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# memorandum

date May 23, 2017

to Isabel Ragland, Pierce Conservation District

from Ilon Logan (ESA) and Elizabeth McManus (Ross Strategic)

subject Puyallup River FFTF Monitoring Plan: **Defining Floodplain Health and Identification of Monitoring Metrics (Tasks 4 & 5)**

This memorandum summarizes the process and outcome of two tasks in the Floodplains for the Future (FFTF) monitoring plan project: defining floodplain health and the identification and selection of metrics. The monitoring plan is one of four components of the *Floodplains for the Future: Puyallup, White, and Carbon Rivers project*, which is funded by a Floodplains by Design grant from the Washington Department of Ecology. The purpose of the FFTF monitoring plan project is to develop a set of shared goals for integrated floodplain management and employ various metrics to ascertain progress relative to those goals as well as continued support for implementation of an aggressive capital program that plans, funds, and implements multi-benefit floodplain projects in the Puyallup, White, and Carbon River floodplains. In the long-term, the monitoring plan is also expected to help build and maintain trust across stakeholder groups for capital investments either through continued implementation of the current suite of actions (e.g., levee setbacks, agricultural land conservation, and habitat restoration), refinements to the suite of actions based on monitoring inputs, or refinements to priorities or sequencing.

This memorandum provides a review of information gathering and stakeholder engagement, floodplain health definitions and watershed-scale goals, the identification and selection of priority metrics, the integration of metrics into an Index of Floodplain Health, and the next steps for the monitoring plan.

## **Information Gathering and Stakeholder Engagement**

The floodplain health definition, suggested metrics, and index were distilled from three types of information. First, background documents were reviewed and relevant information was compiled. This included documents describing prior thinking on floodplain health and goals and documents that describe existing/ongoing monitoring work in the floodplain. Second, FFTF stakeholders were engaged through a series of individual or small-group interviews and meetings at the inception of the project. As described in the memo, *Summary Themes from Floodplain Health Stakeholder Interviews* (Ross, 2017), approximately 35 stakeholders were interviewed, most multiple times. Initial interviews explored interviewees' goals for floodplain health, perspectives on monitoring, and ideas about metrics that would indicate progress toward floodplain health and evaluate the contribution of

floodplain projects toward goals. Initial interviews were followed by supplemental conversations and meetings loosely organized around common interest areas (i.e., flood risk reduction, fish and habitat, farming and agricultural viability) including focused discussions and email review of draft and revised draft metrics. Third, the Integrated Management Group (IMG) was engaged several times in specific workshop conversations on floodplain health and draft metrics.

Information from all these sources has been integrated to prepare this memo. More detailed companion documents describe the stakeholder interviews (*Summary Themes from Floodplain Health Stakeholder Interviews* [Ross, 2017]), watershed reaches and related goals (*Watershed and Reach Descriptions Memorandum* [ESA, 2017a]), and existing monitoring (*Synthesis of Existing Monitoring in Watershed* [ESA, 2017b]).

## Shared Definition of Floodplain Health and Floodplain Goals

During 2015 and 2016, FFTF partners and stakeholders discussed various definitions for floodplain health and developed a long-term vision for the Puyallup River watershed along with various goals at the watershed scale and reach scale. The definition and goals are important foundational pieces of the monitoring plan.

ESA and Ross tested a few potential definitions of floodplain health during interviews and meetings with the IMG to gauge support and determine a definition that is the best representation of FFTF partner and stakeholder values. The following definition presents the latest iteration and will be considered by the IMG at their next meeting for confirmation.

FFTF partners believe:

*Healthy Puyallup floodplains will **support sustainable salmon populations** through their natural physical and biological processes, the **long-term viability of agricultural lands**, and communities with **reduced risk to regular and catastrophic flooding**.*

Thus, floodplain health is defined as:

*“The condition of multiple elements that when considered together contribute to a functioning floodplain, including the natural physical processes and biological factors that support salmon populations; the long-term viability of agricultural lands; and the reduction of the risk of flooding.”*

Stakeholder interviews and conversations with the IMG confirmed this shared, high-level vision for floodplain health which stakeholders described as:

- Safeguarding people and infrastructure from flooding and flood damage;
- Viable agriculture; and,
- Sustainable, harvestable fish populations, and the habitat to support them.

The concept and definition of viable agriculture has been advanced as part of the Farming in the Floodplain Project. According to the Farming in the Floodplain Existing Conditions Report (ESA, 2016), agricultural viability can be defined as the ability of a farmer or a group of farmers to: (a) productively farm on a given piece of land or in a specific area; (b) maintain an economically viable farm business; (c) keep the land in agriculture long-term; and (d) steward the land so it will remain productive into the future.

As summarized in the *Watershed and Reach Descriptions Memorandum* (ESA, 2017a), FFTF partners also have identified a set of watershed-wide goals relevant to improving and maintaining floodplain health. Reach scale goals have also been identified (see memo for list). The following list of goals is slightly updated from the January 13<sup>th</sup>, 2017 memo.

- Reduce flood risk and damage to private property
- Reduce flood risk and damage to Pierce County infrastructure
- Integrate agricultural interests into proposed large levee setback projects
- Protect/conservate agricultural lands (includes identification of lands)
- Prevent conversion of agricultural lands to non-ag uses
- Maintain viable farming economy/critical mass of farmland and farm businesses
- Improve drainage on existing farms
- Reconnect floodplain to the river (at various flow levels)
- Re-establish intertidal habitat in estuary
- Improve spawning habitat quality and increase salmon abundance
- Provide more space for the river to migrate
- Improve water quality
- Increase public access to floodplains

The shared definition of floodplain health and the floodplain goals informed metrics identification.

## **Identification and Selection of Metrics**

Potential metrics were identified based on review of existing monitoring and from stakeholder engagement. During interviews, small-group meetings, and in workshops with the IMG, participants were asked specifically about their suggestions for metrics and asked about their information needs and how they would make judgements or understand if floodplain health were improving. A long list of potential metrics was developed and binned into four categories: flood (metrics focused on measuring flood risk and flood damage reduction); fish (metrics focused on measuring salmon productivity and habitat); farm (metrics focused on measuring agricultural land use and viability); and other (metrics that sought to measure other dimensions of floodplain health such as public access). For each potential metric, information was compiled to help understand what the metric would communicate relative to floodplain goals, potential data sources, frequency of ongoing monitoring (if any), and a baseline from which to measure change going forward.

Potential metrics were reviewed by the project team using the following criteria:

- Quantitative (as much as possible)
- Repeatable/reproducible
- Simple to understand and communicate
- Connected to floodplain health and FbD investments
- Representing all of the floodplain goals (flood, fish, farm) and integrated where possible
- Able to track landscape-level impacts and ecosystem change from restoration strategies and actions
- Aspirational

A “starting list” of potential metrics was developed by the project team and proposed to the IMG for consideration and discussion at a workshop on November 14, 2016 (see Attachment A). The team asked FFTF partners and stakeholders to consider whether the list struck an appropriate balance across the perspectives, if there were gaps, or if some metrics were not useful. This list included largely integrated metrics (i.e., metrics selected to speak to multiple benefits such as flood reduction and agriculture) and some individualized metrics (i.e., metrics focused either flood, fish, or farms). The group liked the idea of integration in general, but thought the proposed metrics did not address the core elements of floodplain health directly enough and advised a more explicit focus on changing land use within the floodplain and on human conditions in the floodplain (e.g., safety and damage, agricultural viability, salmon abundance for harvest) (see Ross 2017 for the complete list of metrics discussed). From this feedback, the project team reworked potential metrics and presented three inter-related lists (flood, farm, fish) for additional stakeholder review. This additional review included more explicit conversations about linking metrics to floodplain goals, potential data sources, and baseline in individual conversations, small group meetings, and additional discussions with the IMG. During this work, care was taken to ask about and record remaining areas of concern or issues with each potential metric.

Working final metrics are in Table 1 below. These were presented to the IMG in March 2017 and feedback was requested by the project team. Attachment B includes a table contain more information on the final metrics including links between metrics and watershed goals, existing monitoring efforts, potential baselines, and remaining issues. Although the final metrics remain binned in the three issue areas, they were structured to be easily integrated in the index of floodplain health (discussed later in this memo).

Not all the working final metrics have clear data collection strategies identified yet, and some questions remain about data availability. These will be addressed as part of developing the monitoring plan and may result in refinement of these metrics in consultation with the IMG.

**Table 1. Working Final Puyallup FFTF Monitoring Plan Metrics**

<b>Flood Risk Reduction</b>	<b>Farming and Agriculture</b>	<b>Fish and Habitat</b>
<ul style="list-style-type: none"> <li>• Number of "at-risk" structures that have been removed from within the floodplain or have reduced flood risk because of physical or structural removal or because of a natural event.</li> <li>• Number of projects identified in Pierce County Feasibility Study by reach that are: identified; completed; in progress; future.</li> <li>• Cost (dollars) of flood damages</li> <li>• Amount (dollars) of flood risk reduction investments</li> <li>• Percent of flood-compatible land use in the floodplain (i.e., amount of land that can be periodically flooded without damage)</li> </ul>	<ul style="list-style-type: none"> <li>• Results of Farming Information survey (gathers info on drainage)</li> <li>• Number of acres of conserved farmland</li> <li>• Number of parcels with changes in land use from agriculture to non-ag land uses including number of parcels located within zip codes that are OTA organic hotspots</li> <li>• Gross and net revenue from farming</li> <li>• Number of farm businesses</li> <li>• Number of parcels identified as Tier1 and Tier 2 properties that are conserved or converted to non-ag land uses</li> </ul>	<ul style="list-style-type: none"> <li>• Amount (acres) of floodplain that has been physically, structurally, or reconnected or restored, or reconnected because of a natural event.</li> <li>• Amount (acres) of restored intertidal/mudflat habitat</li> <li>• Amount (percent) of forest within 200 feet of anadromous streams</li> <li>• Connectivity (area of connected floodplain)</li> <li>• Land use/land cover (percent of floodplain forested/bare/water)</li> <li>• Length of active channel</li> <li>• Changes in water temperature</li> <li>• Changes in fish abundance</li> </ul>

Just like data collection strategies are still being refined, a reference baseline from which to monitor progress from has not yet been established for each of the metrics. Based on conversations with FFTF partners so far, baselines for each metric will generally fall into one of three categories: (1) historical baseline, which is an effort to understand changes to the floodplain since development began; (2) data-related baseline, which uses the origination date for a particular data set (e.g., census data); and (3) project-related baseline, which is meant to understand changes to the floodplain since initiation of the Floodplains by Design project funding (2013). Potential baselines for the final metrics will be discussed with the project team and FFTF partners during development of the monitoring plan and appropriate baselines will be agreed upon.

## **Metrics Integration and Development of the Floodplain Health Index**

The purpose of the FFTF monitoring plan project is to develop a set of shared goals for integrated floodplain management and employ various metrics to ascertain progress relative to those goals as well as continued support for implementation of an aggressive capital program to achieve floodplain health in the Puyallup watershed. FFTF partners understand that floodplain projects have a higher likelihood of success when they improve ecological function, reduce flood risk, and meet other agricultural needs because they are more likely to garner the necessary community support and funding. Thus, the key to successful collaborative floodplain management is ensuring that integration of individual stakeholder issues and goals is occurring at the project and watershed scales and describing progress across multiple benefits through a set of metrics that can be easily tracked and clearly communicated to decision-makers and the public. The metrics will be presented as part of the Index of Floodplain Health, which will serve as a system for tracking floodplain improvement or degradation from the multi-benefit perspective established by FFTF stakeholders.

### ***Index of Floodplain Health***

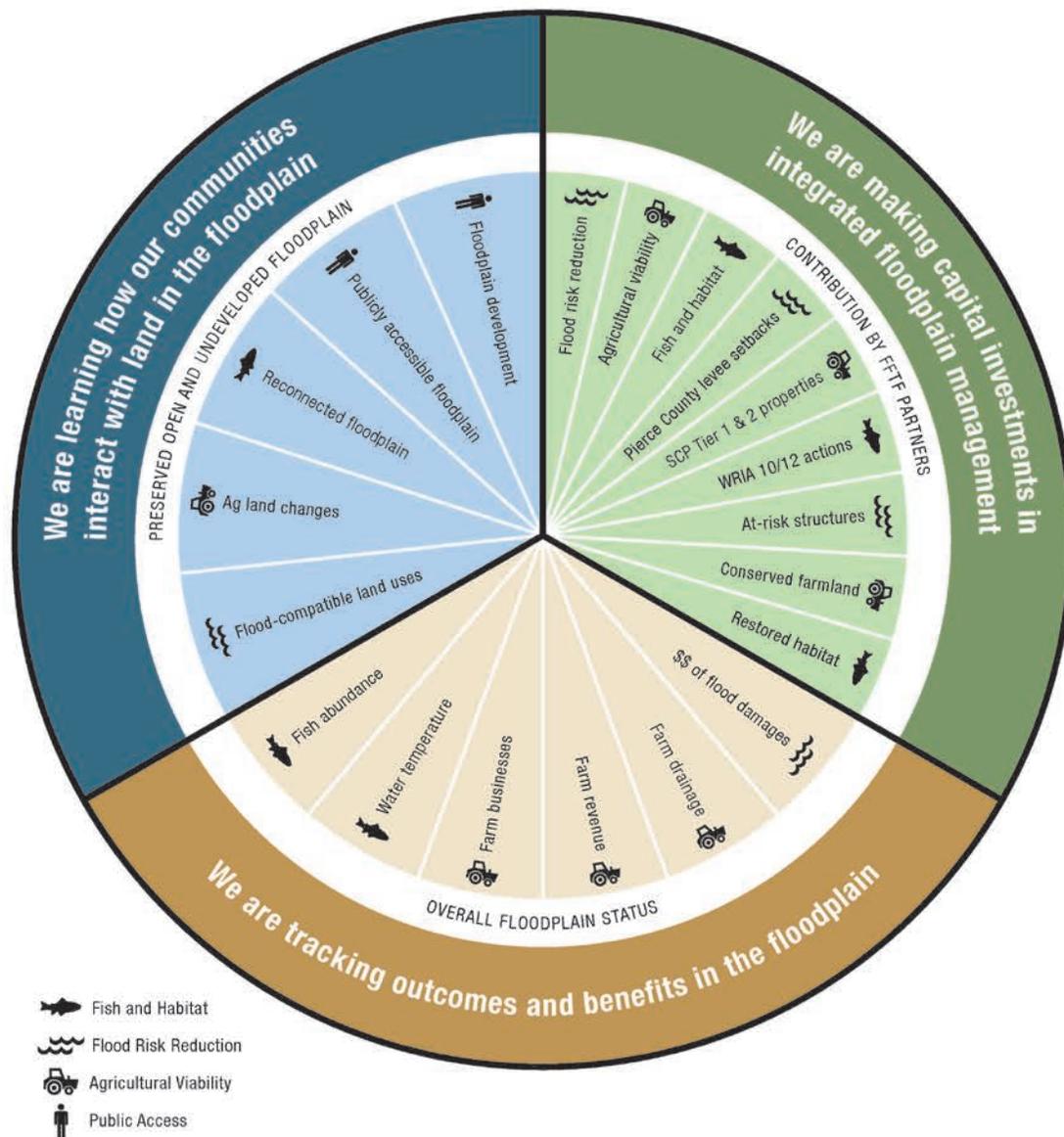
The Index of Floodplain Health presents a measurement for answering the question: *How are we improving floodplain health?* The index is comprised of individual and rolled-up metrics that ask (and answer) an additional set of questions about floodplain health. Three questions were identified by the project team for consideration:

- How are our communities interacting with land in the floodplain?
- What are our capital investments in integrated floodplain management and are we making progress toward our goals?
- What outcomes and benefits are we seeing across the floodplain?

Using the metrics to answer the questions will help understand whether or not capital investments agreed to by the FFTF collaboration are contributing substantially to achieving the goals identified by the FFTF partners. This understanding will inform and direct efforts of the continued collaboration and can also inform additional capital program development. The graphic on the next page presents the index, individual and rolled-up metrics, as explained in the following sections.



## How Are We Improving Floodplain Health?



### ***How are our communities interact with land in the floodplain?***

This question addresses and tracks the cumulative impacts of policies, programs, and capital investments coming together in the floodplain. The individual metrics that track changes in land uses are relevant and can be followed over time via GIS data in dynamic or static map formats. A single ‘rolled-up’ metric – Amount preserved of open and undeveloped floodplain – will track the combined area of floodplain that does not (and will not) contain built elements and is available for select agricultural uses, flood storage, and possible restoration.

- Amount (acres or percent) of flood-compatible land use in the floodplain
- Number of parcels with changes in agriculture land use
- Amount (acres) of floodplain that has been reconnected or restored (at various flood stages)
- Amount of publicly accessible trails/open space in floodplain
- Number of development permits in the floodplain

Although land uses are not driven or determined by FFTF efforts, they may be influenced by FFTF partner activities. Further, information about the above metrics will be used to inform investments in integrated floodplain management.

### ***What are our capital investments in integrated floodplain management from FFTF partners?***

This question addresses and tracks investments by FFTF partners. This includes financial investments as well as outcomes, such as acquisitions and habitat creation or improvements (e.g., 10 acres of intertidal habitat). Individual metrics also answer the question “How are we making progress toward our goals” by tracking projects or actions identified in the three major planning documents (Pierce County Feasibility Study; Pierce County Shared Conservation Partnership Strategy; and, WRIA 10/12 Salmon Habitat Protection and Restoration Strategy).

Also, individual metrics can be used to help answer the secondary question: “Is there equity in advancement toward the landscape problems and goals of salmon recovery, agricultural viability, and flood risk reduction?” A single ‘rolled-up’ metric – Total amount (dollars) of investment by FFTF partners – will track the combined amount of financial contributions.

- Amount (dollars) of flood risk reduction investments (by Pierce County and others)
- Amount (dollars) of agriculture viability investments (by Shared Conservation Partnership and others )
- Amount (dollars) of fish and fish habitat investments (by Lead Entity and others)
- Number of planned levee setbacks completed or in progress (per Pierce County Feasibility Study)
- Number of parcels identified as Tier1 and Tier 2 properties that are conserved or converted to non-ag land uses including restoration (per Pierce County Shared Conservation Partnership Strategy)
- Number of planned near and long-term actions completed or in progress (per WRIA 10/12 Salmon Habitat Protection and Restoration Strategy)

- Number of "at-risk" structures that have been removed from within the floodplain or have reduced flood risk
- Number of acres of conserved farmland
- Amount (acres) of restored intertidal/mudflat habitat; improved or restored spawning habitat; riparian habitat

This group of metrics is directly influenced by FFTF partner activities and investment choices are guided and informed by the FFTF efforts.

### ***What outcomes and benefits are we seeing across the floodplain?***

This question addresses trends in the quality and quantity of things we value (farm viability, salmon recovery, flood risk reduction) in floodplain. It includes a mixture of economic-based and ecological metrics that are currently being tracked by other entities. Each metric will be summarized qualitatively in terms of whether they are they increasing/improving, decreasing/declining, staying the same, etc.? A single 'rolled-up' metric – Overall floodplain health – will be a qualitative assessment of the individual metrics and to provide the overall rating.

- Cost (dollars) of flood damages
- Results of Farming Information survey (gathers info on drainage)
- Gross and net revenue from farming
- Number of farm businesses
- Changes in water temperature and meeting DOE standards
- Fish abundance metric (TBD if feasible)

Similar to the land use metrics under the first question, outcomes and benefits are not directly determined by FFTF efforts, they are rather influenced by FFTF partner activities. Further, information about the above metrics will be used to inform investments in integrated floodplain management.

### **Next Steps**

The next steps in the monitoring plan project include:

- Test draft Floodplain Health Index with the IMG and refine as needed
- Continue to refine metrics by working out definition, baseline, and data considerations
- Assemble existing data sets and test the mapping and integration (start with some proof of concept mapping)
- Determine weighting (if any) for Floodplain Health Index
- Craft Monitoring Plan draft for IMG review

## **References**

- Ross Strategic. 2017. *Summary Themes from Floodplain Health Stakeholder Interviews*. Memorandum dated February 28, 2017 (revised March 27, 2017). Prepared for the Floodplains for the Future – Puyallup, White, and Carbon Rivers partnership.
- ESA (Environmental Science Associates). 2016. *Farming in the Floodplain Project Existing Conditions Report*. Prepared for PCC Farmland Trust. August 2016.
- ESA (Environmental Science Associates). 2017a. *Watershed and Reach Descriptions*. Memorandum dated January 13, 2017. Prepared for the Floodplains for the Future – Puyallup, White, and Carbon Rivers partnership.
- ESA (Environmental Science Associates). 2017b. *Synthesis of Existing Monitoring in Watershed*. Memorandum dated January 13, 2017. Prepared for the Floodplains for the Future – Puyallup, White, and Carbon Rivers partnership.

**Attachment A**

**Metrics Lists for Workshop on November 14, 2016**



## **Floodplains for the Future -- Metrics**

November 14, 2016 Workshop

### **Themes About Metrics:**

- Metrics should reflect the values / outcomes we hope to achieve in the floodplain
- They should be easily communicated, and quantifiable where possible
- Ideally there should be a combination of metrics that speak to individual values and metrics that integrate / synthesize values

### **Starting List of Potential Metrics to Consider:**

1. Percent of flood-compatible land use in the floodplain (amount of land that can be periodically flooded without damage)
2. Community rating system ratings (for jurisdictions)
3. Depth of flooding / days of flooding / flood damage and losses
4. Acres of restored estuary habitat
5. Miles of restored riparian habitat / riparian habitat quality (how to measure this)
6. Main habitat types for salmon (estuaries, main stem, side channel, tributaries of floodplains, and tributaries)
7. Measure of fish population viability appropriate to floodplains (productivity?)
8. Number of acres in active agriculture in the (watershed or floodplain?)
9. Number of "seasons" farmers can plant (as a measure of how drainage is functioning and viability)
10. Measure of farm infrastructure or community (miles farmers have to travel to markets or infrastructure? Fragmentation/connectivity of farmland?)
11. Connectivity measure related to trails and/or measure of trail use or other trail outcomes
12. Amount of maintained (developed?) publicly accessible land in the floodplain (e.g., parks, trails. . .)
13. Community perception / satisfaction (measured by surveying; around what elements?)
14. Percent effective impervious surface in the watershed

## Potential Metrics Suggested During Interviews:

- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• # of homes removed from floodplain</li><li>• Community rating system ratings (for jurisdictions)</li><li>• # days at flood stage</li><li>• Amount of land use compatible with FP (i.e., can the land use withstand periodic flooding)</li><br/><li>• Acreage of reconnected floodplain at a variety of flows</li><li>• Restoration plant survival / sustainability of projects</li><li>• Habitat quality</li><li>• Amount of habitat types (estuary, riparian)</li><li>• Culvert inventory</li><li>• # acres intertidal/mudflats</li><li>• Miles of natural vegetated stream channels</li><li>• #stream miles with riparian buffer</li><li>• Amount of large woody debris</li><li>• WQ - turbidity, temperature, fecal coliform</li><li>• Amount of restored habitat/side channel habitat</li><li>• Water temperatures</li><li>• Channel depth/pool habitat</li><li>• Riparian stand density, total basal area</li><li>• Redd counts</li><li>• #wild fish returning</li><li>• # of large trees (riparian)</li><li>• Riparian species composition/height</li><li>• # acres aquatic habitat available at range of flows</li><li>• Type of habitat - channel, edge, secondary channel, FP</li><li>• # of farms acres with salmon-safe certification</li><li>• Fish population measures</li><br/><li>• Did parcel acquisition produce multiple benefits</li><li>• # of farm plans/BMPs installed</li><li>• # acres lost to development</li><li>• # acres acquired land &amp; type</li><li>• #acres restored providing multiple benefits - ag, habitat connectivity</li><li>• Amount of pervious surfaces within X ft of river (or in the watershed)</li><li>• Community perception of projects / community satisfaction</li><li>• Rate at which floodwaters recede</li></ul> | <ul style="list-style-type: none"><li>• Gross and net revenue for farming</li><li>• # farm businesses, # acres in production</li><li>• # acres farmland protected by levees and dikes</li><li>• # of ag economy infrastructure/facilities/support services</li><li>• # farm jobs</li><li>• # acres of ag easement</li><li>• # farm date sales</li><li>• # of new marketing opportunities</li><li>• Farm infrastructure - farmers markets, food co-ops, cold storage, processing centers</li><li>• # farms with buffers (acreage)</li><li>• #TMDLs</li><li>• # economically viable farms</li><li>• # acres in active ag (or percent in active ag of total ag acres)</li><li>• # of fields farmers unable to use (too wet)</li><li>• # of fields where cover crops are planted</li><li>• # economically viable farms affected by drainage ditches</li><li>• Contiguosness of protected farmland</li><li>• Some measure of how drainage functions</li><li>• Number of "seasons" farmers can plant (as a measure of how drainage is functioning)</li><li>• Loss of ag land ("no loss")</li><li>• Some measure of the effect on local/micro economy related to nationally-recognized "organic hot spot" measures.</li><li>• Number of farms implementing BMPs</li><li>• A metric that measures successful stewardship of natural resources</li><li>• Payments to farmers for conservation activities</li><li>• Farmer participation in voluntary programs</li><li>• Average size of farms (in acres)</li><br/><li>• # trail users</li><li>• # opportunities to connect to place based education</li><li>• Amount of community access</li><li>• Outcomes of community access (e.g., increased health)</li></ul> |
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**Attachment B**

**Working Final Metrics – May 2017**



**FARM/AG METRICS**

**Sources of information:**

Farmland Conservation Committee - 2015 list  
 Jordan Jobe/Hilary Aten/Sarah Wilcox/Spencer Easton - 11/17/2016 email  
 Shared Conservation Partnership - 11/30/16 meeting  
 Larry Bailey - 11/11/16 email

Interviews with: Jordan Jobe, Sarah Wilcox, Robin Fay, Amy Hendershot, Hilary Aten, Rawley Johnson, Holly Foster, Larry Bailey, and others  
 Group discussion with: Sarah Wilcox, Jordan Jobe, Hilary Aten, Spencer Easton - 2/9/17

Metric	Watershed Goal(s) <i>Reach Goals</i>	Meaning/Purpose	Potential Data Source(s)	Frequency	Priority Reach(s) for	Map?	Baseline	Key Terms and Definitions	Metric-Specific Status, Questions, Next Steps
1 <b>FARM DRAINAGE:</b> Results of Farming Information survey (gathers info on drainage)	<i>Lower Puyallup:</i> Improve drainage in a way that also improves habitat	Tracking changes in farmers responses to questions about drainage and constraints on farm production will provide an indication of drainage improvements generally.	Phone survey led by PCD	Annually	Lower Puyallup White River	No	per survey		*Need to develop survey questions and text/review with farmers *Need to determine/ document survey methodology, roles, plan, resources needed going forward
2 <b>CONSERVED FARMLAND:</b> Number of acres of conserved farmland	Conserve 85% of agricultural lands in production Implement SCP Goals (longterm goal of 50,000 acres or more in farmland; 10-year voluntary conservation goal of 6,000 acres)  <i>Lower Puyallup:</i> Provide net increase of agricultural land in Clear Creek area; Prohibit further development of agricultural lands in Fife <i>Middle Puyallup:</i> Protect existing agricultural lands and provide net increase in active farming <i>Upper Puyallup, Carbon River, and White River:</i> Preserve agricultural land and protect	Tracking the amount of conserved farmland will provide a measure of progress toward conservation goal(s).	Shared Conservation Partnership (SCP)	Annually or every 2-3 years	<i>need to determine</i>	Yes	<i>need to determine</i>		*Need to verify data availability and test concept. *Need to determine baseline and settle on frequency *Need to determine priority reaches if applicable
3 <b>AG TO NON-AG CHANGES:</b> Number of parcels with changes in land use from agriculture to non-ag land uses  Sub-metric: Number of parcels located within zip codes that are OTA organic hotspots	Prevent development of agricultural land Implement SCP Goals (long-term goal of 50,000 acres or more in farmland; 10-year voluntary conservation goal of 6,000 acres)  <i>Middle Puyallup:</i> Prevent conversion/development of floodplain agricultural land	Tracking the amount of land use changes at the parcel scale will provide an indication of agricultural land losses and a measure of progress toward limiting conversion of ag lands  OTA organic hotspots are a federal benchmark for linking economic health at the county level to organic agriculture; they boost household incomes and reduce poverty levels — at greater rates than general agriculture activity.	Pierce County GIS parcel information  OTA Organic Hotspots database	Annually or Biennially	<i>need to determine</i>	Yes	<i>need to determine</i>		*Need to verify data availability and test concept, particularly the OTA hotspot overlay. *Need to determine baseline and settle on frequency *Need to determine priority reaches if applicable
4 <b>FARM REVENUE:</b> Gross and net revenue from farming	Maintain a viable farming economy	Tracking the amount of revenue of active farming will provide an indication of increase, decrease, or maintenance of current active agriculture levels.	USDA Ag Census	Every 5 years (2017 next)	Lower Puyallup White River	No	2007 census	Information at County scale; difficult to isolate watershed only	*Need to determine reporting methodology given scale limitations. If this can't be used need to determine an alternate data source, or metric.
5 <b>FARM BUSINESSES:</b> Number of farm businesses	Maintain a critical mass of farmland and farm businesses	Tracking the amount of individual farms will provide an indication of increase, decrease, or maintenance of current active agriculture levels.	USDA Ag Census	Every 5 years (2017 next)	Lower Puyallup White River	No	2007 census	same as above	*Need to determine reporting methodology given scale limitations. If this can't be used need to determine an alternate data source, or metric.
6 <b>SCP TIER &amp; 2 PROPERTIES:</b> Number of parcels identified as Tier1 and Tier 2 properties that are conserved or converted to non-ag land uses	Identify areas for preservation through acquisition Preserve forest land and prevent conversion Implement SCP Goals (longterm goal of 50,000 acres or more in farmland; 10-year voluntary conservation goal of 6,000 acres)  <i>Middle Puyallup:</i> Prevent conversion/development of floodplain agricultural land	Tracking the number of Tier 1 and Tier 2 properties conserved will provide a measure of progress toward prohibiting or limiting conversion of ag lands identified through Strategic Conservation Partnership GIS-based prioritization of farmlands in Pierce County.	Shared Conservation Partnership (SCP)-funded Pierce County GIS-based prioritization	Annually or Biennially	<i>need to determine</i>	Yes	2016	Track Tier 1 and Tier 2 separately, but can also show them combined to reduce confusion to public. (from SCP "Tier 1 properties are those highest priority properties assigned directly to a lead organization for direct relationship cultivation; Tier 2 are high priority propertie that receive some form of outreach requiring lesser resources")	*Need to determine priority reaches, if any.
7 <b>FARM/AG VIABILITY INVESTMENTS:</b> Amount (dollars) of ag viability related investments	Maintain a viable farming economy/critical mass fo farmland and farm businesses	Tracking the amount of FbD investments in related to ag viability needs/activities	Shared Conservation Partnership	Annual	All reaches	No	Start of FbD Funding - 2013		*Need to determine what sources of information that can be acquired in a consistent way.

**FLOOD RISK REDUCTION METRICS**

**Sources of information:**

PC SWM Rivers Flood Hazard Management Plan - 2013 Volume I

PC Geomorphic Evaluation and CMZ Analysis - 2003

Interviews with: Hans Hunger, Ryan Dicks, Mike Neville, Mark Palmer, Jen Burke, Doug Beagle, Helmut Schmidt and other

Phone call w/Hans Hunger, Helmut Schmidt on 2/3/17

Additional review and input via email from Doug Beagle (3/27/17,

Additional review and input phone calls from Hans Hunger and Helmut Schmidt (5/17/17

Metric	Watershed Goal(s) <i>Reach Goals</i>	Meaning/Purpose	Potential Data Source(s)	Frequency	Priority Reach(s) for	Map?	Baseline	Key Terms and Definitions	Metric-Specific Status, Questions, Next Steps
1 <b>AT-RISK STRUCTURES:</b> Number of "at-risk" structures that have been removed from within the floodplain or have reduced flood risk. <i>Categories:</i> a) Physically removed through acquisition, b) Reduced flood risk through structural solution (i.e., levee setback) c) Removed from flood risk through abandonment after natural event	Reduce flood risk to private homes by removing them or lowering flood levels  <i>Lower Puyallup:</i> Protect infrastructure in floodplain <i>Middle Puyallup:</i> Remove at-risk RV parks <i>Upper Puyallup, Carbon River, White River:</i> Remove at-risk homes	Tracking the number of at-risk structures that have been removed from the floodplain or reduced from flood risk will provide a measure of progress toward reducing the overall risk to people and property in the floodplain	Pierce County SWM  County GIS layers for SFHA and CMZ	annual	All reaches	No	1999 reconnection study by Pierce County?  Start of FbD Funding - 2013?  Using FFTF defined	"Floodplain" is defined as the combined area identified as the FEMA special flood hazard area AND the Channel Migration Zone, Level 3 - Severe Zone.  For Upper Puyallup and Upper Puyallup, Floodplain should also include the other two levels of CMZ.	*Pierce County would track this number on annual basis. *Need to determine baseline - should it be 2008 (study date) or should it be 2013 (start of FbD funding)
2 <b>PIERCE COUNTY LEVEE SETBACKS:</b> Number of projects identified in Pierce County Feasibility Study by reach that have been: 1) identified (32) 2) completed 3) currently in progress 4) future	Implement levee setbacks as identified in Pierce County Feasibility Study	Tracking the number of completed/implemented and in progress projects against the total number of projects.	Levee Setback Feasibility Analysis 2008  Pierce County SWM	annual	All reaches except Upper White	Maybe	Start of FbD Funding - 2013? 2008?		*Pierce County would track the sites on annual basis. The 32 projects include 20 sites along the Puyallup River, 6 sites on the Carbon River and 6 sites on the White River. *Need to determine baseline - should it be 2008 (study date) or should it be 2013 (start of FbD funding)
3 <b>\$\$ of FLOOD DAMAGES:</b> Cost (dollars) of flood damages	Reduce risk to Pierce County infrastructure Reduce flood risk to private property	Tracking the amount of money incurred by flood damages	Individual municipalities (track this for FEMA)?	annual?	All reaches	No	Start of FbD Funding - 2013	Flood damage cost will be limited to information that can be acquired in a consistent way. Potentially it will just include costs tracked by each jurisdiction for FEMA emergency funding. Other costs will not be able to be tracked (such as the loss of economic productivity during and after a storm event, expenses incurred by private parties, costs of first responders and emergency help etc.)	Could any of the programs listed in Table 1.1 (1991-2010 155M total costs) be tracked and used in monitoring plan? PC SWM River Improvement Fund, PC REET River Improvement Fund, NFIP Flood Insurance Claims? Separate and track individual, or aggregate and provide a combined total for tracking?
4 <b>FLOOD RISK REDUCTION INVESTMENTS:</b> Amount (dollars) of flood risk reduction investments	Reduce risk to Pierce County infrastructure Reduce flood risk to private property	Tracking the amount of FbD investments in related flood risk prevention needs/activities	Pierce County SWM	annual	All reaches	No	Start of FbD Funding - 2013		*Need to determine what sources of information that can be acquired in a consistent way. 1) Amount of FbD funding, 2) Surface Water Mgmt money, 3) other?
5 <b>FLOOD-COMPATIBLE LAND USES:</b> Percent of flood-compatible land use in the floodplain (i.e., amount of land that can be periodically flooded without damage)	<i>Upper Puyallup, Carbon River, White River:</i> Integrate agricultural interests into proposed large levee setback projects	Tracking the amount of flood-compatible land use will provide an indication of in the increase or decrease of floodplain function.	County GIS layers for SFHA and CMZ  Puget Sound Partnership; Puget Sound Ecosystem Monitoring Program (PSEMP)	annual	All but Upper Puyallup and Upper Carbon?	Yes	PSP Floodplains Implementation Strategy "floodplain footprint" (a combination of GIS layers 2011-2015)	Floodplain is defined above.	*Need to define flood-compatible in a simple and transparent way that can be tracked over time in a repeatable/reproducible way. Will likely include: 1) open space, 2) recreational uses (e.g., ballfields, 3) agriculture (some types of crops only, and a farm where accessory buildings will not be damaged, etc.)  PSP is currently refining a baseline for monitoring and interim target for its Floodplains Vital Sign. They have developed 5 tiers of land use in the floodplain based on ecosystem function. We may be able to adapt these tiers to something like "really incompatible" to "more compatible" and be able to categorize agricultural uses, low or high density development, and natural land cover.

**FISH AND HABITAT METRICS**

**Sources of information:**  
 WRIA 10 Chinook Monitoring and Adaptive Management Phase I Summary Report: Preliminary Monitoring and Adaptive Management Framework - 7/1/2013  
 Common Indicators list - Lisa Spurrier email 11/15/16  
 PC SWM Rivers Flood Hazard Management Plan - 2013 Volume I and II (App H Fish Habitat Maps)  
 Puyallup Tribe State of our Watersheds Report - 2016  
 Interviews with: Martin Fox, Patrick Reynolds, Russ Ladley, Lisa Spurrier, Tom Kantz, Tom Nelson, and others  
 Phone call w/Lisa Spurrier, Sherrie Duncan, Martin Fox, Patrick Reynolds, Tom Nelson, Char Naylor on 2/2/17  
 Additional review and input via email and/or phone calls from Martin Fox (5/11/17), Patrick Reynolds (5/9/17), and Russ Ladley and Char Naylor (5/10/17)

Metric	Watershed Goal(s) Reach Goals	Meaning/Purpose	Potential Data Source(s)	Frequenc	Priority Reach(s) for Metric	Map (y/n)?	Baseline	Key Terms and Definitions	Metric-Specific Status, Questions, and Next Steps
<p><b>1 RECONNECTED FLOODPLAIN:</b> Amount (acres) of floodplain that has been reconnected to river. <i>Categories:</i>                      1a) 100-year flood                      1b) 2-year flood                      1c) Mean annual flow</p> <p><i>Results can be further stratified by:</i>                      --Amount physically reconnected through restoration project (e.g., tide gate removal, intentional levee breach)                      --Amount reconnected through structural solution (eg., levee setback)                      --Amount reconnected as a result of natural event (e.g., levee break or breach)                      --Amount of reconnected that can be reforested (available for enhancement/restoration)</p>	Reconnect floodplain to the river to provide additional storage during floods; refuge habitat for fish during major floods (100-year); refuge habitat during regular floods (2-year); and, rearing habitat (mean annual flow).	Tracking changes in reconnected floodplain via multiple pathways	Pierce County SWM	Annually	All reaches	Yes	1999 reconnection study by Pierce County?  Start of FbD Funding - 2013?  Using FFTF defined Floodplain planning area starting in 2017?	"Floodplain" is defined as the combined area identified as the FEMA special flood hazard area AND the Channel Migration Zone, Upper Hazard Level (Severe Zone). For Upper Puyallup and Upper Puyallup, Floodplain should also include the other levels of CMZ (low, moderate, high).	Reconnected floodplain will be calculated as each levee setback project is completed. The Levee Setback Feasibility Analysis 2008 (Pierce County) and the Flood Plain Reconnection Feasibility Study (NSD 2014) provide estimates of reconnected floodplain area.
<p><b>2 RESTORED ESTUARY HABITAT:</b> Amount (acres) of reconnected intertidal/mudflat habitat in estuary</p>	<i>Lower Puyallup:</i> Re-establish intertidal habitat and productive nursery habitat	Tracking changes in amount of habitat in Puyallup estuary	Pierce County SWM; Habitat Work Schedule	Annually	Lower Puyallup only	Yes	Start of FbD Funding - 2013  Some historic baseline (TBD)		*Need to determine best repeatable method for tracking. Probably easiest to "manually" through Habitat Work Schedule, as opposed to using aerial imagery and comparing changes. Increases in estuary habitat are mostly (if not all) occur as a result of an intentional restoration effort and not from natural events, thus tracking through HWS is reasonable and would capture changes.
<p><b>3 RESTORED RIPARIAN HABITAT:</b> Amount (percent) of upland forest within 200 feet of anadromous streams (within and beyond floodplain)</p>	Establish a functional riparian corridor  <i>Upper Puyallup, Middle Puyallup, Carbon River:</i> Increase riparian cover/shade	What is the extent of anadromous streamside riparian cover? Can be used to track trends in riparian restoration and	NAIP aerial imagery  Chinook M&AMP - CI_F01	Every 2 years (NAIP)	Large Channels in all reaches Small Channels in reaches where they occur	Maybe	Start of FbD Funding - 2013  Some historic baseline (TBD)		*Metric will eventually be tracked per Chinook M&AMP. Until then, Puyallup FbD could use GIS tools to assess and track riparian cover using NAIP imagery. *Go forward with this now or wait? *Would need to define "forest cover" consistent with available spatial data
<p><b>4 WATER TEMPERATURE:</b> Changes in water temperature</p>	Improve water quality to meet DOE standards and to promote hyporeic flows	Tracking changes in water temperature could be used to provide a measure of water quality of streams and rivers; temperature could be used as a proxy for pH, DO, and other constituents (without directly monitoring these as well)	Ecology Statewide Water Quality Network (26 stations in watershed; 6 TMDLs)	Annually	All reaches	No	<i>need to determine (some stations started in 1975)</i>	There are six water quality improvement projects (total maximum daily loads [TMDLs]) in the watershed.	*Verify which temperature station(s) to use *Determine whether other (new/additional) temperature monitoring is needed and if it is needed who would do it *Determine feasibility of hyporeic zone monitoring using piezometers.
<p><b>5 FISH AND HABITAT INVESTMENTS:</b> Amount (dollars) of fish and fish habitat investments</p>	Improve habitat quality and quantity	Tracking the amount of FbD investments in related to fish and fish habitat	TBD	Annually	All reaches	No	Start of FbD Funding - 2013		*Need to determine what sources of information that can be acquired in a consistent way. 1) Amount of FbD funding, 2) SRFB, 3) ESRP, etc.
<p><b>6 WRIA 10/12 ACTIONS:</b> Number of planned near and long-term actions identified in the WRIA 10/12 Salmon Habitat Protection and Restoration Strategy by reach that have been:                      1) identified (6 long-term; 9 near-term)                      2) completed                      3) currently in progress                      4) future</p>	Implement actions identified in WRIA 10/12 Salmon Habitat Protection and Restoration Strategy	Tracking the number of completed/implemented and in progress actions against the total number of actions.	WRIA 10/12 Salmon Habitat Protection and Restoration Strategy  Pierce County Lead Entity	Annually	All reaches	Maybe	Start of FbD Funding - 2013? 2008?		*Pierce County Lead Entity tracking actions per salmon recovery activities. In WRIA 10 long-term projects to construct levee setbacks, restore floodplain connectivity, restore estuarine habitat, and screening the Electron diversion dam are high priorities. Near-term Actions that protect and/or improve habitat in presently productive streams or that correct barriers to high quality habitat will be supported. In WRIA 12, projects to restore nearshore habitats, correct significant barriers, place LWD, and restore riparian conditions may be high priorities if they are cost effective. *Need to determine baseline - should it be 2008 (study date) or should it be 2013 (start of FbD funding)
<b>Additional metrics for future monitoring phases/funding rounds</b>									
<p>RESTORED ACTIVE RIVER CHANNEL: Length (linear feet) of active channel</p>	Reconnect floodplains to the river  <i>Lower Puyallup:</i> Provide more space for the river <i>Middle Puyallup:</i> Allow river to migrate through old oxbows; Re-establish connections to side channels	Tracking changes in the length of active channel to show increases in channel complexity (from setback levee projects and other restoration efforts)	NAIP aerial imagery	Every 2 years (NAIP)	All reaches	Yes	TBD		*Could use GIS tools to measure and track active channel length using NAIP imagery. Need to determine / test if this metric/analysis is really possible and useful. Need to verify any conversion of NAIP maps to GIS that will be needed and test for feasibility.
<p>RESTORED IN-STREAM HABITAT: <i>Could include</i>                      a) Amount (acres) of spawning habitat by reach                      b) Amount of wood (number, volume, key pieces per Fox and Bolton 2007 quantities) for specific length of stream                      c) Amount of holding pools (&gt;1m residual depth) for specific length of stream</p>	Improve habitat quality and quantity  <i>Carbon River:</i> Improve spawning habitat <i>White River:</i> Improve habitat in lower river; Protect/restore riparian floodplain habitat from Lake Tapps upstream to diversion dam	Tracking changes in-stream features to show changes in habitat quality (from setback levee projects and other restoration efforts)	None	Annually	TBD	Yes	TBD		*Metric will be tracked per Chinook M&AMP. Until then, Puyallup FFTF would need to determine specific reaches for monitoring and prioritize this metric for allocation of funds to perform field monitoring.
<p>FISH ABUNDANCE AND PRODUCTIVITY: <i>Some potential ideas</i>                      - # of Redds by spawning reach by species                      - # of juveniles by species                      - Escapement by species                      - Other?</p>	Increase abundance and productivity of fish resources for harvest	Reflect outcomes related to improved floodplain management	Tribal data?	Annually	TBD	No	TBD		*Metric could be explored for individual levee setback projects, but is not feasible for the watershed-scale monitoring program.