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# Measuring Bed Gradation



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# What is Bed Gradation?

Bed Gradation is a measure of how fine or coarse the stream bed is.



Source: 123rf.com



Source: King County



Source: Activerain.com



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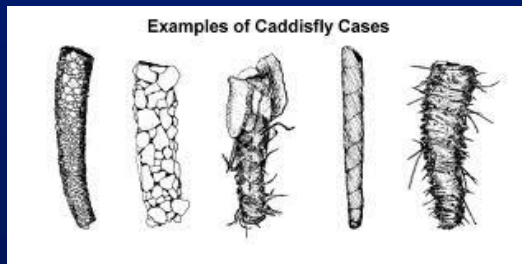
# Bed Gradation

Why is bed gradation important?

1. Different animals (and plants) need certain substrate for part (or all) of their life:
  - Trout – gravel to spawn on
  - Benthic invertebrates



Gravel



Silt



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# Bed Gradation

Why is bed gradation important?

## 2. Bed roughness

- Energy is lost as the water rubs on the bed. If you need to calculate the flow or velocity of your stream, you will need to know how rough the bed is.

## 3. Stream Classification (Rosgen classification)

C1 – Bedrock bed

C2 – Boulder bed

C3 – Cobble bed

C4 – Gravel bed

C5 – Sand bed

C6 – Silt/Clay bed



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# Particle Size Classes

Boulder	> 300 mm (~12 inches)
Cobbles	64 mm (~2 ½ inches) to 300 mm
Gravel	2 mm (~thickness of penny) to 64 mm
Sand	0.062 mm to 2 mm (Feels gritty)
Fines (silt/clay)	< 0.062 mm (Feels smooth)

Size ranges may vary depending on discipline



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# How to Measure Bed Gradation?

1. Pick up every rock across the river and measure its size (very time consuming!!)
2. Randomly select enough particles to obtain a representative sample



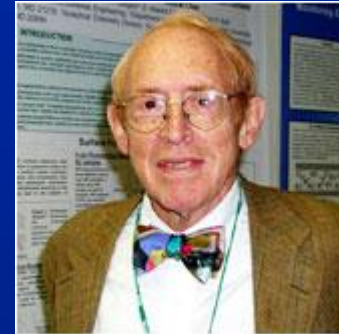
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# How to Measure Bed Gradation?

## Wolman Pebble Count

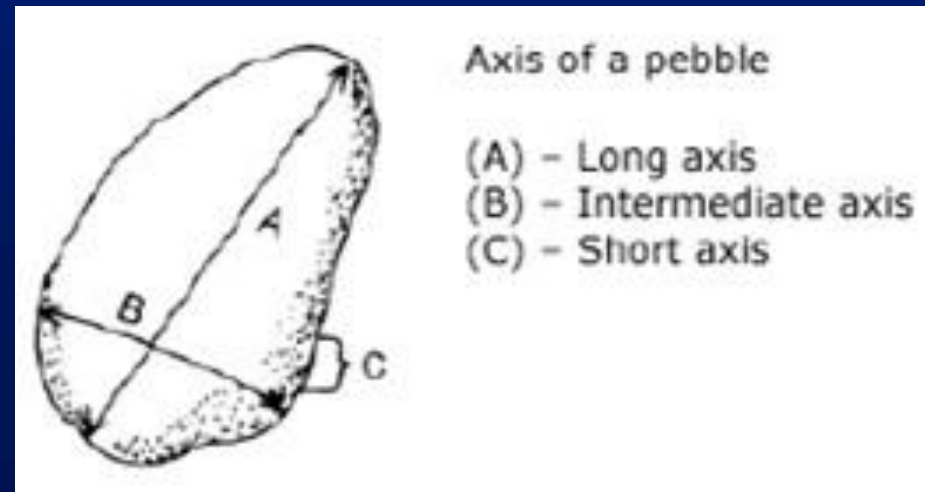
1. Start at one edge of the bank  
(doesn't matter which side)



Source: USACE-IWR

2. Reach down with a single finger and pick up the first  
particle you touch (no peaking). – Everyone try it!

3. Measure the length of the intermediate axis with a  
ruler (usually in mm)





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# How to Measure Bed Gradation?

## Wolman Pebble Count

4. Take one step and repeat until you have 100 or more samples.
  - Cross the river as many times as necessary to get at least 100 particles.
  - Do not stop in the middle of the stream once you reach 100 particles. You must complete your transit across the stream making measurements at the same rate.





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# Ruler vs. Sieve vs. Gravelometer

## 1. Sieve Analysis

- Sample size depends on largest diameter in sample.
- For gravel-bed streams, you may need to collect a hundred pounds of sample (or more)!
- Samples need to be sent to a lab and will cost ~\$100 per sample
- A stack of sieves is shaken and particles are sorted by size. Each sieve is then weighed. Results are in **MASS for each size class.**





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# Ruler vs. Sieve vs. Gravelometer

## 2. Gravelometer

- Particles are individually inserted into gravelometer
- The opening that retains the particle is recorded.
- Particles may pass through diagonally
- Results are in **number of particles** in each size class
- Faster than ruler method but limits you to the size classes on the gravelometer
- Can be done with one person (not recommended for safety reasons)



Source: Carnet Technology



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# Ruler vs. Sieve vs. Gravelometer

## 3. Ruler

- Intermediate axis is measured with a ruler
- Results are in number of particles in each size class
- Simplest method and gives the most accurate results
- Cheapest methods
- Best done with two people



Source: West Virginia DEP



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# Ruler vs. Sieve vs. Gravelometer

## Important!

- You cannot compare results from a gravelometer with those from a ruler or sieve analysis.
- You must use the same method each year when doing a pebble count.
- I recommend the ruler method.

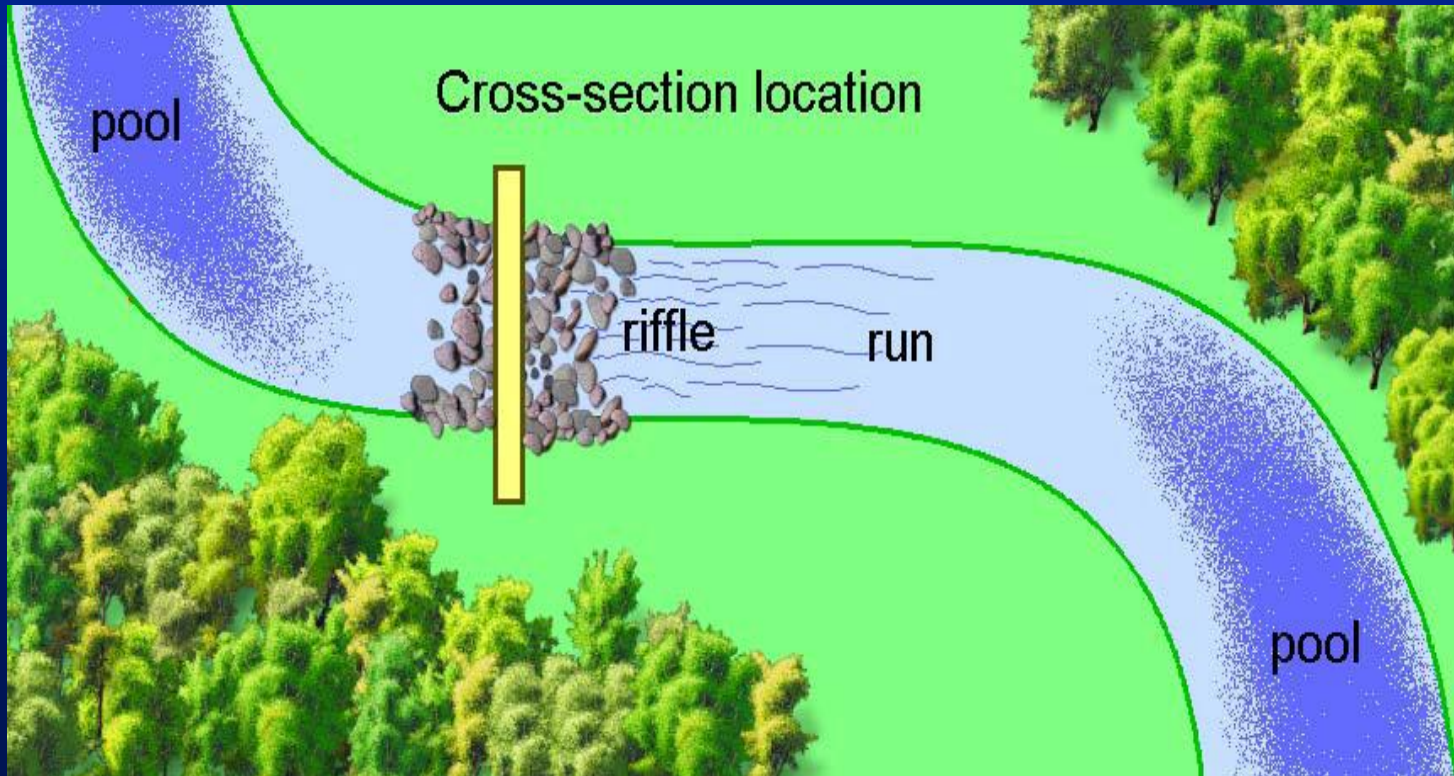


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# Where to Measure Bed Gradation

Riffle – this is the first place that excess sediment (usually sand) will show up, BUT.....





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# Where to Measure Bed Gradation

Riffle – this is the first place that excess sediment (usually sand) will show up. But...it is occasionally difficult to find good riffles to monitor (AuSable runs, Manistee habitat structure, et c.). Issues with bedrock streams.

Think about what you are trying to monitor and develop a custom monitoring program that is best suited for your stream. We can help you with this.



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# Data Sheet

	Millimeters	Longitudinal (100 total at 10 transects)				Riffle (100 minimum)			
		Count	Total #	Item %	% Cum.	Count	Total #	Item %	% Cum.
Silt/Clay	< .062								
	.062 - .125								
Sand	.126 - .25								
	.26 - .50								
	.51 - 1.0								
	1.1 - 2.0								
	2.1 - 4.0								
Gravel	4.1 - 5.7								
	5.8 - 8.0								
	8.1 - 11.3								
	11.4 - 16.0								
	16.1 - 22.6								
	22.7 - 32								
	33 - 45								
Cobble	46 - 64								
	65 - 90								
	91 - 128								
	129 - 180								
Boulder	181 - 256								
	257 - 362								
	363 - 512								
	213 - 1024								
	1024 - 2048								
	Bedrock								

Site: \_\_\_\_\_

Staff: \_\_\_\_\_

Reach: \_\_\_\_\_

Date: \_\_\_\_\_

**Pebble Count**

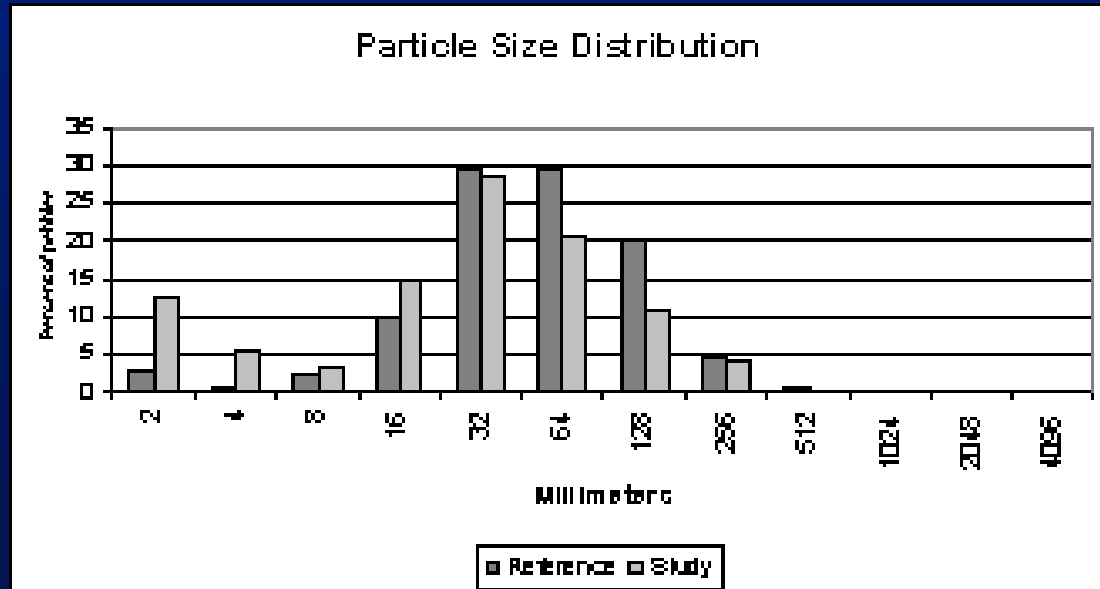
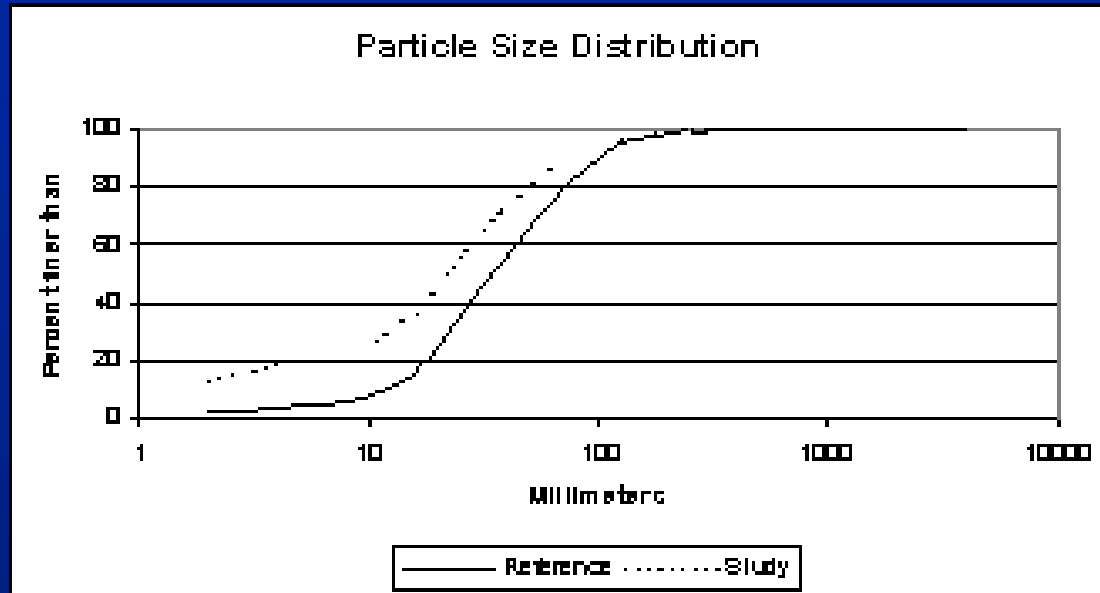
*Reference Reach Field Form*



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# Graphing Pebble Count Results



Source: U S Forest Service

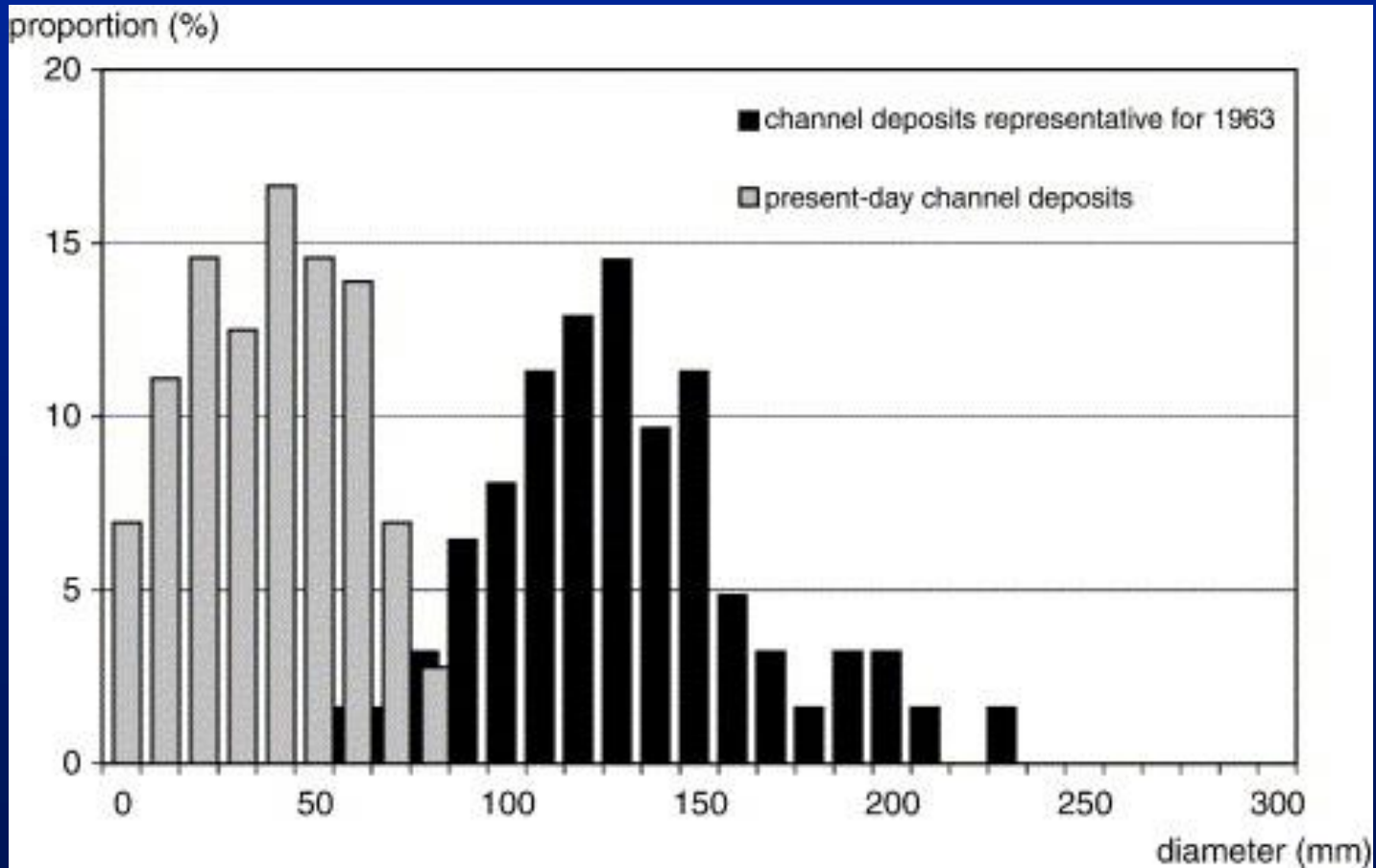




# Graphing Pebble Count Results

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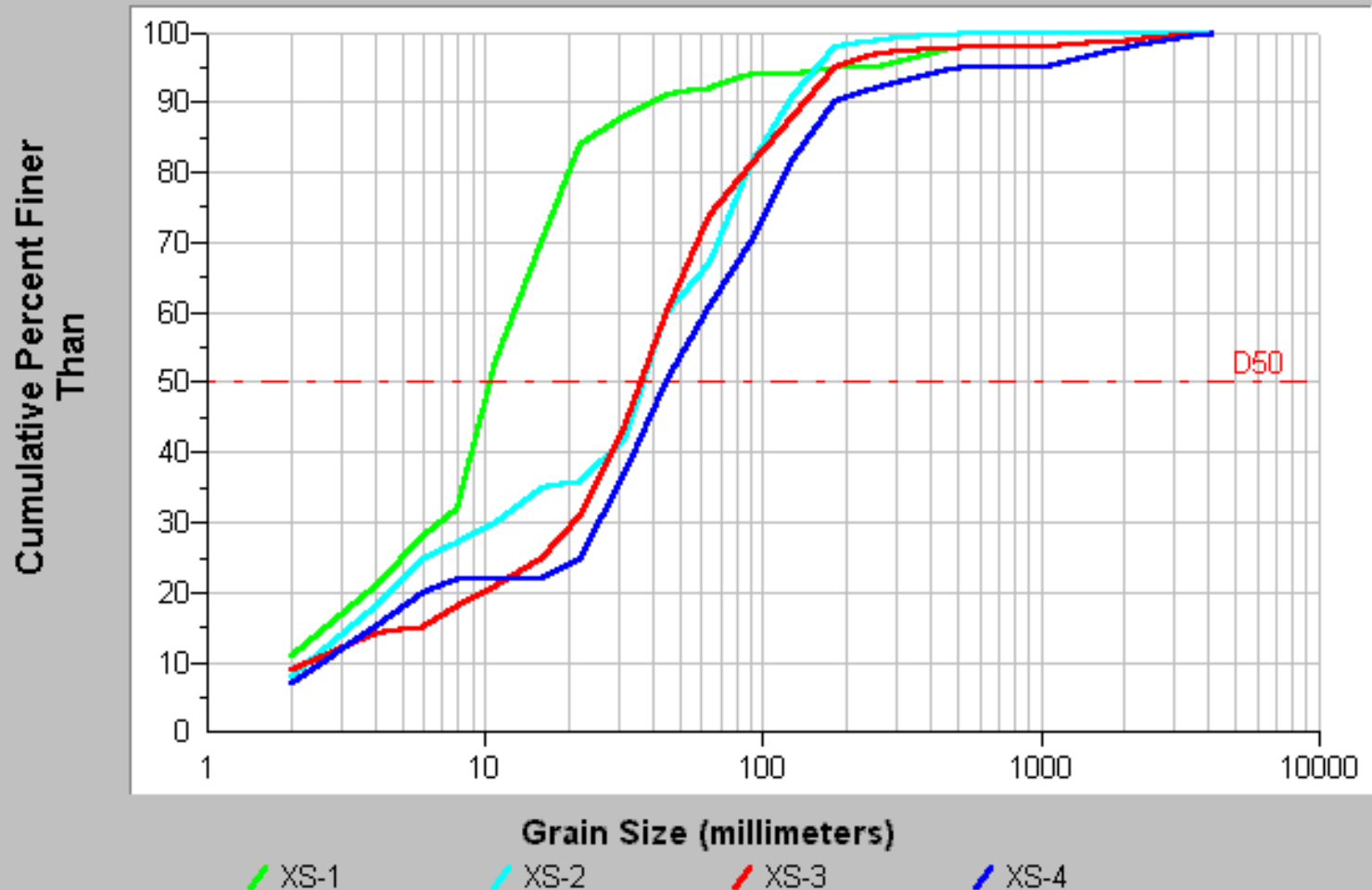
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# Graphing Pebble Count Results

- Variance at X-Sec
- Variation over time

## Pebble Counts Upper Greenwood Creek 2001





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# Frequency of Data Collection

- Riffle should be revisited each year. Ideally this would occur around the same time each year, but if the timing has to slip, data should still be usable.
- A minimum of three (3) pebble counts should be performed each year at the riffle. They should be performed by different people for each pebble count. No one should do more than one pebble count. More than three pebble counts can be performed if you have more than three people in your field crew.
- For example, if you have 5 people in your field crew, at least three of them should do a pebble count. All 5 can do a pebble count if you have time (more data the better!).



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# After the Pebble Count

Questions??



Source: Wastetimepost.com