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

Date: May 13, 2021, 10:00-12:30 pm PT
Goals: Share, discuss, and collaboratively refine the preliminary level of services (LOS) for the marine shoreline assets. Revisit any outstanding items from the March 2021 workshop.

10:00 AM	**Welcome -** Elizabeth McManus (Ross Strategic, Facilitator) and Charlotte Dohrn (WEC)
10:10 AM	**Levels of Services for Marine Shorelines -** Charlotte Dohrn (WEC), Matthew Medina (Kitsap County) • Definition and purpose of levels of services • Understanding the current approach, methods, and limitations for evaluating marine shoreline levels of services • Discussion: ○ What are your thoughts on this concept? Is there anything that surprised you? ○ What are some elements of the current approach that are important to keep as we move forward? ○ Are there any elements that you would suggest we not include – because there is too much uncertainty, because they don't align with your understanding of ecosystem services, or another reason? ○ Are there any data sources that we missed that you would like to see included? ○ What should we focus on for any revisions? *Materials: Document describing concepts and methods for developing of levels of services for marine shorelines; Web map showing preliminary results for shoreline levels of service; Document describing shoreline level of service web map details*
11:30 AM	**Break**
11:45 AM	**Revisiting the big picture -** Mindy Roberts (WEC), Charlotte Dohrn (WEC) • Review what implementing the KNRAMP will accomplish and how to get there • Discussion: ○ Now that we have seen how the preliminary shoreline levels of services are shaping up, how will this help achieve goals of protecting natural assets and ecosystem services? ○ Moving from development to implementation and use, what research, documentation, menus of management responses, etc. does the group want to see? What does the group need/want to see to facilitate implementing and using this information?

12:10 PM	**Updates from partners -** Paul McCollum (Port Gamble S'Klallam Tribe), Sam Phillips (Port Gamble S'Klallam Tribe), Tom Ostrom (Suquamish Tribe) • Port Gamble S'Klallam Tribe • Suquamish Tribe
12:20 PM	**Check-ins, wrap-up, and next steps -** All • Timeline for future level of service workshops • Other next steps
12:30 PM	**Adjourn**

Marine Shorelines Workshop: Level of Service Concepts

This document summarizes the preliminary approach for assessing baseline level of service (LOS) for marine shorelines in Kitsap County.

LOS 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.

Level of service metrics can guide Kitsap County's investments in activities, such as restoration, monitoring, and maintenance. The sections below include an overview of shoreline management units, a description of each attribute that is included in assessing LOS, and a description of how attributes are combined to calculate an overall LOS for each management unit. The approach described here is a starting point and will be revised based on feedback during the workshop and future updates.

Kitsap County Shorelines and Management Units

Kitsap County has about 254 miles of shoreline, which falls into approximately 107 drift cell units, plus 69 areas of no appreciable drift (NAD), for a total of 176 units. Drift cell and NAD units range from 0.02-17.8 miles. The longest unit is along the Hood Canal from Anderson Landing to Port Gamble. The shortest unit is the Curley Creek estuary. Shoretypes present in Kitsap County include feeder bluffs, transport zones, accretion shoreforms, areas of no appreciable drift, and pocket beaches. Based on analysis conducted in 2017, about 48% of Kitsap County shorelines are armored, including about 40% of feeder bluffs (MacLennan et al. 2017).

For the Kitsap Natural Resources Asset Management Program (KNRAMP), marine shoreline management units are delineated using drift cell and NAD boundaries for a total of 176 management units. Onshore sub-units encompass the DNR ShoreZone shoreline to 200m onshore, aquatic subunits extend from the shoreline to 10m waterward. The management units include both the onshore and aquatic subunits, but the subunits are used separately to calculate some of the metrics below.

Attributes Included in Shoreline Level of Service Analysis

The four attributes described below provide information about condition of marine shorelines and the ecosystem services they provide. During the March 2021 workshop, the group discussed including five attributes: shoreline armor, riparian vegetation, water quality, submerged vegetation, and forage fish. In developing the preliminary approach presented here, we have included four attributes that encompass the attributes discussed during the previous workshop. Attributes 1, 2, 3 are assessed on a 0-4 condition rating scale. We determined it was not possible with the data or information available at the moment to assess using a condition scale for some attributes; these attributes are included in M4. The subsections below provide additional detail on marine shoreline attributes 1-4.

M1. Shoreline Processes (Armor)

Indicator: % drift cell armored

Proposed condition rating:

Condition rating	0	1	2	3	4
% armor	>75%	51-75%	26-50%	1-25%	<1%
Description	Highly armored	Moderate-high armor	Low-moderate armor	Low armor	No armor

Science summary: Armoring has direct and indirect affects on numerous ecosystem functions, goods, and services (Dethier et al. 2017). Shoreline armoring negatively impacts physical processes, causing structural changes that result in functional responses, such as decreased habitat for fish and invertebrates and degraded migratory habitat for salmon (MacLennan et al. 2020). Studies throughout Puget Sound have documented local and landscape-scale impacts of shoreline armoring. Beaches with armor typically become steeper and narrower over time, coarse gravels replace finer sediment, and fewer logs, seagrass, and organic debris are found. At the drift cell scale, impacts of armor are likely cumulative causing beaches to become steeper, narrower, and have courser sediments that are less preferable for forage fish spawning. At a local scale, armored beaches have fewer logs, seagrass, algae, organic debris, and fewer of some types of invertebrates. Loss of shallow water habitat may disrupt juvenile salmon migration and feeding (Dethier et al. 2016). Feeder bluffs supply much of the sediment to the shoreline in Puget Sound; armoring feeder bluffs leads to degradation of nearshore habitat (Ramirez 2018).

Linked ecosystem services: Forage fish, habitat, sediment supply, shellfish, climate resiliency, fish migration, seafood, connectivity, marine riparian, birds

Notes and considerations:

- Alternative condition rating approaches could be considered (e.g., uneven breaks, natural breaks, continuous linear relationship). For example, MacLennan et al. (2020) classified percent feeder bluff armor as a measure of the degradation to sediment processes on a scale from 1 to 5 using the “natural breaks” method.
- There is not sufficient data to consider soft shoreline armor, armor materials, armor elevation, or other important characteristics. Shoreline armor data have been collected over many years,

and updating these data has been variable. In recent updates, very short armor segments or changes in armor (<20ft) were not recorded.

- Other assessments, such as the Beach Strategies Phase 2, recommend using the percent of the sediment source that is armored in each drift cell to quantify the amount of degradation to sediment processes and forage fish habitat; however, not all drift cells in Kitsap County include a sediment source (MacLennan et al. 2020).

Data source: Coastal Geologic Beach Strategies Phase 2 Analysis, available here.

M2. Riparian Vegetation

Indicator: % forested cover within 0-200m landward from the existing shoreline

Proposed condition rating:

Condition rating	0	1	2	3	4
% forest cover	<5%	6% -25%	26%-50%	51%-75%	>75%
Description	No forest cover	Low forest cover	Low-moderate forest cover	Moderate-high forest cover	High forest cover

Science summary: The condition of marine riparian habitat influences important processes including sediment input, bank stability and erosion, shading and temperature regulation, nutrient fluxes, and inputs of terrestrial invertebrates (Hall 2019). Marine riparian buffers play an important role in filtering nonpoint source pollution and protecting water quality (Brennan 2004). Research has shown that juvenile chum and chinook salmon associate more with upland vegetation characteristic of mature forests (e.g., cedar trees, mosses), and other studies have found increased surf smelt egg mortality on unshaded beaches (Pentilla 2001). Historically, mature marine riparian communities were likely evergreen forests, with associated understory species, and other tree species found in areas of high disturbance or specific local conditions (Brennan 2007).

Linked ecosystem services: Forage fish, habitat, climate resiliency, seafood, cross-directional connectivity, marine riparian, water quality, birds, view, carbon sequestration

Notes and considerations:

- Alternative condition rating approaches could be considered (e.g., uneven breaks, natural breaks, continuous linear relationship).
- Percent forest cover is a proxy for contiguous forest buffer. Studies have assessed minimum and recommended vegetation buffer widths for different functions (e.g., water filtration, LWD provisioning; Brennan 2009), but specific analysis of the ecological function provided by different percent covers within the uplands adjacent to marine shorelines has not been identified. However, analysis of pilot sites found that percent forested cover and the average width of contiguous forested cover are correlated (Hall 2019). The current approach does not evaluate the function of riparian cover – overhang/shading, height, composition.
- Some shoretypes (e.g., spits) that historically would not have had riparian forest cover, and may need to be excluded from the analysis, but more research is needed. Have identified at least one location (near Blake Island) where this is an issue.
- A standard protocol for assessing marine riparian condition is under development by the Puget Sound Partnership, however the data recommended are not yet available. Research by NOAA and others have identified a need to update and correct errors in shoreline data to more accurately assess riparian vegetation.

Data source: % cover by drift cell derived from NOAA's Coastal Change Analysis Program land cover data, available here.

M3. Water quality

Indicator: Shellfish growing area water quality classification status

Proposed condition rating:

Condition rating	0	1	2	3	4
Classification status	Prohibited	Restricted	Conditionally Approved	N/A	Approved
Description	Sanitary surveys indicate a health risk to consumers	Water quality does not meet standards, but shellfish may be transferred and harvested	Meets the approved criteria intermittently	N/A	Sanitary survey shows no contamination or public health risk

Science summary: The status of shellfish growing areas provides information about water quality and pollution in the nearshore environment. Fecal coliform is the bacterial indicator used to measure water quality for shellfish growing areas. Fecal coliform must remain below a geometric mean value of 14 colony forming units (CFU) or most probable number (MPN) per 100 mL, and less than 10% of all samples exceed 43 CFU or MPN per 100 mL to meet the water quality standard (WAC, 2021). The Department of Health conducts regular "sanitary surveys" of the shoreline and nearshore environment, including identifying possible pollution sources, sampling marine waters to determine fecal coliform bacteria levels, and analyzing how tides, currents and precipitation events may affect the distribution of pollutants. Water samples are collected throughout the year and classification status is modified if conditions change.

Linked ecosystem services: shellfish, seafood, water quality, recreation

Notes:

- Classification status polygons are not aligned with drift cells; the classification status polygon that made up the majority of a drift cell is used as the condition rating of that drift cell. Some areas of Kitsap County are not classified or monitored.
- Could use the monitoring stations and fecal coliform concentration reporting rather than the shellfish growing area polygons, but would require interpolation.
- WAC 173-201A-210 provides marine water designated uses and criteria for temperature, dissolved oxygen, turbidity, and pH. The data for these characteristics are often not reported at a large scale but condition ratings are already outlined for aquatic life and recreation use.
- Direct measurements of water quality (i.e., fecal coliform sampling) is more variable than classification status. Classification status may not be updated regularly to reflect current conditions, but likely provides a more consistent picture.
- Kitsap county appears to not have any "restricted" areas – could remove from the condition rating scale.

Data source: Washington Department of Health Shellfish Growing Area Classification Status, available here.

M4. Presence of ecosystem attributes

Indicator: Summed metric of presence of eelgrass beds, unarmored feeder bluffs, and forage fish spawning grounds

Presence rating approach:

Attribute	Present Score	Absent Score
Eelgrass beds	0.34	0
Unarmored feeder bluffs	0.33	0
Forage fish spawning grounds	0.11 (sand lance), 0.11 (surf smelt), 0.11 (herring)	0

Science summary: The KNRAMP group has identified a number of attributes where information about presence and location is available, but there is not adequate data or it is not straightforward to rate the condition of attributes on a scale as shown in M1-M3. In the current, preliminary version of the shoreline LOS approach, these attributes – eelgrass, forage fish, and unarmored feeder bluffs – are included as presence/absence attributes. These attributes provide important ecosystem services where they are present; absences may be "natural" (e.g., unsuitable substrate for eelgrass) or caused by anthropogenic impacts. Bluffs, eelgrass, and forage fish were all identified as valued ecosystem components of the nearshore environment by the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP). Eelgrass beds provide structured habitat, support the food web, and providing nursery grounds and shelter during migration for salmon and other species (Mumford 2007). Feeder bluff erosion is the primary source of sediment for Puget Sound Beaches, creating shallow water habitat utilized by juvenile salmon and other species (Johannessen and MacLennan 2007). Forage fish, including sand lance, surf smelt, and herring are a critical prey species supporting the food web in Puget Sound; forage fish rely on nearshore habitat for spawning (Penttila 2007).

Linked ecosystem services: Forage fish, habitat, climate resilience, fish migration, water quality, carbon sequestration

Notes:

- Other attributes, such as kelp, provide important ecosystem services and could be incorporated with additional data. Further conversations and research could enable assessing some "presence" attributes with a condition rating.
- Eelgrass is absent from several Kitsap County waterbodies, which may be due to anthropogenic impacts or naturally occurring conditions depending on the location. 35 sites in Kitsap County have been monitored more than once; while trends often fluctuate and depend greatly on the temporal scale, researchers have documented declines at 4 out of the 35 sites.
- Forage fish data are documented intertidal spawning habitat for sand lance and surf smelt, plus shallow subtidal and intertidal spawning habitat of herring. Documented habitat may not provide a complete picture of areas where forage fish do and do not currently spawn.

Data sources: DNR eelgrass monitoring available here; WDFW forage fish spawning survey data available here; locations of unarmored bluffs from Coastal Geologic, available here.

Calculating LOS

The overall level of service (LOS) for each marine shoreline management unit is calculated from the condition ratings and presence of the attributes described above. Level of service for each management unit is calculated by taking the mean of attributes M1-M3, and then subsequently adding the value of M4. The maximum possible level of service score is 5. The level of service score reflects the condition of shoreline attributes as well as the presence of attributes that provide important services. It is assumed that degraded condition corresponds to a low level of service, and relatively intact shoreline condition corresponds to a high level of service. Scores are classified as a very low, low, medium, and high level of service, according to the table below:

Qualitative LOS	Overall LOS Score (max 5)
Very Low	0
Low	>0 and <= 2
Medium	>2 and < 4
High	>= 4

The tables below provide examples for how the LOS for several hypothetical management units would be calculated. For the May 2021 shorelines workshop, we will consider two similar options for calculating LOS, one that uses an arithmetic mean and one that uses a geometric mean.

Method 1 - Arithmetic Mean

Management Unit	Condition Attributes (M1-M3)			Condition LOS (max 4)	Presence Attributes (M4)			Attribute Count (1)	Overall LOS Score (max 5)	LOS
	M1 Rating	M2 Rating	M3 Rating		FB	FF	EG			
DCXXX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Very Low
DCXXX	0.00	2.00	1.00	1.00	0.33	0.11	0.00	0.44	1.44	Low
DCXXX	3.00	2.00	1.00	2.00	0.33	0.33	0.34	1.00	3.00	Medium
DCXXX	4.00	4.00	4.00	4.00	0.00	0.00	0.00	0.00	4.00	High
DCXXX	4.00	4.00	4.00	4.00	0.33	0.33	0.34	1.00	5.00	High

Method 2 - Geometric Mean

Management Unit	Condition Attributes (M1-M3)			Condition LOS (max 4)	Presence Attributes (M4)			Attribute Count (1)	Overall LOS Score (max 5)	LOS
	M1 Rating	M2 Rating	M3 Rating		FB	FF	EG			
DCXXX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Very Low
DCXXX	0.00	2.00	1.00	0.00	0.33	0.11	0.00	0.44	0.44	Low
DCXXX	3.00	2.00	1.00	1.82	0.33	0.33	0.34	1.00	2.82	Medium
DCXXX	4.00	4.00	4.00	4.00	0.00	0.00	0.00	0.00	4.00	High
DCXXX	4.00	4.00	4.00	4.00	0.33	0.33	0.34	1.00	5.00	High

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Marine Shorelines Workshop: Definitions of Attributes

The table below provides detailed information of the attributes that are found in the KNRAMP – Prelimary Shoreline Level of Service Results.

Attribute Name	Alias	Description
DCName	Drift Cell Name	Drift Cells located in Kitsap County
DCType	Drift Cell Type	Types include left-to-right, right-to-left, and no appreciable drift (NAD)
ArmrPct	% Drift Cell Armored	Calculated by Coastal Geologic; the percentage of the drift cell that is armored
SdSrcAP	% Sediment Source Armored of Drift Cell	Calculated by Coastal Geologic; the percentage of feeder bluffs in the drift cell that are armored
M1_CR	Marine Attribute 1 (M1) Condition Rating	Condition rating is based on the percent of shoreline armor in the drift cell, and assigned as outlined in the concepts document
Perc_For	% Forest Cover	The percentage of 30m cells within the onshore drift cell that are classified as deciduous, evergreen, or mixed forest types
M2_CR	Marine Attribute 2 (M2) Condition Rating	Condition rating is based on the percent forested cover, and assigned as outlined in the concepts document
AreaID_Acr	Shellfish Growing Area Sub-Area ID	Unique record ID for each DOH Shellfish Commercial Growing Area ID sub-area
CLASS	Conditional Class for Shellfish Growing Area	DOH Shellfish Growing Area Classification Status, assessed at the drift cell scale

M3_CR	Marine Attribute 3 (M3) Condition Rating	Condition rating is based on the classification status, and assigned as outlined in the concepts document
fb_pres	Unarmored Feeder Bluff Presence	
lnc_prs	Sand Lance Presence	
smlt_prs	Smelt Presence	
hrrng_p	Herring Presence	
elgrss_	Eelgrass Presence	
sum_prs	Sum of Presence Attributes	(lnc_prs + smlt_prs + hrrng_p + elgrss_)
LOS_cond	Level of Service of M1-M3	LOS Method 1 Arithmetic Mean (M1_CR +M2_CR +M3_CR)/3
		LOS Method 2 - Geometric Mean $((M1\_CR*M2\_CR*M3\_CR)^{(1/3)}$
LOS_all	Combined Level of Service Score	(LOS_cond + sum_prs)

LOS	Level of Service	Qualitative description of the LOS, categorized as described in the concepts document