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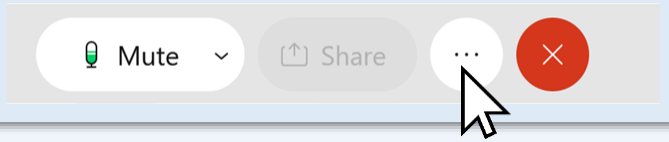
No sound? Connect your audio and listen for a sound check before we start.

Please connect your audio.

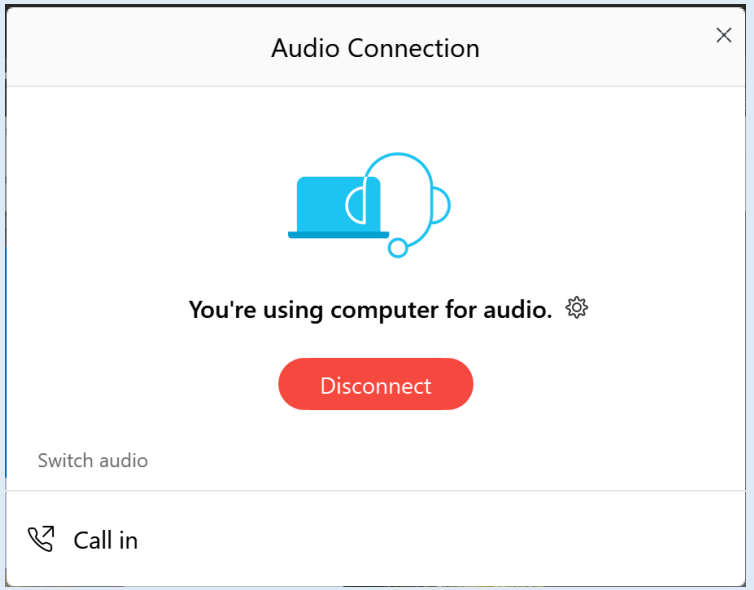
1 → 2 → 3

1 **Move your cursor to the WebEx controls at the bottom of your screen**



2 **Select the ellipses, then "Change audio Connection"**

3 **Select Audio Connection**



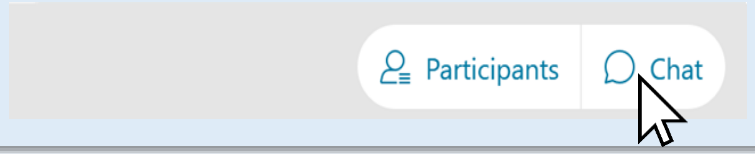
If you select "Call in"

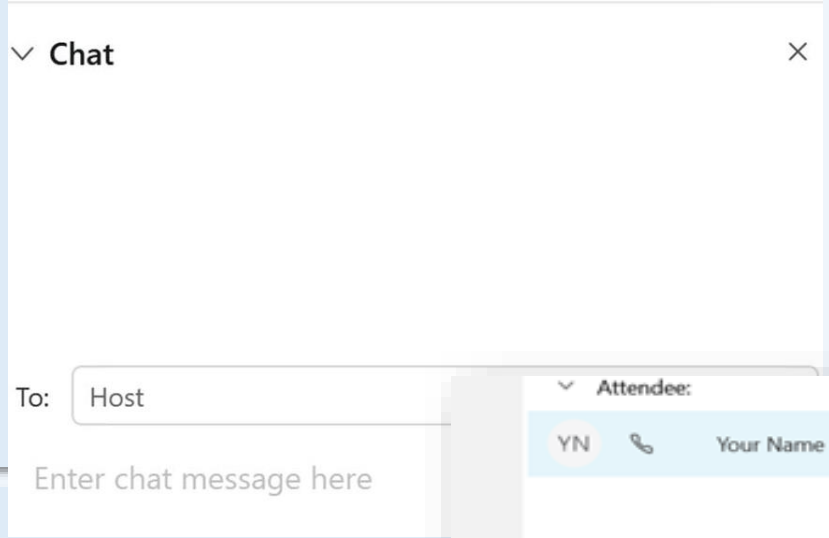
- Call US Toll: +1-415-655-0001 **--OR--**
- Call U.S. Toll (Seattle): +1-206-207-1700
- Enter Webex-generated codes followed by "#"

Still can't hear us? Send the WQ Program host a chat through the chat box.

Using Webex features

You can ask questions via the chat function

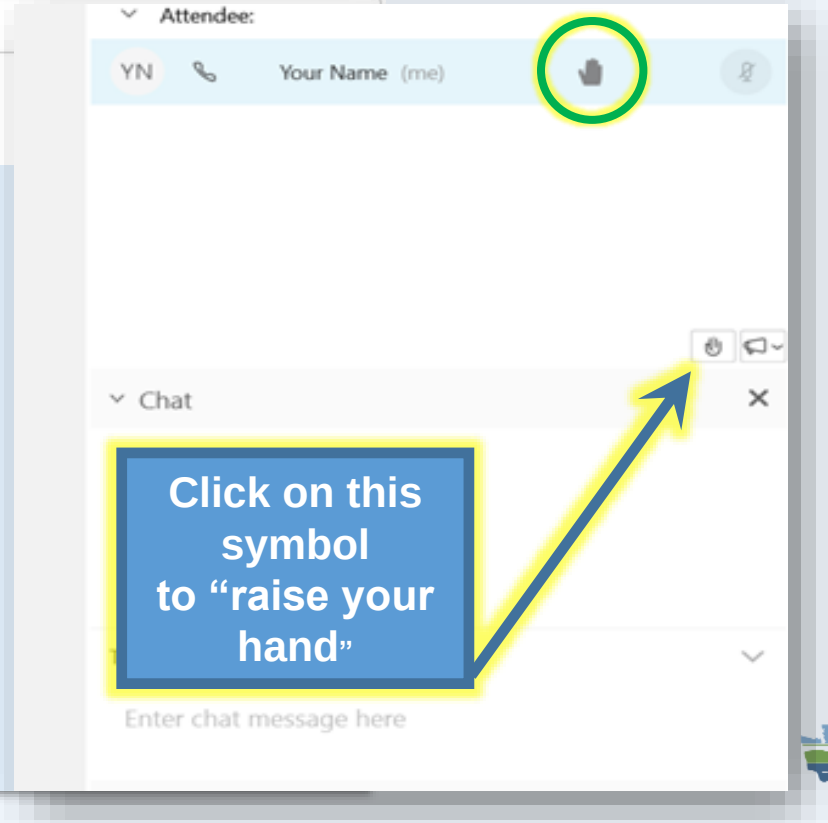




You can also ask questions by raising your hand

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



Salmon Spawning Habitat Protection Rule

Science Advisory Group (SAG)
Meeting #3: Fine Sediment
December 9, 2020

DEPARTMENT OF ECOLOGY
State of Washington

Goals for Today's Meeting

- Make determinations on feasibility, utility, and subjectivity of fine sediment measures
- Receive feedback on Ecology's Watershed Monitoring Program
- Next Steps

Introductions of SAG Members

Name and affiliation of members present

Ecology Standards Staff

Susan Braley

Webinar Facilitator

Susan.Braley@ecy.wa.gov

Bryson Finch

Water Quality Standards Scientist

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Marla Koberstein

WebEx Moderator

Marla.Koberstein@ecy.wa.gov

Chad Brown

Water Quality Management Supervisor

Chad.Brown@ecy.wa.gov

Today's Agenda

- Recap of the last meeting's discussion on fine sediment
- Discuss individual physical, biological, and chemical based parameters used to characterize fine sediment
- Review Ecology's existing data and monitoring methods
- Next steps

Intro: List of Parameters

Parameter	Type of measure
Light penetration Turbidity Total suspended solids	**Water column**
Percent fine sediment (by weight or volume) Geometric mean diameter of sediment Relative bed stability Riffle stability Embeddedness Subsurface sediment in riffles	**Physical streambed**
Channel characteristics	**Physical Channel Characteristics**
Intragravel dissolved oxygen*	**Chemical**
Benthic macroinvertebrate index (BIBI)* Fine sediment biotic index (FSBI)	**Biological**

Water Column Measures

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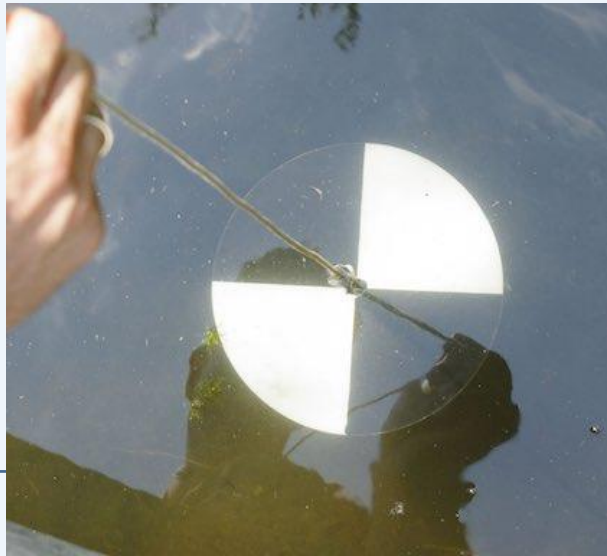
Water Column Measures

Water column measures are defined as a measure of the suspension of materials in the water column resulting in reduced light penetration, changes in behavior, and physiological based effects (typically particles <2 mm)

- Effects
  - Decreased primary and secondary production
  - Decreased growth of fish
  - Benthic invertebrate drift
  - Decreased predatory efficiency
  - Behavioral changes

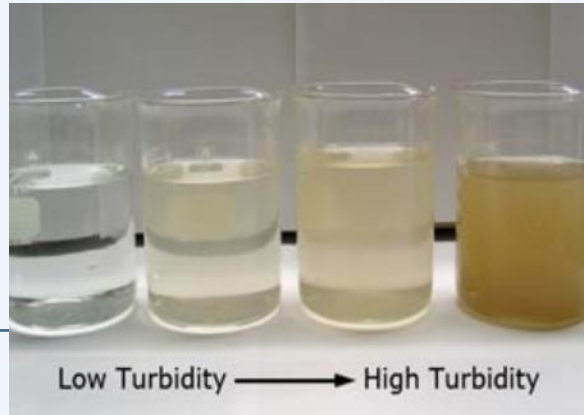
- Selected Measures
  - Light penetration
  - Turbidity
  - Total suspended solids



Water Clarity Recommendations

- Light penetration:
  - Settleable and suspended solids should not reduce the depth of the photic zone by more than 10% from background
  - Method: secchi disk

- Turbidity:
  - Compare turbidity to background conditions
  - Method: turbidimeter (various forms)



Total Suspended Solids

- Total suspended solids
  - Measure of solid material per volume of water
  - Generally captures inorganic material but also organics
  - Particles larger >2 um (<2um = dissolved) and less than 2mm
  - Can be used to calculate sedimentation rates
  - Method: water filtration

$$\text{TSS (mg/L)} = \frac{(A - B)}{V}$$

A = mass of filter + dried residue (mg),
B = mass of filter (tare weight) (mg), and
V = volume of sample filtered (L)

Discussion

Light Penetration Turbidity Total Suspended Solids

- How useful are these parameters in evaluating fine sediment?
- What are disadvantages of using these measures?
- How feasible are these to measure?
- Are these measures redundant?

Streambed Measures

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Streambed Measures

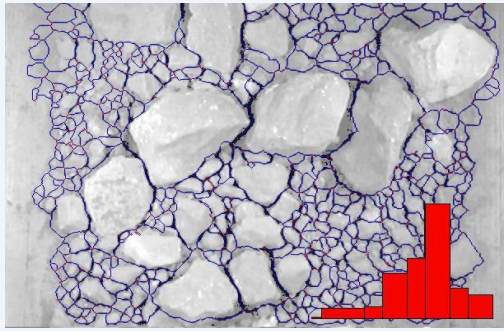
Defined as proportion of fine sediment among substrate

- Parameters of interest:
  - Percent surface fines
  - Embeddedness
  - Geometric mean diameter of substrate
  - Riffle stability
  - Relative bed stability
  - Subsurface sediment

Percent Surface Fines (weight or volume)

Defined as the percentage of streambed area with exposed fine sediments

- Relationship between surface fines and aquatic life effects needs further research
  - Relationships found between fines and EPT taxa
  - Studies suggest 20-30% fines as an effect threshold at <6mm and 10% fines less than 0.85mm for early life stages of fish

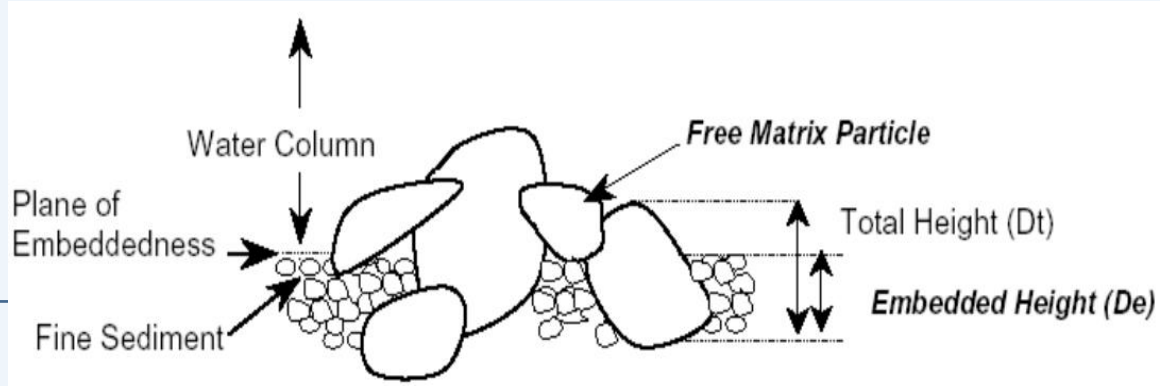


- Percent fines known to be a good metric of spawning habitat
- Some have suggested geometric mean and median particle size are superior measures

Embeddedness

Embeddedness measures the degree to which cobbles and large gravels are buried because of fine sediment deposition

- A high degree of variability can result from embeddedness measures collected with different methods, calculations, or observers
- Embeddedness frequently measured in riffles
- Should include cobble embeddedness and free matrix (unbedded particles)
- Useful for trend information
- Relationships with aquatic life is limited



Geometric Mean Diameter

Defined as the central tendency of a particle size composition of substrate materials

- Data collected can be used to characterize the distribution of substrate size
- Sometimes used as an index of the quality of spawning gravels
- Substrate size related to spawning suitability
- Similar metrics:
  - Fredle index
  - Modified fredle index
  - Arithmetic mean
  - Median particle size

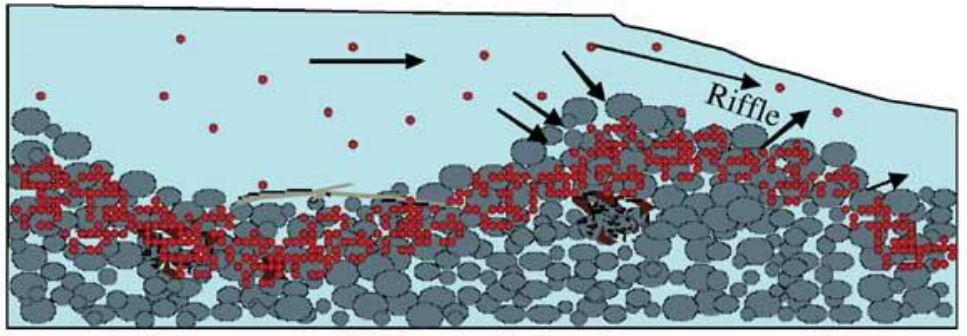
Subsurface Sediment in Riffles

Defined as percentage of core samples composed of fine sediment

- Most applicable in riffles and spawning areas

- Excessive subsurface sediments have detrimental effects on salmonid and invertebrate habitat suitability and redd conditions

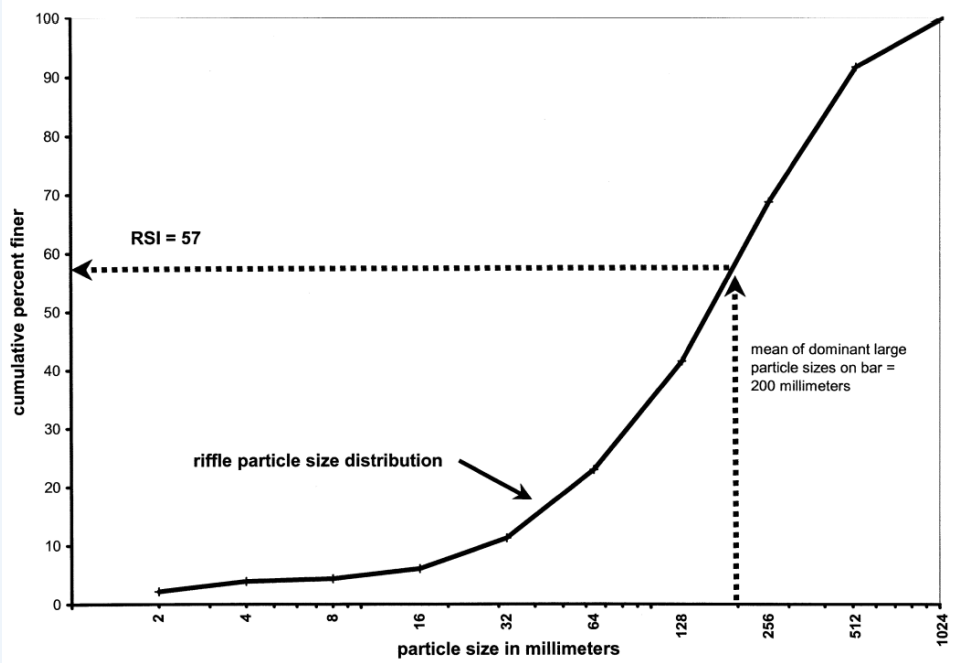
- Several studies have established targets

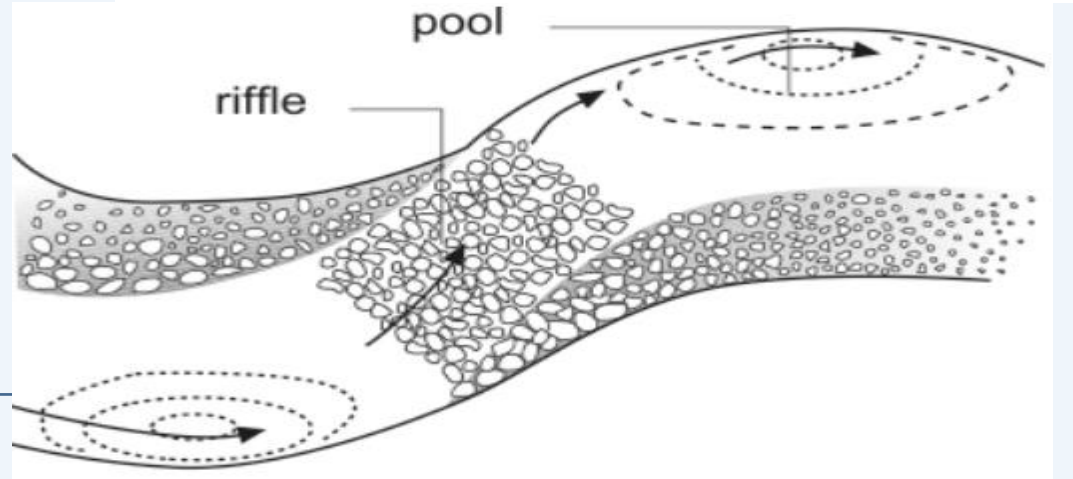


Riffle Stability Index

Defined as the percentage of substrate particles (from a Wolman pebble count) that are smaller than the largest particles that are moved in channel forming flows

- May be a factor in redd scour
- As riffle stability degrades, pool habitat decreases





Relative Bed Stability

A measure of the relationship of the median particle size in a stream reach compared to the critical particle size calculated to be mobilized at bankfull

- Includes reach-wide pebble count and critical particle size (calculated from channel dimensions, flow characteristics, channel roughness factors)

RBS = D50 or DGM /D_CBF
D50 = Substrate median diameter as evaluated by a modified pebble count
DGM = Substrate geometric mean as evaluated by a pebble count
DCBF = The diameter of particles just beginning to move at bankfull
= (0.61RS)/τ*c
R = Bankfull hydraulic radius
S = Bankfull slope

τ*c = Shield's parameter for critical shear stress for incipient motion

Discussion

Streambed Measures

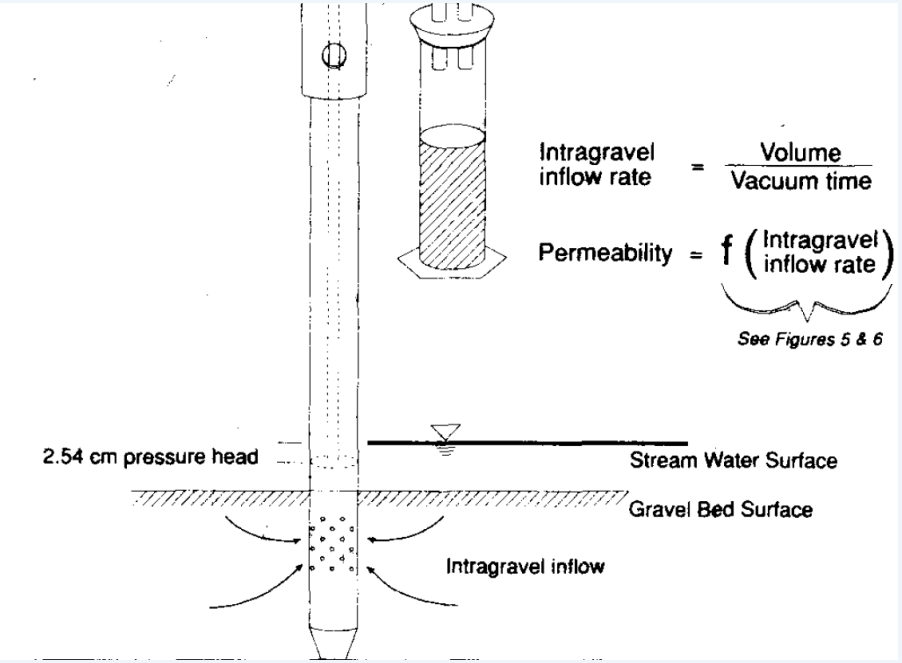
- How useful are these parameters in evaluating fine sediment?
- What are disadvantages of using these measures?
- How feasible are these to measure?
- Are these measures redundant?

Chemical Metrics

Intragravel Dissolved Oxygen

Defined as dissolved oxygen content within substrate

- Measures reduced permeability of fine sediment in the aquatic environment
- Less oxygen exchange to support fish embryos macroinvertebrates
- Impacted by groundwater and hyporheic flow



Discussion

Chemical Measures

- How useful is this parameter in evaluating fine sediment?
- What are disadvantages of using this measure?
- How feasible is it to measure intragravel DO?
- Is this measure duplicative of other measures?

Biological Metrics

Benthic Indexes

Uses the presence/absence of benthic macroinvertebrates to determine stream health

- Fine sediment known to adversely impact benthic macroinvertebrate community structure
- Not specific to particular pollutant
- May be difficult to directly link BIBI to fine sediment without other data

- Examples:
  - Aquatic fine sediment biotic index (Relyea et al. 2012)
  - Benthic index of biotic integrity (B-IBI)
  - Ecology multi-metric index
  - Hilsenhoff biotic tolerance index

Ecology MMI

Wash. State Dept. of Ecology Multi-Metric Index

Score	1	3	5
Taxa Richness	[0, 24)	[24, 33]	(33, ∞)
Ephemeroptera Richness	[0, 4]	(4, 6]	(6, ∞)
Plecoptera Richness	[0, 3)	[3, 5]	(5, ∞)
Trichoptera Richness	[0, 4)	[4, 6]	(6, ∞)
Clinger Percent	[0, 26)	[26, 47]	(47, 100]
Long-Lived Richness	[0, 3)	[3, 5]	(5, ∞)
Intolerant Richness	[0, 2)	[2, 2]	(2, ∞)
Percent Dominant	(70, 100]	[54, 70]	[0, 54)
Predator Percent	[0, 11)	[11, 19]	(19, 100]
Tolerant Percent	(19, 100]	[11, 19]	[0, 11)

Discussion

Biological Measures

- How useful is this parameter in evaluating fine sediment?
- What are disadvantages of using this measure?
- How resource intensive is it to measure Biological Indices?
- Is this measure duplicative of other measures?

Channel Characteristics

Channel Characteristics

- Valuable metrics for evaluating sources of sediment and anthropogenic influences
- Biological effects of channel characteristics are more difficult to quantify
  - Commonly compared to a reference condition

- Parameters of interest:
  - Width/depth ratio
  - Sediment rating curves
  - Bank stability
  - Changes in peak flow
  - Pool depth / frequency
  - Riffle stability index
  - Sinuosity
  - Etc…

BREAK

Ecology Watershed Monitoring Program

DEPARTMENT OF ECOLOGY
State of Washington

Habitat Metric Dictionary

DEPARTMENT OF ECOLOGY
State of Washington

Dictionary of Metrics for Physical Habitat

Definitions and Calculations Used for Watershed Health Monitoring and Related Studies

Table of Contents

- **Method no longer used**
  - Poor signal to noise ratio
- Replaced with 4 new bed observation methods:
  - Angle
  - Position
  - Failure
  - Cover
- Basis of new method:
  - Forest Service/BLM in PIBO

METRIC CATEGORY: **Bank Quality**

Group: Bank instability
Scope: All non-null observations per DCE, entire site reach

Reported: Bank instability ratings, count (i)
Bank instability rating, average (ii)

Definition:
(i) count, of bank instability observations associated with the main channel (channel 0) as observed at the ends of each channel-spanning transect. Unit = observations of instability.

(ii) average, of bank instability observations associated with the main channel (channel 0), as rated at the ends of each channel-spanning transect. Unit = percent.

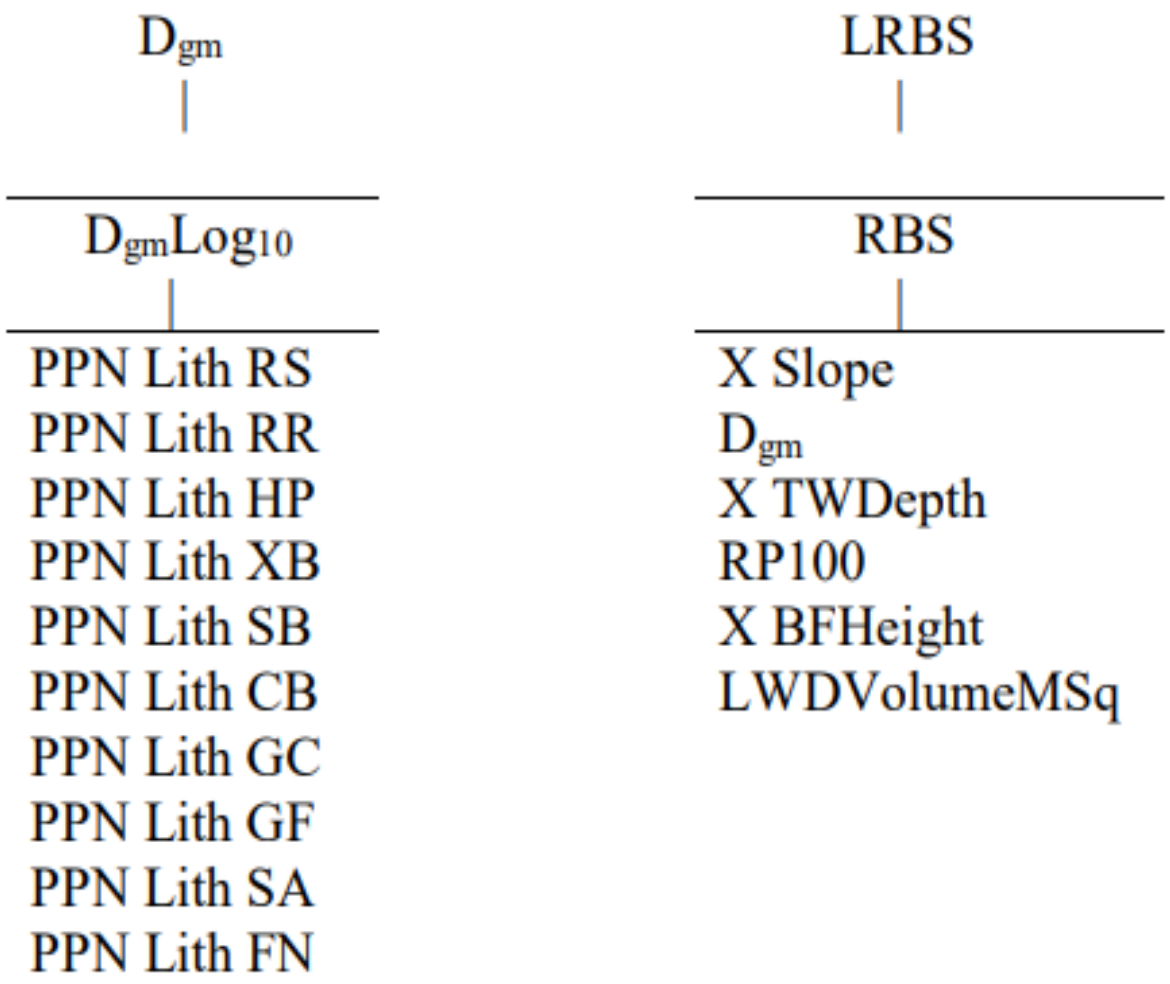
WHM export ID:
(i) N_BankInstab
(ii) X_BankInstab

Observation type: Visual assessment
Allowed observation values: ≥ 0 to ≤ 100
Data collection schema: Plots at ends of 11 evenly-spaced cross-channel transects, transects perpendicular to channel. Site reach length is variable 150 - 2000 m.
Maximum observations (DCE): 22; 1 observation per bank X 11 transects
Minimum reporting qualifiers: Survey at least 77% complete (17 plots rated)
Reporting years (to date): 2009-2017

Calculation:
(i) count(Bank instability observations) <> is.null[1]
(ii) (Σ((Bank instability ratings, left bank and right bank)) / N_BankInstab

Metric Category: Bed Stability

Diagrammatic hierarchical relationship of D_{gm} and LRBS to dependencies which also report from WHMWeb:



Metric Category: Channel Dimensions

Reported	WHM export ID
Channel slope, average	X Slope
Bankfull width,	
count	N BFWidth
average	X BFWidth
std. dev.	SD BFWidth
Wetted width,	
count	N WetWidth
average	X WetWidth
std. dev.	SD WetWidth
Length of site reach, distance	Site Length
Thalweg increment, distance	TWIncrement
Thalweg depth,	
count	N TWDepth
average	X TWDepth
std.dev.	SD TWDepth
Bankfull height,	
count	N BFHeight
average	X BFHeight
std. dev.	SD BFHeight
Bankfull depth,	
count	N BFDepth
average	X BFDepth
std. dev.	SD BFDepth
Wetted cross section,	
count	N Wet WxD
average	X Wet WxD
std. dev.	SD Wet WxD
Bankfull cross section,	
count	N BF WxD
average	X BF WxD
std. dev.	SD BF WxD

Metric Category: Substrate

Reported	WHM export ID
Entire reach	
Embeddedness, count	N_Embed
Embeddedness, average	X_Embed
Embeddedness, std. dev.	SD_Embed
Mid-channel	
Embeddedness, mid-channel, count	N_EmbedCenter
Embeddedness, mid-channel, average	X_EmbedCenter
Embeddedness, mid-channel, std. dev.	SD_EmbedCenter
Number of all substrates observed, count	N_Substrate
Percent substrate, each diameter category	
Smooth bedrock	PCT_BedrockS
Rough bedrock	PCT_BedrockR
Pavement (i.e., concrete)	PCT_Pavement
Large boulders	PCT_BoulderL
Small boulders	PCT_BoulderS
Cobble	PCT_Cobble
Coarse gravel	PCT_GravelC
Fine gravel	PCT_GravelF
Sand	PCT_Sand
Fines	PCT_Fines
Hardpan	PCT_Hardpan
Wood	PCT_Wood
Other	PCT_Other
Percent substrate, diameter categories combined	
Bedrock, Smooth or rough	PCT_Bedrock
Coarse gravel and larger	PCT_GravelCx
Fine gravel and smaller	PCT_GravelFb
Sands and fines	PCT_SandFines
Boulder, large and small	PCT_Boulder

Metric Category: Riparian Disturbance

Reported	WHM export ID
Human influence plots, count	N_HumanInfluence
Proximity weighted presence, each disturbance type	
Buildings	PWP_Bldg
Landfills or trash	PWP_Trash
Logging	PWP_Log
Mining	PWP_Mine
Park or lawn	PWP_Lawn
Pasture, rangeland, or hayfield	PWP_Range
Paved road or railroad	PWP_Pave
Unpaved road or motor trail	PWP_Unpav
Human foot path	PWP_Path
Clearing or lot	PWP_Clear
Pipes, in or out	PWP_Pipe
Row crops	PWP_Crop
Wall, dike, or revetment	PWP_Dike
Proximity weighted presence, combined human influence types	
All	PWP_All
Agricultural	PWP_Ag
Percent disturbance, by proximity to channel	
At bank, all human-influence types	PCT_BankAny
At bank, agricultural human-influence types	PCT_BankAg
Close to bank, all human influence types	PCT_CloseAny
Close to bank, all human influence types	PCT_CloseAg

METRIC CATEGORY: **Sinuosity**

Group: Sinuosity
Scope: All non-null observations per DCE, entire site reach

Reported: Sinuosity of site reach, index (i)

Definition: (i) index, of deviation from the straight-line, point-to-point distance between the upper and lower ends of the site reach, as the ratio of shortest direct point-to-point aerial transit path to overall length of sinuous watercourse as estimated by the sum of site-level reach sub-segment lengths. Unit = dimensionless.

Reported for protocol = narrow only.

WHM export ID:	(i) Sinuosity
Observation type:	Derived from bearing readings
Allowed values:	≥ 1
Data collection schema:	Observations parallel to thalweg of the site reach sufficient to characterize reach. Site reach length is variable, 150 - 2000 m.
Maximum observations (DCE),	
narrow protocol:	30
wide protocol:	not reported
Minimum reporting qualifiers,	
narrow protocol:	20
wide protocol:	not reported
Reporting years (to date):	2009-2017

Calculation:

Field Methods

SOP #	Method	SOP #	Method
EAP070	Hygiene *vs* invasive species	EAP115	Densiometer
EAP073	**Benthic invertebrates (kick net)**	EAP116	Fish cover
EAP095	Water samples	EAP117	Riparian vegetation
EAP105	Site layout, slope & bearings	EAP118	Riparian disturbance
EAP106	Site layout	**EAP119**	**Thalweg profile**
EAP107	Coordinates	EAP120	Habitat units
EAP108	In situ water quality	**EAP121**	**Large woody debris**
EAP109	Discharge	**EAP122**	**Slope**
EAP110	Sediment metals	EAP123	Compass bearings
EAP111	Periphyton	EAP124	Vertebrates (backpack fisher)
EAP112	Bank erosion	Request	Electronic forms management
EAP113	Channel dimensions	n/a	Chemistry sample management
EAP114	**Substrate at major transects**		

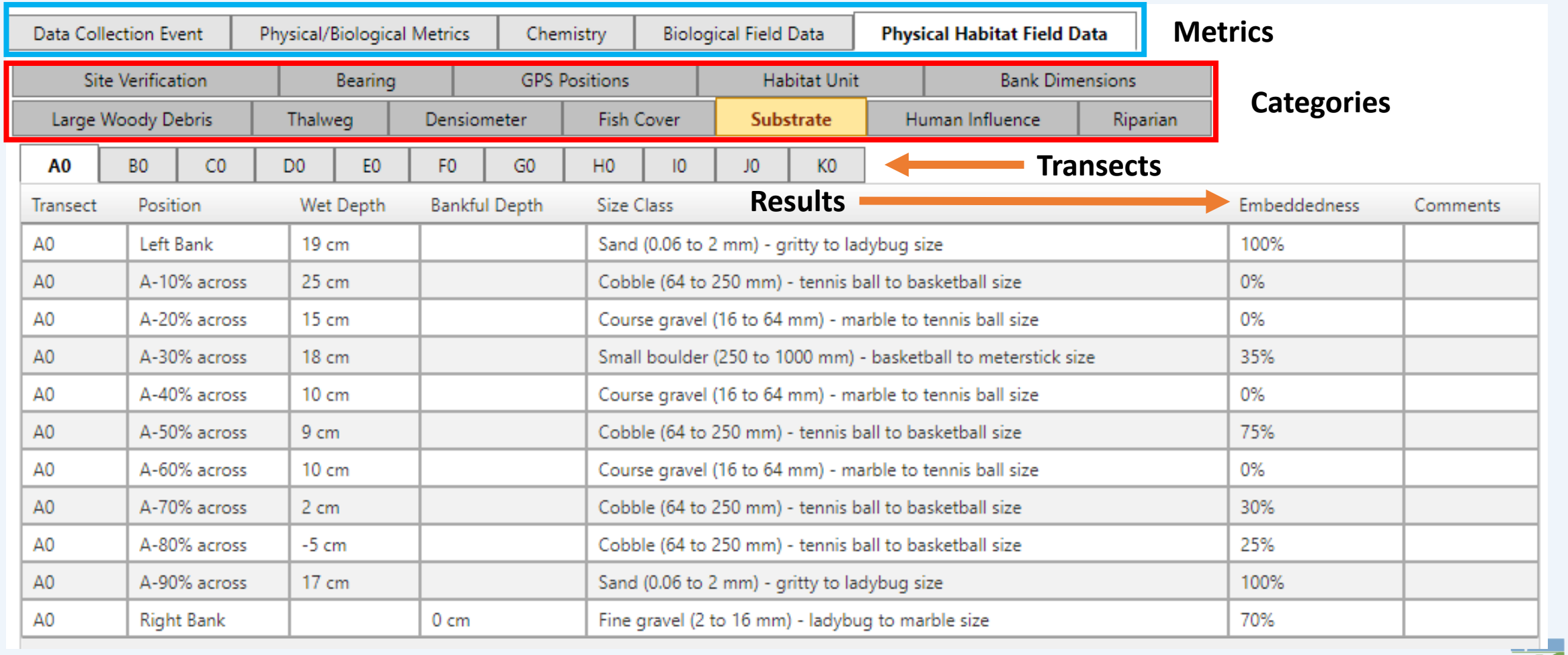
https://fortress.wa.gov/ecy/publications/UIPages/PublicationList.aspx?IndexTypeName=Topic&NameValue=Standard+Operating+Procedure+(SOP)+%e2%80%94+Watershed+Health+Monitoring&DocumentTypeName=Publication

Diagnosis or “Causal Analysis”

Ecology invertebrate data, reported in PSSB https://pugetsoundstreambenthos.org/

Row	Site Code, Location	Year, Project	Scores		
			Fine Sediment Sensitivity Index	Hilsenhoff Biotic Tolerance Index	Metals Tolerance Index
1	SEN06600-HAMM03, Hamma Hamma River	2019, Status and Trends WA Statewide Sentinel Site Monitoring	85	2.3	1.3
2	SEN06600-LITT06, Little Pend Oreille River	2019, Status and Trends WA Statewide Sentinel Site Monitoring	110	3.0	1.8
3	SEN06600-GRIF09, Griffin Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	135	3.3	2.0
4	SEN06600-TWIN02, Twin Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	160	3.9	2.5
5	SEN06600-ELLS01, Ellsworth Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	85	5.5	0.6
6	SEN06600-LAUG07, Laughing Water Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	160	3.1	0.7
7	SEN06600-TRAP08, Trapper Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	180	3.9	1.8
8	SEN06600-UMTA18, Umtanum Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	55	5.6	3.1
9	SEN06600-TWEN05, Twentyfive Mile Creek (Chelan)	2019, Status and Trends WA Statewide Sentinel Site Monitoring	180	4.8	0.4
10	SEN06600-ASOT13, Asotin Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	180	4.1	2.2
11	SEN06600-CUMM10, Cummings Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	140	4.4	2.3
12	SEN06600-DEAD19, Deadman Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	115	2.5	1.2
13	SEN06600-MARB21, Marble Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	150	3.8	0.9
14	SEN06600-POOR22, Poorman Creek	2019, Status and Trends WA Statewide Sentinel Site Monitoring	110	3.4	0.8
15	SEN06600-SULL20, Sullivan Creek, North Fork	2019, Status and Trends WA Statewide Sentinel Site Monitoring	130	3.1	0.6
16	SEN06600-TEAN04, Teanaway River, Middle Fork	2019, Status and Trends WA Statewide Sentinel Site Monitoring	170	4.1	0.8

Example



Transect	Position	Wet Depth	Bankful Depth	Size Class	Embeddedness	Comments
A0	Left Bank	19 cm		Sand (0.06 to 2 mm) - gritty to ladybug size	100%	
A0	A-10% across	25 cm		Cobble (64 to 250 mm) - tennis ball to basketball size	0%	
A0	A-20% across	15 cm		Course gravel (16 to 64 mm) - marble to tennis ball size	0%	
A0	A-30% across	18 cm		Small boulder (250 to 1000 mm) - basketball to meterstick size	35%	
A0	A-40% across	10 cm		Course gravel (16 to 64 mm) - marble to tennis ball size	0%	
A0	A-50% across	9 cm		Cobble (64 to 250 mm) - tennis ball to basketball size	75%	
A0	A-60% across	10 cm		Course gravel (16 to 64 mm) - marble to tennis ball size	0%	
A0	A-70% across	2 cm		Cobble (64 to 250 mm) - tennis ball to basketball size	30%	
A0	A-80% across	-5 cm		Cobble (64 to 250 mm) - tennis ball to basketball size	25%	
A0	A-90% across	17 cm		Sand (0.06 to 2 mm) - gritty to ladybug size	100%	
A0	Right Bank		0 cm	Fine gravel (2 to 16 mm) - ladybug to marble size	70%	

Example

Display of Raw Data for DCE -> BIO06600-CHRI01-DCE-2011-0712-10:48

Data Collection Event | **Physical/Biological Metrics** | Chemistry | Biological Field Data | Physical Habitat Field Data

Metrics

Physical | Biological ← **Categories**

Study ID	Site ID	Data Collection Start Date	Metric Category	Metric Subcategory ▲	Metric Name	Result Value	Method
WHM_BIO	BIO06600-CHRI01	July 12, 2011	BankQuality	BankInstability	N BankInstab	22 count	WHM_N_BankInstab
WHM_BIO	BIO06600-CHRI01	July 12, 2011	BankQuality	BankInstability	X BankInstab	41.136 %	WHM_X_BankInstab
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	N BF WxD	10 count	WHM_N_BF_WxD
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	N BFDepth	10 count	WHM_N_BFDepth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	N Wet WxD	20 count	WHM_N_Wet_WxD
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	SD BF WxD	3.321 m2	WHM_SD_BF_WxD
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	SD BFDepth	31.427 cm	WHM_SD_BFDepth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	SD Wet WxD	2.83 m2	WHM_SD_Wet_WxD
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	X BF WxD	12.758 m2	WHM_X_BF_WxD
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelCrossSection	X Wet WxD	4.654 m2	WHM_X_Wet_WxD
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	N BFHeight	11 count	WHM_N_BFHeight
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	N TWDepth	100 count	WHM_N_TWDepth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	SD BFHeight	9.901 cm	WHM_SD_BFHeight
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	SD TWDepth	36.925 cm	WHM_SD_TWDepth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	X BFDepth	80.5 cm	WHM_X_BFDepth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	X BFHeight	37.455 cm	WHM_X_BFHeight
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelDepth	X TWDepth	45.75 cm	WHM_X_TWDepth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelWidth	N BFWidth	21 count	WHM_N_BFWidth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelWidth	N WetWidth	21 count	WHM_N_WetWidth
WHM_BIO	BIO06600-CHRI01	July 12, 2011	ChannelDimensions	ChannelWidth	SD BFWidth	2.744 m	WHM_SD_BFWidth

Conclusion: Fine Sediment

- Multifaceted approach to characterizing fine sediment impairment is most appropriate
- Monitoring should capture both the physical and biological health of a stream
- Lines of evidence approach may be necessary to characterizing an impairment because a single indicator may not substantiate a fine sediment impairment
- Ecology's Watershed Health Monitoring Program and protocols may be refined to characterize fine sediment

Final Thoughts?

Dissolved Oxygen

- Seasonal criteria approach to DO
- Capturing the diurnal fluctuation in DO

Others?

Next Steps

- Ecology staff will use information/suggestions/feedback gained from SAG meetings to develop preliminary rule language

- Future science advisory group meeting
  - Tentatively February– future doodle poll
  - Voice your thoughts on preliminary rule language

- Public webinar to share preliminary rule language in Spring 2021

Thank you for your participation!