APPENDIX B
SEDIMENT TRANSPORT AND MOBILITY ANALYSIS METHODS AND RESULTS

B.1 SEDIMENT DATA COLLECTION AND ANALYSIS

The sediment mobility and transport capacity in the main channel of the Tucannon River was calculated using the results of the HEC-RAS one-dimensional (1-D) hydraulic model and applicable sediment mobility and transport formula. These results were then compared to sediment grain size distributions from samples to evaluate erosional and depositional trends at locations along the Tucannon River.

B.1.1 Sediment Grain Size Sampling

Sampling of the bedload channel sediment within the main channel was conducted on gravel bars throughout 55 miles of the mainstem channel during August of 2010. The average discharge at the Starbuck gage during sampling was 49 cubic feet per second (cfs). This low-flow condition exposed sediment deposits transported by recent sediment mobilizing discharges; this material is assumed to be representative of the bedload. Bulk sediment samples and Wolman pebble counts (Wolman 1954) were taken at 23 locations distributed along 55 miles of river to capture potential changes in sediment grain size distribution. Two of the 23 samples were taken in major tributaries (Pataha and Panjab Creeks) upstream of their confluence with the Tucannon River, as well as an additional sample of bank sediment from Pataha Creek. Wolman pebble counts were used to define the surface armor grain size distribution, while bulk sediment samples were used to define the subsurface (sub-armor) grain size distribution. Details regarding the sediment grain size distribution for each sample are provided in the sediment grain size distribution reports at the end of this appendix as Attachment B-1. These reports also contain additional sample site notes and information.

B.1.2 Threshold Sediment Grain Size

The threshold (or critical) sediment grain size is the grain size that is just mobile under given hydraulic forces. This analysis used the dimensionless critical shear stress concept (Shields 1936) to define the mobility threshold for sediment grains exposed to the force of flowing water. The approach uses the following relationship between critical grain size (D_c) and critical dimensionless shear stress (τ^*_c):

$$\tau^*_c = \frac{\tau}{(\rho_s - \rho) g D_c} \qquad \text{(B-1)}$$

where:

τ = bed shear stress

ρ_s = sediment grain density

ρ = water density

For this evaluation, a critical dimensionless shear stress (τ^*_c) of 0.050 was used. This value is valid for critical grain sizes in the cobble size range (Fischenisch 2001).

B.1.3 Relative Mobility (Transport Stage)

The relative mobility of a given sediment grain size can be quantified using the dimensionless form of shear stress, Equation B-1, to determine the transport stage (Φ), Equation B-2.

$$\emptyset = \tau^* / \tau^*_c \qquad \text{(B-2)}$$

where:

τ^* = dimensionless shear stress of a given grain size for a known shear stress

τ^*_c = dimensionless critical shear stress

Transport stage values less than 1.0 indicate an immobile grain size, whereas values greater than 1.0 indicate a mobile grain size. As the transport stage increases beyond a value of 1.0, the expected transport rate increases exponentially.

B.1.4 Sediment Mass Transport Capacity

The sediment mass transport capacity in the river was analyzed for the modeled flow events using representative grain sizes that are present in the bedload material. Four sediment transport models were used in this analysis: 1) Wilcock and Crowe (2003); 2) Wilcock (2001); 3) Meyer-Peter and Müller (1948, as modified by Wong and Parker 2006); and 4) Cui (2007). See the documents cited in the Reference section for a presentation and explanation of each sediment transport model. These models are most appropriate for systems with coarse sediments with median grain sizes larger than 2 millimeters (mm) (0.08 inches) (fine gravel).

The sediment transport models were used to calculate the spatial distribution of dimensionless transport rate (W^*) in the river during the modeled flow events. This information was used to calculate the sediment mass transport rate (Q_b) as follows in Equation B-3:

$$Q_b = \frac{W^* B u^{*3} \rho_s}{(s-1)g} \quad \text{(B-3)}$$

where:

W^*	=	dimensionless transport rate
B	=	transport width
u^*	=	shear velocity ($u^* = \sqrt{\tau/\rho_w}$)
τ	=	shear stress
ρ_w	=	fluid density
ρ_s	=	sediment grain density
s	=	sediment specific gravity
g	=	gravitational acceleration

B.1.5 Results

The results of the sediment mobility and transport analysis are presented in sets of plots organized by return period (*Figures B-1 through B-4 at the end of Appendix B*). Four plots in each figure cover the length of the model and show the following:

- The threshold (critical) sediment grain size at each model cross-section for the high and low discharges (Q) with error bars for a reasonable range in the critical dimensionless shear stress ($0.045 \leq \tau^*_c \leq 0.055$)
- The armor and sub-armor D_{50} (mm) at the sample locations (Pataha and Panjab Creek samples are labeled)
- The channel relative confinement, shown as a multi-colored bar near the top of the plot
- The locations of depositional areas as identified by the sediment mobility analysis and professional judgment
- The locations of the major tributaries used as flow change locations in the model
- The delineated reaches as defined in the main body of the report

Depositional Area Indicators

Areas that are likely to be depositional at a particular discharge may show any combination of the following:

- A critical grain size smaller than a nearby sediment sample grain size
- Visual evidence of gravel deposits in aerial photography or from site visits
- A sediment supply rate from upstream greater than the local transport capacity

Erosional Area Indicators

Areas that are likely to be erosional at a particular discharge may show any combination of the following:

- A critical grain size larger than a nearby sediment sample grain size
- Visual evidence of a plain bed channel with limited bed forms and steep banks
- A sediment supply rate from upstream less than the local transport capacity

Sediment Transport Rating Curves

Several sediment transport rating curves were developed for two locations on the Tucannon River: one just upstream of the Marengo discharge gage at RM 27.2 and the other near the Starbuck discharge gage at RM 8.1. These rating curves were developed using the methods described in Section B.1.4 - Sediment Mass Transport Capacity. The curves provide the unit mass transport capacity in the main channel for sediments with median grain sizes of 32, 48, 64, and 70 mm over a discharge range from 400 cfs to 5,000 cfs (approximately the 10-year return period peak discharge). For discharges larger than 5,000 cfs, backwater influences and extensive floodplain interaction disrupt the rating curve trend. Evaluation of transport capacity for events greater than the 10-year return period requires additional considerations. These rating curves are used in the sediment budget analysis (Appendix C) to determine annual sediment transport capacity.

B.1.6 Evaluation Summary

On the basin scale, the results of the analysis indicate:

- For a 1-year return period, the river is a mix of erosion and depositional areas.
- For a 2-year return period, the river is transitioning to mostly erosional, although

many depositional areas may remain.

- For a 5-year return period, the river is mostly erosional, although some depositional areas may remain.
- For a 10-year return period, the river is almost entirely erosional, although some small depositional areas may remain.

For events greater than the 10-year return period, the results indicate that the river is essentially entirely erosional during the peak discharge. However, at these large flood events, overbank flow and floodplain sediment deposition is likely.

In general, if the system is not entirely supply-limited, sediment will selectively deposit during the falling limb of event hydrographs in locations that tend to produce lower shear stresses than locations immediately upstream.

Potential Erosional Area Drivers

In general, the areas that tend to be erosional in the system have one or more of the following characteristics:

- Channel confinement relative to upstream sections. Confinement is natural in some locations but is most often the result of levees, roads, or bridge abutments. As the channel is confined, the depth for a given flow increases, resulting in greater hydraulic energy and erosional forces (i.e., shear stress).
- A local increase in channel slope over a distance sufficient to increase the flow velocity and decrease the flow depth. Overall variation in channel slope is gradual as the riverbed follows a concave down profile from the headwaters to the mouth. However, some increases in slope are sufficient to create local erosional areas.
- A change in discharge disproportionate to the change in channel cross-sectional area. However, these increases in discharge are often associated with tributaries that may also provide an increase in sediment supply, thus reducing the potential for net erosion.

Potential Depositional Area Drivers

In general, the areas that tend to be depositional in the system have one or more of the following characteristics:

- A wide accessible floodplain that limits channel confinement relative to upstream sections. Floodplain accessibility and the presence of side channels reduce the hydraulic forces in the main channel by dissipating hydraulic energy in the floodplain and reducing the discharge in the main channel.
- A local decrease in channel slope over a distance sufficient to decrease the flow velocity and increase the flow depth. Overall variation in channel slope is gradual as the riverbed follows a concave down profile from the headwaters to the mouth. However, some decreases in slope are sufficient to create local depositional areas (i.e., near the confluence with the Snake River).
- A backwater from a downstream channel constriction. Some locations upstream of major channel constrictions become backwatered as flow depth increases to pass through the constriction. These depositional areas may also limit the supply of sediment through the constricted channel section, thus increasing the likelihood of erosion through the constriction.
- A change in sediment supply disproportionate to the change in sediment transport capacity. These increases in sediment supply are associated with tributaries and other hill slope sediment sources.

B.2 REFERENCES

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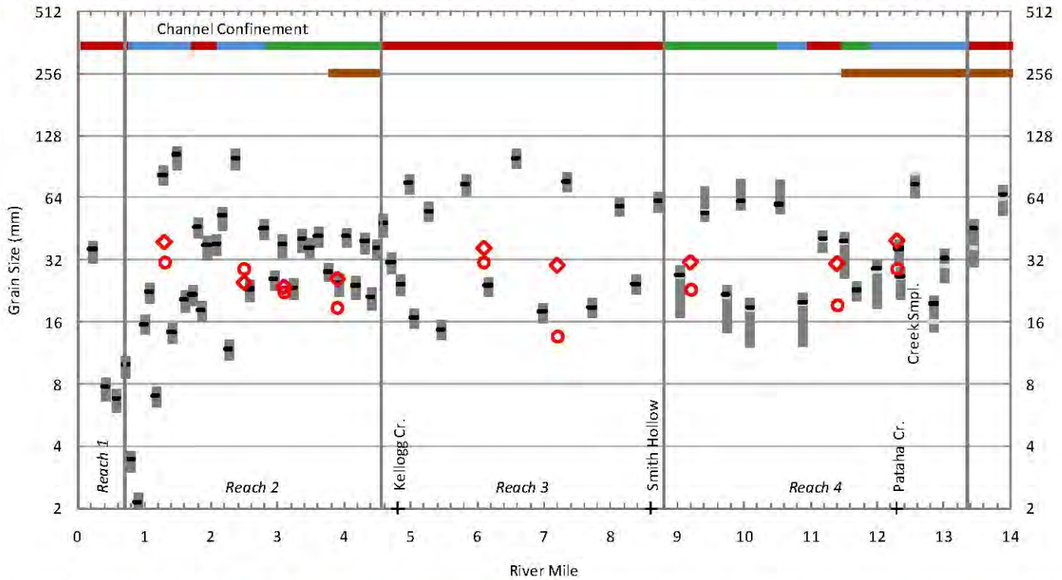
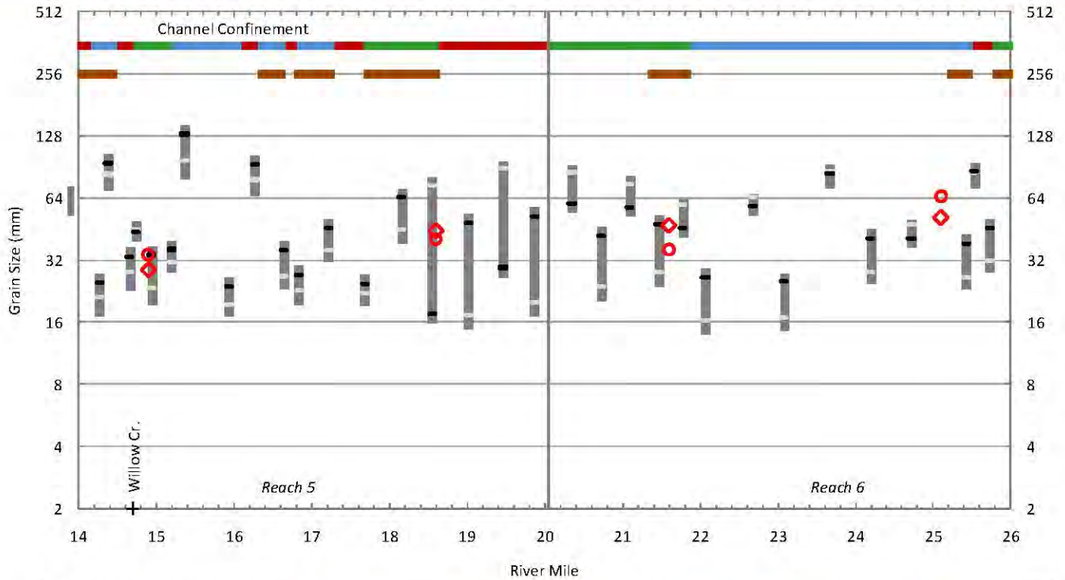
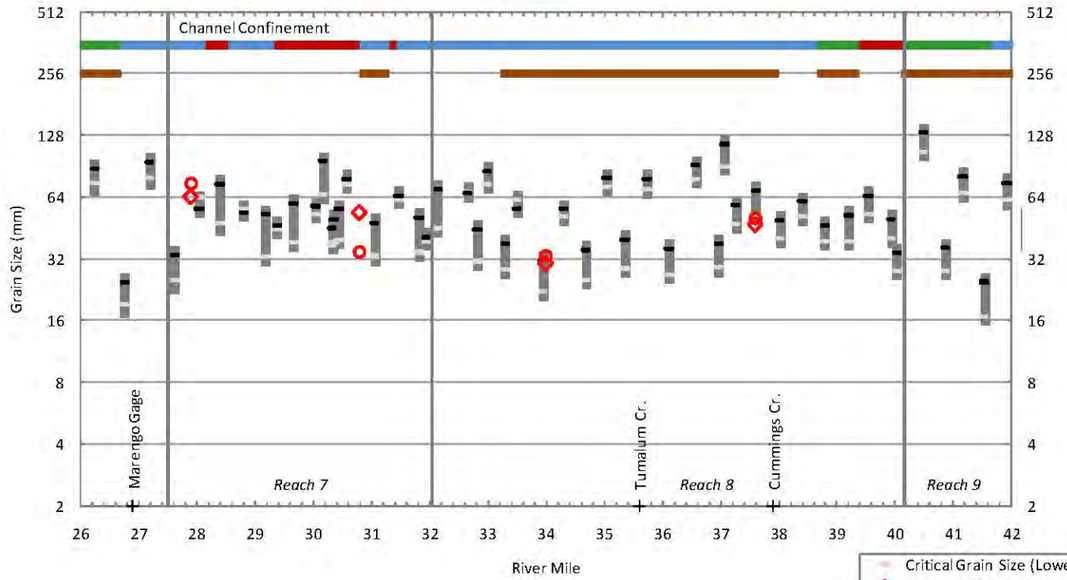
Wolman, G.M., 1954. *A Method of Sampling Coarse River-bed Material.* Transactions, American Geophysical Union. Volume 35, Number 6. December 1954.

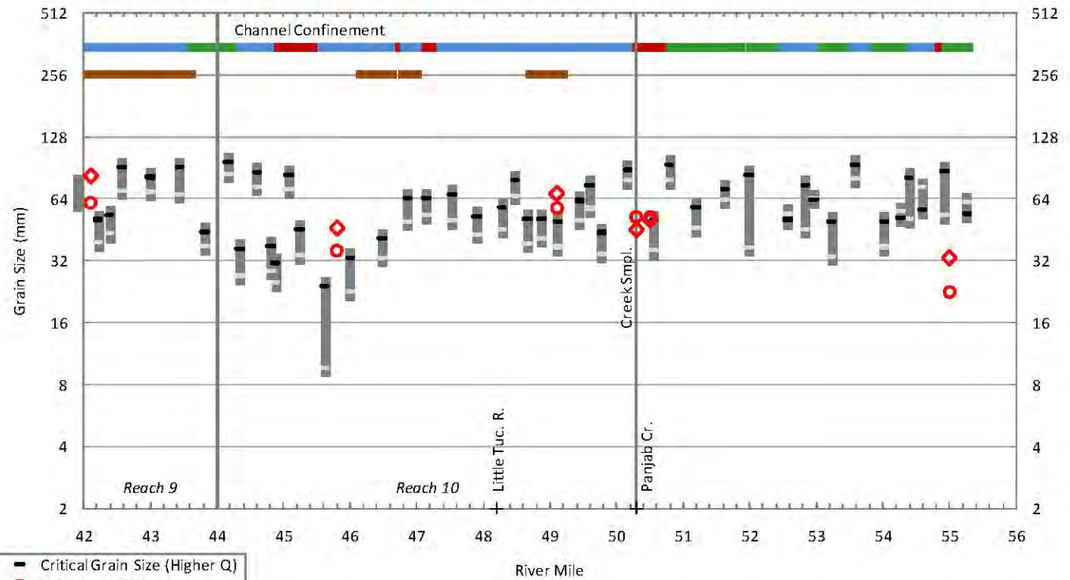
Wong, M. and G. Parker, 2006. Reanalysis and correction of bed-load relation of Meyer-Peter and Müller using their own database. *Journal of Hydraulic Engineering 132*(11): 1159-1168.

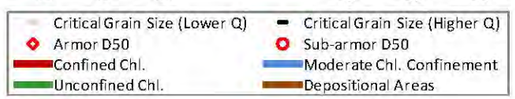
FIGURES











Notes:

1) Critical grain sizes are for a τ*c of 0.050 for the high and low discharge (Q) in the range.
2) Error Bars are for a τ*c of 0.045 and 0.055 above and below the range of discharges.
3) Armor and Sub-armor D50 is from field samples collected on gravel bars at low flow.
4) The 1 year return period flow (484 cfs at Starbuck) is estimated using a partial duration series for flood peaks and an LPIII analysis.
5) Flow change locations are labeled with the tributary name. The location of the gage at Marengo is also labeled.
6) Calculations use the main channel hydraulic conditions from the HEC-RAS 1-D basin scale LiDAR generated surface model. See Appendix and Report text for more information.
7) Channel confinement based on aerial photographs, valley bottom topography, and professional judgment.

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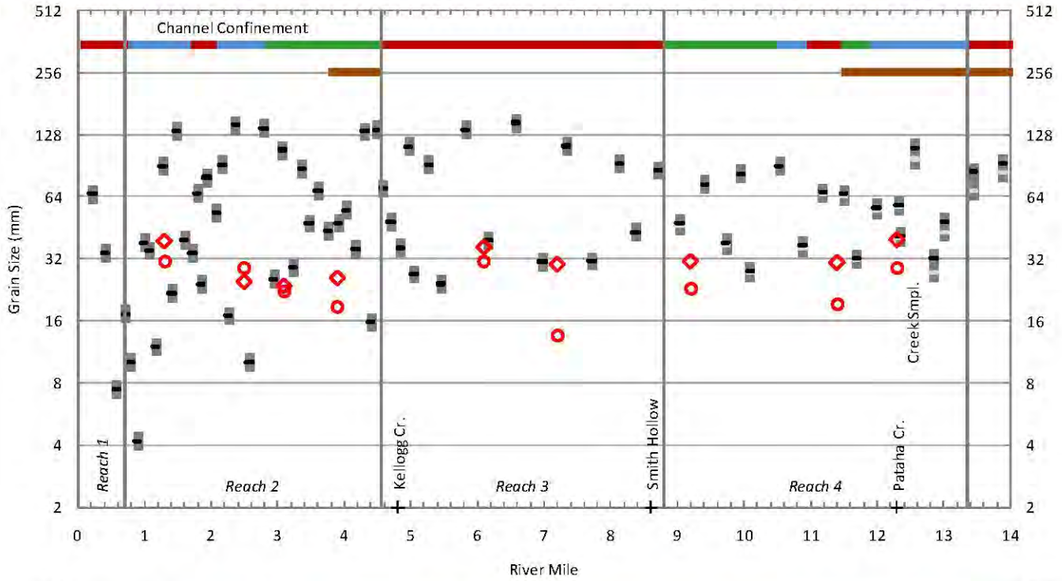
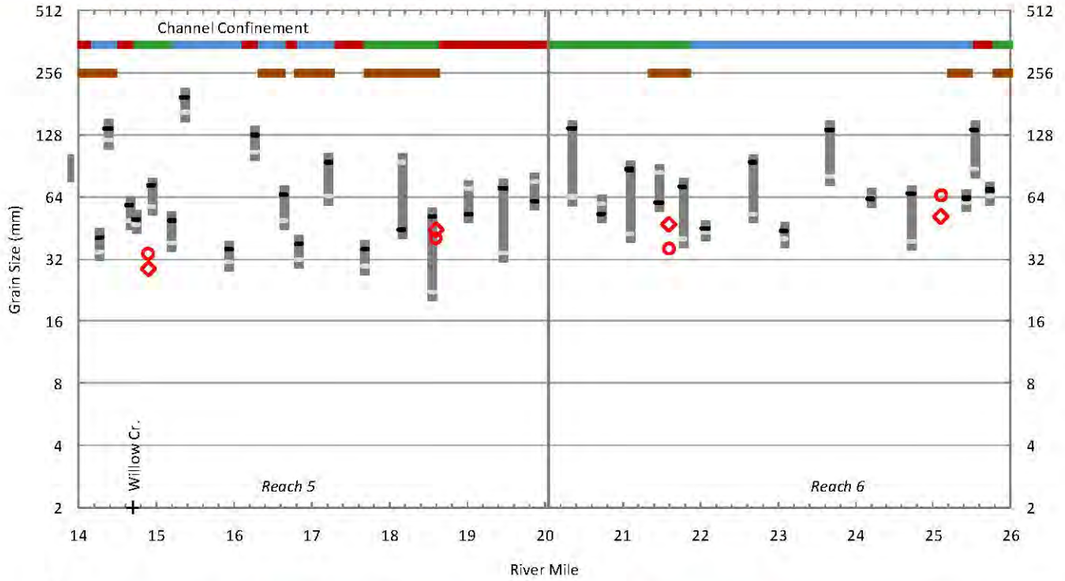
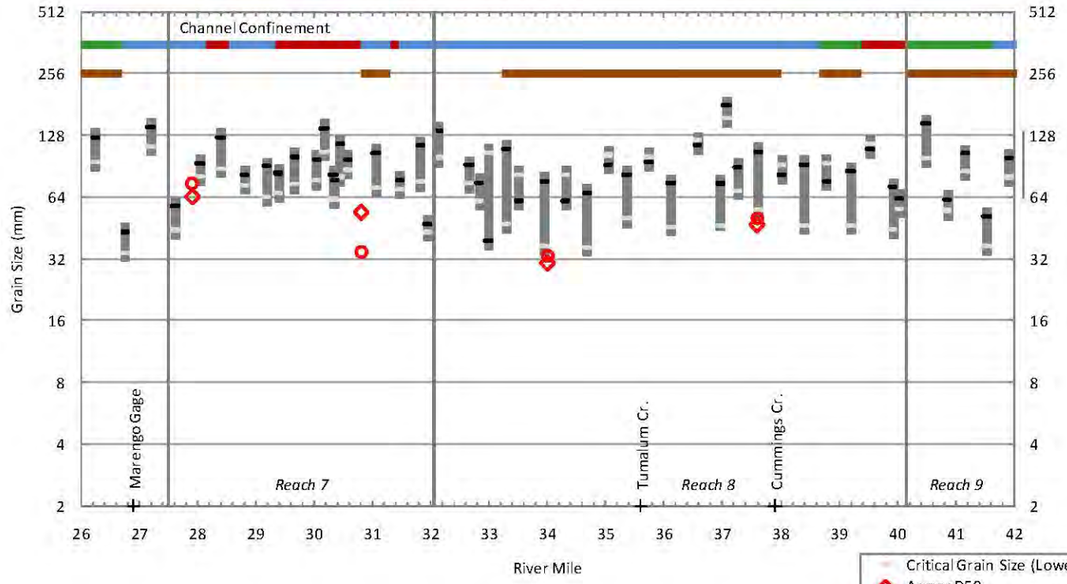
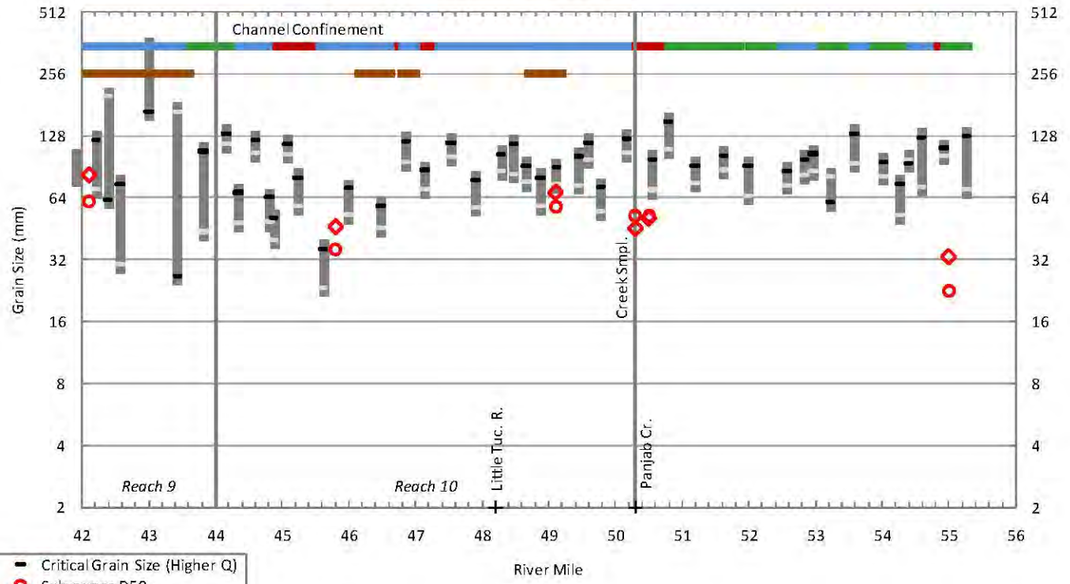
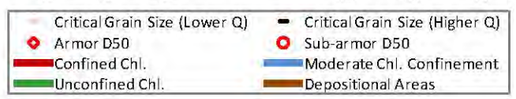
Figure B-1
Erosion/Depositional Tendencies, 1-year Return Period Discharge Range
Draft Tucannon River Geomorphic Assessment and Habitat Restoration Study
Columbia Conservation District











Notes:

1) Critical grain sizes are for a τ*c of 0.050 for the high and low discharge (Q) in the range.
2) Error Bars are for a τ*c of 0.045 and 0.055 above and below the range of discharges.
3) Armor and Sub-armor D50 is from field samples collected on gravel bars at low flow.
4) Flow change locations are labeled with the tributary name. The location of the gage at Marengo is also labeled.
5) Calculations use the main channel hydraulic conditions from the HEC-RAS 1-D basin scale LiDAR generated surface model. See Appendix and Report text for more information.
6) Channel confinement based on aerial photographs, valley bottom topography, and professional judgment.

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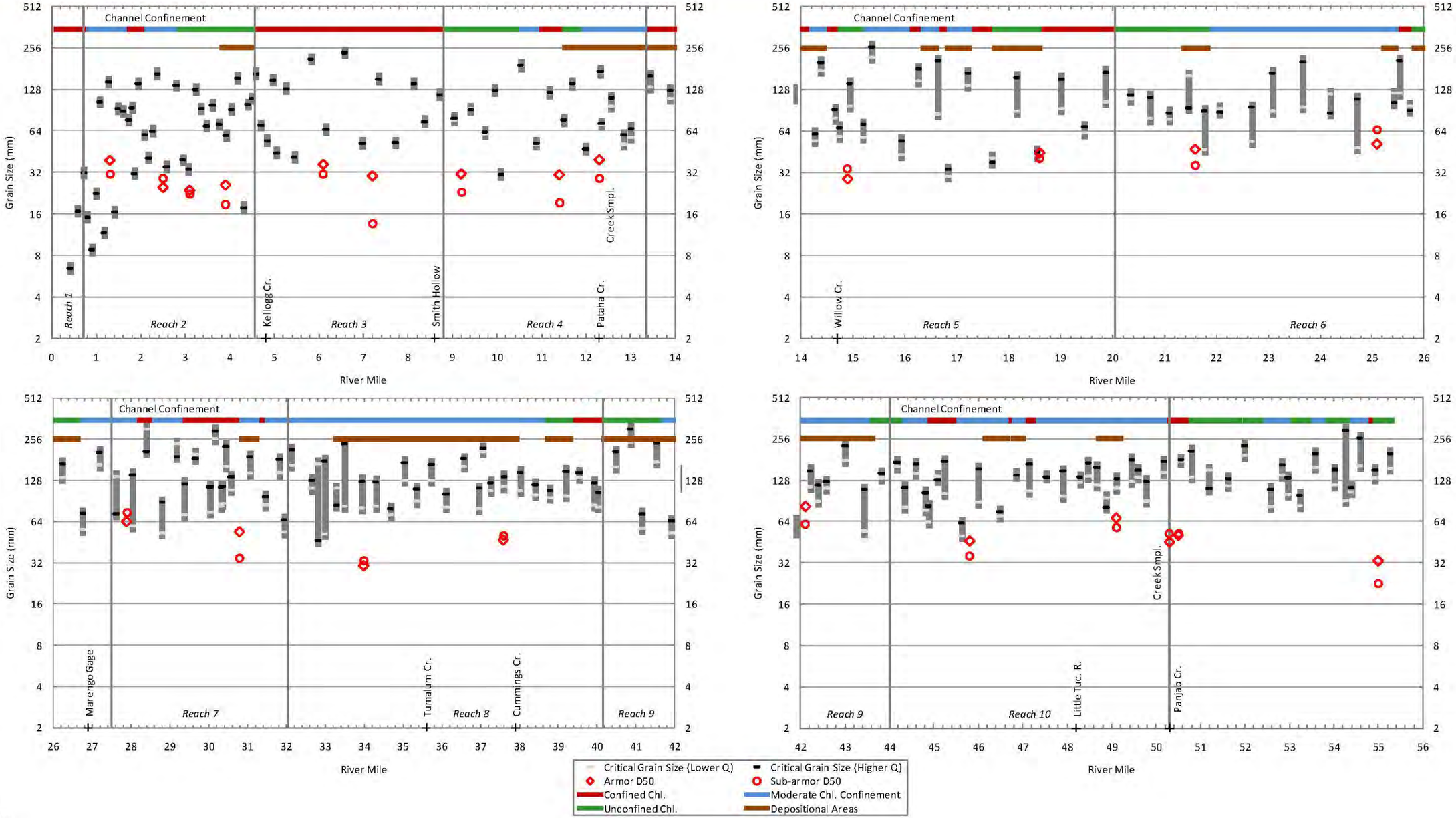
Figure B-2
Erosion/Depositional Tendencies, 2-year Return Period Discharge Range
Draft Tucannon River Geomorphic Assessment and Habitat Restoration Study
Columbia Conservation District



Notes:

1) Critical grain sizes are for a τ*c of 0.050 for the high and low discharge (Q) in the range.
2) Error Bars are for a τ*c of 0.045 and 0.055 above and below the range of discharges.
3) Armor and Sub-armor D50 is from field samples collected on gravel bars at low flow.
4) Flow change locations are labeled with the tributary name. The location of the gage at Marengo is also labeled.
5) Calculations use the main channel hydraulic conditions from the HEC-RAS 1-D basin scale LiDAR generated surface model. See Appendix and Report text for more information.
6) Channel confinement based on aerial photographs, valley bottom topography, and professional judgment.

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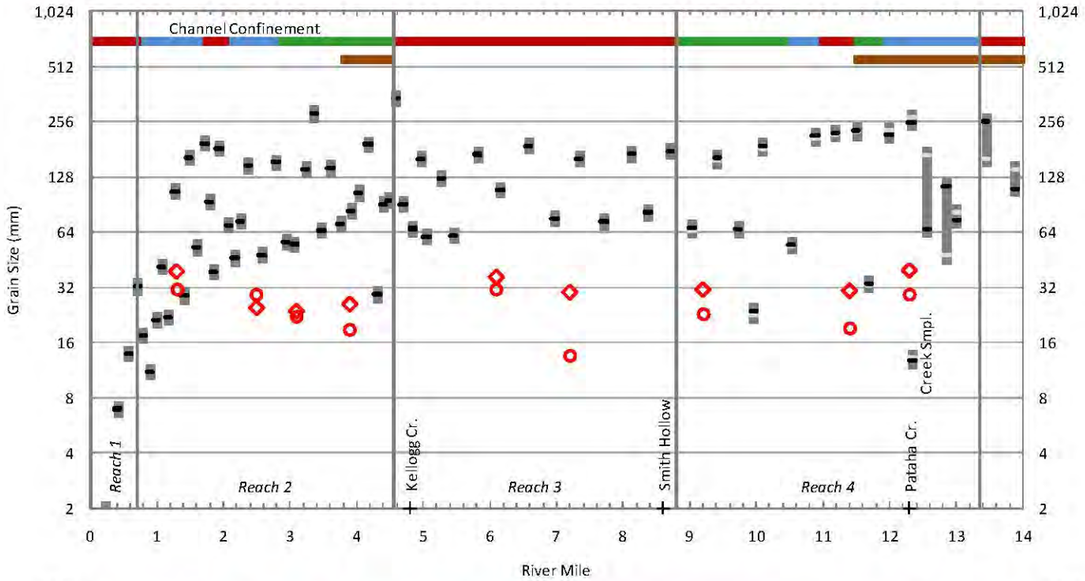
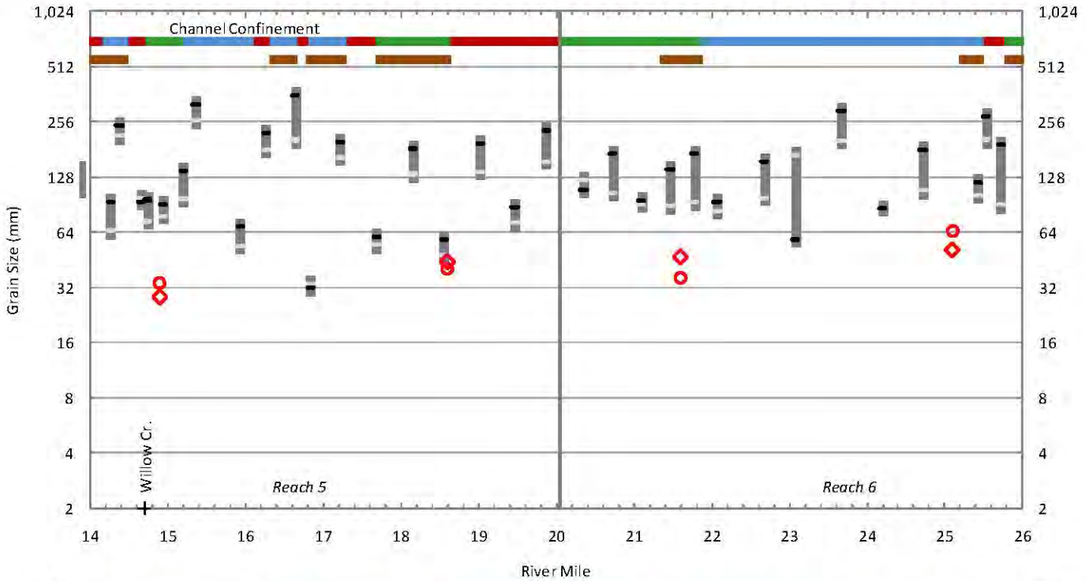
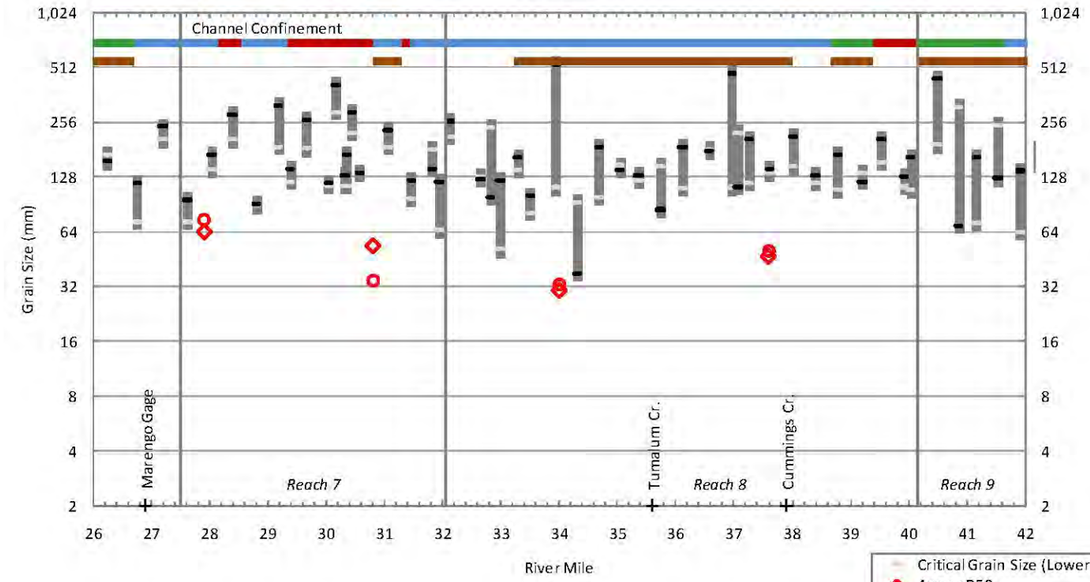
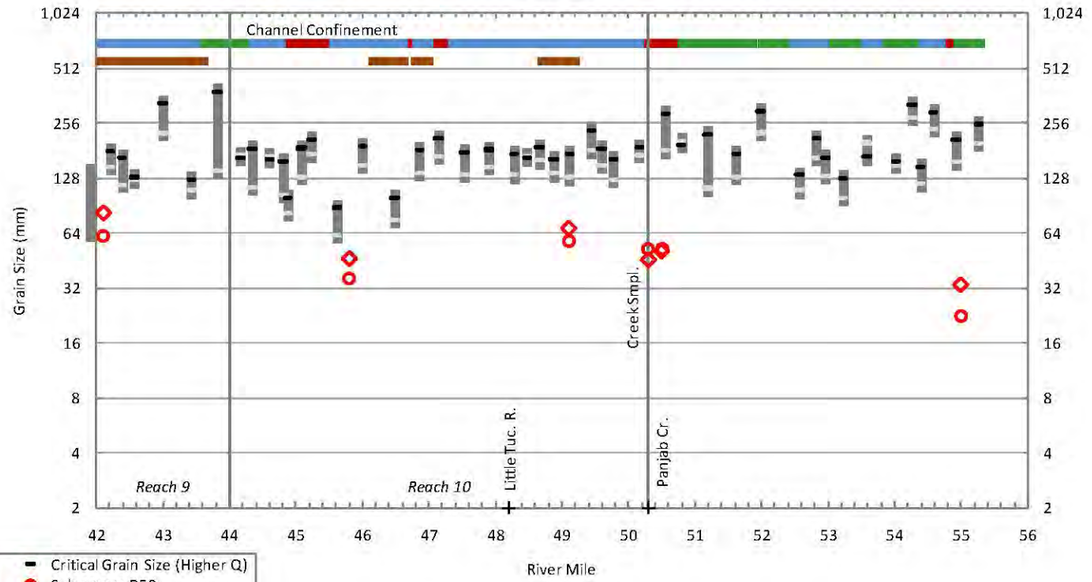
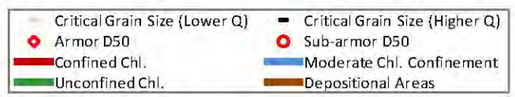
Figure B-3
Erosion/Depositional Tendencies, 5-year Return Period Discharge Range
Draft Tucannon River Geomorphic Assessment and Habitat Restoration Study
Columbia Conservation District











Notes:

1) Critical grain sizes are for a τ*c of 0.050 for the high and low discharge (Q) in the range.
2) Error Bars are for a τ*c of 0.045 and 0.055 above and below the range of discharges.
3) Armor and Sub-armor D50 is from field samples collected on gravel bars at low flow.
4) Flow change locations are labeled with the tributary name. The location of the gage at Marengo is also labeled.
5) Calculations use the main channel hydraulic conditions from the HEC-RAS 1-D basin scale LiDAR generated surface model. See Appendix and Report text for more information.
6) Channel confinement based on aerial photographs, valley bottom topography, and professional judgment.

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Figure B-4
Erosion/Depositional Tendencies, 10-year Return Period Discharge Range
Draft Tucannon River Geomorphic Assessment and Habitat Restoration Study
Columbia Conservation District

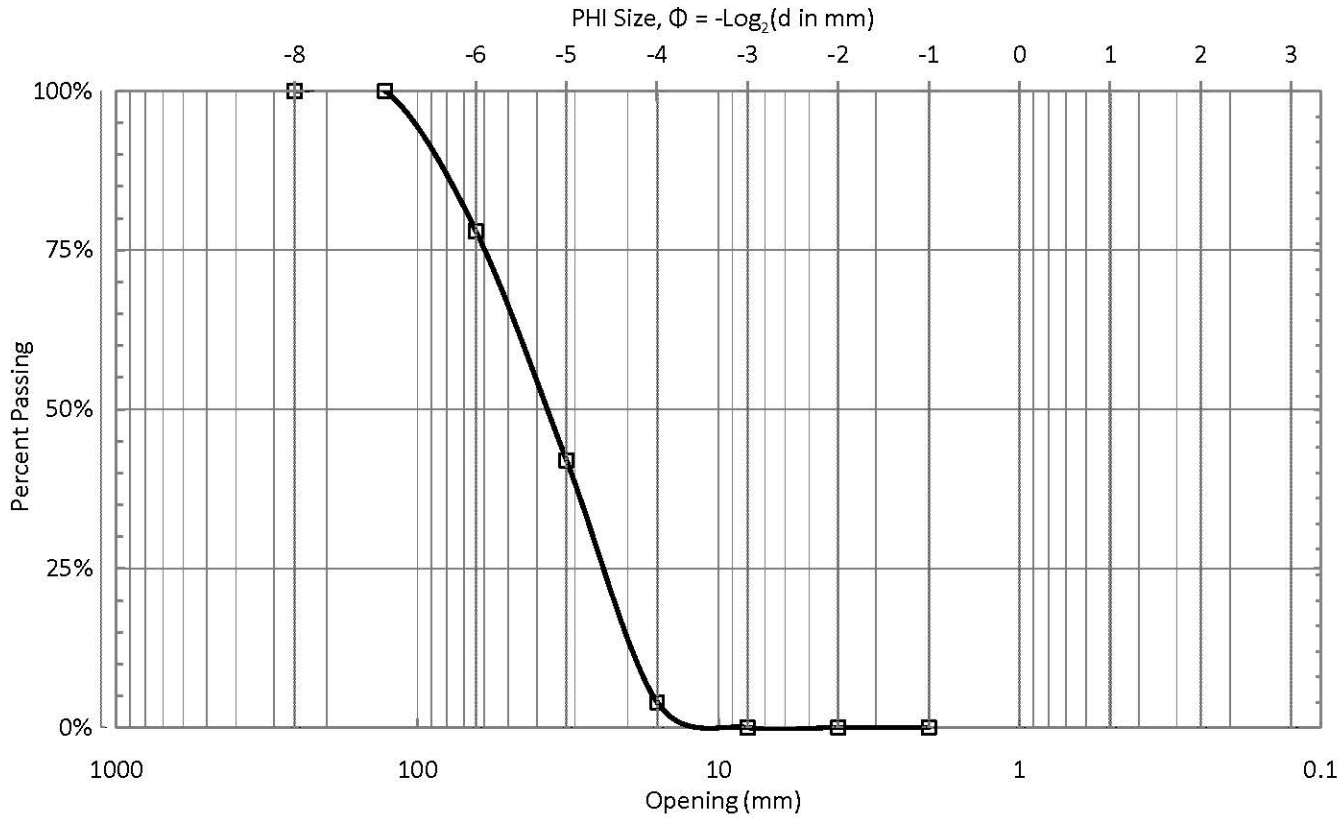
ATTACHMENT B-1
SEDIMENT GRAIN SIZE DISTRIBUTION REPORTS

Sample	River Mile	Grain Size (in mm)		Percent in Subarmor Layer				
		Armor D_{50}	Sub-armor D_{50}	64-256 mm Cobble	2-64 mm Gravel	0.625-2mm Sand	<0.625 mm Fines	64-256 mm Cobble
Tucannon 1 - Downstream of 261 Bridge	1.3	39	31	16%	73%	9%	2%	
Tucannon 2	2.5	25	29	2%	92%	6%	1%	
Tucannon 3 - Lower Tucannon Ranch	3.1	24	22	2%	85%	12%	1%	
Tucannon 4 - Upper Tucannon Ranch	3.9	26	19	12%	79%	9%	0%	
Tucannon 5 - Downstream of Fletcher Road	6.1	37	31	17%	75%	7%	1%	
Tucannon 6	7.2	30	14	5%	77%	17%	2%	
Tucannon 7 - RV Park	9.2	31	23	15%	71%	13%	1%	
Tucannon 8 - Red Roof House	11.4	31	19	4%	80%	12%	3%	
Tucannon 9 - Pataha Creek	Pataha 1.3	40	29	14%	76%	9%	1%	
Tucannon 10 - Upstream of Highway 12 Bridge	14.9	29	34	4%	94%	1%	1%	
Tucannon 11 - Upstream of Brines Bridge	18.6	44	40	14%	85%	1%	0%	
Tucannon 12	21.6	47	36	21%	74%	3%	1%	
Tucannon 13	25.1	51	65	51%	48%	1%	0%	
Tucannon 14	27.9	64	74	58%	41%	0%	0%	
Tucannon 15	30.8	54	34	20%	69%	10%	0%	
Tucannnon 16 - WDFW	34	30	33	18%	69%	12%	1%	
Tucannnon 17	37.6	47	50	38%	57%	5%	0%	
Tucannnon 18	42.1	82	62	48%	49%	2%	0%	
Tucannnon 19 - Tucannon Camp	45.8	46	36	29%	61%	9%	0%	
Tucannnon 20 - Campground Beach	49.1	68	58	41%	59%	0%	0%	
Tucannnon 21 - Panjab Creek	Panjab	45	52	20%	72%	7%	0%	
Tucannnon 22 - Upstream of Panjab	50.5	51	53	36%	58%	5%	0%	
Tucannnon 23	55	33	23	23%	64%	12%	0%	
Average		42	38	22%	70%	7%	1%	
Minimum		24	14	2%	41%	0%	0%	
Maximum		82	74	58%	94%	17%	3%	
Standard Deviation		14.9	16.5	16%	14%	5%	1%	

Sediment Grain Size Distribution Report

Sample ID : TR_1_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	78.0%
1-1/4"	1.3	32	42.0%
5/8"	0.63	16	4.00%
5/16"	0.31	8.0	0.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	100%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	52
D_{50}=	39
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 1.3

Armor X

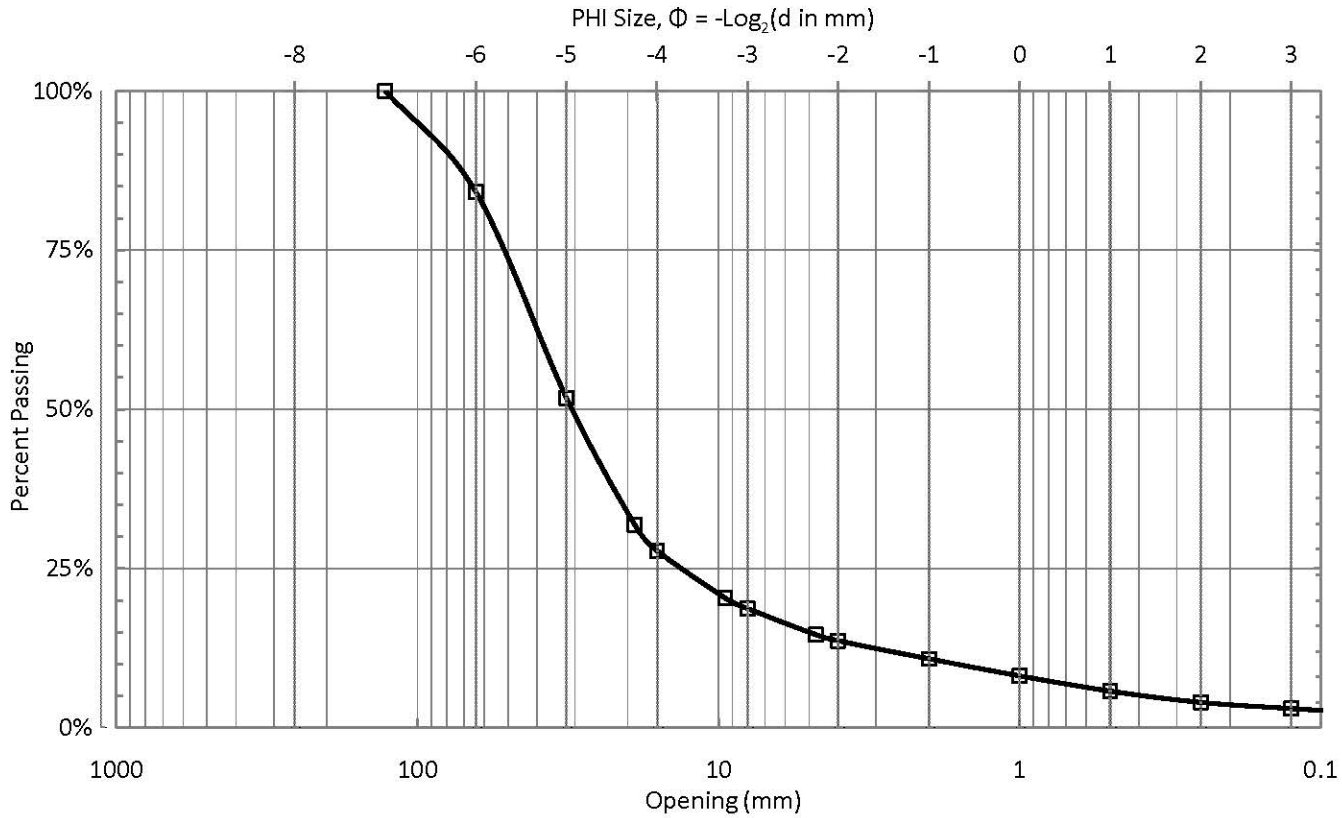
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_1_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	84.1%
1-1/4"	1.3	32	51.8%
3/4"	0.75	19	31.9%
5/8"	0.63	16	27.8%
3/8"	0.37	9.5	20.4%
5/16"	0.31	8.0	18.7%
No. 4	0.187	4.75	14.6%
No. 5	0.16	4.0	13.6%
No. 10	0.079	2.0	10.8%
No. 18	0.039	1.0	8.13%
No. 35	0.020	0.50	5.73%
No. 60	0.010	0.25	3.96%
No. 120	0.0049	0.125	2.98%
No. 200	0.0030	0.075	2.37%
No. 230	0.0025	0.063	2.23%
No. 270	0.0021	0.053	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
16%	73%	9%	2%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	45
D_{50}=	31
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 1.3

Armor

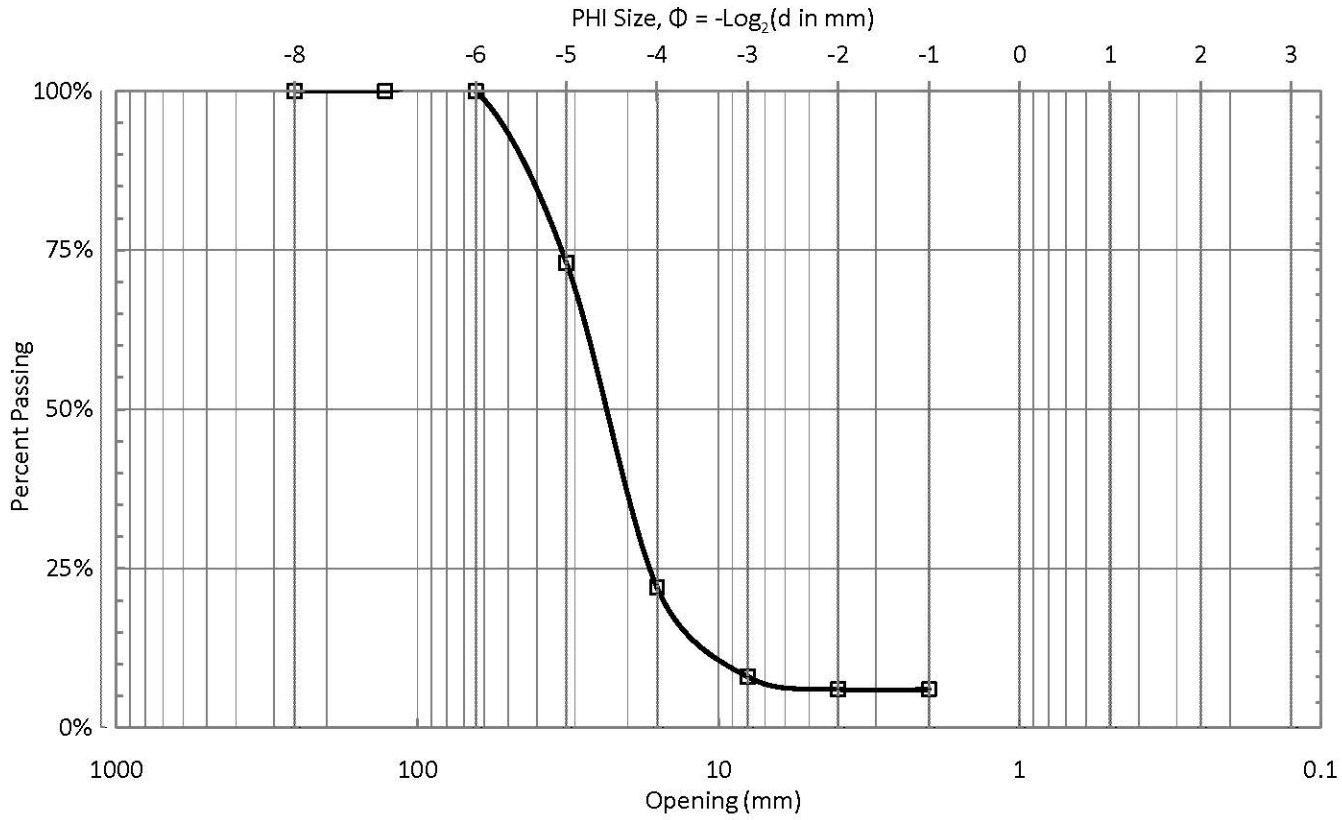
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_2_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	100%
1-1/4"	1.3	32	73.0%
5/8"	0.63	16	22.0%
5/16"	0.31	8.0	8.00%
No. 5	0.16	4.0	6.00%
No. 10	0.079	2.0	6.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	94%	6%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	29
D_{50}=	25
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 2.5

Armor X

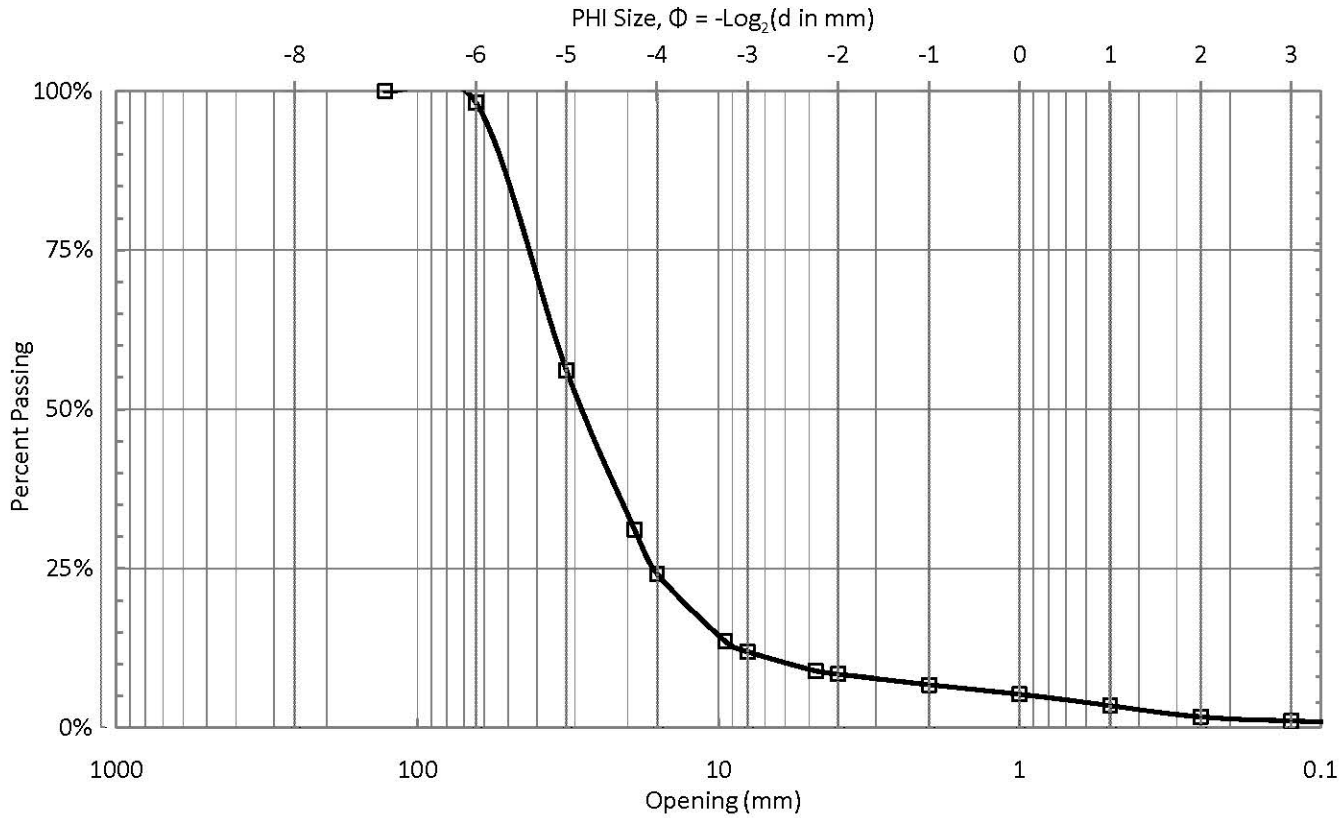
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_2_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	98.2%
1-1/4"	1.3	32	56.1%
3/4"	0.75	19	31.1%
5/8"	0.63	16	24.2%
3/8"	0.37	9.5	13.6%
5/16"	0.31	8.0	11.9%
No. 4	0.187	4.75	8.90%
No. 5	0.16	4.0	8.40%
No. 10	0.079	2.0	6.72%
No. 18	0.039	1.0	5.24%
No. 35	0.020	0.50	3.44%
No. 60	0.010	0.25	1.67%
No. 120	0.0049	0.125	1.05%
No. 200	0.0030	0.075	0.774%
No. 230	0.0025	0.063	0.726%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
2%	92%	6%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	39
D_{50}=	29
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 2.5

Armor

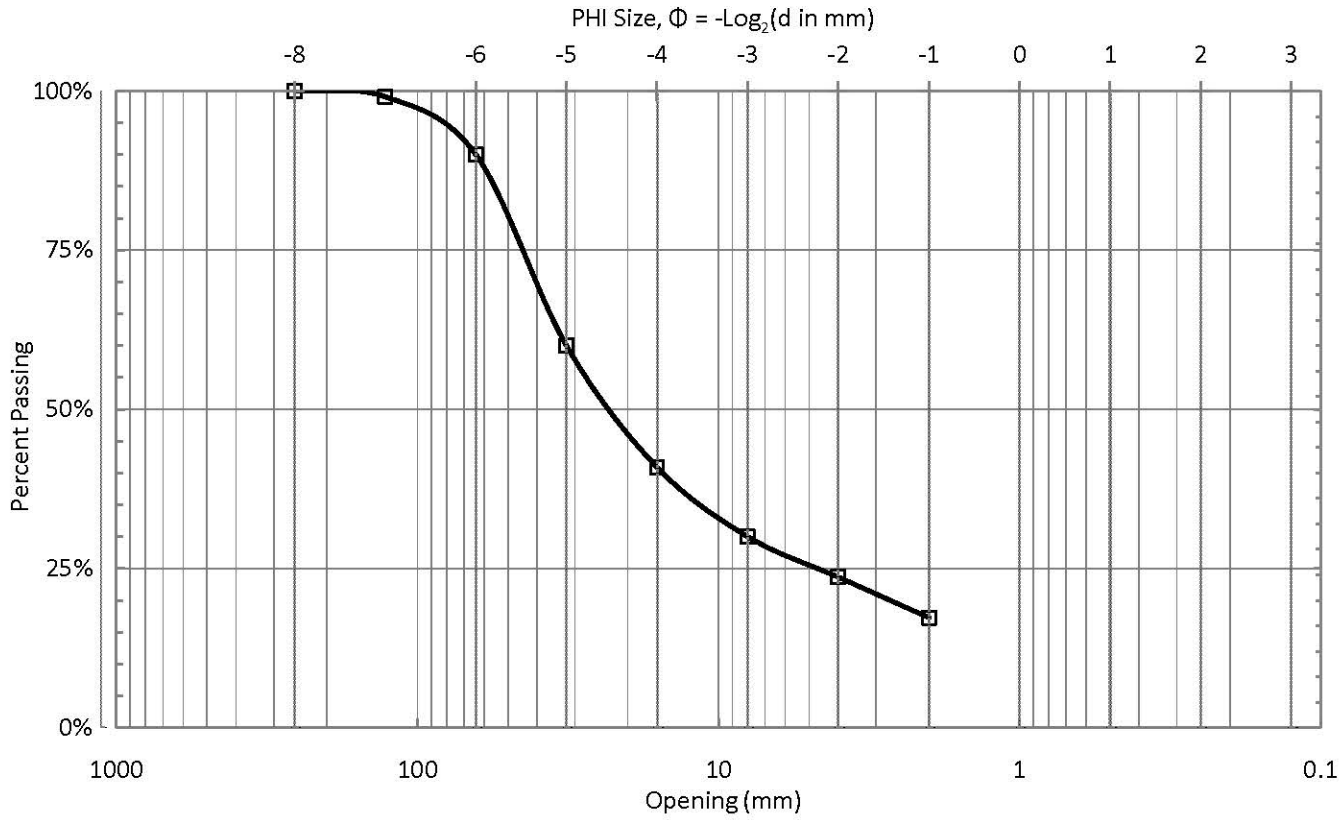
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_3_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	99.1%
2-1/2"	2.5	64	90.0%
1-1/4"	1.3	32	60.0%
5/8"	0.63	16	40.9%
5/16"	0.31	8.0	30.0%
No. 5	0.16	4.0	23.6%
No. 10	0.079	2.0	17.3%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	75%	24%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	37
D_{50}=	24
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 3.1

Armor X

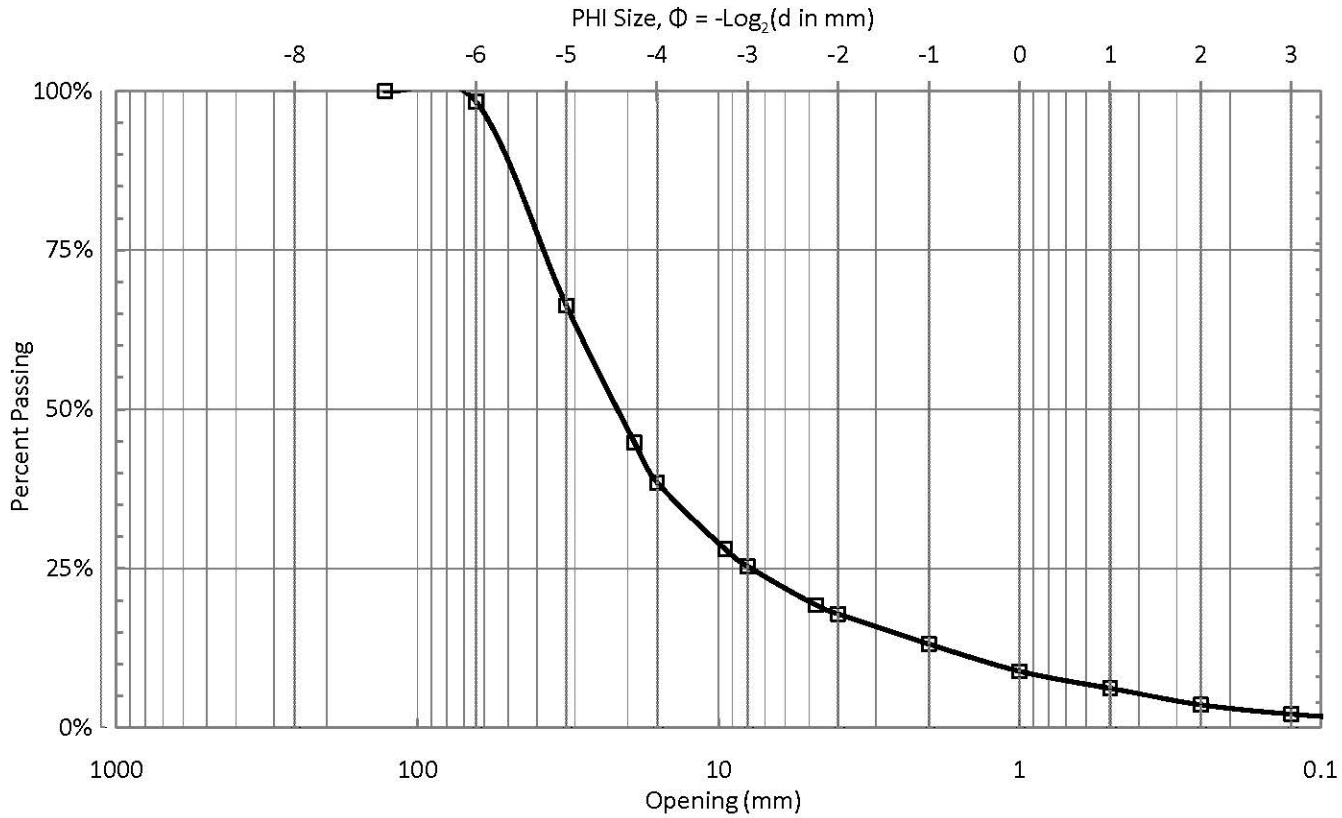
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_3_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	98.4%
1-1/4"	1.3	32	66.3%
3/4"	0.75	19	44.8%
5/8"	0.63	16	38.5%
3/8"	0.37	9.5	28.0%
5/16"	0.31	8.0	25.3%
No. 4	0.187	4.75	19.2%
No. 5	0.16	4.0	17.9%
No. 10	0.079	2.0	13.1%
No. 18	0.039	1.0	8.85%
No. 35	0.020	0.50	6.17%
No. 60	0.010	0.25	3.58%
No. 120	0.0049	0.125	2.10%
No. 200	0.0030	0.075	1.45%
No. 230	0.0025	0.063	1.45%
No. 270	0.0021	0.053	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
2%	85%	12%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	31
D_{50}=	22
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 3.1

Armor

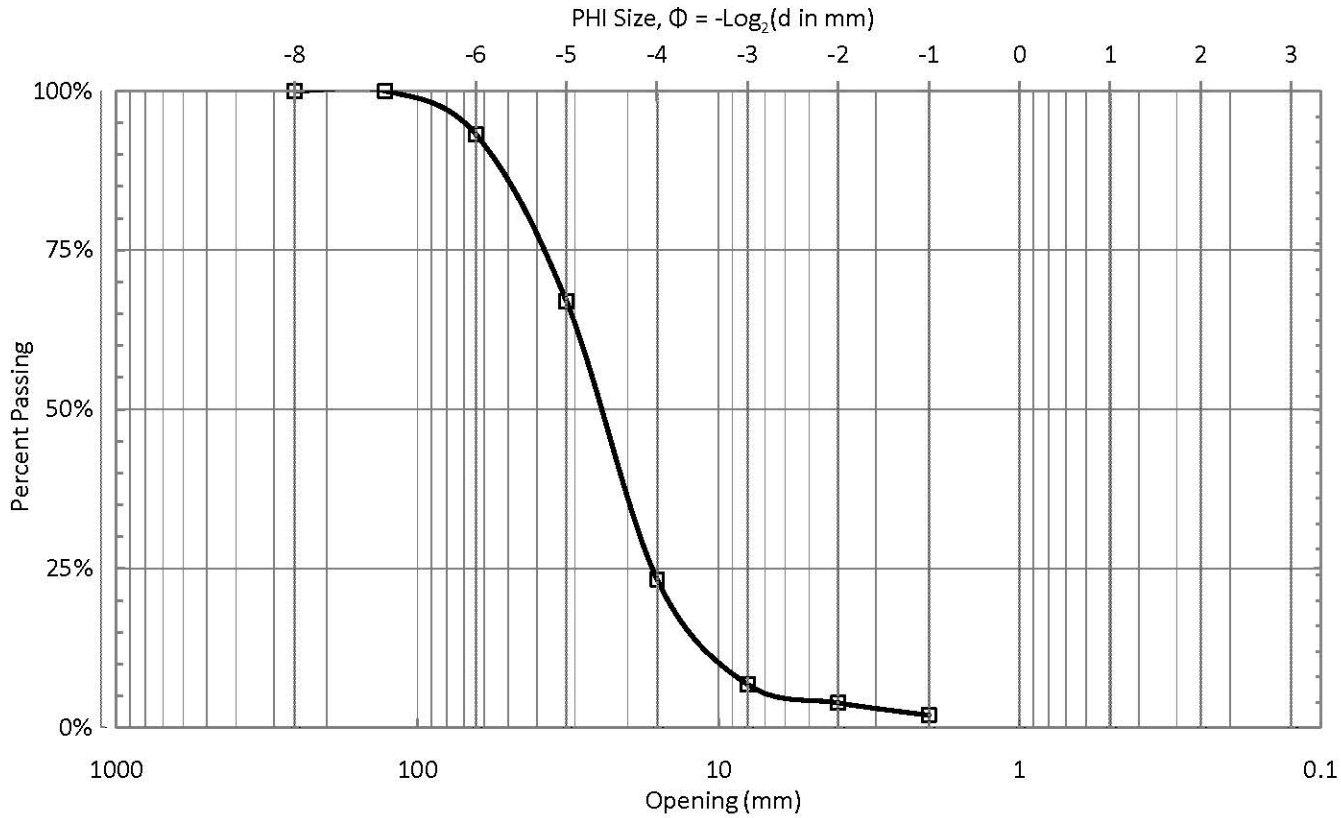
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_4_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	93.2%
1-1/4"	1.3	32	67.0%
5/8"	0.63	16	23.3%
5/16"	0.31	8.0	6.80%
No. 5	0.16	4.0	3.88%
No. 10	0.079	2.0	1.94%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	96%	4%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	31
D_{50}=	26
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 3.9

Armor X

Sub-Armor

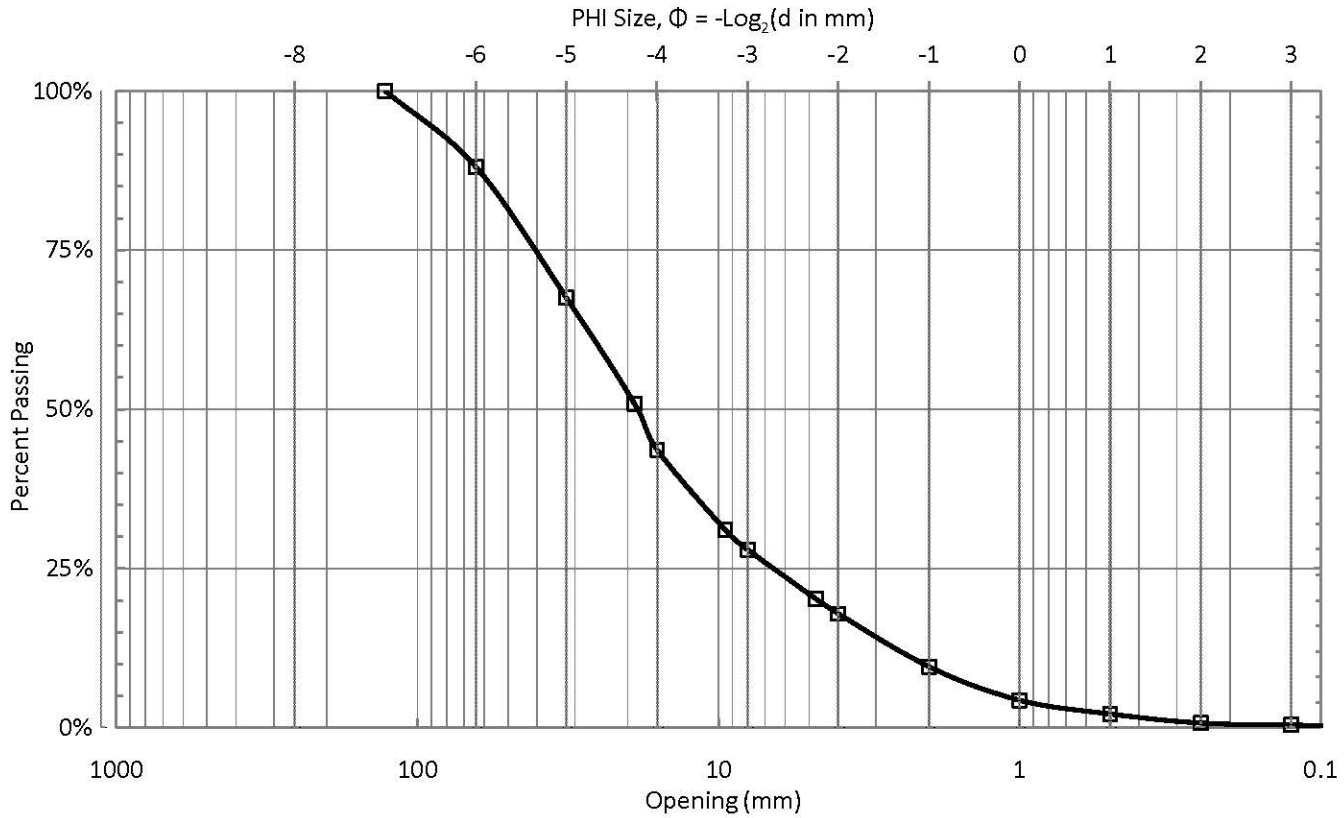
Location Notes

Mid-channel bar where channel splits just downstream of riprap on left bank. Gravel dug from channel.

Sediment Grain Size Distribution Report

Sample ID : TR_4_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	88.1%
1-1/4"	1.3	32	67.5%
3/4"	0.75	19	50.9%
5/8"	0.63	16	43.6%
3/8"	0.37	9.5	31.1%
5/16"	0.31	8.0	28.0%
No. 4	0.187	4.75	20.2%
No. 5	0.16	4.0	17.9%
No. 10	0.079	2.0	9.58%
No. 18	0.039	1.0	4.31%
No. 35	0.020	0.50	2.14%
No. 60	0.010	0.25	0.717%
No. 120	0.0049	0.125	0.408%
No. 200	0.0030	0.075	0.294%
No. 230	0.0025	0.063	0.290%
No. 270	0.0021	0.053	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
12%	79%	9%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	30
D_{50}=	19
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 3.9

Armor

Sub-Armor X

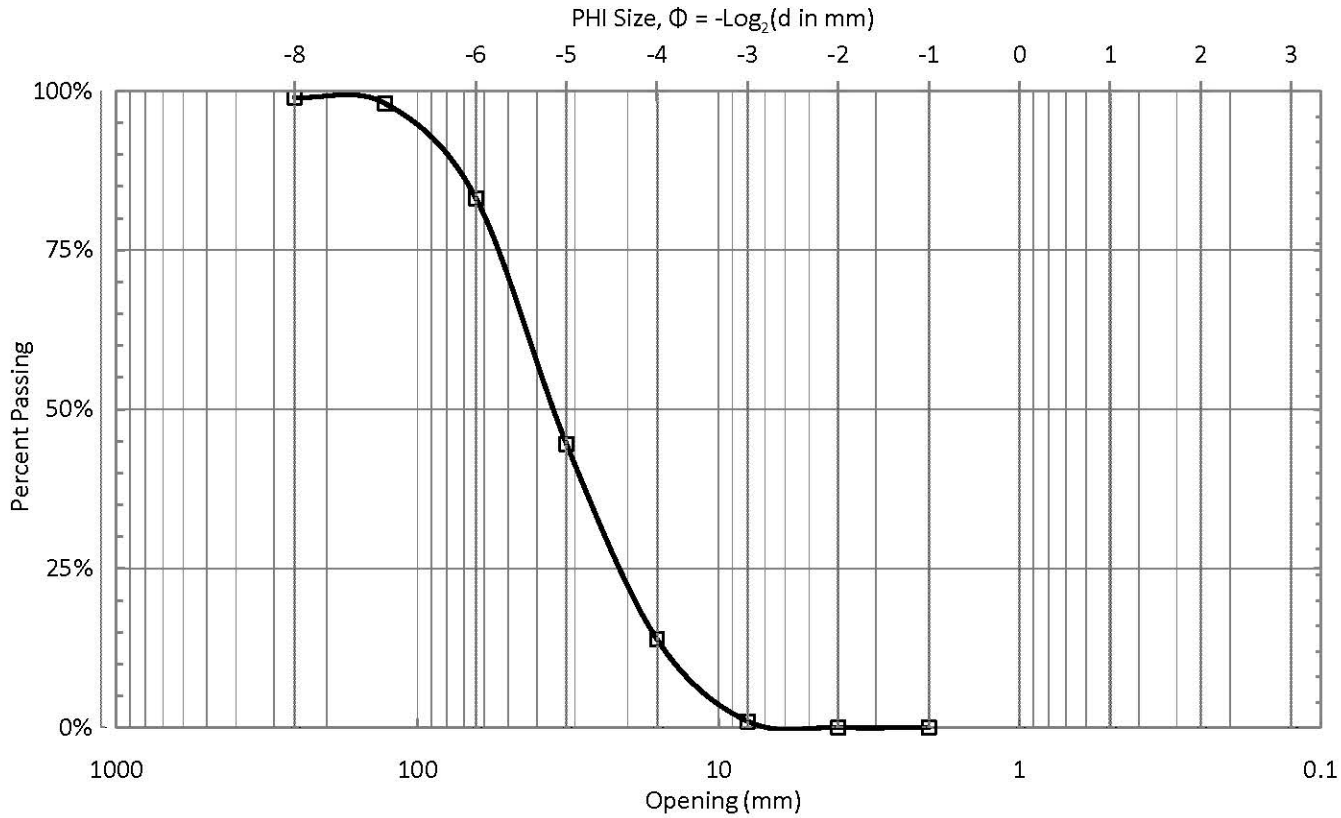
Location Notes

Mid-channel bar where channel splits just downstream of riprap on left bank. Gravel dug from channel.

Sediment Grain Size Distribution Report

Sample ID : TR_5_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	99.0%
5"	5.0	128	98.0%
2-1/2"	2.5	64	83.2%
1-1/4"	1.3	32	44.6%
5/8"	0.63	16	13.9%
5/16"	0.31	8.0	0.990%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
2%	98%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	49
D_{50}=	37
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 6.1

Armor X

Sub-Armor

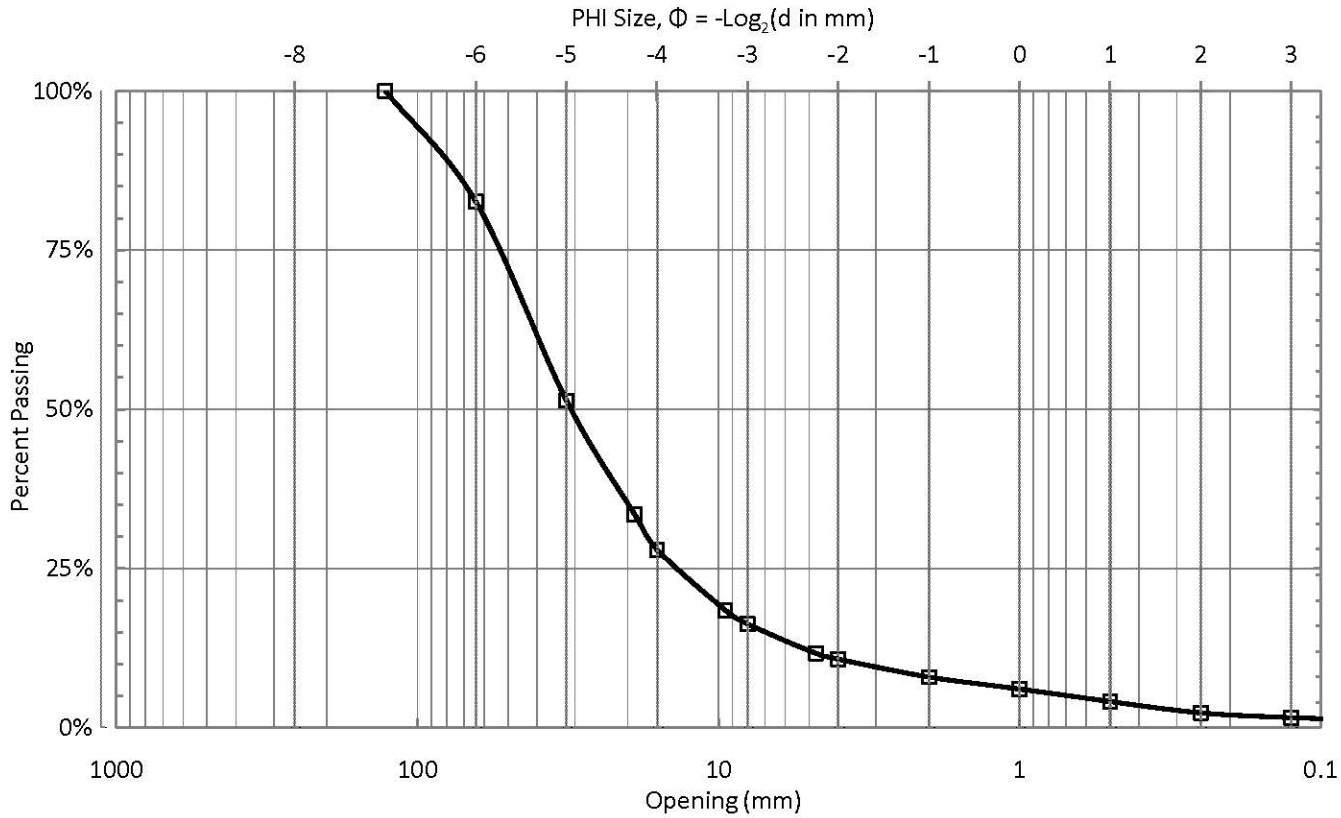
Location Notes

Some of the larger cobbles appear to be riprap from upstream. Sample location downstream of engineered rock weir.

Sediment Grain Size Distribution Report

Sample ID : TR_5_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	82.6%
1-1/4"	1.3	32	51.4%
3/4"	0.75	19	33.5%
5/8"	0.63	16	28.0%
3/8"	0.37	9.5	18.5%
5/16"	0.31	8.0	16.3%
No. 4	0.187	4.75	11.7%
No. 5	0.16	4.0	10.7%
No. 10	0.079	2.0	7.94%
No. 18	0.039	1.0	6.06%
No. 35	0.020	0.50	4.09%
No. 60	0.010	0.25	2.31%
No. 120	0.0049	0.125	1.56%
No. 200	0.0030	0.075	1.26%
No. 230	0.0025	0.063	1.21%
No. 270	0.0021	0.053	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
17%	75%	7%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	46
D_{50}=	31
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 6.1

Armor

Sub-Armor X

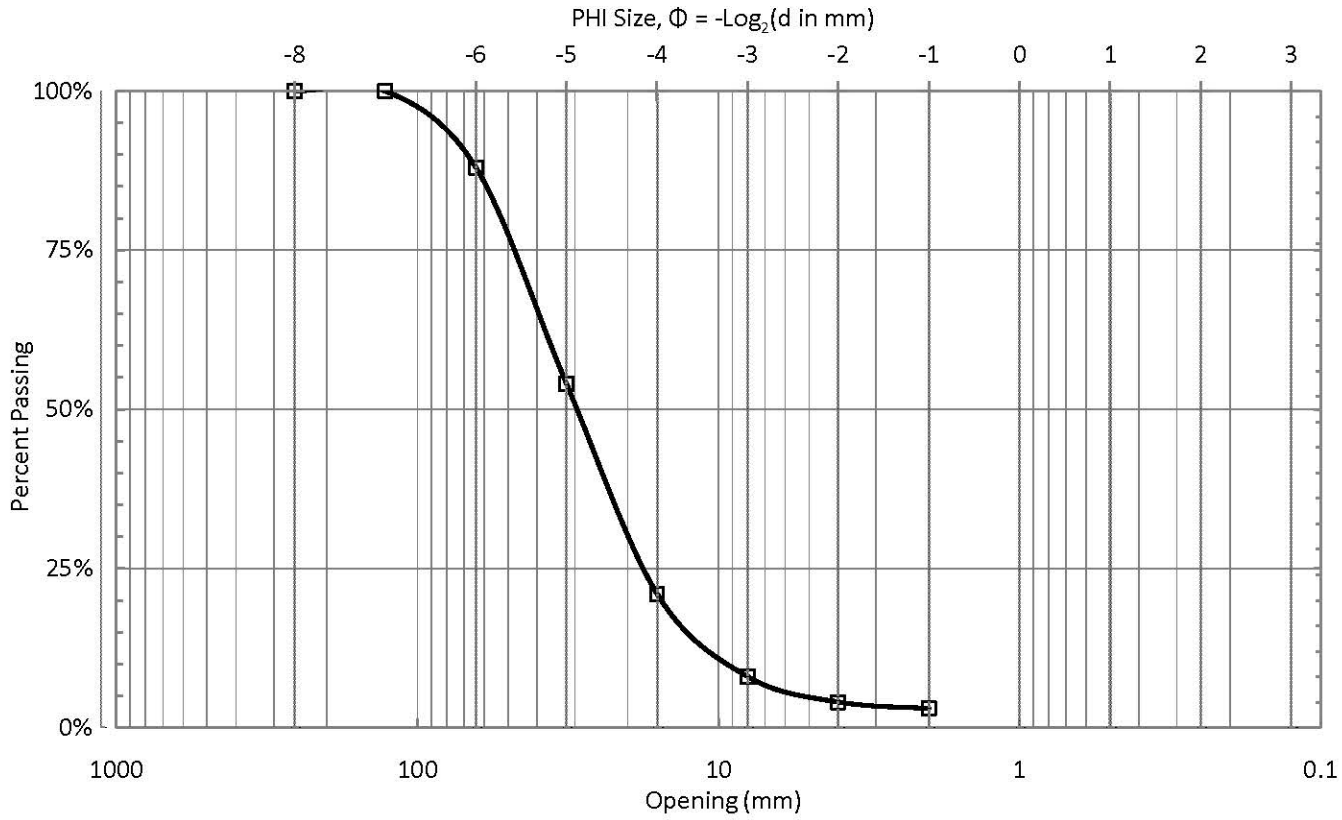
Location Notes

Some of the larger cobbles appear to be riprap from upstream. Sample location downstream of engineered rock weir.

Sediment Grain Size Distribution Report

Sample ID : TR_6_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	88.0%
1-1/4"	1.3	32	54.0%
5/8"	0.63	16	21.0%
5/16"	0.31	8.0	8.00%
No. 5	0.16	4.0	4.00%
No. 10	0.079	2.0	3.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	96%	4%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	42
D_{50}=	30
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 7.2

Armor X

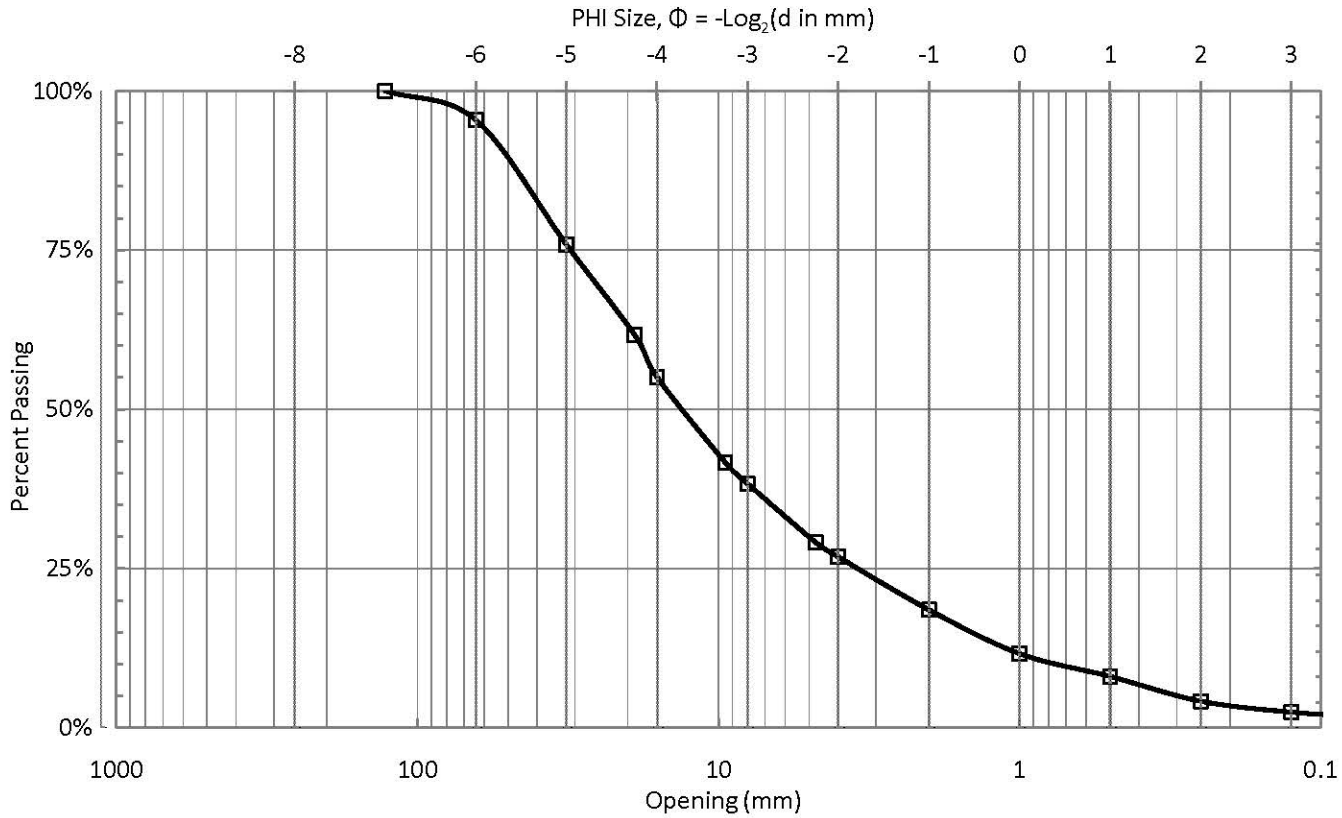
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_6_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	95.4%
1-1/4"	1.3	32	75.9%
3/4"	0.75	19	61.7%
5/8"	0.63	16	55.0%
3/8"	0.37	9.5	41.7%
5/16"	0.31	8.0	38.3%
No. 4	0.187	4.75	29.1%
No. 5	0.16	4.0	26.8%
No. 10	0.079	2.0	18.5%
No. 18	0.039	1.0	11.6%
No. 35	0.020	0.50	8.03%
No. 60	0.010	0.25	4.14%
No. 120	0.0049	0.125	2.42%
No. 200	0.0030	0.075	1.79%
No. 230	0.0025	0.063	1.77%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
5%	77%	17%	2%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	22
D_{50}=	14
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 7.2

Armor

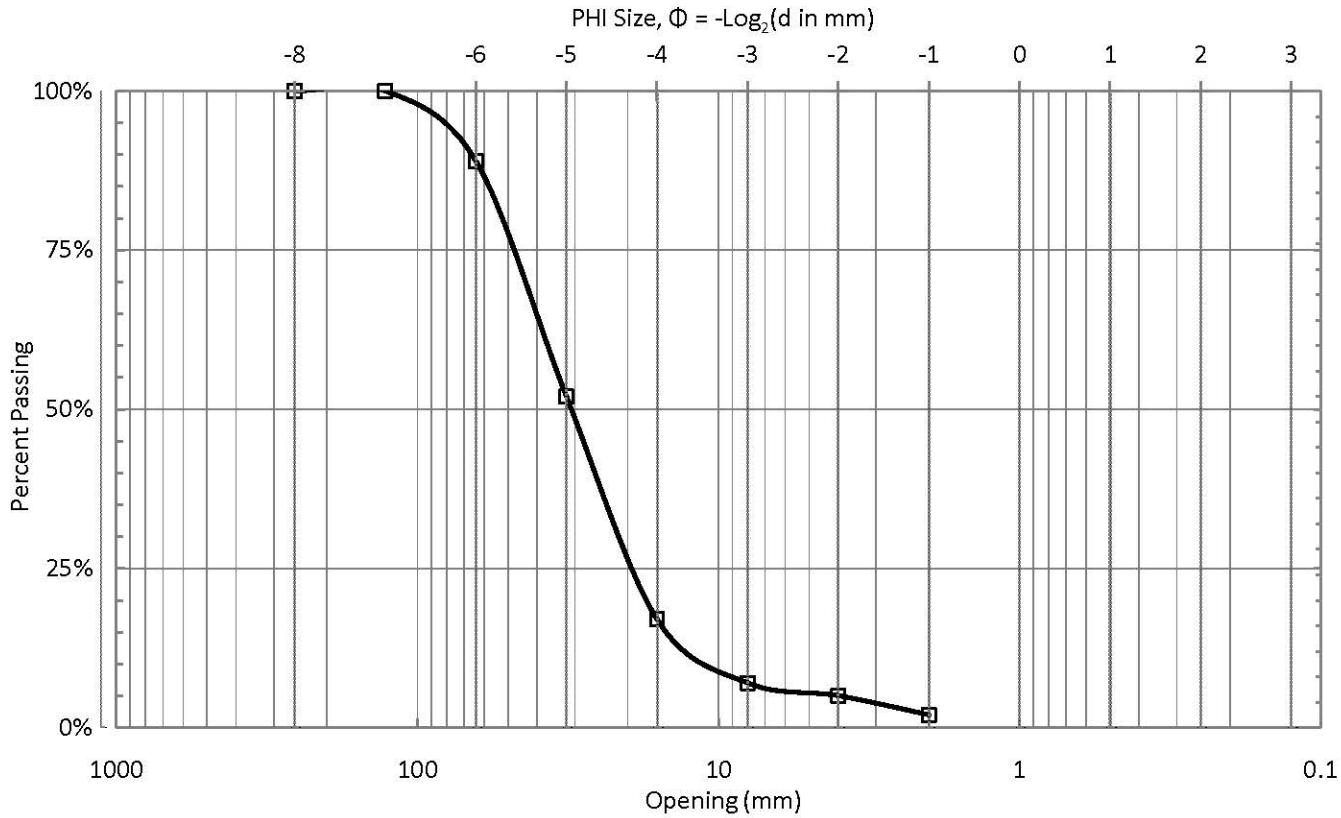
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_7_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	89.0%
1-1/4"	1.3	32	52.0%
5/8"	0.63	16	17.0%
5/16"	0.31	8.0	7.00%
No. 5	0.16	4.0	5.00%
No. 10	0.079	2.0	2.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	95%	5%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	43
D_{50}=	31
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 9.2

Armor X

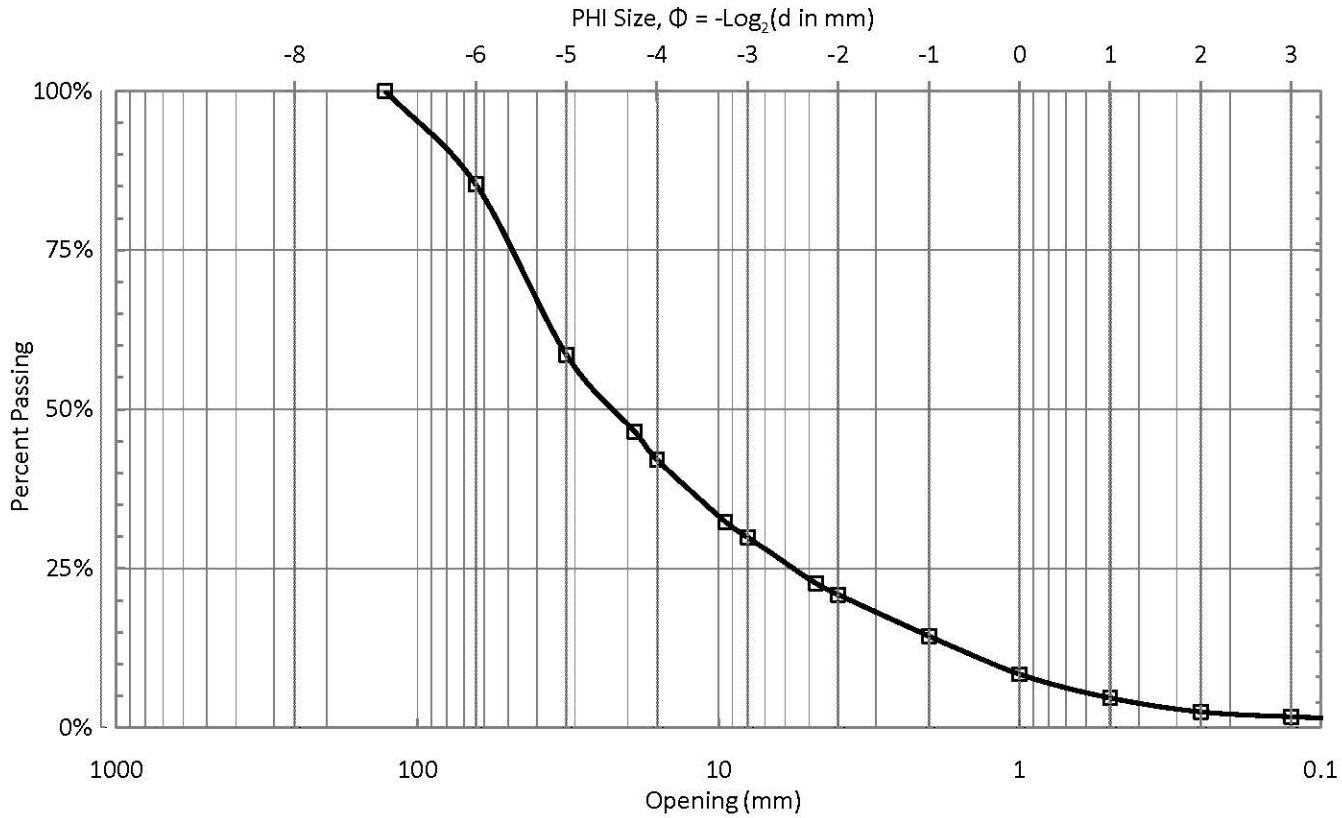
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_7_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	85.3%
1-1/4"	1.3	32	58.6%
3/4"	0.75	19	46.5%
5/8"	0.63	16	42.1%
3/8"	0.37	9.5	32.4%
5/16"	0.31	8.0	29.9%
No. 4	0.187	4.75	22.7%
No. 5	0.16	4.0	20.9%
No. 10	0.079	2.0	14.4%
No. 18	0.039	1.0	8.39%
No. 35	0.020	0.50	4.66%
No. 60	0.010	0.25	2.47%
No. 120	0.0049	0.125	1.70%
No. 200	0.0030	0.075	1.36%
No. 230	0.0025	0.063	1.34%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
15%	71%	13%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	40
D_{50}=	23
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 9.2

Armor

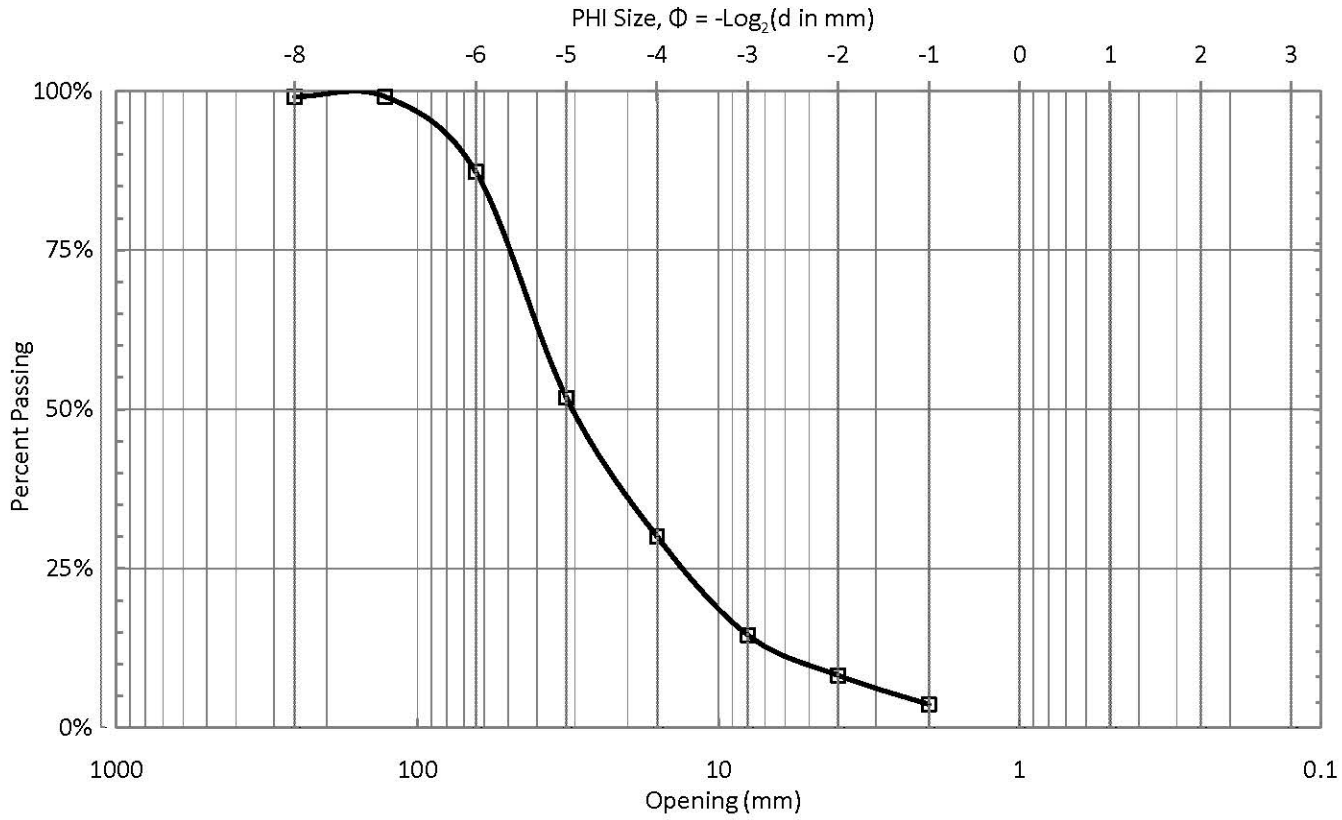
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_8_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	99%
5"	5.0	128	99.1%
2-1/2"	2.5	64	87.3%
1-1/4"	1.3	32	51.8%
5/8"	0.63	16	30.0%
5/16"	0.31	8.0	14.5%
No. 5	0.16	4.0	8.18%
No. 10	0.079	2.0	3.64%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	91%	8%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	44
D_{50}=	31
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 11.4

Armor X

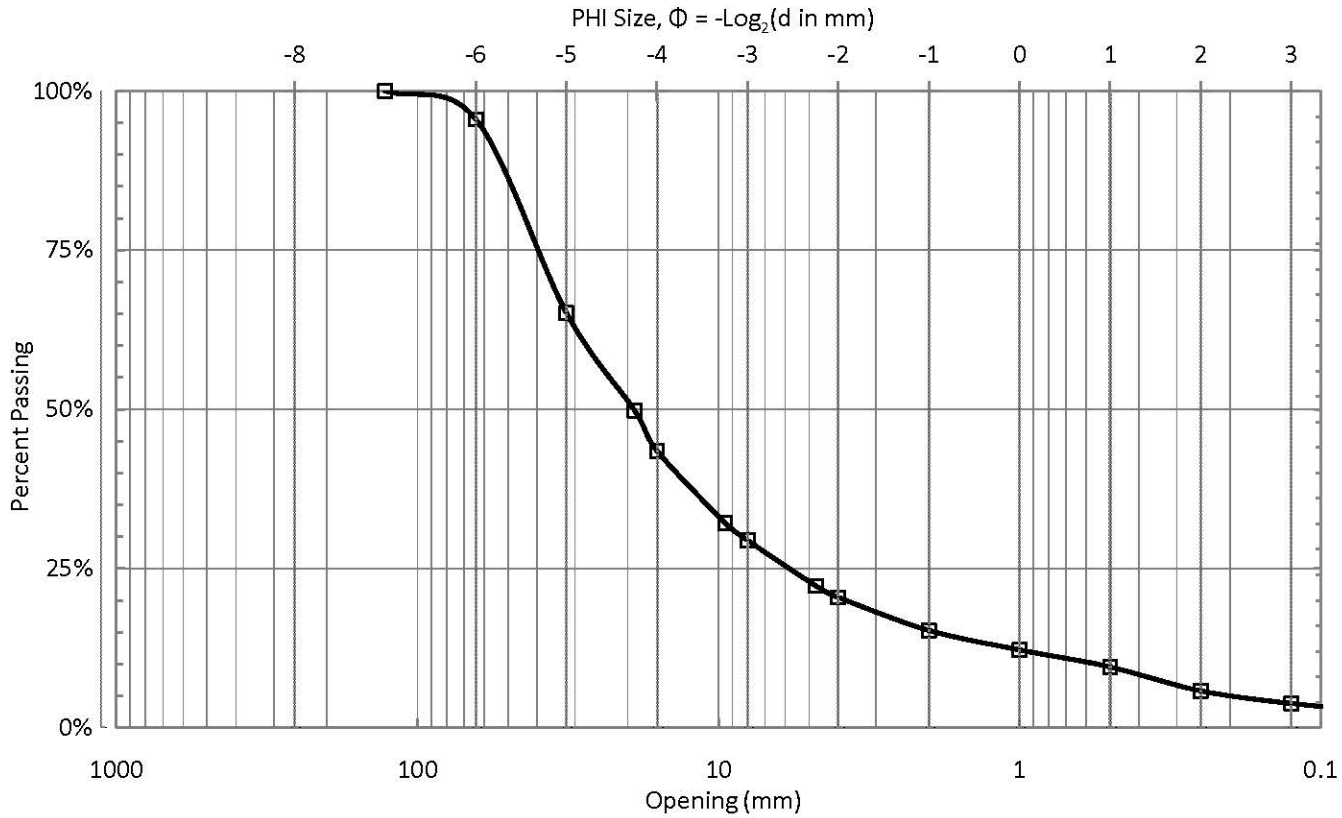
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_8_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	95.6%
1-1/4"	1.3	32	65.1%
3/4"	0.75	19	49.8%
5/8"	0.63	16	43.5%
3/8"	0.37	9.5	32.2%
5/16"	0.31	8.0	29.4%
No. 4	0.187	4.75	22.3%
No. 5	0.16	4.0	20.5%
No. 10	0.079	2.0	15.3%
No. 18	0.039	1.0	12.2%
No. 35	0.020	0.50	9.52%
No. 60	0.010	0.25	5.76%
No. 120	0.0049	0.125	3.79%
No. 200	0.0030	0.075	2.90%
No. 230	0.0025	0.063	2.89%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
4%	80%	12%	3%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	32
D_{50}=	19
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 11.4

Armor

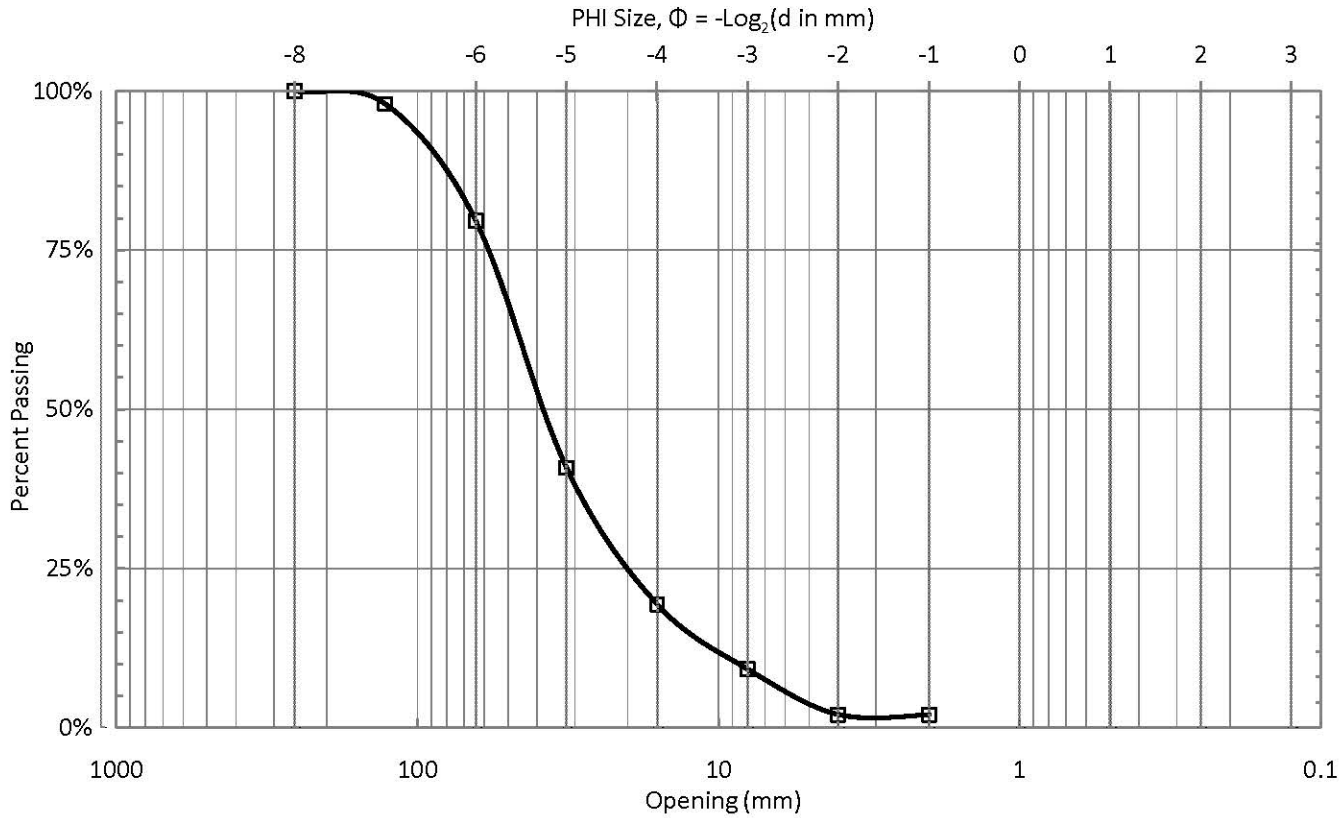
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_9_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	98.0%
2-1/2"	2.5	64	79.6%
1-1/4"	1.3	32	40.8%
5/8"	0.63	16	19.4%
5/16"	0.31	8.0	9.18%
No. 5	0.16	4.0	2.04%
No. 10	0.079	2.0	2.04%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
2%	96%	2%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	52
D_{50}=	40
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile Pataha Cr.

Armor X

Sub-Armor

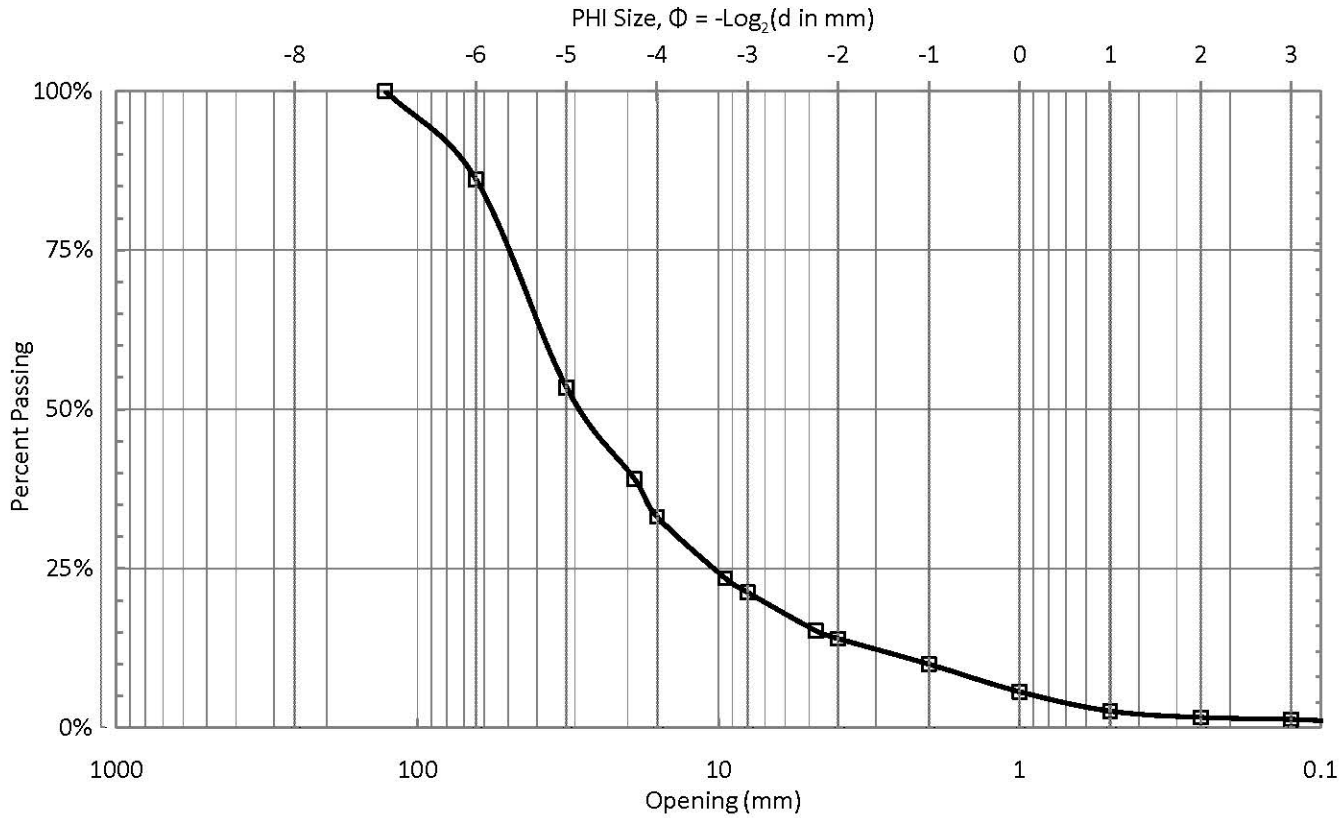
Location Notes

Sample taken in Pataha Creek 1.3 miles upstream of confluence with the Tucannon River. Bar overgrown with grass. Sample taken on riffle.

Sediment Grain Size Distribution Report

Sample ID : TR_9_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	86.2%
1-1/4"	1.3	32	53.4%
3/4"	0.75	19	39.0%
5/8"	0.63	16	33.1%
3/8"	0.37	9.5	23.5%
5/16"	0.31	8.0	21.2%
No. 4	0.187	4.75	15.2%
No. 5	0.16	4.0	14.0%
No. 10	0.079	2.0	9.96%
No. 18	0.039	1.0	5.63%
No. 35	0.020	0.50	2.59%
No. 60	0.010	0.25	1.60%
No. 120	0.0049	0.125	1.29%
No. 200	0.0030	0.075	0.832%
No. 230	0.0025	0.063	0.829%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
14%	76%	9%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	43
D_{50}=	29
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile Pataha Creek

Armor

Sub-Armor X

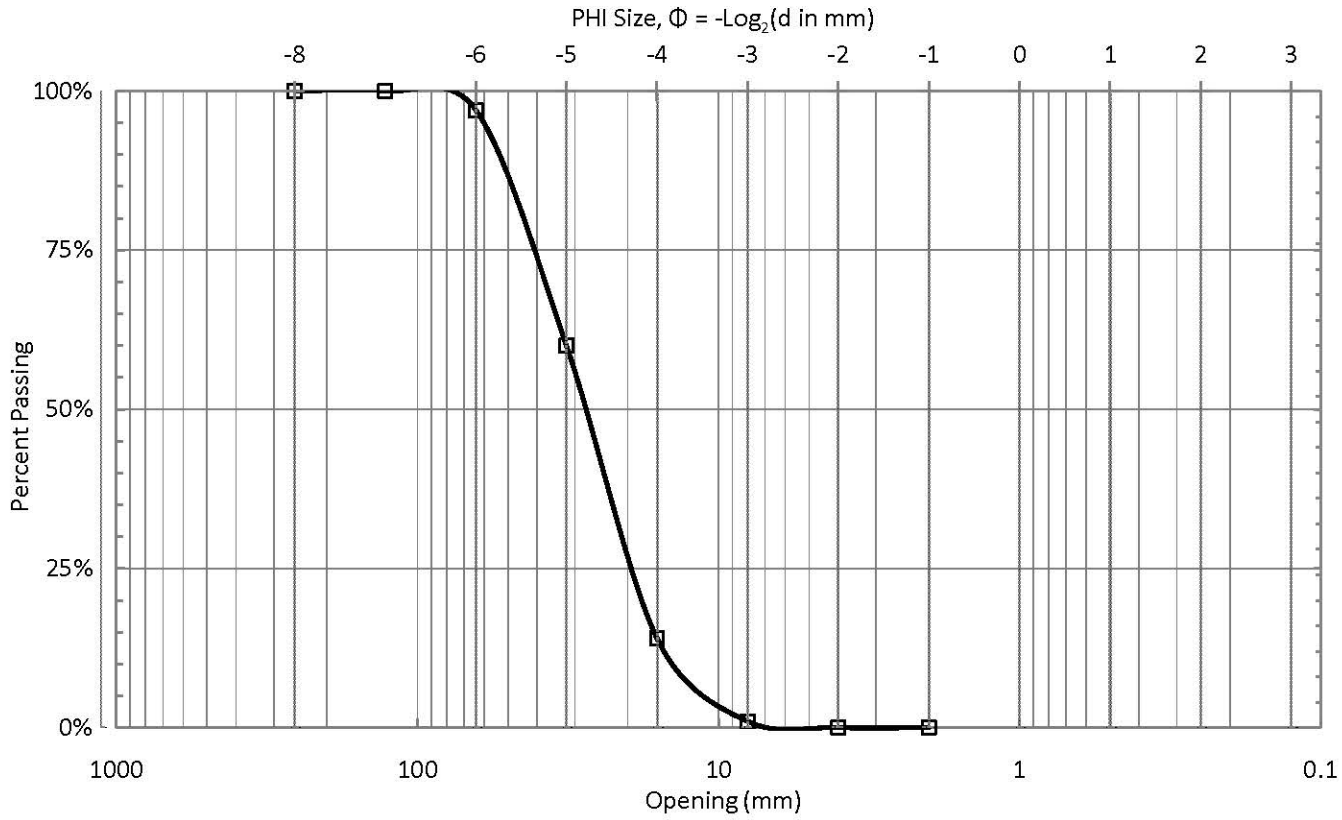
Location Notes

Sample taken in Pataha Creek 1.3 miles upstream of confluence with the Tucannon River. Bar overgrown with grass. Sample taken on riffle.

Sediment Grain Size Distribution Report

Sample ID : TR_10_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	97.0%
1-1/4"	1.3	32	60.0%
5/8"	0.63	16	14.0%
5/16"	0.31	8.0	1.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	100%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	36
D_{50}=	29
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 14.9

Armor X

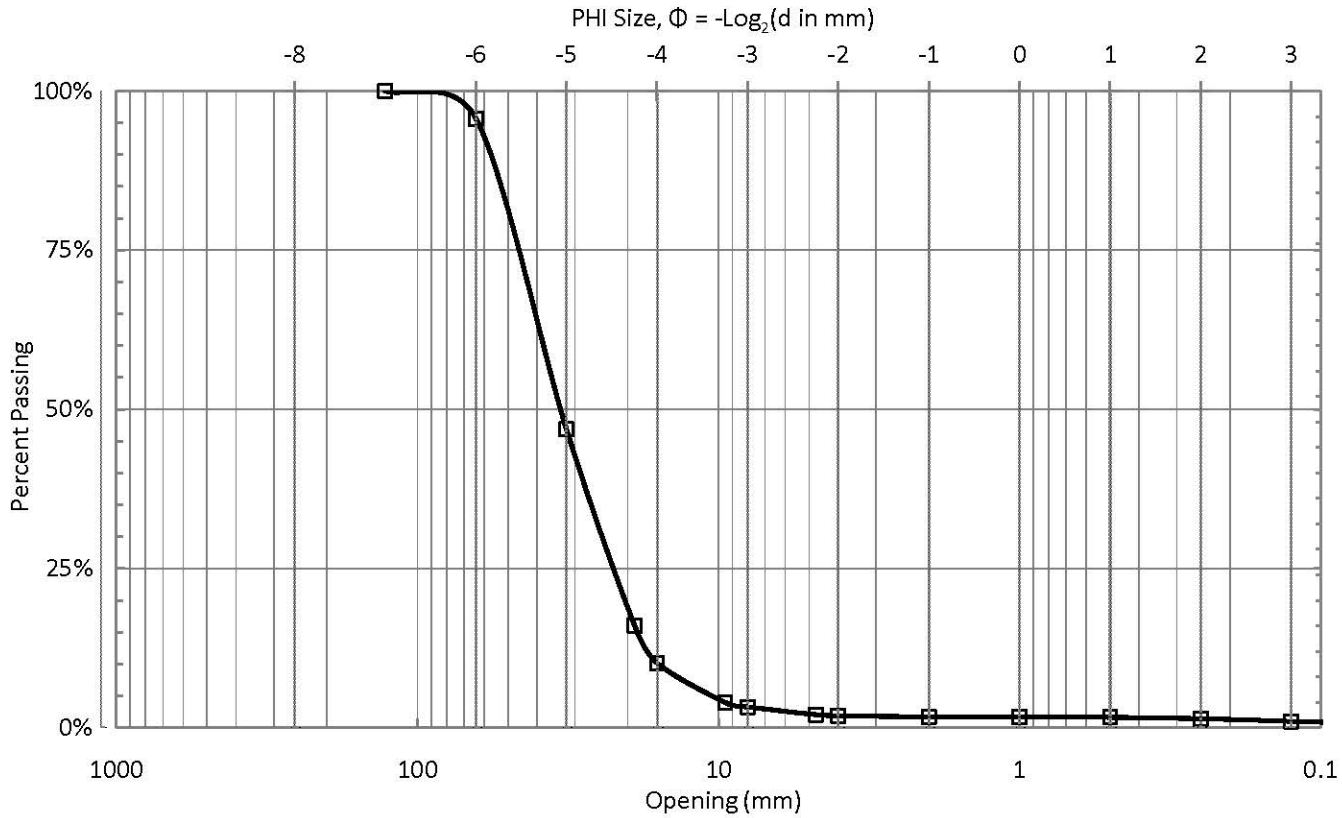
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_10_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	95.7%
1-1/4"	1.3	32	46.9%
3/4"	0.75	19	16.0%
5/8"	0.63	16	10.1%
3/8"	0.37	9.5	3.95%
5/16"	0.31	8.0	3.24%
No. 4	0.187	4.75	2.03%
No. 5	0.16	4.0	1.85%
No. 10	0.079	2.0	1.70%
No. 18	0.039	1.0	1.68%
No. 35	0.020	0.50	1.64%
No. 60	0.010	0.25	1.39%
No. 120	0.0049	0.125	0.970%
No. 200	0.0030	0.075	0.720%
No. 230	0.0025	0.063	0.714%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
4%	94%	1%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	44
D_{50}=	34
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 14.9

Armor

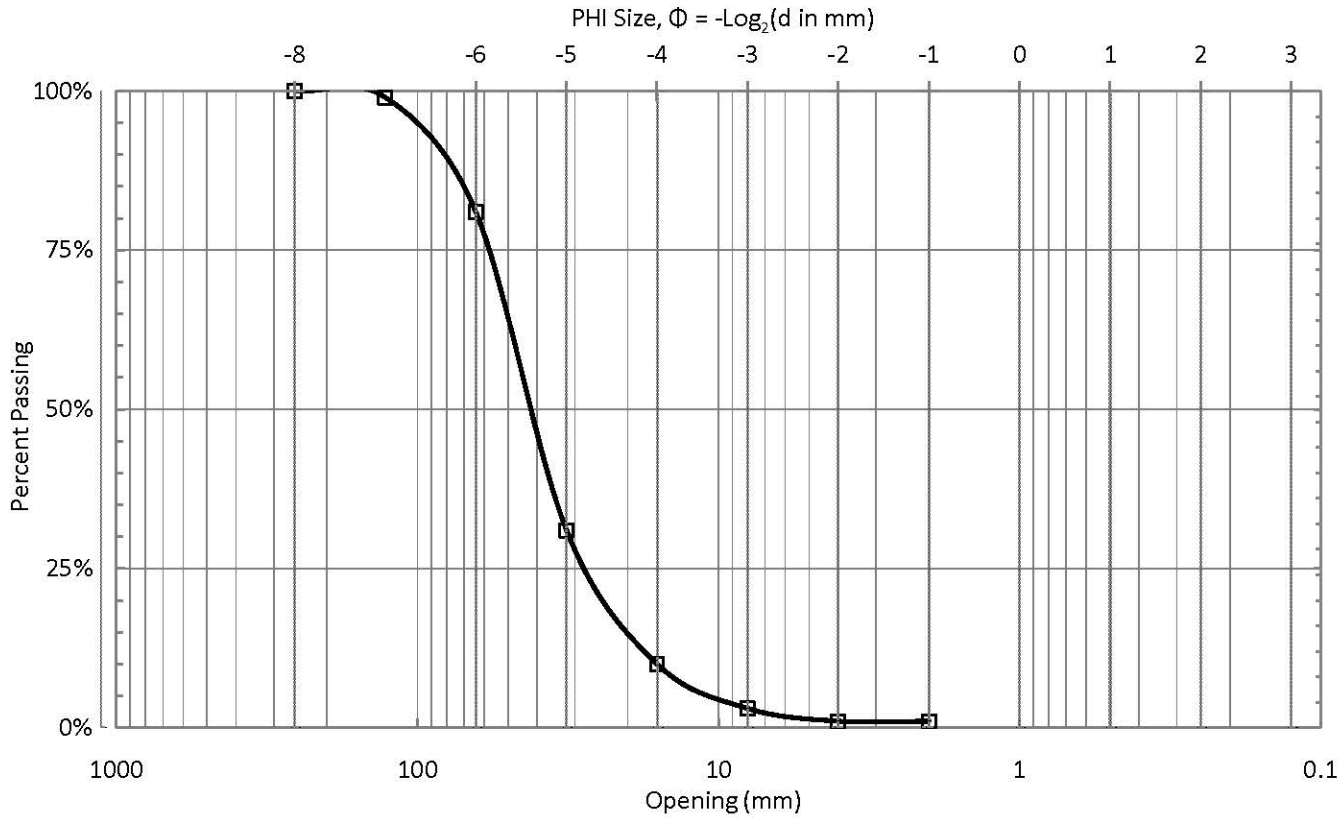
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_11_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	99.0%
2-1/2"	2.5	64	81.0%
1-1/4"	1.3	32	31.0%
5/8"	0.63	16	10.0%
5/16"	0.31	8.0	3.00%
No. 5	0.16	4.0	1.00%
No. 10	0.079	2.0	1.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	98%	1%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	54
D_{50}=	44
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 18.6

Armor X

Sub-Armor

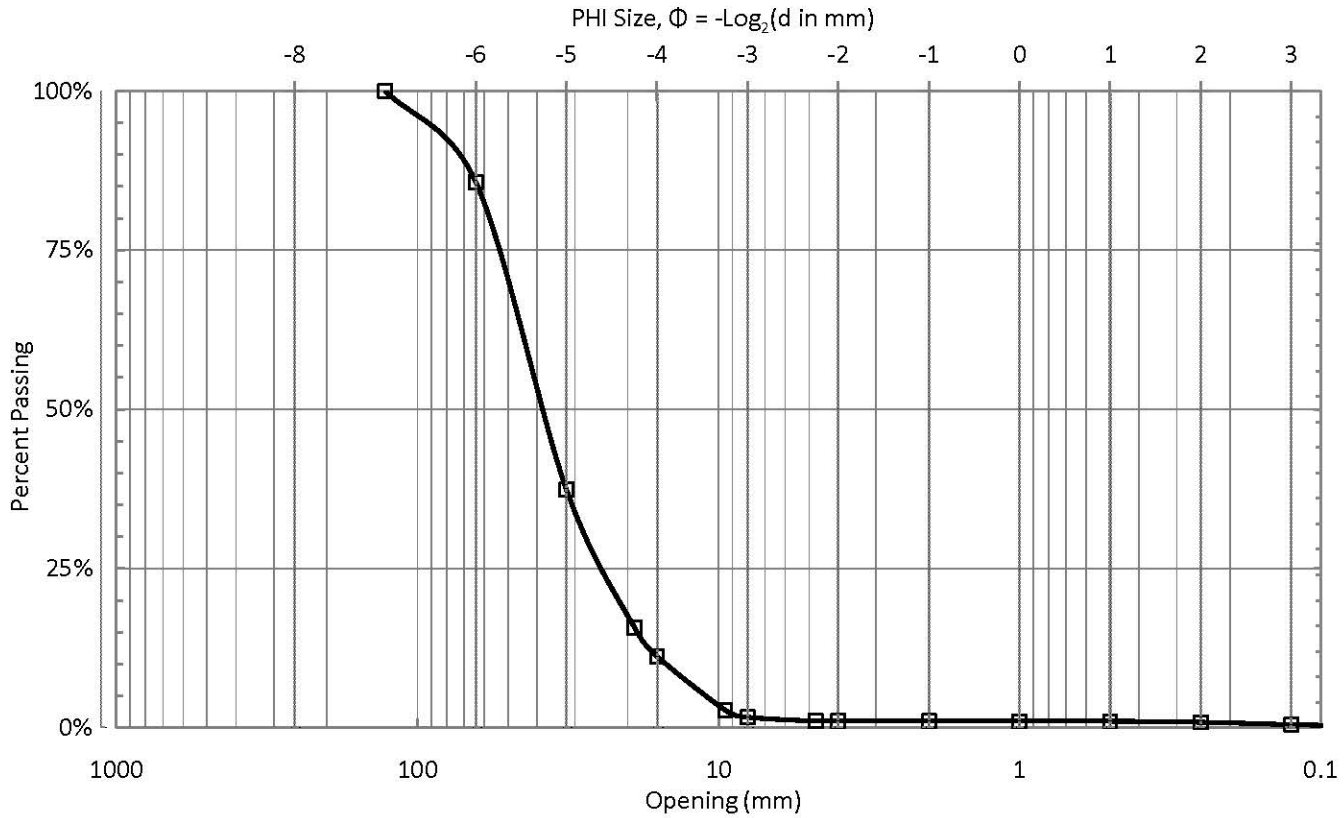
Location Notes

Thick grass on both banks.

Sediment Grain Size Distribution Report

Sample ID : TR_11_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	85.7%
1-1/4"	1.3	32	37.4%
3/4"	0.75	19	15.7%
5/8"	0.63	16	11.2%
3/8"	0.37	9.5	2.76%
5/16"	0.31	8.0	1.63%
No. 4	0.187	4.75	1.04%
No. 5	0.16	4.0	1.03%
No. 10	0.079	2.0	1.02%
No. 18	0.039	1.0	1.01%
No. 35	0.020	0.50	1.00%
No. 60	0.010	0.25	0.855%
No. 120	0.0049	0.125	0.471%
No. 200	0.0030	0.075	0.272%
No. 230	0.0025	0.063	0.272%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
14%	85%	1%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	50
D_{50}=	44
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 18.6

Armor

Sub-Armor X

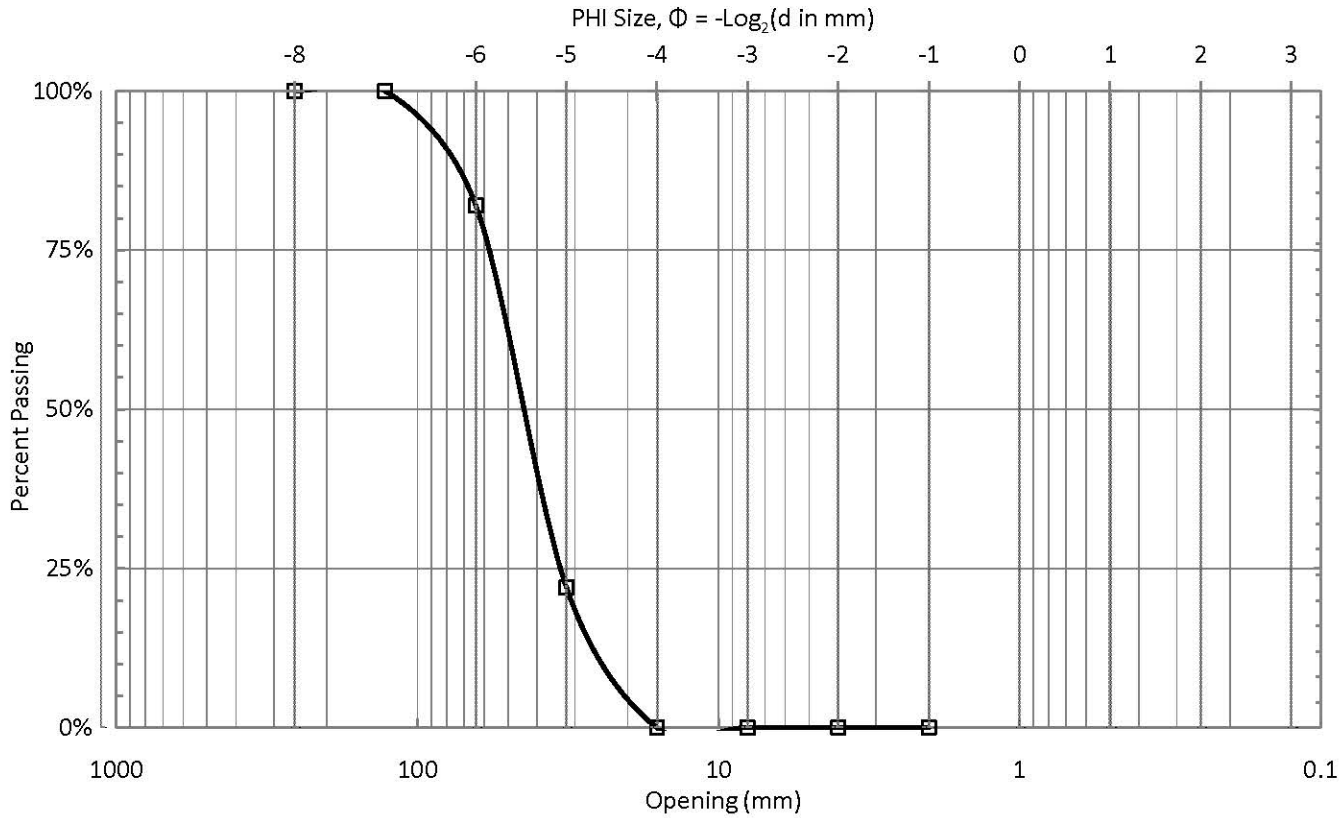
Location Notes

Thick grass on both banks.

Sediment Grain Size Distribution Report

Sample ID : TR_12_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	82.0%
1-1/4"	1.3	32	22.0%
5/8"	0.63	16	0.00%
5/16"	0.31	8.0	0.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	100%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	55
D_{50}=	47
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 21.6

Armor X

Sub-Armor

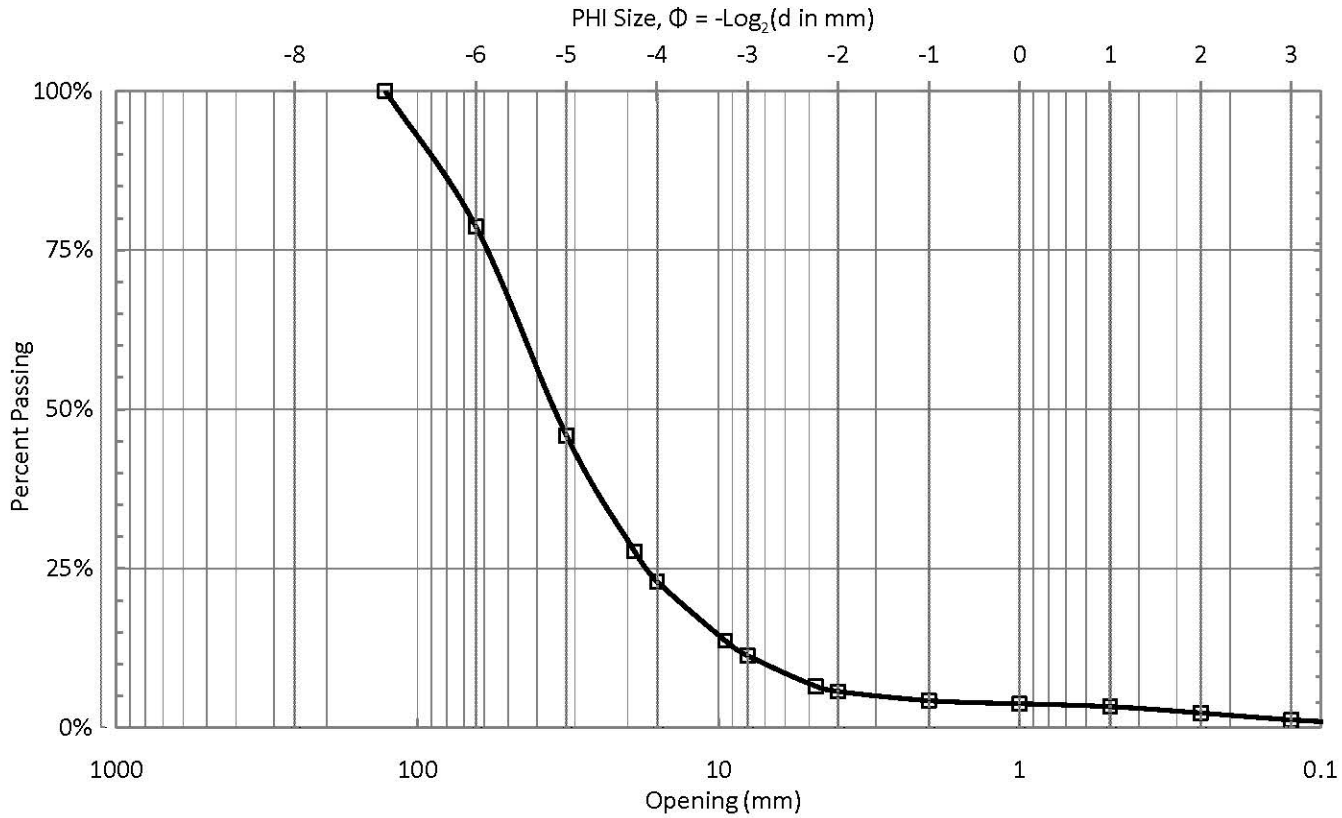
Location Notes

There is another small channel river left that was not sampled.

Sediment Grain Size Distribution Report

Sample ID : TR_12_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	78.7%
1-1/4"	1.3	32	45.9%
3/4"	0.75	19	27.7%
5/8"	0.63	16	23.0%
3/8"	0.37	9.5	13.7%
5/16"	0.31	8.0	11.3%
No. 4	0.187	4.75	6.48%
No. 5	0.16	4.0	5.68%
No. 10	0.079	2.0	4.22%
No. 18	0.039	1.0	3.74%
No. 35	0.020	0.50	3.29%
No. 60	0.010	0.25	2.29%
No. 120	0.0049	0.125	1.21%
No. 200	0.0030	0.075	0.725%
No. 230	0.0025	0.063	0.724%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
21%	74%	3%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	51
D_{50}=	36
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 21.6

Armor

Sub-Armor X

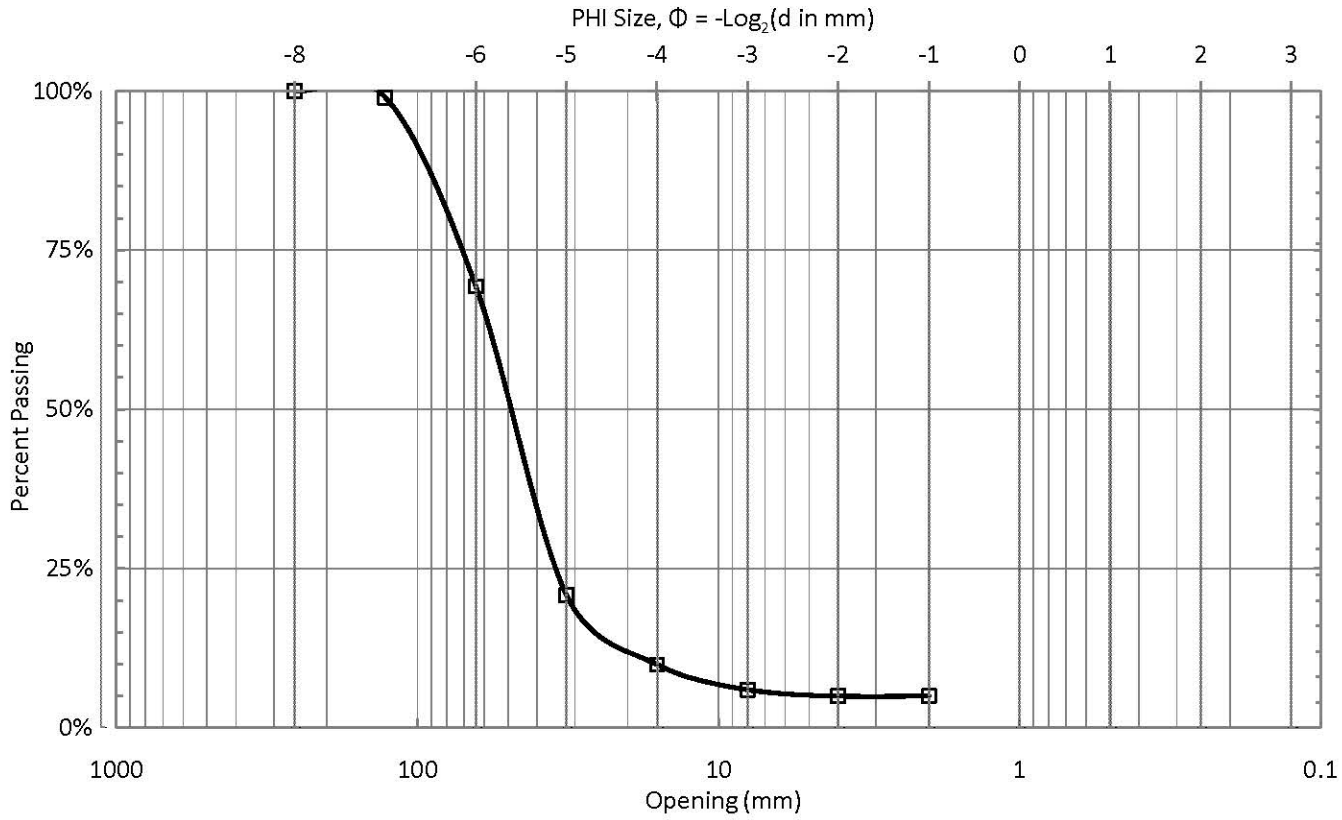
Location Notes

There is another small channel river left that was not sampled.

Sediment Grain Size Distribution Report

Sample ID : TR_13_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	99.0%
2-1/2"	2.5	64	69.3%
1-1/4"	1.3	32	20.8%
5/8"	0.63	16	9.90%
5/16"	0.31	8.0	5.94%
No. 5	0.16	4.0	4.95%
No. 10	0.079	2.0	4.95%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	94%	5%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	61
D_{50}=	51
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 25.1

Armor X

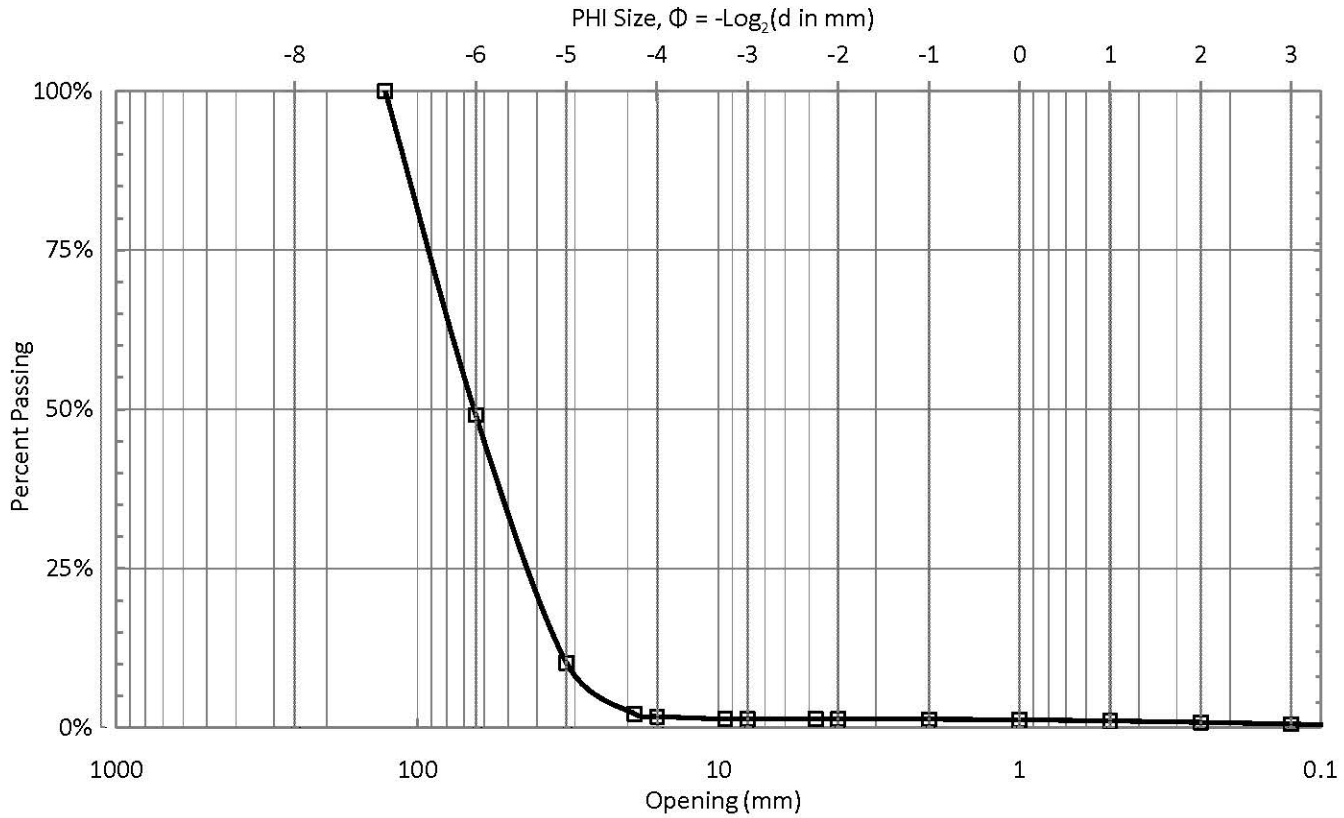
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_13_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	49.1%
1-1/4"	1.3	32	10.2%
3/4"	0.75	19	2.17%
5/8"	0.63	16	1.75%
3/8"	0.37	9.5	1.35%
5/16"	0.31	8.0	1.35%
No. 4	0.187	4.75	1.34%
No. 5	0.16	4.0	1.33%
No. 10	0.079	2.0	1.31%
No. 18	0.039	1.0	1.24%
No. 35	0.020	0.50	1.06%
No. 60	0.010	0.25	0.828%
No. 120	0.0049	0.125	0.552%
No. 200	0.0030	0.075	0.395%
No. 230	0.0025	0.063	0.373%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
51%	48%	1%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	84
D_{50}=	65
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 25.1

Armor

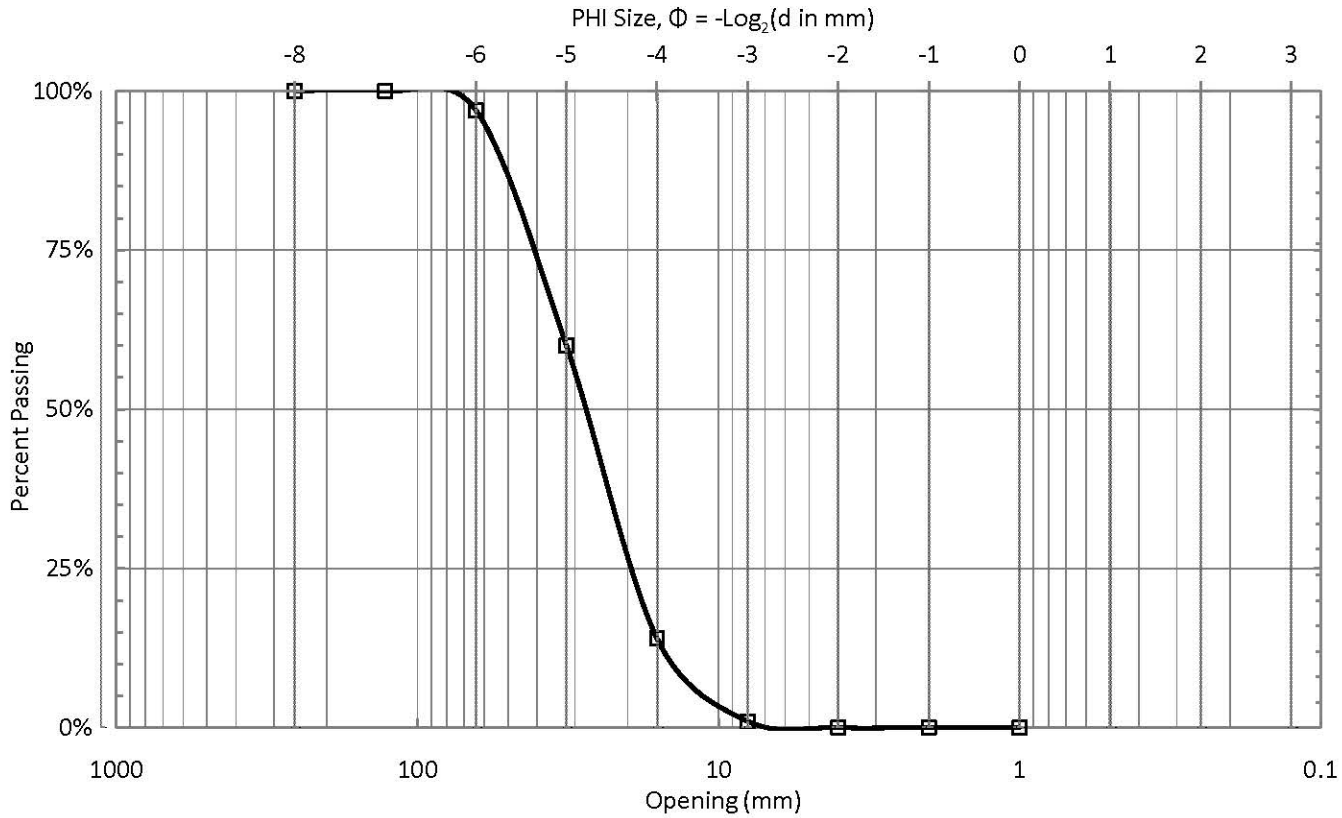
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_14_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	97.0%
1-1/4"	1.3	32	60.0%
5/8"	0.63	16	14.0%
5/16"	0.31	8.0	1.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	100%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	84
D_{50}=	64
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 27.9

Armor X

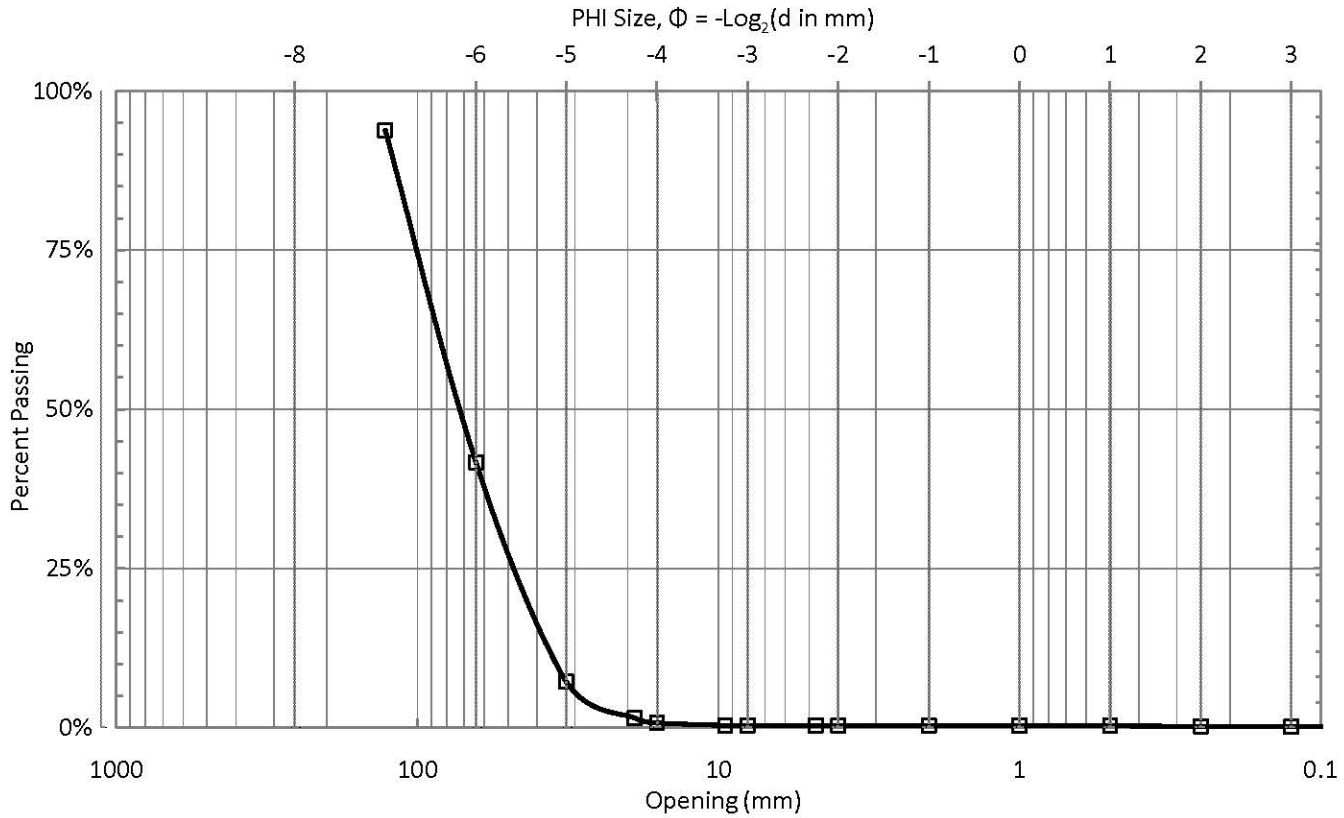
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_14_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	0.939%
2-1/2"	2.5	64	41.7%
1-1/4"	1.3	32	7.21%
3/4"	0.75	19	1.51%
5/8"	0.63	16	0.761%
3/8"	0.37	9.5	0.348%
5/16"	0.31	8.0	0.333%
No. 4	0.187	4.75	0.323%
No. 5	0.16	4.0	0.319%
No. 10	0.079	2.0	0.315%
No. 18	0.039	1.0	0.311%
No. 35	0.020	0.50	0.299%
No. 60	0.010	0.25	0.214%
No. 120	0.0049	0.125	0.117%
No. 200	0.0030	0.075	0.0745%
No. 230	0.0025	0.063	0.0742%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
58%	41%	0%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	93
D_{50}=	74
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 27.9

Armor

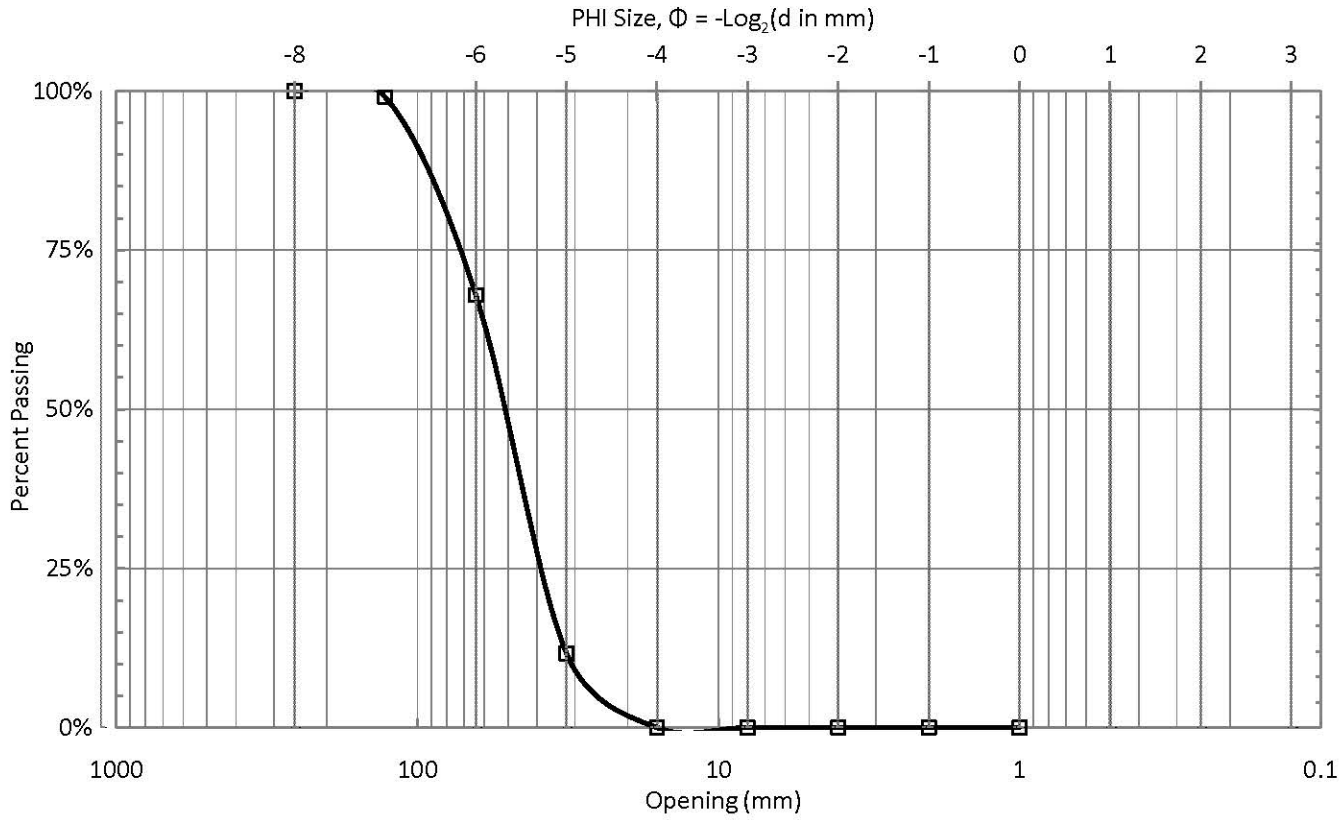
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_15_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	99.0%
2-1/2"	2.5	64	68.0%
1-1/4"	1.3	32	11.7%
5/8"	0.63	16	0.00%
5/16"	0.31	8.0	0.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	99%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	62
D_{50}=	54
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 30.8

Armor X

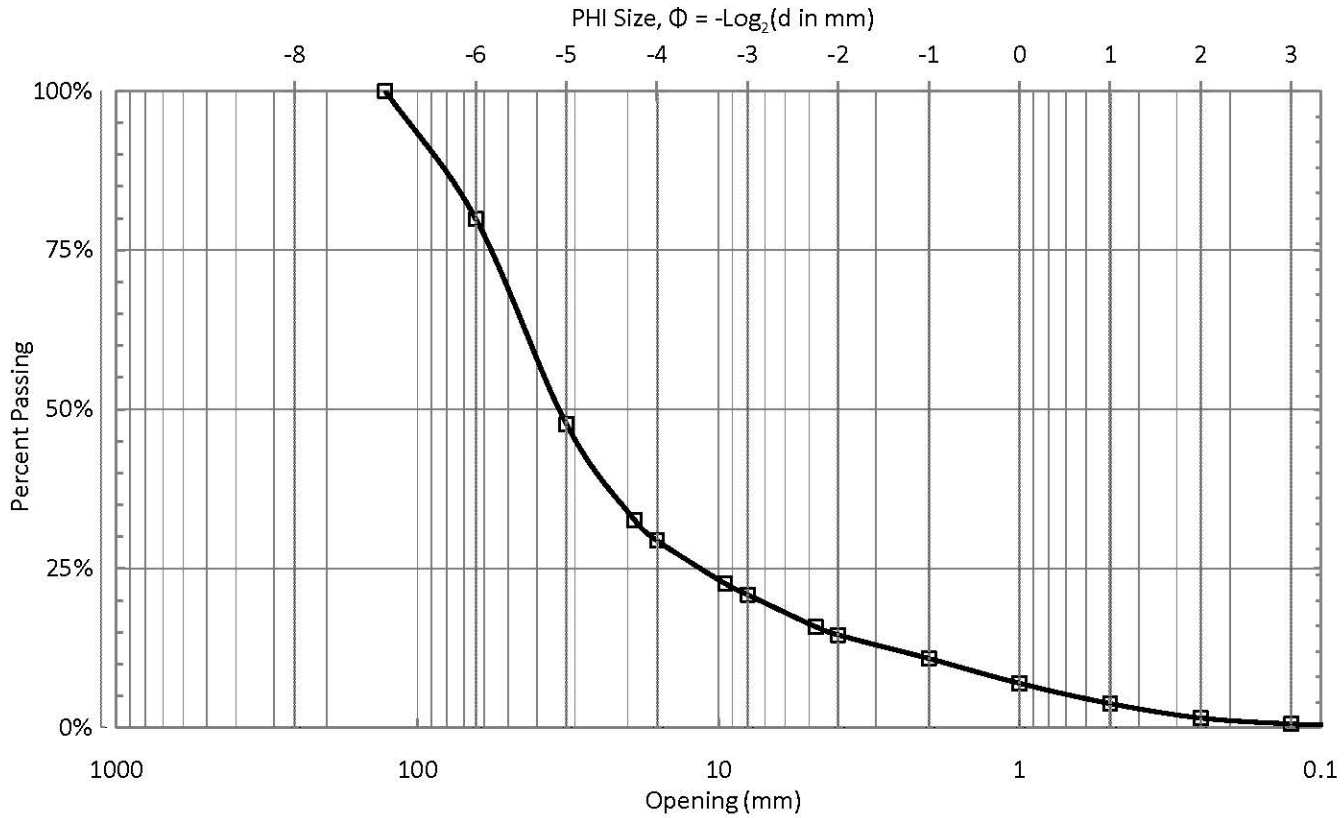
Sub-Armor

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_15_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	79.9%
1-1/4"	1.3	32	47.6%
3/4"	0.75	19	32.6%
5/8"	0.63	16	29.4%
3/8"	0.37	9.5	22.6%
5/16"	0.31	8.0	20.9%
No. 4	0.187	4.75	15.8%
No. 5	0.16	4.0	14.5%
No. 10	0.079	2.0	10.8%
No. 18	0.039	1.0	6.95%
No. 35	0.020	0.50	3.78%
No. 60	0.010	0.25	1.51%
No. 120	0.0049	0.125	0.582%
No. 200	0.0030	0.075	0.356%
No. 230	0.0025	0.063	0.353%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
20%	69%	10%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	49
D_{50}=	34
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 30.8

Armor

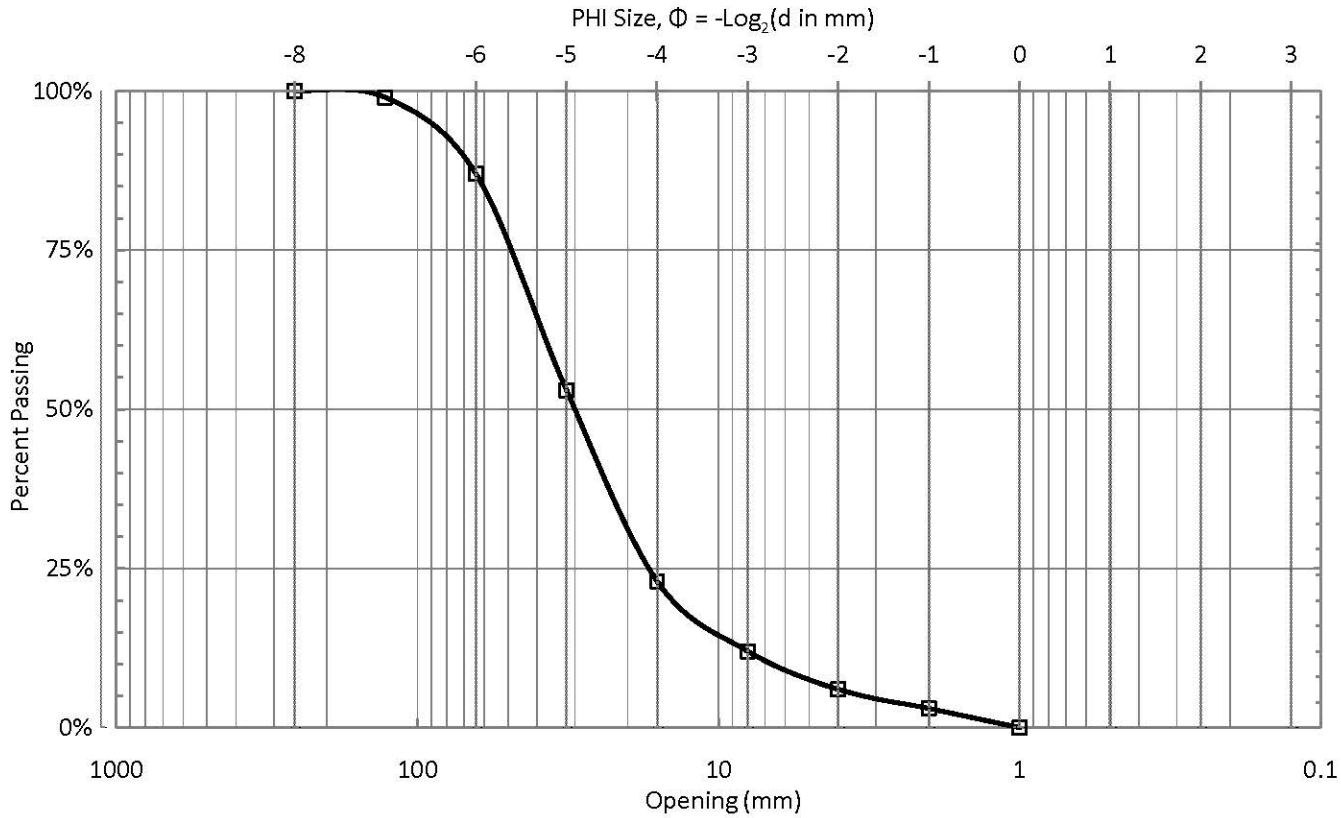
Sub-Armor X

Location Notes

Sediment Grain Size Distribution Report

Sample ID : TR_16_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	99.0%
2-1/2"	2.5	64	87.0%
1-1/4"	1.3	32	53.0%
5/8"	0.63	16	23.0%
5/16"	0.31	8.0	12.0%
No. 5	0.16	4.0	6.00%
No. 10	0.079	2.0	3.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	93%	6%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	43
D_{50}=	30
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 34

Armor X

Sub-Armor

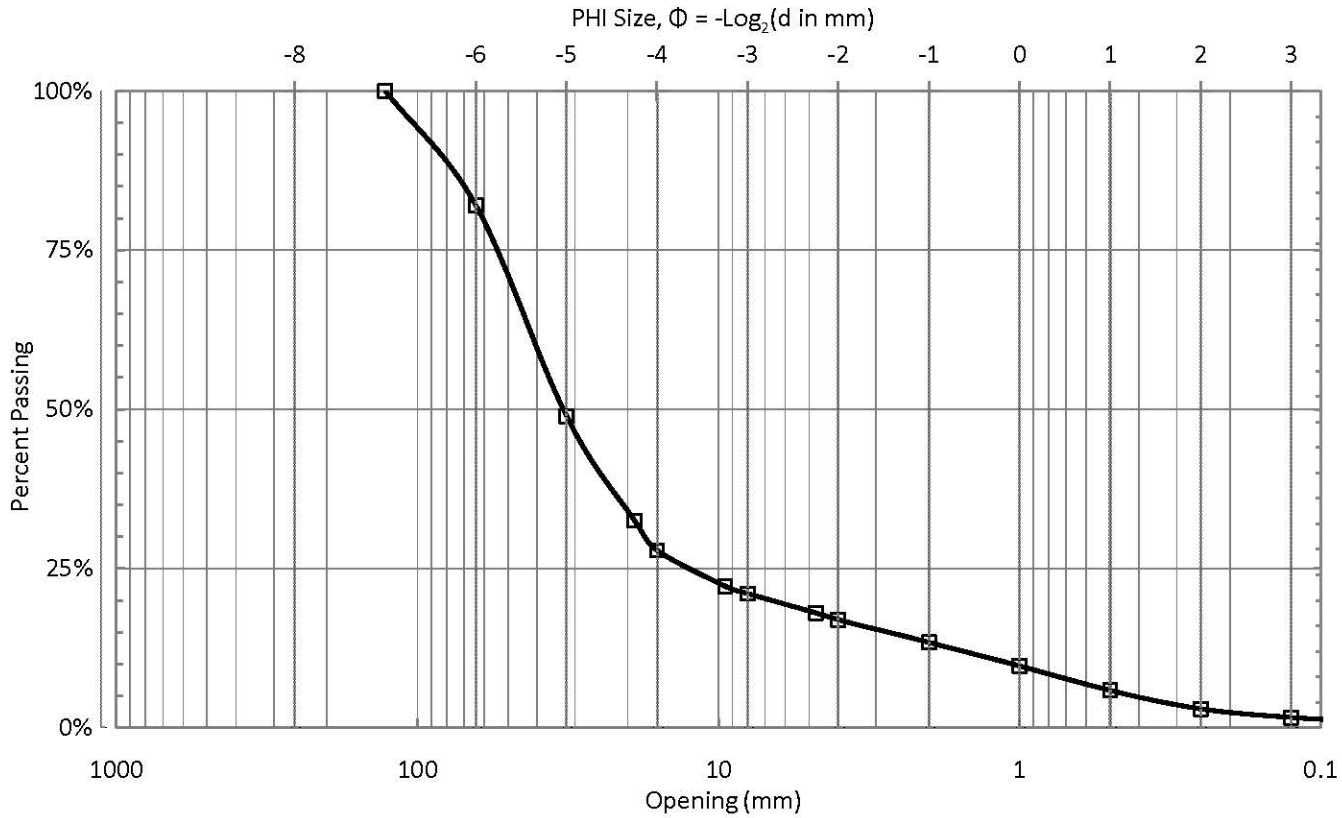
Location Notes

Just downstream of braided section with engineered log jams. Agrading in braided section cobble layer.

Sediment Grain Size Distribution Report

Sample ID : TR_16_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	82.0%
1-1/4"	1.3	32	48.9%
3/4"	0.75	19	32.5%
5/8"	0.63	16	27.8%
3/8"	0.37	9.5	22.2%
5/16"	0.31	8.0	21.1%
No. 4	0.187	4.75	18.0%
No. 5	0.16	4.0	16.9%
No. 10	0.079	2.0	13.4%
No. 18	0.039	1.0	9.70%
No. 35	0.020	0.50	5.84%
No. 60	0.010	0.25	2.93%
No. 120	0.0049	0.125	1.59%
No. 200	0.0030	0.075	1.08%
No. 230	0.0025	0.063	1.06%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
18%	69%	12%	1%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	48
D_{50}=	33
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 34

Armor

Sub-Armor X

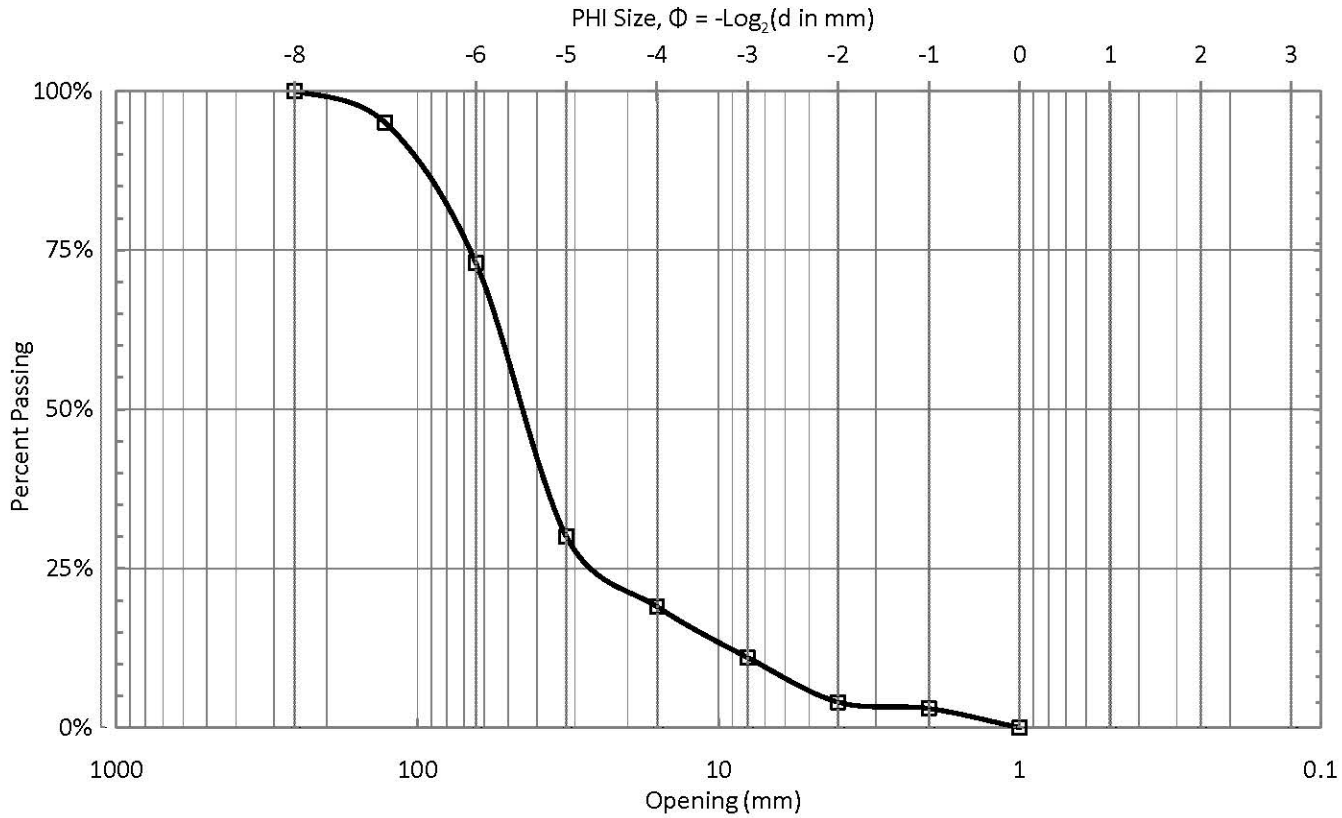
Location Notes

Just downstream of braided section with engineered log jams. Agrading in braided section cobble layer.

Sediment Grain Size Distribution Report

Sample ID : TR_17_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	95.0%
2-1/2"	2.5	64	73.0%
1-1/4"	1.3	32	30.0%
5/8"	0.63	16	19.0%
5/16"	0.31	8.0	11.0%
No. 5	0.16	4.0	4.00%
No. 10	0.079	2.0	3.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
5%	91%	4%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	58
D_{50}=	47
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 37.6

Armor X

Sub-Armor

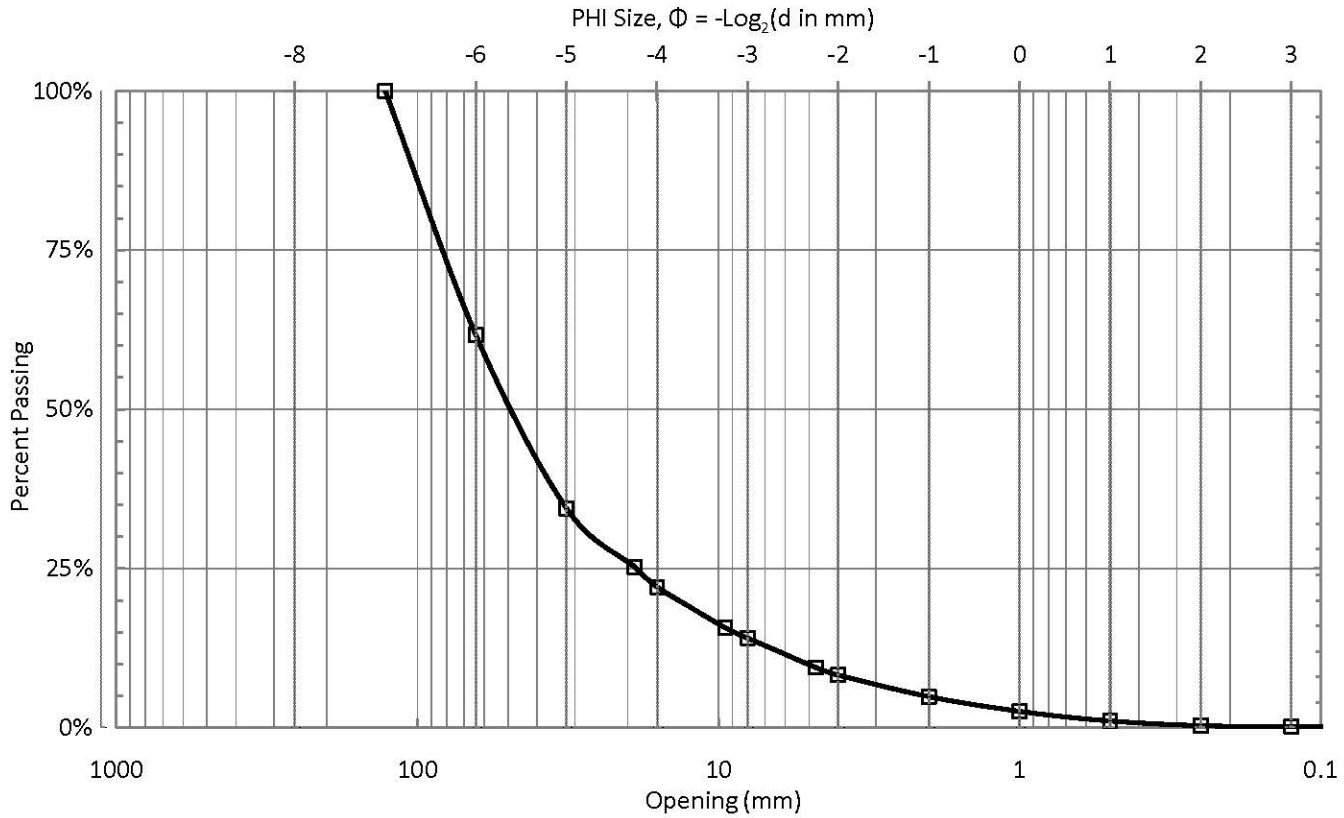
Location Notes

Taken on left bank point bar.

Sediment Grain Size Distribution Report

Sample ID : TR_17_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	61.7%
1-1/4"	1.3	32	34.4%
3/4"	0.75	19	25.2%
5/8"	0.63	16	22.1%
3/8"	0.37	9.5	15.7%
5/16"	0.31	8.0	14.1%
No. 4	0.187	4.75	9.44%
No. 5	0.16	4.0	8.25%
No. 10	0.079	2.0	4.86%
No. 18	0.039	1.0	2.56%
No. 35	0.020	0.50	1.04%
No. 60	0.010	0.25	0.311%
No. 120	0.0049	0.125	0.150%
No. 200	0.0030	0.075	0.105%
No. 230	0.0025	0.063	0.104%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
38%	57%	5%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	70
D_{50}=	50
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 37.6

Armor

Sub-Armor X

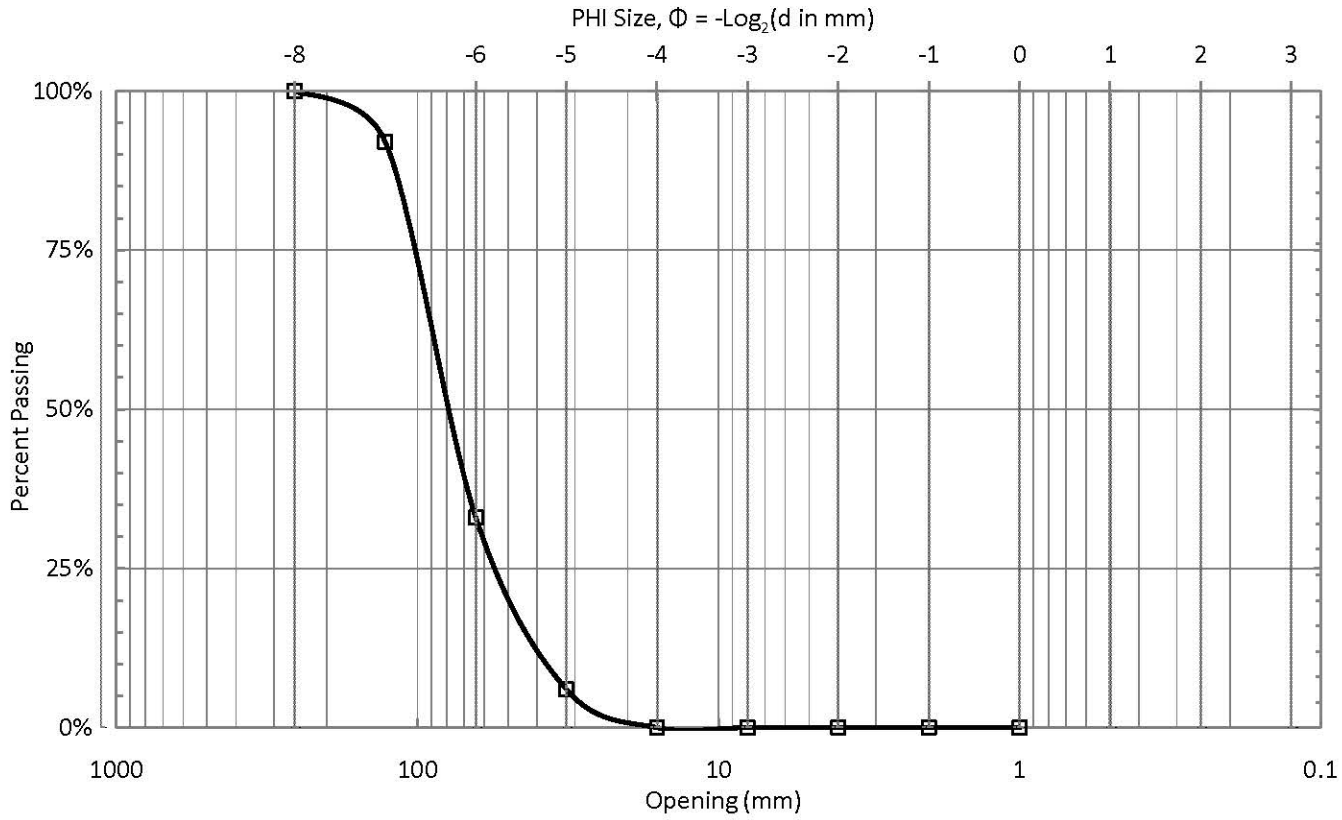
Location Notes

Taken on left bank point bar.

Sediment Grain Size Distribution Report

Sample ID : TR_18_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	92.0%
2-1/2"	2.5	64	33.0%
1-1/4"	1.3	32	6.00%
5/8"	0.63	16	0.00%
5/16"	0.31	8.0	0.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
8%	92%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	99
D_{50}=	82
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 42.1

Armor X

Sub-Armor

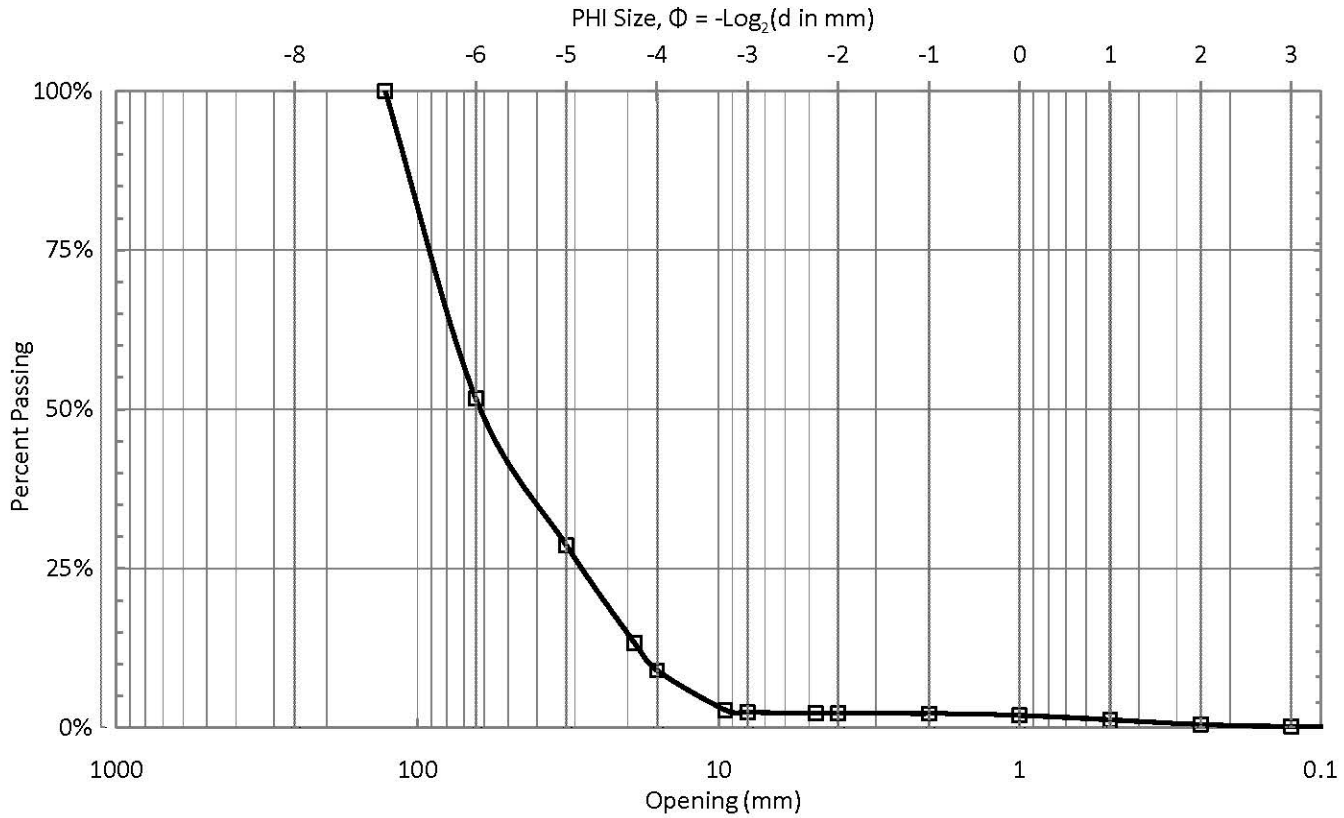
Location Notes

Bedrock on river left 30 ft upstream of site with deep pool.

Sediment Grain Size Distribution Report

Sample ID : TR_18_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	0.939%
2-1/2"	2.5	64	51.7%
1-1/4"	1.3	32	28.6%
3/4"	0.75	19	13.3%
5/8"	0.63	16	8.99%
3/8"	0.37	9.5	2.76%
5/16"	0.31	8.0	2.41%
No. 4	0.187	4.75	2.26%
No. 5	0.16	4.0	2.25%
No. 10	0.079	2.0	2.20%
No. 18	0.039	1.0	1.93%
No. 35	0.020	0.50	1.23%
No. 60	0.010	0.25	0.475%
No. 120	0.0049	0.125	0.190%
No. 200	0.0030	0.075	0.110%
No. 230	0.0025	0.063	0.110%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
48%	49%	2%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	82
D_{50}=	62
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 42.1

Armor

Sub-Armor X

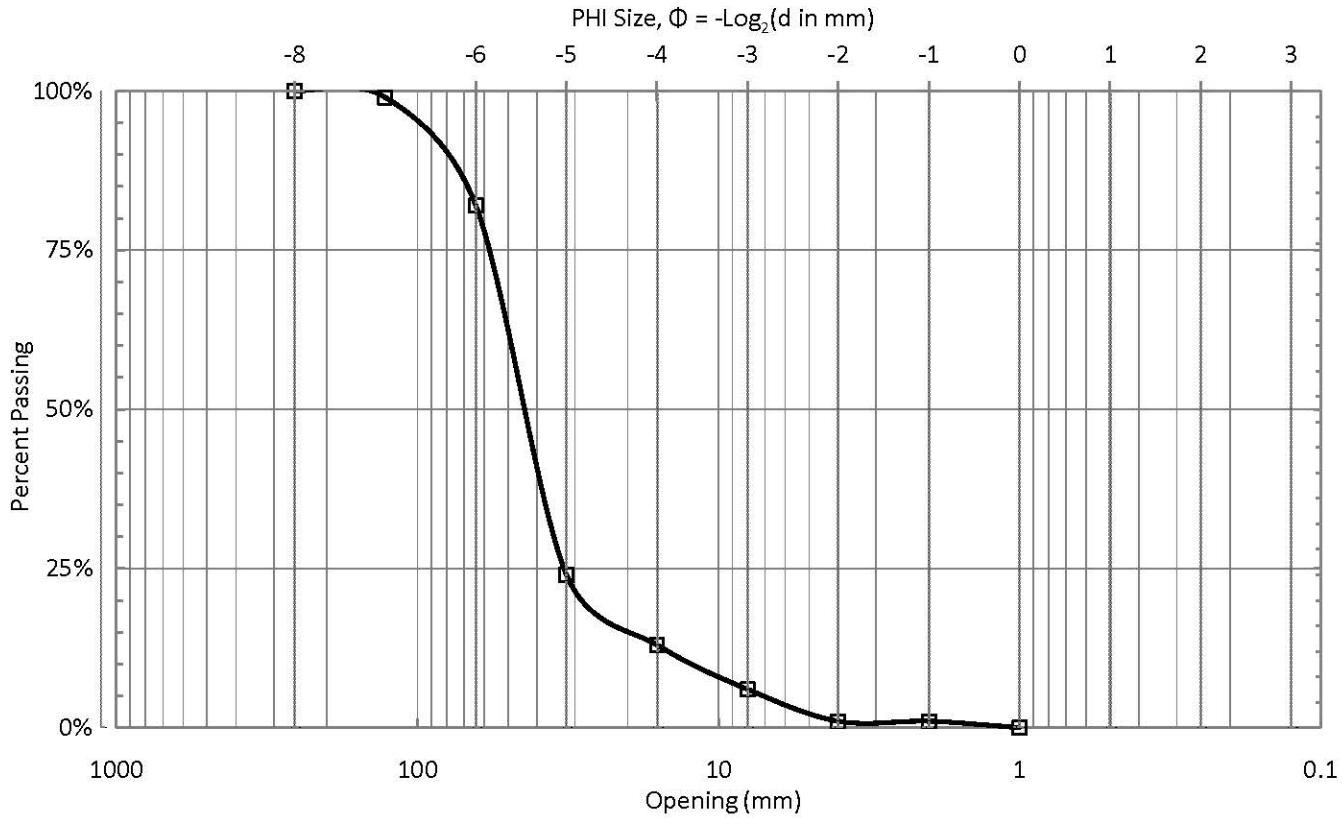
Location Notes

Bedrock on river left 30 ft upstream of site with deep pool.

Sediment Grain Size Distribution Report

Sample ID : TR_19_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	99.0%
2-1/2"	2.5	64	82.0%
1-1/4"	1.3	32	24.0%
5/8"	0.63	16	13.0%
5/16"	0.31	8.0	1.00%
No. 5	0.16	4.0	1.00%
No. 10	0.079	2.0	1.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
1%	98%	1%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	55
D_{50}=	46
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 45.8

Armor X

Sub-Armor

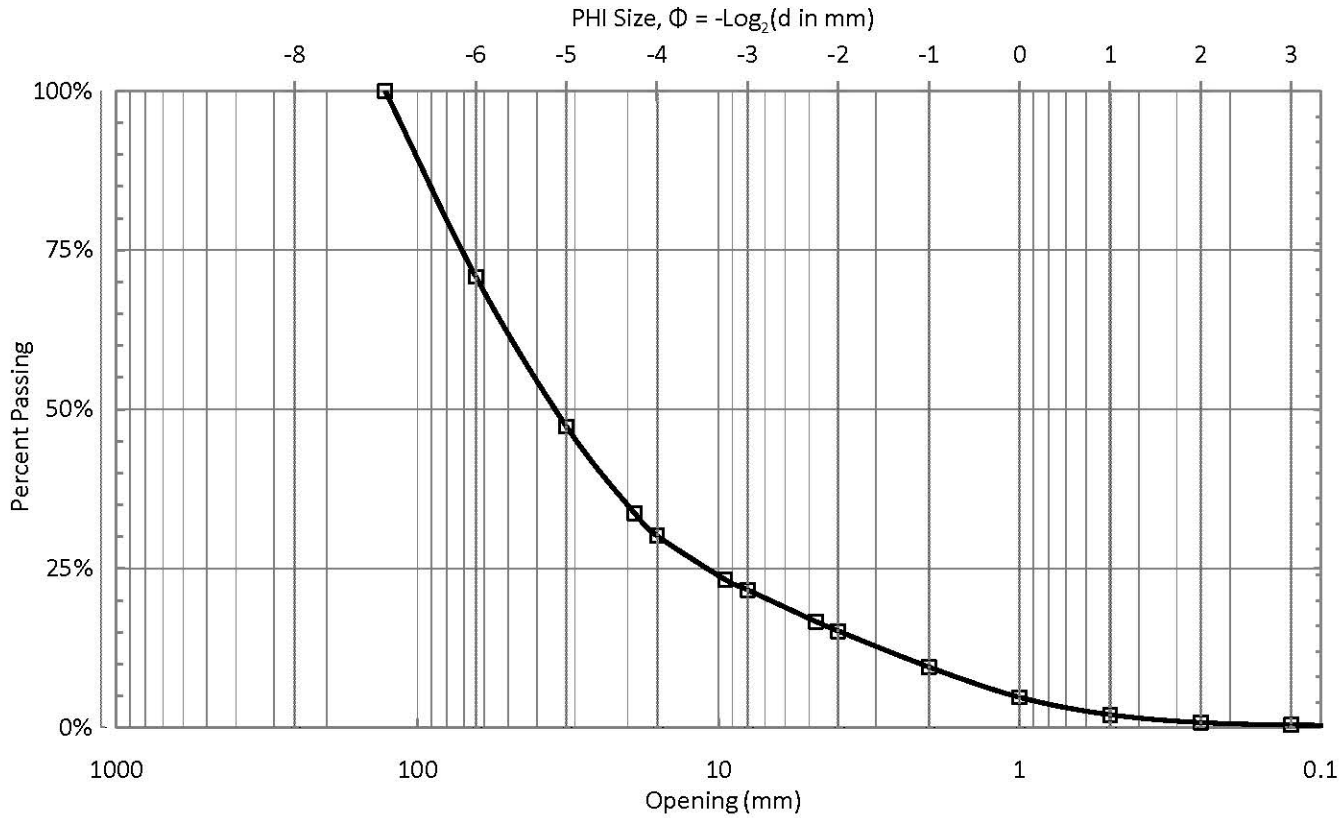
Location Notes

Mid-channel bar just downstream of Tucannon Campground.

Sediment Grain Size Distribution Report

Sample ID : TR_19_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	70.8%
1-1/4"	1.3	32	47.3%
3/4"	0.75	19	33.7%
5/8"	0.63	16	30.1%
3/8"	0.37	9.5	23.2%
5/16"	0.31	8.0	21.6%
No. 4	0.187	4.75	16.7%
No. 5	0.16	4.0	15.2%
No. 10	0.079	2.0	9.52%
No. 18	0.039	1.0	4.77%
No. 35	0.020	0.50	2.02%
No. 60	0.010	0.25	0.795%
No. 120	0.0049	0.125	0.425%
No. 200	0.0030	0.075	0.296%
No. 230	0.0025	0.063	0.293%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
29%	61%	9%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	56
D_{50}=	36
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 45.8

Armor

Sub-Armor X

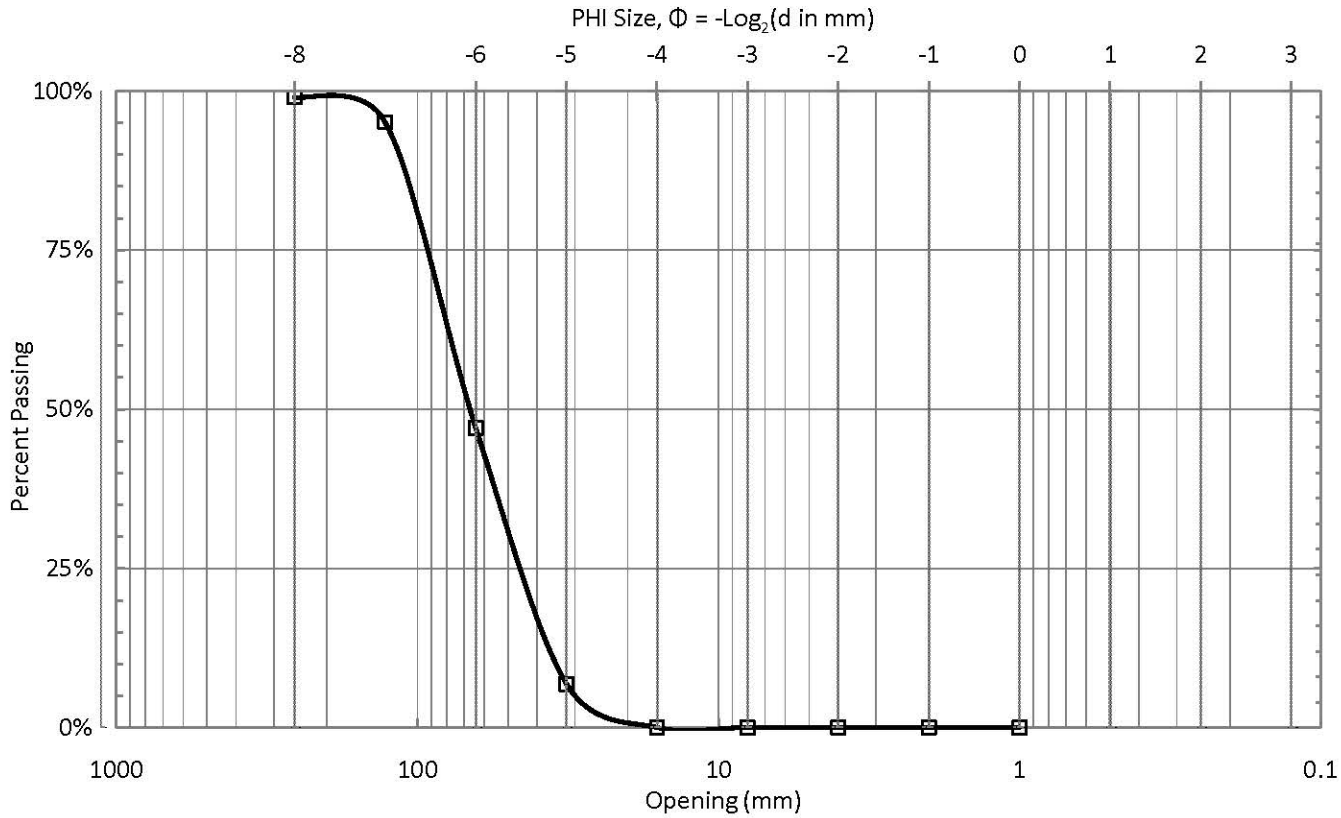
Location Notes

Mid-channel bar just downstream of Tucannon Campground.

Sediment Grain Size Distribution Report

Sample ID : TR_20_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	99.0%
5"	5.0	128	95.1%
2-1/2"	2.5	64	47.1%
1-1/4"	1.3	32	6.86%
5/8"	0.63	16	0.00%
5/16"	0.31	8.0	0.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
5%	95%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	88
D_{50}=	68
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 49.1

Armor X

Sub-Armor

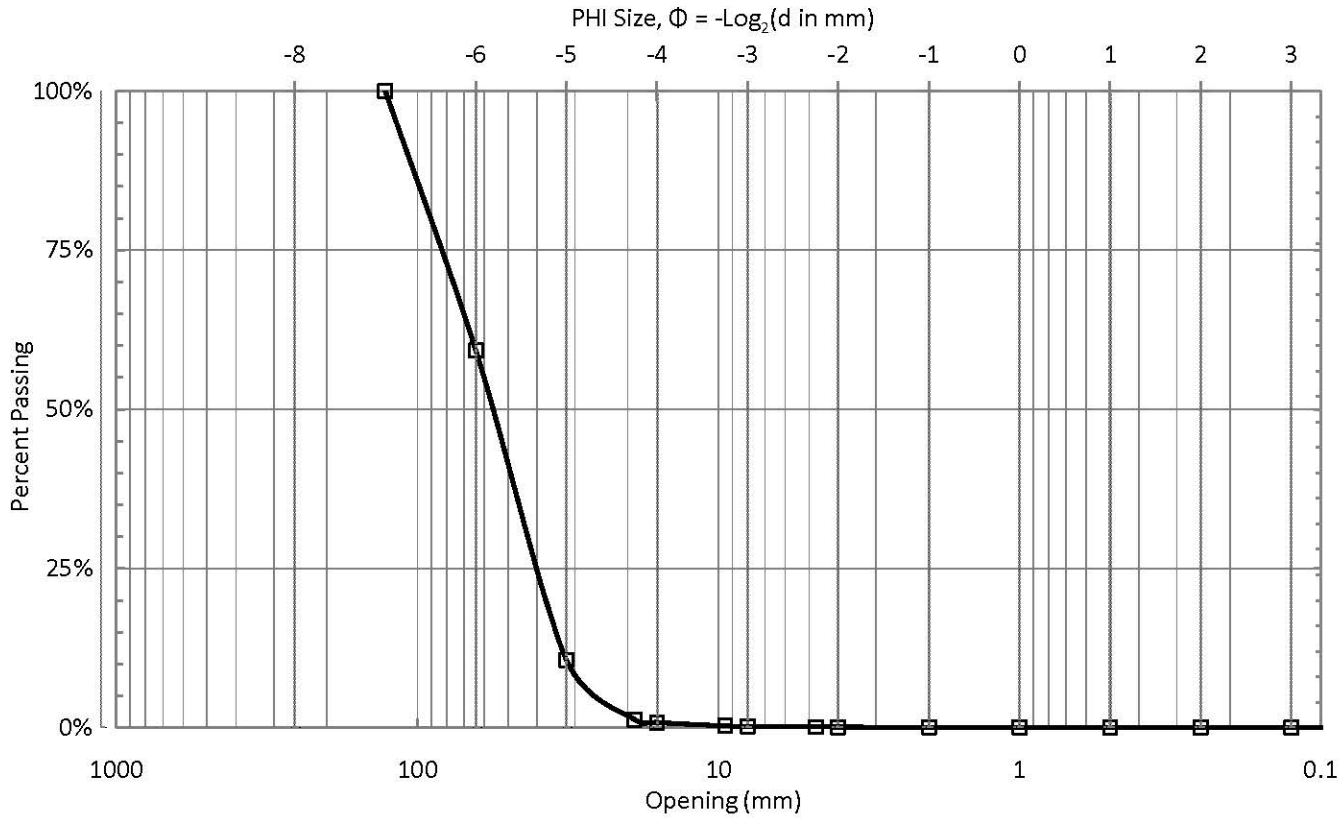
Location Notes

Right bank bar adjacent to campsite.

Sediment Grain Size Distribution Report

Sample ID : TR_20_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	59.2%
1-1/4"	1.3	32	10.6%
3/4"	0.75	19	1.27%
5/8"	0.63	16	0.803%
3/8"	0.37	9.5	0.274%
5/16"	0.31	8.0	0.208%
No. 4	0.187	4.75	0.101%
No. 5	0.16	4.0	0.0864%
No. 10	0.079	2.0	0.0640%
No. 18	0.039	1.0	0.0530%
No. 35	0.020	0.50	0.0392%
No. 60	0.010	0.25	0.0248%
No. 120	0.0049	0.125	0.0175%
No. 200	0.0030	0.075	0.0144%
No. 230	0.0025	0.063	0.0141%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
41%	59%	0%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	73
D_{50}=	58
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 49.1

Armor

Sub-Armor X

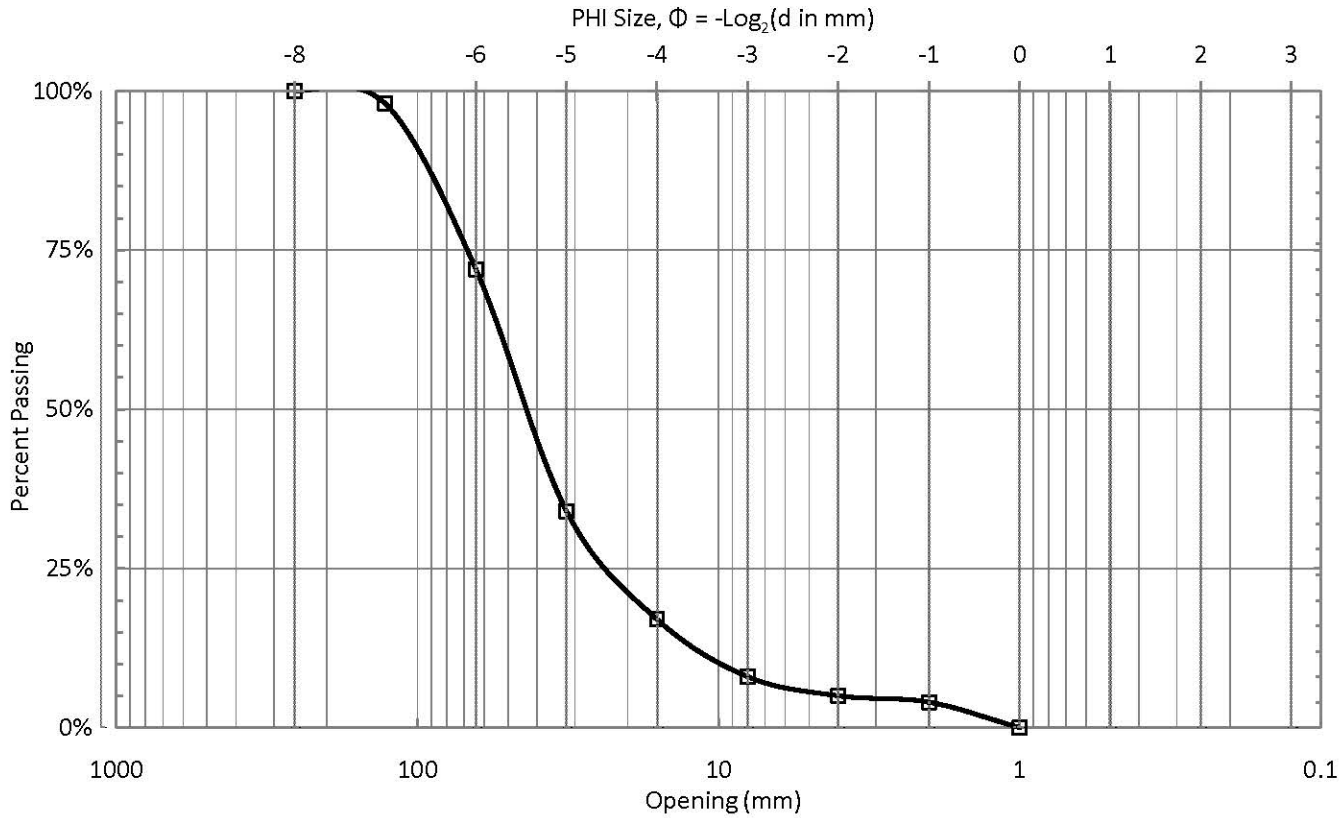
Location Notes

Right bank bar adjacent to campsite.

Sediment Grain Size Distribution Report

Sample ID : TR_21_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	98.0%
2-1/2"	2.5	64	72.0%
1-1/4"	1.3	32	34.0%
5/8"	0.63	16	17.0%
5/16"	0.31	8.0	8.00%
No. 5	0.16	4.0	5.00%
No. 10	0.079	2.0	4.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
2%	93%	5%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	58
D_{50}=	45
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 50.3

Armor X

Sub-Armor

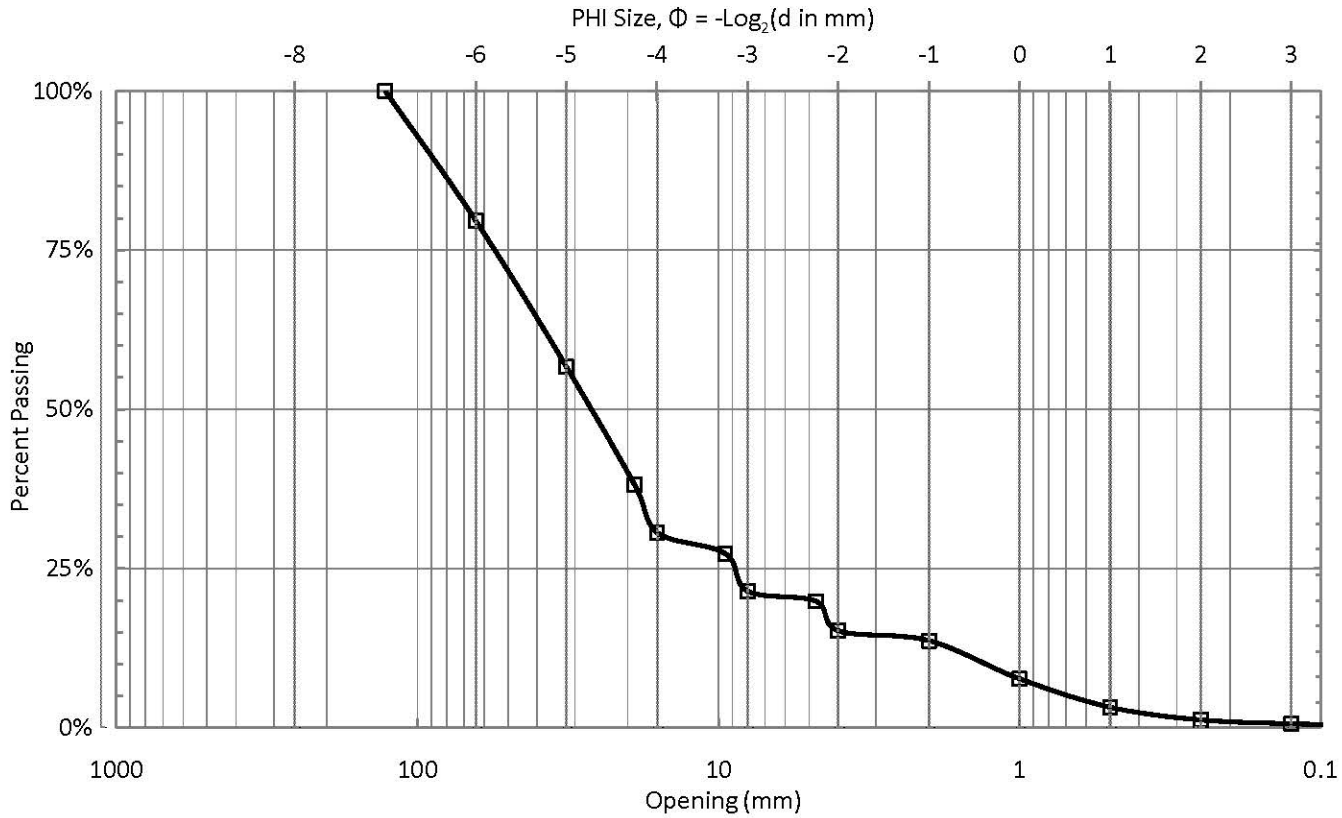
Location Notes

Sample taken in Panjab Creek near the confluence with the Tucannon River at river mile 50.3. Lots of large wood in stream. Side channel bar upstream.

Sediment Grain Size Distribution Report

Sample ID : TR_21_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	79.6%
1-1/4"	1.3	32	56.7%
3/4"	0.75	19	38.1%
5/8"	0.63	16	30.6%
3/8"	0.37	9.5	27.3%
5/16"	0.31	8.0	21.4%
No. 4	0.187	4.75	19.9%
No. 5	0.16	4.0	15.2%
No. 10	0.079	2.0	13.7%
No. 18	0.039	1.0	7.67%
No. 35	0.020	0.50	3.20%
No. 60	0.010	0.25	1.21%
No. 120	0.0049	0.125	0.602%
No. 200	0.0030	0.075	0.392%
No. 230	0.0025	0.063	0.291%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
20%	72%	7%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	87
D_{50}=	52
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 50.3

Armor

Sub-Armor X

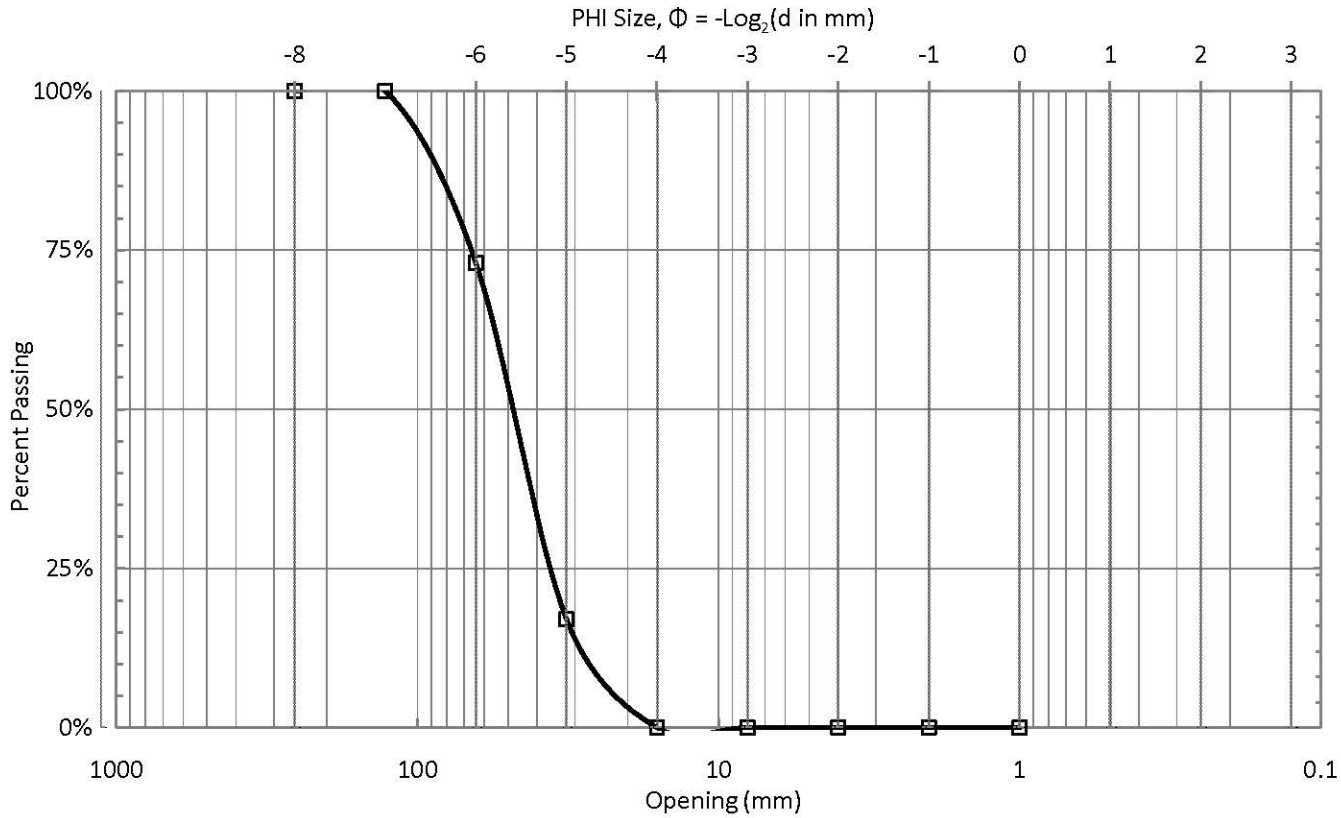
Location Notes

Sample taken in Panjab Creek near the confluence with the Tucannon River at river mile 50.3. Lots of large wood in stream. Side channel bar upstream.

Sediment Grain Size Distribution Report

Sample ID : TR_22_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	100%
2-1/2"	2.5	64	73.0%
1-1/4"	1.3	32	17.0%
5/8"	0.63	16	0.00%
5/16"	0.31	8.0	0.00%
No. 5	0.16	4.0	0.00%
No. 10	0.079	2.0	0.00%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
0%	100%	0%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	59
D_{50}=	51
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 50.5

Armor X

Sub-Armor

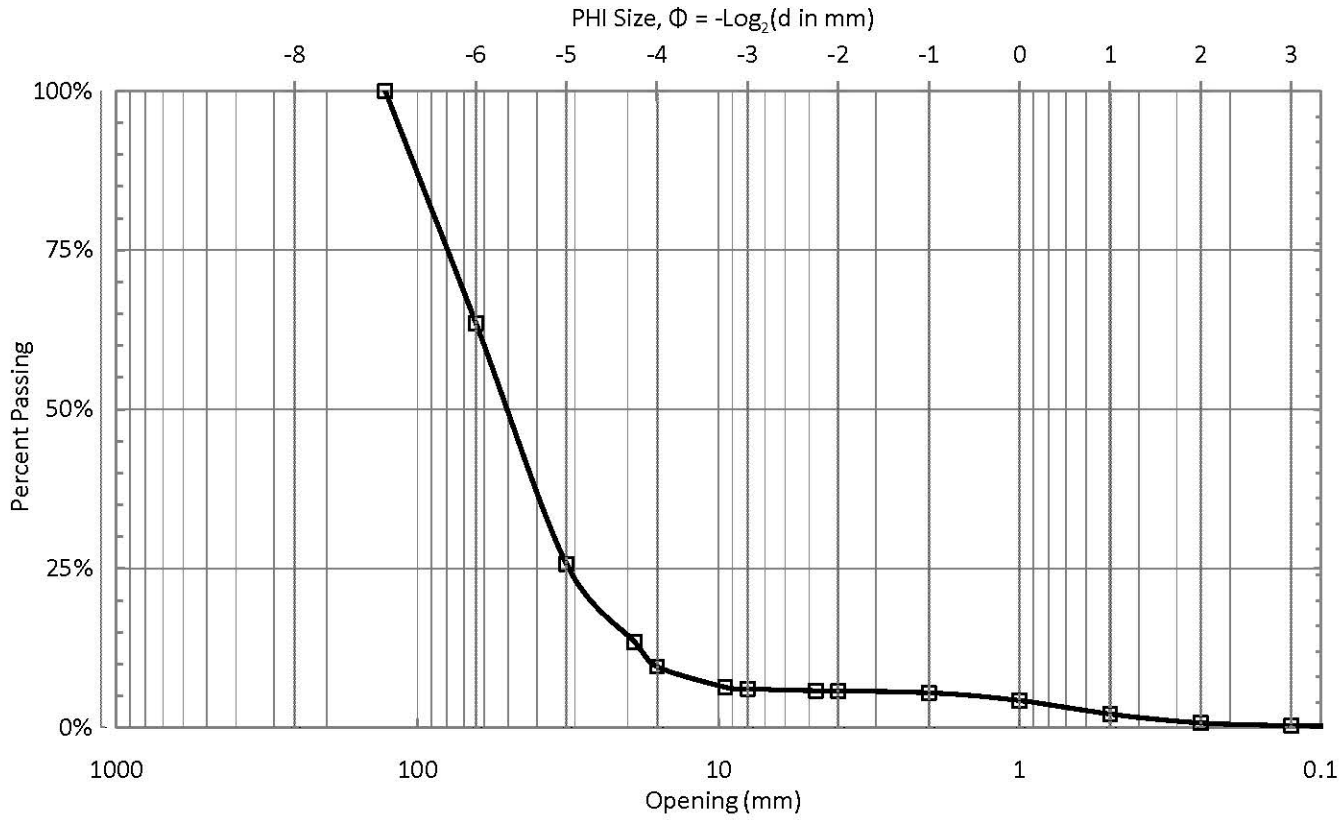
Location Notes

Mid-channel bar.

Sediment Grain Size Distribution Report

Sample ID : TR_22_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	0.939%
2-1/2"	2.5	64	63.5%
1-1/4"	1.3	32	25.7%
3/4"	0.75	19	13.4%
5/8"	0.63	16	9.59%
3/8"	0.37	9.5	6.35%
5/16"	0.31	8.0	6.09%
No. 4	0.187	4.75	5.80%
No. 5	0.16	4.0	5.74%
No. 10	0.079	2.0	5.47%
No. 18	0.039	1.0	4.26%
No. 35	0.020	0.50	2.12%
No. 60	0.010	0.25	0.738%
No. 120	0.0049	0.125	0.305%
No. 200	0.0030	0.075	0.188%
No. 230	0.0025	0.063	0.186%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
36%	58%	5%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	67
D_{50}=	53
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 50.5

Armor

Sub-Armor X

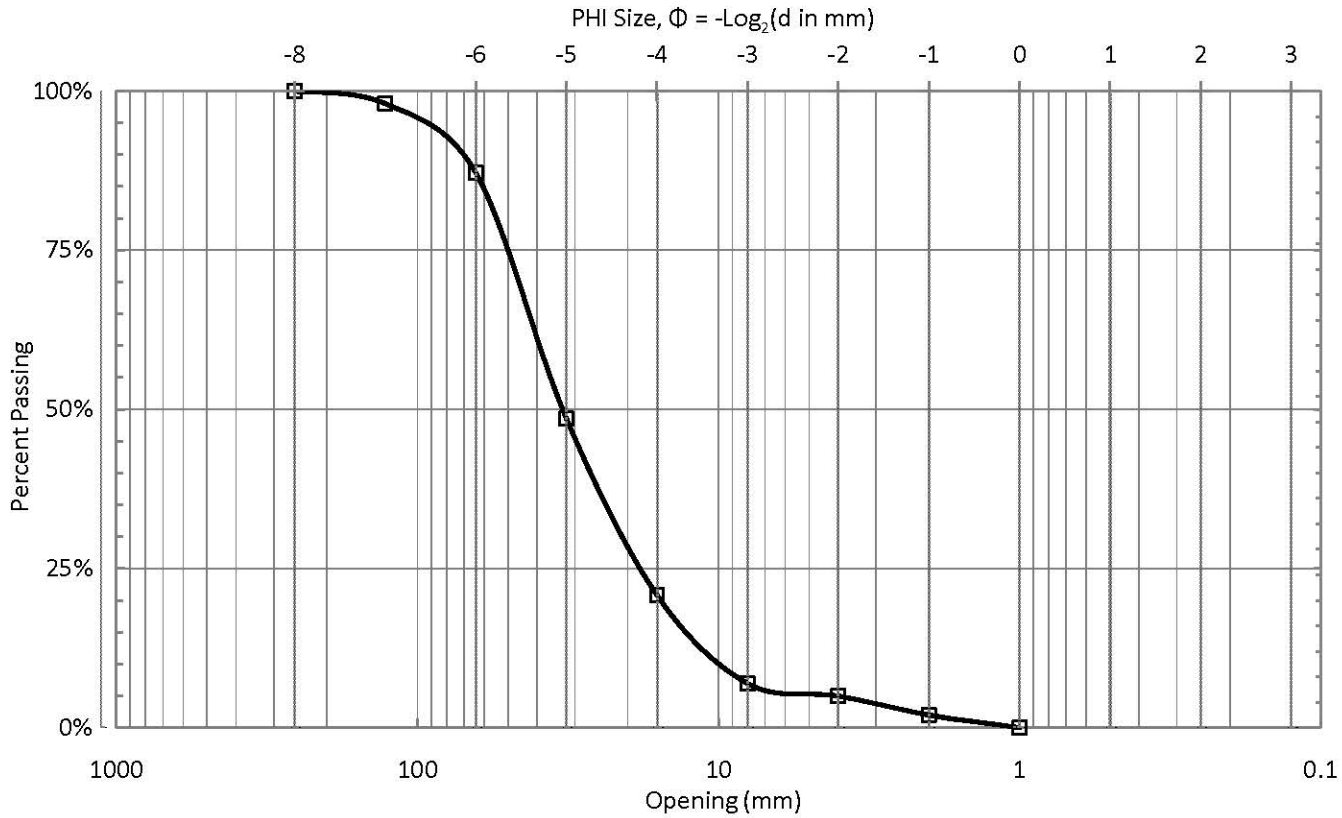
Location Notes

Mid-channel bar.

Sediment Grain Size Distribution Report

Sample ID : TR_23_A

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
10"	10	256	100%
5"	5.0	128	98.0%
2-1/2"	2.5	64	87.1%
1-1/4"	1.3	32	48.5%
5/8"	0.63	16	20.8%
5/16"	0.31	8.0	1.98%
No. 5	0.16	4.0	4.95%
No. 10	0.079	2.0	1.98%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
2%	93%	5%	NA

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	46
D_{50}=	33
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 55

Armor X

Sub-Armor

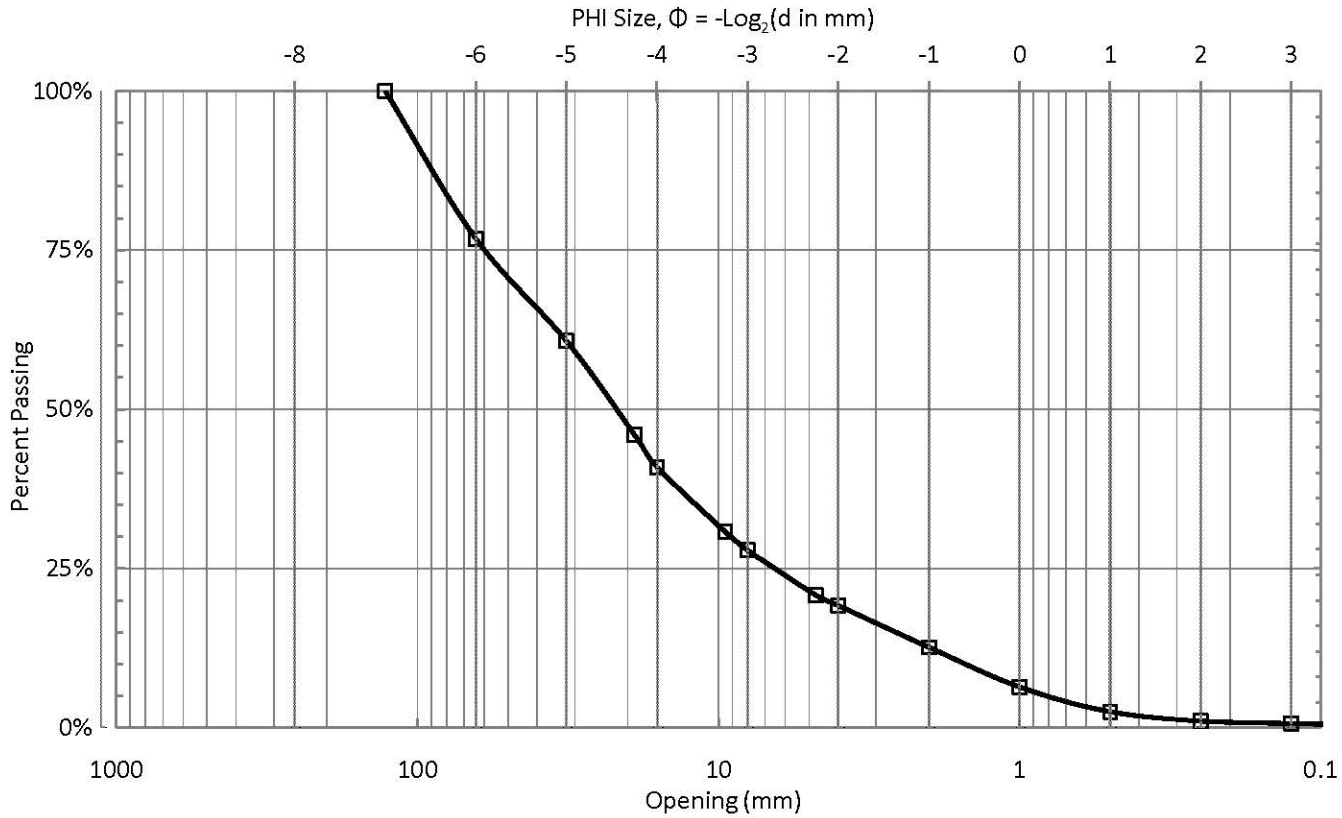
Location Notes

Just downstream of tributary with alluvial fan. Sample taken in lee of rootwad. No other bars in vicinity.

Sediment Grain Size Distribution Report

Sample ID : TR_23_SA

Project: Tucannon River
Client: CCD



US Sieve Class	Nominal Opening (in)	Nominal Opening (mm)	Percent Passing
5"	5.0	128	100%
2-1/2"	2.5	64	76.8%
1-1/4"	1.3	32	60.7%
3/4"	0.75	19	46.0%
5/8"	0.63	16	40.9%
3/8"	0.37	9.5	30.8%
5/16"	0.31	8.0	27.9%
No. 4	0.187	4.75	20.8%
No. 5	0.16	4.0	19.2%
No. 10	0.079	2.0	12.6%
No. 18	0.039	1.0	6.38%
No. 35	0.020	0.50	2.49%
No. 60	0.010	0.25	1.04%
No. 120	0.0049	0.125	0.639%
No. 200	0.0030	0.075	0.457%
No. 230	0.0025	0.063	0.453%
No. 270	0.0021	0.053	0.000%

Pct. Cobbles	Pct. Gravel	Pct. Sand	Pct. Fines
23%	64%	12%	0%

Coefficients (mm)	
D_{90}=	-
D_{85}=	-
D_{65}=	40
D_{50}=	23
D_{30}=	-
D_{15}=	-
D_{10}=	-

Sample Location

River Mile 55

Armor

Sub-Armor X

Location Notes

Just downstream of tributary with alluvial fan. Sample taken in lee of rootwad. No other bars in vicinity.