency capabilities and needed support. Such policy discussions would ultimately need to deal with all of the steps outlined in this data sharing guide, as well as needed features and cost. It will be essential to include all entities involved from field data collection to regional scale in such a collaborative effort.

- Executive actions at a policy level
    - Utilize a collaborative process that includes data creating agencies, wider scale data users, regulatory agencies, and funding entities to develop and collectively establish policy related to the above issues and any additional data sharing issues as necessary.

- Funder actions
    - Appropriate policy actions as described in policy documents should be supported through contract language, as needed.

- Agency actions
    - Participate in collaborative efforts to establish policies.
    - Endorse regional policy documents, and adopt within agency
- Field sampler actions
    - Follow policy, as appropriate. Include appropriate policy in data management plans and describe in metadata, as needed.

- Database project actions
    - Participate in regional collaborative processes to provide data management expertise and IT recommendations.

CONCLUSION

This guide outlines various approaches that agencies and sampling projects can take to preserve their data and make them available for use by others. Adherence to the data management considerations outlined here would significantly improve the quality and availability of data for use beyond the data originators, and some recommendations would facilitate data use within originating projects or agencies. The extent to which these practices will be used depends on directions issued by project funders and voluntary adoption by agencies. They would be strengthened by development of a full suite of best practices, including example data sharing agreements and formal policy statements as outlined above.

To make a significant difference, the principles and recommendations from this general guidance document should be incorporated into agency and regional policies as appropriate, and become part of formal business practices. It would be beneficial to the region as a whole, data creating agencies and to any organization that uses data from outside its own collection programs to participate in collaborative efforts to refine and implement these recommendations.

Table 1. Partial list of database / data warehouse projects in the Pacific Northwest.

Name	Website	Data Types
StreamNet	www.streamnet.org	Fish abundance (redd counts, dam counts, hatchery returns, etc.), fish distribution, 100K hydrography, fish related facilities (hatcheries, dams, barriers, passage, screens, etc.), hatchery releases, age, Protected Areas, etc. Also will store and disseminate any other data.
Pacific Northwest Water Quality Data Exchange	http://deq12.deq.state.or.us/pnwwqx/	Water quality, soil and sediment quality, tissue analyses, and population data
Fish Passage Center	www.fpc.org/	Smolt migration (mainstem), upstream fish passage counts, real-time hatchery releases, hydropower releases, etc.
Pacific Fisheries Information Network	http://www.psmfc.org/pacfin/	Commercial fish harvest data
Recreational Fisheries Information Network	http://www.recfin.org/	Marine recreational fisheries data
Regional Mark Processing Center	http://www.rmpc.org/	Coded-wire tag marking and recovery data, marked fish releases, etc.
PIT Tag Information System	http://www.psmfc.org/content/view/47/186/	PIT tag release and recovery data.
Integrated Status and Effectiveness Monitoring Program	http://www.nwfsc.noaa.gov/research/divisions/cbd/mathbio/isemp/index.cfm	Pilot project to assemble fish and habitat data in the Wenatchee, WA, and John Day, OR, subbasins
Interactive Biodiversity Information System	habitat@nwhi.org	Wildlife life history information, terrestrial habitat information.

Appendix A

Suggested Minimum Contents for Metadata for Tabular Data

The following metadata elements represent information that is essential for understanding data and using them appropriately. This is adapted from the ODFW Data Clearinghouse (https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=1) instructions for submitting data sets (http://nrimp.dfw.state.or.us/DataClearinghouse/DataTemplates/DC_RecordCreation_20June08.doc). These recommended elements are a subset of FGDC Biological Data Profile metadata but exceed the minimum FGDC requirement. They also include several items not specifically included in FGDC, as noted below. While the full suite of FGDC metadata provides the most utility, the basic information is covered here.

It may be appropriate to scale the amount of metadata to the degree of summarization included in any data set. For example, an agency-wide data set built from many data sets obtained from local offices would likely describe the origin of the data in general terms, while each of the original local data sets should have origin and methods explained in specific detail.

Further refinement of minimum metadata needs should be considered as part of establishing a regional level data sharing policy.

Citation Information

Title: = "Name of the dataset."
Originator/owner: = "The name of the organization or individual that developed or owns the dataset."
Pub. Date: = "The date when the data set is published or otherwise made available for release."
URL link: = “the URL link to access the data, or the URL to the project if the data are not available on line”

Contact Information

Contact Person: = "The person responsible for providing access to the data."
Submitting Agency: = “The name of agency responsible for the data.”
Contact Job Position: = "The job position of the person responsible for providing access to the data."
Contact Phone: = "The telephone number by which individuals can speak to the organization or individual."
Contact E-Mail: = "The email address by which individuals can speak to the organization or individual" (This element was not specifically included in the FGDC BDP)

Description

Abstract: = "A brief narrative summary of the dataset."
Purpose: = "A summary of the intentions with which the dataset was developed."

General Information

Project Name: = “The name of the project as used by the funding agency” (This element is not specifically included in the FGDC BDP. It would fit in “Supplemental Information”.)

Funding Entity/Program: = “The entity and program providing funds to collect or create the dataset.” (This element is not specifically included in the FGDC BDP. It would fit in “Supplemental Information.)

Project Number: = “The number assigned to this project by the funding entity.” (This element is not specifically included in the FGDC BDP. It would fit in “Supplemental Information”.)

Time Period: = "The year (and optionally month, or month and day) for which the data is applicable." (This should be broken into Start and End dates to fit FGDC fields)

Geo. Extent: = "General text description of the geographic location covered by the dataset."

Status: “Complete,” “In progress as of this date” or “Planned”

Keywords: = "Generalized keywords to aid in searching for this document."

Intended Usage: = “A description of the intended ultimate use of the data (e.g. management decision, technical publication, peer reviewed journal, etc.)” (This element was not specifically included in the FGDC BDP. This might be considered the same as the “Purpose” field)

Usage Caveats: = "Restrictions and legal prerequisites for using the dataset after access is granted."

Format: = “The native dataset format.”

Data Quality Information

Lineage-Source: = “A general description of the dataset source(s) and processing steps in its development.”

Appendix B

Outline for a Data Management Plan

A data management plan can be very helpful in assuring that all people involved in creating or using a data set understand how the data will be managed. This will avoid misunderstanding, especially among participants in a data collection program or between a funding entity and a project sponsor. It also assures that all steps in the process of collecting, storing, analyzing, using and sharing the data are thought through before field work begins, and assures that critical steps are not overlooked, especially the final disposition of the data so that data are not lost over time. Emphasis should be on the specific actions planned for handling the data once they are created. Details of the project, its purpose, sampling protocols used, etc. should be included in the metadata, and need only be referenced briefly in the data plan.

A data management plan should address the following items.

I. Project Description
   a. Title
   b. General description[1]

II. Contacts
   a. Project Leader
   b. Person responsible for collecting the data in the field
   c. Person responsible for entering the data
   d. Person responsible for managing (maintaining, changing, updating, correcting) the data after collection and entry

III. Data
   a. General Description
   b. Collection methods. Identify the manuals, standards or protocols being followed for data collection. If no formal protocol is followed, provide general description of method.[1]
   c. Data capture. Provide copy of field forms, or describe electronic tools. Are all needed data elements included in the forms?
   d. What standards are being followed for data management (standard coding schemes, formats, etc.)?
   e. Data dictionary (include data definitions, coding, units, and whether optional or required)
   f. QA process / procedures to be employed
   g. Data storage process and format (including data backup procedures)
   h. Where data will be stored (locally, and other databases) and versioned
   i. Data "ownership" or control (describe)
   j. Data analysis (how the data will be summarized or analyzed. If detailed analysis will be performed, write a separate data analysis plan)
   k. Access to data (who, how, describe any restrictions or limitations)
   l. Sensitive data (how this will be handled)
   m. Long term data storage and dissemination

IV. Schedules
   a. Description of data pathway and operations
   b. Schedule for each node in the data flow (a flow diagram may be helpful)
   c. Methods for tracking data status
   d. How and when data will be made available to others (schedule, rights of use, etc.)

V. Metadata
   a. Provide metadata or link to it, if available at project initiation, or
   b. Describe who will develop metadata, and when and where it will be available

[1] Details should be included in the metadata. Only a general description is needed here.

Appendix C

Summary Checklists

A. Recommendations for **field agencies**

1. *Standardize sampling to the degree possible*
   Increases consistency of data, eases compiling data from different offices into an agency or wider database. Especially important within an agency. Standardize within each specific kind of sampling to the degree possible
2. *Follow existing data management guidelines/standards*
   Use existing 'best practices' documents to guide how data are recorded to maximize consistency in recording and managing data
3. *Automate data capture and management, to the degree possible*
   Electronic tools can greatly speed data entry, improve accuracy, improve data flow and utility in the agency, and enable data sharing. These can include data capture devices, automated data validation, agency wide data systems, canned reports, etc.
4. *Use common coding and formatting and describe in a data dictionary.*
   Ideally, all offices and projects in an agency should use the same code lists and formats. Work toward adopting (or crosswalk to) regional or national code systems. Describe data element definitions, coding, units of measure, formats, and acceptable data ranges in a data dictionary.
5. *Describe all data sets with metadata*
   All data sets should include explanatory information so they can be understood and used appropriately by others. Metadata should meet or exceed minimum national standards. Initial metadata development can take time, but subsequent sets of metadata are easier and can mostly be created by cut and paste.
6. *Publish metadata*
   For data sets that will be shared, publish metadata as a web service in XML, allowing the metadata to be located through online clearinghouses and portals.
7. *Implement quality controls*
   A quality control process should be implemented and followed at all steps in data creation, management and use. System automation can simplify QA/QC.
8. *Develop a data management plan*
   Preparing a data plan prior to initiating sampling will ensure that data are entered, stored and used appropriately. This will avoid oversights and lost data.
9. *Develop a data analysis plan*
   If data will be analyzed, a description of the analysis approach should be written. For simple analyses or summarization, this can be included in the data management plan.
10. *Select an approach for sharing data*
    For data sets that will be shared outside the agency, determine the approach, either posting directly to the Internet, or posting through an intermediary database project.
11. *Establish data sharing and use policies*
    Agency policy makers should address issues such as priorities of data to share, subsequent use of agency data, timeliness of data release, treatment of sensitive data, and other policy level issues. Participation in collaborative efforts to develop regional scale data policies is recommended.

B. Recommendations for **field samplers**

1. *Standardize sampling to the degree possible*
   Follow agency direction for sampling. Work toward adopting standardized field sampling methods to the greatest degree possible. Document methods used and record any adjustments or deviations from standard protocols.
2. *Follow existing data management guidelines/standards*
   Use existing 'best practices' documents to guide how data are recorded to maximize consistency in recording and managing data
3. *Automate data capture and management, to the degree possible*
   Enter field data into electronic format during sampling or immediately after. Archive a copy in a safe place. Use electronic data capture devices in the field, as available.
4. *Use common coding and formatting and describe in a data dictionary.*
   Follow agency direction. Use standardized code lists and formats to the degree possible. Do not create new coding systems. Adhere to agency data dictionary, or develop a dictionary to describe data definitions, codes, units of measure, formats.
5. *Describe all data sets with metadata*
   Include a set of metadata with each data set to describe the data. Use agency adopted format, or at least the items listed in this guide. Cut and paste from other metadata as much as possible to decrease workload, with only the differences newly described.
6. *Publish metadata*
   Follow agency process for publishing metadata.
7. *Implement quality controls*
   Follow established quality control procedures when entering and correcting data. Use automated data systems with built in quality checks (e.g., range checks, required formats, drop down lists, etc.) if possible. System automation can simplify QA/QC.
8. *Develop a data management plan*
   Preparing a data plan prior to initiating sampling will ensure that data are entered, stored and used appropriately. This will avoid oversights and lost data.
9. *Develop a data analysis plan*
   If data will be analyzed, a description of the analysis approach should be written. For simple analyses or summarization, this can be included in the data management plan.
10. *Select an approach for sharing data*
    Follow agency procedures for sharing data. Submit data sets to appropriate systems or entities.

C. Recommendations for **funding entities**

1. *Standardize sampling to the degree possible*
   Funder should recognize agency/sponsor selection of sampling methodology or negotiate methodology unless there is specific need for a particular protocol. Specific needs can be negotiated and stipulated in contract language.
2. *Follow existing data management guidelines/standards*
   During contract negotiations encourage project sponsor to follow existing data guidelines.
3. *Automate data capture and management, to the degree possible*
   Support project sponsors to able use of appropriate data capture and management tools, including field data capture tools and development of consolidated database systems. Specify if data are to be entered into a specific database.
4. *Use common coding and formatting and describe in a data dictionary.*
   During contract negotiations encourage project sponsors to use standardized data definitions and coding, if such exist for the data being collected. Require a data dictionary that provides data definitions, codes, units of measure, formats, etc. with the data.
5. *Describe all data sets with metadata*
   Request or require that metadata be provided with any data sets produced by a project.
6. *Publish metadata*
   Negotiate with the project sponsor to specify how metadata is to be disseminated.
7. *Implement quality controls*
   Funder should discuss quality control process with sponsor, and specify any required steps in the contract.
8. *Develop a data management plan*
   Funder should require preparation of a data management plan as part of project proposal.
9. *Develop a data analysis plan*
   Funder should require preparation of a data analysis plan as part of project proposal if sufficient detail will not be part of the data management plan.
10. *Select an approach for sharing data*
    Funder and sponsor should agree on how data will be shared and specify in data plan. Require that data be provided in a machine readable format, not in .pdf or summary reports.
11. *Establish data sharing and use policies*
    Funding entities should participate in collaborative efforts to establish regional scale data policies and priorities.

D. Recommendations for **executive policy makers**

1. *Standardize sampling to the degree possible*
   Within agency, establish policy regarding which standardized sampling protocols will be required, if any. Within region, work collaboratively toward regional scale policy recommendations regarding desired sampling protocols.
2. *Follow existing data management guidelines/standards*
   Within agency, establish policy on which guidelines are required.
3. *Automate data capture and management, to the degree possible*
   Within agency, determine approach to building data systems and deploying field data entry tools. Within region, collaboratively determine if support is needed to develop regional scale data dissemination capabilities in agencies.
4. *Use common coding and formatting and describe in a data dictionary.*
   Within agency, establish policy on which coding systems and data dictionaries are to be used. Within region, collaboratively support broad consolidation of data dictionaries.
5. *Describe all data sets with metadata*
   Within agency, develop policy on use of metadata.
6. *Publish metadata*
   Within agency, establish policy on publication of metadata.
7. *Implement quality controls*
   Within agency, establish data quality control policies.
8. *Develop a data management plan*
   Within agencies and regionally support need for data management plans.
9. *Develop a data analysis plan*
   Within agencies and regionally support need for data analysis plans.
10. *Select an approach for sharing data*
    Within agency, determine best policy approach toward sharing data, including which data should be shared and how. Within region, collaboratively determine policies related to desired approaches for sharing data.
11. *Establish data sharing and use policies*
    Within agency, determine policy on issues such as any need for data sharing agreements, timeliness of data release, sensitive data, etc. Within region, use collaborative approach to develop regional scale data sharing policies and programs. Explore regional scale data sharing strategies and goals (functions, not technical IT approaches) and needed functions for regional scale dissemination of data.

E. Recommendations for **database management projects**

1. *Standardize sampling to the degree possible*
   Provide assistance and advice if field sampling is relevant to the specific data program (e.g., PIT or CWT tagging). Otherwise, database projects have no role in field sampling procedures.
2. *Follow existing data management guidelines/standards*
   Provide advice or assistance, if requested.
3. *Automate data capture and management, to the degree possible*
   Provide technical assistance to agencies with developing internal data management systems and templates for field data entry, as requested and as possible within project scope and capabilities. Actions may include providing technical advice or actual development of data entry templates, local or agency database systems, data translation tools, and/or data output interfaces.
4. *Use common coding and formatting and describe in a data dictionary.*
   Provide technical assistance with data dictionary development, as requested.
5. *Describe all data sets with metadata*
   Provide advice and technical assistance with development of metadata, as requested and within scope and capability of database project.
6. *Publish metadata*
   Provide advice and technical assistance, as requested. Some database projects may be able to publish metadata for partner agencies.
7. *Implement quality controls*
   Provide advice and technical assistance, as requested.
8. *Develop a data management plan*
   Provide technical advice, as requested.
9. *Develop a data analysis plan*
   Provide technical advice as requested and if relevant to the database project.
10. *Select an approach for sharing data*
    Provide technical advice, discuss options, as requested. Include data in project database if of relevant type. Assist partner agencies by posting data if requested and within capabilities.
11. *Establish data sharing and use policies*
    Participate in collaborative data policy efforts to discuss technical options, provide expertise and make technical recommendations.

Appendix C
Columbia River Inter-Tribal Fish Commission
DRAFT Data Sharing Strategy

Statement of Purpose

The CRITFC and its member tribes are responsible for meeting their co-management responsibilities for natural resources within the tribes' ceded areas. In total this represents about 25% of the entire Columbia Basin (most of the remaining salmon-bearing streams above the Bonneville Dam) and the estuary and ocean areas used by Columbia Basin anadromous fish populations.

These co-management responsibilities are described primarily in 1) the treaties signed with the U.S. government in 1855, 2) a series of court decisions and orders under the federal *U.S. v Oregon* case, 3) the Pacific Salmon Treaty between the United States and Canada, 4) recent proceedings under renegotiation of the Columbia River Treaty with Canada, 5) the tribal anadromous fish restoration plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit*, and 6) the negotiated Columbia Basin Fish Accords between the tribes and the federal Action Agencies under the FCRPS BiOp. Many of the salmon populations under these authorities are listed as threatened or endangered under the Endangered Species Act, giving their restoration particular importance.

The CRITFC data management program is responsible for 1) collecting, assembling, analyzing, maintaining, and disseminating data and other information on salmon in the mainstem, estuary and ocean ecosystems, 2) coordinating this information with related information from subbasins to create a gravel-to-gravel data system covering the entire salmon life cycle, 3) maintaining the StreamNet Library databases and providing library services and access to all stakeholders in the Columbia Basin, 4) sharing technology and expertise with our member tribes to increase the data management capacity of all parties, 5) creating decision support tools to organize knowledge in ways useful for decision makers, and 6) coordinating data sharing efforts with state and federal natural resource managers.

CRITFC's data management goals are:

1. **Maintain accurate and consistent data** at all spatial scales from field collection through calculation of routine summaries and indicators to special analyses at larger spatial scales. Incorporate QA/QC and metadata procedures at each step in data management processes, as appropriate. Spatially reference all appropriate data.
2. **Update databases in a timely manner**. Complete data entry/verification processes within three months after the end of the data collection season.

3. **Provide access to data users through web services and tools**. Produce pre-season, in-season, and post-season management reports according to the appropriate schedules. Publish shared data within three months of data verification, according to agreed-upon data sharing agreements.
4. **Develop data management practices and tools collaboratively** with tribal and other agency partners. Develop shared tools and provide technical expertise to member tribes through the Tribal Data Network project. Develop and incorporate standard regional data management practices jointly with other regional partners.

Strategies

CRITFC will work internally and with each tribe to enhance their data management capacity. CRITFC is dedicated to building tools and systems to better manage and share data electronically from one computer or database to another. It is also the strategy of CRITFC to spatially reference all data of fish and habitat to the finest appropriate spatial scale.

Accuracy

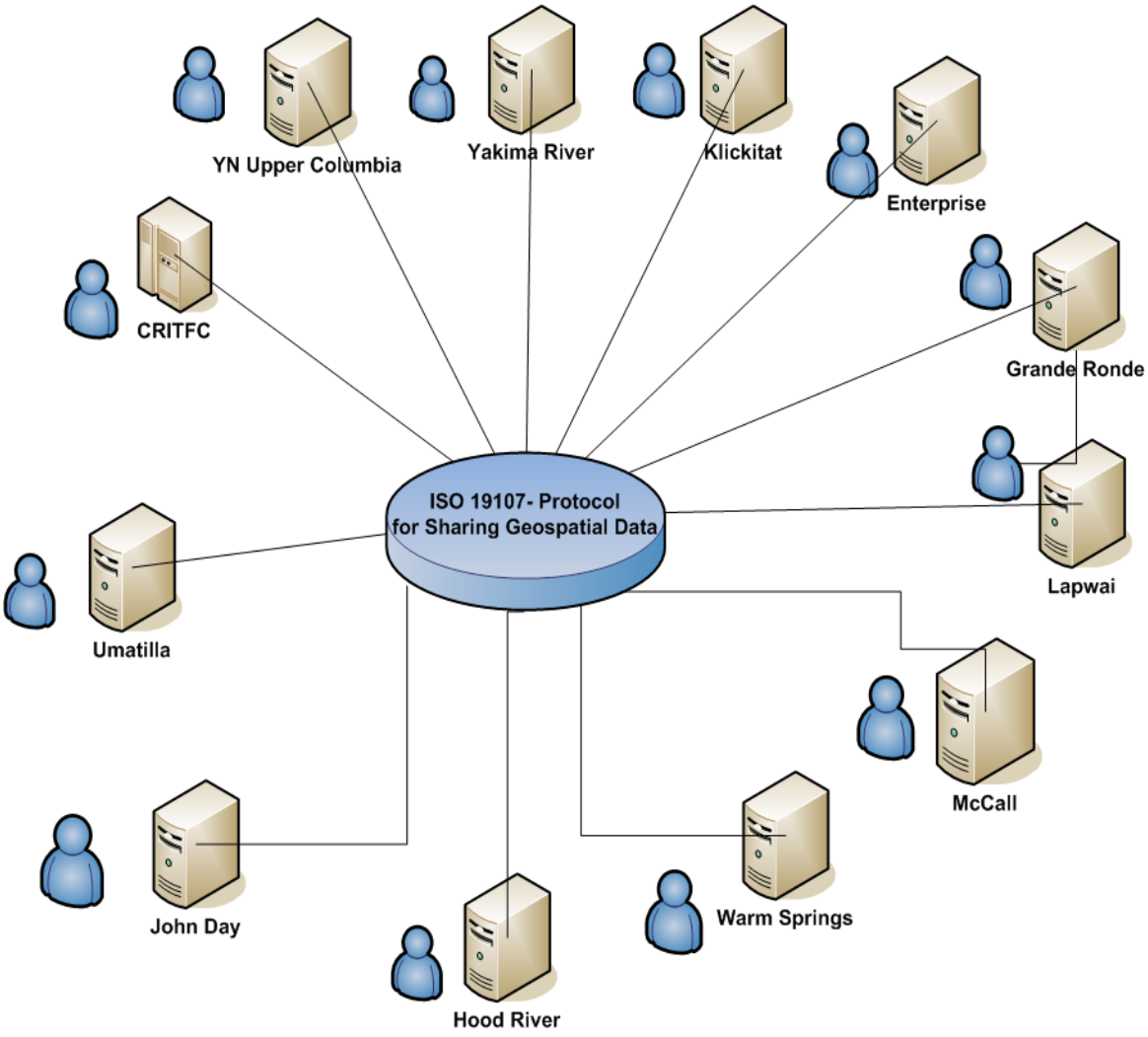
Accuracy is also improved by keeping data pathways as simple as possible, using automation where appropriate, validation code at every data entry point, and human validation when necessary.

- Tools – Data capture, processing, conversion
  CRITFC has been successful in developing direct electronic data capture and reporting with the two digital pen pilot projects. These two projects have greatly streamlined and automated data capture, processing, accuracy, and dissemination, thus producing more reliable reports with less staff time. The tools we have developed for these projects will soon be more broadly shared with our tribes to enhance several of their projects from the raw data collection stage through the web dissemination phase.
- QA/QC – Automated with staff review
  CRITFC is dedicated to maximizing quality assurance and quality control (QA/QC) at all levels of data handling. Validation code is or will be written into every level of data entry or data movement in our database systems, using transparent QA/QC routines. Databases devoted to collection of raw data are automated to run data QA/QC with some human checks at many of the major data handling events. Similar processes will be integrated into all future databases, tools, and applications that CRITFC builds for its projects or its member tribes.

Timely
CRITFC intends to build and help our tribes build into data collection and reporting systems as much automation as possible to make data timelier for decision makers. Our goal is that data entry and validation will be completed for each data set no later than three months after the end of the data collection season. Posting of data to be shared with other agencies will be completed no later than three months after data validation is completed. Faster schedules will be used to report data necessary for in-season management decisions.

Accessible
The ability to access data is no longer a question of technology. Information can be shared between systems of all types quickly and safely when infrastructure and staff time is available to build the systems. The major block to future accessibility of data or information in the Columbia Basin will be the human trust factor. Without an established and trust environment with institutionalized data sharing policies in place, access to anything other than high-level indicators of fish populations and habitat will be piecemeal and *ad hoc*. CRITFC will work with member tribes, our Commission and regional partners to develop appropriate data sharing policies and agreements.

Structure
The CRITFC member tribes anticipate developing a distributed database network similar to the following figure. Standard web-based protocols for sharing geospatial data will be used for many queries.



This diagram represents the current offices of CRITFC member tribes where field data is collected and processed. Tribal data sharing policies will dictate what structures are actually built to handle data. The functional design of the Tribal Data Network is built on the assumption that metric level anadromous fish data, from which population level indicators can be easily constructed is the most cost efficient and useful level of aggregated data to share. These data can be used as is by lifecycle modelers, co-managers, the Accords, the Fish and Wildlife program, and NOAA for delisting decisions. They are detailed in the Tribal Data Network Functional Design Document.

CRITFC plans to provide access to all the metric and indicator level data it can via the web, and to assist member tribes to build capacity to provide web access to all the metric and indicator level data they wish to share. CRITFC will collaborate with member tribes and co-managers to avoid duplication and redundancy of effort, while capitalizing on economies of scale. CRITFC plans to continue building tools to assist member tribes to build capacity.

CRITFC plans to continue publishing all it scientific reports both in print and electronically, and to make electronic versions available regional wide via the web and the StreamNet library.

CRITFC plans to assist member tribes in producing base line data sets for key populations and geospatial areas. The Tribal Data Network plans to initially focus on the development of key metrics including the number of smolts per spawner for key fish runs and populations for the 2013 check in. The Tribal Data Network Grand Ronde pilot project will endeavor to develop lifecycle stage survival metrics in collaboration with co-managers, which can then be used as a basis to look for initial improvement due to habitat mitigation projects in the 2013 check in. The Tribal Data Network will initially develop water flow and temperature data for analysts to use as habitat data to look for a relationship between habitat and different stages of the anadromous lifecycle. Additional habitat data will be added to the Tribal Data Network's data management schema over time, using the Grand Ronde as an initial pilot. Eventually, gravel-to-gravel lifecycle monitoring can be implemented, and the egg-smolt survival improvements written into the Accords will be measured with improved confidence intervals.

Present Status

CRITFC has operated the StreamNet Library databases and collection since the inception of the Coordinated Information System/StreamNet project in 1988. The StreamNet system is unique in that it associates the numerical databases with technical reference databases documenting the source of the numeric data and the technical analysis describing how the data were used and what they mean within a fishery management context. The Library also provides users with access to the reports themselves and a full suite of library services.

The signing of the Fish Accords through the Tribal Data Network project, has allowed CRITFC to begin to plan for data management and sharing with its member tribes and the region in a coordinated manner with the latest in technology and internet applications. Until 2009, CRITFC like many other agencies in the region relied on each program manager or biologist to handle their own data and share it with the region. This type of data management (or lack of data management) rarely involved databases and data was passed by emails between partners. CRITFC began its information management activities in 1989 with the creation of the Coordinated Information System (now StreamNet) library database. This database (library catalog and material) essentially provides in-depth metadata for all the StreamNet databases. In 2002 a GIS/database coordinator and temporary GIS technician positions were created with a combination of BIA and BPA funding, in part to provide technical support to subbasin planning teams in Oregon. These positions were made permanent through a combination of BIA, PSC,

NOAA and BPA sources in 2005. This staff of two began to develop databases and tools to automate collection and reporting of some of the salmon data from several CRITFC projects.

Since the Fish Accords were signed in 2008, CRITFC's data management staff has increased using funding from several of those projects and existing sources to centralize data management functions in one group. Below is a list of current staff positions, functions and funding sources that are presently involved in data management at CRITFC and coordinated data management with our tribes:

Present functionality & funding

- Tribal Data Steward/Systems Developer – This person designs and implements the hardware and software systems supporting data management at CRITFC, shares that expertise with our member tribes and develops applications to improve data handling and management at CRITFC and its member tribes. The incumbent conducts an annual tribal data workshop and is a lead contact for data management issues with other agencies. This position develops the framework for providing access to and sharing of fishery and habitat data among the Columbia River Inter-Tribal Fish Commission (CRITFC) member tribes and with other Columbia River Basin Agencies. Development of new tools and applications is slow because this individual must deal with a diversity of issues and can spend only a small portion of time developing applications. Funding - fully funded by the Tribal Data Network project.
- GIS/Database coordinator –This position has the responsibility to provide database and GIS services and analyses. The incumbent coordinates the work of other GIS and data professionals to balance workloads, improve overall efficiency and meet project deliverable deadlines. Funding – funded through a combination of BIA and several BPA projects.
- Database administrator –This position provides database support to CRITFC and its member tribes' projects, programs, and goals and includes the application of current and emerging database concepts, principles, methods and practices for data flow and data management needs. The incumbent also assists the Tribal Data Steward to develop data entry, QA/QC, and database reporting applications. Funding – The position is funded by the Tribal Data Network project and other specific BIA and BPA projects that collect and manage data.
- GIS specialist –This position supports all natural resource-based GIS activities for CRITFC through development of geo-databases, tools, and some web applications. The incumbent also provides some GIS support to cooperative projects among our member tribes. Only a small portion of time is available to develop web applications for data sharing. Funding provided through a combination of BIA, NOAA, and BPA funding for specific projects.

- Information Technology Specialist –This position assists CRITFC's GIS and data management staff with streamlining data collection, QA/QC processes and analyses and reporting by using innovative software and technology. Most of the time is devoted to the needs of specific projects rather than providing general support. Funding – provided through a combination of BIA, NOAA, and BPA funding for specific projects.

Status of databases

The StreamNet Library database uses fully functional professional library cataloguing software to maintain and manage the Library catalog. Originally a commercial product (InMagic) was used to manage the catalog but this was converted to an open-source product (Koha) to save money needed for journal subscriptions. The catalog database has been stable and is continually updated as new material is acquired for the collection. The catalog is accessible through the StreamNet website or directly at http://www.fishlib.org/cgi-bin/koha/opac-main.pl

Since 2002, when staff were hired or dedicated to GIS and database development, CRITFC has been steadily building databases and geo-databases to manage and share data among CRITFC projects and with the region. Since 2009 the GIS and database staff have been committed to upgrading our Access databases to SQL, expanding current databases in their capacity to share data among and between many CRITFC and tribal projects, and developing automated user interfaces to collect raw data and deliver summary results and reports to CRITFC staff and the region through web interfaces. CRITFC is also committed to spatially referencing all its tabular data, and encouraging the four treaty tribes and the region to do the same.

Status of CRITFC's databases and geo-databases:

- Bonneville Stock Sampling of Chinook, sockeye and steelhead have been maintained in Access databases and tools since 2006. Recently they were moved into SQL databases featuring automated data collection, certain QA/QC procedures and production of basic reports.
    - Digital pen technology and a SharePoint server introduced to enter raw data collected at the dam on adult fish directly in electronic form.
    - Automated system for sending PIT data from another CRITFC project to be used and stored in our Bonneville Dam SQL database. CRITFC plans to expand databases devoted to PIT data collection and analyses from our and our member tribes' projects.
    - Adult fin clip and age data available in multiple formats on web: http://test.critfc.org/data_maps/BonnevilleAgeReports.aspx
    - Mainstem adult ladder counts (including zone 6) are automatically downloaded and stored for several project to use in the Bonneville SS SQL database: http://test.critfc.org:8080/damcounts/

- Summary database of Salmon and Steelhead data collected at Bonneville dam since 1985, currently in development phase, soon to be in the public though web applications. Need staff dedicated to web development to finish this project.

- Genetic Stock database – Plan to incorporate stock ID data with the Bonneville Stock Sampling database to spatially and temporally display stock composition information for salmon migrating over Bonneville Dam. Need staff dedicated to web development to finish this project.

- Preliminary Nez Perce subbasin harvest data: (available upon request to Nez Perce Fishery Program) in development since 2010. Digital pen technology and a SharePoint server were introduced to upload raw data in electronic format. Automatic summarizations and reports have been developed.

- CRITFC technical reports database automates the production of html language to place technical report information on CRITFC web pages:
  http://test.critfc.org/data_maps/Tech_rep.aspx

- PCSRF Project interactive map and Geo-database is moving to ArcGIS server:
  http://maps.critfc.org/cgi-bin/mapserv?program=mapserv&map=..%2F..%2Fmapdata%2Fpcsrfproj.map&zoomsize=2&mapshape=&imgshape=&imgbox=&qstring=&qlayer=&qitem=&shapeindex=&savequery=

- Subbasin Planning Limiting Factors interactive map and Geo-database is moving to ArcGIS server:
  http://maps.critfc.org/cgi-bin/mapserv?program=mapserv&map=..%2F..%2Fmapdata%2Ffourth.map&zoomsize=2&map_subbasins_tolerance=100&mapshape=&imgshape=&imgbox=&qstring=&qlayer=&qitem=&shapeindex=&savequery=

- Geo-databases of the habitat/fish models (EDT, QHA, Others) input and output data, reach-by-reach, used in Subbasin Planning – ready to be shared as a web service, but need staff dedicated to web development.

- Spatial and tabular data on CRITFC/EPA toxics study of the mid-1990s – ready to be shared as a web service, but need staff dedicated to web development.

- User access web site for Climate Change work and activities of the CRITFC tribes. Currently a database with stream temperature and geo-database with spatial layers for modeling is only in-house. Need additional staff time to make this available to the public.

- Fish Accords database currently in Access database form with spatial reference to HUC levels contains the habitat and biological benefits that were estimated in April of 2008 to reflect the final set of tribal proposed actions in the Fish Accords. CRITFC expects to improve upon this database and use it for future progress check-ins.

- SQL database built to store and collect habitat data for spring Chinook spawning and habitat project in the Grande Ronde, not collected in the CHaMPs database. Currently the database is only available to CRITFC and partners. In production, new tools developed seasonally.

- Crosswalk Fish Populations/Units Tool that spatially displays salmon population data and boundaries developed by many entities and regional processes is soon to be a funded BPA project. Many sets of data that CRITFC has developed will be part of this project, including:
    - Population units developed by NOAA Technical Recovery Teams under the Endangered Species Act.
    - Hatchery Reform Population maps - http://hatcheryreform.us/hrp/tools/population/view/view_populations.action
    - Population/unit boundaries based on the Subbasin Plans and a subsequent regional review coordinated by CBFWA were the foundation of this geodatabase.

Gaps

The following specific tasks are required for CRITFC to achieve regional data integration and sharing goals.

1. Assist member tribes to populate DET's with legacy and current data and document data flows and structures according to standard protocols, structures and data dictionaries
2. Develop and maintain web-based applications and tools to meet the data sharing needs of CRITFC and its member tribes.
3. Develop and maintain data entry, QA/QC and management applications and tools according to standard protocols, structures and data dictionaries
4. Assist the CRITFC to populate DET's with legacy and current dataand document data flows and structures according to standard protocols, structures and data dictionaries
5. Maintain and update StreamNet Library collection and catalog.
6. Accelerate conversion of Library hardcopy material to electronic formats for Internet access.

In the past CRITFC's data collection projects were staffed by one staff biologist and several temporary fishery technicians. Data were collected, but the diminished staffing in the off-season meant that the data were never organized into accessible databases. Budgets were sufficient to occasionally purchase needed hardware and software, but were insufficient to hire people to organize the accumulating amount of data. Each year the backlog got larger and the problem of organizing it became greater. Organizing these legacy data into shareable formats will take one person dedicated to the task.

In addition, the recent emphasis on improving data management applications and data sharing has created a need for additional technical capacity. Experience with the data pen and other new technology has proven the feasibility of automating much of the present manual data capture practices. However, while present staff can evaluate new procedures, they do not have the time to program, test, and train new users to implement better procedures. A software programmer in needed to develop better data management applications that can be shared between our member tribes and CRITFC.

A web page developer is also needed to develop and manage web pages and tools for the tribes to publish their data for access by other agencies. The Tribal Data Network is designed to link the databases held by CRITFC and each tribe by using agreed-upon protocols in a distributed database model. We presently have one-third of the funding needed for this position. That is sufficient to meet CRITFC's web development needs, but far short of developing the needed new web applications and tools or meeting the requests for assistance by our member tribes.

Discussions with our member tribes through our annual data management workshops and in the Coordinated Assessment project have identified the need for a dedicated data technician working with each tribal fishery program. Partial funding for these positions exists with some of our tribes. We request additional funding for two FTE data technician positions be added to the Tribal Data Network project to be contracted with our member tribes as needed to meet their need for data technicians.

In summary, the following personnel gaps have been identified for CRITFC and its member tribes to fully participate in the regional data sharing efforts.

1. 2 FTE data technicians to work with member tribes;
2. 1 FTE programmer to develop, test and train users on new data management tools;
3. 1 FTE data technician to
4. 0.67 FTE Web page developer to develop web tools and pages for tribes to share data among themselves and with other regional partners

Appendix D

Confederated Tribes of the Colville Reservation Data Sharing Strategy for Viable Salmonid Population Indicators

DRAFT, October 2011

Introduction:

The Colville Tribes monitor fish habitats over an extensive area including both anadromous and resident fish along with wildlife. As data are collected and accumulate over time, we fully recognize the importance of good data management. The Colville Tribes have always cooperated in regional efforts to the extent that time and resources allow but being located in remote north central Washington State makes participation logistically difficult. Advances in electronic media and electronic data exchange enhance our ability to coordinate with others in the Columbia River basin. Therefore, over the last several years we have been actively expanding our data infrastructure for our internal use following available regional guidance. However, resource limitations (mostly personnel) have restricted our ability to share data more broadly. The Okanogan Basin Monitoring and Evaluation Program has been on the front line of the Colville Tribes data management effort related to anadromous fish since 2006 and will continue to lead our efforts into the future as other monitoring efforts (resident fish) and data systems (Chief Joe Hatchery) come on line.

The primary anadromous fish habitats that remain within the Colville Tribes jurisdiction exist within the Okanogan River Basin. However, very little information existed within this subbasin related to anadromous fish and their habitats prior to 2004, when the Okanogan Basin Monitoring and Evaluation Program (OBMEP) first began being funded (BPA Proposal RMECAT-2003-022-00). Federal hydropower projects and private power utility systems have had major negative impacts on anadromous fish that once flourished in the Columbia River and its tributaries. In 2004, the Okanogan Subbasin Plan specifically outlined the need for establishing OBMEP in order to create a baseline of empirical data to help inform managers. By providing quantitative information to resource managers they would be better equipped to create beneficial restoration projects with the potential to reverse declines in listed stocks of anadromous fish.

Over the last 5 years, OBMEP has evolved into a robust monitoring program and the data collected have been used in a multitude of ways. These OBMEP data represent unique information related to fish and habitat within the Okanogan River Basin and are used to fill gaps in the Stream/Net database, Data-Access in Real Time (DART) online database, and the USGS Surface Water Monitoring Network.

In 2008, OBMEP was identified as a project under NOAA Fisheries final biological opinion related to the operation of the Federal Columbia River Power System for salmon and steelhead listed under the Endangered Species Act and included as part of the 2008 Columbia River Fish Accords as part of the Memorandum of agreement between the Colville Tribes and Federal Columbia River Power System (FCRPS) Action Agencies, thus securing long term consistent funding for this project through 2017. Most importantly, NOAA Fisheries recently completed recommendations for implementing research, monitoring, and evaluation (R,M&E), for the 2008 FCRPS BiOp and the OBMEP is consistent with those guidelines. In addition to planned R,M&E in the Pacific Northwest region, OBMEP is an international project requiring considerable coordination and integration with agencies outside of the United States.

The OBMEP data collection will continue to be primarily focused on status and trend monitoring at the population scale for all anadromous fish species in the Okanogan River Basin for the next 20+ years. The OBMEP will continue to monitor key components of juvenile fish production, habitat condition, water quality, and adult enumeration. Data will be collected using standardized protocols developed over the last 5 years. The OBMEP protocols will be modified to incorporate new knowledge and shared with other interested partners. Future research under the OBMEP will be limited to filling identified data gaps and small projects that will support future habitat restoration actions or fisheries management changes.

Purpose & Scope:

The OBMEP collects data related to salmon and steelhead fish populations that rely on the habitats of the Okanogan River basin for their survival. Primary anadromous focal species under OBMEP data collection include the following Technical Recovery Team (TRT) Populations: Upper Columbia River Summer/Fall ESU Chinook, Okanogan River ESU Sockeye, Upper Columbia River DPS (endangered) Steelhead and Upper Columbia River Spring ESU (endangered) Chinook. When OBMEP was originally conceived it was envisioned that these data would be used by the Colville Tribes and other co-managers to improve fisheries management and inform habitat restoration activities.

However, over the years additional agencies and data users have concluded that these data are important to help them meet their goals and objectives. Today, OBMEP data are linked to reporting for BPA fish and wildlife mitigation, the NPCC Columbia Basin F&W Program, ISEMP (BPA #200301700), the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), Columbia Basin Fish & Wildlife Authority (CBFWA) Status of the Resources (SOTR) reports, and other established regional monitoring, data management, and reporting efforts in the Columbia River Basin. Over the next several years, they will continue to provide data input, reports, products, and expertise derived from efforts in the Okanogan.

On a more local scale, within the Okanogan subbasin, efforts are coordinated with other management agencies and stakeholder groups that are collecting information to ensure that no duplication of efforts occurs within this watershed. They coordinate monitoring and evaluation efforts with the Upper Columbia Regional Technical Team through the Upper Columbia Monitoring Strategy (Hillman 2006). The Okanogan River is an international watershed and the OBMEP does not stop at international borders. They facilitate collecting data seamlessly by collaborating with the Okanogan Nation Alliance (ONA), who in turn facilitates collaboration with other Canadian stakeholders such as Environment Canada, the Ministry of Land, Water, and Air Protection, and the Department of Fisheries and Oceans.

They work to ensure that data collected under OBMEP can be integrated with data from other watersheds in the Upper Columbia ESU and into Canada. They have developed clear guidance, protocols, and training for the collection of all field data. The OBMEP protocols have been expanded to include standardized protocols adopted by PNAMP related to data management guidelines for date and time formatting (NED 2007), meta-data (Rentmeester 2010), and macro-invertebrates with invertebrate data collection protocols (Hayslip 2007).

Current Data Sharing Capabilities:

Data management beyond the application of standardized protocols has greatly expanded within OBMEP since the database and website was developed in 2007. They have developed data management documents related to the OBMEP database including both a user's manual (Summit 2007a) and translation manual for importing data (Summit 2007b). Data are consolidated within the OBMEP program and onto a server located at OBMEP offices and also distributed to the NOAA Fisheries STEM databank and summarized into annual reports and presentations that are provided to BPA and other regional stakeholders on both sides of the border. Data are shared directly with the Upper Columbia Salmon Recovery board to provide information to state-wide salmon recovery efforts and regional forums. They also share data directly with the Okanogan Nation Alliance, Mid-Columbia PUD's, Stream/Net, Data Access in Real Time (DART), and sponsor data hosting by the surface water monitoring networks run by USGS, WDOE, and Environment Canada. Summarized data are available on the OBMEP web site (http://Colville Tribesobmep.com/obmep.php) which provides public access to data and reports.

The primary products produced from this program are the data collected but as the data archive builds data analysis and reporting will play an ever increasing role. Data needed to evaluate viable salmonid population parameters (VSP) will be the primary focus of future biological monitoring efforts. Abundance, productivity, spatial structure will be our primary focus given that diversity metrics are difficult to apply to the Upper Columbia ESU due to past hatchery practices.

Assessment of Gaps, Needs, and Priorities:

1. Future data management needs include the continuation of compiling data under OBMEP which is funded through 2017 and the Chief Joe Hatchery RM&E effort slated to begin in 2012. Through continuation and expansion of this RM&E, new questions will arise and new data gaps identified. The Colville Tribes are aware of this and prepared to adjust and modify methods and data collection focuses as fisheries biology and knowledge continues to evolve.
2. Hundreds of millions of dollars have been spent on habitat and population manipulation actions with little or no rigorous assessment of the biological impacts these actions have had on anadromous salmonid populations. The OBMEP proposal addresses this issue by integrating multiple watersheds within the Okanogan River Basin in a subbasin scale monitoring program that measures population productivity and abundance metrics, and integrates them with past and on-going management actions.

    The primary management questions in regards to VSP criteria that will be answered by this program over time are:

    A. Are the number of salmon and steelhead adults in the Okanogan River Basin trending toward recovery over time? (VSP criteria-Abundance)

B. Are the number of salmon and steelhead juvenile out-migrants in the Okanogan River Basin trending toward recovery over time? (VSP criteria-Productivity
C. Is the spatial distribution of salmon and steelhead moving toward inclusion of all historically available habitat and life history strategies in the Okanogan River Basin over time? (VSP criteria-Spatial structure and diversity)
D. Making progress in linking habitat quality and quantity to fish population processes though the use of the EDT3 model.

3. The Colville Tribes historically lacked empirical data upon which to manage fisheries. With the advent of OBMEP, new analysis and analytical tools can be developed that calculate metrics and utilize these data to convey information that enhances our understanding of fish populations in the Okanogan River basin. As these tools are developed more reports and outputs will be made available. In addition other projects such as the Chief Joe Hatchery R,M&E project will expand the existing data sets and analysis that are available. The Chief Joseph Hatchery project will expand our data management to include hatchery effectiveness monitoring data specifically related to summer/fall and spring Chinook within the Okanogan River basin.

   The Goals of the Chief Joe Hatchery monitoring project are to:

   A. Use in season run forecasts to collect locally adapted broad stock and maintain a HNI of 0.67 or greater in accordance with HSRG recommendations.
   B. Determine if hatchery impacts are affecting naturally produced Chinook in the Okanogan River.
   C. Apply data to the AHA model in order to manage fish populations and hatchery activities synergistically.

4. As data sets continue to grow and increased infrastructure (i.e. PIT tag arrays, Okanogan River weir) becomes available through expanding Colville Tribal projects, partnerships with affiliated agencies, precision as well as the amount of VSP indicators that are calculable will increase. The primary indicator currently calculable by OBMEP is Natural Spawner Abundance and spatial structure. As monitoring continues to grow, VSP indicators addressing Recruits/Spawner as well as Smolt to Adult Returns will become calculable for more species.
   a. Currently PIT tags interrogations, rotary screw traps, adult weirs and video monitoring, snorkel surveys, hydro-acoustic surveys in Lake Osoyoos, juvenile tacking, spawning ground (redd, carcass, live count) surveys are a few methods of data collection conducted within the Okanogan subbasin in regards to VSP indicators.
   b. The OBMEP primary focus is on Steelhead, but coordination efforts with other projects or agencies has eliminated the duplication of efforts in the watershed for other salmonid species of interest; primarily Chinook and Sockeye.
      i. The new OBMEP data base has the ability to host data compiled by other agencies on the Colville Tribe's infrastructure, allowing data

queries/analysis/summaries for all salmonid species of interest in the Okanogan subbasin to be easily accessed from one location.

c. With this increased level of data sharing and availability, increased data sets and derived metrics, and increased calculable VSP indicators it is relatively easy to create a DET to share these indicators amongst interested parties.
    i. It is the hope of the Colville Tribes that the DET can pull data from their databases through programming and scripting to become self-generated, reducing the possibility of human error as well as work load.
    ii. If the DET is implemented in this way and made available to outside sources, there will be a need for a data sharing agreement in the form of a disclaimer, or something similar, to protect the Colville Tribes data from wrongful use or manipulation.

DET as a Business Practice for VSP Indicators:

1. The partner capacity of the OBMEP is high-level and was designed with the foresight to facilitate the sharing of data on a regional and international scale with many partners and agencies.
2. Recently, the Colville Tribes purchased new infrastructure including a new database server and a web server to facilitate access from outside entities. An upgrade to the database format was also completed, converting the database from a Microsoft Access database to a SQL Server database. This new platform has opened up a world of new ways to interface with the data in the database. When Access was used, the needs and priorities to successfully share data were to develop queries to extract data from Access, develop scripts or manually reorder the data to a standardized format for the agency or entity with which it was shared, and use e-mail or a file sharing service to deliver the data. With SQL Server and the new web server, our needs can largely be met with the development of custom, standardized user interfaces in a web-based platform. Therefore, there is a staffing need of an individual, who can continue to facilitate current data sharing efforts and expand future capabilities. Ideally, the individual would have some programming experience to continue to develop scripts, tools, and interfaces with the OBMEP database to standardize and automate reporting of VSP parameters.
3. Management and governance is going to be an important issue to address as the region strives to implement this DET across the region/basin. It is important to OBMEP that there is uniformity of definitions in regards to terminology and methodology. Also, to operate on a region/basin wide level it is important to continue dialogue through workshops and management to ensure that decisions are made and conducted in a manner mutually beneficial to, at least, the majority of all interested and active parties. OBMEP will need assistance in coordinating with the multitude of data repositories, agencies, co-managers, and regional players involved in the basin wide data sharing strategy.
4. There are currently 4 permanent PIT tag array sites operating in the Okanogan Basin with plans for up to 11 additional permanent sites to be installed over the next few years. PIT tag data are essential to calculating VSP parameters such as smolt-to-adult ratios and adult escapement. Data from the four permanent sites currently installed are available over the internet via a

wireless modem at the PIT tag site. However, the amount of data that can be transferred within a given month is limited by the plan that was purchased. As the amount of data and frequency of downloading increases, it is feasible and may be more cost-effective to install wireless internet at the permanent PIT tag array sites. This would allow for unlimited data transfer at a comparable cost now and likely a lower cost in the future.

5. Related to item 4, an additional area for improvement is the management of PIT tag data and the need to easily import PIT tag data into the OBMEP database for routine analyses. Currently, the data are manually uploaded to PTAGIS, where the data are publically available to all. If the individual mentioned in task 2 above has some programming experience, it may be possible for them to develop scripts to automatically transfer PIT tag data from PTAGIS into the OBMEP database. However, if they lack these skills, additional funds may be needed for the current IT professionals contracted by the Colville Tribes to develop the automated scripts for importing data from PTAGIS into the OBMEP database. Incorporating the PIT tag data into the OBMEP database reporting environment will contribute to more timely analyses of the data.

Appendix (request from CCT):

A. Gaps, Needs, Priorities Assessment

References:

BPA Proposal RMECAT-2003-033-00 – Okanogan Basin Monitoring & Evaluation Program (OBMEP)

http://www.cbfish.org/Proposal.mvc/Summary/RMECAT-2003-022-00

Appendix E
Confederate Tribes Umatilla Indian Reservation
Columbia River Basin Data Sharing Strategy for
Three Viable Salmonid Population (VSP) Indicators

Purpose and Scope

The purpose of data management for the Confederated Tribes of the Umatilla Indian Reservations is to promote and facilitate the collection, maintenance and beneficial use of data within tribal government. Our goal is to create systems to maintain accurate, consistent and transparent data content**,** thereby allowing tribal board members and agency directors' access to the best possible data for decision making and policy development.

The First Foods frame work and the River Vision are the primary policy statements guiding DNR and Fisheries programs in CTUIR. CTUIR seeks to manage data to inform these policies, summarized below.

First Foods: *To protect, restore, and enhance the First Foods - water, salmon, deer, cous and huckleberry – for the perpetual cultural, economic and sovereign benefit of the CTUIR. We will accomplish this using traditional ecological and cultural knowledge and science to inform: 1) population and habitat management goals and actions; and 2) natural resource policies and regulatory mechanisms.*

River Vision: *The Umatilla basin includes a healthy river capable of providing First Foods that sustain the continuity of the Tribe's culture. This vision requires a river that is dynamic, and shaped not only by physical and biological processes, but the interactions and interconnections between those processes.*

CTUIR's Information Technologies (IT) department is working with DNR to foster a culture that recognizes data as an asset and that a data management strategy as vital to support tribal goals. Its purpose is to: *Ensure that information technology (IT) policies, systems, infrastructure, and capacity meet the needs of the core business functions of CTUIR government.*

To meet the business need of the DNR department, OIT has developed a data management strategy that will help guide DNR policies by facilitating access to data necessary for the decision making process. CTUIR's data management strategy has six components. We seek to describe the current data collection, analysis and reporting processes, integrate data collected from regional offices, maintain that data on our centralized database, assure data quality, archive our data, and develop an information system. This strategy creates pathways, for data to flow to decision makers for policy creation and a feedback loop to refine data collections.

Data Management Strategy

CTUIR retains the rights as a sovereign nation to collect, store, analyze and utilize data to develop policies and inform the Tribal public. A vision for information management has been

developed through a collaborative process involving several Tribal departments. At the core of the vision is a process defined by the following tasks:

Describe the current data collection, analysis and reporting processes: CTUIR will document existing data collection, analysis and reporting in a manner that is useful for the stakeholders. We will identify decision makers, parameters collected, metrics calculated, and existing data flows. CTUIR will coordinate with staff to conduct systematic needs assessments for all data flows identified. This includes identifying and interviewing all data collectors, data consumers, and other stakeholders in order to identify and prioritize needs

Integrate data collected from regional offices: OIT will present the findings of the documentation effort and the data flow diagramming to the stakeholders. We will identify junctures in the process where the benefits will be realized from having a central data management repository and customized user interfaces.

Maintain data on our centralized database: CTUIR seeks to make it a common business practice to synchronize data collected from regional offices. We will work with staff to ensure that data are being maintained in centralized data systems in a timely fashion, and ensuring that basic QA/QC standards are being met.

Assure data quality: CTUIR seeks consistent and complete data and will work with regional biologists to standardize the fisheries data collection and data entry process and create systems to QA/QC data.

Archive DNR data: The archiving of data will consist of storing data into the centralized database and developing data dictionaries and metadata tools to describe data. Using these tools OIT will make stored data easy to find and retrieve when needed.

Development of information system: The idealized information system would be developed for presenting and summarizing data as well as development of tools to make retrieval of data fast and applicable to the decision making process. CTUIR will work with database developers to design user interfaces to meet the needs of end users. This would include mocking up conceptual designs and conducting QA/QC testing of user interfaces as they are produced by technical staff.

This strategy will allow fisheries data to be accessible to inform fisheries policy. Fishery policy will in turn refine project goals and the data collection process.

Collaboration

CTUIR is prepared to collaborate with our co-managers to make sharing data a common business practice. CTUIR supports making available population level data for the three Viable Salmonid Population (VSP) indicators (Natural Origin Spawning Abundance, Smolt to Adult Return Ratios, and Recruits per Spawner Ratios). CTUIR is willing to adopt a common data exchange template and will continue to coordinate with the Coordinated Assessment Phase III work plan to manage DETs. CTUIR is ready to work with co-managers given that this template does not infringe on CTUIR's tribal sovereignty rights; including the ability to house all raw data

pertaining to resources in CTUIR's traditional use areas. These data must be available in a format that supports query, synthesis and analysis in support of policy development. CTUIR supports the data exchange template as long as the duties and requirements of this project do not require a disproportionate or unmanageable cost to CTUIR employees and resources.

Data Sharing Strategy

This strategy provides a common vision of CTUIR to exchanging information between collectors, analysts, and end users for the purposes of effective evaluation of the tribal salmonid resource and progress toward the recovery of anadromous salmonids listed under the Endangered Species Act (ESA). This data sharing strategy outlines an approach that will ensure that data and information can be shared in a timely, efficient, and collaborative manner across the basin. CTUIR will implement a data sharing strategy which includes creating a data sharing policy, establishing a common trust environment, advancing data discovery and retrieval, and developing the tools necessary for data sharing.

Institute a data sharing policy: CTUIR is a sovereign nation and signatory to the accords of 2007. As a sovereign signatory to the accord, CTUIR will manage its own data to support decision making and policy development. A data sharing policy will be developed to outline in what format data are to be shared, document what the intentions of the sharing of the data are and identify what types of data will be shared.

Establish a common trust environment: CTUIR will work with regional biologists, analysts and end users to put in place uniform, information security standards, information access rules, user authorization, and access control to promote common trust.

Advance data discovery and retrieval: CTUIR will manage and store regional fisheries data on a centralized database. CTUIR will develop a spatially based relational database and a custom designed user interfaces to query information, summarize data and automate reporting. CTUIR will document all data with Metadata dictionaries.

Develop the tools necessary for data sharing: CTUIR will continue to make fisheries data available through web access and will develop the tools necessary at the institutional, leadership, and workforce levels to collaborate and share knowledge, expertise and information.

Populations Covered and Geographic Scope:

CTUIR co-manages Steelhead, Chinook, and Coho populations in the Grande Ronde, Walla Walla, and Umatilla Basins.

Grande Ronde Salmonid populations: Upper Grande Ronde Summer Steelhead, Upper Grande Ronde Spring Chinook, Catherine Creek Steelhead, Catherine Creek Spring Chinook, Lookingglass Creek Spring Chinook

Walla Walla Salmonid populations: Walla Walla Summer Steelhead, Walla Walla Spring Chinook, Walla Walla Touchet Summer Steelhead

Umatilla Salmonid populations: Umatilla Steelhead, Umatilla Spring Chinook, Umatilla Fall Chinook, Umatilla Coho

Current data sharing capabilities

Infrastructure: CTUIR has the necessary hardware, software and backup systems to manage a centralized database.

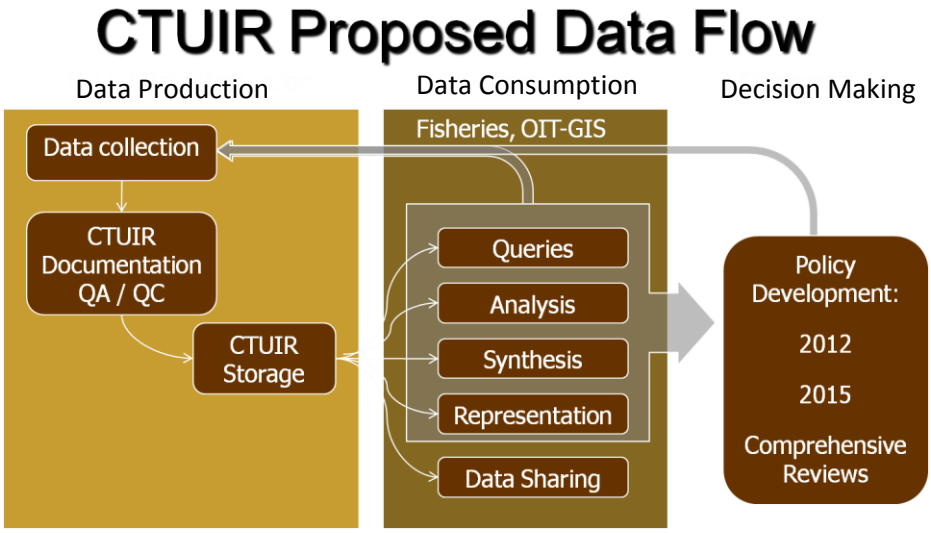
Staff: The data management needs of CTUIR benefit from the support of highly qualified IT, Records Management and GIS Programs. Most positions within these programs have advanced certified degrees and work collectively to provide integrated solutions for the needs of CTUIR. CTUIR currently employs a Database Administrator/Web programmer Matt Gerbrandt. Mr. Gerbrandt has the capacity to build reporting, translation and exchange tools in house for the purposes of reporting VSP indicators. Mr. Gerbrandt has built data exchange templates to meet the needs of our water quality reporting requirements to EPA's STORET/WQX program. Greater progress towards our fisheries data management and data sharing goals would be made with a dedicated data management coordinator. This person would work with data collectors, data managers, database administrators, and policy analysts to ensure CTUIR's data goals are met.

Web access data sharing: CTUIR's regional offices in La Grande Oregon, Walla Walla and Dayton Washington are connected to the central government over high speed internet carriers. CTUIR has created a repository for data at CTUIR's central office in Mission Oregon and we will take steps to make it a common business practice to upload data onto a centralized database. Access to the central servers occurs through a password protected login. Staff have access to a variety of software packages and custom built web applications for uploading data and performing QA/QC functions.

Fisheries data are currently reported on our website: http://data.umatilla.nsn.us/. Tools are developed within a web browser which summarize and graph information making it easier to identify outliers and errors, and allowing the user to flag data and enter comments regarding the use of flagged data in analysis.

Data management processes: Data collection occurs throughout all programs within the Tribal Government. In most cases data is collected, analyzed and stored locally in offices in La Grande Oregon, Walla Walla and Dayton Washington. The need for centralizing data to make it more useable, provide a more efficient methods for data storage, provide QA/QC protocols and a unified point of dissemination to the public has been recognized throughout the Government. Small pilot projects have proved successful in the Fisheries program as well as the Water Resources Program. Greater progress would be made with a dedicated staff person.

Schematic demonstrating idealized information systems



Assessment of gaps, needs, and priorities

Future data management needs: CTUIR needs to hire a Data Management Coordinator. This position would improve CTUIR's ability to coordinate information internally and allow for a greater ability to serve data out to the public and state and federal agencies.

- CTUIR needs to document current data collection, analysis and reporting processes in order to inform the development of the idealized data flows, which inform Tribal policy makers and the Tribal community as well as other state and federal agencies.
- CTUIR needs to improve on the current work flow processes to integrate data into a centralized data base.
- CTUIR needs to create systems that will allow users the ability to easily and efficiently QA/QC data stored on our centralized databases.
- CTUIR needs to research and develop interactive, informative tools for presenting and summarizing data as well as tools to make retrieval of data fast and applicable to the decision making process.

Proposed project to address gaps: CTUIR will hire a data management coordinator. This person would be a liaison between data collectors, data managers, database administrators, and policy analysts. Their primary responsibility would be ensuring that CTUIR DNR data are collected, stored, and distributed in a way that meets the needs of CTUIR Government, as well as the larger community.

Appendix F

Confederated Tribe of Warm Springs Reservation, Oregon

Columbia River Basin Data Sharing Strategy for Three Viable Salmonid Population (VSP) Indicators

Summarized by StreamNet for Coordinated Assessments Project

Purpose Statement

Over the years there have been numerous administrative and scientific calls for a comprehensive monitoring and evaluation program to provide consistent, region-wide information about the status of salmon populations and their response to management actions (Botkin et al. 2000, ISAB 2001). Coordination at this level requires committed promotion of standardized data sets, similar experimental designs, field sampling methodologies, use of a common data language, analytic techniques, and data architecture.

The CTWSRO is participating in the Coordinated Assessments Project, representing a preliminary basin wide effort to establish sharing capacity as it relates to three Viable Salmonid Population (VSP) indicators: natural origin spawner abundance, smolt to adult ratio, and recruit per spawner ratio. This document summarizes current data management and sharing efforts with regard to these three indicators, and presents a preliminary assessment of additional resources required to implement an ongoing business practice involving consistent, reliable, database facilitated exchange of these indicators.

Scope

The CTWSRO co-manages populations in the Deschutes, Hood River and John Day subbasins with the Oregon Department of Fish and Wildlife (ODFW) and works collaboratively with the United States Fish and Wildlife Service (USFWS) to manage hatchery operations at the Warm Springs National Fish Hatchery. The CTWSRO utilizes an adaptive management strategy to achieve recovery objectives, protect remaining populations, and preserve the physical characteristics of anadromous fish stocks. Long term agency goals include the protection and strengthening of wild populations of spring Chinook and fall Chinook salmon satisfying tribal and recreational harvest objectives, and reduction of demographic risk of extirpation of summer and winter steelhead.

Established monitoring-based data collection efforts include: spawning ground surveys (multiple-pass index-reach redd counts, adult live fish counts, carcass counts and tag retrieval, genetic sampling for origin derivation), monitoring of adult spawning escapement via weir or video monitoring, annual adult and juvenile distribution surveys, juvenile outmigrant rotary screw trapping, video monitoring, snorkeling to monitor juvenile densities, habitat surveys, run timing and stray rate assessments, measuring reproductive success of both indigenous and non-indigenous stocks, and CREEL surveys to monitor tribal harvest.

Additional data-generation projects underway or planned include:

- implementation of a more statistically robust assessment of smolt abundance (e.g. snorkel surveys using randomly selected areas and habitat),

- installation of PIT tag arrays to facilitate escapement and out migrant estimates, validate existing employed methods, monitor straying and immigration/emigration timing, and calculate VSP indicators as smolt-to-adult ratio,
- Installation of a resistance board weir in Shitike Creek to increase the ability to monitor populations of steelhead and spring Chinook salmon,
- Expansion of juvenile outmigration monitoring with additional rotary screw traps to investigate natural production in tributary streams.
- increased monitoring of newly established Hood River subbasin adult collection facilities (weirs and traps) replacing that lost with the removal of the Powerdale Dam in late 2010.

Current data sharing capabilities (based on DET, DAFD, and GNP Assessments)

Current State of 3 VSP Indicator Calculations

CTWSRO co-manages with ODFW and USFWS in monitoring and supplementation efforts within the Hood River and Deschutes River subbasins. Salmonid populations of interest include Hood River coho, chum, Chinook and steelhead, and Deschutes River spring and fall Chinook and steelhead. Each population and stream system provides unique monitoring challenges. In the Hood River, removal of the Powerdale dam in late 2010 introduced a number of management obstacles as well as opportunities for re-introduction efforts and potential for full in-basin rearing. In the Deschutes, generation of reliable SAR and R-S values for fall Chinook is not currently feasible due to difficulties estimating certain metrics throughout their life history

Natural spawner abundance is calculated for salmonids in the Hood River subbasin and Deschutes fall Chinook. This indicator could be supplied for spring Chinook in the Deschutes subbasin, with some additional manipulations of data generated from current monitoring processes. Smolt to adult ratios are calculated for Deschutes spring Chinook populations as well as some of the Hood River salmonid populations to which monitoring efforts are extended. Additional money, equipment (e.g. PIT arrays) and staff hours will be necessary to supply this indicator for Deschutes fall Chinook.

Recruit to spawner ratios were attainable for some Hood River stocks prior to the removal of Powerdale dam, but may not be post-removal. This indicator is not currently calculated for Deschutes subbasin spring Chinook populations.

Summary of tribe's current data sharing systems

There are very few cases in which CTWSRO biologists are sole proprietors of a given indicator's data life cycle (a data life cycle encompasses the stages of creation or collection, processing, dissemination, use, storage, and disposition). This interagency codependency extends back to data accrual, with CTWSRO, ODFW and USFWS biologists each contributing to the calculated metric or indicator via a complement of measurements. CTWSRO biologists responsible for populations in their respective subbasins experience varying degrees of agency cooperation and exchange with regard to sharing of indicators and metric information.

The CTWSRO recently implemented a switch to a Macintosh platform, in order to curtail licensing and other costs associated with maintaining a tribal-wide Microsoft platform. While the new platform can accommodate modern communication technologies, software, and most compatibility expectations, the switch has seen some challenges. These relate primarily to the integration of existing Access and SQL Server databases, and pervading issues associated with the accommodation of lower resolution legacy data. There have been additional challenges experienced by those sectors using significantly outdated computer equipment in the interim to platform migration.

The current state of CTWRSO's technological infrastructure precludes streamlined, database-facilitated exchange of generated indicators and/or their metrics. Subsequently, modes of data sharing and exchange occur primarily via Excel spreadsheets, e-mail, and word documents. Progress and annual reports are generated to comply with contractual obligations to the Bonneville Power Administration (BPA), National Oceanographic and Atmospheric Administration (NOAA), United States Fish and Wildlife Service (USFWS), United States Department of Agriculture (USDA) and other funding sources.

For general users of the data, accessing metric and indicator information is cumbersome and overall availability is inconsistent. Indicators and/or their metrics are dispersed between several documents, are reported and displayed with no contextual information, are presented somewhere in the text of a report covering all aspects of the monitoring program, or are not reported at all.

Summary of tribe's data management processes

The CTWSRO does not have a robust system of data management: there are no standard methodologies to the creation, collection, storage, retrieval, or conversion of organizational data to usable management information.

Generally speaking, project data is stored on personal computers and disseminated via Excel tables, word documents and e-mails. In many cases, a current manager has inherited preexisting projects (and corresponding vast amounts of data) from a previous manager. Often, the latter was the single source of information for the where, what, when and how of the data, resulting, inevitably, in the loss of these values at the end of his/her tenure. For a generalized depiction of data flow, reporting responsibilities, and storage methods see "Figure 1: Data Management Diagram – CTWSRO 2011" located at the end of this document.

Comparing or combining related data gathered by different projects proves problematic due to a lack of standards in collecting, processing or storing the data. Compounding the situation, legacy data is archived in archaic systems (e.g. filing cabinets): extraction of pertinent data and an analysis of these data is not a feasible endeavor at this time.

Future needs to address gaps

The CTWSRO does not have a dedicated IT staff resource. Attempts to develop a robust and expandable database are impeded by an absence of in-house IT support who can provide timely systems oversight and troubleshoot any software, hardware and/or related connectivity issues.

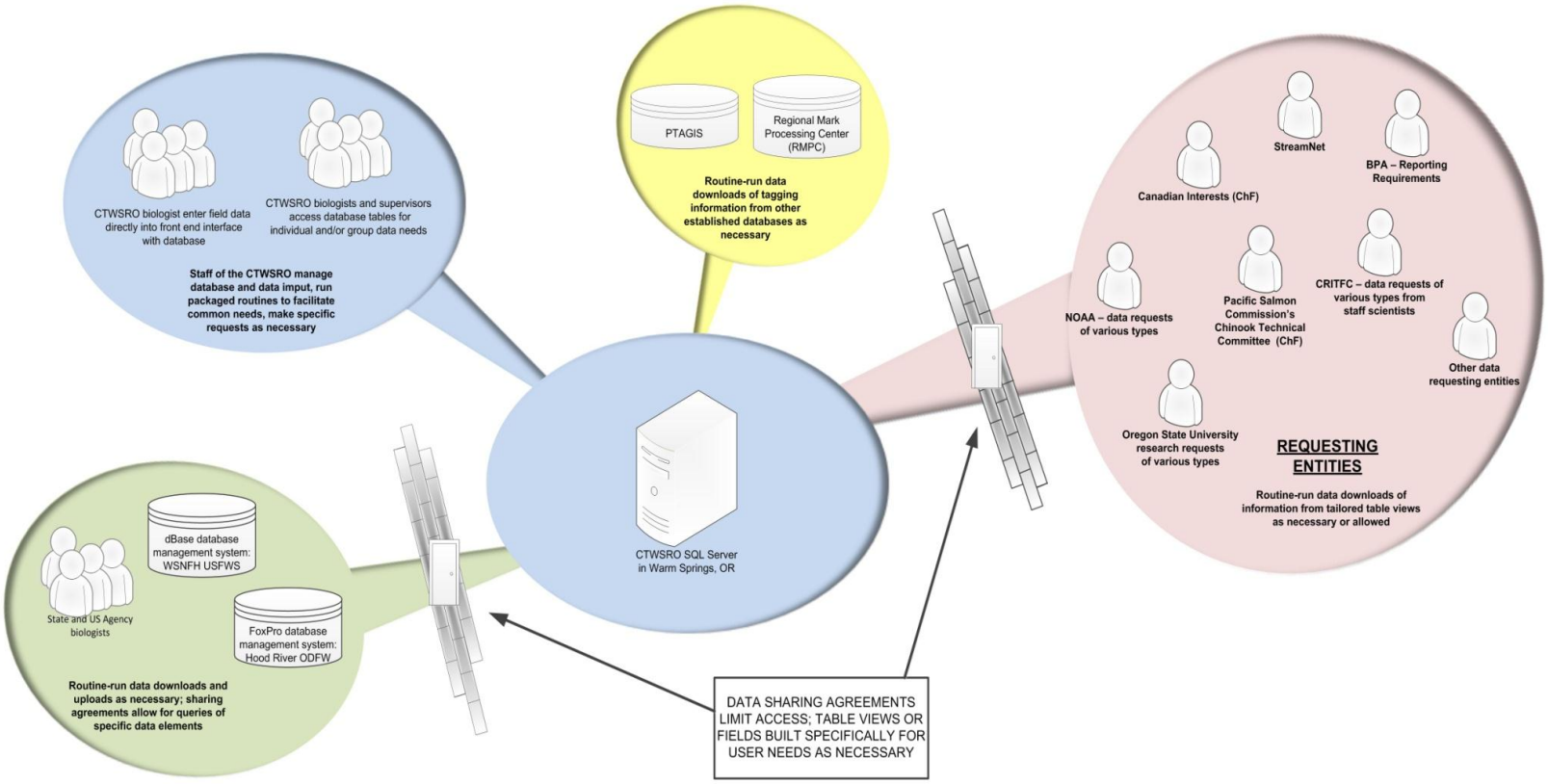
Additionally, the CTWSRO needs to establish data management plans and tools encompassing:

- conversion of legacy data into a modern format, to allow for long term analysis,
- development of data standards: common terminology and common data element definitions to facilitate the integration of databases and to promote public access to commonly defined data from disparate sources
- development of documentation and common protocol regarding data collection methodologies, documentation, format, entry, and dissemination,
- development of a robust data review process, throughout data life stages,
- establishment of a data steward(s) to manage the development, approval, and use of data, and ensure that it can be used to satisfy data requirements throughout the organization,
- improved availability of references, citations, reports, systems, or other published materials that are sources for data items.
- development of a well-planned, comprehensive, centralized CTWSRO database system, housing region wide data generated from fisheries and habitat monitoring.

The following figure (Figure 2) offers a generalized representation of a centralized data management system. Such systems, when implemented strategically, significantly improve data consistency, accessibility, and integrity. System characteristics such as prudently constructed user interfaces and ‘push of a button’ data extraction routines improve user experience and help to streamline the process of data dissemination.

Figure 2: Future Data Management Flow Diagram (simplified)– CTWSRO Hood River DRAFT

Improving consistency and efficiency through Data Management



Created By:	J Miles
Date:	07.06.2011 - DRAFT
File:	CTWSRO_Future_DMFD_A_v1
Notes (Annotations, general comments, references, etc.):	CTWSRO in-house centralized data management system facilitates data sharing and analysis....

Priority program level recommendations

Partner Capacity and Shared Technical Infrastructure

The CTWSRO works collaboratively with ODFW and the USFWS to generate data invaluable to viability monitoring of salmonid populations in the Deschutes and Hood River subbasins. They report to numerous other agencies and monitoring entities, including the BPA, the Pacific Salmon Commission, and the US Chinook Technical Committee. There are established practices of data exchange between the tribe and these agencies, involving modes that include Excel, word, e-mail and published reports. While these modes have sufficed in the past, changes in reporting requirements and needs, as well as increases in the volume of data elements and complexity of data analysis, necessitates active participation in a region wide coordinated move toward database-facilitated exchanges of these data. Continued investment by the CTWSRO in capacity building projects will help ensure effective design, implementation, coordination, management, and service delivery of their data housing and sharing systems.

Existing and future efforts to establish a relational database system and associated framework would be best served by contracting a consultant or facilitator to: a) identify the gaps/needs in the CTWSRO's technical infrastructure and b) appropriately guide the CTWSRO in their acquisition of an efficient, low cost system that has flexible implementation, with an ability to meet current and projected levels of data collection and exchange. Any assessment should include: a) data consistency needs between field office biologists, b) staffing, technical, hardware, and sharing agreement needs, c) training needs for users of any new systems, hardware, software, etc., d) user front-end needs, e) data stewardship needs and, in the interest of further enabling partner capacity, f) promotion of common data sharing technologies, formats, elements, variables, terminologies, and definitions.

Development of a system of data processing, storage, analysis, reporting, and distribution to meet the crucial needs of a large-scale monitoring program is no small task. Contracting an outside resource will ultimately reduce the potential for practices and organizational structure that are too soon obsolete, incapable of accommodating integration of new methods, data, data sharing partners and reporting requirements, or whose end products do not meet the needs of biologists and management.

Management and Governance

In order to positively contribute to the coordinated basin-wide effort to improve informed decision through data sharing, CTWSRO management will need to: 1) identify shared goals and needs within the organization, 2) establish consistency and improved communication between field offices and supervisors, 3) promote the understanding that quality and accessibility of metadata - the who, what, when, why and how data is collected, managed, stored, and disseminated - is as necessary to informed decision making as the data itself and 4) establish and maintain sound data management practices that help to ensure the validity and integrity of any generated data.

Management, biologists and IT staff of the CTWSRO will greatly benefit from continued dialogue through workshops and activities that contribute to efforts to implement both a data exchange template and region-wide data sharing system.

Common Data Exchange Templates

Building a robust technical infrastructure is going to take time. In the interim, the CTWSRO will need to support the region-wide effort to improve transparency by participating in data exchange via a Data Exchange Template. This template will provide a means to share estimates for the 3 VSP indicators, as well as provide a small set of supporting metrics and metadata. Participation will necessitate a business practice that makes data needed to evaluate the VSP parameters a primary focus of biological monitoring efforts. Data analysis will need to follow guidance as it becomes available from NOAA fisheries or other sources. Lastly, there must be a commitment to timely provision of empirical data requests by fisheries managers assigned the task of protecting runs in the Columbia River Basin.

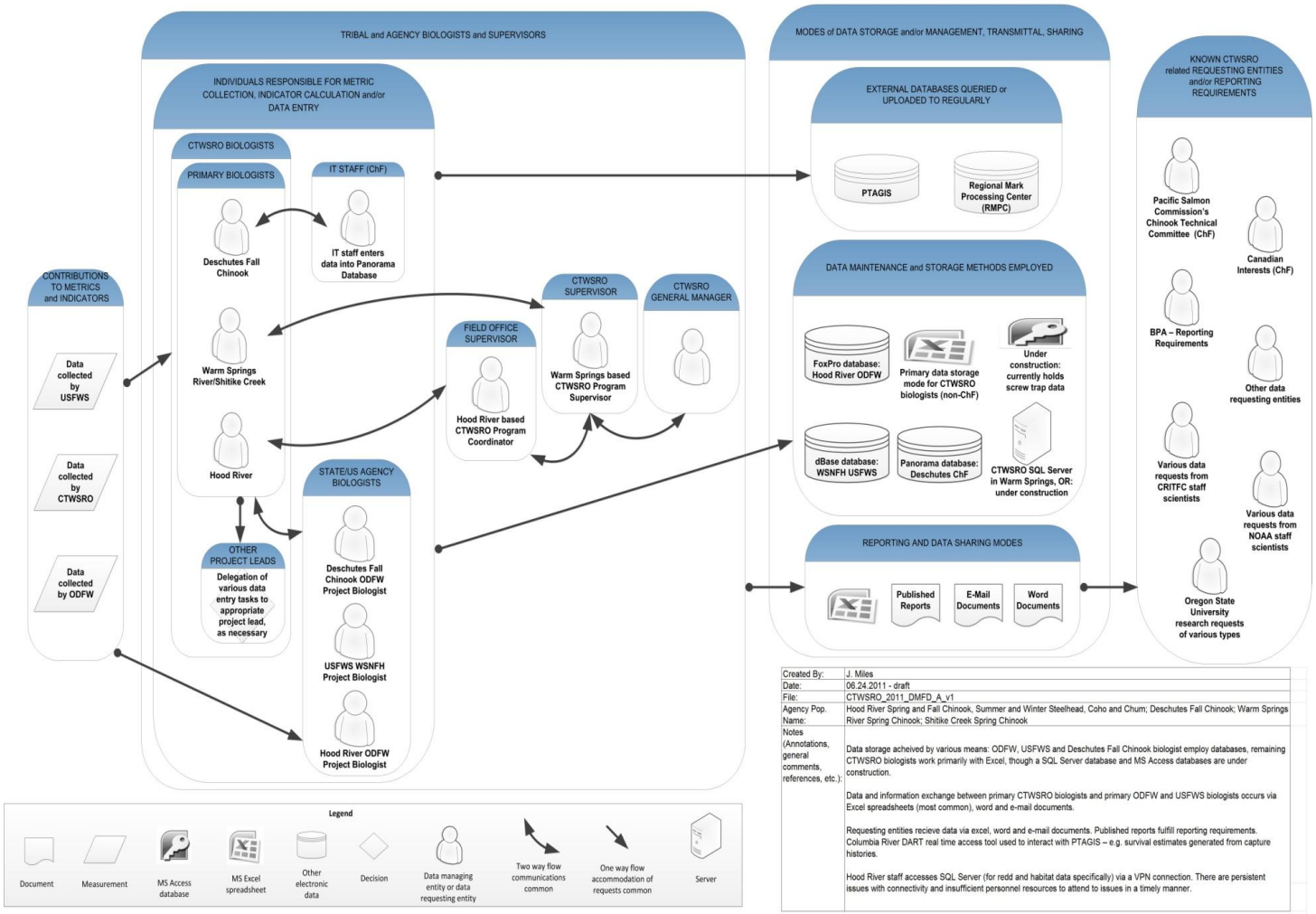
To avoid the devaluing of its data via inevitable and rapid changes in information technology, the CTWSRO recognizes the need to manage based on best practices and standards of information management. In the interest of long term informed decision making, the CTWSRO will continue to participate collaboratively in established regional monitoring, data management, and reporting efforts in the Columbia River Basin, as well as the coordinated Columbia River basin-wide effort to make three VSP indicators readily available.

Citations

Botkin, D.B., D.L. Peterson, and J.M. Calhoun (technical editors). 2000. The Scientific Basis for Validation Monitoring of Salmon for Conservation and Restoration Plans. Olympic Natural Resources Technical Report. University of Washington, Olympic Natural Resources Center, Forks, Washington, USA.

Independent Scientific Advisory Board (ISAB), (2001). Model Synthesis Report: An analysis of decision support tools used in Columbia River Basin salmon management. March 2, 2001. ISAB 2001-1a. For the Northwest Power Planning Council and the National Marine Fisheries Service.

Figure 2: Current Data Management Diagram – CTWSRO 2011 - DRAFT



Created By:	J. Miles
Date:	06.24.2011 - draft
File:	CTWSRO_2011_DMFD_A_v1
Agency Pop. Name:	Hood River Spring and Fall Chinook, Summer and Winter Steelhead, Coho and Chum; Deschutes Fall Chinook; Warm Springs River Spring Chinook; Shitike Creek Spring Chinook
Notes (Annotations, general comments, references, etc.):	Data storage acheived by various means: ODFW, USFWS and Deschutes Fall Chinook biologist employ databases, remaining CTWSRO biologists work primarily with Excel, though a SQL Server database and MS Access databases are under construction. Data and information exchange between primary CTWSRO biologists and primary ODFW and USFWS biologists occurs via Excel spreadsheets (most common), word and e-mail documents. Requesting entities recieve data via excel, word and e-mail documents. Published reports fulfill reporting requirements. Columbia River DART real time access tool used to interact with PTAGIS – e.g. survival estimates generated from capture histories. Hood River staff accesses SQL Server (for redd and habitat data specifically) via a VPN connection. There are persistent issues with connectivity and insufficient personnel resources to attend to issues in a timely manner.

Appendix G

Idaho Fish and Game
Columbia River Basin Data Sharing Strategy for
Three Viable Salmonid Population (VSP) Indicators
Draft 10_7_2011

Purpose and Scope

The purpose of this Data Sharing Strategy is to describe the management infrastructure and identify needs and gaps for the Idaho Department of Fish and Game's (IDFG) sharing of population level indicators for Snake River Chinook salmon and steelhead. IDFG will be reporting indicators for populations defined by the Interior Columbia Basin Technical Recovery Team. The near-term goal is to share the three viable salmonid population (VSP) indicators which estimate population abundance (abundance of natural spawning adults) and population growth rate (adult to adult return rate and smolt to adult return rate). IDFG plans to calculate and distribute the final VSP indicators (population spatial structure and diversity) and hatchery metrics after completing the near-term goals.

IDFG collects data to support VSP indicator calculations for 26 Spring/Summer Chinook salmon populations. Data are available to support calculation of natural spawner abundance and adult to adult return rate for all populations. Smolt to adult return rates (SAR) are calculated for the Snake River basin at the aggregate level for stocks upstream of Lower Granite Dam. Population specific SAR may be calculated in the future for some Chinook salmon populations. In the future the Genetic Stock Identification (GSI) project will help fill data gaps in the current monitoring effort to support calculation of VSP indicators at the Major Population Group level for Chinook salmon populations in Idaho.

For the 15 summer steelhead populations in Idaho the VSP indicators are calculated at the Snake River Distinct Population Segment (DPS) aggregate level at Lower Granite Dam. Partial population indicators for natural spawner abundance and adult to adult return rates are available for seven of the steelhead populations. All steelhead populations in Idaho are listed as Threatened. In the future the GSI project will provide data to support calculation of VSP indicators at the Major Population Group level for steelhead populations in Idaho.

The VSP indicators for the Snake River sockeye salmon ESU are calculated using the Redfish Lake population. Natural spawner abundance and SAR are calculated annually. Adult to adult return rates are not currently calculated. IDFG plans to calculate and distribute the adult to adult return rates, spatial structure and diversity information for Snake River sockeye salmon.

IDFG envisions a distributed data system, where the raw data and metrics are managed internally. Data would be stored on a centralized database and indicators would be calculated by IDFG. Final indicators can be disseminated directly from IDFG through the Idaho Fish and Wildlife Information System (IFWIS) hosted on the IDFG website (fishandgame.idaho.gov/ifwis) or can be submitted to a regional database, such as StreamNet.

Current data sharing capabilities (based on DET, DAFD, and GNP Assessments)

Data used to calculate VSP indicators for Idaho Chinook salmon and steelhead populations is collected by biologists at numerous regional offices. Raw data is stored in centralized databases maintained by IDFG. Demand has not existed for annual calculations of all three VSP indicators at the population level. IDFG is placing a priority on calculating all VSP metrics in-house for distribution to others as necessary. As the capacity to derive the indicators is achieved, the goal is to distribute the indicators through the IFWIS data base with automated data sharing for regional data consumers as feasible

i. The IFWIS system is a comprehensive information system for standardizing data on fish, wildlife, and plants in Idaho. The system was designed to share metric level data within the department and derived data to the public. IDFG has the ability to share VSP indicators and supporting metadata through IFWIS. Due to current funding constraints this is not currently being done. SARs are calculated for the aggregate Snake River Basin populations. Currently, the IFWIS portal houses queries to access raw data and serves up redd counts and hatchery salmon and steelhead adult return data. All IDFG databases are not available on the IFWIS portal. The following databases store information to support calculation of VSP indicators:

   a. Spawning Ground Survey (SGS) Database: Data available from the SGS database through the IFWIS portal query include number of redds, drainage, and transect information. The Nez Perce and Shoshone-Bannock tribes collaborate and will be submitting data for areas surveyed by tribal personnel. Carcass data is also available through this interface. Carcass surveys on the spawning grounds provide hatchery and natural origin carcass numbers and supporting data which is entered into the SGS database. We have the ability to link the carcass data in the SGS database to the age information stored in the Aging Database. Once age is derived from scale, fin-ray samples, and coded wire tags (CWT) the data can be used to update the original estimated ages of the recovered carcasses. Queried data can be presented in a spreadsheet or a pivot table and is also available for download to a computer. Primary funding is through Streamnet.

   b. Hatchery Database: The hatchery database is divided into three separate modules; trapping, events and spawning. A separate module for incubation, rearing and release is in development. The trapping module stores fish data collected at the hatchery trap or fish weir (such as gender, marks, PIT tags, and fork length). The events module includes all processes that occur from fish ponding to the final disposition of the fish. Final disposition includes pond mortalities, spawning, and live or dead fish distribution. Data is uploaded into the hatchery database in near real time. The hatchery database is available for query through the IFWIS portal and can be presented in a spreadsheet or pivot table. It is also available for

download. Primary funding is through the USFWS Lower Snake River Compensation Plan.

c. Aging Database: Stores information related to aging of salmon and steelhead. Data may be collected from Fin ray and scale samples removed from fish at dams, weirs, or spawning ground surveys (carcasses). The IDFG Nampa Research Office houses the fish aging lab. Known age fish are entered into the aging database and then used to derive age composition ratios for populations. The age composition ratios are applied to fish data available in the SGS database. This database is currently not available for query through the IFWIS portal. Funding for the aging database is primarily from Bonneville Power Administration (BPA).

d. Genetics Database: Genetic samples are taken from all species of anadromous fish and processed at the Eagle Genetics lab. Data is uploaded in a database and currently not available for query. Funding for the Genetics Database is from multiple sources.

ii. Currently, metrics used to derive indicators are only available on internal spreadsheets. VSP indicators are publicly available through 2008 on the Salmonid Population Summary web database powered by NOAA. The NOAA website does not provide sufficient metadata for most of the indicators available.

iii. IDFG is not currently sharing VSP indicators. Sharing of the VSP indicators is primarily a response to newly emerging basinwide assessments (such as NOAA five year status review). This relatively new need has resulted in a lag in response while the agency creates the data management and infrastructure to address these needs. Spring/Summer Chinook salmon redd counts and adult returns to hatcheries are currently available and being shared through IFWIS. Adult return data for sockeye salmon and steelhead will be uploaded into the portal in the future. The current sharing strategy is available in the attached data management flow diagram (Figure 1).

Assessment of gaps, needs, and priorities

Gap- IDFG has not institutionalized annual calculation of the three primary VSP indicators.
Need- Calculate VSP indicator metrics and make them available with supporting metadata.
Priority- Institutionalize calculation of VSP metrics and expand IFWIS to include capability to share VSP indicator data.

Gap- Lack of standardized definitions of data and metadata.
Need- Basin-wide agreement to define what data and supporting information should be shared and when it can be made available.
Priority- Participate in Regional forums to refine data needs and meta-data requirements.

Gap- VSP metric and indicator data storage, entry, and sharing capacity.

Need- Capacity within internal (IFWIS) or regional database to directly enter data, indicators and metrics.

Priority- Build capacity within field offices to directly enter data into IFWIS to speed data storage, calculation, and sharing.

Appendix H

Data Management Plan

Knowledge is power and shared knowledge builds trust; timely and equal access to information is essential to sharing knowledge

Nez Perce Tribe

Department of Fisheries Resources Management

Version 1.0
October 18, 2011

Contents

I. Statement of Purpose

"Everyone is entitled to his own opinion, but he is not entitled to his own facts."
– Senator Daniel Moynihan

Management and dissemination of project results and data are as important as collecting data itself, but often receives less attention. The Nez Perce Tribe (NPT; Tribe) Department of Fisheries Resources Management (DFRM; Department) takes seriously the need to make primary data and metadata available within the region (ISRP 2005). Columbia Basin fish managers are working to establish a cyberinfrastructure that supports advanced data acquisition, data storage, data management, data integration, data mining, data visualization and other computing and information processing services distributed over the Internet beyond the scope of a single institution. In fisheries management usage, cyberinfrastructure is a technological and sociological solution to the problem of efficiently connecting multiple entities, data, computers, and people with the goal of enabling region-wide analysis, collaborative products, and shared knowledge.

The Department currently implements over 50 contracts associated with hatchery production, watershed restoration, research, harvest monitoring, and resident fish. The Tribe's fishery management activities encompass a vast geographic area, over 13 million acres, within the present-day states of Idaho, Oregon, Washington, and Montana. Data collected under these contracts is extensive, and relates not only to contract implementation but also quantifies fisheries resource condition and response to management actions supporting 1855 Treaty rights, the Federal Columbia River Power System Biological Opinion, U.S. vs. Oregon management agreement, Snake River Basin Adjudication, Northwest Power and Conservation Council Fish and Wildlife Program, and Lower Snake River Compensation Plan mitigation. Hence, the volume and complexity of information gathered through the above activities needs to be compiled and organized in a systematic manner. Appropriate data management involves archiving monitoring data, integrating data from different co-manager activities, and making the data accessible in local and regional databases. The Nez Perce Tribe, and other fisheries co-managers, have statutory authority to manage fish and wildlife resources within the Columbia River basin, and those management decisions must be based on the best available information. For this reason it is imperative that data management receive careful attention.

The purpose of the data management plan for the NPT DFRM is to facilitate secure, redundant storage, maintenance, and efficient exchange of science-based information generated by the Department while maintaining data integrity. Implementation of this plan will build capacity within the Tribe to support individual project and regional reporting, collaborative analyses, and informed policy and management decisions. Data collected by the DFRM will be available to the Tribe and its co-managers, and adequately backed up in both the field and main offices. The Nez Perce Tribal Executive Committee Strategic Action Plan Goal D, strategy 4, action 'C' identifies development of websites and other appropriate medium for the dissemination and exchange of information (NPTEC 2009).

II. Goals

"Knowledge is a tool, and like all tools, its impact is in the hands of the user"
- Dan Brown, The Lost Symbol

Our goals include: 1) implementation of systems to maintain accurate, consistent and transparent data content; 2) web-accessible fish and habitat data, 3) timely transfer of summary data to tribal decision makers and regional consumers, and 4) collaborative data storage, maintenance, analysis, and reporting relationships within the region.

III. Objectives

The DFRM collects and maintains a wide range of data types (Appendix HA). Structured or quantitative data is the data that resides in fixed fields within a record or file[1]. Geospatial data is structured data corresponding to a known geographic location.

Usefulness of the data is maximized when is it standardized and validated. We will utilize standardized performance metrics as recommended by the Ad Hoc Supplementation Work Group (Beasley et al. 2008). We will work to ensure all data is: electronically recorded, validated, secure, shared and accessible, and adequate infrastructure capacity is maintained.

1. **Electronically Recorded Data**
   Raw and derived data will be entered into electronic databases within three months of capture date.
   a. Internal databases (Access limited to DFRM employees) – DFRM will generate data that is unique to the Department, sensitive in nature, and/or supports derived metrics posted to external databases. These data types will be maintained on the DFRM servers. A summary of these stand-alone databases will be posted annually on the DFRM website.
   b. External databases (Access open to public or password protected) - DFRM will work with co-managers and stakeholders to provide external access to appropriate data according to standardized protocols and formats. Summary data will be open for public access along with supporting metadata, while metric level data may be password protected.

2. **Validated Data**

[1] Definition taken from the PC Magazine Encyclopedia available at http://www.pcmag.com/encyclopedia/. Unstructured or Qualitative data do not reside in fixed locations. These data types include all other free-form information such as photographs, written reports, maps.

Raw data will be validated within six months of entry according to the project's defined Quality Assurance/Quality Control (QA/QC) minimum accuracy specifications as established in Quality Assurance Project Plans (QAPP).

3. **Secure Data**
   Long-term data integrity for raw and derived data will be maintained while allowing access to internal and external users.
   a. Data Storage Site – DFRM will utilize centralized servers and regional databases to house raw and derived data.
   b. Controlled Access/Change Authority – Raw data will be housed in a password secured website and have integrated security for data management.
   c. Backup and Disaster Recovery Plan - DFRM Research will implement a Data Disaster Recovery Plan for the departments utilizing fileservers. A Data Disaster Recovery Plan will also be implemented for all DFRM databases and webservers.

4. **Shared and Accessible Data**
   Data will be electronically accessible to stakeholders in a timely manner. DFRM will work with our regional partners to ensure that the data is captured with the appropriate metadata and is transparent and transferrable to other stakeholders.
   a. Primary Data – Raw data will have controlled access to DFRM employees until QA/QC procedures have been followed. Raw data will be provided through password protected access to our co-managers as necessary to support analyses and management decisions.
      i. Internal Data and Document Sharing - DFRM Research will improve data integrity and data sharing by implementing fileservers, databases where appropriate and a replication plan.
      ii. External Data and Document Sharing – DFRM Research will provide data sharing consistent with Tribal policy and the regional reporting requirements.
   b. Derived Data – Summary data of standardized performance measures will be available to the general public via the DFRM Website (www.nptfisheries.org) and other regional websites.
   c. Metadata - It is important for NPT to establish a data inventory and metadata catalog to inform internal and external users of available data. DFRM Research will utilize regionally recommended Data Exchange Templates (DETs) and Data Analysis Flow Diagram (DAFDs). Geospatial information will be documented using the Federal Geographic Data Committee's (FGDC) "Content Standard for Digital Geospatial Metadata" format. All geospatial metadata must have content items 1, 4, 5, and 7 completed (http://www.fgdc.gov/csdgmgraphical/index.html).

d. Digital Documents - DFRM Research will implement a digital document management system to facilitate storage and dissemination of reports, publications, whitepapers, etc.
e. Geospatial Data – DFRM will use the NPT GIS data servers for geospatial data storage and retrieval.

5. **Adequate Data Management Resources**

Secure and maintain sufficient hardware and staffing to manage data from acquisition, storage, maintenance, to dissemination described in steps 1- 4 above.

a. Staffing - DFRM will require dedicated data management (IT) staff and existing in-house GIS professionals to maintain and expand the current data sharing tasks.
b. Hardware/software – DFRM will establish and maintain file servers, web servers, and database servers. DFRM will work to maximize use of tribal, regional and commercial infrastructure. Network infrastructure maintained by NPT Information Systems and by Land Services' GIS division will be utilized.
c. DFRM Website - DFRM Research will be enhancing DFRM's public presence by continuing to improve and expand services available on the current DFRM website (www.nptfisheries.org).

IV. Strategies

The Nez Perce Tribe envisions a distributed data system within DFRM, where the primary data and derived metrics are generated, entered, validated, backed-up, and maintained internally. Data will be stored on centralized databases within the Department. Some of the databases will be fully assessable to the public while others will have restricted access. Standardized Performance Measures and High Level Indicators will be disseminated directly from NPT and available through the DFRM website (www.nptfisheries.org) and/or submitted to regional databases, such as the Salmon Population Summary (SPS) database. Biological fish data will be reported using the populations defined by the Interior Columbia Basin Technical Recovery Team for ESA listed species and CBFWA defined populations for non-listed populations (CBFWA 2009). Physical habitat data will be geospatially referenced and organized by watershed at the 5th order HUC.

a. Electronically Recorded Data

The Tribe will implement direct electronic data capture devices and standardized data entry programs where they are available to reduce data entry error. Data recorded on data sheets will continue to occur in many cases, however a concerted effort will continue to develop the most efficient and error free systems of collecting data. Data collected with Global Positioning System (GPS) receivers will follow defined data collection standards specified within the project QAPP. We will target primary and derived data entry within two months of capture date.

Data entry occurs at the project level by project specific technical staff and is directly entered into DFRM databases.

b. **QA/QC Validated Data**

Quality Assurance and Quality Control (QA/QC) is currently done on a project specific scale. Development and/or adoption of QA/QC standardized protocols are needed and should occur prior to January 1st 2013 by establishing minimum accuracy specifications in QAPP. In geospatial context, a feature class will be deemed inaccurate if the position is beyond 5-meters or located outside its normal extent as an example (e.g., a redd point location is not located on land and is not located 10 meters beyond the known location). Again, this could all be spelled out in project QAPPs.

QA/QC occurs at the project level by project specific staff most familiar with the data collection and data entry histories. Currently staffing should be adequate to cover this task. QAPP are lacking and need to be developed and would benefit from additional short term staffing.

c. **Secure Data**

The DFRM has five remote primary field offices[2] (Sweetwater, McCall, Orofino, Joseph, and Nez Perce Tribal Hatchery) that are separate from the main office in Lapwai. In order to securely store their files, as well as accommodate for file sharing, DFRM will install file servers at each location.

All DFRM fileservers incorporate a RAID 5 system configuration and will replicate to at least three other DFRM fileservers to ensure data redundancy in case of hardware failure. The replication strategy will be set to replicate all changes to all servers as they occur (Figure 1). The main fileserver's copy of all DFRM fileserver's data located in Lapwai will be backed-up to an external hard drive each day. Four external hard drives will house the backed-up data utilizing one external hard drive per week to ensure that at least a month's worth of data will be retained and available for restore purposes. External hard drives that are not currently in use will be stored in an off-site location at least 5 miles from Lapwai for Data Disaster Recovery purposes. A copy of all installation software for each server and license keys will be stored at the off-site storage in order to expedite server restore operations in support of disaster recovery operations. This redundancy ensures that the valuable (irreplaceable) information obtained and generated by the DFRM is recoverable in the event of major disaster, hardware failure, or a loss of a personal computer, etc.

All geospatial RDMS servers incorporate a RAID 5 system configuration with monthly full backups and daily differential backups to an LTO tape backup library. Tapes (will) be stored off-site and rotated on a quarterly basis.

Securing data will occur at the Department level under the oversight of a DFRM data steward and Land Services GIS system administrator (see appendix HB).

[2] Satellite offices (Kooskia National Fish Hatchery, Dworshak National Fish Hatchery, Grangeville, and Powell) will utilize the tribal network and utilize file serves located at the field offices and geospatial servers located in Lapwai, Idaho to store data.

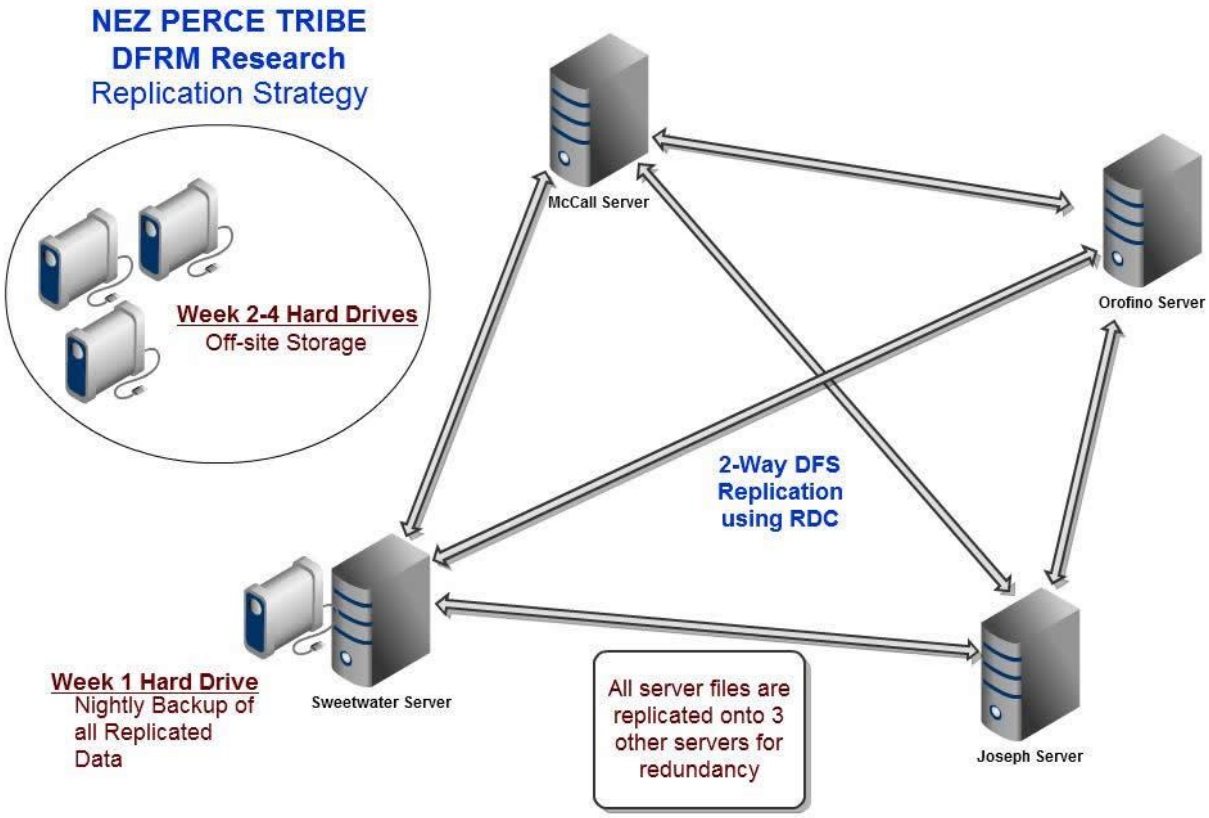


Figure 1. Current Nez Perce Tribe Department of Fisheries Resources Management infrastructure in place to ensure data from individual users is replicated daily across four file servers, subsequently backed up daily to a main file server in a separate location.

d. **Shared and Accessible Data**

This strategy provides a common vision for NPT DFRM to exchange information between collectors, analysts, and end users for the purposes of effective assessment of aquatic resources and evaluation of progress toward the recovery and restoration all species and populations of anadromous and resident fish and their habitats within Nez Perce Territory. This data sharing strategy outlines an approach that will ensure that data and information can be shared in a timely, efficient, and collaborative manner across the basin. NPT will implement a data sharing strategy which includes creating a data sharing policy, establishing an environment of mutual trust, data discovery and retrieval, and developing the tools necessary for data sharing (adapted from CTUIR 2011).

Institute a data sharing policy: NPT is a sovereign nation under contract to conduct fisheries management projects. As a sovereign nation, NPT will manage its own data to support decision making and policy development. A data sharing policy will be developed to outline the format data is to be shared, document the intentions of the data sharing and identify what types of data will be shared (adapted from CTUIR 2011).

Establish a common trust environment: NPT DFRM will work with regional biologists, analysts and end users to put in place uniform, information security standards, information access rules, user authorization, and access control to promote common trust (adapted from CTUIR 2011).

Advance data discovery and retrieval: NPT DFRM will manage and store regional fisheries data on centralized databases. NPT DFRM will develop and maintain a spatially based relational database and a custom designed user interfaces to query information, summarize data and automate reporting. NPT DFRM will document all data with Metadata dictionaries (adapted from CTUIR 2011).

Develop the tools necessary for data sharing: NPT DFRM will continue to make fisheries data available through web access and will develop the tools necessary at the institutional, leadership, and workforce levels to collaborate and share knowledge, expertise and information (adapted from CTUIR 2011).

The Department will utilize centralized, regionalized databases, developed to unify data collection activities spanning across multiple agencies and populations. The Department is participating in a regional effort initiated by the Lower Snake River Compensation Plan (LSRCP) Snake Basin Data Group to place primary data into a centrally located database with equal access to the participants. This neutrally located database (to be housed at Pacific States Marine Fisheries Commission) ensures that each participating agency has equal access to the exact same raw information. This allows co managers to work on the same data, thus making resource management decisions transparent.

To date this project allows participating agencies to utilize the tools developed by Snake Basin Data Group to enter and input information for adult trapping and spawning of Chinook and steelhead. This project will be expanding to incorporate hatchery incubation, rearing, marking and release, juvenile trapping, spawning ground/carcass, snorkeling, temperature, etc. information as well. This information is entered into the program and then synched to a central database. Once in the central database, all participating agencies can access the same raw data for use in summarization, analysis, reporting, and co management decisions (Figure 2). In addition to equal access to all data by participating agencies, all other agencies and general public will have access to data summaries and downloads as identified by the Lower Snake policy group. These other agencies or groups do not participate in data input, but are allowed to view and extract agreed upon information summaries.

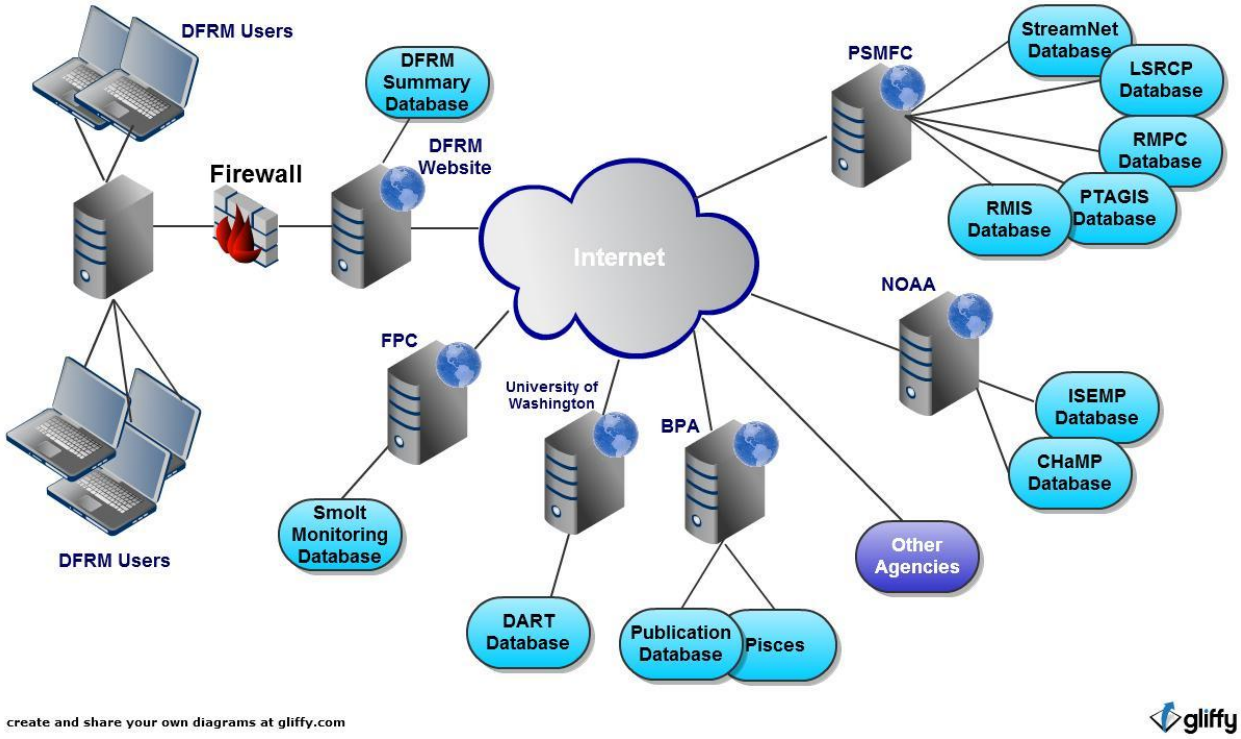


Figure 2. A common central database is used to store raw information uploaded by participating users that also have full access to retrieve all information for use in analysis, reporting, and making co management decisions. Other agencies, as agreed to by the Snake Basin Data Group, also have limited access to the data and generated summaries.

NPT DFRM will utilize a server replication strategy to increase the availability of data to internal DFRM staff (Figure 3). NPT staff will access all data from a single mapped drive. All servers will replicate to other servers so that if a local server is unavailable the user will be redirected to another server automatically. This will be seamless to the user and increase the availability of the data for all DFRM users. All workstations will be configured to save their data to the shared namespace automatically. Laptops will have a synchronization application installed that will upload and sync data when the user returns to the office and attaches to the network.

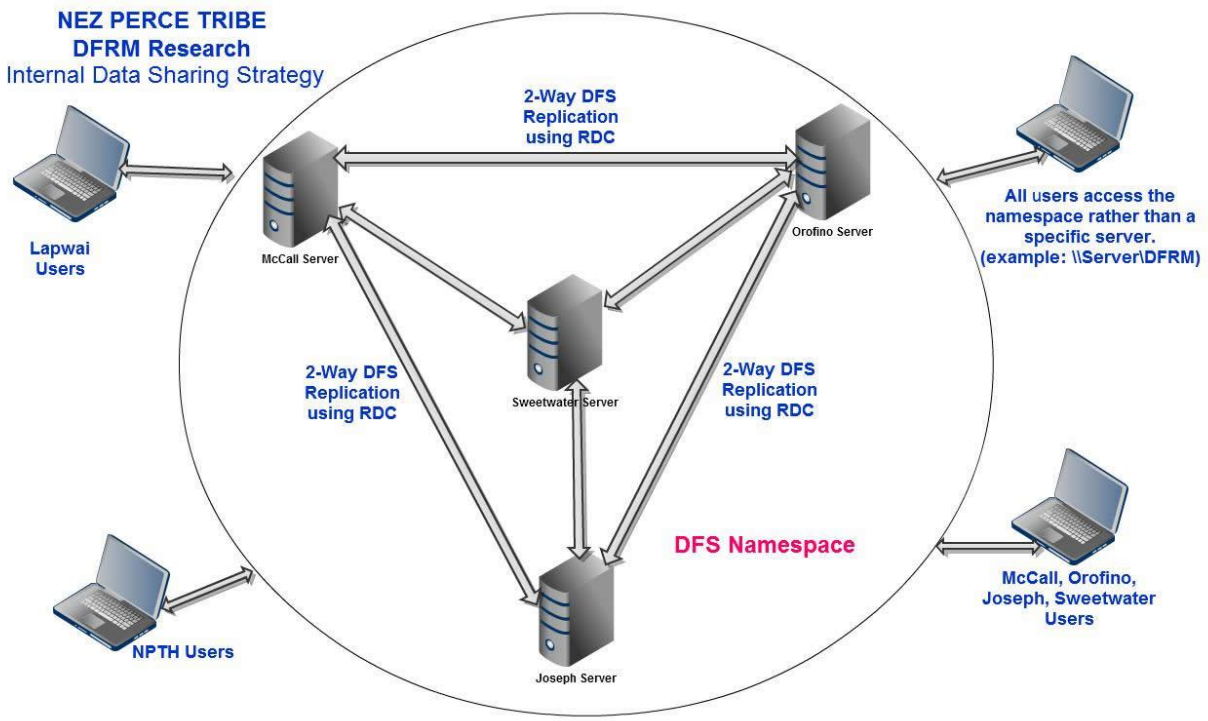


Figure 3. Internal data and file sharing within the Nez Perce Tribe.

The Tribe intends on providing regionally accepted performance measure data following field data collections, data retrieval from the central database, summary, analysis, and reporting. In the past, DFRM projects used annual report submissions to the BPA web site (http://www.efw.bpa.gov/searchpublications/) thus making project information publicly available. Those submissions will still occur, however DFRM annual reports and summarized regionally accepted performance measures will be available on the DFRM website http://www.nptfisheries.org. This will allow more efficient access to the Tribe's valuable information.

Geospatial data will be available on RDMS servers administered by NPT GIS (Geographic Information System) staff within the NPT Land Services Department. The geospatial servers have been configured as a distributed system that incorporates RDMS storage, system redundancy, and geospatial website deployment. A DFRM data steward will be responsible for compiling, incorporation, and maintenance of geospatial information. If a data steward is not available within the DFRM program, a Land Services GIS staff member will be assigned to assist the DFRM database administrator (DBA). Integrated GIS maps will be available on DFRM Website. Right now the data is externally accessible at http://imsland.nezperce.org/DFRMWatershed/nexviewer_flex.html.

In addition to the DFRM website, appropriate components of program data and results will also be provided to the following websites: The tribe is a partner on the Snake Basin Hatchery working group that currently houses the Tribe's adult trapping data (Snake Basin Data Group);

Pacific States Marine Fisheries Commission (PSMFC) (http://www.psmfc.org/), including: PIT Tag Information System (PTAGIS) (http://www.ptagis.org/), and the Regional Mark Processing Centre (RMPC) (http://www.rmpc.org/); Integrated Status and Effectiveness Monitoring Program (STEM) (http://www.nwfsc.noaa.gov/research/divisions/cbd/mathbio/isemp/index.cfm); Columbia Habitat Monitoring Project (CHaMP); Fish Passage Center (FPC) (http://www.fpc.org/); StreamNet (http://www.streamnet.org/); and NOAA Northwest Science Center Salmon Population Summary database (https://www.webapps.nwfsc.noaa.gov/apex/f?p=238:1:0::NO:::) (Figure 2).

Data transfer and sharing is an integrated effort at the project specific, department, and regional levels. A data management technical team with representatives from each of the DFRM divisions, NPT information services, and natural resources land services will guide data management within the DFRM activities. The Lower Snake River Compensation Plan data technician will coordinate data sharing and standardization for LSRCP data sets. The NPT DFRM data steward will represent the NPT in regional data management forums and discussions.

e. **Adequate Data Management Resources**

Staffing

We understand data management and sharing supports informed management decisions at both regional and local levels. We desire to be involved in the regional effort. Our agency approach for centralizing and securing project specific data will be compatible with regional standards that will be established in the coming months and years. This is most efficiently achieved if a NPT data steward is able to participate in regional data coordination forums (Science/content and technical). The focus of these groups will be to improve communication between the agencies and tribes and the basin-wide data consumers (link to reporting) and to ensure reporting needs are met in the most cost effective and efficient means possible.

We envision local level fish and aquatic habitat data management to be supported by: staff directly associated individual projects (lots), data technicians (2), database specialists (2), GIS database administrator (1), GIS database coordinator, and a data steward (1). See Needs Assessment (gaps) section for description of current status.

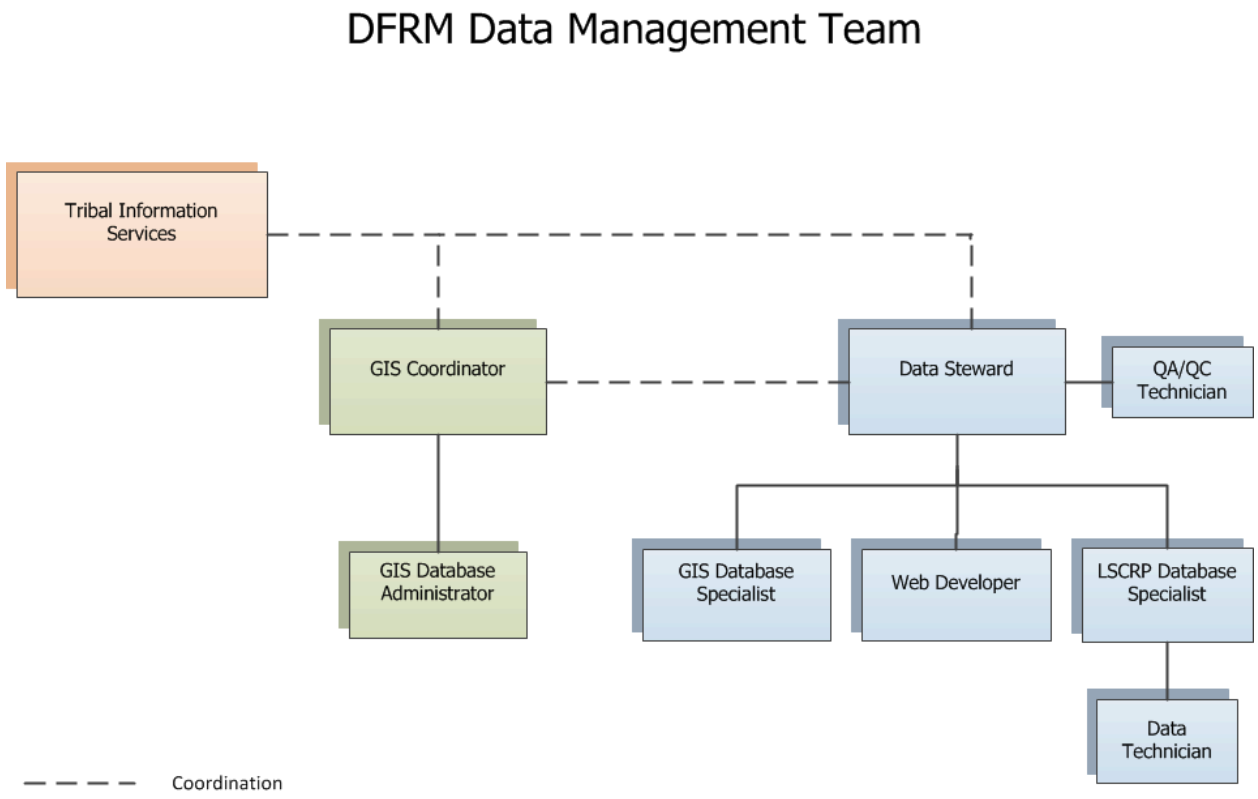


Figure 4. Nez Perce Tribe Department of Fisheries Resources Management target staff structure for fisheries and aquatic habitat data management.

Infrastructure

The NPT DFRM will utilize infrastructure from multiple Tribal programs. The DFRM infrastructure refers to network hardware essential for data management and information transfer. Currently required data management infrastructure includes: four file servers, a dedicated database server, and a web server. Objectives: 1) Replication strategy with a backup plan; 2) Centralized data storage; and 3) Efficient data availability to the public through a web-based application. See Needs Assessment (gaps) section description current status.

Website

The Nez Perce Tribe DFRM website (www.nptfisheries.org) will house a database for summary data, description of metadata (utilizing NOAA data dictionary), and summary/annual reports related to all projects. The department is currently working towards making this crucial data available through the DFRM website, in addition, the information for standardized performance measures will also be available. See Needs Assessment (gaps) section for description of current status.

In addition to annual reports posted to the DFRM website, we will utilize project specific and region-wide databases that have been developed to centralize data associated with widely used data collection activities and standardized performance measures. The Nez Perce Tribe DFRM website (www.nptfisheries.org) will house a standardized database for summarized data,

description of meta-data, and summary/annual reports related to this project. Appropriate components of program data and results will be provided to the following websites: Bonneville Power Administration, Snake Basin Data Group Pacific States Marine Fisheries Commission (PSMFC), including: PIT Tag Information System (PTAGIS), and the Regional Mark Information System (RMIS); StreamNet, Integrated Status and Effectiveness Monitoring Program (STEM); Fish Passage Center (FPC); and NOAA Northwest Science Center.

The department is working towards implementation of a web-based tool for the research division with plans on combining all other divisional data. The application will be located in the tribe's main Information Technology office in Lapwai, ID. The tool will have a relational database component, hosted on MS SQL Server 2008 R2, web based component currently being developed and a spatial component based on the tribe's extensive GIS. The system will be open to the public and any interested parties with some security measures implemented and will be available on the Nez Perce Tribe DFRM website (www.nptfisheries.org). It will provide access to live data collected daily, as well as data summaries built to provide information about various performance measures.

V. Needs Assessment (Gaps)

In order to achieve the data management goals in this Plan, the Tribe requires additional staffing and infrastructure. Currently, data is primarily maintained on individual computers housed in multiple field offices, with very limited data back-up, and no centralized system for data retrieval/transfer. Frequent requests for information and data summaries require a substantial amount of staff time. The current structure results in repeated summaries of the same data and inconsistencies in results. The current system has minimal linkage to other departments within the Tribe and other agencies outside the Tribe. Finally, there is enormous amount of data collected which is not currently connected and is stored on individual computers. This data needs to be entered, backed up, centralized, secured, and made available for use by others in the region.

Staffing

The Nez Perce Tribe currently has four staff associated with DFRM data management. Two these positions are supported with Tribal funds. One position is funded by the Lower Snake River Compensation Program. One position is funded by Bonneville Power Administration (BPA) through the NPCC F&W program. Seven pay periods of a Data Stewards time have been funded by BPA but the position remains unfilled while full funding secured. Four pay periods of a QA/QC technician are funded by BPA. In order to fully implement the staffing strategy described above, the Department requires funding support for 2.60 additional staff; two full time data technicians, and a full time for the data steward (Table 1). In addition, one time funds are needed to formally document Quality Assurance/Quality Control protocols and enter historical data.

Infrastructure

The Nez Perce Tribe DFRM has recently expanded its data management infrastructure to include a web server, a database server and file servers at its four primary field offices. When paired

with the Tribe's existing GIS database servers and T1 internet connectivity the essential data management infrastructure is functional. The primary infrastructure gap is the establishment of standardized data entry programs. Efforts are ongoing to develop these programs in several forums. It is likely that infrastructure expansion will be needed in the near future to include two additional file servers and file sever hard drive upgrades (Table 1).

Website

The Nez Perce Tribe DFRM has established its own website. However dedicated staff to maintain and further develop the website is lacking. We are seeking funding support for a 0.5 FTE web developer (Table 1).

Table 1. Summary of Nez Perce Tribe Department of Fisheries Resources Management data management staffing, infrastructure, and web-site needs as of September 2011.

Category	Current Status	Needs	Cost to fill gaps (priority)
Staffing	LSRCP Database Specialist GIS Coordinator[1] GIS Database Administrator Watershed Database Specialist Data Steward (0.25 FTE)[2] QA/QC technician (0.15 FTE)[2]	Data Steward (0.75 FTE) Data technician (1 FTE) QA/QC technician (0.85 FTE) Historical data entry QA/QC protocol document	$81,000 (1) $50,000 (2) $43,000 (2) $50,000 (2)[3] $15,000 (3)[3]
Infrastructure	1 web server 1 database server 4 file servers 3 GIS database servers T1 connectivity Off-site storage site	Standardized data entry programs 2 file servers File server hard drive upgrades	Ongoing (1) $8,000 (3) $5,000 (3)
Website	www.nptfisheries.org[4]	Web Developer (0.5 FTE)	$60,000 (3)
Cost (Priority 1) (Priority 2) (Priority 3) **Total**			 $81,000 $143,000 $88,000 **$312,000**

[1] Position serves entire NPT program.
[2] Money contracted, position currently not filled.
[3] One-time cost.
[4] Currently no dedicated web staff.

VI. Key Issues

Collaboration

The NPT DFRM is prepared to collaborate with our co-managers to make sharing data a common business practice. NPT DFRM is willing to adopt a common data exchange template and will continue to coordinate with the Coordinated Assessment Phase III work plan to manage DETs. NPT DFRM is ready to work with co-managers given that this template does not infringe on NPT's tribal sovereignty rights; including the ability to house all raw data pertaining to

resources in NPT traditional use areas. This data must be available in a format that supports query, synthesis and analysis in support of policy development. NPT DFRM supports the data exchange template as long as the duties and requirements of this project do not require a disproportionate or unmanageable cost to NPT employees and resources (adapted from CTUIR Data Sharing Strategy). We desire to collaborate in regional forums to define content and agree to DETs (information and metadata requirements to attach to indicator data).

Relationship to other projects

Columbia River Inter-Tribal Fish Commission - The Tribe currently is coordinating with the Columbia River Inter Tribal Fish Commission who is funded through the Accords to centralize and standardize tribal data via a Tribal Data Network (TDN) project. The TDN's primary goal is to ensure the availability and sharing of accurate and timely data among Columbia River Inter-Tribal Fish Commission (CRITFC)-member tribes and with other agencies to meet the reporting needs of the Accords and BiOps, while also building capacity within the tribes to support informed policy management decisions. The Tribal Data Network will facilitate supportive tools for decision making on the implementation of; the Columbia Basin Fish Accords, recovery planning under the Endangered Species Act (ESA), and tribal co-management needs with regard to US v. Oregon(US v OR) and the Pacific Salmon Treaty (PST) . The Tribal Data Network should not become a central repository for data, but should be a distributed network of databases. The tools built will assist the tribes in moving and consolidating data from the field to their respective tribal web sites. Member tribes have indicated that they will control their own monitoring data, and house it in their own databases. The tribes have taken a gravel to gravel approach for mitigation and monitoring and have requested assistance from CRITFC in assessing what happens to their fish in the portions of the anadromous lifecycle that fall outside of the ceded lands, thus CRITFC will assist the tribes assemble data on fish for the mainstem Columbia and Snake Rivers and the ocean environment. All four tribes will handle monitoring data they collect for the portion of the anadromous lifecycle that falls within the ceded lands.

Salmon Population Summary (SPS) Database - We work with NOAAF to provide data necessary to populate their SPS database. The Tribe desires to perform the calculations annually and provide NOAA with the appropriate metadata and supporting metrics to meet their requirements.

Lower Snake River Compensation Program (LSRCP) - LSCRP funded projects requires collection of data necessary to evaluate the production program and its effects on the natural populations. LSRCP is developing a centrally stored database containing: adult trapping, event, spawning, incubation and rearing, and redd count survey data through multiple standardized data entry software programs that are uploaded via the web to a neutrally located SQL database located at PSMFC in Portland, Oregon. Data is made available to all participating stakeholders via a secure web reporting site (http://fishandgame.idaho.gov/ifwis).

Fish Passage Center (FPC) - The Nez Perce Tribe directly provides Smolt Monitoring data from the Imnaha Trap located near Joseph, Oregon along the Imnaha River. The data includes number of smolts trapped and PIT Tag information. Nez Perce Tribe staff directly enters data into the P3 program and a program provided by the FPC. The data is then uploaded by Nez Perce Tribe Staff to a local FPC SQL database which is housed at the Nez Perce Tribe DFRM office located in Joseph, Oregon The data is then synchronized and uploaded to a SQL Database server located at the Fish Passage Center.

Columbian River Data Access in Real Time (DART) – We do not directly provide any information to DART. They access our data indirectly through other entities with whom we exchange data.

PNAMP Data Management LT - We are not active participants in PNAMP and do not directly provide any information to PNAMP DMLT. We have expressed a willingness to participate in PNAMP if funding was provided to enable staff time and travel.

Cost share partnerships

The Nez Perce Tribe supplies some staffing and infrastructure support for the DFRM data management effort. (GIS coordinator, GIS database administrator, Internet connectivity). The U.S. Fish and Wildlife Service Lower Snake River Compensation Plan initiated funding in FY 2010 for a data steward. This staff resource is housed within the Nez Perce Tribe Department of Fisheries Resources Management Research Division and is responsible for database development and collaboration.

Data sharing and use agreements

The following acknowledgement is provided on the PTAGIS website, the Department envisions a similar policy/statement/agreement for use of data provided through the DFRM website and databases. Intellectually property rights and publication rights and acknowledgement of data source. PTAGIS - *"It is the responsibility of the Data User to contact the Tag Data Coordinator(s) as to the availability and correctness of their respective tagging, release and/or recovery data. The Data User is expected to contact the appropriate Tag Data Coordinator(s) prior to citing these data in any literature for other than internal distribution (both reviewed and non-reviewed documents). This will provide verification and context for data derived from the PTAGIS database. Securing appropriate permissions, in writing, prior to submission of data for publication will help to ensure the appropriate and ethical use of data. Initiating contact with Tag Data Coordinator(s) will provide Data Users the opportunity to arrange appropriate acknowledgements, citations and/or authorship."*

Standardized performance measures

DFRM is developing the equipment infrastructure necessary to ensure efficient and timely public distribution of information on regionally accepted performance measures (Beasley et al 2008), organized by the categories; abundance, survival-productivity, distribution, genetic, life history, habitat, and in-hatchery measures.

VII. Appendix HA – Common data types collected by Nez Perce Tribe

Data Type	Comment
Fish abundance	Focal species include (spring summer Chinook, fall Chinook, coho, steelhead, sturgeon, lamprey); target population scale (utilize TRT defined populations); performance metrics consistent with AHSWG
Fish distribution	
Fish survival	
Productivity	
Diversity	Genetic and life history
Fish release numbers	
Fish marking	
Harvest estimates	
Water temperature	
Stream flow	
Watershed assessments	
Culvert inventory	
Known barrier inventory	
Road density	
Stream channel profile	
Embeddedness	
Particle size distribution	
Canopy cover	
Large woody debris	
Weeds	
Macro invertebrates	
Bank stability	

VIII. Appendix HB - Data Steward Job Description

Class Description/Grade: Professional IV; Grade 21
Position/Assignment: Data Steward; Full-time Regular
Department/Division (Program) and Duty Station: Department of Fisheries Resources Management - Research Division; Sweetwater Office
Direct Supervisor: Policy and Procedures, Scope of Work, and Contracting: Director of Biological Services (Research Division); Manager III. Technical: Research Division Deputy Director; Manager II.

Primary Duties/Essential Tasks
Within Tribe:

- Administer and coordinate, and data management systems and website operations for Department of Fisheries Resources Management.
- Enable and maintain data entry, data validation (QA/QC), back-up and recovery, posting, and transfer/retrieval for NPT generated data in manner that is efficient.
- Design, implementation, maintenance and repair of an organization's database. Development and design of database strategies, monitoring and improving database performance and capacity, and planning for future expansion requirements. Plan, coordinate and implement security measures to safeguard the database.
- Maintain computer hardware and software that comprises a computer network. This normally includes the deployment, configuration, maintenance and monitoring of active network equipment. Maintain file, web and database servers. Responsible for growing the system, administering permissions and security, and assuring continuous system availability.
- Maintain department website(s). Ensuring that the web servers, hardware and software are operating accurately, help in designing the website, generating and revising web pages, and examining traffic through the site.
- Ensure management activities and data collection by the NPT are up to date and communicated on the DFRM website.
- Establish the basic structure of the system, defining the essential core design features and elements that provide the framework. Be knowledgeable of various programming languages.
- Maintain a liaison and integrated working relationship with the Nez Perce Tribe Land Services and Information Services staff.
- Maintain a liaison and integrated working relationship with the Columbia River Intertribal Fish Commission data management staff.
- Collaborate with Lower Snake River Compensation Plan Database Administrators.
- Chair the Department of Fisheries Resources Management data management technical team.
- Complete project reports required by contract(s) and support fisheries management, including project findings and management recommendations.
- Hire, train, supervise and evaluate project staff associated with research division data management consistent with Nez Perce Tribe Policies and Procedures.
- Monitor and manage project expenditures and ensure contract deliverables are met.

- Attend in-service training and technical or professional classes, seminars, or conferences to improve technical or professional skills and to maintain knowledge of current state-of-the-art database and web design and management.
- Work within the guidelines defined in Nez Perce Tribe policies and procedures.

Regionally:

- Represent Nez Perce Tribe Department of Fisheries Resources Management in regional data management forums and projects (LSRCP, StreamNet, CRITFC, ISEMP, PNAMP DMLT, PTAGIS, and CBFWA) to ensure NPT data collection and management needs are compatible with regional approaches.
- Maintain a liaison with other projects managing and posting fish and environmental data in the Columbia River Basin to ensure NPT generated data is web assessable in formats compatible with regional standards and infrastructure.
- Attend and present information at local, state, and regional research and management meetings to disseminate project information, keep current with data management and website technologies.
- Maintain positive working relationships with Nez Perce personnel and other agencies' staff during coordinated administrative, managerial, and field activities.
- Work within operational permits and guidelines from tribal, local, state, and federal management agencies.
- Coordinate data posting, transfer, and retrieval with funding entities.

Appendix I:

Oregon Department of Fish and Wildlife

Columbia River Basin Data Management Plan and Sharing Strategy for Viable Salmonid Population (VSP) Indicators

November 2011

Contents

I. Statement of Purpose and Scope

The purpose of this document is to outline the Oregon Department of Fish and Wildlife's strategy and implementation needs for sharing total spawner abundance, natural origin spawner abundance, age composition by origin, hatchery fraction, smolt to adult survival rate, and recruits per spawner data that it collects on Oregon populations of Columbia River Basin salmon and steelhead. Listed salmonid populations have been defined by the Technical Recovery Teams; efforts that focus on non-listed salmonid populations will be guided by ODFW's Native Fish Conservation Policy.

II. Goals

ODFW's goals are to develop a coordinated data management system that:

- Supports salmon recovery, as well as research, monitoring and evaluation programs in Oregon in order to efficiently and effectively participate in regional resource management efforts.
- Provides effective information management that transparently links information collection and decision making.
- Relies on a consistent approach that enables automated information sharing with internal staff, co-managers, and the public as appropriate.

III. Current Data Sharing Capabilities

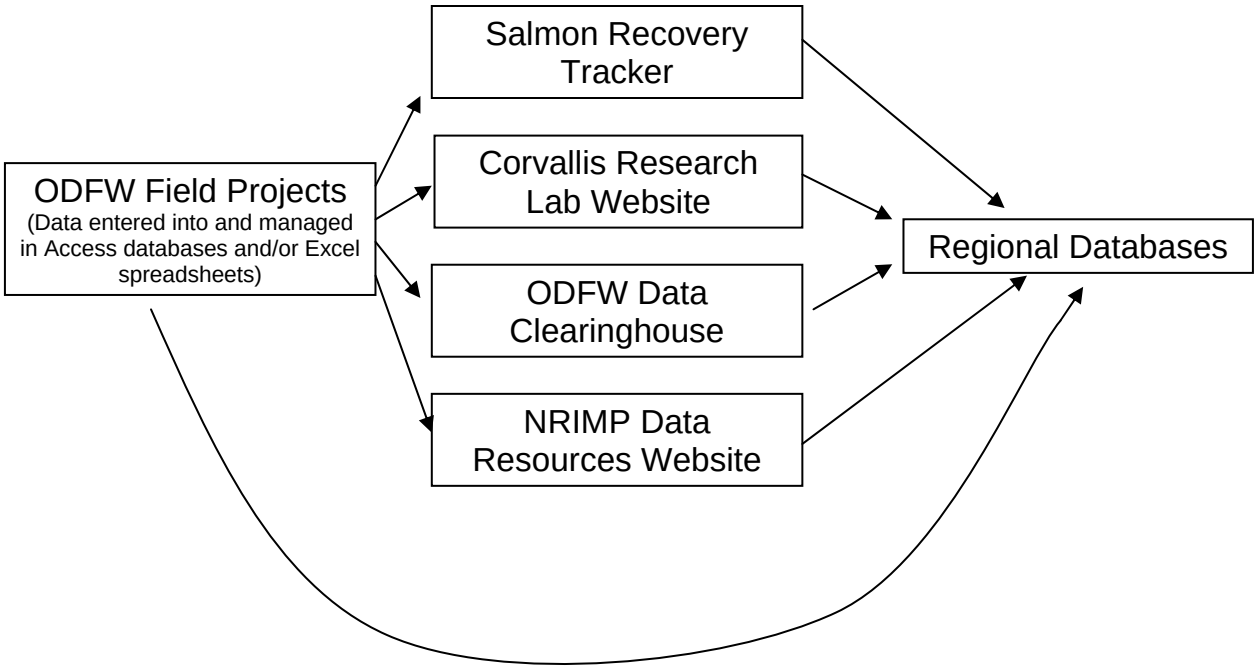
Much of ODFW's data is collected and maintained in disparate formats, and individual data collecting projects often decide when and how to share their data. Oregon recovery planners spend a significant amount of time compiling necessary information before performing analyses and evaluations. This inefficient approach also creates a significant workload increase for the data originators to pull the information together upon request. Once the data are ready for distribution, ODFW relies on four primary agency data sharing systems:

a. **Salmon and Steelhead Recovery Tracker (Salmon Tracker)** (http://odfwrecoverytracker.org/) - provides information on the health of Oregon's anadromous salmon and steelhead populations. Website users can explore and download information related to salmon conservation and recovery in Oregon.
b. **Corvallis Research Lab Website** (http://nrimp.dfw.state.or.us/crl/) – provides links to current project sites where some data may be found, as well as links to annual project reports, progress reports, information reports and Oregon Plan reports.
c. **ODFW Data Clearinghouse** (http://nrimp.dfw.state.or.us/DataClearinghouse/) - houses natural resource information, including reports, data files, databases, GIS files, maps and pictures from natural resource data collection projects. The goal of the Data Clearinghouse is to make Oregon's natural resource information more accessible and to provide a centralized accumulation and distribution service for Oregon's natural resource data.

d. **NRIMP Data Resources Website** (http://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259) - The data resources available here include GIS data, maps, photos, reports, searchable databases, and tables. Subjects include fish, habitat, wildlife, ODFW-specific data, and other/misc.

IV. ODFW Data Management Needs, Gaps, and Priorities

Below is a schematic showing the linkages between ODFW's current primary data sharing systems, the field projects that collect and analyze the data, and regional databases that utilize the data. Under the current structure data may be shared with regional databases in a number of ways; by direct feed from individual field projects, by feed from one or more of the four primary data sharing systems; or a combination of feeds. This system results in an overly complex, inefficient, and non-standardized data management and sharing approach.



Presently, ODFW's data sharing systems incorporate some level of metadata documentation that can be used to populate a Data Exchange Template (DET). However, in most instances these metadata are incomplete and in all cases there is currently no process for automatically populating DETs.

The schematic below shows a draft of ODFW's desired future design for data management and sharing. Under this scenario, there is a clear structure to data flow. ODFW is committed to pursuing this design, or adapting the design as necessary to meet agency and regional needs. As examples of this commitment, ODFW is poised to initiate a complete inventory of data collection efforts in the later part of 2011, and will form a group to review inventory results and identify high profile targets for standardization in 2012. To facilitate this change over the long-term, ODFW will:

- Develop conservation and recovery plans that identify data priorities.
- Continue to build on the Salmon Tracker website.
- Refine this draft strategy as needed.
- Restructure some Oregon StreamNet resources in the short term to focus Coordinated Assessment (CA) indicators and metrics, juvenile data, and on agency data management, with the goal of speeding data flow and increasing the volume of data that are available in the future.
- Participate in PNAMP and have already obtained funding for ISTM workgroup data management support.

V. Data Management and Sharing System Development Objectives

Obj. 1. Populate the ODFW Data Catalog with all agency data collection efforts
Obj. 2. Provide oversight through the Data Management Oversight Group
Obj. 3. Develop Data Management Plans, data flow and analysis diagrams & metadata
Obj. 4. Develop applicable data input modules
Obj. 5. Deploy the ODFW Data Clearinghouse for internal and limited external data sharing
Obj. 6. Implement the Salmon Tracker web application as the Regional data sharing tool

a. Activities and Estimated Timelines by Objective:

Obj. 1. Populate the ODFW Data Catalog with all agency data collection efforts.

Task 1.1. **Year 1:** Focus on data collection efforts related to listed populations already maintained in StreamNet.

Task 1.2. **Year 2:** Expand efforts to include all other data collection efforts related to listed populations.

Task 1.3. **Year 3-5:** Expand efforts to include all other existing and new data collection efforts and keep existing Data Catalog records up-to-date.

Obj. 2. Provide oversight through the Data Management Oversight Group.

Task 2.1. Assemble a data management oversight group to:

2.1.1. **Year 1:** Identify priority data types and collection efforts for sharing data.

2.1.2. **Year 1-2:** Identify and implement stable funding options.

2.1.3. **Year 1-2:** Develop a standard Data Management Plan template and institute for priority and new data collection efforts.

2.1.4. **Year 1-5:** Develop data standards for agency implementation.

2.1.5. **Year 2-5:** Refine our data screening process based on lessons learned to ensure appropriate data utility once data are shared.

Obj. 3. Develop Data Management Plans, data flow and analysis diagrams & metadata.

Task 3.1. **Year 1-3:** Continue development of metadata and analysis diagrams for ODFW Programs in Corvallis Research, Columbia River Management, and LaGrande Research.

3.1.1. **Year 4-5:** Expand to include other data collection efforts as resources allow.

Task 3.2. **Year 1-5:** Compile existing priority datasets to aid with metadata, diagram and input module development.

Task 3.3. **Year 2-5:** Develop data management plans for existing priority field projects and new projects as needed.

Obj. 4. Develop applicable data input modules.

Task 4.1. **Year 1:** Investigate necessary data input modules for ODFW Programs in Corvallis Research, Columbia River Management, and LaGrande Research.

Task 4.2. **Year 2:** Begin development of data input modules in agency standard formats for ODFW Programs in Corvallis Research, Columbia River Management, and LaGrande Research.

Task 4.3. **Year 3-5:** Assist other priority projects with migrating existing priority datasets to the agency standard format, and developing/modifying data input modules as needed.

Obj. 5. Deploy the ODFW Data Clearinghouse for internal and limited external data sharing.

Task 5.1. **Year 1:** Enhance query and site security processes.

Task 5.2. **Year 1-5:** Create draft records for existing priority datasets compiled to aid with metadata, diagram and input module development.

Task 5.3. **Year 2-5:** Redesign the ODFW Data Clearinghouse to improve internal data reporting and sharing, and in preparation for broader sharing.

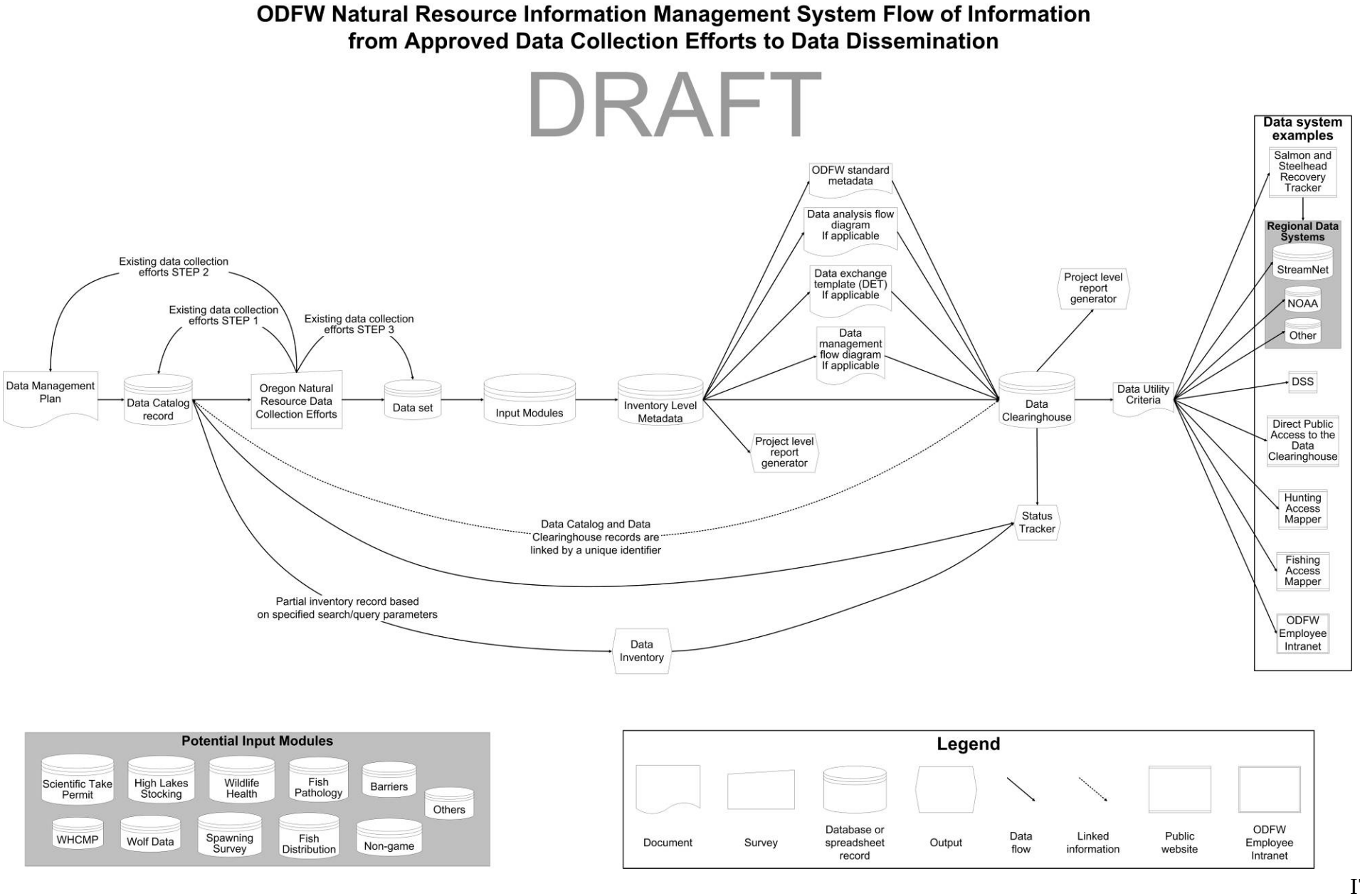
Task 5.4. **Year 3-5:** Pilot populating the Salmon Tracker via datasets contained in the Data Clearinghouse.

Task 5.5. **Year 4-5:** Pilot distribution of datasets contained in the Data Clearinghouse to data receivers other than the Salmon Tracker.

Obj. 6. Implement the Salmon Tracker web application as the Regional data sharing tool.

Task 6.1. **Year 2-5:** Modify the Salmon Tracker as necessary to meet regional needs and reporting obligations.

b. Draft diagram of ODFW's desired future design for data management and sharing.



VI. Key Actions

Table 1. The table below shows the actions that are required to fill gaps in ODFW's current data management and sharing approach to create the streamlined data sharing process shown above. An 'X' indicates the gap(s) that will be partially or completely addressed by fulfilling the "Needs" listed.

NEEDS	GAPS							
	Non-standardized data entry and management formats	Highly variable terminology and data definitions	Paucity of agency-wide information management standards and protocols	Paucity of metadata outside of GIS datasets	Inadequate inventory of data or data collection efforts	Inadequate data quality assurance standards	Inadequate resources for data management	Inability to auto-populate DETs.
Consistent local data storage systems that are easily up-loadable to enterprise-level data systems	X	X	X	X	X	X	X	X
Enhanced data management infrastructure (hardware, software, and data management staff)	X	X	X	X	X	X	X	
Dedicated time from field staff, and analysts to assist in developing metadata, DETs, and data flow and analysis diagrams	X	X	X	X	X	X	X	X
Simplified DET structure with input from the projects that generate and manage the data								X
Complete inventory of existing datasets that contribute to calculating	X	X	X	X	X	X		

NEEDS	GAPS							
	Non-standardized data entry and management formats	Highly variable terminology and data definitions	Paucity of agency-wide information management standards and protocols	Paucity of metadata outside of GIS datasets	Inadequate inventory of data or data collection efforts	Inadequate data quality assurance standards	Inadequate resources for data management	Inability to auto-populate DETs.
VSP/Recovery Plan indicators								
Standardized "Data Management Plan" to be followed by new data collection projects	X	X	X	X	X	X	X	
Clear definitions for desired indicators		X		X				X
ODFW Data Dictionary of common terms, data formats and coding schemes	X	X	X	X		X	X	
Enterprise-level information systems that maintain and share raw and/or derived data in a standard format that is accessible and readable by external information systems	X							X
Regionally consistent data collection and management standards, or establish processes to convert data to these standards prior to sharing		X	X	X		X	X	X
Local and/or enterprise systems to automate DET creation, or make it more	X	X		X				X

	GAPS							
NEEDS	Non-standardized data entry and management formats	Highly variable terminology and data definitions	Paucity of agency-wide information management standards and protocols	Paucity of metadata outside of GIS datasets	Inadequate inventory of data or data collection efforts	Inadequate data quality assurance standards	Inadequate resources for data management	Inability to auto-populate DETs.
efficient								

VII. Funding

It is recognized and acknowledged that current resources (funding, staff, hardware and software) for data stewardship support are not adequate to accomplish the objectives listed above, particularly given the expansive data collection and management (current and planned) for Lower Columbia, Mid-Columbia and Snake River salmon and steelhead populations (Table 2). Therefore, in order to complete the actions required to fill gaps in ODFW's current data management and sharing approach identified in Table 1, funding will be sought from NOAA, BPA through the CA effort, and through the short-term redirection of StreamNet funding, beginning in FFY-2012.

ODFW StreamNet had previously prioritized on populations described in the Status of the Resource Report. FFY-2012, the plan is to shift focus to exchanging CA and Recovery Plan indicators and metrics data, increase focus on juvenile data, help develop metadata and data plans, and assist ODFW with data system development designed to serve data to the Salmon Recovery Tracker. Oregon StreamNet will not exchange updates for most existing abundance trends, hatchery returns, and dam/fish passage and hatchery facility data. Beginning in FFY-2013, data exchanges with StreamNet will limited at best, but instead Oregon StreamNet will focus on the Objectives and Tasks listed above and the data types needed for population assessments.

A review of existing BPA funded data collection projects that contain a "Data Management" work element revealed that these funds are being used primarily to input and analyze field data. Redirecting these funds to meet the shortfall of this Strategy is not appropriate, as it would undermine the data, which is the foundation of this Strategy effort.

Currently, the highest priority for CA funding is for two FTE's which would be stationed with and supervised by appropriate recovery programs to help field staff address a number of the tasks listed above. Another priority is to acquire funding to complete the Salmon Tracker for coastal Coho, all salmon and steelhead in the LCR, and steelhead in the Mid-C (Obj. 6). "Bridge" funding has been requested through NOAA for this effort. Future funding, including that obtained from the CA process, will be used to expand the Salmon Tracker to other populations in Oregon with ESA listed populations being the first priority and within those listed populations the first priority will be those populations targeted for low to very low extinction risk. Because all the Objectives listed above are necessary to construct a functional and efficient data management and sharing system for ODFW, funding shortfalls will slow the pace and reduce the scope of completing Objectives 1 – 6 rather than resulting in the elimination of certain Objectives.

Table 2. Data Collection & Management (Current or Planned) for Lower Columbia, Mid-Columbia and Snake River salmon and steelhead populations and VSP indicators (including SARs) by species, run, Stock Management Unit (SMU), and population to be provided through this work plan. An "X" indicates where monitoring data are available for VSP indicators of adult abundance (A), adult productivity (P), smolt to adult return rates (SAR), diversity including age and origin (D), and spatial distribution (SD).

Species, Run	SMU	Population	A	P	SAR	D	SD
Chinook, Fall							
	Lower Columbia						
		Big	X	X		X	X
		Clackamas	X		X	X	X
		Clatskanie	X	X	X	X	X
		Hood	X	X		X	X
		Lower Gorge	X	X		X	X
		Sandy	X	X		X	X
		Sandy - Late	X	X		X	X
		Scappoose	X	X		X	X
		Upper Gorge	X	X		X	X
		Youngs	X	X		X	X
	Mid Columbia						
		Deschutes					
		John Day					
		Umatilla					
		Walla Walla					
	Snake						
		Snake					
Chinook, Spring							
	Lower Columbia						
		Clackamas	X	X	X	X	X
		Hood	X	X	X	X	X
		Sandy	X	X	X	X	X
	Mid Columbia						
		Crooked					
		Lower Deschutes					
		Metolius					
		Umatilla	X	X	X	X	X
		Upper John Day	X	X	X	X	X
		Walla Walla					

Species, Run	SMU	Population	A	P	SAR	D	SD
Chinook, Spring							
	Mid Columbia						
		John Day, Middle Fork	X	X	X	X	X
		John Day, North Fork	X	X	X	X	X
	Snake						
		Big Sheep	X	X		X	X
		Catherine	X	X	X	X	X
		Imnaha	X	X		X	X
		Lookinglass					
		Lostine/Wallowa	X	X	X	X	X
		Minam	X	X	X	X	X
		Upper Grande Ronde	X	X	X	X	X
		Wenaha	X	X		X	X
	Upper Snake						
		Burnt					
		Eagle					
		Malheur					
		Owhyee					
		Pine					
		Powder					
Chum							
	Lower Columbia						
		Big					
		Clackamas	X	X	X	X	X
		Clatskanie					
		Lower Gorge					
		Sandy					
		Scappoose	X	X		X	X
		Upper Gorge					
		Youngs					
Coho							
	Interior Columbia						
		Umatilla					
		Wallowa					
	Lower Columbia						
		Big	X	X		X	X
		Clackamas	X	X	X	X	X

Species, Run	SMU	Population	A	P	SAR	D	SD
Coho							
	Lower Columbia						
		Clatskanie	X	X	X	X	X
		Lower Gorge	X	X		X	X
		Sandy	X	X	X	X	X
		Scappoose	X	X	X	X	X
		Upper Gorge/Hood	X	X		X	X
		Youngs	X	X		X	X
Steelhead, Summer							
	Lower Columbia						
		Hood	X	X	X	X	X
	Mid Columbia						
		Crooked					
		Deschutes Eastside	X	X	X	X	X
		Metolius					
		Umatilla	X	X	X	X	X
		Upper John Day	X	X	X	X	X
		Walla Walla	X	X			
		Willow					
		John Day, Middle Fork	X	X	X	X	X
		John Day, North Fork	X	X	X	X	X
		Deschutes Westside	X	X			
		John Day, Lower	X	X		X	X
		John Day, South Fork	X	X	X	X	X
	Snake						
		Imnaha					
		Joseph	X	X		X	X
		Lower Grande Ronde					
		Upper Grande Ronde	X	X		X	X
		Wallowa	X	X		X	
Steelhead, Winter							
	Lower Columbia						
		Big	X	X		X	X
		Clackamas	X	X	X	X	X
		Clatskanie	X	X	X	X	X
		Hood	X	X	X	X	X

Species, Run	SMU	Population	A	P	SAR	D	SD
Steelhead, Winter							
	Lower Columbia						
		Lower Gorge	X	X		X	X
		Sandy	X	X		X	X
		Scappoose	X	X	X	X	X
		Upper Gorge	X	X		X	X
		Youngs	X	X		X	X
	Mid Columbia						
		Fifteenmile	X	X	X	X	X

Appendix J

Shoshone Bannock Tribes Data Sharing Management Plan for Viable Salmonid Population Indicators

Summarized by StreamNet for Coordinated Assessments Project

Introduction:

The Shoshone Bannock Tribes (SBT) has been pivotal in the protection, monitoring and management of Salmon in the Snake River for many years. In 1991 the Snake River sockeye salmon became the first of 13 Columbia River Salmon and steelhead populations to be listed as endangered under the Endangered Species Act (ESA). Chinook Salmon and steelhead of the Salmon River subbasin were listed as threatened under the ESA in 1992 and 1997 respectfully. The SBT have played a major role in addressing the dramatic declines in these ecological and culturally significant species. With funding from the Lower Snake River Compensation Plan (LSRCP) and Bonneville Power Administration (BPA), through the Columbia River Fish Accords, the SBT began to participate in planning activities associated with anadromous fish and developed defined production and hatchery projects to increase abundance, distribution, genetic diversity, and productivity of anadromous salmonids.

The SBT is currently participating in the Coordinated Assessments Project, a new data specific demand of effort to establish sharing capacity as it relates to three Viable Salmonid Population (VSP) indicators: natural origin spawner abundance, smolt to adult ratio, and recruit per spawner ratio. This document summarizes current data management and sharing efforts of the SBT, and presents a preliminary assessment of additional resources required to implement a new demand for sharing data related to these indicators.

Purpose and Scope:

As a result of protecting and rejuvenating salmon populations in the Snake River Basin, the Shoshone Bannock Tribe's Fish and Wildlife Department has developed three primary salmon monitoring and propagation programs: Salmon River habitat enhancement projects, Snake River Sockeye research and Sawtooth Lake limnological research, and Salmon River Anadromous Fish Management Projects.

The anadromous salmon populations, as identified through the Interior Columbia Technical Recovery Team (TRT), under SBT management and/or co management include 13 focal populations: 1) Snake River Steelhead (DPS) of the Upper Salmon

Mainstem, 2) Camas Creek Snake River Spring/Summer Chinook (ESU), 3) Loon Creek Snake River Spring/Summer Chinook (ESU), 4) Bear Valley Creek Snake River Spring/Summer Chinook (ESU), 5) East Fork Salmon Snake River Spring/Summer Chinook (ESU), 6) Yankee Fork Snake River Spring/Summer Chinook (ESU), 7) Upper Salmon Mainstem Snake River Spring/Summer Chinook (ESU), 8) Valley Creek Snake River Spring/Summer Chinook (ESU), 9) Panther Creek Snake River Spring/Summer Chinook (ESU), 10) Stanley Lake Snake River Sockeye (ESU), 11) Redfish Lake Snake River Sockeye (ESU), 12) Pettit Lake Snake River Sockeye (ESU), and 13) Alturas Lake Snake River Sockeye (ESU).

Data collection efforts aimed at monitoring and evaluating program effectiveness of listed TRT salmonid populations, in regards to Viable Salmon Population (VSP) indicators include: spawning ground surveys (redd counts, adult live fish counts, carcass counts, genetic sampling for origin derivation), smolt survival from Sawtooth Lakes to Lower Granite Dam (LGR), adult weir trapping, juvenile rotary screw trapping, video monitoring, snorkel surveys, habitat monitoring, and CREEL surveys (monitoring tribal harvest).

Current Data Sharing Capabilities:

Each of the primary Tribal projects is overseen by its individual project manager. Data is managed on the manager's/biologist's personal computer and limited interaction occurs between each manager. The SBT does, intermittently, utilize the Idaho Department of Fish and Game's (IDFG) Idaho Fish and Wildlife Information Systems (IFWIS) trapping, spawning ground survey, and carcass portals. This system is aimed at standardizing data on fish, wildlife, and plants in Idaho. The IFWIS portals utilized by the SBT allow authorized users to query data and provide a location for the SBT to backup portions of their data.

Sockeye salmon parr and smolt that are retrieved in the four traps between Sawtooth Lakes and LGR are scanned for Passive Integrated Transponder (PIT) tags and, when PIT tags are present, this data is reported to the Fish Passage Center and PITAGIS.

Progress and annual reports are also generated to comply with contractual obligations to BPA, NOAA, USFWS, USFS and other funding sources. Typically, searching the appropriate databases with the primary authors name will provide interested parties with these documents; otherwise, the best way to obtain these reports is to directly contact the SBT project manager.

Data sharing capabilities between Tribal fisheries managers is very limited to non-existent. Even when overlaps occur between projects on potentially useful data, data is not shared to increase sample size. This is due to lack of infrastructure, data sharing

policy, and internal communication. As the SBT Fish and Wildlife programs continue to increase their data sets and grow as an organization, these issues will need resolution.

Assessment of Gaps, Needs, and Priorities Specific to 3 VSP Indicators and DET:

The SBT Fish and Wildlife Department are currently collecting quality data in regards to the productivity and fitness of salmonid populations under their management. Furthermore, their monitoring efforts are useful to quantify the effectiveness of previous implemented projects, especially in regards to providing future management directions for hatchery and habitat restoration efforts.

Currently, the primary need found within the SBT Fish and Wildlife Department is the lack of an agency wide data management plan and data backup. As mentioned above each program manager manages data pertinent to their project on their personal computer. SBT has no formal data backup system and no internal database. The lack of data backup has resulted in the loss of precious data previously collected by Tribal biologists. Furthermore, the lack of internal database makes it very difficult for project managers to share useful data amongst each other.

Facilitating data sharing internally will increase the SBT's ability and effectiveness for data analysis. Currently, the SBT have a wealth of information in regards to VSP indicators, however, they are only beginning to analyze data between seasons to create these indicators. Therefore, there is a buildup of collected, unanalyzed data. Implementing an internal regulatory system that is aimed at organizing and creating a consistent protocol for data analysis will greatly mitigate this issue.

Some of the current managers have inherited preexisting projects with vast amounts of data collected by previous managers. This data is archived in archaic systems and the SBT manager do not currently have the ability to access this historic data to conduct long term analysis. Converting this data into a more current data type would allow current managers to view previous data and methods and ultimately increase the productivity, effectiveness, and accuracy of their present day efforts.

A formal agency wide data management plan would resolve these issues as well as implement a standardized protocol on how data is shared within the Tribe as well amongst the region. It would facilitate organization and scheduling amongst the primary project leaders not only streamlining efficiency but improving quality and accuracy of data published. A data management plan would allow the SBT biologists to manage past, present, and future data in a more efficient way, ultimately increasing their ability to generate VSP indicators and benefitting region wide restoration efforts.

It is currently very difficult for individuals to locate reports generated by the SBT Fish and Wildlife Department. A website housing these reports as well a general statement of purpose and current projects would benefit the public, tribal members and management, as well as region wide interested agencies. A website housing this type of information would also greatly facilitate future coordination efforts similar to the present coordinated assessment.

To address these needs and implement formal data sharing the SBT should hire an experienced, professional, IT/Data consultant who can identify, and resolve some of these issues. A designated data coordinator could help implement a data plan into the future.

DET as a Business Practice for VSP Indicators:

1. Currently, the partner capacity of the SBT Fish and Wildlife Department, with the exception of IDFG's IFWIS portals, is relatively low. The SBT is severely lacking in internal organization and formal protocol which would make them a powerful component in a basin wide VSP DET partner. The data currently collected however is very pertinent to VSP indicators for populations under SBT management. As the Fish and Wildlife Department continues to expand in infrastructure and data collected it is increasingly important to provide the effort to assist the SBT in participation and development of VSP indicators for populations under their authority.
2. Shared technical infrastructure, as well as internal technical infrastructure, is major arenas where the SBT need improvement. With an increase in internal infrastructure SBT will be able to create more VSP indicators with higher levels of accuracy. A data coordinator would play a pivotal role in identifying infrastructure needs necessary to support information flows for multiple partners.
3. The DET is a major issue dissuading the SBT managers from enthusiastically agreeing to roll the existing DET into a business practice to share what they currently calculate. With a revised, more condensed and intuitive DET, which also reduces potential for user error, there would be an increase in enthusiasm to implement the DET as a business practice to share data and VSP indicators amongst the Basin.
4. Management and governance is going to be an important issue to address as co-managers strive to implement this DET across the region/basin. In this coordination effort, it is important that there is uniformity of definitions in regards to terminology and methodology. Also, to operate on a region/basin wide level it is important to continue dialogue through workshops and management to ensure that decisions are made and conducted in a manner mutually beneficial to, at least, the majority of all interested and active parties. Furthermore, this dialogue

will serve as an area to keep all parties active in the implementation of DET efforts. A data coordinator could represent the SBT in these activities.

Summary of Future Needs to Address Gaps:

Ultimately, the SBT needs an IT/Data consultant to attend regional data coordination meetings and to develop a data management strategy capable of addressing and resolving the listed issues perpetuating the advancement of the SBT Fish and Wildlife Department and provide data requested by NOAA Fisheries.

Additionally, to achieve data integration and sharing as proposed by the Coordinated Assessments Program, the SBT needs to develop plans, tools, and extra resources including, but not limited to:

- Development of an comprehensive, centralized internal data housing and back-up system (including hardware and software),
- Development of data standards, data collection protocols, data review, and internal infrastructure for data sharing,
- Convert and obtain archived data into usable format for long term analyses,
- Increased marking for evaluation of production programs, and
- Educational coursework for the advancement of technical staff.

Appendix K:

Washington Department of Fish and Wildlife

Columbia River Basin Data Management and Sharing Strategy for Three Viable Salmonid Population (VSP) Indicators

Contents

I. Statement of Purpose

The purpose of this data management and sharing strategy is to improve the ability of Washington Department of Fish and Wildlife (WDFW) to manage and share information at the population scale for three (3) high-level salmon indicators (three focus indicators) in the Columbia River: 1) Abundance of natural spawning anadromous salmonids; 2) adult to adult return rate; and 3) smolt to adult return rate. This WDFW Strategy will be used to guide priorities and investments in infrastructure (hardware or software) and staffing for the next several years.

The scope of this WDFW Strategy is limited to the three focus indicators to ensure that the project is manageable and has a high likelihood of success. Additional indicators will be addressed in subsequent processes and strategy documents, including remaining VSP indicators and resident fish and wildlife monitoring indicators.

I. Goals

General WDFW data management and sharing goals:

- Implement systems that are secure, accurate, consistent, and accessible;
- Ensure that data and information are aligned with, and inform, priority salmon recovery and management programs within WDFW and the region; and
- Build collaborative partnerships that leverage existing technology and resources.

Goals for this data management sharing strategy:

- Assess WDFW's 's current data management and sharing capacity for the three focus indicators;
- Describe key data management and sharing gaps and needs; and
- Identify solutions, options, and projects for meeting the gaps and needs.

II. Objectives

WDFW Strategy Objectives

- Promote internal and external policy-level discussions about how best to support adequate data management and ensure priorities are funded that facilitate basin-wide salmon and steelhead evaluations and assessments.

- Identify priorities that will inform:
    - Northwest Power and Conservation Council's Fish and Wildlife Program Category Review for Data Management and Regional Coordination projects.

    - NOAA funding processes to support recovery monitoring and align data management funding necessary for status assessments.

    - Additional external and internal funding processes, in order to better align all these efforts with BPA funding for data management within the Columbia River Basin.

- Over the long-term, realize a sustained flow of high quality abundance and productivity data in order to efficiently support calculation of reliable and transparent salmon and steelhead population indicators.

III. Current Data Management and Sharing Capacity

In 2011 through the Coordinated Assessment project, WDFW conducted an assessment of data management and sharing capacity for the three focus indicators for salmon populations in Washington State. The findings from this work have been incorporated into this strategy. The Gaps, Needs, Assessment report is available in Appendix 1 of this strategy.

IV. Needs Assessment (Gaps)

A. Reporting, Transparency, Communication, and Accountability

One of the primary findings of the gaps, needs, and assessment work was that the major issues hindering the calculation and sharing of the three focus indicators are systematic and institutional, and will require broad, region-wide or agency-wide collaboration and coordination. Correcting individual fish population data management and sharing issues, while part of the solution, will not by itself result in major or substantive changes in the way data are shared across the Columbia Basin. What is required is an investment in standardization of data collection and analysis methods, data management tools and business rule development, standardization in data sharing architecture and infrastructure, and forums for collaboration.

B. Internal Data Stewardship

Data sharing at the scale of the Columbia River relies upon standardization, consistency, quality control, and automation, from data collection to data storage and maintenance to reporting. While there has been significant progress in recent years, continued investments are needed. The current state of data sharing in the Columbia River, and within WDFW, will require care and feeding to help transition from a system of primarily individual non-standardized databases to one that allows for easy sharing and access to the three identified indicators. This transition will require an investment.

There is a gap in managing current information, and this gap may increase in the near term, as WDFW transitions to an automated reporting and sharing infrastructure. Proper quality control of existing data will require active oversight as data moves through the existing infrastructure. Over time operating procedures and business practices will need to be developed and implemented to ensure consistency within and outside the agency, as well as quality control over the long term.

During initial years of this transition (2012-2014), WDFW will require the equivalent of 2 FTEs to help transition from its current data management systems to those that will deliver the data sharing being described in this data sharing strategy and anticipated for the additional indicators.

C. Coordination

Efficient and effective data management and sharing will require ongoing coordination both within WDFW among headquarters, programs, and the regions, as well as externally with federal, state, and local partners and co-managers to ensure consistency for data collection, storage, and dissemination. WDFW anticipates an increased need for coordination especially in the near-term (1-3 years) as automated systems are developed and come online. Funding for basin-wide policy and technical coordination will need to maintained and possibly increased to accommodate this need.

D. Data Architecture

WDFW will employ a network of distributed databases and systems using a combination of both internal (e.g., SASI) and external (e.g., PITAGIS) systems. Not all the infrastructure is in place so WDFW will need to develop both local and enterprise-level databases to automate data sharing. Where possible, WDFW plans to leverage existing technology and resources and will pursue opportunities to coordinate the development of regional systems or local systems to avoid duplication of efforts, and to take advantage of sharing technology or ideas. Where possible, WDFW will also take advantage of technologies such as web services to share information real time.

WDFW evaluated the data architecture for the three focus indicators and developed a diagram illustrating how data flow from databases and other electronic data sources, through the analyses (illustrated using Directed Acyclic Graphs) to inform the three focus indicators (Fig. 1). This diagram is explained in more detail under section D. Databases and Software Infrastructure.

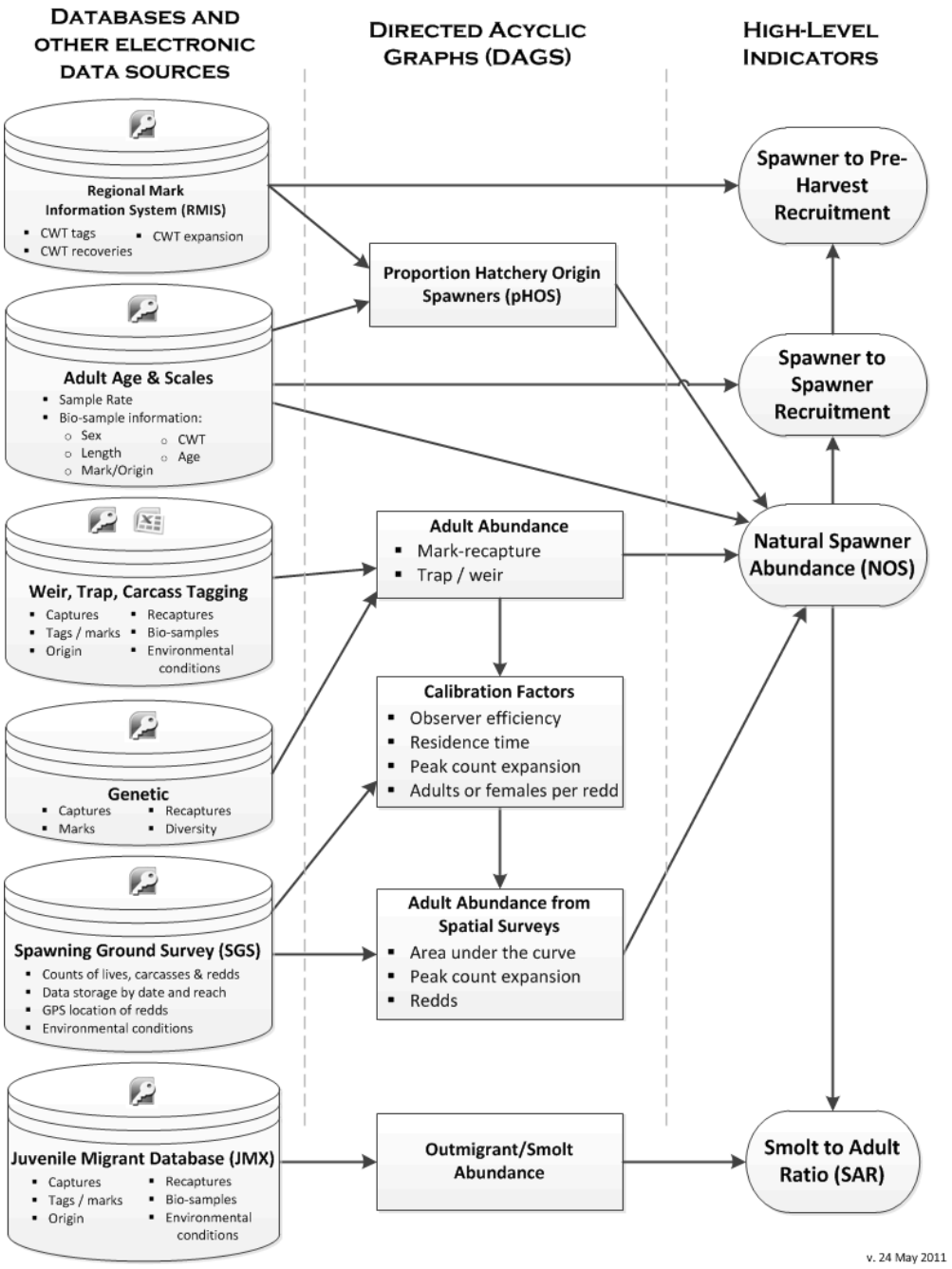


Figure1. Linkage between databases, directed acyclic graphs, which are a specific data flow diagram, and indicators used in decision analyses

E. Key Databases and Infrastructure

i. WDFW Salmon Conservation and Reporting Engine (SCoRE)

WDFW is developing Salmon Conservation and Reporting Engine (SCoRE). SCoRE is a web-based information sharing system that is designed to consolidate and summarize data and information that represents the Washington Department of Fish and Wildlife's contribution to salmon

conservation and salmon recovery. SCoRE is a multi-phase project that will be completed over the next several years. SCoRE will be WDFW's primary vehicle for delivering data and information to its partners and the public.

Problem Statement (Gap)
WDFW does not have a comprehensive, high-level, web-based reporting system that summarizes salmon data and information for internal and external consumption. This results in inefficiencies and a lack of transparency and accountability.

Proposed Solution
Develop an internal data reporting engine that builds upon existing internal and external databases and data systems to report high-level indicators of salmon conservation and recovery. SCoRE is a work in progress and currently many of the primary data sets required to populate SCoRE still need to be developed. The following list of projects captures the key priority areas of database and infrastructure development.

ii. Regional Mark Information System (RMIS)

RMIS informs all three focus indicators. RMIS is a regional system that was developed by the Pacific States Marine Fisheries Commission (PSMFC) to access the regional state and tribal Coded-Wire Tag databases. PSCMFC through their Regional Mark Processing Center operates and maintains RMIS. The Regional Mark Processing Center designs, develops, implements, and evaluates the central database for the storage and retrieval of coastwide CWT and related fisheries information. The Regional Mark Processing Center validates multi-agency submissions of CWT release, recovery, and related data for Pacific salmon and steelhead research studies and harvest management. The data center is managed using Oracle and Linux based applications on its server at the Pacific States Marine Fisheries Commission.

Problem Statement (Gap)
RMIS itself is operational and functional. The gap is in WDFW's ability to feed RMIS. The goal is to automate and make more efficient the process of reporting information from WDFW systems to RMIS.

Proposed Solution
Develop or enhance the following WDFW systems to feed RMIS. This work is already underway within WDFW and expected to be completed by 2011 or early 2012.

1) Juvenile migrant data exchange database (JMX)
2) WDFW hatchery management system (FishBooks)
3) WDFW internal coded-wire tag recovery database (WaDERS).

iii. Adult Age and Scales Sampling Database

The adult age and scales database informs all three focus indicators. This database stores fish bio-tissue sample data used to determine population age profiles from scales and bony structures for population productivity calculations.

Problem Statement (Gap)
There is no statewide or centralized database for Age/Scale sampling reporting. Current Age/ Scale Sampling datasets are fractured into regional data sets with high levels of inconsistency among data elements and coding schemes.

WDFW's system consists of regional databases/datasets that are not standardized. This approach does not facilitate data sharing and does not meet current or future needs for reporting on the three focus indicators.

Proposed Solution
Build a statewide Age/Scale database and standardize field data collection forms and datasets for both adult and juvenile life stages. This database would capture field data collection protocols, standardization, transfer automation, and documentation of collection and analysis methodology as appropriate.

iv. Weir, Trap, Carcass Tagging Database

This database does not yet exist but is needed to inform all three focus indicators. This database will capture Adult Mark/ Recapture information, including weir, data, capture/ recapture, and sampling records. This database is closely aligned with, and may be combined with, the Age/ Scales Sample database listed above. This data from this database set is a key contributing dataset for PTAGIS and RMIS.

Problem Statement (Gap)
There is no statewide or centralized database for Weir, Trap, Carcass Tagging reporting. Current Age/ Scale Sampling datasets are fractured into regional data sets and are inconsistent their data elements and coding schemes. DART contains dam counts, but does not account for bio-samples, tags/marks, or recaptures. PTAGIS houses every fish with a PIT tag, given the party responsible for trapping actually uploads their tagging and recapture files, but not everything is PIT tagged. Existing systems are inadequate for WDFW needs.

Datasets of this nature have not been developed or are in widely varying formats or with differing elemental components do not lend themselves to easy and consistent compilation into consolidated Coordinated Assessment Indicator datasets.

Proposed Solution
Build a statewide Adult Mark/ Recapture database/databases and standardized field data collection forms and feeder datasets.

v. Genetics Database

A genetics database will inform primarily the Natural Spawner Abundance indicator. This database contains genetic sample and analysis information and genetic stock identification information from the WDFW genetics lab.

Problem Statement (Gap)
The current WDFW genetics database is functional but would benefit from a stronger connection to the other sampling method databases and from better accessibility at a regional scale.

Proposed Solution
Prioritize the development of other systems and build the interface with the genetics database at a later time, once the work can be better scoped. No funding needed at this time.

vi. Spawning Ground Survey Database

The Spawning Ground Survey (SGS) database primarily informs Natural Spawner Abundance (NOS) indicator. SGS is one of WDFW's key foundational databases for spawning data. SGS is fundamental to delivering any data sharing. The SGS database contains counts of carcasses and redds by date and reach, and also contains GPS location of redds and environmental condition of natural spawner salmon surveys. SGS contains the raw data that that this data sharing strategy is built upon.

Problem Statement (Gap)

Because the SGS has no capability for data entry in the regions and no ability to retrieve that information from for centralized storage, there is no way to readily enter or access the Natural Origin Spawner (NOS) raw data. This results in a major bottleneck in the foundational NOS data. Data from Eastern Washington are routinely not captured into the statewide/centralized SGS system. The result over time has been that distributed staging databases have been modified by regional biologists and now no longer interact with each other without a great deal of manual manipulation.

Proposed Solution

Develop a web-based front end data entry and retrieval application for the SGS database that would connect it to the distributed databases in the WDFW regions.

vii. Junvenile Migrant Exchange database (JMX)

This database primarily informs the Smolt to Adult Ratio indicator. This database holds juvenile captures, tags/marks, origin, recaptures, bio-samples, environmental conditions as well as protocols and methods.

Problem Statement (Gap)

WDFW is currently receiving Environmental Protection Agency Data Exchange grant to develop a data exchange node for juvenile data. There is no current gap anticipated for developing this database. WDFW is partnering with the Northwest Indian Fisheries Commission to complete this project. The project is on track and anticipated to be completed by December 2011.

Proposed Solution

Complete the JMX project and implement statewide. No funding needed at this time.

viii. Salmon and Steelhead Stock Iventory (SaSI) Database

The Salmon and Steelhead Stock Inventory (SaSI) database informs all three focus indicators. SaSI is WDFW's primary summary database for reporting spawning escapement estimates. SaSI utilizes and combines several raw databases to generate the spawning escapement estimates. SaSI contains stock status monitoring information and various metadata relevant to the constituent stocks. The data within SaSI is the result of cooperative assessments between WDFW and Washington resource co-managers. SaSI consists of a database and web-enabled user interface through which data can be submitted. SaSI data can be accessed by the public through the WDFW application called SalmonScape.

Problem Statement (Gap)

This database lacks a data steward. SaSI population definitions and population delineations are used by WDFW manage wild populations. However, these are WDFW specific definitions and delineations need to be aligned with NOAA salmonid population definitions to make data sharing possible.

Proposed Solution
WDFW needs an FTE to fill the SaSI data steward position. WDFW needs better tools and web user interface for data entry, documenting metadata and protocols, data analyses, and data dissemination

ix. FishBooks

This database contains numerous metrics associated with hatchery operations and hatchery fish production. This data set is our primary hatchery data system and informs RMIS, coded wire tagging, and internal HSRG monitoring systems. This database serves as a complete hatchery data management system, allowing for input from hatchery workers on all aspects of fish receiving, spawning, rearing and release. Other recorded data elements include feed, treatment and environmental metrics.

Problem Statement (Gap)
FishBooks is operational but needs to be further refined thorough the incorporation advanced reporting and analysis elements for internal use by hatchery operators and regional fish biologists. FishBooks needs better reporting and integration into other WDFW data systems such as those data systems in use by WDFW aging and mark recovery labs, thus speeding data transfer and analysis. FishBooks needs greater reporting capabilities delivering release return information to co-managers, partners, and the general public through integration with WDFW's agency fish conservation website (SCoRE) and available live web services.

Proposed Solution
Identify individual work elements that would address this integration effort needed.

V. Recommendations

The WDFW Strategy resulted in the following recommendations:

1) **Invest in Internal Infrastructure.**
The WDFW Strategy identified the following gaps in internal infrastructure that would assist in automating reporting process for the three focus salmon indicators.

   a. **Fund the development of a centralized WDFW Age & Scales database**
   A centralized WDFW age and scales database would utilize web-based data transfer and statewide standardized codes and will contribute to creating comprehensive population age profiles and productivity estimates. In addition to new data this system will be populated with historical age information (1980 forward) by converting data from older, electronic formats where available and entering data manually as needed. This database will include a user-friendly, web-based interface to facilitate data entry and extraction. The data from this system will be made available via WDFW's Salmon Conservation Database (SCoRE), and will be consistent with data sharing standards outlined in the Columbia Basin Data Sharing Strategy.

b. Fund the development of WDFW Weir, Trap, and Carcass Tagging database
This proposed data system will be the central repository for adult PIT Tagging data (i.e. for Wind River steelhead) and PIT Tag recoveries with appropriate biological data. From this system, data would be uploaded to WDFW's Salmon Conservation database (SCoRE) regional data systems such as PTAGIS and RMIS. A system to centrally manage this information does not exist.

c. Fund the development of a front-end, web-based, data entry and retrieval application for WDFW's Spawning Ground Survey (SGS) database.
This system will provide real-time access to spawning and escapement data. Key metadata will be integrated into this system in the form of an additional data collection methodology documentation module. This project will help to convert the current distributed database and distributed data collection model to a centralized, agency corporate dataset. Reporting from this system will be integrated with WDFW's Salmon Conservation Reporting website (SCoRE) and through automated web services. Advantaged include ease of maintenance and upgrade implementation as well as centralized and consistent reporting.

2) Create Data Steward Positions

a. Invest in data stewards to bridge the gap between biologists and the technical side of data management. The StreamNet and the CRITFC Tribal Data Network project could possibly be reprioritized to meet this need within WDFW.

3) Build Partnering Capacity

a. Fund Regional Coordination Positions
Regional coordination positions are critical to ensure that WDFW participates in key policy, science, and technical forums.

b. Invest in and Improve Standardization
Develop common data exchange templates (DETs); apply data dictionary definitions to existing data bases; and expand the use of Metadata.

Appendix 1 – Gaps, Needs, and Priorities Assessment

WDFW Region 5 Gaps, Needs, and Priorities

Many questions of the Gaps, Needs, and Priorities (GNP) document contain common themes across populations in Washington Department of Fish and Wildlife Region 5 (Lower Columbia). This report summarizes the key findings for each of the individual questions in the GNP document developed in the Coordinated Assessment project.

The major issues illuminated here can be better addressed at a region-wide or agency-wide level and not by fish population. There are gaps and needs specific to populations, but they are primarily at the data collection end. Barriers hindering the calculation and sharing of indicators when raw data is collected are generally systematic and institutional.

Section A – Indicator and supporting data sharing

A.1 Is this indicator calculated by the agency/tribe? If yes indicate by whom.
One major issue is that WDFW manages populations at the SaSI stock level, which do not exactly align with CBFWA defined populations. Many of the indicators that are calculated represent a portion of the total CBFWA population.

A.2a If no, what is the obstacle to calculating the indicator?
The most common limitation is lack of data collection. This region has many populations and WDFW has to prioritize which populations it monitors. Historically, monitoring effort has centered on estimating total escapement. Age data collection is now common and calculating Recruits per Spawner is sometimes possible, but not done due to limited staff time. Smolt-to-Adult ratio is the most data-limited and thus least commonly calculated.

A.2b If no, does the agency/tribe collect supporting data that could be used to generate the indicator?
In some situations, sufficient raw data is available to calculate the indicator, but the indicator is not calculated. Most often this is age data that could be used to calculate Recruits per Spawner.

A.2c If no, does another agency/tribe calculate this indicator? If so, identify.
The Yakama Nation manages all aspects of salmon/steelhead populations in the Klickitat River. Otherwise, no outside entity currently collects data or calculates indicators for populations in WDFW Region 5.

A.2d If no, does the agency/tribe provide supporting data used to generate the indicator to the agency/tribe that calculates the indicator?
Very little monitoring from outside agencies has taken place. In the past, USFWS conducted spawning ground surveys within this region (Chum Salmon in the Lower Gorge population for example). The data from these surveys has been integrated into WDFW databases and used in population estimates when appropriate.

A.2e If supporting data that can be used to generate the indicator are available, but are not being shared, what are the barriers for sharing the data?

There are numerous barriers present. These usually do not prevent biologists from calculating indicators outright, but they hinder the process and necessitate the biologists create their own Excel sheets to amalgamate and manipulate data into the formats they need.

Barriers include:

1) WDFW managed databases do not store the data at the precision needed for analysis.
2) Databases do not store the data needed (otolith origin data for chum, mark-recapture data).
3) Data is entered too slowly into centralized databases, so the biologists enters it himself/herself to expedite process.

A.3a In what format is the indicator stored/documented? Describe the location where the indicator is stored/documented.

WDFW manages a statewide SQL database capable of housing more than 25 specific high-level indicators for SaSI stocks, including Natural Spawner Abundance (termed 'Natural-Origin Spawners' in the system). The closest it gets to SAR is 'Smolts per Female' and there is no analog to Recruits per Spawner. The system is managed at the state level and individual biologists enter calculated indicators directly from their computer.

Natural spawner abundance is usually entered into this database when calculated. A significant gap is that the data-type specified is typically 'Total Natural Spawners' which doesn't indicate the origin of the fish. (The data-type 'Natural-Origin Spawners' is available per the data dictionary, but I didn't come across that being used.) My conversations with biologists show that there is inconsistency to what data entered as 'Total Natural Spawners' represents. Sometimes it combines hatchery-origin and wild-origin fish, sometimes it is wild fish only.

All indicators are stored electronically on an Excel file when calculated. This is the only electronic storage location for SAR and RpS. The file is usually stored on locally networked drive (accessible to other WDFW employees) but the format varies widely from biologist to biologist and is rarely opened by anyone but the biologist who created it.

A written report is supposed to accompany population-level data analysis each season. This step has largely been neglected. Reports that have been completed vary from only containing final counts to detailing precise field and analytical records as well as detailed age, sex, and origin structure.

A.3b What is the current file format of the supporting data used to generate the indicator?

Supporting data is almost always (I'm yet to find an exception) stored directly on an Excel file managed by the biologist. The biologist uses this file to amalgamate raw data, organize it into the necessary structure, perform calculations, and store the results.

A.3c Is the indicator currently being shared electronically? If yes, explain how.

Natural Spawner Abundance is usually shared on the SaSI database mentioned above. The other indicators are not electronically shared.

A.3d If the indicator and supporting data are not being shared, what is needed to allow sharing?

Sharing the indicators would necessitate that the SaSI database structure be modified to hold Smolt-to-Adult Ratio and Recruits per Spawner. Stricter standards to how the data is entered (data-types are clearly defined, but poorly adhered to) by individual contributors.

Sharing the supporting data (metrics) would be much more complicated. For some populations (e.g. Chum) estimates are generated from a succession of statistical models that don't rely on constant metrics from past seasons. Other estimation methods (e.g., Steelhead) do use standard metrics (females / redd) that could more easily be stored and shared.

A.3e What obstacles are there within the entire data collection, data management and indicator calculation process that hinder or slow calculation and sharing of the indicator? Consider initial data capture, data entry, data storage, data sharing (internal and external), analysis, etc.

There are obstacles within each of these stages:

Data Collection: Data gathered on spawning ground surveys is transferred to a survey card and sometimes precision is lost in this step. For instance, live spawning fish are classified as holding or spawning and redds are classified as new or old in the field. These differences aren't always reflected on the survey card. River reaches that are surveyed are standardized, but occasionally field crews will survey only a portion of a reach, which hinders later data analysis.

Scale and otolith samples must first be sent to the lab in Olympia. Turn-over in reading the samples is sometimes slow (years occasionally).

A major limitation in the total process of calculating indicators is the amount of data collected. WDFW Region 5 manages about 75 CBWFA populations and doesn't have the resources to monitor each of these to a degree where the calculation of indicators is possible. For some of the populations, monitoring does occur, but not enough to make the calculation of high-level indicators appropriate.

Data Entry: Data is commonly entered multiple times, first by a biologist who enters necessary data into their own Excel sheet used to compile data from many sources and later by a technician into standardized databases (MS Access usually). The biologist enters data on their own to expedite the process and to ensure the data is correct and in the proper format.

Data Storage: WDFW has been improving data storage in recent years and the overall system is in a state of flux. The most significant obstacle is that data storage receptacles don't always store the data needed (examples of this are otolith origin data for Chum Salmon and mark-recapture data for all species). In other situations data is not stored at the precision needed for analysis (Live counts [spawners v. holders] and reach distance in SGS [an Access database] are examples).

Numerous long term efforts to improve data storage are nearing fruition and the beneficial impacts from these are still yet to be had. These efforts focus on raw data storage however, and not sharing indicators. Some data storage receptacles are statewide (e.g. SGS) while some are managed only by Region 5 (Age and Scales).
Coordination and communication between the regional and statewide office with respect to data management could be improved. Some databases attempt to hold raw data from throughout the state. Implementation of these databases has been slow and Region 5 has their data ready to populate the statewide databases when ready.

Data Sharing (internal): Files and databases are stored on a network that is accessible to all WDFW employees across the state. The main databases are easily accessible. Internal access to data (when available) does not seem to be a limiting factor. In almost every case the biologist performing

calculations manages an Excel workbook with amalgamated data, calculations, and results. These files are rarely accessed by anyone but the person who created it.

Data Analysis: Compiling data necessary for analysis is challenging for biologists. This is in part because the process is inherently cumbersome as data originates from many sources. The current path of least resistance to perform analysis almost always involves the creation of a MS Excel workbook created and managed by the biologist doing the calculations. This process is clearly wrought with inefficiencies and drawbacks, but it is understandable given the current state of data storage. It is hard for me to imagine another method (without using unique Excel sheets) as long as current analytical methods and data storage systems are used.

Dan Rawding has proposed using the program WinBUGS, a Bayesian modeling software package, to calculate high level indicators. This method would be a significant shift from current analytical methods. A principle procedural advantage to this method is the fact that data could largely be drawn from existing databases (some data massaging would still be necessary). Testing of the method has begun for individual populations, but would require additional data storage infrastructure (for the statistical code, massaged data, etc.) before full-scale implementation.

Reporting / Data Sharing (external): WDFW's primary data sharing vector is the SaSI SQL server. This database is managed in Olympia (the dedicated staff position in charge of it has been vacant for years however) and stores high-level indicators for SaSI defined salmon/steelhead stocks. There are numerous interfaces that query this database. They include the SaSI Web Portal (http://sasi.dfw.wa.gov/sasi/), which resembles StreamNet, but requires a WDFW username and password to log-in. A limited amount of data including SaSI stock status (i.e. healthy, depressed) is publically available at the interactive map-based site SalmonScape (http://wdfw.wa.gov/mapping/salmonscape/).

WDFW is developing a new public interface on their website called SCoRE (Salmonid Conservation and Reporting Engine) that will contain more salmon data than is currently publically available. A functional beta-version is being tested, but has not been released to the public. This site will graph historical escapement estimates for each population, as well as link to the detailed SaSI stock reports. This site appears to be geared toward the general public and may not be an efficient platform for data exchange for higher level reporting purposes.

A major gap in WDFW Region 5 is the lack of written reports. This hinders the archiving of field and statistical methods, as well as calculated results that aren't stored in databases. Anecdotally, I found a great deal of information that isn't formally documented. Staff turn-over is slow (many key employees have been here a decade or more) so the lack of documentation hasn't caused significant issues (yet?). It also made creating DAFDs/DETs for this project very difficult for me because 100% of the information had to originate directly from the biologists.

Section B – Access to data

B.1 Are any regional (multi-agency) electronic databases used to store the supporting data used to generate this indicator? Identify all that are used.

No, some data is submitted to regional databases (PTAGIS, RMIS) but these are not used in the calculation of the three indicators in the CA project.

B.2 Who has direct access to the data used to calculate the indicator?

The raw data is available to many employees in WDFW in the sense that they could query an Access database from their computer, or walk to the file cabinet that houses complete scale cards. However, only the biologist has all the data in one place in the format needed to calculate the indicator.

B.3 What barrier(s) exists that prevent access to supporting data for the indicator by external entities?
Many barriers exist. First, the primary databases WDFW manages to house raw data are only accessible internally. Second, not all data used is formally stored anywhere besides the Excel file managed by the biologist. I think sharing this data externally will be a major hurdle given that WDFW is still trying to effectively do this internally.

Section C – Data exchange template approach

C.1 Are multiple agencies collecting supporting data that contribute to the indicator? If so, please explain.
No. The Yakama Nation exclusively manages populations in the Klickitat River. A few CBFWA populations span the Washington / Oregon border (e.g. Columbia Upper Gorge Tributaries Fall Chinook). WDFW and ODFW don't directly share data or attempt to calculate indicators for the complete CBFWA population for these populations that are shared.

C.2 Are multiple agencies calculating the same indicator? If so, please explain.
No.

C.3 Can the agency/tribes current data management system be easily modified to support implementation of a data exchange template approach as a business practice for this indicator?
From a technological standpoint, implementation of a DET approach seems straightforward at WDFW. The statewide SaSI SQL database is already designed to hold high-level indicators and it could probably be modified to hold commonly used supporting metrics and additional indicators. Currently, the SaSI Web Portal (http://sasi.dfw.wa.gov/sasi/) is the only location this data is accessible without communicating with the database directly (to my knowledge). At present the site requires a WDFW password to access. I imagine a third party database could directly communicate with the SaSI SQL database with proper security clearance.

The realistic feasibility of implementing a DET at WDFW in the short term is unlikely as there are more than technological hurdles. For instance, the staff position managing and updating the whole SaSI system has been vacant for years and the database infrastructure is stagnant. Another hurdle is that the SaSI database system is designed to hold data at the SaSI stock population level, which generally represents a finer scale than the CBFWA level that the CA project level is geared towards.

My opinion regarding the difficulty of overcoming these latter complications dictate that I answer 'no' to this question, as I don't think it would be 'easy'.

C.4a If no, describe additional hardware requirements.
A functioning server infrastructure is already in place at the statewide Olympia office. I can't tell if additional or updated hardware would be necessary to share a wider range of data.

C.4b If no, describe additional software requirements.
WDFW already manages a SQL database so there might not be additional software needs.

The SaSI database structure would have to be modified to hold additional high-level indicators and supporting metrics. The population scale the system holds information would have to be addressed if indicators are to be reported at a level other than SaSI stocks.

C.4c If no, describe additional network requirements.
The destination database would have to communicate with the SaSI SQL database. This seems feasible but I didn't look further into what the logistics are.

C.4d If no, describe additional security requirements.
Unclear from my research.

C.4e If no, describe additional backup requirements.
Unclear from my research.

C.4f If no, describe additional staff requirements.
This is a major limitation as data management could clearly benefit from additional effort in WDFW Region 5. Every staff member I talked to cited lack of staffing resources as a primary limiting factor with data management. Within the Region 5 office IT staff is stretched thin and perform duties far beyond managing data (e.g. field work, GIS analysis, equipment maintenance). There are numerous data management projects both planned and in the works that are proceeding slowly due to limited staff available. Maintenance of the entire SaSI system is currently an unfunded state mandate (per Bob Woodard, pers. communication 8 June 2011)..

C.4g If no, other data management requirements
Unclear from my research.

C.5 Is a data sharing agreement necessary?
Unclear from my research.

WDFW Region 2 Gaps, Needs, and Priorities

Many questions of the Gaps, Needs, and Priorities (GNP) document contain common themes across populations in Washington Department of Fish and Wildlife Region 2 (Upper Columbia). This report summarizes the key findings for each of the individual questions in the GNP document developed in the Coordinated Assessment project.

The major issues can be better addressed at a region-wide or agency-wide level and not by fish population. There are gaps and needs specific to populations, but they are primarily due to lack of better methods at this time. Barriers hindering the calculation and sharing of indicators when raw data is collected are generally systematic and institutional.

Section A – Indicator and supporting data sharing

A.1 Is this indicator calculated by the agency/tribe? If yes indicate by whom.

One major issue is that WDFW manages populations at the SaSI stock level, which do not exactly align with CBFWA defined populations. Many of the indicators that are calculated represent a portion of the total CBFWA population. Definitions need to be defined per data dictionary, (example is definition of smolt). Biologists term SAR as "emigrant to adult".

A.2a If no, what is the obstacle to calculating the indicator?
The most common limitation for calculating specific indicators is lack of data collection due to complexity of certain populations. Until a better method is found, SAR's and RPS indicators are not as precisely calculated for Steelhead populations as for Chinook. Monitoring efforts have centered on estimating total escapement, age data collection is now common, Smolt-to-Adult ratio is the most data-limited and the least commonly calculated.

A.2b If no, does the agency/tribe collect supporting data that could be used to generate the indicator?
In some situations, sufficient raw data is available to calculate the indicator, but the indicator is not calculated. Most often this is age data that could be used to calculate Recruits per Spawner.

A.2c If no, does another agency/tribe calculate this indicator? If so, identify.
WDFW is the primary entity involved in calculating indicator.

A.2d If no, does the agency/tribe provide supporting data used to generate the indicator to the agency/tribe that calculates the indicator? The USFWS collects spawning ground data on the Entiat River for Spring, Summer and Steelhead populations. The Chelan County PUD collects Wenatchee Summer Chinook Redd count data and Wenatchee Sockeye Redd count data. Bioanalysts conduct spawning grounds surveys for the Okanogan and Methow Summer Chinook populations. The data from these surveys has been integrated into WDFW databases and used in population estimates when appropriate.

A.2e If supporting data that can be used to generate the indicator are available, but are not being shared, what are the barriers for sharing the data?
There are numerous barriers present. These usually do not prevent biologists from calculating indicators outright, but they hinder the process and necessitate the biologists create their own Excel sheets to amalgamate and manipulate data into the formats they need.

Barriers include:

1) WDFW managed databases do not store the data at the precision needed for analysis.
2) Databases do not store the data needed (otolith origin data).

A.3a In what format is the indicator stored/documented? Describe the location where the indicator is stored/documented.
WDFW manages a statewide SQL database capable of housing more than 25 specific high-level indicators for SaSI stocks, including Natural Spawner Abundance (termed 'Natural-Origin Spawners' in the system). The closest it gets to SAR is 'Smolts per Female' and there is no mention to Recruits per Spawner. The system is managed at the state level and individual biologists enter calculated indicators directly from their computer.

Natural spawner abundance is usually entered into this database when calculated. However not all populations NSA are entered into this database. Populations list Escapement, Redd counts or Natural

Spawner or they may not have any data at all in the SQL database. A significant gap is that the data-type specified is sometimes different than the DET format. An example is the definition of smolt vs. emigrant, calculating Run Escapement vs. spawning escapement and NORs "natural origin recruit" vs. RPS.
All indicators are stored electronically on an Excel file when calculated. This is the only electronic storage location for SAR and RpS. The file is usually stored on locally networked drive (accessible to other WDFW employee's in-office).

Written reports are conducted yearly to summarize final counts to detailing precise field and analytical records as well as detailed age, sex, and origin structure.

A.3b What is the current file format of the supporting data used to generate the indicator?
Supporting data is stored directly on an Excel file managed by the biologist. The biologist uses this file to manipulate raw data, organize it into the necessary structure, perform calculations, and store the results.

A.3c Is the indicator currently being shared electronically? If yes, explain how.
Natural Spawner Abundance is usually, (not for all populations), shared on the SaSI database mentioned above. NSA, NOR and hatchery SARs for most populations are shared via annual reports. The other indicators are not electronically shared.

A.3d If the indicator and supporting data are not being shared, what is needed to allow sharing?
Sharing the indicators would cause the need for the SaSI database structure to be modified to hold Smolt-to-Adult Ratio and Recruits per Spawner. Similar standards need to be followed on to how the data is entered by individual biologists.

Sharing the supporting data (metrics) would be much more complicated. For some populations estimates are generated from a succession of statistical models that don't rely on constant metrics from past seasons. Other estimation methods do use standard metrics that could more easily be stored and shared.

A.3e What obstacles are there within the entire data collection, data management and indicator calculation process that hinders or slows calculation and sharing of the indicator? Consider initial data capture, data entry, data storage, data sharing (internal and external), analysis, etc.

There are obstacles within each of these stages:

Data Collection: River reaches that are surveyed are standardized, but occasionally field crews will survey only a portion of a reach, which hinders later data analysis.

Scale and otolith samples must first be sent to the WDFW scale analysis lab in Olympia which causes a delay in data management.
A major limitation in the total process of calculating indicators is the amount of data collected and methodology. For some of the populations, Steelhead in particular, monitoring occurs with the best method available, but not enough to make the calculation of high-level indicators, as deemed in the DET, possible.

Data Entry: Data entry slows calculation of indicators as data is commonly entered one time by a technician into a standardized databases (MS Access usually). The Biologist extracts what he/she needs from database into a excel spreadsheet where they calculate the indicators.

Data Storage: The most significant obstacle is that data storage receptacles don't always store the data needed (examples of this are otolith origin data).

Data Sharing (internal): Files and databases are stored on a network that is accessible to all WDFW employees in office. The main databases are easily accessible. Internal access to data (when available) does not seem to be a limiting factor. In almost every case the biologist performing calculations manages an Excel workbook with manipulated data, calculations, and results. These files are rarely accessed by anyone but the biologists who created it.

Data Analysis: Compiling data necessary for analysis is challenging for biologists. This is in part because the process is inherently cumbersome as data originates from many sources and is located in many places. The current method of biologist is creating a MS Excel workbook managed by the biologist doing the calculations.

Reporting / Data Sharing (external): WDFW's primary data sharing vector is the SaSI SQL server. This database is managed in Olympia and stores high-level indicators for SaSI defined salmon/steelhead stocks. External data sharing is not available beyond the SQL server and written annual reports.

Section B – Access to data

B.1 Are any regional (multi-agency) electronic databases used to store the supporting data used to generate this indicator? Identify all that are used.
No, some data is submitted to regional databases (PTAGIS, RMIS, DART, SaSI, UCME-in office WDFW database) but these are not used in the calculation of the three indicators in the CA project.

B.2 Who has direct access to the data used to calculate the indicator?
The raw data is available to many employees in WDFW in the sense that they could query an Access database from their computer, or walk to the file cabinet that houses complete scale cards. However, only the biologist has all the data in one place in the format needed to calculate the indicator.

B.3 What barrier(s) exists that prevent access to supporting data for the indicator by external entities?
The primary databases WDFW manages to house raw data are only accessible internally on a shared network.

Section C – Data exchange template approach

C.1 Are multiple agencies collecting supporting data that contribute to the indicator? If so, please explain.
Yes and No, Chelan County PUD collects Redd counts for Wenatchee Summer Chinook and Wenatchee Sockeye that contribute to calculating the indicator. USFWS conducts spawning ground surveys for the Entiat populations but the Steelhead estimates do not use this information in calculating run escapement. Bioanalysts conduct Summer spawning ground surveys for the Methow and Okanogan populations.

C.2 Are multiple agencies calculating the same indicator? If so, please explain.
No.

C.3 Can the agency/tribes current data management system be easily modified to support implementation of a data exchange template approach as a business practice for this indicator?
From a technological standpoint, implementation of a DET approach seems straightforward at WDFW. The statewide SaSI SQL database is already designed to hold high-level indicators and it could probably be modified to hold commonly used supporting metrics and additional indicators. Currently, the SaSI Web Portal (http://sasi.dfw.wa.gov/sasi/) is the only location this data is accessible without communicating with the database directly. At present the site requires a WDFW password to access. I imagine a third party database could directly communicate with the SaSI SQL database with proper security clearance.

The SaSI database system is designed to hold data at the SaSI stock population level, which generally represents a finer scale than the CBFWA level that the CA project level is geared towards.

C.4a If no, describe additional hardware requirements.
WDFW Wenatchee office does not have a server

C.4b If no, describe additional software requirements.
Additional software will be needed. The SaSI database structure would have to be modified to hold additional high-level indicators and supporting metrics. The population scale the system holds information would have to be addressed if indicators are to be reported at a level other than SaSI stocks.

C.4c If no, describe additional network requirements.
The destination database would have to communicate with the SaSI SQL database. Need for better connectivity, currently the Wenatchee office has cad 5.
C.4d If no, describe additional security requirements.
Security is efficient.
C.4e If no, describe additional backup requirements.
Unclear from my research.

C.4f If no, describe additional staff requirements.
This is a major limitation as data management could clearly benefit from additional efforts, such as a data steward, IT support or web programmer, in WDFW Region 2.

C.4g If no, other data management requirements
Unknown at this time.

C.5 Is a data sharing agreement necessary?
Yes due to varying ownerships of data.

Yakama Nation Fisheries Program
Data Management Status Summary and Needs Assessment
October 7, 2011

Introduction

For the past decade or more the Yakama Nation Fisheries Program (YNFP) has been working to develop, maintain, and improve its data management, networking, and sharing capabilities. The purpose of this document is to summarize YNFP data management and sharing efforts to date, and to present a preliminary assessment of additional resources required to develop and implement a long-term, programmatic YNFP data management plan.

Yakama Nation Fisheries Program Responsibilities

The Yakama Nation is integrally involved in the management and restoration of all anadromous fish populations and their habitats throughout its ceded area. These populations include: spring (native), summer (unknown), and fall (introduced) run Chinook, summer and winter run steelhead (native), and coho (introduced) in the Klickitat River Basin; spring (native and integrated Upper Yakima Hatchery), summer (reintroduced), and fall (native/supplemented) run Chinook, summer run steelhead (native), coho (re-introduced), and sockeye (re-introduced) in the Yakima River Basin; coho (re-introduced), spring and summer Chinook, and steelhead in the mid-Columbia Basin (Wenatchee, Entiat, Methow); Hanford Reach fall Chinook, Pacific lamprey; and sturgeon. In addition, the Yakama Nation is responsible for documenting harvest in Treaty fisheries in the Columbia River mainstem and in tributaries throughout its ceded area.

Present Yakama Nation Data Management and Sharing Status

Dedicated data stewards have been employed under Yakima-Klickitat Fisheries Project Data, Management, and Habitat contracts for the Yakima Basin (BPA project No. 198812025) since 2000 and for the Klickitat Basin (BPA project No. 198812035) since 2003. Detailed information management plans for these two basins have been developed and are available upon request (Yakima Basin, contact Bill Bosch, bbosch@yakama.com; Klickitat Basin, contact Michael Babcock, mbabcock@ykfp.org). In other portions of the YN ceded area, data management has generally been taken on by project biologists. The primary focus of existing data management activities has been to support internal project and program priorities within specific basins. The YN has also worked to share existing data with co-managers, other agencies, and the public (for example, see Figures 1, 2, and major accomplishments below), but many existing project data and information are still only available via project reports (available through the PISCES and TAURUS web sites) or via e-mail contacts with existing data stewards or project biologists.

The YNFP is increasing its data collection and reporting capabilities through the implementation of a number of ongoing and new projects. Due to project and budget priorities, data management plans for these projects have not been fully considered, developed or implemented. Yet clearly, these projects will be collecting data critical to assessment of VSP indicators for many listed and non-listed populations throughout a large portion of the Columbia River Basin.

Yakama Reservation Watershed Project (BPA project No. 1996-035-01). The Satus, Toppenish and Ahtanum watersheds are home to approximately half the total spawning abundance—and two of the four distinct populations—of Yakima Subbasin steelhead. Currently, these watersheds are habitat limited for a variety of reasons. Stream channel, floodplain and vegetation restoration projects addressing habitat related limiting factors (i.e., flow, key habitat quantity, habitat diversity, temperature, sediment load, channel stability) identified in the Yakima Subbasin Plan form the core of this project. The ultimate goal of the project is to restore the natural hydrologic function of the watersheds as much as possible. This in turn will increase steelhead spawning success and juvenile survival to outmigration. In addition to steelhead, restoration work will likely benefit other anadromous and resident fish species (e.g., coho salmon, chinook salmon, bull trout, and westslope cutthroat trout) and many wildlife species as well.

Mid-Columbia Reintroduction Feasibility Study (BPA project No. 1996-040-00). The long term vision of this restoration project is to restore coho salmon to the Wenatchee and Methow river basins at biologically sustainable levels that will support harvest in most years. The project works toward development of locally adapted, naturally spawning coho populations in the Wenatchee and Methow subbasins by increasing the fitness of reintroduced coho salmon by reducing domestication and emphasizing local adaptation. The program will use strict broodstock collection protocols, which ultimately will place a limit on the proportion of natural origin adults in the hatchery program and place a limit on the proportion of hatchery origin adults on the spawning ground. The project has several very distinct phases, as per the Master Plan, that should provide the adaptation necessary for recolonization of the current, local stock to critical habitat areas within the Wenatchee and Methow basins.

Klickitat Watershed Enhancement (BPA project No. 1997-056-00). This project works to restore, enhance, and protect watershed function within the Klickitat subbasin. Project work emphasizes restoration and protection in watersheds and reaches that support native salmonid stocks, particularly steelhead (Oncorhyncus mykiss; listed as "Threatened" within the Mid-Columbia ESU), spring Chinook (O. tshawytscha) salmon, and bull trout (Salvelinus confluentus; ESA "Threatened"). Restoration activities are aimed at restoring stream processes by removing or mitigating watershed perturbances and improving habitat conditions and water quality. Watershed and habitat improvements also benefit fall Chinook (O. tshawytscha) and coho (O. kisutch) salmon, resident rainbow trout, and cutthroat trout (O. clarki) and enhance habitat for many terrestrial and amphibian wildlife species. Protection activities compliment restoration efforts within the subbasin by securing refugia and preventing degradation.

Yakama Nation Ceded Lands Lamprey Evaluation and Restoration (BPA project No. 2008-470-00). The goal of the lamprey restoration project is to restore natural production of Pacific lamprey in the Yakama Nation ceded lands of the Wind, White Salmon, Klickitat, Yakima, Methow, Entiat rivers and streams. Very little information exists about lamprey abundance and distribution throughout the Ceded lands and essentially no information has been collected concerning known or potential limiting factors. One of the primary and over-arching objectives over the next couple years is to survey key habitats and collect baseline information that will be used to develop a long-term restoration strategy. Other key objectives within this time frame will be to evaluate potential artificial propagation and translocation of adult lampreys.

Upper Columbia Nutrient Supplementation (BPA project No. 2008-471-00). This project will quantify and evaluate nutrient status and availability in the Methow River Basin, a Subbasin of the Upper Columbia River watershed area in north central Washington, in response to diminished anadromous salmon runs. More specifically, this project is conducting a rigorous multi-trophic level sampling program to quantify and evaluate baseline water quality and nutrient availability, primary secondary and tertiary productivity rates including algal, periphyton, benthic macroinvertebrate and fish communities . A stratified random sampling design was used to select study sites in each of the upper, middle, and lower reaches of the study area (Twisp River). The goal is to develop a comprehensive pre- and any post-treatment (experimental nutrient addition) biological assessment.

Expanded Tribal Catch Sampling (BPA project No. 2008-502-00). This project will improve the monitoring and catch sampling of the Zone 6 tribal fisheries by increasing the collection of more tribal catch data through increased sample rates and employing the use of additional data collection methods. Improving data collection in the Zone 6 tribal fisheries will provide additional information for managers to make decisions. This project will also result in increasing the precision and accuracy of run reconstruction data, and ultimately spawning escapement estimates to tributaries above Bonneville Dam which are a critical element of VSP indicator calculation.

Status and trends reporting (BPA project No. 2009-002-00). The long-term goal of the Status and Trend Annual Report (STAR) project is to support the mitigation described in the NPCC Fish and Wildlife Program, and the obligations expressed in the 2008 FCRPS Biological Opinion and 2008 Fish Accords, by annually reporting progress towards salmon recovery efforts relevant to the Columbia Cascade Province. It is envisioned that this YN project will work across projects and watersheds, to collect, organize and report data on status and trends of fish populations, with initial focus on activities in the mid- and upper-Columbia watersheds.

Yakima Basin steelhead Viable Salmon Population (VSP) monitoring (BPA project No. 2010-030-00). Key issues this study will address include:
1) Ground truth and refine genetic stock identification (GSI) based population-specific abundance estimates.
2) Address uncertainties regarding the extent, distribution, and contribution of mainstem spawners.
3) Estimate the proportion of steelhead from each population that overwinters in the mainstem Yakima River versus tributaries.
4) Estimate survival to spawning rates for steelhead that overwinter in the mainstem versus tributaries of the Yakima River.
5) Describe prespawn migration patterns of steelhead.
6) Determine the timing and spawning distribution in each population.
7) Estimate the number of redds constructed per female.
8) Estimate the survival to kelting rates for each population.

Major YNFP data management accomplishments to date include:

- Development and maintenance of ykfp.org web site to host information relating to Yakima and Klickitat Basin project activities including: redd counts, juvenile and adult migration counts, technical reports and publications, project review/conference information, etc.
- Comprehensive VSP accounting and reporting for Yakima Basin spring Chinook (see Appendix A in YKFP M&E 199506325 Annual Report available through the ykfp.org or BPA project web sites)
- Automated integration of Prosser and Roza dam daily count data with DART
- Integration of PIT and CWT release and recovery data with PTAGIS, RMPC, and Fish Passage Center databases
- Production and support of data bases necessary to support BPA quarterly and annual reports (available via PISCES and BPA reports web site)
- Production and support of data bases necessary to support NPCC project proposals (available via CBfish.org)
- Development and maintenance of databases to support the following M&E data collection activities: Prosser and Roza video counts; Prosser denil and Roza adult trap sampling; Yakima Basin juvenile migration timing and biological data sampling; juvenile PIT tagging operations at all subbasin locations; Cle Elum spring Chinook spawning and rearing; Cle Elum facility water usage, temperature, and flow monitoring; Prosser steelhead kelt reconditioning; spawner surveys at all subbasin locations; scale sampling; age and sex composition; radio telemetry and tracking; Klickitat habitat surveys; Lyle Falls adult trap counts; Klickitat smolt trap counts; Klickitat stream temperature and sediment data; Zone 6 and tributary harvest accounting; and Zone 6 Treaty commercial fish ticket accounting
- Development of GIS maps as needed to support YNFP activities
- Development and maintenance of spreadsheets to summarize and track annual trends in above data
- Maintenance of hardware and software necessary to support the above

General data flow diagrams have been developed for the Yakima and Klickitat Basins (Figures 1 and 2).

Assessment of Gaps, Needs, and Priorities

With existing staff and budgets, the Yakama Nation is essentially in maintenance mode using all of our current resources to maintain products (described above) that we have already developed. To better address data management and sharing needs across the YNFP's geographic scope, and to achieve the vision of regional data integration and sharing described by the Coordinated Assessments project, the YN needs to integrate existing data bases into a standardized, centralized data system and provide coordinated access to the system. Development of the necessary electronic and policy infrastructure will require additional resources including, but not necessarily limited to:

- Additional FTE time to develop a strategic, YNFP program-wide data management plan, building upon and updating existing subbasin/project level data management plans, and incorporating new projects (identified above);
- additional hardware and software infrastructure necessary to support development and maintenance of data structures, tools, and reports beyond that described above;

- additional FTE time to develop and maintain these data structures, tools, and reports;
- additional FTE time to build the software tools necessary to facilitate standardized data collection and reporting;
- and additional FTE time to maintain and trouble-shoot hardware and networks.

For the YNFP to achieve the level of refinement in VSP reporting described in the Coordinated Assessments process, improvements in monitoring will be required which provides additional marking to better identify hatchery proportions for all populations, and additional statistician time to assist with analysis and expansion of trap/weir/marked versus unmarked data.

The following specific tasks are required for the YNFP to achieve regional data integration and sharing goals.

1. Survey and document data flow and data structures for all existing program data collection activities and data repositories.
2. Develop a strategic, YNFP program-wide data management plan.
3. Develop standardized protocols, data structures, and data dictionaries for all routine fisheries monitoring activities, e.g., spawning ground surveys, adult and juvenile trap sampling, etc.
4. Work with Yakima and Klickitat data stewards, as well as other YNFP biologists to load historical (legacy) data into standardized data structures.
5. Work with Yakima and Klickitat data stewards to revise and/or develop data entry modules allowing new data to be entered into standardized data structures.
6. Implement standardized data entry modules throughout YNFP.
7. Work with CRITFC, WDFW, and other agencies to identify appropriate regional data repositories for various YNFP data, e.g., Adult Age and scales; Weir, trap, and carcass tagging; genetic; spawning ground survey; juvenile migrant data; etc.
8. Work with Yakima and Klickitat data stewards, CRITFC, and others to develop necessary tools to load YNFP data to regional data repositories.
9. Develop and implement a plan for YNFP data backup and disaster recovery at all site locations.
10. Develop and implement a plan to maintain and trouble-shoot hardware and networks at YNFP sites throughout the ceded area.

For budgeting purposes relative to this preliminary needs assessment, we believe two FTEs, one data technician, and supporting capital funds for necessary hardware, software, and web infrastructure are required to satisfactorily achieve the above tasks. The budget should be refined pending the outcome of planning exercises (tasks 1-3 above). Substantial resource sharing with the Yakima (198812025) and Klickitat (198812035) data stewards, the status and trends coordinator (200900200), and tribal data network lead (200850700) is envisioned. Additional cost savings might be gained by making use of centralized Inter-Tribal or regional staff and existing products.

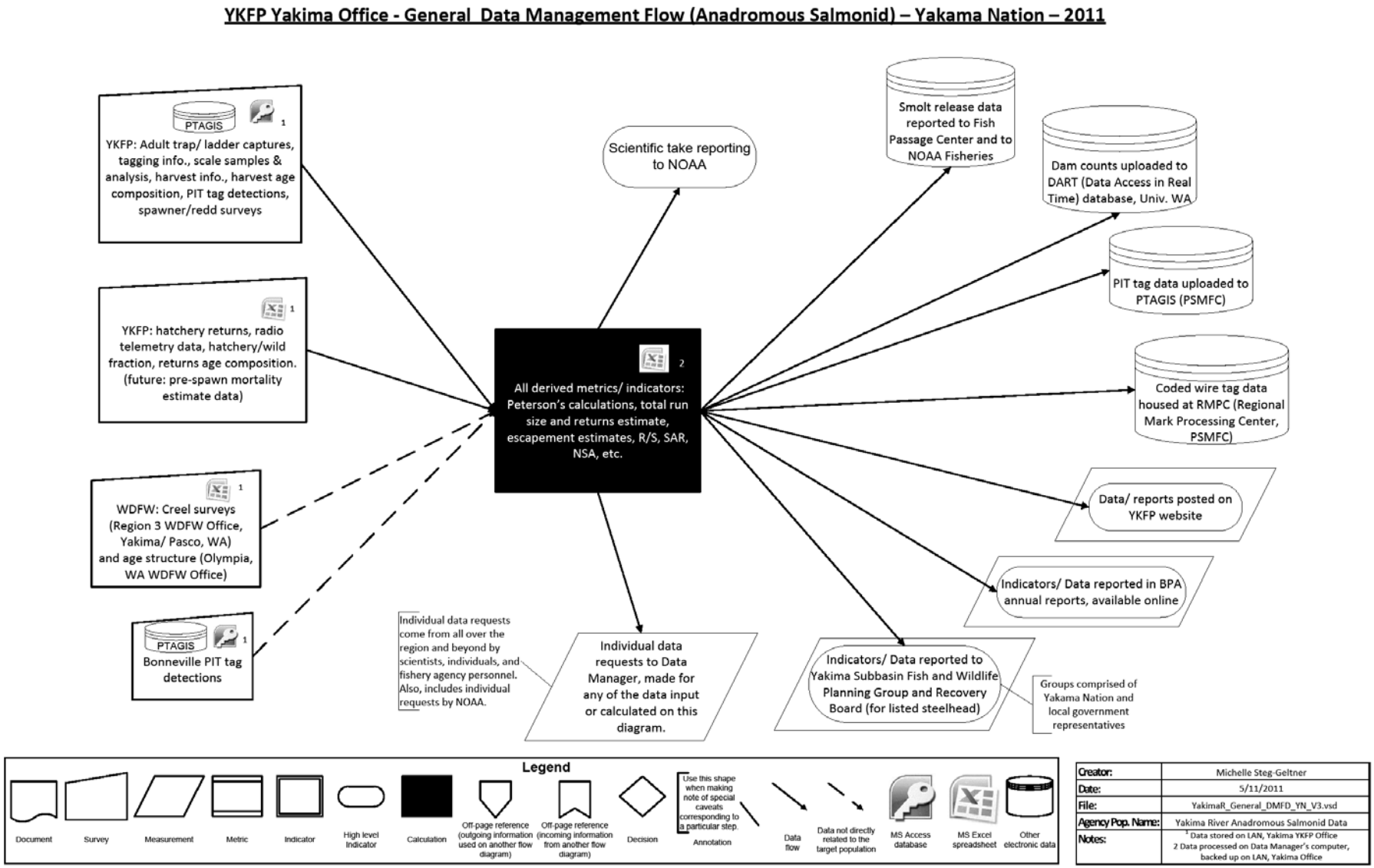


Figure 1. General Data Analysis Flow Diagram for present Yakima Basin information management activities.

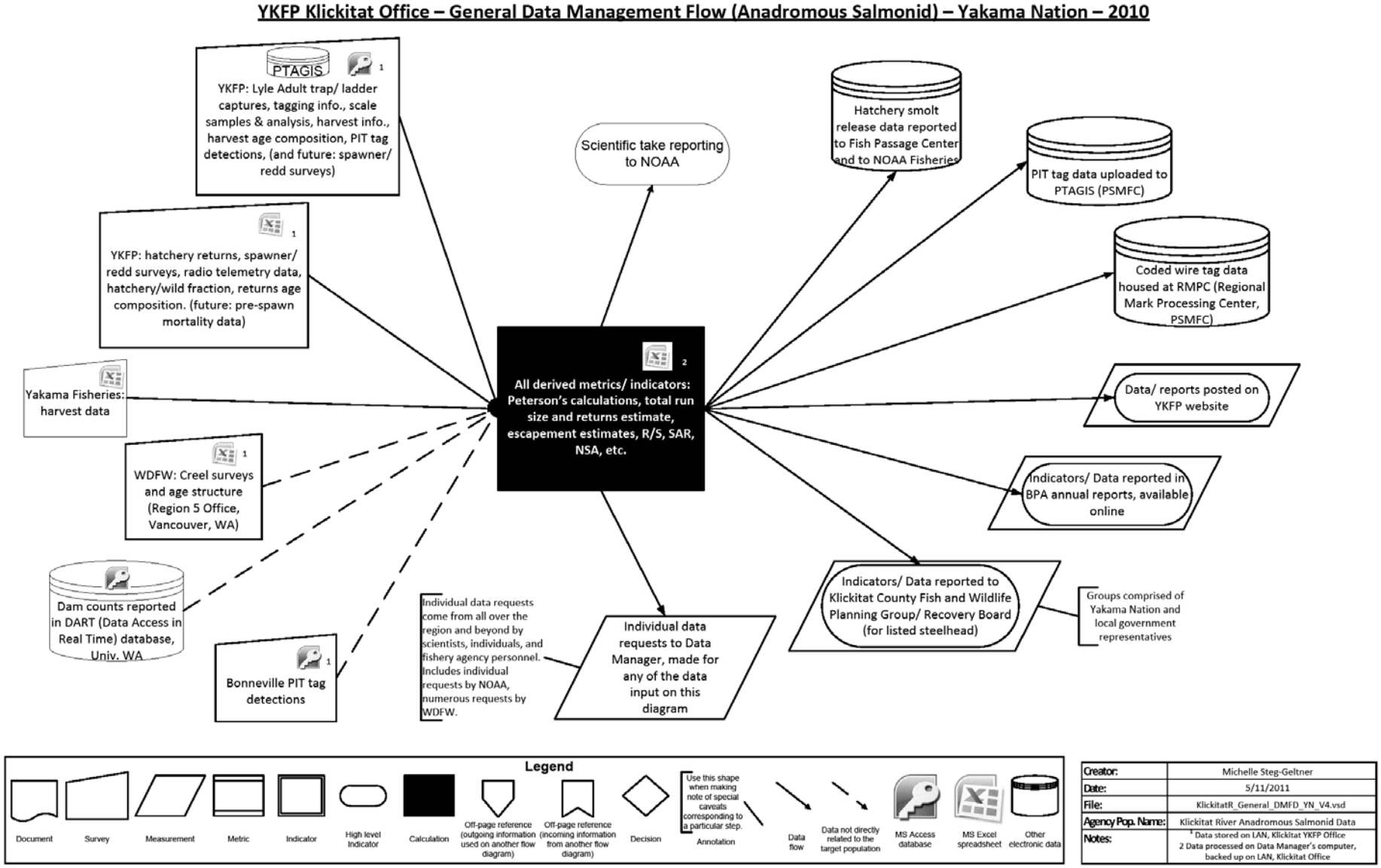


Figure 2. General Data Analysis Flow Diagram for present Klickitat Basin information management activities.

Appendix M: Budget Exercise Prioritization Table

	Basin-wide Strategy Recommendation(s)	CONTRACTOR	Sub-Contractor	PROJECT TITLE	BPA PROJECT NUMBER	BPA Contract NUMBER	FY2012 PROJECT WORKING BUDGET (Taurus)	FY2012 Contract amount	FY2012 Modifications or Priorities?	Additional Recommended Data Management funding 2013	Additional Recommended Data Management Funding 2014	Additional Recommended Data Management funding 2015	Additional Recommended Data Management Funding 2016	Additional Recommended Data Management funding 2017	Addresses BiOp RPA or AMIP	Fish-Accords' priority	Tier 1,2,3?	Associated BPA Projects (numbers)	Cost Share?	Comments
	TAURUS DATA MANAGEMENT PORTFOLIO PROJECTS																			
1		NHI		Habitat and Biodiversity	2003-072-00		$ 165,821			$ 165,821	$ 165,821	$ 165,821	$ 165,821	$ 165,821	RPA 71 -					
2		KT		Data Management Project	2011-020-00					$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000		Yes				
3		PSMFC		Columbia Basin Pit-Tag Information	1990-080-00		$ 2,616,917			$ 2,616,917	$ 2,616,917	$ 2,616,917	$ 2,616,917	$ 2,616,917	RPA - 50					
4		PSMFC		Fish Passage Center	1994-033-00		$ 1,461,609			$ 1,461,609	$ 1,498,149	$ 1,535,603	$ 1,573,993	$ 1,613,343	RPA - 50, 51, 52, 53, 54, 71	Yes				
5		UW		Data Access in Real Time (DART)	1996-019-00		$ 293,938			$ 293,938	$ 293,938	$ 293,938	$ 293,938	$ 293,938	RPA 72					
6		CRITFC		Streamnet Library	2008-505-00		$ 471,071			$ 462,833	$ 479,552	$ 466,535	$ 478,198	$ 490,153	RPA 51	Yes				BPA will meet with project sponsor to discuss relationship of this project, Tribal Data Network project, and individual needs of Member tribes to address Coordinated Assessment priorities.
7																				Projects below are directly linked to the Coordinated Assessments priorities.'
8	Build a network of Data Stewards	PSMFC		Streamnet - Coordinated Information System (CIS)/Northwest Environmental Database (NED)	1988-108-04		$ 2,034,576			$ 2,034,576	$ 2,034,576	$ 2,034,576	$ 2,034,576	$ 2,034,576	RPA 51					
9			ODFW		1988-108-04			$ 421,859												
10			IDFG		1988-108-04			$ 225,500												
11			WDFW		1988-108-04			$ 387,759												
12		CRITFC		Tribal Data Network	2008-507-00		$ 362,032			$ 350,903	$ 368,840	$ 378,061	$ 387,513	$ 397,201	RPAs 51, 56, 57, 59, 71, 72	Yes				
13		Place holder		Regional Data Management Support and Coordination	2008-727-00		$ 512,000								RPA 72					
14	Develop tools	CRITFC		Salmon population crosswalk	PNAMP				$ 79,541	$ -	$	$	$ -	$ -	51, 71, 72	N	1	2008-727-01	Yes	$79,541 from 1-yr through BiOp placeholder, project 2008-727-00.
15	Develop a data management strategy	SBT	TBD	Develop Tribal Fisheries Data Management Strategy and Policy.	PNAMP, StreamNet	2008-727-00	na		$ 20,000	$ -	$	$	$ -	$ -		N	1	2008-727-00	no	This project is needed to assist the tribe in strategic planning to support the Basin-wide Data Sharing Strategy. Demand for data goes beyond the Tribe's responsibility for managing data and a strategic plan will help the Tribe build data systems that support external demands. From data management placeholder funds 2008-727-00.

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16	Develop a data management strategy	CTWSRO	TBD	Develop Tribal Fisheries Data Management Strategy and Policy.	PNAMP, StreamNet	2008-727-01	na		$ 20,000	$ -	$	$	$ -	$ -		N	1	2008-727-00	no	Hire consultant / contractor to review current CTWSRO Fisheries Data situation and develop Fisheries Data Management Policy (FDMP). Develop strategies and timelines for implementation of Plan. Funded from BiOp Data management placeholder funds 2008-727-00. Funding may be available from the tribe's Natural Production Monitoring project currently under development (2008-311-00).
17	Develop a data management strategy	YN	TBD	Develop Tribal Fisheries Data Management Strategy and Policy.	PNAMP, StreamNet	2008-727-02	na		$ 10,000	$ -	$	$	$ -	$ -		N	1	2008-727-00	no	Hire consultant / contractor to review current YN Fisheries Data situation and develop Fisheries Data Management Policy (FDMP). Develop strategies and timelines for implementation of Plan. Proposed timeline early 2012. Funded from BiOp Data management placeholder funds 2008-727-00. BPA will discuss with tribe whether Accord funds may be available for this effort.
18				**TOTAL FOR BPA DATA MANAGEMENT PROJECTS**			**$ 7,917,964**			**$ 7,486,597**	**$ 7,557,793**	**$ 7,591,451**	**$ 7,650,956**	**$ 7,711,949**						
19																				
20				**Total for projects addressing CA Basin-wide Strategy**			**$ 2,908,608**		**$ 129,541**	**$ 2,385,479**	**$ 2,403,416**	**$ 2,412,637**	**$ 2,422,089**	**$ 2,431,777**						$129,541 is the remainder of the FY12 data management placeholder; BPA would like to ensure this is the highest priority work before funding.
21																				
22																				
23	NON-BPA Projects - Cost share by other entities																			These projects are aligned with the Data Sharing Strategy and will compliment BPA funded activities.
24	Build a network of Data Stewards	CTUIR		Database developer (0.75 FTE)	2008-507-00					$ 63,506	$ 63,506	$ 63,506	$ 63,506	$ 63,506	RPA 72	No	0		CTUIR support	This position is currently funded by the tribe through their GIS and Fisheries Programs to support sharing fisheries related data.
25	Improve infrastructure	IDFG		Idaho Fish and Wildlife Information System	NA											No	0		The IDFG cost share for Anadromous fish data management is $145,000.	Idaho cost share is: DJ (Federal aid in Sportfish Restoration) $167,000 (50%), Pitman-Robertson Federal Wildlife Restoration Funds $98,600, LSRCP/Idaho Power Company (hatchery data management) $66,000, License (direct, not match) $123,700 (50%).

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26	Improve infrastructur	NPT														NO	0		NPT cost share for GIS data Management is $100,000.	Nez Perce Tribe general fund monies support the land seriveice department including GIS coordinator and GIS dta base adminstrator, and the basic internet connection infrastructures which support the fisheries department.
27	Improve infrastructur	PSMFC		LSRCP Standardized Data entry Programs												No	0		LSRCP	Lower Snake River Compensation Program (LSRCP) - LSCRP funded projects requires collection of data necessary to evaluate the production program and its effects on the natural populations. LSRCP is developing a centrally stored database containing: adult trapping, event, spawning, incubation and rearing, and redd count survey data through multiple standardized data entry software programs that are uploaded via the web to a neutrally located SQL database located at PSMFC in Portland, Oregon. Data is made available to all participating stakeholders via a
28	Improve infrastructure	WDFW		WDFW Salmon Conservation and Reporting Engine (SCoRE) SCoRE will be WDFW's primary vehicle for delivering data and information to its partners and the public.												No	0		WDFW is developing this system through a combination of funds outside of BPA funding.	Develop an internal data reporting engine that builds upon existing internal and external databases and data systems to report high-level indicators of salmon conservation and recovery. SCoRE is a work in progress and currently many of the primary data sets required to populate SCoRE still need to be developed. The list of projects provided under Tier 2 captures the key priority areas of database and infrastructure development.
29	NEW WORK TASKS																			
30	Build a network of Data Stewards	CCT		Colville Tribes Regional Data Coordinator	1988-108-04				If possible	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	RPA 51,	No	1	2003-022-00	50%	Cost share through contributions from M&E projects within tribe.
31	Build a network of Data Stewards	SBT		SBT Regional Data Coordinator	1988-108-04				If possible	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	RPA 51, 72	No	1		50%	The SBT requires FTE support to particpate in the Science/Content Forum, Technical Forum, and to coordinate data management within the Tribe. If 0.5 FTE is provided through the StreamNet project, the Tribe will identify 0.5 FTE to complete funding for this position.
32	Build a network of Data Stewards	CTUIR		CTUIR Data Coordinator (1 FTE)	2008-507-00				yes	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000			1		possibly	Possible cost share through M&E projects within the tribe.
33	Build a network of Data Stewards	CTWSRO	no	Provide funding for 0.5 FTE CTWSRO Fisheries Data Steward Position	2008-507-00				If possible	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	RPA 71, 72	No	1	2008-311-00 (f	yes	Proposed new Data Steward / Coordinator for CTWSRO Fisheries Program, to be funded 50% by BPA Natural Production Project (funding for project pending), and 50% by CA Project. This position would be filled after the development of the FDMP. Proposed timeline late 2012.

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34	Build a network of Data Stewards	NPT		NPT Data Technician					yes	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000		No	1			Data entry and generate VSP indicators.
35	Improve infrastructure	NPT		NPT QA/QC Technician						$ 43,000	$ 43,000	$ 43,000	$ 43,000	$ 43,000		No	1	20030017		Data entry QA/QC.
36	Build a network of Data Stewards	NPT		NPT Data Steward	2008-507-00				If possible	$ 81,000	$ 81,000	$ 81,000	$ 81,000	$ 81,000	RPA 71, 72	No	1	201005700, 199604300,	no	
37	Build a network of Data Stewards	YN		Yakama Nation Fisheries Program Data Coordinator	2008-507-00				If possible	$ 72,000	$ 73,300	$ 74,600	$ 75,900	$ 77,200	RPA 71, 72	No	1	1988-120-25, 1988-120-35, 2009-002-00, 2008-502-00, 2008-507-00	no	Primary tasks from p. 5 of narrative: 1, 2, 3, 4, 7; Secondary tasks: 5, 6, 8, 9, 10. BPA will work with project sponsor to understand relationship with Status and Trends Report project (STaR) and significant coordination funding within Klickitat and Yakima subbasins.
38										$ 486,000	$ 487,300	$ 488,600	$ 489,900	$ 491,200						
39	Additions to existing budgets:			Streamnet - Coordinated Information System (CIS)/Northwest	1988-108-04					$ 135,000	$ 135,000	$ 135,000	$ 135,000	$ 135,000						
40				Tribal Data Network	2008-507-00					$ 351,000	$ 352,300	$ 353,600	$ 354,900	$ 356,200						
41																				
55	Improve infrastructure	CCT		Incorporating Okanogan Watershed PIT tag data into OBMEP database of Colville Tribes	2003-022-00				No			$ 25,000	$ -	$ -	RPA 51,	No	2	2003-022-00	0%	Software development to support PTAGIS inqiries for the OBMEP project.
42	Improve infrastructure	CRITFC		Develop and maintain data entry, QA/QC and management applications and tools according to standard protocols, structures and data dictionaries	new					$ 110,000	$ 112,750	$ 115,569	$ 118,458	$ 121,419	51, 56,	Y	2	2008-507-00	No	New task for Tribal Data Network project. Develop applications for data flow.
56	Build a network of Data Stewards	CRITFC		Assist the CRITFC to populate DET's with legacy and current data and document data flows and structures according to standard protocols, structures and data dictionaries	new					$ 80,000	$ 82,000	$ 84,050	$ 86,151	$ 88,305	51, 56,	Y	2	2008-507-00	Yes $26,644 From Upstream Migration Studies	New task for Tribal Data Network project. Data steward for CRITFC.

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43	Improve infrastructure	CTWSRO	TBD	Assess CTWSRO Data infrastructure		na	na		no	$ 15,000							2		no	Hire consultant / Contractor to assess infrastructure communications / Network connections between main office and satellite offices (Hood River, John Day, The Dalles, Willamette Falls). Proposed timeline early 2013
44	Improve infrastructure	CTWSRO	TBD	Improve CTWSRO data sharing infrastructure		na	na		no		$ 25,000						2	TBD	yes	Acting upon recommendations of infrastructure assessment, Design, Purchase, and install equipment to improve connectivity with satellite offices. Costs to be shared with projects at individual offices.Proposed Timeline 2014.
57	Build a network of Data Stewards	CTWSRO	no	Provide funding for 0.33 FTE Data Base Administrator / Programmer		na	na		yes		$ 33,000	$ 33,000	$ 33,000	$ 33,000			2	2008-311-00 (I	yes	Proposed new Data Steward / Coordinator for CTWSRO Branch of Natural Resources, to be funded 33% by BPA Natural Production Project (funding for project pending), 33% by CA Project, and 33% by CTWSRO Tribal funds. Proposed timeline late 2012 / early 2013.
45	Improve infrastructure	IDFG		Automating data sharing of VSP and High Level Indicators						$ 93,000	$ 93,000	$ 93,000	$ 93,000	$ 93,000	RPAs 51, 71, 72		2			Validate software to capture field data to ensure raw data used to calculate VSP indicators and High Level Indicators, Validate reporting tools to ensure that data used to calculate VSP and HLI are accurate, manage databases that contain raw data or VSP and HLI level data, Interact with field biologists in use and validation of applications, database and reporting tools as a method of providing quality assurance, work with programmers to troubleshoot data capture applications and reporting tools
46	Improve infrastructure	IDFG		Idaho Fish and Wildlife Information System						$ 15,000							2			Acquire hardware and software necessary to support data sharing into IFWIS system.
47	Improve infrastructure	NPT		NPT Historical Data Entry							$ 50,000					No	2			One time effort/cost to enter historical data into standardized databases.
58	Improve infrastructure	NPT		NPT QA.AC protocol document						$ 15,000						No	2			
59	Improve infrastructure	NPT		NPT File Server Expansion						$ 8,000						No	2			
60	Improve infrastructure	NPT		NPT File Server hard drive upgrades						$ 5,000						No	2			One-time effort/cost to formally develop an standardize QA/QC protocals used by each project.

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61	Improve infrastructure	NPT		NPT Web Developer (0.5 FTE)						$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000		No	2			Responsible for analysis, development, maintenance, reporting and applications for projects relating to DFRM's basin wide web presence and the development of tools in support of efficient acquiring and
48	Improve infrastructure	ODFW		Provide funding for 2 FTE Fisheries Data Steward Positions						$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000			2		Yes. ODFW is reprioritizing agency efforts to support SalmonRecoveryTracker.org.	ODFW is reprioritizing their StreamNet funds to begin development of a statewade data sharing system. To expedite development and data entry into that system, two data stewards are needed for coordination within and between regional offices. This project would cover approximately 65 salmon and steelhead populations in Oregon.
49	Improve infrastructure	WDFW		Adult Age and Scales Sampling Database The adult age and scales database informs all three focus indicators. This database stores fish bio-tissue sample data used to determine population age profiles from scales and bony structures for population						$ 150,000							2			Build a statewide Age/Scale database and standardize field data collection forms and datasets for both adult and juvenile life stages. This database would capture field data collection protocols, standardization, transfer automation, and documentation of collection and analysis methodology as appropriate. A centralized WDFW age and scales database would utilize web-based data transfer and statewide standardized codes and will contribute to creating comprehensive population age profiles and productivity estimates. In addition to new data this system
50	Improve infrastructure	WDFW		Weir, Trap, and Carcass Tagging Database This database does not yet exist but is needed to inform all three focus indicators. This database will capture Adult Mark/ Recapture information, including weir, data, capture/ recapture, and sampling records. This							$ 150,000						2			Build a statewide Adult Mark/ Recapture database/databases and standardized field data collection forms and feeder datasets. This proposed data system will be the central repository for adult PIT Tagging data (i.e. for Wind River steelhead) and PIT Tag recoveries with appropriate biological data. From this system, data would be uploaded to WDFW's Salmon Conservation database (SCoRE) regional data systems such as PTAGIS and RMIS. A system to centrally manage this information does not exist.
51	Improve infrastructure	WDFW		Spawning Ground Survey (SGS) Database The Spawning Ground Survey (SGS) database primarily informs Natural Spawner Abundance (NOS) indicator. SGS is one of WDFW's key foundational databases for spawning data. SGS is fundamental to								$ 150,000					2			Develop a web-based front end data entry and retrieval application for the SGS database that would connect it to the distributed databases in the WDFW regions. This system will provide real-time access to spawning and escapement data. Key metadata will be integrated into this system in the form of an additional data collection methodology documentation module. This project will help to convert the current distributed database and distributed data collection model to a centralized, agency corporate dataset. Reporting from this system will be integrated with WDFW's Salmon
	Improve infrastructure.	WDFW		Assist WDFW in historical regional data compilation.						$ 120,000	$ 100,000	$ 60,000	$ 30,000				2			

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62	Improve infrastructure	WDFW		Genetics Database A genetics database will inform primarily the Natural Spawner Abundance indicator. This database contains genetic sample and analysis information and genetic stock identification information from the WDFW genetics lab.									$ 60,000				2			Future Anticipated Need: Prioritize the development of other systems and build the interface with the genetics database at a later time, once the work can be better scoped. No funding needed at this time.
63	Improve infrastructure	WDFW		Salmon and Steelhead Stock Iventory (SaSI) Database The Salmon and Steelhead Stock Inventory (SaSI) database informs all three focus indicators. SaSI is WDFW's primary summary database for reporting spawning escapement estimates. SaSI utilizes									$ 40,000	$ 40,000			2			Future Anticipated Need: WDFW needs better tools and web user interface for data entry, documenting metadata and protocols, data analyses, and data dissemination me.
52	Improve infrastructure	YN		Yakama Nation Fisheries Program Software Developer						$ 72,000	$ 73,300	$ 74,600	$ 75,900	$ 77,200			2	1988-120-25, 1988-120-35, 2009-002-00, 2008-502-00, 2008-507-00		Primary tasks from p. 5 of narrative: 5, 6, 8; Secondary tasks: 1, 2, 3, 4, 7, 9, 10. Need better understanding of the relationship between this project and the Tribal Data Network project.
53	Improve infrastructure	YN		Yakama Nation Fisheries Program Data Technician						$ 48,000	$ 50,000	$ 51,200	$ 52,400	$ 53,600			2	1988-120-25, 1988-120-35, 2009-002-00, 2008-502-00, 2008-507-00		Primary tasks from p. 5 of narrative: 9, 10; Need better understanding of relationship between this project and Tribal Data Network project.
54	Improve infrastructure	YN		Capital for hardware, software, web servers, tools, packages, vehicles, phones, supplies, etc. to support above						$ 50,000							2	1988-120-25, 1988-120-35, 2009-002-00, 2008-502-00, 2008-507-00		These amounts can be refined pending the outcome of strategic planning (tasks 1-3 from narrative). Also dependent on the amount of regional resource sharing available to provide products of common need.
64				**TOTAL FOR NEW WORK TASKS or Cost Share**			**$ -**			**$ 1,041,000**	**$ 1,029,050**	**$ 946,419**	**$ 848,909**	**$ 766,524**						