Salmon Spawning Habitat Protection Rule

Science Advisory Group (SAG)
Meeting #5
July 27, 2021
1:30 pm

DEPARTMENT OF ECOLOGY
State of Washington

Goals for Today's Meeting

- Provide SAG members opportunity to preview Ecology's preliminary decisions for dissolved oxygen and fine sediment criteria
- Discuss concerns about feasibility, protection levels, or parameters used to characterize sediment

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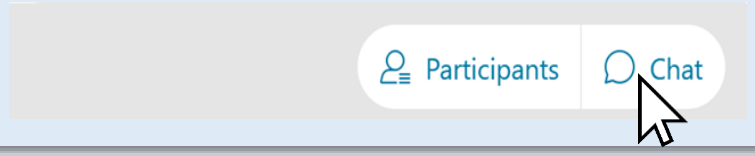
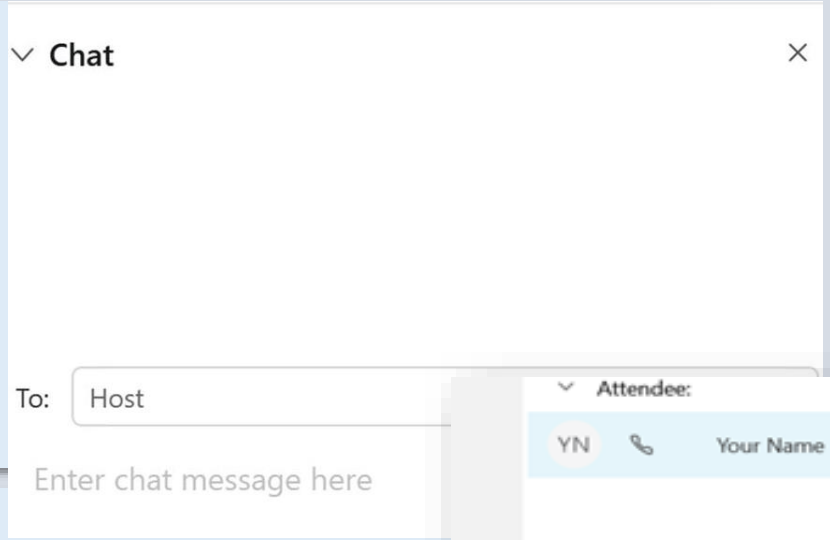
Introductions of SAG Members

Name and affiliation of members present

Using Webex features

You can ask questions via the chat function

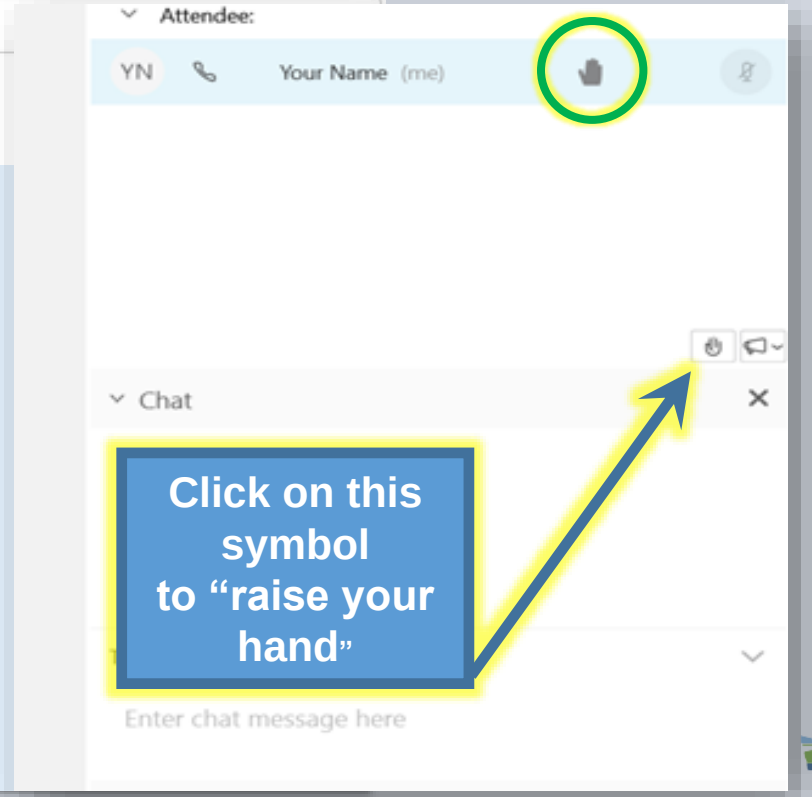




You can also ask questions by raising your hand

We ask that you:

1. **State your name** first before speaking.
2. **Mute your audio** unless speaking.
3. **Lower your hand** when you are done speaking



Today's Agenda

- Preview preliminary revisions to dissolved oxygen criteria
- Review dissolved oxygen criteria justifications
- Questions
- Review proposed structure of fine sediment criteria
- Review justifications for parameters used for impairment determination
- Questions
- Next Steps

Dissolved Oxygen

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WA Current Dissolved Oxygen Criteria

Use Category	DO (mg/L) (1-Day Min)
Char Spawning and Rearing	9.5*
Core Summer Salmonid Habitat	9.5*
Salmonid Spawning, Rearing, and Migration	8.0*
Salmonid Rearing and Migration	6.5
Non-anadromous Interior Redband Trout	8.0*
Indigenous Warm Water Species	6.5

***Salmonid spawning protective levels: 8.0 – 9.5 mg/L**

1986 EPA Recommendations

Salmonid Waters

a. Embryo and Larval Stages

- No Production Impairment = 11* (8)
- Slight Production Impairment = 9* (6)
- Moderate Production Impairment = 8* (5)
- Severe Production Impairment = 7* (4)
- Limit to Avoid Acute Mortality = 6* (3)

(* Note: These are water column concentrations recommended to achieve the required intergravel dissolved oxygen concentrations shown in parentheses. The 3 mg/l difference is discussed in the criteria document.)

Preliminary DO Criteria

Use Category	DO (mg/L) (1-day minimum)		Oxygen Saturation (1-day minimum)		Intragravel DO (mg/L; 1-day median spatial value)
Char Spawning and Rearing	10 ~~9.5~~	OR	90%	OR	8.0
Core Summer Salmonid Habitat	10 ~~9.5~~				8.0
Salmonid Spawning, Rearing, and Migration	10 ~~8.0~~				8.0
Salmonid Rearing and Migration	6.5				-
Non-anadromous Interior Redband Trout	10 ~~8.0~~				8.0
Indigenous Warm Water Species	6.5				-

DO Criteria Justifications: Water Column

- EPA GoldBook (1986):
  - “If slight production impairment or a small but undefinable risk of moderate impairment is unacceptable, then one should use the no production impairment (11 mg/L) values as a mean, and slight production impairment (9 mg/L) as a minima.”
- National Academy of Sciences (1972):
  - Suggests that oxygen criteria to protect eggs should be halfway between maximum (11 mg/L) and high protection levels (9 mg/L)
- Scientific literature since 1986

EPA DO Depression Assumption

- EPA assumes a 3 mg/L depression in dissolved oxygen from the water column to gravels
  - EPA recommendation of 11.0 mg/L is predicated upon a minimum intragravel DO level of 8.0 mg/L and utilizes a 3 mg/L worst-case scenario DO depression value
  - 3 mg/L assumption is based upon two pre-1986 studies (Koski 1965; Hollender 1981)
    - Reported high percent sands/fines (Koski: 40-42%; Hollender: 27-51%)

DO Criteria Justifications

- EPA hired AquaTerra to conduct a literature review of DO depression in 2008
  - Data qualifiers: review if 1-3 mg/L DO depression is true in relatively fine sediment-free gravels

Reference	DO Depression (Low fine sediment load; mg/L)	DO Depression (High sediment load; mg/L)	Study Type	Notes
Argent and Flebbe (1999)	0		Lab	0 – 25% fine sediment
Bowen and Nelson (2003)	0.3 - 0.7	6.6 – 7.3	Field	High: storm runoff event
Guimond and Burr (2007)	<2.0		Field	Interpretation of a figure
Giest et al. (2002)	0.8 – 1.7	5.5 – 9.4	Field	Upwelling vs. downwelling sites
Heywood and Walling (2007)	1.1 – 1.8	4.2 – 5.9	Field	Stream with low and high sediments
Merz and Seika (2004)	0.2 – 2.0		Field	Different gravel depths examined
Meyer (2003)	0.6		Field	Lower part of redd examined

DO Depression Assumption

- Ecology is assuming a maximum 2 mg/L DO depression from the water column to gravels
  - Literature is available to support the assumption of 2 mg/L
    - Literature suggests high DO depression occurs in the presence of high fine sediment and groundwater influences
  - **Optimal** spawning gravels and habitat should have a minimal DO depression (0-2 mg/L)
    - High DO depression values can often be attributed to less than ideal environmental conditions such as fine sediment content, water temperature, groundwater, nutrients, etc…
  - We agree with protective IGDO value of 8.0 mg/L
    - Support demonstrated in EPA recommendations (1986) and Hicks (2002)

Why include 8.0 mg/L IGDO Criteria?

- Provides flexibility for streams with water column levels <10 mg/L and DO depression values <2 mg/L
  - Example:
    - Stream A: DO level in water column: 10 mg/L, DO depression value 2 mg/L, IGDO = 8 mg/L
    - Stream B: DO level in water column: 9 mg/L, DO depression value 1 mg/L, IGDO = 8 mg/L
- A more direct measurement determination of protection
- Guidance on water quality sampling will be necessary (“fish windows”)

Oxygen Saturation Justifications

- EPA does not have an oxygen saturation recommendation
  - <90%, 90 or 95% has been approved by EPA

- Ecology's preliminary decision is to use a 90% oxygen saturation value

  - EPA has approved 95%, 90%, and <90% oxygen saturation values for states
    - 95%: Oregon, California, & Vermont
    - 90%: Idaho, California, Arizona, Washington (Columbia River)
    - <90%: Maine, Hawaii, California, Massachusetts, New Hampshire, Rhode Island, Vermont

Oxygen Saturation Justification

- Current water column based criteria does not account for temperature and elevation influences on DO
  - Theoretically we are currently applying water column DO requirements to sub-alpine and alpine streams
- We have oxygen saturation data from several reference sites (considered least disturbed sites) in Washington State that supports 90% oxygen saturation
- Need for flexibility during summer months when early life stages are not present and stream temperatures are higher

Oxygen Saturation Least Disturbed Reference Sites

Site	# of Days	Total Days Sampled	Maximum Temperature (°C)	Minimum DO (mg/L)	Minimum DO% Saturation	Average DO% Saturation	% of Measurements <95% Saturation	Aquatic Life Use
BURP15	7	13	13.3	7.49	76.8%	96.2%	**31%**	Core Summer
LOST15	5	10	13.9	8.81	94.1%	97.7%	**10%**	Core Summer
MMIL15	2	4	9.3	8.70	84.4%	92.6%	**50%**	Core Summer
NGOO15	4	8	11.4	9.40	93.6%	98.5%	**25%**	Core Summer
OYST02	5	7	14.6	9.70	93.3%	98.4%	**29%**	Salmon Spawning
RUSH04	4	8	8.5	8.87	82.9%	93.8%	**50%**	?
SPAN11	4	7	13.7	8.52	92.6%	97.3%	**29%**	Char Spawning
TUCA11	6	11	13.4	8.88	94.0%	100.6%	**18%**	Salmon Spawning
USLA15	1	2	9.8	9.57	94.7%	94.8%	**100%**	Char Spawning
HAMM03	12	23	13.1	9.58	88.9%	95.0%	**65%**	Core Summer
LAUG07	11	22	13.4	8.83	91.2%	95.9%	**55%**	Core Summer
TWIN02	9	18	11.9	8.60	79.2%	87.3%	**100%**	Char Spawning
UMTA18	9	17	21.7	7.90	90.7%	96.8%	**47%**	Salmon Spawning

Support for 90% Oxygen Saturation

Designated Use	Elevation	Max Temperature (°C)	Oxygen Saturation (%)	Minimum DO level at 90% SAT (mg/L)	Current DO criteria (mg/L)
Salmonid spawning, rearing, and migration	Sea level	17.5	90	**8.6**	**8.0**
Core summer salmonid habitat		16		**8.9***	**9.5**
Core summer salmonid habitat (supplemental spawning)		13		**9.5**	**9.5**
Char spawning		12		**9.7**	**9.5**
Char spawning (supplemental criteria)		9		**10.4**	**9.5**

* See supplemental spawning criteria for summer months

Support for 90% Oxygen Saturation

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Salmonid spawning, rearing, and migration	Sea level	17.5	90	**8.6**	**8.0**
		14		**9.3**	
		11		**9.9**	
		8		**10.7**	
		5		**11.5**	
Core summer salmonid habitat	Sea level	16	90	**8.9***	**9.5**
		14		**9.3***	
		11		**9.9**	
		8		**10.7**	
		5		**11.5**	
Char Spawning	Sea Level	12	90	**9.7**	**9.5**
		8		**10.7**	
		5		**11.5**	

* 95% saturation

** Supplemental spawning temperature criteria is 13°C

Questions or Comments?

Fine Sediment Criteria

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Summary of Preliminary Decisions

- Narrative criterion = Yes
- Use of reference ecoregions/background conditions = Yes
- Weight of evidence approach for impairment listings = Yes
- Use of thresholds for potential screening analysis = TBD

- Approach:
  - Follow watershed monitoring sampling methods with revisions (reach & transect approach)
  - Target locations of potential anthropogenic influence or poor biological health

Other State's Implementation Approaches

- ID, MT, CO, OR, NM – use broad narrative criteria in rule
  - Implementation of criteria provided in separate guidance document
  - We aim to use a similar approach as other states

- Idaho*: established target levels based on literature and local reference conditions*
- Montana*: statistical comparison with reference sites (preferred) and weight of evidence approach*
- Colorado*: use of reference sites within regions*
- New Mexico*: establish reference sites for ecoregions*

- We plan to use a similar approaches as other states for the water quality assessment but provide flexibility in the assessment approach
  - Guidance will be finalized after rule adoption through a public process

Narrative Criterion for Fine Sediment

- Ecology's preliminary decision is to add a narrative criterion that specifically addresses fine sediment
  - Limited quantitative relationships between parameters used to quantify fine sediment and biological endpoints
  - A holistic understanding of the water body is needed

Example:

"Human related sources of fine sediment shall not cause adverse effects on aquatic life, their reproduction, or habitat. Sediment loading shall be compared to reference sites that represent naturally attainable conditions and are minimally impacted by anthropogenic influences."

Classifying Fine Sediment

- Researchers do not have a standardized definition for the size of “fine sediment”
- Reported “fine sediment” sizes include less than 0.833 mm, 0.85 mm, 1 mm, 2 mm, 3.3 mm, 6 mm, and 6.35 mm (McNeil and Ahnell 1964, Tagart 1976, Lisle and Eads 1991, Koski 1981, Weaver and Fraley 1993, Bjornn et al. 1977, Kondolf et al. 1993).
- Anadromous salmon and trout prefer substrate size ranging from 13 to 102 mm in diameter for spawning (Bell, 1986).
- Salmon have been observed spawning in gravels larger than 30 mm and in most observations, the substrate is less than 150 mm (Shepherd et al. 1986).
- Watershed Health Monitoring Program Classification:
    - bedrock (>4 m),
    - pavement/concrete (>4 m),
    - hardpan (>4 m)
    - large boulders (>1 m to 4 m),
    - small boulders (250 to 1000 mm),
    - cobble (64 to 250 mm),
    - coarse gravel (16 to 64 mm),
    - fine gravel (2 to 16 mm),
    - sand (0.06 to 2 mm), and
    - fines (≤0.06 mm)

Summary of Parameters

Environmental Compartment	Measure	Primary or Optional Parameter?
Water Column	Suspended Solids	Optional
Streambed	Percent Substrate	Primary
Streambed	Subsurface Fines	Optional* (if measuring intragravel dissolved oxygen)
Streambed	Relative Bed Stability	Primary
Chemical	Intragravel Dissolved Oxygen	Optional* (if measuring subsurface fines)
Biological	Fine Sediment Biotic Index	Primary

Preliminary Fine Sediment Criteria: Structure

Anthropogenic influence determination - **PRIMARY**

- Anthropogenic sources of fine sediment must be demonstrated
- If a fine sediment impairment is suspected, then there must be an assessment of human disturbance and riparian habitat using existing watershed health monitoring methods as well as supplemental information (e.g. photographs, GIS)
- Naturally occurring sources of sediments will not result in an impairment listing

Category	Left Bank				Right Bank			
Buildings	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Clearing or Lot	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Park/Lawn	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Pasture/Range/Hay Field	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Row Crops	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Pipes (Inlet/Outlet)	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Landfill/Trash	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Logging Operations	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Mining Activity	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Human Foot Path	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Unpaved Motor Trail	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
PavedRoad/Railroad	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank
Wall/Dike/Revetment/Riprap/Dam	Absent	10-30m	0-10m	On Bank	Absent	10-30m	0-10m	On Bank

Preliminary Fine Sediment Criteria: Structure

Water column measure (suspended sediments) - OPTIONAL

- **Suspended solids** will be an optional representative measure of water column concentrations of fine sediment

- Why?
  - TSS only captures a portion of original sample (often excludes sands) and has shown to be an unreliable measure of solid-phase material in natural water samples (Gray et al. 2000)
  - Turbidity does not provide specificity to characterize fine sediment (can include natural detritus such as leaf matter, decomposing algae, etc…)
  - Light penetration does not specifically capture fine sediment materials
  - Water column measure will be optional due to high variability, flow dependence, and limited correlation with fine sediment in substrate

Preliminary Fine Sediment Criteria: Structure

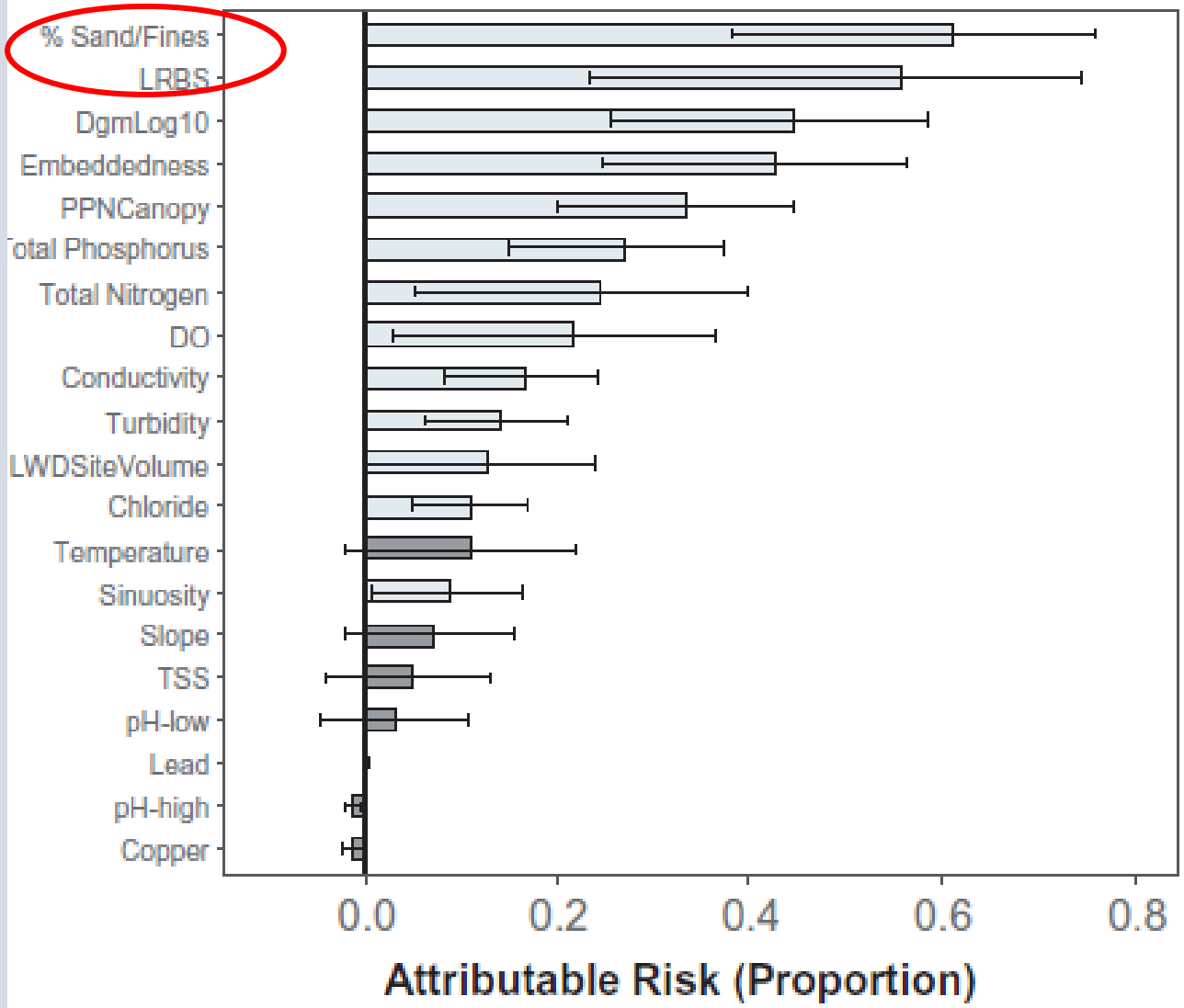
3. Streambed measures (bedded sediments)
   - **Percent surface substrate** (visual) - PRIMARY
   - **Relative bed stability** - PRIMARY
   - **Percent subsurface sediment** - OPTIONAL if measuring IGDO

- These parameters are representative of both site-specific fine sediment conditions (percent substrate & subsurface fines) as well as a catchment level assessment of geological processes (relative bed stability)
- Streambed measures are a direct measurement of sediment quality

Preliminary Fine Sediment Criteria: Structure

- Why **percent surface fines (visual)**?
  - Standardized method by EPA (EMAP) and Ecology
  - Measured in Ecology's Watershed Health Monitoring (WHM) Program
  - Existing data on many water bodies in WA
  - Larson et al. (2019) reported percent fines was the most attributable factor to poor stream health in WA streams surveyed
  - Sutherland et al. (2010) concluded that visual assessment of percent fines was the 2nd best predictor of sediment deposits by considering land use
  - Used by Colorado, New Mexico, Montana, Idaho, and Oregon (draft)

Larson et al. 2019



Proportion of stream miles that could be improved to “not poor” if the environmental parameter were improved.

Preliminary Fine Sediment Criteria: Structure

- Why **relative bed stability**?
  - Developed and standardized by EPA (EMAP) and Ecology
  - Measured in Ecology's Watershed Health Monitoring Program
  - Larson et al. (2019) reported RBS was the 2nd most attributable factor to poor stream health in WA streams surveyed
  - Represents a more holistic and catchment level approach to sediment stability (similar to riffle stability index)
  - Existing data on many water bodies in WA
  - Used by New Mexico and Oregon (draft)

Preliminary Fine Sediment Criteria: Structure

- Why **percent subsurface fines**?
  - Sutherland et al. (2010) concluded that percent subsurface fines was the best predictor of sediment deposits by considering land use
  - Several studies demonstrating relationships between survival and subsurface sediments
  - Tiered approach to habitat quality has been developed (Idaho and New Mexico)
  - Provides more direct information about spawning habitat than a visual assessment
  - Optional measure if IGDO is measured

Preliminary Fine Sediment Criteria: Structure

4. Chemical measures (subsurface sediment)
   - **Intragravel dissolved oxygen level –** OPTIONAL if measuring subsurface fines

- Why?
  - Direct measurement of dissolved oxygen where early life stages of salmonids reside
  - Several studies demonstrating protective levels for early life stages of salmonids
  - Accounts for several factors (substrate size, permeability, sediment oxygen demand, water flow, groundwater influences, etc..) that can influence dissolved oxygen exposure

Preliminary Fine Sediment Criteria: Structure

5. Biological survey (stress-response relationship) - **PRIMARY**
    - **Fine sediment sensitivity index**

- Why?
    - Standardized methods by EPA (EMAP) and Ecology
    - Measure within Ecology's Watershed Health Monitoring Program
    - Existing background data on many water bodies in WA
    - Index is available that specifically looks at fine sediment sensitive species
    - Assists in connecting sediment quality with a biological response
    - Used by Colorado and Oregon (draft)

Questions or Comments?

Next Steps

- Public Webinar: late summer
  - Early feedback on preliminary decisions
  - Share general approach in public meeting prior to rule proposal
- Proposed rule: early fall 2021 (Oct)
  - Receive public comments
- Rule adoption: early 2022
- Impairment determination process
  - Develop assessment methods for determining impairment (303d listings) – hold public review
  - Finalize methodology within 18 months after rule adoption – implement in next Water Quality Assessment

Thank you for your participation!