Toward a Natural Resources Asset Management Plan for Kitsap County
Workshop Agenda

Date: June 30, 2021, 11:00-1:30 pm PT
Goals: Share, discuss, and collaboratively refine the preliminary level of services (LOS) for riparian assets. Revisit any outstanding items from the May 2021 workshop.

11:00 AM	**Welcome and Introductions -** Elizabeth McManus (Ross Strategic, Facilitator) and Mindy Roberts (WEC)
11:10 AM	**Levels of Services for Riparian Assets -** Charlotte Dohrn (WEC), Matthew Medina (Kitsap County) • Provide an overview of management units and understand current approach, methods, and limitations for evaluating riparian levels of services. • Share feedback on approach and create clear understanding of revisions/next steps. • Discussion: ○ Sharing initial reactions and clarification questions. Are there any surprises? ○ What should we keep and what should we not include moving forward? How do we prioritize? ○ Are there any revisions that the group would like to see? ~~○~~ Are there any missed data sources that we should review? ○ *Materials:* • *Summary document on development of levels of services for riparian areas* • *Web map/document with levels of services for riparian areas with layer capability*
12:30 PM	**Break**
12:45 PM	**Discussion on desired level of service concepts and approach** • Brainstorm and outline steps to develop framework for desired levels of services. • Discussion: ○ What does the concept of desired level of service encompass? ○ How should we gather information about desired level of service and how will we use this information? ○ What are long-term priorities that should be leveraged to gather information about desired level of service?
1:10 PM	**Updates from partners** - Paul McCollum (Port Gamble S'Klallam Tribe), Sam Phillips (Port Gamble S'Klallam Tribe), Tom Ostrom (Suquamish Tribe) • Sharing results from Big Beef Creek analysis (Sam Phillips) • Updates from Port Gamble S'Klallam Tribe • Updates from Suquamish Tribe
1:~~20~~ 25 PM	**Wrap-up and Next Steps** • Upcoming workshop: July 27

1:30 PM	**Adjourn**

Stream & Riparian Workshop: Level of Service Concepts

This document summarizes the preliminary approach for assessing baseline level of service (LOS) for streams and riparian areas in Kitsap County.

Level of service definition: A ranked metric usually used for capital facilities to define the kind and level of service that is required for meeting the needs of residents at current and projected demand. LOS metrics can guide Kitsap County's investments in activities, such as restoration, monitoring, and maintenance of natural assets.

The sections below include an overview of riparian management units, a description of each attribute that is currently included in assessing LOS, and a description of how attribute condition ratings are combined to calculate an overall LOS for each management unit. The approach described here is a starting point, we expect to revise many aspects of these methods based on feedback during the workshop and future updates.

Kitsap County Streams and Riparian Management Units

Kitsap County has approximately 980 miles of streams. The hydrology of the Kitsap Peninsula is unique compared to other regions in the state - it characterized by primarily small, rainfall-dominated, lowland streams. The Kitsap Peninsula includes over 580 streams that drain into Puget Sound and Hood Canal; most streams on the Kitsap Peninsula have surface drainage areas of less than one square mile, and few exceed 10 square miles (WRIA 15, 2021). Kitsap County contains 17 full and partial sub-watersheds (NHD HUC12 units). The table below shows the approximate number of stream miles within each sub-watershed; note that all 10 sub-watersheds that are only partially contained within Kitsap County are grouped together. The Big Beef Creek sub-watershed contains the most stream miles, while Bainbridge Island contains the least.

Sub-watershed (NHD HUC12)	Stream miles - perennial	Stream miles - intermittent	Stream miles - total
1. Big Valley-Puget Sound	42	88	130
2. Port Gamble-Hood Canal	30	81	111
3. Bainbridge Island	8	35	43
4. Barker Creek-Dyes Inlet	27	52	79
5. Chico Creek-Sinclair Inlet	19	33	52
6. Blackjack Creek-Port Orchard	42	52	94
7. Big Beef Creek-Hood Canal	78	72	150
Additional sub-watersheds partially within Kitsap County (n=10)	126	190	316

Management units are the spatial foundation of the asset management system and provide the spatial "container" for analysis and results. We developed temporary management unit polygons for streams

and riparian areas using National Hydrography Data (NHD) flowlines and a riparian buffer (Figure 1 below). In the latest guidance regarding riparian management zones (RMZ), the RMZ is defined by the distance of one 200-year Site Potential Tree Height (SPTH), measured from the edge of the channel migration zone (CMZ) or edge of the active channel (Windrope et al., 2020). In Kitsap County, the 200 year SPTH of a Douglas fir ranges from 144 feet – 231 feet. Based on an analysis conducted by WDFW, using Natural Resource Conservation Services and NHD data, the stream length-weighted 200 year SPTH is 204 feet (Windrope et al., 2018). The temporary management units we used in assessing LOS for stream and riparian areas in Kitsap County currently use the standard width of 204 feet, though this could be updated to reflect the variable widths in WDFW's SPTH Map Tool (link).

The hydrography data we used is represented as a single flowline, and does not include a spatial delineation of the channel migration zone or active channel. The 204-foot buffer that creates the management unit polygon is applied directly from the mapped flowline. Further processing of county wide LiDAR data or visible surface water data available from WDFW could provide a mapped layer of channel migration zones or active channels. Management unit polygons are divided laterally at the boundaries of catchments or catchment groups (Figure 1). Some of the preliminary management units include several smaller branching tributaries that fall within the same catchment group.

For simplicity in this preliminary analysis, we generated management units only for the larger tributaries and the main stem of streams (stream order 2 and above). We will need to decide if we want to include management units for all streams, only perennial streams, larger order streams, or use other criteria. Additionally, due to the riparian buffering technique, management units currently overlap. Some riparian management units extend slightly beyond the boundaries of Kitsap County; we will need to decide to keep stream and catchment segments intact, or cut at the county boundary.

The management units used in this preliminary LOS analysis are temporary. During the workshop, we will discuss plans for developing new riparian management units using the advanced capabilities of ArcHydro.

Temporary riparian management units:

- Number of units: 598
- Estimated Average length: 0.624 mi.
- Length range: 0.001 mi. to 3.228 mi.
- Mean area: 0.054 sq. mi.
- Area range: 0.005 sq. mi. to 0.243 sq. Mi.

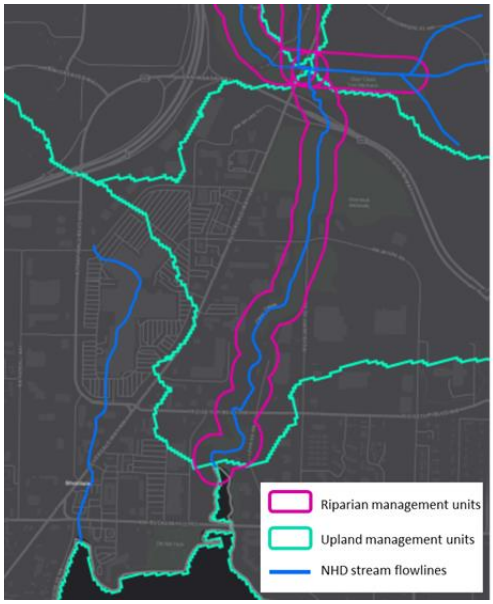

Figure 1 (right). Temporary riparian management units shown in pink, with the full hydrography shown in blue. The green upland units are used to break the riparian units laterally. Note the overlapping buffers in this version where tributaries join the main stem.

Attributes Included in Stream and Riparian Level of Service Analysis

The analysis of riparian LOS uses five attributes to provide information about the condition of streams and riparian areas and the ecosystem services they provided. This is slightly different from the list discussed during the March 2021 workshop. The following sections include a brief overview of the science, ecosystem services linked to the attribute, condition ratings, and considerations for each attribute. The five stream and riparian attributes included in this analysis are:

- S1: Riparian vegetation
- S2: Imperviousness
- S3: Biological condition
- S4: Water quality
- S5: Fish passage

S1. Riparian vegetation

Indicator: % forest cover and tree height in the riparian management unit

Proposed condition rating:

Condition rating	0	1	2	3	4
% forest cover & tree height	<30%	30% -59%	60%-89%	≥90%	≥90% and average height >100ft
Description	Low forest cover	Low-moderate forest cover	Moderate-high forest cover	High forest cover	High forest cover, mature forest

Science summary: Healthy riparian ecosystems are fundamentally important for clean water, healthy salmon populations, and climate resilient watersheds. Fully functioning riparian ecosystems stabilize stream banks, shade streams and banks, remove pollutants, and contribute nutrients and woody debris. Loss of forest cover and fragmentation contributes to salmon population decline in the Pacific Northwest (Andrew et al., 2011). In western Washington, old, structurally complex, conifer-dominant forests are the desired future condition of riparian ecosystems and the latest guidance recommends managers work to protect and restore these conditions (Windrope et al., 2020). An analysis of historical riparian forest condition in the Hood Canal and Eastern Strait of Juan de Fuca areas, found that old, structurally diverse conifer forests characterized stream ravines, and over half of historic conifer sites in bottomlands shifted to other stand compositions over the historical period (Labbe et al., 2013). Older forests with larger trees provide more large wood to streams than smaller trees, which creates fish habitat (Quinn et al., 2020). Older forests transpire less water than young, rapidly growing stands; maintaining older forests can increase dry-season low flows (WRIA 15, 2021). The proposed condition rating for riparian vegetation includes both a measure of forest cover, as well as the modeled height of the canopy to represent the benefits of older, mature riparian forests.

Linked ecosystem services: Key species presence and productivity, other species, habitat, climate resilience, connectivity, connectivity between ground and surface water, flood regulation

Notes and considerations:

- Alternative condition rating scales could be considered. For example, at the watershed scale, watersheds that are over 65% forested have been found to protect a stream's biological community, and 40% forested is recommended by some as a goal for urban watersheds (NOAA, n.d.).
- Percent cover in the 204-foot riparian buffer is an imperfect estimate of riparian forest condition. Fully forested buffers are important for supporting functional stream and riparian ecosystems, though forests closer to the stream may have more direct impact. For example, a management unit with 60% forest cover that is located continuously along the stream is likely in better condition than a unit with 60% cover where the trees are patchy or absent along the stream.
- Cover and height metrics do not capture other important forest characteristics, like stand composition and species diversity.
- Where management units overlap lakes, the shoreline, or for larger streams where there may be surface water not covered by riparian vegetation; % riparian estimates for the whole unit may be inaccurate.
- Previous work under this project considered tree cover and tree height as separate attributes. This could be considered if preferred by the group and supported by the literature/recommendations.

Data source: Washington Department of Fish and Wildlife (WDFW) High Resolution Change Detection (HRCD) 2017 tree cover

S2. Imperviousness

Indicator: % imperviousness in the sub-watershed (HUC 12)

Proposed condition rating:

Condition rating	0	1	2	3	4
% impervious	61-100%	26% -60%	11%-25%	6-10%	≤5%
Description	High impervious cover; poor stream quality	Moderate-high impervious cover; poor-fair stream quality	Moderate impervious cover; fair stream quality	Low-moderate impervious cover; fair to good stream quality	Low impervious cover; excellent stream quality

Science summary:

Impervious surface cover disrupts the process of surface water filtering into the ground and can contribute to higher storm water runoff, greater sediment quantities, and increased pollutant loads in streams. Relationships between impervious surface area and impacts to streams are well quantified. Schueler et al. (2009) modeled stream quality as a function of watershed impervious cover, finding that the health of sensitive streams can be impacted by as little as 5-10% of impervious surface area, with greater impairments expected above 25% (NOAA, n.d.). Urban land cover types are associated with decreased biological condition (Morley and Karr, 2002), and minimizing imperious surfaces is a key strategy for protecting salmon habitat (NWIFC, 2020).

Linked ecosystem services: Key species presence and productivity, other species, habitat, climate resilience, connectivity, connectivity between ground and surface water, flood regulation, water supply

Notes and considerations:

- This attribute is assessed at the sub-watershed scale and the condition rating is applied to all riparian management units within that watershed. The impervious cover model used to specify the condition rating scale is described at the watershed scale, and 30m resolution impervious cover data is likely more accurate at the watershed scale than at the management unit scale. However, we should consider if including watershed-scale metrics is appropriate for this analysis and the goals of the asset management system.
- Impervious cover is likely highly correlated with S1 and S3. We should consider if including this variable is value-adding from an analysis or management perspective.
- Impervious cover is derived based on coefficients associated with different land cover classifications, and may not capture the nuance of interventions like replacing pavement with more permeable options or other interventions.

Data source: NOAA C-CAP 30m derived impervious surface land cover – 2015-2017

S3. Biological condition

Indicator: Average aggregated B-IBI score for stream

Proposed condition rating:

Condition rating	0	1	2	3	4
B-IBI Score	≤20	21-40	41-60	61-80	81-100
Description	Very poor – low diversity	Poor – diversity depressed	Fair – taxa richness reduced	Good – Slightly disturbed	Excellent – comparable to reference conditions

Science summary:

The Benthic Index of Biotic Integrity (B-IBI) is a quantitative method for assessing the biological condition of streams, based on the abundance and type of macroinvertebrate species present at a site. Monitoring B-IBI provides an assessment of stream condition based on the characteristics of biota sampled, which reflect the influence different land uses and activities (e.g., agriculture, urban development, recreation, forestry, etc.) have on a watershed. These activities and disturbances can influence the flow regimes, habitat, chemical introduction, energy cycles, and invasive taxa, and therefore stream health. Low B-IBI scores and degraded salmon habitat may be correlated at the site scale; for example, one study found that Coho and chum salmon did not use stream reaches for spawning with low B-IBI scores (Plotnikoff and Polayes, 1999). To assess LOS, we used data from the Puget Sound Stream Benthos project, which reports B-IBI as an index developed and calibrated for the Puget Sound Lowlands that measures pollution tolerance/intolerance of taxa, taxonomic composition, and population attributes (Puget Sound Stream Benthos, n.d.). We downloaded B-IBI scores since 2015, aggregated for each stream network in Kitsap County for a total of 37 ratings. For streams with more than one year of data since 2015, we used an average to apply the condition rating.

Linked ecosystem services: Key species presence and productivity, other species, habitat

Notes and considerations:

- Data can be aggregated and summarized numerous ways when downloaded, may need to better understand the best way to access and represent these data at the site scale and consider how many years of data to include. Data appear patchy for any given year.
- Though sampling frequency and locations are variable, some streams have several sampling locations; incorporating how B-IBI varies along the stream would provide a more complete picture of stream health. Updated methods are needed to represent several sites along a stream network and determine how far up and down stream to apply condition ratings.
- B-IBI is likely correlated with other attributes.

Data source: Puget Sound Stream Benthos, 2015-present

S4. Water quality

Indicator: Fecal coliform bacteria water quality standard

Proposed condition rating:

Condition rating	0	1	2	3	4
Fecal coliform bacteria counts	Annual GMV >100 FC/100ML; >10% samples >200 FC/100 ML	NA	Annual GMV <100 FC/100ML; >10% samples >200 FC/100 ML	NA	Annual GMV <100 FC/100ML; <10% samples >200 FC/100 ML
Description	Fails both parts of the standard; high bacteria levels		Meets first standard and fails second; periodic high bacteria		Meets both parts of the standard; low bacteria levels

Science summary:

E. Coli is a reliable fecal bacteria indicator of bacteria presence that originate from point source (sewer overflows and effluent discharge) and non-point pollutions sources (stormwater runoff). The presence of E. Coli is known to cause illness, therefor monitoring bacteria is essential to mitigate human health risk from recreation swimming, shellfish consumption and drinking water (Kitsap Public Health District, 2015). Stream monitoring is typically conducted at stream mouths to assess cumulative impacts for stream water quality of the basin, with some monitoring occurring above stream mouths to isolate reaches with elevated pollution risk. Monthly monitoring provides continuous long-term water quality results for Kitsap County. Data is gathered from 69 streams across Kitsap County. Kitsap Public Health District changed the biologic metric used to indicate water quality from Fecal Coliform to E. Coli in the water year (Oct – Sept) 2020 - 2021. For the purpose of this preliminary analysis, we used data indicating whether stream samples met a two tiered water quality standard for the 2019 – 2020 water year. Water years 2020 –2021 and beyond will use E. Coli as the primary bacterial metrics used to assess water quality.

Linked ecosystem services: Recreation, other species, water supply

Notes and considerations:

- Kitsap Public Health District regularly monitors only 69 major creeks in Kitsap County. As a result, many smaller creeks/streams in Kitsap County do not have sampling data.
- In 2021, the fecal coliform standard was updated and streams will now be monitored for E. Coli bacteria. Condition ratings will need to be updated to reflect the new standard and new monitoring data.
- We used partial data from Kitsap Public Health to assess water quality and include this attribute in the LOS score. We approximated the locations of some monitoring locations based on the hydrography data we used for management units. We will need to update methods when we have the exact station locations, which will hopefully allow us to use data from all 69 streams.

Data source: Kitsap Public Health 2020 monitoring data

S5. Fish passage

Indicator: Fish passage barrier presence

Proposed condition rating:

Condition rating	0	1	2	3	4
Presence of barrier in upland management unit	NA	Yes	NA	NA	No
Description		Barrier present in unit			No barriers present in unit

Science summary:

Development can drive hydrologic changes, such as channel morphology, streambed material, nutrients, and stream flow, which effects the habitat suitability for aquatic species. Roads and other forms of development often result in the creation of barriers to fish passage, such as culverts. For example, one of the greatest concerns is the increased stream flow velocity through a culvert and culvert length which contribute to preventing fish from accessing upstream reaches (Thurman and Horner-Devine, 2007). Maintaining hydrologic connectivity is critical to allow ESA listed salmon to access reaches that provide spawning and rearing habitat. Among the types of human constructed fish passage barriers identified in Kitsap County are culverts, dams, diversions, and others. Recently, fish passage barriers were inventoried in Kitsap County with data maintained in a statewide database. A fish passage barrier inventory provides basic information about the location, type of barrier, a reasoning for being a barrier, and potential species present. The inventory excludes information habitat extent and other metrics used to generate a prioritization values. Kitsap County has approximately 1,277 fish passage barriers constructed.

Linked ecosystem services: Key species presence and productivity, other species, habitat, connectivity

Notes and considerations:

- Existing fish passage barrier prioritization indexes are not suitable to use in a condition rating. Alternatively, certain variables used in the prioritization index could be repurposed for a condition rating but we currently do not have access to that data. The preliminary method only accounts for the presence or absence of a barrier.
- The current method does not incorporate information on extent of barrier, species blocked, habitat available upstream or habitat quality, or presence of barriers above and below in the stream network; methods need refining.

Data source:

- WDFW Fish Passage database

Calculating LOS

The overall LOS for each riparian management unit is calculated by taking an average of the condition ratings for S1, S2, S3, S4, S5. For riparian attributes, the maximum possible score is 4, and the minimum possible score is 0. The LOS score reflects the condition of stream and riparian assets. In this approach, we assume that degraded condition (low scores) corresponds with a low level of service and reduced ecosystem services. In addition to the numerical LOS score (i.e., the mean of the condition ratings across attributes), we assign a qualitative LOS rating according to the table below. Given the preliminary nature of the riparian and stream LOS assessment and the revisions needed to both the management units and attributes analyses, we have not included alternative methods for calculating LOS (e.g., geometric mean) at this time.

Qualitative LOS	Overall LOS Score (max4)
Very Low	0-1
Low	≥1-2
Medium	≥2-3
High	≥3-4

References

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Streams Workshop: Definitions of Web App Attribute Fields

The table below provides detailed information of the attributes that are found in the Web App: KNRAMP – Preliminary Level of Service Results.

Attribute Name	Description
SU_ID	Stream management unit ID
AU_ID2	Intermediate ID
Prm_IDs	Intermediate NHD ID
NHDPIDs	NHD ID
Count_l	Count of stream segments in unit
Trm_pth	NHD Terminal Path Identifier
S_name	Stream name
Est_length	Estimated total length of stream segments in unit
Per_for	Percent of the management unit forested
Md_Hght	Median height of modeled tree canopy in the management unit
S1	Condition rating for S1, Riparian vegetation
Per_imp	Percent impervious surface cover in the sub-watershed
S2	Condition rating for S2, imperviousness
Mn_BIBI	Average aggregated B-IBI for stream system
S3	Condition rating for S3, biotic condition
Meets1	Meets first WQ standard
Meets2	Meets second WQ standard
S4	Condition rating for S4, water quality
fpb	Presence (1)/Absence (0) of barriers to fish passage
S5	Condition rating for S5, fish passage
los	Level of service, mean of S1-S5
Los_qual	Qualitative level of service