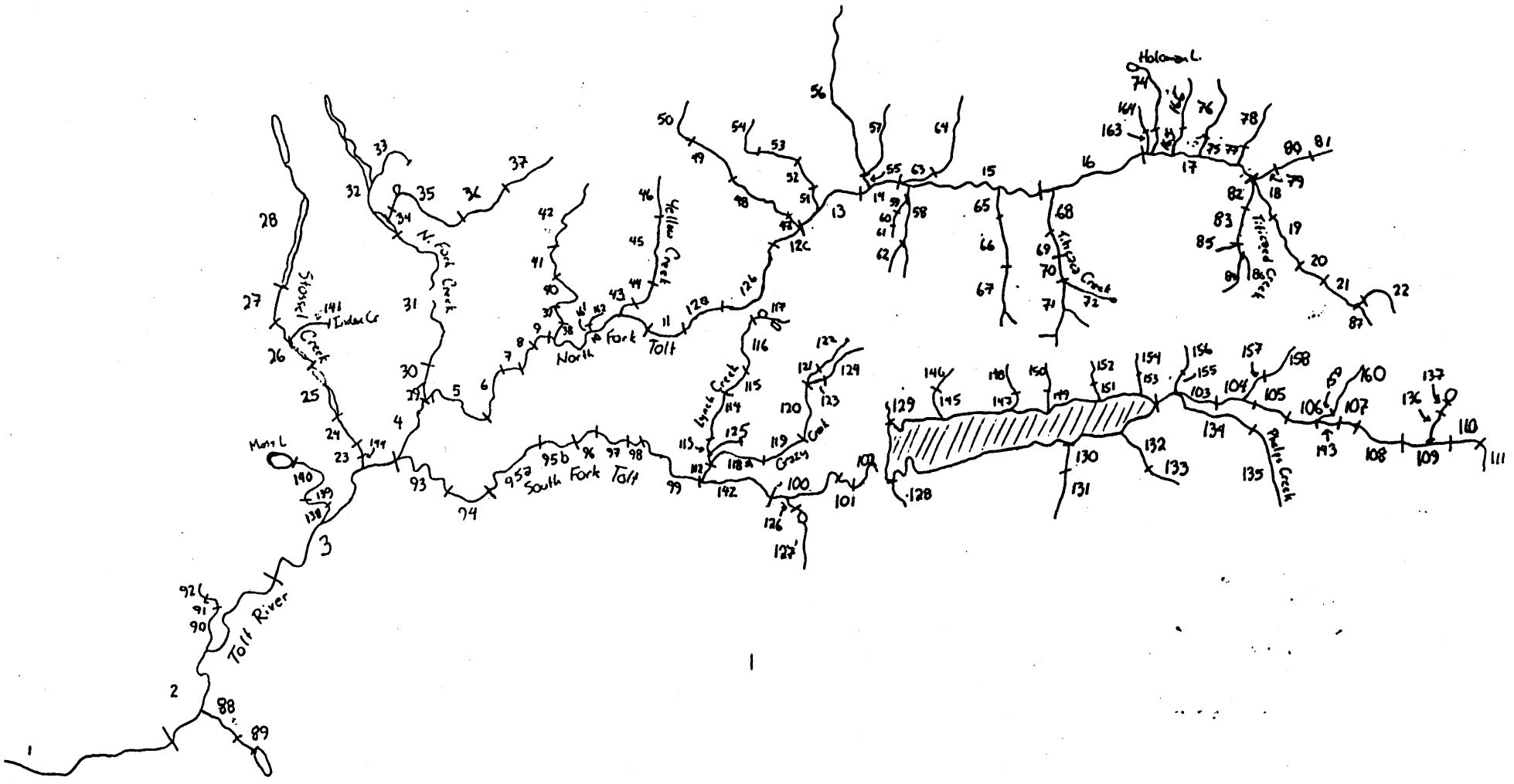
Tolt River Watershed

Response Segments



Form ee-1. Response Segment worksheet

RESPONSE SEGMENT WORKSHEET

SEDIMENT

FS - Fine Sediment Deposition
MS - Mixed Sediment Deposition
CS - Coarse Sediment Deposition

PEAK FLOWS

SD - Scour Depth
SF - Scour Frequency
BE - Bank Erosion

WOOD

WL - Wood Loss
WA - Wood Accumulation

CATASTROPHIC EVENTS

DT - Debris Torrent

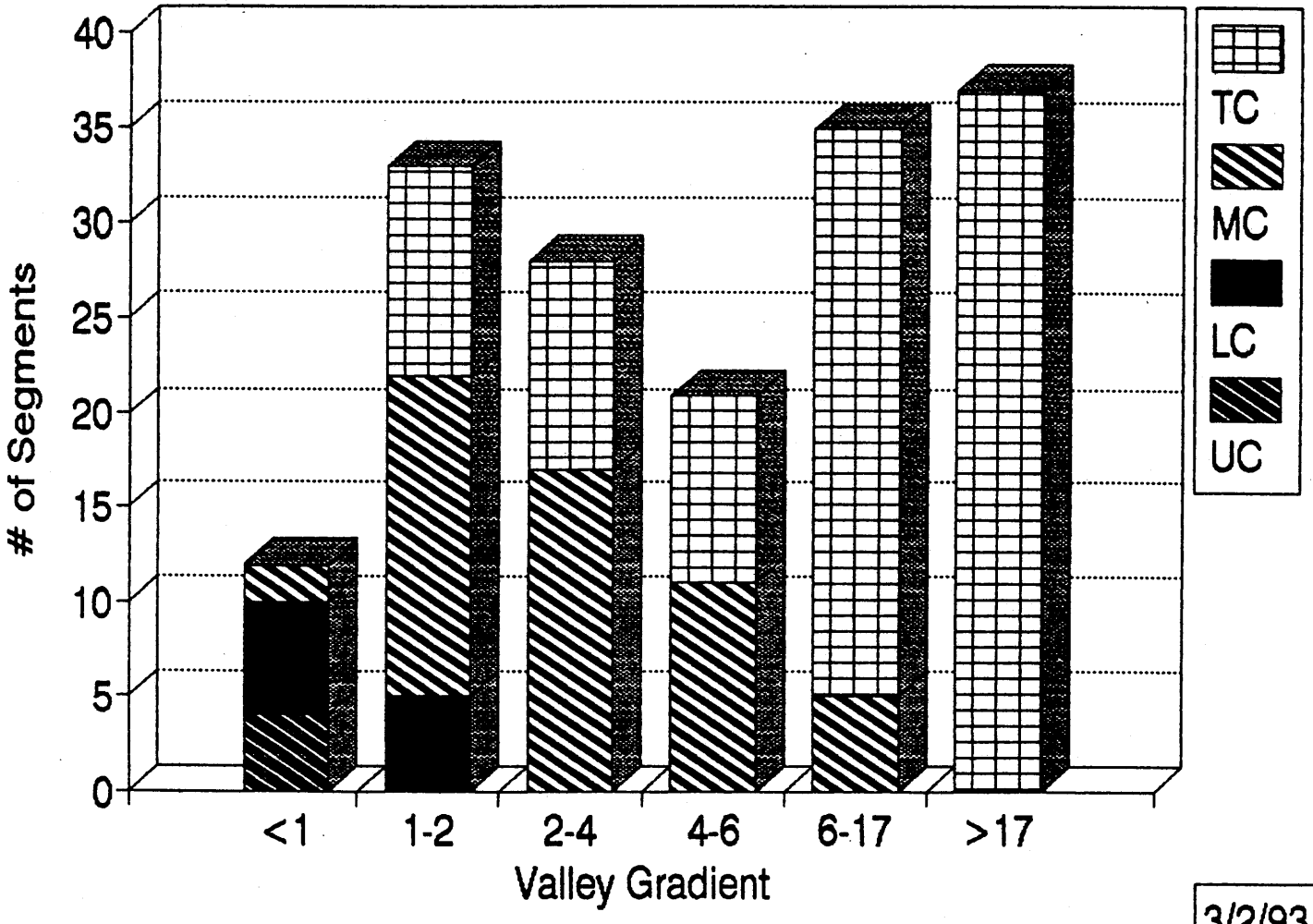
VALLEY CONFINEMENT OF CHANNEL	< 1.0 Dune/Ripple	1.0 - 2.0 Riffle/Pool (Meandering)	2 - 4 Riffle/Pool (Obstruction)	4 - 6 Cascade	6 - 17 Step/Pool	> 17
VW > 10 CW UC = UNCONFINED	1, 25, 114, 116 (4)					
4 CW < VW < 10 CW LC = LOOSELY CONFINED	2, 13, 28, 90, 109, 119 (6)	17, 63, 103, 127, 138 (5)				
2 CW < VW < 4 CW MC = MODERATELY CONFINED	12, 32 (2)	,15, 26, 31, 55, 64, 93, 97, 99, 105, 113, 117, 120, 125, 134, 140, 141, 142 (17)	16, 19, 35, 69, 89, 94, 102, 104, 108, 121, 123, 135, 143, 144, 150, 157, 159 (17)	46, 65, 73, 108, 110, 112, 132, 144, 163, 165, 162 (11)	75, 77, 79, 91, 130 (5)	
1 CW < VS < 2 CW TS = TIGHTLY CONFINED		3, 5, 7, 14, 24, 27, 30, 39, 50, 115, 11 (11)	4, 6, 10, 18, 42, 54, 83, 95, 98, 100, 118 (11)	20, 23, 33, 41, 56, 57, 101, 139, 8, 51 (10)	9, 21, 29, 34, 36, 38, 43, 45, 47, 52, 53, 60, 66, 68, 70, 81, 82, 87, 88, 96, 107, 128, 129, 133, 137 (30)	22, 37, 42, 48, 52, 58, 59, 61, 62, 67, 71, 72, 74, 76, 78, 80, 84, 85, 86, 92, 111, 122, 124, 126, 131 (37)
					146, 147, 149, 151, 153, 155,	136, 145, 148, 150, 152, 154, 156, 158, 160, 161, 164, 166,

VALLEY GRADIENT (PERCENT) AND CHANNEL BED MORPHOLOGY

Revised 2/16/93

Tolt River Watershed

Frequency of Response Segments



3/2/93

TOLT RIVER WATERSHED ANALYSIS
Response Segments Revised 3/2/93

STREAM	SEG#	GRADIENT	CONFINE
Tolt R. mainstem	1	<1	UC
Tolt R. mainstem	2	<1	LC
Tolt R. mainstem	3	1-2	TC
North Fk. Tolt	4	2-4	TC
North Fk. Tolt	5	1-2	TC
North Fk. Tolt	6	2-4	TC
North Fk. Tolt	7	1-2	TC
North Fk. Tolt	8	4-6	TC
North Fk. Tolt	9	6-17	TC
North Fk. Tolt	10	2-4	TC
North Fk. Tolt	11	1-2	TC
North Fk. Tolt	12	<1	MC
North Fk. Tolt	13	<1	LC
North Fk. Tolt	14	1-2	TC
North Fk. Tolt	15	1-2	MC
North Fk. Tolt	16	2-4	MC
North Fk. Tolt	17	1-2	LC
North Fk. Tolt	18	2-4	TC
North Fk. Tolt	19	2-4	MC
North Fk. Tolt	20	4-6	TC
North Fk. Tolt	21	6-17	TC
North Fk. Tolt	22	>17	TC
Stossel Creek	23	4-6	TC
Stossel Creek	24	1-2	TC
Stossel Creek	25	<1	UC
Stossel Creek	26	1-2	MC
Stossel Creek	27	1-2	TC
Stossel Creek	28	<1	LC
North Fork Creek	29	6-17	TC
North Fork Creek	30	1-2	TC
North Fork Creek	31	1-2	MC
North Fork Creek	32	<1	MC
North Fork Creek	33	4-6	TC
N1 - N.Fk Cr trib	34	6-17	TC
N1 - N.Fk Cr trib	35	2-4	MC
N1 - N.Fk Cr trib	36	6-17	TC
N1 - N.Fk Cr trib	37	>17	TC
N2 - N.Fk Tolt tri	38	6-17	TC
N2 - N. Fk Tolt tr	39	1-2	TC
N2 - N.Fk Tolt tri	40	2-4	MC
N2 - N.Fk Tolt tri	41	4-6	TC
N2 - N.Fk Tolt tri	42	>17	TC
Yellow Creek	43	6-17	TC
Yellow Creek	44	4-6	TC
Yellow Creek	45	6-17	TC
Yellow Creek	46	4-6	MC
N3 - N.Fk Tolt tri	47	6-17	TC
N3 - N.Fk Tolt tri	48	>17	TC
N3 - N.Fk Tolt tri	49	2-4	TC
N3 - N.Fk Tolt tri	50	1-2	TC
N4 - N.Fk Tolt tri	51	6-17	TC

TOLT RIVER WATERSHED ANALYSIS
Response Segments Revised 3/2/93

STREAM	SEG#	GRADIENT	CONFINE
N4 - N.Fk Tolt tri	52	>17	TC
N4 - N.Fk Tolt tri	53	6-17	TC
N4 - N.Fk Tolt tri	54	2-4	MC
N5 - N.Fk Tolt tri	55	1-2	MC
N5 - N.Fk Tolt tri	56	4-6	TC
N6 - N5 trib	57	4-6	TC
N7 - N.Fk Tolt tri	58	>17	TC
N8 - N6 trib	59	>17	TC
N8 - N6 trib	60	6-17	TC
N8 - N6 trib	61	>17	TC
N9 - N6 trib	62	>17	TC
Dry Creek	63	1-2	LC
Dry Creek	64	1-2	MC
N10 - N. Fk Tolt t	65	4-6	MC
N10 - N.Fk Tolt tr	66	6-17	TC
N10 - N.Fk Tolt tr	67	>17	TC
Titicaca Creek	68	6-17	TC
Titicaca Creek	69	2-4	MC
Titicaca Creek	70	6-17	TC
Titicaca Creek	71	>17	TC
Titicaca Creek	72	>17	TC
Holoman Creek	73	4-6	MC
Holoman Creek	74	>17	TC
N11 - N.Fk Tolt tr	75	6-17	MC
N11 - N.Fk Tolt tr	76	>17	TC
N12 - N.Fk Tolt tr	77	6-17	MC
N12 - N.Fk Tolt tr	78	>17	TC
N13 - N.Fk Tolt tr	79	6-17	MC
N13 - N.Fk Tolt tr	80	>17	TC
N13 - N.Fk Tolt tr	81	6-17	TC
Titicaed Creek	82	6-17	TC
Titicaed Creek	83	2-4	TC
Titicaed Creek	84	>17	TC
N14 - Titicaed tri	85	>17	TC
N15 - Titicaed tri	86	>17	TC
N16 - N. Fk Tolt t	87	6-17	TC
M1 - mainstem trib	88	6-17	TC
M1 - mainstem trib	89	2-4	MC
M2 - mainstem trib	90	<1	LC
M2 - mainstem trib	91	6-17	MC
M2 - mainstem trib	92	>17	TC
South Fk. Tolt	93	1-2	MC
South Fk. Tolt	94	2-4	MC
South Fk. Tolt	95	2-4	TC
South Fk. Tolt	96	6-17	TC
South Fk. Tolt	97	1-2	MC
South Fk. Tolt	98	2-4	TC
South Fk. Tolt	99	1-2	MC
South Fk. Tolt	100	2-4	TC
South Fk. Tolt	101	4-6	TC
South Fk. Tolt	102	2-4	MC

TOLT RIVER WATERSHED ANALYSIS
Response Segments Revised 3/2/93

STREAM	SEG#	GRADIENT	CONFINE
South Fk. Tolt	103	1-2	LC
South Fk. Tolt	104	2-4	MC
South Fk. Tolt	105	1-2	MC
South Fk. Tolt	106	2-4	MC
South Fk. Tolt	107	6-17	TC
South Fk. Tolt	108	4-6	MC
South Fk. Tolt	109	<1	LC
South Fk. Tolt	110	4-6	MC
South Fk. Tolt	111	>17	TC
Lynch Creek	112	4-6	TC
Lynch Creek	113	1-2	MC
Lynch Creek	114	<1	UC
Lynch Creek	115	1-2	TC
Lynch Creek	116	<1	UC
Lynch Creek	117	1-2	MC
S1 - Lynch Cr trib	118	2-4	TC
S1 - Lynch Cr trib	119	<1	LC
S1 - Lynch Cr trib	120	1-2	MC
S1 - Lynch Cr trib	121	2-4	MC
S1 - Lynch Cr trib	122	>17	TC
S2 - S1 trib	123	2-4	MC
S2 - S1 trib	124	>17	TC
S3 - Lynch Cr trib	125	1-2	MC
S4 - S. Fk trib	126	>17	TC
S4 - S. Fk trib	127	1-2	LC
S5 - reservoir tri	128	6-17	TC
S6 - reservoir tri	129	6-17	TC
S7 - reservoir tri	130	6-17	MC
S7 - reservoir tri	131	>17	TC
S8 - reservoir tri	132	4-6	MC
S8 - reservoir tri	133	6-17	TC
Phelps Creek	134	1-2	MC
Phelps Creek	135	2-4	MC
S9 - South Fk trib	136	>17	TC
S9 - South Fk trib	137	6-17	TC
Moss Creek	138	1-2	LC
Moss Creek	139	4-6	TC
Moss Creek	140	1-2	MC
Index Creek	141	1-2	MC
South Fk. Tolt	142	1-2	MC
South Fk. Tolt	143	2-4	MC
Stossel Creek	144	2-4	MC
Reservoir trib	145	>17	TC
Reservoir trib	146	6-17	TC
Reservoir trib	147	6-17	TC
Reservoir trib	148	>17	TC
Reservoir trib	149	6-17	TC
Reservoir trib	150	>17	TC
Reservoir trib	151	6-17	TC
Reservoir trib	152	>17	TC
Reservoir trib	153	6-17	TC

TOLT RIVER WATERSHED ANALYSIS
Response Segments Revised 3/2/93

STREAM	SEG#	GRADIENT	CONFINE
Reservoir trib	154	>17	TC
South Fork trib	155	6-17	TC
South Fork trib	156	>17	TC
South Fork trib	157	2-4	MC
South Fork trib	158	>17	TC
South Fork trib	159	2-4	MC
South Fork trib	160	>17	TC
North Fork trib	161	>17	TC
North Fork trib	162	4-6	MC
North Fork trib	163	4-6	MC
North Fork trib	164	>17	TC
North Fork trib	165	4-6	MC
North Fork trib	166	>17	TC

Response Segments - "Violations" of rule for breaking segment where equal or 1-less order tributary joins the segment

1) Segment 15 (N Fk Tolt) - 4th Order
3rd order, unnamed tributary joins near upper end, but did no break segment here. Instead, broke upstream at jct w/ Titicaca which is 2nd Order, but approx. same watershed area as 3rd Ord segment. The 3rd Order segment is very small + does not exert noticeable influence on the very wide, braided segment 15. (field veri

2) Segment 100 (South Fork Tolt) - 3rd Order
2nd order, unnamed tributary joins ~400' upstream of lower segment break. South Fork Tolt is a very large 3rd Order in this area (acts like a 4th order) + the small, 2nd Order strea is very small + exerts no visible influence. (field verified)

3) Segment 103 (South Fork Tolt) - 3rd Order
2nd order Phelps Creek joins mid-segment with the braided South Fork. Both streams have enlarged active channel areas. The confluence point of these streams has shifted downstream over time, such that Phelps Creek actually joins South Fork within the reservoir backwater area, whic is the downstream end of the segment.

There are several places where the segment was not broken on a 2n order tributary at the confluence with a 1st order. Many of those 1st

Form ee-2. Channel condition and disturbance assessment worksheet

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	***Disturbance Indicators:*** **Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage**
1(<1UC)	±ΔW 70-87 (last observed +ΔW following '90 flood)	70,76,87 Δt=17 yrs (only upper ½ of segment covered by photos)	Some braiding, frequent splitting (normal for mouth of a large river). Increased vegetation on bars & decreased width of side channels on photos. Renewed widening due to 90 flood. Levees & riptop along both banks limit active channel migration (see photo tracings)
2(<1LC)	-ΔW net - varies thru-out segment	70,76,87 Δt=17 yrs	Increased vegetation on bars in several locations. In middle of segment, channel has changed course & occupies previous side channel to North. Numerous areas of fresh deposition - gravel on inside of bends
3(1-2TC)	Ø	70,76,79,87 Δt=17yrs	Increased vegetation on some bars
4(2-4TC)	Ø	70,76,79,87,90 Δt=20yrs	Mostly confined by valley walls; channel width = valley width
5(1-2TC)	+ΔW (localized)	Δt=20yrs	Two sharp bends with deposits upstream of the constriction (observed in 87 & 90 photos) result in localized enlargement. Otherwise, tightly confined by bedrock.
6(2-4TC)	Ø	Δt=20yrs	Slide on LB at lower end of segment has enlarged since '76 photo, less vegetation. Increased vegetation on bar upstream of constriction, middle of reach - slight ↓ in width.
7(1-2TC)	Ø	Δt=20yrs	Straight, tightly confined

mainstem ↑ ↓ N. Fork

1.

Form ee-2. Channel condition and disturbance assessment worksheet

North Fork

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
8(4-6 TC)	Ø	70, 76, 79, 87 Δt=17 yrs	Very tightly confined
9(6-17 TC)	Ø	70, 76, 79, 87, 90 Δt=20 yrs	Very tightly confined Canyon walls are well vegetated
10(2-4 TC)	Ø	Δt=20 yrs	Increased vegetation in MW area on RB, upstream of Yellow Cr. confluence. Post '87 harvest in this area retained veg within MW area & along inner gorge, both sides of N. Fk.
11(1-2 TC)	-ΔW (slight)	Δt=20 yrs	Minor ↓ w, gravel bars vegetated. Post '87 harvest retained buffer along inner gorge.
12(<1 MC)	+ΔW	Δt=20 yrs	Increased width in vicinity of bends, middle of segment. Tributary that enters at upper end of segment appears 'blowout' in 70-79 photos, healing in 87 & 90 photos.
13(<1 LC)	+ΔW '64→76 -ΔW '76-90	64, 70, 76, 82, 87, 90 Δt=26 yrs	Segment coincides w/ 'Way Co 4' Rapid - Entire riparian area harvested. Rapid: +ΔW '58-64; +ΔW 64-70; then slowing + small recovery ⇒ net -ΔW '58-89. Two tribs have 'blowout' in '64 photos, healing by '87; two more tribs 'blowout' in '70 photos, healing by 87. * Compare '90 photos w/ field conditions to see effects of '90 flood * (see photo tracings)
14(1-2 TC)	Ø	Δt=26 yrs	Tightly confined. Large area of MW on RB, middle of segment - pre-64. Increasing veg on MW area 64→90. Most of riparian veg is cut pre-64; upper 25% of seg has mature trees on LB.

(2.)

Form ee-2. Channel condition and disturbance assessment worksheet

North Fork

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	***Disturbance Indicators:*** **Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage**	
15 (1-2 MC)	+ΔW '58-76 -ΔW '76-87-90 (upper ½)? -ΔW '76-87 } lower ½ +ΔW 87-90	Δt = ~~26~~ 32 yrs	Segment includes 'WeyCO3' of Rapid (upper ½ of segment). Rapid: +ΔW '58-76; 100% of riparian veg harvested (~50% of harvest between 69-70). Narrowing of channel '76-87, upper ½ (WeyCO3). Increased width in lower half during this period. Some trend continues to 90 - "widening" is propagating downstream. Titicaca harvested 70-76. Two distinct areas of widening in segment: upper ½ recovering; lower ½ propagating downstream	See tracing
16 (2-4 MC)	Ø	Δt = 26 yrs	Bridge constructed btwn 64-70. Open trib at upper end of segment (Holoman Cr) in 64 - remains open for entire period. 50% of riparian area cut pre-64, 100% by '76.	
17 (1-2 LC)	+ΔW '58-64 Ø - '64-70 +ΔW - '70-76 Ø - '76-82 -ΔW '82-87 Ø 87-90 +ΔW 90-91	Δt = 32 yrs	Segment coincides with 'WeyCO1' of Rapid: Sporadic increase in width from '58-82, then decrease in 82-89 period. 50% of riparian area cut pre-64; 100% by '76. 4 Open tribs + 1 debris flow in 64 - 2 closed tribs by '89. Renewed widening in lower ½ between 90-91 (90 flood)	See tracings
18 (2-4 TC)	+ΔW 70-82 Ø 82-90 +ΔW 90-91	64-90-91 Δt = ~~26~~ 27 yrs	Increased width slows between 82-87. Titicaca opened in pd between 70-76 (enters mid-segment). 0% riparian harvested in 64; 50% by 70; 100% by '76. Greatest enlargement between 70-76-82. No harvest upstream (NF bndry at upper end of segment). Renewed widening btwn 90-91; 3 open tribs enter. '90 flood effect	'91 NF photos → channel c splitting. ir
19 (2-4 MC)	-ΔW? or Ø 64-87 +ΔW in '91 photos	64-87 +91 Δt = ~~27~~ 27 yrs	Appears widened in '64 photos; gradual narrowing thru '87; increased vegetation on bars - ~~incomplete photo coverage (NF bad)~~ 100% riparian veg intact. ('92 FS stream survey says extensive braiding - natural landslides from Red Mtn upstream, mature forest has kept stream channel intact despite erodible banks; Aggraded channel, int. flow)	
20 (4-6 TC)	+ΔW pre 64 Ø or +ΔW 64-91	64-87-91 27 yrs	Appears widened in 64 photos - openings in canopy. ('92 FS stream survey says mostly steep BR channel, transports sediment generated by natural landslides off Red Mtn) Little or no change 91. Riparian veg intact but several open areas. Fresh debris slide off Red Mtn enters at top of seg.	
21 (6-17 TC)	+ΔW pre 64 Ø or +ΔW 64-91	27 yrs	Appears widened in 64 photos - openings in canopy ('92 FS stream survey indicates large natural landslides off Red Mtn - probably experienced debris flow in this segment) Sparse riparian vegetation (natural); actively eroding	

3.

Form ee-2. Channel condition and disturbance assessment worksheet

North Fork

↑

Stossel ↓ Creek

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
22(>17TC)			
23(4-6TC) +144(2-4MC)	Ø	70,76,79,87 Δt=17yrs	Not open. Riparian area on east side of creek + along N bank of Toft harvested pre-70 (pulled to roads on S side of Toft). Small, vegetated alluvial fan at mouth.
24(1-2TC)	Ø	Δt=17yrs	Not open. ~70% of riparian area on east side harvested btwn 70-76.
25(<1UC)	Ø	Δt=17yrs	Not open. Shrub/scrub wetland. Harvest on both sides of wetland btwn 70-76. Densely veg wetland of little open water
26(1-2MC)			
27(1-2TC)			
28(<1LC)			

Stossel Creek ↑

No photos (NF)

No photo coverage DNR

4.

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
North Fork Creek ↓	29(E-17TC)	Ø	70,76,79,87, 90 Δt=20yrs	Not open. E½ of riparian area cut btwn 70-76 (W½ is smaller timber-old burn?). Straight; tightly confined.
	30(1-2TC)	+ΔW 70-76 Ø 76-87 -ΔW 87-90	Δt=20yrs	Riparian area harvested on E side btwn 70-76 - ~50% of length of east side. Slight ↑ w in this area 70-76; no further increase by '87; slight ↓ w by '90 due to increased veg on bars.
	31(1-2MC)	~~+ΔW? 76-79~~ Ø	70,76,79 Δt=9yrs	Area of MW on LB, lower end of seg shows ↑ veg. Possible ↑ W in upper end of seg btwn 70-76-79 photos (poor quality 79 photos). All riparian veg intact; no open tribs
	32(<1MC)	Ø	70,76,79 Δt=9yrs	Wetland area - shrub/scrub; several ponds (beaver?) w/ increased open water 70-79.
	33(4-6TC)	Ø	70,76,79 Δt=9yrs	Not open
↑				
N1 (N Fk Creek trib) ↓	34(6-17TC)	Ø	70,76,79 Δt=9yrs	Not open
	35(2-4MC)	Ø	70,76,79 Δt=9yrs	Not open; two large shrub/scrub wetlands in segment

+ g't '87 & '90 photos DNR? (or field rev

5.

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage	
N1-NFkCr trib ↓	36(6-17TC)	−ΔW	70, 76, 79 Δt=9yrs	Debris flow upstream caused enlargement in this segment. gradual ↑ veg over time. 100% of riparian area harvested pre-70.	+ gil 87 W photo or field [illegible]
↑	37(>17TC)	+ΔW 70-76 −ΔW 76-79(?)	70, 76, 79 Δt=9yrs	Debris flow initiated at head of channel, pre-70. Channel widened 70-76; '79 photos poor quality, indicate −ΔW. 100% of riparian veg harvested pre-70.	" " "
N2-NFkTolt trib ↓	38(6-17TC)	Ø	70, 76, 79, 87, 90 Δt=20yrs	Not open	
	39(1-2TC)	Ø	Δt=20yrs	Not open - shrub/scrub wetland	
	40(2-4MC)	Ø	Δt=20yrs	Not open - shrub	
	41(4-6TC)	Ø	Δt=20yrs	Not open	
↑	42(>17TC)	Ø(−ΔW)	Δt=20yrs	Not open but evidence of pre-70 debris slide - shrubs in valley bottom. Very short, open channel area at bottom of segment below rd Xing. 100% harvested pre-70	

6.

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
Yellow Cr ↓	43(6-17TC)	+ΔW 70-76 Ø 76-79 -ΔW 79-87	70, 76, 79, 87 Δt: 17 yrs	No riparian harvest. Trib that enters from N sluiced out between 70-76. Initiates in wl - beaver dam blew? Less water in pond in 76. Trib slums caused widening of Yellow Cr in this segment. Increased veg, healing in '87.
	44(4-6 MC)	Ø	Δt=17 yrs	Not open. Riparian veg intact - hardwoods.
	45(6-17TC)	Ø	Δt=17 yrs	Not open - deciduous veg in valley bottom, past debris slide?? Mass wasting in inner gorge, lower end of segment (partially vegetated) - evident in 70 photos; mostly vegetated by 76 & well vegetated by 87. Riparian veg intact.
	46(4-6MC)	Ø	Δt=17yrs	Not open - riparian veg intact. Deciduous veg in valley bottom - past debris slide??
↑ ↓ N3 NFk Tolt trib	47(6-17TC)	Ø 70-79 -ΔW 79-87-90	70,76,79,87,90 Δt=20yrs	Opened pre-70; gradual ↑ veg in '87 & 90 - healing Sed generated from above - rip veg intact Some erosion of inner gorge evident in 70; increased veg by 87
	48(>17TC)	Ø (tightly confined)	Δt=20 yrs	Very deeply incised canyon; riparian veg harvested pre-70, MW of inner gorge 76-90 - still active. Zone of sed transport - contributed to widening in seg 12 of NFk Tolt.
	49(2-4TC)	-ΔW (lower ⅓)	17 yrs	Riparian veg harvested both sides, upper ⅔ of segment, pre-70. Small areas of MW in inner gorge where rip veg harvested. Areas of widening downstream. Increased veg on bars in middle ⅓ of segment

Form ee-2. Channel condition and disturbance assessment worksheet

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
162(4-6MC)	Ø	70-87 Δt=17yrs	Closed canopy, no evidence of instability
163(4-6MC)	Ø	64-87-90 Δt=23yrs	100% cut pre '64, increased vegetation 76-87 Not open, no evidence of instability
164(>17TC)	+ΔW	Δt=23yrs	~50% cut pre-64, 100% by 70. Road Xing, fill failure ⇒ slight opening in 76; another fillslope failure btwn 76-87 ⇒ ↑w in upper ½
165(4-6MC)	-ΔW 64-76 Ø 76-90	Δt=23yrs	100% cut pre-64, channel split & open in '64; Into 1 channel in '76 & increased veg 76-90
166(>17TC)	Ø	Δt=23yrs	~10% cut pre-64; 75% cut by '76; then 90% cut btwn 76-87. Channel is open in 64, no change 64-90 - still open in '90.

Photo	Segment	Comments	Avg w
19-31	135 (upper Phelps)	Open from Mt Phelps down thru trees, gradual narrowing downstream	30-40'
	134 (lower Phelps)	Slightly open, middle part in 2 channels	30-40'
	5 Fk under reservoir	Sinuous & open in upper ½; more confined & narrow in lower ½	

Form ee-3. Field Site Selection Worksheet

Segment Chosen	Rationale
✓ 64 (1-2)MC	smaller; widening in '76 seemed odd since low gradient
✓ 68 (6-17)TC	6-17%; some widening earlier, stabilized one of few in group
58 (>17 TC	small; disturbed
59 (>17)TC	small; not-disturbed
✓ 126 (6-17)TC	small; undisturbed, unharvested + good reference stream for this
✓ 124 & 122 (>17TC)	piracy!! interested in checking it out geomorph roup
✓ 119 <1 MC	undisturbed
65 (4-6)MC	only segment visited in this segment category widened earlier years. Contributes sediment to downstream
✓ 63 (1-2)LC	only segment in this category visited. Disturbance in the area
✓ 5 (1-2)TC	Fish concern; we see recent large gravel bars building behind constrictions
✓ 6 (2-4) TC	Mass failure on left side of bank; accessible B.S debris jam
✓ 1 (<1)LC	It was sunny and it was a frigid day. Also, one in category
13 (<1)LC	Earlier widening in recovery. Curious about effect of 1990 storm
✓ 15 (<1)MC	Represents category; widened and remaining so
✓ 100 (2-4)TC	At base of giant slide
✓ 141 (2-4)MC	Fish index creek
✓ 3 (1-2) TC	Fish concern
93 (1-2) MC	Fish concern
✓ 94 (2-4) MC	Fish concern
✓ 11 (1-2)MC	Transition btwn canyon & U-shaped valley
✓ 95 (2-4) TC	Fish concern
108 (4-6)MC	Recent debris slide - check above & below for effects; only seg in this category & upper S Fork
✓ 103 (1-2)LC	Braided seg on S Fk - reservoir effects
✓ 134 (1-2) MC	Braided seg on Phelps Cr - geomorph concern
✓ 19 (2-4 MC)	Only widened segment in uncut forest

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Form ee-1. Response Segment worksheet

RESPONSE SEGMENT WORKSHEET

SEDIMENT

FS - Fine Sediment Deposition
MS - Mixed Sediment Deposition
CS - Coarse Sediment Deposition

PEAK FLOWS

SD - Scour Depth
SF - Scour Frequency
BE - Bank Erosion

WOOD

WL - Wood Loss
WA - Wood Accumulation

CATASTROPHIC EVENTS

DT - Debris Torrent

VALLEY CONFINEMENT OF CHANNEL	< 1.0 Dune/Ripple	1.0 - 2.0 Riffle/Pool (Meandering)	2 - 4 Riffle/Pool (Obstruction)	4 - 6 Cascade	6 - 17 Step/Pool	>17
VW > 10 CW UC = UNCONFINED	1,25,114,116 (4)					
4 CW < VW < 10 CW LC = LOOSELY CONFINED	2,90,13,119,109 28 (6)	17,63,103,127,138 (5)				
2 CW < VW < 4 CW MC = MODERATELY CONFINED	12,~~15~~,~~28~~,32,~~109~~ ~~109~~ (3)	11,~~16~~,[redacted],26,31 55,64,~~93~~,97,99 105,113,117,120,125 134,140,~~141~~,142 ~~15~~ (17)	40,54,69,89,~~94~~ 102,104,106,121,123 135,~~136~~,143,[redacted],144 16,35 (13)	46,~~65~~,73,108,110 132 (6)	75,77,79,91,130 (5)	
1 CW < VS < 2 CW TC = TIGHTLY CONFINED		3,5,7,14,24 27,30,37,50,115 (10)	4,6,10,18,~~35~~ 83,95,98,100,118 (9) (10)	8,[redacted],23,33,41 44,~~49~~,56,57,101 112,139 (12)	9,[redacted],29,34,36 38,43,45,47,51 53,60,66,~~68~~,70 81,82,87,88,96 107,128,129,133,137 (25)	22,37,42,48,52 58,59,61,62,67 71,73,74,76,78 80,84,85,86,92 111,122,124,126,131 (20)

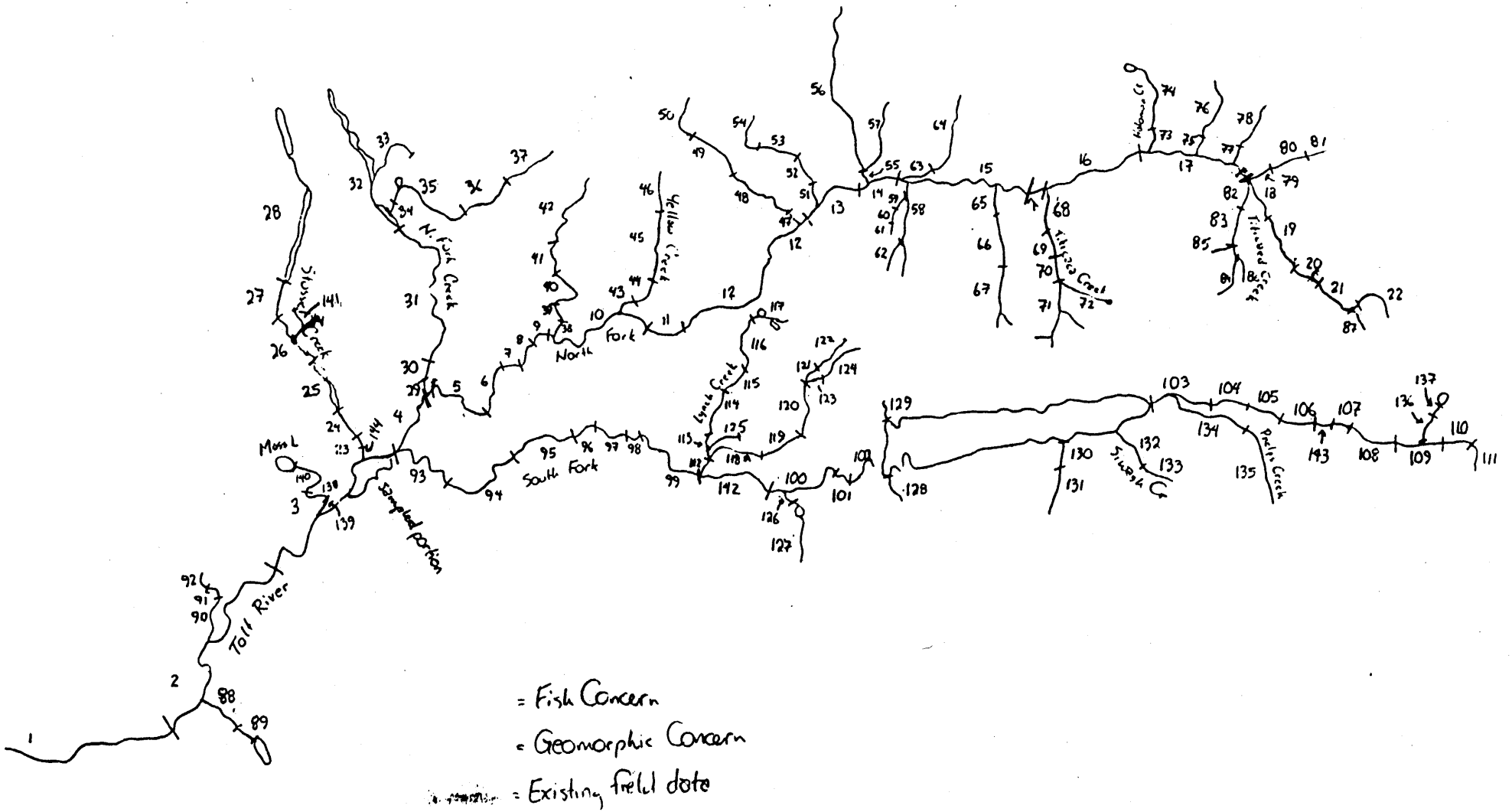
VALLEY GRADIENT (PERCENT) AND CHANNEL BED MORPHOLOGY

Segments selected for field assessment
Geomorph. concern
Fish concern
[redacted] Existing field data

(1st Cut Segments)
1/93

Tolt River Watershed

Preliminary Response Segments



Form ee-2. Channel condition and disturbance assessment worksheet

Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
155(6-17TC)	Ø	64-87 Δt=23 yrs	100% cut pre-64, not open.
156(>17TC)	Ø	" " Δt=23 yrs	Lower ⅔ cut pre-64; 100% by 76 - not open.
157(2-4MC)	Ø	" " Δt=23 yrs	100% closed canopy, mature forest in '64 100% cut by 70 Not open
158(>17TC)	+ΔW 70-76 Ø 76-87	" " Δt=23 yrs	100% closed canopy, mature forest in '64 Lower ½ cut btwn 64-70 & borrow pit nearby. Debris flow in middle ⅓ btwn 70-76 from within CC → +ΔW Still open in 82-87. Upper ½ mature forest still in '82.
159(2-4MC)			
160(>17TC)			
161(>17TC)	Ø	70-87 Δt=17 yrs	Closed canopy, no evidence of instability

NF lands No photo coverage

Form ee-2. Channel condition and disturbance assessment worksheet

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
148(>17TC)	Ø or -ΔW	64-87 Δt=23 yrs	Debris slide immediately below road fillslope in head of channel evident on '64 photos. 100% cut. Lower channel not open, slide vegetated by '76.
149(6-17TC)	+ΔW pre 64 -ΔW 64-76-87	" " Δt=23 yrs	100% cut & open in '64 - evidence of shift (alluvial fan) Increasing veg by '76, continues to increase thru '87.
150(>17TC)	+ΔW 70-76 -ΔW 76-87	" " Δt=23 yrs	100% cut in '64, not open. Opens between 70-76 - debris torrent associated w/ road Xing - does not reach reservoir. Increasing vegetation 82-87.
151(6-17TC)	+ΔW 70-76 -ΔW 76-87	" " Δt=23 yrs	100% cut pre-64, not open. Open btwn 70-76 due to debris slide from road in seg 152. Opening extends to reservoir. Increased veg by '82.
152(>17TC)	+ΔW 70-76 Ø 76-82 -ΔW 82-87	" " Δt=23 yrs	Lower ⅓ cut pre-64; Upper ⅔ mature timber; not open in 64. 100% cut in 70 but not open. Debris slide initiates from rd fillslope btwn 70-76 ⇒ widening. Still open in '82. Deciduous veg in channel in 87.
153(6-17TC)	Ø	" " Δt=23 yrs	100% cut pre-64, not open. Increasing veg, no opening thru 87.
154(>17TC)	Ø 64-70 +ΔW 70-76 -ΔW 76-87	" " Δt=23 yrs	Lower ⅓ cut pre-64; 100% cut by '76. Debris slide near upper rd Xing evident in 76 photos - does not travel far downstream. localized opening. Gradually revegetated.

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
Index Cr	141(1-2MC)	Ø	(field obs)	Second growth wetland area; low gradient
South Fork	142(1-2MC)			(see seg. 99 - split out due to trib entering)
	143(2-4MC)			(see seg 106 - split out due to trib entering)
Stossel Cr	144(2-4MC)	Ø	70,76,79,87 Δt=17yrs	Pre-70 harvest along LB, but no channel opening
	145(>17TC)	Ø	64,70,76,82 87 Δt=23yrs	80% cut pre-64 (small leave block at top of segment) Not open
	146(6-17TC)	Ø	" " Δt=23yrs	100% cut pre-64; Not open
	147(6-17TC)	Ø	" " Δt=23yrs	100% cut pre-64 (trib immediately E is open, pre-64 & harvested) Not open. Thin corridor of deciduous vegetation along stream.

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Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
Phelps Cr	134(1-2 MC)	+ΔW pre 64 Ø 64-70 -ΔW 70-76 Ø 76-87	Δt=23 yrs	~50% of riparian veg harvested pre-64 Active shift evident pre-64. 100% riparian veg harvested by '70. Increased veg on bars btwn 70-76, then little change.
	135(2-4 MC)	+ΔW pre 64 Ø	Δt=23 yrs	100% riparian veg intact in 64; pre-64 debris flow originated on steep, sparsely (natural) vegetated slopes in headwaters ⇒ opening on ~50% of channel. 95% of riparian veg harvested btwn 64-76 Little change evident in channel. Still open in 91.
59 S Fk trib	136(>17 TC)	Ø	91 (USFS)	Closed canopy (naturally open forest stand) No evidence of instability
	137(6-17 TC)	Ø	91 (USFS)	" " " " No evidence of instability
Moss Creek	138(1-2 LC)	Ø	70, 76, 79, 87 Δt=17 yrs	Closed canopy, dense conifers in 70; Harvested btwn 70-76 but not open (no buffer)
	139(4-6 TC)	Ø	" " Δt=17 yrs	Closed canopy, dense conifers 70-76; ~~harvested btwn 70-79~~ no change 76-87; not open (was harvested in 30's probably - second growth)
	140(1-2 MC)		" " Δt=17 yrs	" " " similar veg to Seg 139 but numerous wetland areas

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Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
S4 S Fork trib	127(1-2LC)	Ø	Δt=20yrs	Riparian area & adjacent harvested pre-70. No evidence of instability - very low gradient & small channel
S5 res. trib	128(6-17TC)	Ø	70,76,82,87 Δt=17yrs	100% riparian veg (~90% of basin) cut pre-70; 100% of basin by '76. No widening, MW or evidence of instability. Flows into reservoir near intake.
S6 res trib	129(6-17TC)	+ΔW pre 64 -ΔW 64-82 Ø82-87	Δt=17yrs	pre-64 channel shift (100% of basin harvested pre-64); stabilized by 82 (closed canopy). MW in inner gorge, area upslope & channel widening above this seg continues to '87. Flows into reservoir.
S7 res trib	130(6-17MC)	+ΔW pre 64 Ø 64-87	64,70,76,82,87 Δt=23yrs	100% of riparian veg harvested pre 64; channel shift (splitting) little change in photos 64-87 Flows into reservoir.
	131(>17TC)	+ΔW 64-87	Δt=23yrs	~30% of riparian veg harvested pre 64 (lower ½), some widening; ~50% of riparian veg harvested btwn 70-76; 100% btwn 82-87. 87 photos shows MW in inner gorge & numerous rd fill/slope failures; 1 debris slide in trib. Channel is open in 87.
S8 res trib	132(4-6MC)	+ΔW pre 64 Ø 64-87	Δt=23yrs	100% riparian veg harvested pre-64. Channel widening & shift in alluvial fan at mouth. No MW. Little change 64-87. Flows into upstream end of reservoir.
Siwash Creek	133(6-17TC)	+ΔW pre 64 Ø64-76 +ΔW 76-87	Δt=23yrs	~20% of riparian veg harvested pre-64 (lower end). Some widening evident in 64. 100% riparian veg harvested btwn 76-87 & debris (?) flow in this period (no initiation point evident).

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Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	***Disturbance Indicators:*** **Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage**
S1 Lynch Cr trib	120(1-2MC)	Ø 64-70 +ΔW 70-76 -ΔW 76-87	Δt=23 yrs	Debris slide in seg 122/124 pre-64 had little effect on channel until 76 photo. Riparian veg btwn 70-76. Widening of segment at some time. Increased veg & ↓w 87-90.
	121(2-4MC)	Ø 64-70 +ΔW 70-76 -ΔW 76-87	Δt=23 yrs	Alluvial fan segment. Debris slide upstream (seg 122) pre-64, caused channel shift. Renewed shift & widening btwn 70-76 concurrent w/ riparian veg harvest. Gradual ↑ veg 82-87.
	122(>17TC)	+ΔW pre-64 Ø 64-70 +ΔW 70-82 -ΔW 82-87	Δt=23 yrs	Debris slide pre-64 & dramatic channel shift. Appears to have initiated near upper edge of CC. Inner gorge actively eroding pre-64; stabilizing in 70 & renewed movement btwn 70-82 in upper end. Stabilizing in 87 but still raw banks, MW.
S2 S1 trib	123(2-4MC)	Ø 64-70 +ΔW 70-76 -ΔW 76-82-87	Δt=23 yrs	Closed canopy 64-70; riparian harvest btwn 70-76 + debris slide in seg 124 ⇒ ↑w. Rapid ↑ veg 76-82-90
	124(>17TC)	+ΔW pre 64 -ΔW 64-70 +ΔW 70-76 -ΔW 76-82-87	Δt=23 yrs	Pre-64 failure; obvious slump scarp in headwaters, MW in inner gorge pre-64; healing in 70. Debris slide btwn 70-76 ⇒ channel widening; split into old channel of seg 122. Increased veg, nearly closed by '90.
S3 Lynch Cr trib	125(1-2MC)	Ø	Δt=20 yrs	Lower end harvest btwn 79-87 - no buffer. Originates from WL. No evidence of instability.
S4 S Fork trib	126(>17TC)	Ø	70,76,87,90 Δt=20 yrs	Closed canopy; no harvest; no evidence of instability

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Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	***Disturbance Indicators:*** **Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage**
Lynch Cr	113(1-2MC)	Ø	70,76,79,87,90 Δt=20yrs	No evidence of instability. Harvest btwn 79-87; thin buffer (1-3 tree width) retained along channel. Very flat terrain.
	114(<1UC)	Ø	Δt=20yrs	No evidence of instability. Adjacent area 100% harvested btwn 79-90; buffer 2-4 trees wide retained along channel. Very flat terrain.
	115(1-2TC)	Ø	Δt=20yrs	" " " " (similar to 114)
	116(<1UC)	Ø	Δt=20yrs	Flat, wet valley. Timber adjacent to lower end of segment harvested btwn 87-90; 20-100' wide buffer retained. No evidence of instability.
	117(1-2MC)	Ø	Δt=20yrs	Scrub/shrub wetland; no evidence of instability.
↑ ↓ S1 Lynch Cr trib	118(2-4TC)	Ø	Δt=20yrs	Closed canopy; no harvest; no evidence of instability
	119(<1LC)	Ø	Δt=20yrs	Closed canopy; no harvest; no evidence of instability

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Form ee-2. Channel condition and disturbance assessment worksheet

South Fork Toll

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
106 (2-4 MC) 1143		91 only	100% riparian veg harvested - same age as seg 105. Channel is open but not straight; one short area where it splits around island. Sediment from debris slide in seg 108 affects this segment
107 (6-17 TC)		91 only	Material from upstream debris slide transported thru this segment. Channel is open but not as widened as segment 108. 100% riparian veg harvested; same age as seg 105.
108 (4-6 MC)		91 only	Fresh debris slide enters near middle of segment from LB trib. Material from trib was transported into & through this segment & channel widened. Initiated from upper mountain slopes. Natural sparse trees in riparian area. Channel is braided; a few timbered islands.
109 (<1 LC)		91 only	Scrub/shrub wetland w/ numerous ponds: poorly defined channel; no evidence of instability.
110 (4-6 MC)		91	Channel flows thru scrub/shrub wetland. No evidence of instability. No harvest in vicinity.
111 (>17 TC		91	NF land - sparsely timbered slope; mostly brush. Channel is mostly open & incised. - drains into wetland. Evidence of debris flow but not transported beyond alluvial fan.
112 (4-6 MC)	Ø	70, 76, 79, 87, 90 Δt = 20 yrs	Closed canopy, no evidence of instability. No harvest in riparian area.

Lynch Cr

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Form ee-2. Channel condition and disturbance assessment worksheet

South Fork Tolt

Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
99(1-2 MC) & 142(1-2 MC)	-ΔW	Δt=20 yrs	Bars at bends, visible in 70, 76 photos have increasing veg 79-90. Large, partially vegetated slump on EB, upper end of segment also has ↑ veg. Harvest above topog. brk btwn 87-90 - inner gorge veg retained.
100(2-4 TC)	-ΔW 82-70	70,76,82,87,90 Δt=20 yrs	Sediment supply is controlled by S Fk Slide at upper end of segment. Tightly confined channel has ↑ veg on bars btwn 82→90 & slight narrowing. Also slump on RB, downstm of slide; little change. Discuss slide w/ MW module.
101(4-6 TC)	∅	Δt=20 yrs	Tightly confined, steep gradient
102(2-4 MC)	-ΔW	Δt=20 yrs	Just below tailrace. Increased veg 70→82 ⇒ ↓ W. No evidence of instability.
103(1-2 LC)	+ΔW pre 64 ∅ 64-76 +ΔW 76-87 (slight)	Δt=23 yrs	Channel is meandering, braided in 64-76; no braiding 82-87 (but could just be flow level). Some loss of veg on islands 82-87 ⇒ apparent increase in channel width. 100% riparian veg harvested pre-64.
104(2-4 MC)	∅	Δt=23 yrs	~20% riparian veg harvested pre-64; 100% by '70. Channel meanders thru flat valley bottom, no MW, gentle sideslopes. Channel is open after harvest but no change over time; no evidence of instability.
105(1-2 MC)	∅	Δt=23 yrs	100% riparian veg intact to 70; all harvested btwn 70-76. Some openings prior to harvest; gravel bars exposed post harvest but no widening or instability evident.

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Form ee-2. Channel condition and disturbance assessment worksheet

Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
M2 Tolt R trib 92(>17TC)	Ø	Δt-17yrs	No evidence of instability
South Fork Tolt 93(1-2 MC)	Ø	70,76,79,87,90 Δt-20yrs	2 Slide scarps on RB - initiated pre-70. Little change - partially vegetated. Increased veg in valley bottom; slight ↓ width in some areas.
94(2-4MC)	-ΔW	Δt=20yrs	Pre-70 harvest in 40% of riparian area; MW on RB below unit; revegetated by 90. Increased veg on bars ⇒ ↓ΔW. Widening assoc. w/ pre-70 CC on RB (~1000' long), upper end of segment.
95(2-4TC)	Ø	Δt=20yrs	Tight canyon; no harvest in inner gorge or adjacent. Small areas of MW in inner gorge.
96(6-17TC)	Ø	Δt=20yrs	Tight canyon, no harvest in inner gorge or adjacent. No MW evident
97(1-2 MC)	-ΔW	Δt=20yrs	Two areas of channel splitting in 70,76,79 photos have more veg, confined to one channel in 87-90.
98(2-4TC)	Ø	Δt=20yrs	Tight canyon

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Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	***Disturbance Indicators:*** **Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage**
N13 (trib to Titicoed)	85(>17TC)	Ø 64-87 +ΔW 87-91	64,70,87 Δt=~~53~~ yrs 27	No harvest in riparian area. Debris slide occurred pre-64 Natural - originates on steep, sparsely vegetated slopes. Some renewed widening in 91
N14 (trib to Titicoed)	86(>17TC)	Ø	Δt=~~23~~ yrs 27	No harvest in riparian area. Natural opening in lower end of segment, unknown cause. Still open in 91.
N15 trib to N Fk Tolt	87(6-17TC)	Ø	Δt=26 yrs	No harvest in riparian area. No opening or MW evident. (64 photos & 90 orthophoto)
M1 Tolt R trib (Spark Cr)	88(6-17TC)	Ø 70-87 +ΔW 87-91	70,76,87 Δt=17 yrs	No harvest in riparian area, closed canopy, no MW 70-76. Harvest btwn 76-87 - buffer retained - varying width. No MW or instability evident in '87 orthophoto. Fresh debris slide originates on Red Mtn & all the way down this trib it is sluiced out & widened. Probably during '90 storm ← Still eroding
	89(2-4MC)	Ø +ΔW in 90	Δt=17 yrs	No harvest in riparian area, closed canopy pre-70. Harvest btwn 70-87; thin buffer retained. No MW or instability evident. Dam break in '90 dumped ~3000 cy into river
M2 Tolt R trib	90(<1LC)	Ø	Δt=17 yrs	Closed canopy. Adjacent to Tolt R Rd. Very low gradient, no instability evident.
	91(6-17MC)	Ø	Δt=17 yrs	No evidence of instability

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Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
N12	78(>17MC)	Ø 64-70 +ΔW 70-76 ØΔ 76-87-91	Δt=~~28~~ yrs 27	95% riparian veg intact, closed canopy in 64-70, 100% riparian veg cut by 76 ⇒ Channel widening; debris flow initiated at rd Xing, still open in 87. MW from rd fill slopes, upper end of segment. Still open in 91.
N13 N Fk Tolt trib	79(6-17MC)	Ø 64-70 +ΔW 70-76 -ΔW 76-87	Δt=23 yrs	100% riparian veg intact, closed canopy-64; 100% cut by 70, but no widening apparent. Widened in 76 & some channel shift - no MW or upslope debris slide. Increased veg by 87 ⇒ ↓w. Source of sediment to Seg 17, N Fk Tolt.
	80(>17TC)	Ø 64-70 +ΔW 70-76 (lower end) -ΔW 76-87 "	Δt=23 yrs	100% riparian veg intact, closed canopy 64; 10% cut on lower end btwn 64-70 - widening occurs only in this area in '76 photo. No widening upslope where riparian veg intact
	81(6-17TC)	Ø	Δt=12 yrs	100% riparian veg intact, closed canopy 64-76. (No '87-90 photos)
Titicoed Creek	82(6-17TC)	Ø 64-70 +ΔW 70-76 -ΔW 76-87 +ΔW 87-91	Δt=~~23~~ yrs 27	100% riparian veg intact, but channel is mostly opened, appears widened in '64 photo. 100% riparian veg harvested & channel split in 2 btwn 70-76. Back to one channel, ↑veg by 87. Alluvial fan segment. Still open in 91 w/ large area of fresh deposition in lower part of segment.
	83(2-4TC)	Ø 64-70 -ΔW 70-87 +ΔW 87-91	Δt=~~23~~ yrs 27	100% riparian veg intact in '64. Natural debris slide in trib at upper end of segment has resulted in widening in this segment. (missing 76 photo) 100% of riparian veg removed btwn 70-87 (a few trees retained) - channel also ↓W btwn 70-87. Revised opening in 91 but no recent debris slides - in-channel erosion.
	84(>17TC)	Ø 64-87-91	Δt=~~28~~ yrs 27	100% riparian veg intact; natural openings in canopy. ~~Some ↑w in 91 photos from in-channel erosion, No recent upstream.~~

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
Titicaca Cr	71(>17TC)	Ø 64-82 +ΔW 82-90(?)	Δt=26 yrs	100% riparian veg intact, closed canopy 64-76. Upper ½ of segment harvested btwn 76-82; lower ½ btwn 82-87. Some evidence of widening in lower ½ on 90 ortho-photo & on edge of '87 photo (incomplete coverage). *Check 90 photos
↑	72(>17TC)	Ø 64-82 +ΔW 82-90??	Δt=26 yrs	100% riparian veg intact, closed canopy 64-82. Incomplete photo coverage (87) '90 orthophoto shows 100% riparian veg harvested *Get 90 photos
Holoman Creek	73(4-6MC)	+ΔW pre 64 -ΔW 64-87	Δt=23 yrs	pre 64 - 100% riparian veg cut; open. Alluvial fan segment, active channel shift evident in 64 photo. Increasing veg on fan 70-87. Source of sediment is local/no MW evident. Supplies sediment to Seg 16 & 15 of N Fk Tolt.
↑	74(>17TC)	+ΔW 64-70 -ΔW (or Ø) 70-87-91	Δt=~~22~~ 27 yrs	90% of riparian veg intact pre 64; harvest in lower end only, widening only where harvested in 64. Btwn 64-70, ~60% of riparian veg harvested; widening in harvested areas. Natural debris slide on unharvested area also contributes sediment. Slight recovery 70-87. Still open in 91.
N11 (N Fk Tolt trib)	75(6-17MC)	+ΔW pre 64 -ΔW 64-70 +ΔW 70-76	Δt=12 yrs	100% of riparian veg harvested pre-64. Alluvial fan segment, active channel shift evident in 64 photos; erosion, MW assoc w/ rd Xing & in CC. Confined to one channel in 70 photos (2 in '64). Increased veg in MW area btwn 70-76, but ↑ΔW due to upstrm sed. No 82, 87 photos. *Get '90 photos, or field assess.
↑	76(>17TC)	+ΔW pre 64 Ø 64-76 slight -ΔW 76-87	Δt=27 yrs	90% of riparian veg intact pre-64, but evidence of widening, entire length of channel - probably natural slide - steep chute above. ~50% of riparian veg cut btwn 64-70 → small areas of MW in inner gorge. Some ↑veg, ↓w in 87 photos.
N12 (N Fk Tolt trib)	77(6-17MC)	+ΔW pre 64 Ø 64-70 +ΔW 70-76 -ΔW 76-87 Ø 87-91	Δt=~~22~~ 27 yrs	100% of riparian veg harvested pre-64 & channel appears widened & recently shifted in 64 photo. Alluvial fan segment. Harvest upstream btwn 70-76 → channel shift in this segment; split into 2 channels. Increased veg, back in 1 channel by 87. Still open in '91.

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
Dry Creek	64(1-2 MC)	+ΔW 64-76 -ΔW 76-87 Ø 87-90	Δt=26 yrs	95% of riparian veg cut pre-64 - evidence of widening in 64 photos thru-out segment. 100% rip veg cut by 76. Eroding channel in E trib greatly accelerates & widens in 76 in new unit. - odd because 1-2% & flat sideslopes. Causes ↑ widening downstrm. Still eroding in '87; but lower portion of segment is narrowing in 87-90. * Field assess if possible
NIO (N Fk Tolt trib)	65(4-6 MC)	+ΔW 64-76 -ΔW 76-90	Δt=26 yrs	100% riparian veg cut pre-64. Some widening assoc w/ rd Xing at upper end of segment in 64. Dramatic widening 64-70 from upstream sediment source. Xing removed btwn 70-76. Increased veg density adjacent to channel 76-90. Thus stream contributes sediment to segment 15 of N Fk Tolt.
	66(6-17 TC)	+ΔW 64-76 -ΔW 76-90	Δt=26 yrs	100% riparian veg cut pre-64; some MW assoc w/ upper Rd Xing, but no opening in '64. Increased rds but no new harvest btwn 64-70. However, ↑ MW (1 slide in CC, 2 from road fillslope) in 70 photos & widened channel. This MW areas are source of sediment for seg 65 widening. Increased veg on MW areas & adjacent to channel in 82
	67(>17 TC)	+ΔW 64-70 (lower end) Ø 70-82 +ΔW 82-87	Δt=23 yrs	~60% riparian veg intact in 64. Some widening in lower end within CC 64-70. 100% riparian veg cut btwn 76-82. Channel widened & small, inner gorge failures in 87 photos. Also some shallow MW in natural opening on sideslopes - date to pre-64. * Check 90 photos too see if still widening
Titicaca Cr	68(6-17 TC)	Ø 64-70 +ΔW 70-76-82-87 Ø 87-90	Δt=26 yrs	100% riparian veg intact 64-70. MW evident on RB at 'turn', upper end of reach - natural. 100% riparian veg harvested btwn 70-76 ⇒ channel opening, MW assoc w/ rd Xing. Some recovery in lower end of segment 76-90; but upstream sediment continues widening of upper ½. Source of sediment to Segment 15, N Fk Tolt.
	69(2-4 MC)	Ø 64-70 +ΔW 70-76-82-87	Δt=23 yrs	100% riparian veg intact, closed canopy 64-70. 100% cut btwn 70-76 ⇒ channel opening, but no MW. Continued widening thru '87 due to upstream debris slide.
	70(6-17 TC)	Ø 64-82. +ΔW 82-87	Δt=23 yrs	100% riparian veg intact, closed canopy 64-70. Harvest on RB btwn 70-76, but some buffer retained. No widening until '87 photo due to debris slide from CC to east - enters middle of segment. Check '90 photos to see if still active sed source.

*58 phot... also show... 95% of r... cut & maj... widening... upstream... Rd Xi...

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+-	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
N6 (Trib to N5)	57(4-6TC)	Ø	64, 70, 76, 87 Δt = 23 yrs	~50% riparian veg harvested pre-64; 100% by '70. No evidence of widening, bank instability, or MW. Bounded by moderately-steep slopes
N7 (N Fk Tolt trib)	58(>17TC)	+ΔW 64-76 -ΔW 76-90	64, 70, 76, 82, 87, 90 Δt = 26 yrs	~40% of riparian veg cut pre-64 - in headwaters. 100% by '70. MW in lower end, above rd crossing; RB ⇒ debris flow & widening in lower 2,000 ft. Additional, small MW in inner gorge by '76. Healing by 82 - channel no longer open. Small eroding area still evident in original MW in '90
N8 (N7 trib)	59(>17TC)	Ø	Δt = 26 yrs	~50% riparian veg cut pre-64; 100% by 70. No channel widening, MW, or bank instability evident.
	60(6-17TC)	Ø	Δt = 26 yrs	100% riparian veg cut pre-64. No channel widening, MW, or bank instability evident.
	61(>17TC)	Ø	Δt = 26 yrs	100% riparian veg cut pre-64. No channel widening, MW, or bank instability evident.
N9 (N7 trib)	62(>17TC)	Ø	Δt = 26 yrs	100% riparian veg cut pre-64. Evidence of small, inner gorge failures - healing by '64 - could have moved alot of sediment pre-64. Increased veg by 76 & continuing to 90. No channel opening in photo sequence.
Dry Creek	63(1-2LC)	+ΔW 64-70 -ΔW 70-76-82 Ø 82-90	Δt = 26 yrs	100% riparian veg cut pre-64 & road constructed parallel to channel. Alluvial fan segment. Active shift of confluence of N Fk Tolt. MW assoc w/ road cutslope. Increased veg adjacent to channel and in MW areas by 70→82

Form ee-2. Channel condition and disturbance assessment worksheet

	Channel Response Segment Number	Change in Channel Width ΔW+ -	Time Interval (years) Δt	*Disturbance Indicators:* Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastrophic damage
N3 N Fk Tolt trib	50(1-2 TC)	Ø	70, 76, 79, 87 Δt = 17 yrs	Entire upper drainage basin logged - mostly pre-70. Some MW in inner gorge - post-70; still active 87. Increasing deciduous veg in valley bottom thru-out photo sequence.
N4 N Fk Tolt trib	51(~~6-17~~ TC) 4-6	-ΔW	70, 76, 79, 87, 90 Δt = 20 yrs	Channel appears widened in 70 photos; then completely closed by 87-90. Riparian veg intact, both sides; no MW within segment.
	52(>17 TC)	Ø	Δt = 20 yrs	Riparian area harvested, both sides in ~50% of segment, pre-70. Small areas of MW evident in 70 photos, largely healed by '76. Zone of sediment transport - contributes to widening in seg 13 of N Fk Tolt.
	53(6-17 TC)	Ø	70, 76, 79, 87 Δt = 17 yrs	90% of riparian veg harvested pre-70; one small area of MW in lower end of reach; RB; 2 more areas in 87 photos. Zone of sediment transport
	54(2-4 MC)	Ø	Δt = 17 yrs	100% of riparian veg & most of upper drainage basin harvested pre-70. Bounded by gently slopes, no MW. Closed canopy by 87.
N5 N Fk Tolt trib	55(1-2 MC)	-ΔW (small Δ)	64, 70, 76, 82, 87, 90 Δt = 26 yrs	Riparian veg harvested pre-64 & channel open. Slight reduction in width 76-82; otherwise little change. Channel has shifted SE btwn 76 & 82. Alluvial fan segment; fan is well vegetated.
	56(4-6 TC)	+ΔW	64, 70, 76, 87 Δt = 23 yrs	Riparian veg harvested - ~20% pre-70; 90% by '87. Areas of widening coincide w/ harvest. Also MW on LB, lower end of segment, enlarging 70-87. Upper drainage basin not cut as of 87. Widening especially evident, in upper portion of segment where harvest on both sides of creek (split yarded). Source of sediment to Seg 13 of N Fk Tolt.

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 1 Date 1/5/92 Analyst(s) J. Metzler

% of Segment Sampled 80% (9250'/11500') Stream Order/Type 5?/<1 UC

Sampled from Hwy 203 bridge upstream to end of segment

Flow: High (Moderate) Low

Average Bankfull Width 170'-200' Depth 20'

Valley Width >1,000' (but levees at bankfull width) Channel Gradient <1%

Channel Morphology: Dune-riffle, (Riffle-pool (meandering)), Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size Cobble	0	0
% of Channel Banks	0 (riprapped)	100% (riprap)	
% of Banks Eroding	0%		

Describe composition of bank material: Angular boulders ~~riprap~~. 1-3'D

- Banks are either riprapped or protected by levees 100% of segment both sides

Bank destabilization from: In-channel Upslope n/a - none

Alluvial channel pattern: Straight Braided (Meandering)

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage		
Non-functional	36	24

Number of Pools
moderately frequent Created by bedform, not LOD

0.6 pieces/100'

V* Calculation	Pool	Pool	Pool
Depth to fines	98		
Depth to gravel	63		
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

Pools too deep to wade - approx 5-10% V* is fine

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: The most striking feature of this reach is that banks are either protected by levees or riprap to protect floodplain development. Numerous, large point bars & midchannel bars; frequent channel splitting; Bars are either unveg or veg in "patches" much movement during '90 flood event.

Form ee-4. Channel Assessment Field Data Side 2 of 2

Grain Size Measurements

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Photo	Segment	Comments	Aug
18-30, 19-30	13(cont)	trib 51,52 is open beginning 30 chains above confl - inner gorge failure just downslope of harvest unit	
	12	Upstream - most limit of harvest. recent CC along seg 12; open, channel splitting, widening; logs drug across but thin line of standing trees left	

South Fork

~~19-31~~	~~111~~	~~debris slide off McClain Peaks~~	~~100 x 30'~~
		~~nonforested~~	
	~~110~~	~~open, a few trees, mostly nonforest~~	~~30'~~
	~~109~~		
19-31	111	open in lower ½, nonforest	
	110	closed, open forest & nonforest	
	109	closed "	
	108	closed, in open forest; debris slide enters mid-reach ⇒ opening downstream	20'
	107	open, thru open forest	40'
	143	open " " but hard to see	40'
	106	closed trib enters at top; closed dense forest	
	105	mostly closed, dense forest except 1 open area 40' wide x 120' long	
	104	mostly closed, sinuous - open areas of 1st big bend - 40' wide	

Army Corps Photos - 8/42 1:20,000
(no harvest)

Photo #	Segment	Comments	Avg w
19-31	22	open ~~[illegible]~~, landslides from peaks; mostly non-forest; open forest on S side in lower ½	30'
	87	open, active landslides no forest cover	30'
	21	open; open forest both sides	30'
	20	closed; mature " " "	-
	19	open, in one channel under area at bottom 70'w x 300' long	40'
	Titicaca	3 open tribs (Seg 85 & 2 to N); otherwise mostly closed; one area above pt 4184 is open - 500' x 60' w	
18-31	18	open, one channel, variable w	30-70
	81 (trib)	closed	
	17	open - 3 vegetated islands, no open tribs, variable w	60-200'
18-30-31	16	open, narrow all Tribs closed except 1 E of Titicaca - slight opening. Splitting, not braided	30'
18-30	15	opening begins ~500' below Titicaca sinous (meandering), not braided no open tribs odd hillslope opening 1320' upstrm of Dry Cr	
	14	closed - no open slopes where current MCW	

TOLT RIVER WATERSHED ANALYSIS

FIELD ASSESSMENT OF CHANNEL CONDITIONS

Segment #: 1
Stream: Tolt River mainstem
Type: (<1 UC)
Length: 11,500 feet
Surveyed Length: 9,250 feet

Date: 1/5/93
Surveyor: JoAnn Metzler

This segment is a zone of deposition at the mouth of the river. The channel widens upon entering the Snoqualmie River valley and leaving more confined, steeper gradient segments upstream. Deposited material consists of relatively coarse sediments stored on mid-channel and point bars. Some fine sediment was observed along channel margins, in backwater areas, and along the margin of large scour pools. Pools were too deep to measure, but it was estimated that fine sediment occupied less than 10 percent of the pool volume.

Woody debris plays a minor role in this segment, which is normal in a 5th order stream. It is stored in clumps and as individual pieces on the bars and mobilized during high flows.

Riprap and levees line both banks for the entire length of the segment. Therefore, there is no bank cutting and channel migration is confined between the riprap. Channel response to peak flows is limited to scour and deposition of the bottom sediments, rather than widening. The segment has moderate potential for damage from increased peak flows because the loose, unconsolidated bottom sediments would be easily scoured. Riprap and levees were largely successful in preventing bank erosion during the 1990 flood.

1/25/93 - High flow event - 1500hrs ~ 1.5' below top of riprap at Hwy 203 bridge; very turbid; logs mobilized

(Fisheries Observation - Jeff Light - best gravels on margins; higher flows appear to wash bed & wash fines & gravels suitable for spawning due to dike constraint.) - he was there on 2/1/93 after bankfull flow of 1/25/93.
- also appears to be backwater effect at mouth from Snoqualmie R.

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: Tolt River WRIA#: _____ Sub-WRIA#: _____ WAU: Tolt Segment ~~Reach~~ #: 1
Surveyors: J Mehler Reach length: _____ ft/m Average wetted width: _____ ft/m
Date: 1/5/92 Flow today is: High ~~Moderate~~ Low

Reach location: From Hwy 203 Bridge upstream

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 170 feet/meters
Average valley bottom width = 2,000 feet/meters VBW/ACW = >10

Sinuosity: a. straight (= 1) b. slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

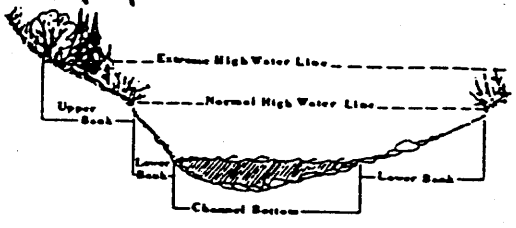
Source of material: alluvial glacial till colluvial lacustrine sediments bedrock unknown
other _____
riprap

Can the stream move the majority of the bed material sizes during high flows? Yes No

Can the stream erode the banks during high flows? Yes No Only in a few places
Riprap

C. Influence of Upper Banks

Average upper bank slope = 0 %
Can the stream undercut the upper banks? Yes No
Riprap
If yes, would this result in mass wasting? Yes No



D. Stream Energy

Average channel gradient = 1 %
Is the profile "stairstepped"? Yes No
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream c. 4th order mainstem
b. 2nd or 3rd order tributary d. 5th order or larger river

From flow chart, response category is:
Type A: unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blowout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting

1. Length of reach affected: (riprap)
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_|
   b. angled back: _/
   c. undercut: /__\

C. Degree of Bank Protection

1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass
   j. riprap

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

Riprap

D. Resistance of Lower Bank Material

1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

2. Bank cohesion (kick the bank!)

Riprap

   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

   a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
   b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
   c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
   d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

   Within the wetted channel, are surface particles distinctly larger than subsurface particles?
   Yes No

   On bars, are surface particles distinctly larger than subsurface particles?
   Yes No

D. Particle Size Distribution

   a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
   b. slight reduction in distribution of smaller particles
   c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

   a. bedrock/large boulder
   b. large and small boulders
   c. large and small boulders, some cobble
   d. mostly cobble with some boulders
   e. cobble/gravel
   f. mostly gravel
   g. mostly fines

F. Angularity

   a. substrate consists mostly of flat or angular rocks resistant to rolling
   b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
   c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

   a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
   b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
   c. larger particles are surrounded by a loose matrix of smaller particles
   d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Bridges very high & adequate - not damaged in '90 flood

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

Riprap on both sides of active channel area - generally effective

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

'90 flood caused damage to road near mouth on RB (fishing access area) - road reconstructed in 92

E. Other Observations

1 Steelhead sited

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	0	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	0	
2. (1. Length) >50%	0	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		0 (riprap)
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		0
E. Flow Deflection = c		0
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	0	
C. Armoring "yes" for either wetted channel or bars	1	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		0
F. Angularity = c		0
G. Particle Packing = c or d		1
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	0	
location = f, g		0
B. Culverts or Bridges Appear Inadequate		0
Total Score =	2	2

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

TOLT RIVER WATERSHED ANALYSIS

FIELD ASSESSMENT OF CHANNEL CONDITIONS

Segment #: 3
Stream: Tolt River mainstem
Type: (1-2 TC)
Length: 16,000 feet
Surveyed Length: 6,000 feet

Date: 1/14 & 19/93
Surveyors: J. Metzler
G. Pess
K. Sullivan
K. Beardslee

This segment begins at the confluence of the North & South Forks and continues downstream to where the valley opens and the stream is loosely confined. The survey began at the confluence and continued downstream, below Stossel Creek, and below the "big bend" approximately 300 feet.

Two large gravel bars at the upper end of the segment have enlarged significantly and pools have filled with fine sediment following the 1990 flood (K. Beardslee). Filling of eddy pools behind large boulders, especially in the upper half of the surveyed segment, was also observed. Only 2 pools greater than 1/2 the active channel width were observed.

Coarse sediment is deposited in point bars and mid-channel bars, which become more frequent moving downstream as the active channel area widens. In general, there is little vegetation on the bars and they are well-armored.

Little bank cutting or mass wasting was observed. There is an old, well-vegetated slump on the left bank downstream of the gaging cable in the upper end of the segment. This is not currently contributing sediment or debris to the channel. There is also an actively moving slump where the channel makes a big bend to the south. The channel is undercutting the toe of the slump and exposing glacial till. This area is a chronic source of fine sediment and woody debris. A film of silt/clay was observed on boulders just downstream of the slump. Alder trees are also being undercut and falling into the channel. Cause of this instability appears to be natural.

Woody debris has mostly been transported through this segment; it does not play a role in pool formation or sediment trapping. There were only a few pieces on the mid-channel bars.

Numerous coho were observed holding in the large pool upstream of the gaging station and smaller scour pools along the edge of the channel near Stossel Creek.

1/25/93 - 945am - High flow event; above bankfull. At confluence, NF is much higher than SFk, creating backwater up SFk.

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 3 Date 1/14/92 (1/19/92) Analyst(s) G. Pess, J. Metzler (G. Pess, K. Sullivan, K. Beardsley, J. Metzler)

Confluence downstream post-flood

← % of Segment Sampled 38% (6,000ft/16,000ft) Stream Order/Type (1-2)TC 5(?)

Flow: High **Moderate** Low

Average Bankfull Width 120' ft (wetted = 100') / Depth 1.25m = 4ft

Valley Width 120-140' Channel Gradient 2%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), **Riffle-pool** (where confined by BR) (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size - cobble/boulder (a few lg boulders)		
% of Channel Banks	95% boulders		5%
% of Banks Eroding	0%		

Describe composition of bank material: Mostly boulders & lg cobble & fines deposited (more fines on LB) behind Dense alder veg / Dang fir/cedar; Old dump on LB ~200' long - not eroding

Bank destabilization from: None In-channel Upslope

Alluvial channel pattern: **Straight** Braided Meandering

RB - Gravel bar at confluence ~2x enlarged since '90 flood

Old dump on LB ~200' below confl - well veg

Eddy pools below boulder full of fines

Numerous deposits on opposite margin - good of fines behind

Lg gravel bar onto from RB at gage cable 75% of channel width

Fines on LB opposite gage site 25 cm deep

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage		
Non-functional		#2

Number of Pools ½ or > Channel width
#2

V* Calculation	Eddy Pool (behind lg boulder)			Pool	Pool
Depth to fines	25	29	23		
Depth to gravel	37	50	61		
Depth of riffle crest	21	21	21		
$V^* = V_f/(V_f+V_r)$	12/16 0.75	24/29 0.72	38/40 .95		

2 Pools - Too deep (couldn't sample) - filling in eddy pools behind lg boulders

* Consider re-visit w/ dry suit *

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Large gravel bar at confluence; significantly enlarged & ↓ pool depth since '90 flood (K. Beardsley obs)

Also lg gravel bar at gaging cable appears fresh; ¾ of width of channel

Eddy pools also frequently filled w/ gravel & fines - unusual

↳ below lg boulders in channel

No bank cutting in vicinity Observed ~20+ coho (& maybe 5+)

Form ee-4. Channel Assessment Field Data Side 2 of 2

Grain Size Measurements

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

1/19/93

Seg 3 - below Stossel w/ George

BC on outside of bend - till exposed, chronic travel
5-25' high; ~250' long
Alder 4-6" dbh atop cuts, some being undercut
Conifer upslope - 30-50% slope
- Retain trees w/ ~~100'~~ 150' for root stability
Slump pocket w/ blue/gray clay exposed - leaning trees being undercut by stream - natural → outside of bend

V* Pocket pool behind 19 boulder below bend:
depth & fines 120- 95-83 12 cm
71-70 cm
97-59

12 ft 10" - long
11 ft wide
8.4" 8.4" riffle crest depth

Frequent silt/clay film on boulders downstrm of BC

~10 more coho on RB, just above BC

~10-15 coho nr LB, ~100' downstm of Stossel Cr + 3 carcasses

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: Toft
Surveyors: _____

WRIA#: _____ Sub-WRIA#: _____ WAU: _____ Reach #: B
Reach length: _____ ft/m Average wetted width: _ ft/m
Date: _____ Flow today is: High Moderate Low

Reach location: N+S Fk Confluence downstream ~500' below Stossel Creek

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 120 (feet/meters)
Average valley bottom width = 120-150 (feet/meters) VBW/ACW = 1.2

Sinuosity: a. straight (= 1) b. slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

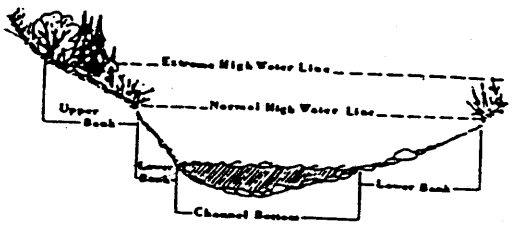
Source of material: alluvial glacial till colluvial lacustrine sediments ? bedrock unknown
other _____
~5% ~5%

Can the stream move the majority of the bed material sizes during high flows? Yes No

Can the stream erode the banks during high flows? Yes No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = 30-50 %
Can the stream undercut the upper banks? Yes No
If yes, would this result in mass wasting? Yes No



D. Stream Energy

Average channel gradient = 2 %
Is the profile "stairstepped"? Yes No
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream
b. 2nd or 3rd order tributary
c. 4th order mainstem ?
d. 5th order or larger river

From flow chart, response category is:

Type A: unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_|
   b. angled back: _/
   c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material > fines pack around larger particles
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

   a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
   b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places — define places
   c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
   d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

   Within the wetted channel, are surface particles distinctly larger than subsurface particles?
   Yes No

   On bars, are surface particles distinctly larger than subsurface particles? > Did pebble counts
   Yes No

D. Particle Size Distribution

   a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
   b. slight reduction in distribution of smaller particles
   c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

   a. bedrock/large boulder
   b. large and small boulders
   c. large and small boulders, some cobble
   d. mostly cobble with some boulders
   e. cobble/gravel
   f. mostly gravel
   g. mostly fines

F. Angularity

   a. substrate consists mostly of flat or angular rocks resistant to rolling
   b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
   c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

   a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
   b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
   c. larger particles are surrounded by a loose matrix of smaller particles
   d. bottom is very loose, most particles can be moved with your foot

   > below big bend

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

'90 flood - 100 yr event
Gaging station top of reach

E. Other Observations

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	0	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	0	
2. (1. Length) >50%	0	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		0
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		1
E. Flow Deflection = c		0
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	0	
C. Armoring "yes" for either wetted channel or bars	1	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		1
F. Angularity = c		1
G. Particle Packing = c or d		1
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	1	
location = f, g		0
B. Culverts or Bridges Appear Inadequate		0
Total Score =	3	5

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 5 Date 2/8/93 Analyst(s) J. Metzler, G. Ress, K. Beardslee

% of Segment Sampled 6100' 100% Stream Order/Type 1-2TC

Flow: High (Moderate) Low

Average Bankfull Width 150' / Depth 8'

Valley Width 150-200' Channel Gradient 1.5-2.5%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), (Riffle-pool (obstruction)), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 90 /size gravel/cobble	5	5
% of Channel Banks	90 " "	5	5
% of Banks Eroding	90 " "		

Describe composition of bank material: Mixed gravel cobble w/some bedrock on RB; fine till layers (p almost continuous erosion on LB-left

Bank destabilization from: (In-channel) Upslope

Alluvial channel pattern: Straight Braided (Meandering)

LOD Count	20 -50 cm Diameter	> 50 cm Diameter	Jams*
Functional: Pools, keyed to wood, sediment storage	11	14	3
Non-functional	13	7	7

Number of Pools >½ ACW
1

- Numerous pocket pools behi large boulders

LOD pieces function as bank protection; jams bars & marg

* Avg 6 per jam

45 pieces + 10 jams @ 6/jam = 105 pieces/6100 = 0.56/10m

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

Only 1 pool - too deep to measure

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Top of seg (break w/6) - "golden cake" exposed on LB, outside of bend 200' long x 10

(see other, "weathered" form for comments)

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 5 Date 2/8/93 Analyst(s) J. Mobley; G. Pess, K. Boardman

% of Segment Sampled _____ Stream Order/Type 1-2 TC

Flow: High (Moderate) Low

Average Bankfull Width 150' / Depth 1.

Valley Width 150-200' Channel Gradient 1.5-2.5%

wetted w = 101'
Bkfl w = 165
Bkf d = 7'

Channel Morphology: Dune-riffle, Riffle-pool (meandering), (Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
Channel Bed	% 90 /size gravel/cobble	5	5
Channel Banks	90 gravel/cobble	5	5
% Banks Eroding	90		

Describe composition of bank material: Mixed gravel/cobble w/ some BR on RB; fine till layers almost continuous on LB - vertical

Bank destabilization from: (In-channel) Upslope

Natural channel pattern: Straight Braided (Meandering)

LOD Count	20-50 cm Diameter	> 50 cm Diameter	Jam
Functional: Pools, keyed to wood, sediment storage	|||||	|||||	|||
Non-functional	|||||	|||||	||

Number of Pools
1

Number of pools backed

10 pieces failures to bank protection
Jams on bars or along margin

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_1+V_f)$			

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Top of seq (break #6) - "yellow cake" exposed on LB outside of bend
BC RB just below exposed "weathered rock" - lower ~ BC ~ 2' hi
Slump of LB, gravel, some blue gray & yellow exposed; BK on inner side continuous
Continuous undercut, continuous of some BC veg w/ alder
Big bar deposit of bed - has entered consider. since fall '92

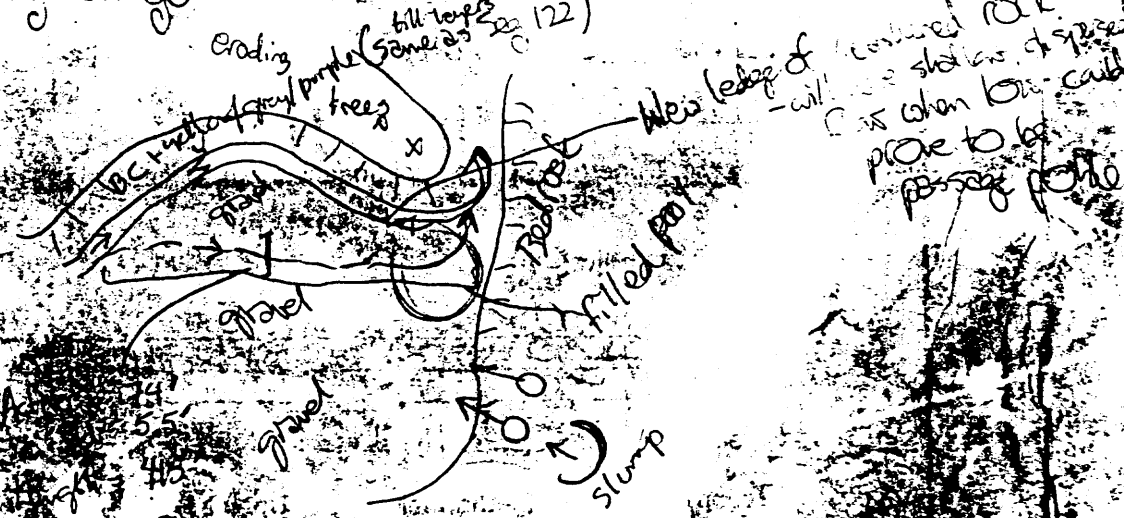
Berm of gravel deposited along RB

Considerable silt deposition during 4/25/93 event

- near trees w/ needles stop deposit

Redistributed existing bar more downstream & toward LB

Cutting on 'jellar cake' on LB is eating down to point



Downstream of weir channel width per w/ deep fine sediment

- very turbid, too deep to measure

Cutting on LB along LB ~15' hi exposing till - graffiti

Large "boulders" of till deposited in mid channel bars

- long aggregates of clay

also subsurface in bars

Gravel bar on inside of next bend, log jam on outside - fewer signs of redistribution than upstream

- One ↑ ht at outer end of bar - sharp face against thalweg

TOLT RIVER WATERSHED ANALYSIS

FIELD ASSESSMENT OF CHANNEL CONDITIONS

Segment #: 3
Stream: North Fork Tolt
Type: (2-4 TC)
Length: 3500 feet

Date: 1/4/93
Surveyor: JoAnn Metzler

This segment consists of two subparts: a very tightly confined, bedrock canyon in the lower half, and a more alluvial channel confined by relatively resisitant, glacial plastered slopes in the upper half.

Stream gradient in the 1,000-foot-long canyon varies from 2 to 6%, with steps up to 8%. The bedrock walls are nearly vertical and pools and shelves have been sculpted by the flowing water. Valley bottom width is equal to the active channel width of approximately 60 feet. There were no exposed gravel bars in this portion of the segment, and all pools had large gravel or larger substrate.

At the lower end of the segment, the stream emerges from the canyon and there is a fairly large area (200 ft high X 100 ft wide) of mass wasting on the left bank. The toe of the slope has been undercut by the stream. An old road location at the top of the slope may have also contributed to the initiation of this failure. Subsurface water emerges near the top of the slope, within the failure area. Three seep channels flow through the failure and continue to erode material. A layer of blue/grey clay was also observed within the failure, possibly a relatively impermeable layer that contributed to the slide. The failure area is healing, and is currently vegetated with alder saplings, 1-3 inches dbh.

The lower end of the segment is where the stream turns a corner and the gradient decreases.

In the upper portion of this segment, the stream is tightly confined by steep to moderately steep sideslopes of bedrock overlain by glacial till. Active channel width averages 70-80 feet and valley bottom width averages 80-100 feet. Along the channel margin, there are several bars of coarse material (cobble to boulder-size) vegetated with alder approximately 2-5 inches dbh. There are also unvegetated bars along the channel margin, usually upstream of clumps of woody debris. Three pebble counts were done on the upstream end of these bars. There are no mid-channel bars.

Bank cutting occurs on the outside of bends, often opposite the vegetated bars. The channel appears to narrow, rather than widening. Woody debris [illegible] along the channel margins. This stream has relatively high energy, due to the tight confinement, substrate gradient and large volume of flow.

Numerous steelhead redds have been flagged in this portion of the segment. Spawning gravel is moderately abundant and very coarse. Small tributaries bring in 1-4 inch gravel, but most of the channel has 4-6 inch gravel. Pools are relatively abundant due to bedrock constrictions, large boulders in the channel and the natural pattern of the bed. Woody debris does not contribute to pool formation. All pools had large gravel or larger substrate.

Near the upper end of the segment, there is a very large debris dam that spans the entire active channel width. The stream has eroded through the left side, creating a bedrock chute approximately 30 feet wide. This feature appears to be quite stable, and has probably been in place for a long time.

The upper end of the segment is where the gradient decreases, just downstream of the gaging station.

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 6 Date 1/4/92 Analyst(s) J. Metzler

% of Segment Sampled 100% = 3500' Stream Order/Type (2-4) TC

Flow: High **Moderate** Low

Average Bankfull Width ~~[illegible]~~ 70' (40-100') / Depth 10'

Valley Width ~~[illegible]~~ 90' (60-90) Channel Gradient ~~[illegible]~~ 3-5% w/ some steps up to 8% gradient

Channel Morphology: Dune-riffle, Riffle-pool (meandering), **Riffle-pool (obstruction)**, Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% ~~[illegible]~~ 60 /size (cobble) ~~[illegible]~~ LC	5% boulder LB	35 ~~[illegible]~~ %
% of Channel Banks	20 LC	30% LB	~~[illegible]~~ 50%
% of Banks Eroding	~~[illegible]~~ 30%		

- mature forest on steep slopes above bedrock walls; contributes to upper bank stability

Describe composition of bank material: mostly bedrock walls (vertical); colluvium till/alluvium in upper ½

Bank destabilization from: In-channel **Upslope** → MW - 200' hi x 100' wide on LB, bottom segment. Has old older saplings 1-3" dbh. 3 small ~~[illegible]~~ still eroding slide area - where BR walls end. Hummocky, clay layer - old roadway at top of slope - trapped?

Alluvial channel pattern: **Straight** Braided Meandering

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage		
Non-functional	~~[illegible]~~ (21)	(42) + large jam at BR chute

Number of Pools
- numerous - mostly from scour in BR constrictions behind boulders

1.8 pieces/100 ft length
- wood in clumps + pieces on outer bend ACW

V* Calculation	Pool	Pool	Pool
Depth to fines	0	0	0
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$	0	0	0

→ No fines observed in pools (too deep to measure)
A few small sand bars on channel margin

d_{50s}/d_{50i} _____ = d. 2.5-3.5 = q. 0.135-0.16-1 big = 0.15

Comments: Numerous SH redds flagged 5-6/92 in section above BR constriction

Bar on LB, midway thru reach has older 2-5" dbh - stabilizing - some BC
On RB, opposite - channel shifting W

Form ee-4. Channel Assessment Field Data Side 2 of 2

Grain Size Measurements

(1) Location: Bar on RB above BR constriction

	Size Class		# Surface Meas.	# Subsurface Meas.	
0.5	<2	6			30
	2-2				87
3	2-4	10			
4.8	4-5.6	4			15
6.8	5.6-8	21			5
9.5	8-11	22			3
13.5	11-16	22			2
19	16-22	11			
27	22-32	5			
38.5	32-45	2			
54.5	45-64	103			
	64-90				
	128				
	180				
	256				
	360				
	>512				
	D_{50}		10.9 (8-11)	3.1 (2-4)	

8693.2

$d^* = 3.5$

(2) Location: Bar on RB upstream of LWD clump, upstream = 1-200

Size Class		# Surface Meas.	# Subsurface Meas	
<2	18			49
2				
2-4	20			10
4-5.6	19			10
5.6-8	21			4
8-11	14			3
11-16	22			
16-22	13			
22-32	2			
32-45				
45-64	1			
90				
128				
180				
256				
360				
>512				
D_{50}		8.4 (8-11)	2.3 (2-4)	

$d^* = 3.6$

(3) Location: Bar on RB, bottom 1/2 above

Size Class		# Surface Meas.	# Subsurface Meas.	
<2	30			45
2	3			2-4-50
2-4	45			
4-5.6	15			5
5.6-8	5			2
8-11	4			
11-16	3			
16-22	2			
22-32	2			
32-45	2			
45-64	1			
90				
128				
180				
256				
360				
>512				
D_{50}		5.1 (4-5.6)	2.1 (2-4)	

$d^* = 2.5$

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: North Fork Tolt R WRIA#: _____ Sub-WRIA#: _____ WAU: Tolt Reach #: 6
Surveyors: J. Metzler Reach length: _____ ft/m Average wetted width: _ ft/m
Date: 1/4/93 Flow today is: High Moderate Low

Reach location: _____

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 70 feet/meters
Average valley bottom width = 90 feet/meters VBW/ACW = 1.3

Sinuosity: a. straight (= 1) b. slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

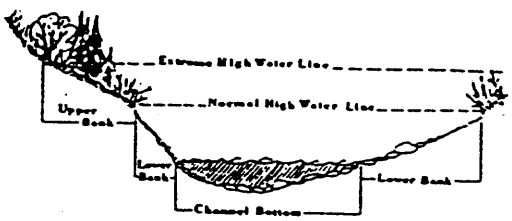
Source of material: alluvial glacial till colluvial lacustrine sediments bedrock unknown
other _____

Can the stream move the majority of the bed material sizes during high flows? Yes No

Can the stream erode the banks during high flows? Yes No Only in a few places → MW on LB, bottom of
: Upstream of BR constrict

C. Influence of Upper Banks

Average upper bank slope = 80 %
Can the stream undercut the upper banks? Yes No
If yes, would this result in mass wasting? Yes No



D. Stream Energy

Average channel gradient = 3-5 %
Is the profile "stairstepped"? Yes No
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream c. 4th order mainstem
b. 2nd or 3rd order tributary d. 5th order or larger river

From flow chart, response category is:

Type A: unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_|
   b. angled back: _/
   c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles? ~~No bars~~
Yes ~~No~~

D. Particle Size Distribution

a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
b. slight reduction in distribution of smaller particles
c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

a. bedrock/large boulder – lower ½
b. large and small boulders
c. large and small boulders, some cobble - upper ½
d. mostly cobble with some boulders
e. cobble/gravel
f. mostly gravel
g. mostly fines

F. Angularity

a. substrate consists mostly of flat or angular rocks resistant to rolling
b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
c. larger particles are surrounded by a loose matrix of smaller particles
d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Very high bridge over BR canyon

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

—

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

'90 flood

E. Other Observations

Area of MW - 200' hi x 100' wide on LB, bottom of segment healing but still eroding

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		0
II. Channel Banks		
A. Channel Capacity = b, c, or d	0	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	0	
2. (1. Length) >50%	0	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		0
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		0
E. Flow Deflection = c		0
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	0	
B. Recent Bed Mobility = d	0	
C. Armoring "yes" for either wetted channel or bars	1	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		0
F. Angularity = c		1
G. Particle Packing = c or d		1
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	0	
location = f, g		0
B. Culverts or Bridges Appear Inadequate		0
Total Score =	1	2

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

Form ee-4. Channel Assessment Field Data - Side 1 of 2

Segment No. 11 Date 7/16/93 Analyst(s) G. Ross, R. Bondurant, J. Mahler

% of Segment Sampled 100% 2,000 Stream Order/Type 1-2 MC TC

Flow: High (Moderate) Low

Average Bankfull Width 10.3 ft / Depth 6.5 ft — bolted q=.65 d=.21

Valley Width 100-120 ft Channel Gradient 2%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), (Riffle-pool (obstruction)), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% /size		
% of Channel Banks			
% of Banks Eroding			

Describe composition of bank material:

Bank destabilization from: (In-channel) Upslope

Alluvial channel pattern: (Straight) Braided Meandering

	LOD Count	20-50 cm Diameter	>50 cm Diameter	Number of Pools
Functional: Pools, keyed to wood, sediment storage	IIII IIII IIII	IIII	IIII	IIII
Non-functional	IIII IIII			

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_1/(V_1+V_f)$			

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Standing trees contributing root strength to banks - large cedars

LOD mostly on margins - provide some bank protection

Numerous big boulder in channel may create turbulence, function as wing deflectors? - Why didn't this answer in 40's?

Few pools - little fines observed too deep to measure

1 Area of BC at bottom of seg ~100' long × 30' hi - source of gravel

+ Mosses on boulders

Big boulders

LOD impacts to bank prot cover forming large levels low, buffer st mostly small

(~~cing~~ break to top of widening

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 15 Date 2/2/92 Analyst(s) G Pess; J Metzler; P Kennard; R. Little, BC

% of Segment Sampled 100% = 10,000' Stream Order/Type ~~1~~ 1-2 MC

Flow: High (Moderate) Low 298 - downstream end

Average Bankfull Width 300' / Depth 6' 359 - above narrowing 86' wet

Valley Width 350' Channel Gradient 1%

Channel Morphology: Dune-riffle, (Riffle-pool (meandering)), Riffle-pool (obstruction), Cascade, Step-pool. Braided

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100% /size cobble/boulder		
% of Channel Banks	100% - cobble/boulder w/ some till & lake-bed deposits		
% of Banks Eroding	90%		

Describe composition of bank material:

Bank destabilization from: In-channel Upslope

Alluvial channel pattern: Straight (Braided) Meandering

LOD Count	20-50 cm Diameter	>50	~~>50 cm Diameter~~ Jams
Functional: Pools, keyed to wood, sediment storage	5		
Non-functional	4	1	

Number of Pools
7

10 pieces + 11 jams (~10 pieces/jam) = 120 pieces = 1.96 pieces/100'

* fines on downstream end behind boulders

V* Calculation	Scar at lower end: scour top	top EB	*Pool LB	middle	RB	LB	Pool: Pool top	RB	LB	Pool end	RB	LB	Pool
Depth to fines	88	99	59	41	63	40	50	70	65	69	83	85	
Depth to gravel	88	96	59	40	49	35	49	53	57	60	67	81	
Depth of riffle crest	99											99	
$V^* = V_f/(V_f+V_r)$	0/11	3/3		1/59	12/50	15/64	19/50	17/46	34/42	9/59	16/32	4/18	
	0	1	0	.02	0.3	0.2	0.4	0.4	0.8	0.2	0.5	0.2	

avg = 0.3

Wetted w: 63, 20, 15 } 3 channels

ACW = 298'

Bkfl d = 6'

A lot of fines behind cobbles & boulders even in riffles

Numerous BC - sources of fine & coarse sed

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments:

Ber at lower end - pebble count shows armored but obviously large sediment load

Some 4-6" dbh alder on islands between braids, but mostly unvegetated

Fresh deposits @ trunks of trees on bars

Except for lake till/colluvial deposits. Banks some of lake

Glaciofluvial terrace at top of widening ~150' hi x 300 wide. Failure after Clay near top of shallow. Terrace cut by stream - not pulling

Good to 4 upstream

Version 1.0 ee-35 October 1992

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: North Fork Tolt WRIA#: _____ Sub-WRIA#: _____ WAU: _____ ~~Reactr~~ Segment #: 15

Surveyors: G. Ross, J. Mahler, B. Collins, P. Little, P. Kennard Reach length: 10,000 ft/m Average wetted width: _ ft/m

Date: 2/2/93 Flow today is: High Moderate Low

Reach location: Braided channel - begins ~4,000' upstream of bridge to ~500 feet below mouth of Tiffany Creek

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 300 feet/meters (braided)

Average valley bottom width = 350 feet/meters VBW/ACW = 1.2

Sinuosity: a. straight (= 1) b. slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

Source of material: alluvial (majority) glacial till colluvial lacustrine sediments bedrock unknown

other _____

Can the stream move the majority of the bed material sizes during high flows? Yes No

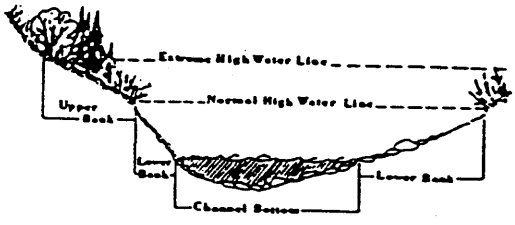
Can the stream erode the banks during high flows? Yes No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = 0-100 % avg 10%

Can the stream undercut the upper banks? Yes No

If yes, would this result in mass wasting? Yes No



D. Stream Energy

Average channel gradient = 1-2 %

Is the profile "stairstepped"? Yes No

If yes, what forms the steps? Bedrock Boulders Woody debris

Do the steps appear stable? Yes No

Position in drainage network: a. 1st order headwater stream b. 2nd or 3rd order tributary c. 4th order mainstem d. 5th order or larger river

From flow chart, response category is:

Type A: unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_|
   b. angled back: _/
   c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles?
Yes No

D. Particle Size Distribution

a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
b. slight reduction in distribution of smaller particles
c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

a. bedrock/large boulder
b. large and small boulders
c. large and small boulders, some cobble
d. mostly cobble with some boulders
e. cobble/gravel
f. mostly gravel
g. mostly fines

F. Angularity

a. substrate consists mostly of flat or angular rocks resistant to rolling
b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
c. larger particles are surrounded by a loose matrix of smaller particles
d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

None

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

None

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

History of widening since 1958

E. Other Observations

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	1	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	1	
2. (1. Length) >50%	1	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		1
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		0
E. Flow Deflection = c		1
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	1	
C. Armoring "yes" for either wetted channel or bars	1	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		0
F. Angularity = c		0
G. Particle Packing = c or d		0
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	1	
location = f, g		0
B. Culverts or Bridges Appear Inadequate		0
Total Score =	7	3

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase (already widened)
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

"Quick Survey" - J Metzler, K Beardslee, G Pess

Seg 19 - North Fork Toft
in mature timber

Wetted w = 19' + 3' + 5' d = 0.7'
Bkfl = 95' d = 4'

Station	Habitat	LOD
0-23	S. Pool (split channel)	2 - forms pool (33' long) + 3 others + 1 jam on bar
23-61	Riffle	1 - traps gravel + 5 (>50) small ones trap gravel
61-92	~~Plunge pool~~	3 - scour ~~& provide~~ cover, create plunge
92-111	Riffle	—
111-133	Pool - scour	1 jam 3 pieces - create scour
133-149	Plunge pool	1 jam 3 pieces
149-195	Riffle	2 pieces - trap gravel
195-217	Scour pool	1 piece
217-265	Scour pool	6 pieces - scour, trap gravel, cover
265-333	RC	6 pieces on bar - trap gravel

Subangular gravel/cobble 3%
sinuous - meandering thalweg
Widened channel but meandering thalweg

P:R = 50:50

Seg 18 - CC (100% harvested btwn 64→76)

0-333 Riffle w/ 2 pocket pools, no cover — 3 - nonfunc. pieces along margin

P:R = 1:99

Wetted w = 20'
d = 16"

Bkfl = 70'
d = 6.5'

Cobble/boulder 4%
Overall larger substrate

Widened channel, relatively straight thalweg

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 44 (4 Gee) Date 7/16/93 Analyst(s) J. Hetler, G. Pess, K. Beardslee

% of Segment Sampled 100% 2,000' Stream Order/Type 4-6 ~~C~~

Flow: High **Moderate** Low

MC - alluvial fan - splitting, shift

Average Bankfull Width 30' / Depth 38" = 3' Wetted w = 11 d = 10"

Valley Width 100' Channel Gradient 6.2

Channel Morphology: Dune-riffle, Riffle-pool (meandering), Riffle-pool (obstruction), Cascade, **Step-pool**

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% /size		
% of Channel Banks			
% of Banks Eroding			

Describe composition of bank material: [illegible]

Bank destabilization from: In-channel Upslope

Alluvial channel pattern: Straight Braided **Meandering**

LOD Count	20-50 cm Diameter	> 50 cm Diameter	Number of Pools
Functional: Pools, keyed to wood, sediment storage	14	7 3	11
Non-functional	9	2	

32 pieces + 3 jams @ 5/jam = 47 pieces

Mostly 4-8" dist. [illegible] Little LOD recruit [illegible] have [illegible] down bigger [illegible]

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

10 largest pieces
51
40
25
23
55
50
51
35
34
43

Stump on RB, upper end of segment - actively eroding - located dep. subsurf water [illegible] ~100' = 50 [illegible]

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: 7'D CMP lower end segment - large boulders create berm at inlet - some water appears to be going underneath - 4.5' outlet drop - too steep - barrier

LOD not forming steps - boulders are - but does cause channel splitting & traps gravel / cobble

Lots of evidence of shifting - 3 fan type segment - old stump shows evidence

Lots of LOD Op

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 63 Date 1/28/93 Analyst(s) G. Ross; J. Metzler; R. Little

% of Segment Sampled 100% = 1750' Stream Order/Type 1-2LC 3rd Order?

Flow: (High) - but clear Moderate Low

Average Bankfull Width 40 ft / Depth 1 ft

Valley Width ∞ (in N Fk valley) very wide, but near wall along RB Channel Gradient 1-2%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), (Riffle-pool (obstruction)) → dune/riffle in pools at lower end due to backwater; ↗ also bedform
Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size gravel/cobble		
% of Channel Banks	100 gravel/cobble w/ fines		
% of Banks Eroding	90%		

Describe composition of bank material: → Alluvium from N Fk - gravel w/ some cobble. Open stand of alder ↳ alder help, but not dense root mat 3-6" dbh immature

Bank destabilization from: (In-channel) Upslope seepage at confluence also

Alluvial channel pattern: Straight Braided (Meandering)

LOD Count	20-50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||| (23)	||| (3)
Non-functional	~~||||~~ |||| (9)	||| (3) (38)

Number of Pools
~~||||~~ || (7)

38 pieces/1750
= 0.07 pieces/m
W = 12 m

V* Calculation	Scour (No LOD) Pool (below dam): thalweg ↓	margin LB ↓	RB				Dammed Pool (behind br[illegible] or mouth): upstrm					downst	Scour Pool: thalweg head	d/f	downstrm				Scour (2 connected) Pool: thal	marg	RB	thal	RB	LB thal	RB
Depth to fines	79	94	95				90	66	53	44	58	31	51	76	93	107			77	77	71	94	79	100	114
Depth to gravel	79	76	93				65	48	47	40	20	20	51	~~6~~4	86	100			77	64	71	81	79	87	98
Depth of riffle crest	~~95~~ 101	101	101				17	17	17	17	17	17	107	107	107	107			105	105	105	105	105	105	105
$V^* = V_f/(V_f+V_r)$	0/22 0	18/25 0.72	2/8 0.25	$\bar{V}^*$ = 0.3			25/48 0.52	18/31 0.58	6/30 0.2	4/23 0.17	38/3 12.7	11/3 3.7	0 0	12/43 0.28	7/21 0.3	7/7 1			0	13/41 0.32	0	13/24 0.55	0	13/18 0.72	16/7 2.3

$\bar{V}^*$ = 3.0 (Dammed Pool) $\bar{V}^*$ = 0.4 (Scour Pool) $\bar{V}^*$ = 0.56 (Scour (2 connected) Pool)

d_{50s}/d_{50i} ________ = d. ________ = q. ________

Comments: Stream is along N edge of N Fk Tolt valley where extensive widening, braiding has occurred. Stream has been "pushed" N & W by N Fk & recently shifted channels near mouth. Dammed pool at lower end has large deposits of fine materi[al] in dune/ripple deposits. Nearly 100% of channel covered w/ fresh deposits of fines & gravels. Large gravel deposit at culvert outlet due to temporary pl[...]

Seg 63 w/ GP, RN, IM

Begin at confluence w/ N Fk
- enters in widened valley - joins branch of N Fk
- alot of fresh debris & fine sed from 1/25 flood

large seep enters on LB at mouth - above grade of channel
emerges from base of rd fillslope ~1 cfs
not at grade w/ Seg 63 or N Fk (~3' above)

BC ~100%

Debris jam near mouth - channel has shifted N - perhaps last flood -
very unstable below
- may have shifted due to ↑ baseline from N Fork

Dammed pool upstrm of jam
large amt of fine sed (V* = 2)
dunes in pool

Wetted w = 18' } riffle
Bkfl w = 36' }
Bkfl d = 70 cm
Wetted d = 17 cm, 15 cm $\bar{d}$ = 16 cm
1.5%

BC most of segment - alders are open, provide some root str

* Short segment, only 2 pebble counts

Actually in the valley of the N Fk - confluence/influence

Angular - subang particles - loose
No staining - alot fresh deposits

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: Dry Creek WRIA#: _____ Sub-WRIA#: _____ WAU: Toh Seg ~~Reach~~ #: 63
Surveyors: J. Mohler, G. Ross, P. Little Reach length: 1750 (ft)/m Date: 1/28/93 Average wetted width: 18 (ft)/m Flow today is: (High) Moderate Low
Reach location: From mouth upstream to culvert

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 36 (feet)/meters
Average valley bottom width = ~200 (feet)/meters VBW/ACW = 5

Sinuosity: a. straight (= 1) (b. slightly sinuous (1.1-1.3)) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

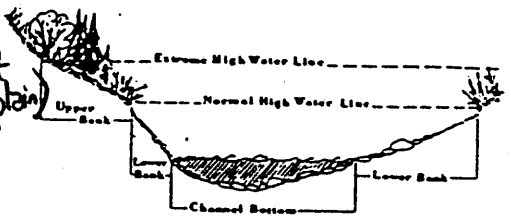
Source of material: (alluvial) glacial till colluvial lacustrine sediments bedrock unknown
other _____

Can the stream move the majority of the bed material sizes during high flows? (Yes) No

Can the stream erode the banks during high flows? (Yes) No . Only in a few places

C. Influence of Upper Banks

Average upper bank slope = 0 %
Can the stream undercut the upper banks? Yes (No)
If yes, would this result in mass wasting? Yes (No) (Flat floodplain)



D. Stream Energy

Average channel gradient = 1-2 %
Is the profile "stairstepped"? Yes (No)
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream (b. 2nd or 3rd order tributary) c. 4th order mainstem d. 5th order or larger river

From flow chart, response category is:
(Type A:) unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   (a.) active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_|
   b. angled back: _/
   c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility
   a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
   b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
   c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
   d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles?
Yes No

D. Particle Size Distribution
   a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
   b. slight reduction in distribution of smaller particles
   c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes
   a. bedrock/large boulder
   b. large and small boulders
   c. large and small boulders, some cobble
   d. mostly cobble with some boulders
   e. cobble/gravel
   f. mostly gravel
   g. mostly fines

F. Angularity
   a. substrate consists mostly of flat or angular rocks resistant to rolling
   b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
   c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)
   a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
   b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
   c. larger particles are surrounded by a loose matrix of smaller particles
   d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Culvert at upstream end appears to have plugged. then released during 1/25/93 flood. Fillslope is slumping on both inlet & outlet sides. Culvert is bent & inlet is ½ plugged with gravel.

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

E. Other Observations

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	0	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	1	
2. (1. Length) >50%	1	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		0
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		1
E. Flow Deflection = c		1
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	1	
C. Armoring "yes" for either wetted channel or bars	0	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		1
F. Angularity = c		0
G. Particle Packing = c or d		0
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	1	
location = f, g		1
B. Culverts or Bridges Appear Inadequate		1
Total Score =	5	6

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 64 Date 1/28/93 Analyst(s) J. Mohler, G. Pess, R. Little

% of Segment Sampled ~2,000'/8000' 25% Stream Order/Type (1-2)MC

Flow: High but clear Moderate Low

Average Bankfull Width 25 ft / Depth 3'

Valley Width 20-70' Channel Gradient 1-2%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), Riffle-pool (obstruction), Cascade, Step-pool

many pools filled w/ gravel

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size gravel-cobble		
% of Channel Banks	100% - similar size		
% of Banks Eroding	80%		

Describe composition of bank material: gravel among fines - till/colluvium/fine sediments/old delta deposits

Bank destabilization from: In-channel Upslope

Alluvial channel pattern: Straight Braided Meandering

LOD Count	20-50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	~~IIII~~ ~~IIII~~ III (13)	~~IIII~~ II (7)
Non-functional	III (3)	

(23)

Number of Pools
~~IIII~~ I (6)

23/2,100 ft = 0.038/m σ = 7.5 m

only 1 pool > ½ ACW
most pools filled w/ recent deposits of gravel/fines

V* Calculation	Pool (low flow)						Pool (low flow)						Pool (same)					
	LB		RB				LB				RB		RB	RB				
Depth to fines (gravel)	62	63	24	79	96		87	90	97	97	105	101	101	105	98			
Depth to gravel	58	63	96	73	87		87	82	79	90	96	89	36	57	61			
Depth of riffle crest	112	112	112	112	112		112	→					112	112	112			
$V^* = V_f/(V_f+V_r)$	(all gravel) 4/54	0/79	8/16	21/39	9/25	$\bar{V}^*$ 0.3	(all gravel) 0/70	8/30	18/33	7/22	9/16	12/23	65/76	48/55	37/51	$\bar{V}^*$=0.52		
	0.07	0	0.5	0.54	0.36		0.27	0.54	0.32	0.56	0.52	0.36	0.87	0.72				

$\bar{V}^*$=0.41

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Riparian veg - dense 2nd growth hemlock 2-8" dbh
Substrate - angular, loose
Fresh deposits on >75% of bottom
Roots important in bank stability
Channel enlargement evident & recent deposition

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: Dry Creek WRIA#: _____ Sub-WRIA#: _____ WAU: Bolt Reach #: 64
Surveyors: J. Metzler Reach length: 2000 (ft)/m Average wetted width: 19 (ft)/m
G. Pess Date: 1/28/93 Flow today is: (High) but clear Moderate Low
R. Little
Reach location: From culvert upstream ~2000'

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 25 (feet)/meters
Average valley bottom width = 50 (feet)/meters VBW/ACW = 2

Sinuosity: a. straight (= 1) b. slightly sinuous (1.1-1.3) (c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

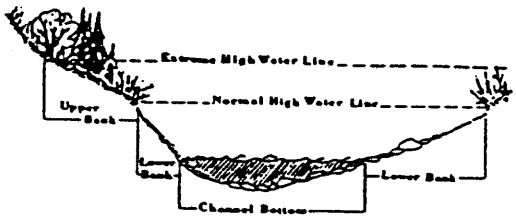
Source of material: (alluvial) (glacial till) colluvial (lacustrine sediments) bedrock unknown
other _____

Can the stream move the majority of the bed material sizes during high flows? (Yes) No

Can the stream erode the banks during high flows? (Yes) No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = 0-50 % - very variable
Can the stream undercut the upper banks? (Yes) No
If yes, would this result in mass wasting? (Yes) No



D. Stream Energy

Average channel gradient = 1-2 %
Is the profile "stairstepped"? Yes (No)
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream c. 4th order mainstem
(b.) 2nd or 3rd order tributary d. 5th order or larger river

From flow chart, response category is:

Type A: unconstrained
Type B: slightly constrained, unconsolidated bottom
(Type C:) laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_| b. angled back: \/ c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. > 75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles?
Yes No

D. Particle Size Distribution

a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
b. slight reduction in distribution of smaller particles
c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

a. bedrock/large boulder
b. large and small boulders
c. large and small boulders, some cobble
d. mostly cobble with some boulders
e. cobble/gravel
f. mostly gravel
g. mostly fines

F. Angularity

a. substrate consists mostly of flat or angular rocks resistant to rolling
b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
c. larger particles are surrounded by a loose matrix of smaller particles
d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Culvert at lower end is ½ full of gravel & appears to have plugged during 1/25/93 storm. Large backwater deposit of gravel/fines extends ~ 150' upstream, 50' wide.

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

E. Other Observations

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 119 Date 1/21/93 Analyst(s) J. Metzler, G. Pess

% of Segment Sampled 1000'/3500' = 29% Stream Order/Type <1 LC - 3rd Order

Flow: High (Moderate) Low 17' Wetted W

Average Bankfull Width ~~20'~~ 22' ACW / Depth 4'
98' valley bottom (flat, broad)

Valley Width 98' Channel Gradient <1%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), Riffle-pool (obstruction), Cascade, Step-pool - N/a Beaver dams/wetlands Low gradient

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size silt/sand	0	0
% of Channel Banks	100 " "	0	0
% of Banks Eroding	~~80~~ 40		

large amt of woody debris

Describe composition of bank material: Fine material - floodplain deposits behind dams
Alot of LOD

Bank destabilization from: In-channel Upslope None

Alluvial channel pattern: Straight Braided (Meandering)

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	Too much to count	
Non-functional	Alder ~~Ellen~~ + Beaver dams	

Number of Pools
Abundant - dams create backwater pools

Segment consists of a series of beaver dams with a few short stretches of slow riffle w/ small gravel. Mostly fine sed behind ponds.

Some bank cutting - natural channel migration across flat valley bottom

V* Calculation	120=0 Sand/silt Pool deposits (upper mid lower)						120=0 silt/clay dep Pool						Pool					
Depth to fines	73	57	93				46											
Depth to gravel	35	26	17				0											
Depth of riffle crest	108	108	108				109											
V* = $V_f/(V_f+V_r)$	38/73 0.52	31/82 0.38	76/91 0.84				46/109 0.42											

d_{50s}/d_{50i} _____ = d. _____ = q. _____ (Only found 1 gravel bar for pebble count - rest is sand & small

Comments: Beaver dam/wetland system - low gradient, area of deposition mostly fine sed; a few sm gravel bars. Look at upstream tribs for source of sed. Could have potential for damage from ↑Qp due to beaver dams blowing out. Also, dam at lower end of reach, is against bridge & obstructing flow. Log stringer bridge is no longer drivable - should remove.

Form ee-4. Channel Assessment Field Data Side 2 of 2

Grain Size Measurements

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: Trib to Lynch Creek WRIA#: _____ Sub-WRIA#: _____ WAU: _____ Reach #: 110
Surveyors: J. Mercier Reach length: _____ ft/m Average wetted width: _____ ft/m
G. Fess Date: 1/21/93 Flow today is: High Moderate Low

Reach location: From log stringer bridge upstream approx 500'

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 22 feet/meters
Average valley bottom width = 98 feet/meters VBW/ACW = 4.4

Sinuosity: a. straight (= 1) b. slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

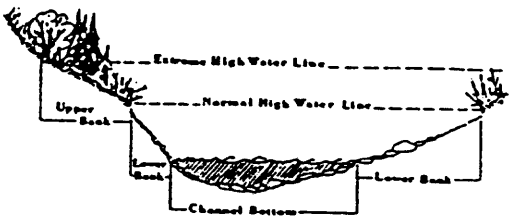
Source of material: alluvial glacial till colluvial lacustrine sediments bedrock unknown
other _____

Can the stream move the majority of the bed material sizes during high flows? Yes No

Can the stream erode the banks during high flows? Yes No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = 0 %
Can the stream undercut the upper banks? Yes No
If yes, would this result in mass wasting? Yes No → flat



D. Stream Energy

Average channel gradient = <1 %
Is the profile "stairstepped"? Yes No
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream c. 4th order mainstem
b. 2nd or 3rd order tributary d. 5th order or larger river

From flow chart, response category is:
Type A: unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_| b. angled back: \/ c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas - wetland
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock - all fines

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits – due to numerous beaver dams

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

   a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
   b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
   c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
   d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

   Within the wetted channel, are surface particles distinctly larger than subsurface particles?
   Yes No

   On bars, are surface particles distinctly larger than subsurface particles?
   Yes No

D. Particle Size Distribution

   a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
   b. slight reduction in distribution of smaller particles
   c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

   a. bedrock/large boulder
   b. large and small boulders
   c. large and small boulders, some cobble
   d. mostly cobble with some boulders
   e. cobble/gravel
   f. mostly gravel
   g. mostly fines

F. Angularity

   a. substrate consists mostly of flat or angular rocks resistant to rolling
   b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
   c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

   a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
   b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
   c. larger particles are surrounded by a loose matrix of smaller particles
   d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel – numerous beaver dams
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Log stringer bridge at bottom of segment has beaver dam under it - little clearance for water.

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

E. Other Observations

Numerous beaver dams - low gradient/wetland system

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	0	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	0	
2. (1. Length) >50%	0	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		0
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		1
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		0
E. Flow Deflection = c		0
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	0?	
C. Armoring "yes" for either wetted channel or bars	0	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		1
F. Angularity = c		1
G. Particle Packing = c or d		1
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	0	
location = f, g		1
B. Culverts or Bridges Appear Inadequate		1
Total Score =	1	7

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 122 Date 1/28/93 Analyst(s) J. Metzler, G. Pess, R. Little

% of Segment Sampled 2000'/5000' 40% Stream Order/Type 2nd Order, >17 TC

Flow: High & murky Moderate Low

Average Bankfull Width 30-50' / Depth 6-10'

Valley Width no defined valley Channel Gradient 40-60% avg

Channel Morphology: Dune-riffle, Riffle-pool (meandering), Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 50 /size boulder/cobble	50%	
% of Channel Banks	30	70%	
% of Banks Eroding	100%		

Describe composition of bank material: Large cobble/boulder in loose matrix of fines; also several clay layers of varying thickness

Bank destabilization from: In-channel Upslope - Stream braids over surface of large m failure

Alluvial channel pattern: Straight Braided Meandering

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	~20/100' in leave block, mostly > 50cm 0/100' in rest of segment surveyed	
Non-functional		

Number of Pools
Step pools mostly filled w/ gravel

Ø LOD except in leave block where it is important in forming steps. No sources of LOD due to harvest. LOD critical for energy dissip. & sed trapping.

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

N/A High gradi

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: This channel is highly unstable & actively shifting. At the lower end, large berms of boulder/cobble cause the channel to split frequently. Cross sectional area is enlarged & still enlarging. Large boulders form unstable steps, LOD completely lacking in all but leave block area. Where LOD present, channel is narrower & moss on boulders indicates some stability.

Channel flows over large mass failure area - not incised, braided, 55% slope - very unstable; clay dy at upper end of slump.

In plateau above slump, channel is only ~12' from Seg 124 - area of 'piracy': Separated only by gravel/c

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 124 Date 1/28/93 Analyst(s) J. Metzler, G. Pess, R. Little

% of Segment Sampled 2000'/4000' = 50% Stream Order/Type 2nd order, >17 TC

Flow: High but clear Moderate Low

Average Bankfull Width 30-50' / Depth 6-10'

Valley Width same as bkfl w Channel Gradient 40-60%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 50 /size boulder/cobble	50%	
% of Channel Banks	30%	70%	
% of Banks Eroding	80%		

Describe composition of bank material: Large cobble/boulder in loose matrix of fines

Bank destabilization from: In-channel Upslope → debris flows in 2 tribs

Alluvial channel pattern: Straight Braided Meandering

LOD Count	20-50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	~20/100' upstream of debris flow, mostly >50 cm & important in forming steps ~5/100' below debris flows	
Non-functional		

Number of Pools
Step pools mostly filled w/ gravel, esp. below debris flows

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

N/A Too steep

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Debris flows in 2 tributaries have caused enlargement of channel. Above debris flows the stream stairsteps over boulders/LOD, mossy boulders, relatively step. Below debris flows are 2 old jams which have been eroded & appear to form relatively unstable nickpoints. These nickpts could migrate upstream & rejuvenate the debris flow tributaries.

Very large alluvial fan below this segment indicates historic high debris load - possibly during period when seg 122 shifted into this channel.

Channel area is eroded & actively eroding. Several slumps on sideslopes.

TOLT RIVER WATERSHED ANALYSIS

FIELD ASSESSMENT OF CHANNEL CONDITIONS

Segment #: 126
Stream: S. Fk Tributary
Type: (>17 TC)
Length: 750 feet
Surveyed Length: 750 feet

Date: 1/19/93
Surveyors: J. Metzler
G. Pess

This very high gradient segment shows a moderate amount of widening and downcutting not evident on 1990 air photos and probably related to the 1990 flood. The culvert at the top of the segment has been recently replaced and the new culvert appears to be adequate, and perhaps oversized.

The surrounding forest has been precommercially thinned, resulted in abundant small woody debris in and across the channel. Due to the steep gradient and confined nature of the channel, there is a high potential for a debris dam and debris torrent because of this relatively mobile woody debris. This material could be bucked and removed from the channel by hand. In the future, directionally falling away from the stream could prevent this situation.

Tree roots appear to be very important in holding together the relatively noncohesive bank material. Channel enlargement has occurred in the lower half of the segment due to high flows. This stream is a source of fine and coarse sediment to the South Fork Tolt.

On 1/26/93, during recession of a peak flow event, this tributary was remarkably clear and not especially high. This might be attributed to the large wetland just upstream of this segment and the relatively small, north-facing drainage area feeding this stream. This visit also revealed a sizeable berm of sidecast of material from road maintenance that was feeding coarse sediment directly into the channel.

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	1	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	1	
2. (1. Length) >50%	1	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		1
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		1
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		0
E. Flow Deflection = c		1
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	1	
C. Armoring "yes" for either wetted channel or bars	0	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		1
F. Angularity = c		0
G. Particle Packing = c or d		1
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	0	
location = f, g		1
B. Culverts or Bridges Appear Inadequate		1
Total Score =	5	8

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 68 Date 2/2/93 Analyst(s) J. Metzler, G. Pess, P. Kennard, B. Collins, RL

% of Segment Sampled 53% 1600'/3000' Stream Order/Type 6-17 TC

Flow: High **Moderate** Low

Average Bankfull Width 50' / Depth 5'

Valley Width 50-75' Channel Gradient 10% avg

12' wetted
42' bkfl
4' hi bkfl

Channel Morphology: Dune-riffle, ~~Riffle-pool~~ (meandering), Riffle-pool (obstruction), **Cascade, Step-pool** → mostly boulders

(where it joins N Fk there is a boulder berm but no alluvial fan)

	Alluvium	Colluvium	Bedrock
% of Channel Bed	20% /size	80% cobble/boulder	
% of Channel Banks		100%	
% of Banks Eroding	80%		

Describe composition of bank material: Large cobble/boulder w/ alder stand (3-5" dbh) providing some root stability

Bank destabilization from: **In-channel** **Upslope**

Alluvial channel pattern: **Straight** Braided Meandering

LOD Count	20-50 cm Diameter	> 50 cm Diameter	Jam
Functional: Pools, keyed to wood, sediment storage	15	13	8
Non-functional	15	13	

Number of Pools
9

56 pieces + 8 jams (~8 pieces/jam) = 120 pieces = 0.247/m

LWD - old log form nice sills - gulch trap sediment Creek plunge pools

root wads also important

- but pools & steps also formed by boulders

- better plunge pool

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

n/a high gradient

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Appears to have had debris torrent - deposited upstream ~200' from N. Fork.

Could have been jam brk above rd -

Slump on LB - probably related to road

Old log stringer bridge full of sed - creek went to W

Debris jam ~400' upstream from north caused channel shift to E - lower end of debris flow deposit

Numerous old logs partially buried beneath 1' of gravel/cobble

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 94 Date 2/4 Analyst(s) J. Mobler K. Bardtke K. Sullivan G. Ress P. Kennard D. Coburn

% of Segment Sampled 81% 2500'/3100' Stream Order/Type 2-4 MC

Flow: High **Moderate** Low

Average Bankfull Width ~105' / Depth ~3' bkfl w. 103' d = 3'

Valley Width 200' Channel Gradient 3% 2-5%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), **Riffle-pool (obstruction)** → LOD - Big boulders - Few pools but several pocket pools
Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size gravel/cobble w/ some boulders		- loose gravel
% of Channel Banks	100%		
% of Banks Eroding	30%		

Describe composition of bank material: Occasional fines but consolidated; mostly gravel/cobble

Bank destabilization from: **In-channel** Upslope

Alluvial channel pattern: Straight Braided **Meandering**

LOD Count	20 -50 cm Diameter	> 50 cm Diameter	Jams 8/jam	Number of Pools
Functional: Pools, keyed to wood, sediment storage	4	11	4	3
Non-functional	3	4	2	

LOD traps gravels - important

few large pools but numerous pocket pools

22 pieces + 6 jams w/ 8/jam = 70/~~500m~~ = 0.09/m

V* Calculation	Scour Pool (Holding hole)					(Lower)	Pool						Pool					
Depth to fines	s/f 49	s/f 26	s/f 34	s/f 49	s/f 59	s/f 72												
Depth to gravel	26	23	31	45	50	62												
Depth of riffle crest	90																	
$V^* = V_f/(V_f+V_r)$	22/64 0.4	3/67 0.04	3/59 0.05	7/45 0.1	9/40 0.2	10/28 0.4												

avg = 0.2

d_{50s}/d_{50i} _____ = d. _____ = q. _____

Comments: Abundant patches of gravel - LOD + big boulders create areas for gravel + pocket pools

Large trees on RB

Active sidechannel at upper end

Midchannel bar - 1st lg bar not vegetated w/ 2-6 "older" - Rest of bars well-veg w/ 2-6 yr; rarely mobilize

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. ~~94~~ 95a Date 2/4/93 Analyst(s) J. Mabee K. Beardslee K. Sullivan G. Ross P. Kennard D. Coburn

% of Segment Sampled 4000' / 8500' (47%) Stream Order/Type 2-4 TIC

Flow: High **Moderate** Low – Turbid

Average Bankfull Width 92' – recent / Depth 60 cm >5%
100 – bkfl 100 cm

Valley Width 110' Channel Gradient 2-5%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), **Riffle-pool (obstruction)**, Cascade, Step-pool

	Alluvium	Colluvium+till	Bedrock
% of Channel Bed	% 70% /size cobble/boulder	30%	
% of Channel Banks	60	30%	10%
% of Banks Eroding	40%		

Describe composition of bank material: Large boulders/bedrock w/ some till being cut – blue/gray w/ overlying colluvium/alluvium (ice contact)?

Bank destabilization from: **In-channel** **Upslope**

Alluvial channel pattern: Straight Braided **Meandering**

LOD Count	20 -50 cm Diameter	> 50 cm Diameter	5m (≥98)	Number of Pools
Functional: Pools, keyed to wood, sediment storage	8	5	5	8
Non-functional	9	4	4	

26 + 9 jams w/ 8/jam = 98

V* Calculation	Scour Pool (top of segment)						Dammed Pool (top)						Scour Pool – bedrock wall (top, 1/2, 1/2, RB, RB, up)					
Depth to fines	57	42	34				50	61	98	86			18	17	5	86	83	67
Depth to gravel	54	38	28				34	35	74	68			18	8	4.5	69	74	40
Depth of riffle crest	71	71	71				85 →			85			65	65	65	65 →		
V* = $V_f/(V_f+V_r)$	3/17	4/33	6/43				16/51	26/50	24/11	18/17			0	9/57	0.5/8.5	11/4	9/9	24/25
	0.2	0.1	0.2			avg: 0.1	0.3	0.5	2.1	1.0	0.98		0	0.2	0.01	2.8	1	1.08 0.9

d_{50s}/d_{50i} _____ = d. _____ = q. _____ (Only 1 pebble count done because only 1 gravel bar)

Comments: till on LB w/ wood buried – Zone of Transport

3.7' of sed deposition on ~~staff gage~~ at seg 95
fines on margins & pocket pools

[illegible] – no flood disturbance

95

Seg ~~94~~:

Large area of exposed till on RB ~~600'~~ 1,000' long x 200' wide near vertical wall; some alder + grass on face but mostly raw

Source of fines + limited gravel - 2 small alluvial cones fed by emerging flow at till/alluvium contact

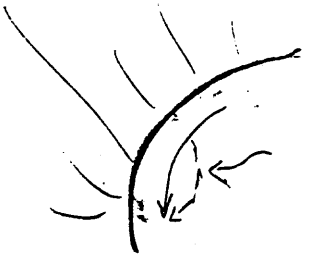
Last week's hi flow did recruit gravel from opposite bank (exposed till) - rattled it back ~ 2" ~ 200' x 2' hi
= 7.4 cubic yards in one storm

5% gradient at slide

Scour pool below slide

	LB up	LB scour dwnst	LB f/g	center-lower	RB lower
df	37	29	55	27	41
dg	35	22	47	20	38
rc	97				97
	2/62	7/75	8/50	7/77	3/59
	0.03	0.09	0.2	0.09	0.05

= .09 avg



Side channel cut off; trib enters near regor

Scour pool below slide

	flat up		dwn	LB lower	lower	up	fines up	up
df	36	54	46	61	73	96	84	57
dg	33	44		56	56	63	42	7
rc	40	40		40	40	40	40	40
	3/7	10/4		5/16	17/16	33/23	42/2	50/33
	0.4	2.5		0.3	1.06	1.4	21	1.5

mostly gravel

avg = 4.0

Lowest end of slide has signif source of gravel recruit
CC at top

Some alders knocked down by '90(?) flood, otherwise little erosion

TOLT RIVER WATERSHED ANALYSIS

FIELD ASSESSMENT OF CHANNEL CONDITIONS

Segment #: 100
Stream: South Fork Tolt River
Type: (2-4 TC)
Length: 6,250 feet
Surveyed Length: 6,250 feet

Date: 1/19 & 21/93
Surveyors: J. Metzler
G. Pess

This segment is within a deep canyon carved through glacial sediments. It is very active in terms of bed and bank movement. In addition to the very large (and famous) slump at the upper end of the segment, three other actively eroding slumps, one "healed" slump, and one large area of bank cutting contribute both fine and coarse sediment and woody debris to the channel. The big slide at the upper end of the segment created a temporary dam on the river and resulted in massive sediment input after the dam was breached.

Fine sediment is stored in eddy pools and along the channel margin. A staff gage near the lower end of the segment indicates that 5.2 feet of fine sediment has been deposited since installation. There is little fine sediment stored in the scour pools within the thalweg.

Coarse sediment is stored on large point bars and on mid-channel bars. The bars are mostly vegetated with alder, except in the upper end of the segment below the "big slide." These unvegetated bars are the likely the result of sediment deposition that occurred after the river broke through the temporary dam created by the slide.

While the gradient averages 2-4%, there are several short stretches of 5-6% where boulder berms create a nearly stairstep profile and short, slip-face cascades.

Wood is abundant, but has mostly been piled into large jams at the head of bars. Occasional pieces extend over the channel and cause scour during high flows.

Due to the erodible banks and unconsolidated bottom, there is a high potential for damage from increased peak flows. However, this segment is less than 1/2 mile below the dam, and no major tributaries enter between the dam and this segment.

1/26/93 - High flow event - much lower in S Fk than N Fk & mainstem
Below bankful; did not mobilize logs on bars

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 100 Date 1/19 & 1/21/93 Analyst(s) G. Pess & J. Metzler

% of Segment Sampled 100% = 650' Stream Order/Type (2-4) TC

Flow: High (Moderate) Low

Average Bankfull Width 80-90 ft / Depth 4 ft

Valley Width 100-120' Channel Gradient ~~4-6%~~ 3-5%

Channel Morphology: Dune-riffle, Riffle-pool (meandering), (Riffle-pool (obstruction)), Cascade, (Step-pool) borderline alternates

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 80 /size boulder/cobble	20	0
% of Channel Banks	60	30	10
% of Banks Eroding	40%		

Describe composition of bank material: Alluvial deposits of boulder/cobble w/ some glacial till lacustrine deposits on RB; a few BR outcrops

Bank destabilization from: In-channel (Upslope)

Alluvial channel pattern: Straight Braided (Meandering)

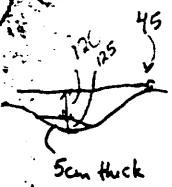
LOD Count 147 total	20-50 cm Diameter	> 50 cm Diameter	Number of Pools
Functional: Pools, keyed to wood, sediment storage	8	16	4
Non-functional	43	90	

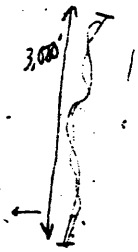
Count is for ½ of segment

jams at head of bars or along channel margin

counted wood for ½ of reach = 4.7 pieces/100' length

V* Calculation	120-0 Scour Pool #1 to deep ~50' down pool						120-0 Scour Pool #2 to deep below 2nd pool						Pool					
Depth to fines	0	120					46	16	14									
Depth to gravel	5	125					32	14	13									
Depth of riffle crest	45	45					94	94	94									
$V^* = V_f/(V_f+V_r)$	125-45 / 0.86						16/62 0.22	2/80 0.02	1/81 0.01									





147 / 910m

d_{50s}/d_{50i} _____ = d_* _____ = q_* _____

Comments: See notes

40' = wetted w/ } middle of segment
86' = ACW

[illegible] - started ~150' below 126, walked upstream

[illegible] bar at get at Seg 126 - 2 - 6" dbh alder, some smaller

[illegible] - mud channel

[illegible] rks

[illegible] LB [illegible] Seg 126 - similar to mud chan[illegible]

Old slump on RB - still creeping but not cut out

[illegible] 15% [illegible] wide - surrounding area veg w/ maple/alder

slump has fewer trees, stumps

Large debris jam at head of point bar

eddy 40'x10' - [illegible] crest

Fine sed in backwater pool - 119-116 - 3cm deep; riffle crest - 96 cm

119-106 - 13cm deep

Scour Pool Fe[illegible] ~~Alg~~ fines in ~~[illegible]~~ Hayes gal (scour pool) 28' wide

9/5 → 18 cm 45' long (Herd Rain)

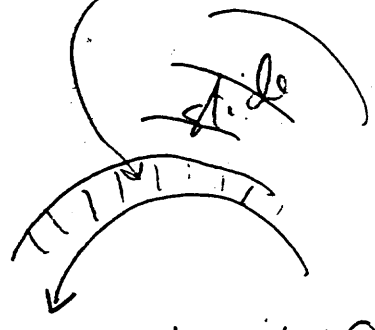
5%

Seg 160' (cont) upstream

Another lakebed on RB, exposed vert cut ~8' hi, 160' long {75' wetted, 85' bkfl}
has not slumped ~40% slope - dense veg w/ 2nd growth
undercut by stream, contributing Fine Sed
- did pebble count

~300' upstream

Big Slide RB near top of seg - ~500' hi - check photos for extent
berm of mtl ~30' hi is still being cut by river - raw sand w/ some cobble
contributes fines
- evident in gravel downstream - cemented riffles



Dense 1-3" dbh has colonized most of slide area - being undercut on top of berm
Numerous bars downstream of slide - evidence of lg sed load
Similar to smaller slumps downstream, but much larger scale

Small MW on LB just upstream of slide

at upstrm end of slump a stream pours in - >17% boulder/cobble
~5' wide at bottom (~3' wide further up)
- clear but flow is hi

At pools Most of fine sed in eddy pools - edge of channel behind lg boulders
Step pools are scoured & scour pools have little - ~20% of bottom surface

At gage - 5.20' of fine sediment has filled since installed
gage is not in channel any longer

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: S. Fk. Toll WRIA#: _____ Sub-WRIA#: _____ WAU: _____ Segment Reach #: 100
Surveyors: G. Pess, J. Metzler Reach length: _____ ft/m Average wetted width: 40 (ft)/m
Date: 1/21/93 Flow today is: High (Moderate) Low

Reach location: From ~400' below bridge to ~700' upstream of "big slide"

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 85 (feet)/meters
Average valley bottom width = 110 (feet)/meters VBW/ACW = 1.3

Sinuosity: a. straight (= 1) (b.) slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

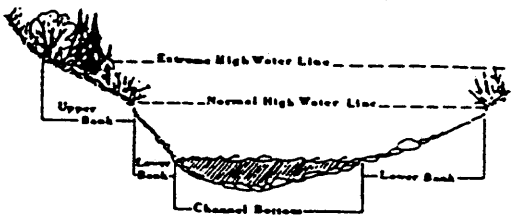
Source of material: (alluvial) glacial till (colluvial 30%) lacustrine sediments (bedrock 10%) unknown
other _____ → 60%

Can the stream move the majority of the bed material sizes during high flows? (Yes) No

Can the stream erode the banks during high flows? (Yes) No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = 60 %
Can the stream undercut the upper banks? (Yes) No
If yes, would this result in mass wasting? (Yes) No



D. Stream Energy

Average channel gradient = 4 %
Is the profile "stairstepped"? Yes (No)
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream (c.) 4th order mainstem
b. 2nd or 3rd order tributary d. 5th order or larger river

From flow chart, response category is:
Type A: unconstrained
(Type B:) slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   (a.) active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blownout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_|
   b. angled back: \/
   c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility
   a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
   b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
   c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
   d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles?
Yes No

D. Particle Size Distribution
   a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
   b. slight reduction in distribution of smaller particles
   c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes
   a. bedrock/large boulder
   b. large and small boulders
   c. large and small boulders, some cobble
   d. mostly cobble with some boulders
   e. cobble/gravel
   f. mostly gravel
   g. mostly fines

F. Angularity
   a. substrate consists mostly of flat or angular rocks resistant to rolling
   b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
   c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)
   a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
   b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
   c. larger particles are surrounded by a loose matrix of smaller particles
   d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Very high bridge in bedrock canyon section

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

Large slide at upper end of reach - early 60's

E. Other Observations

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	0	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	0	
2. (1. Length) >50%	0	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		0
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		1
E. Flow Deflection = c		0
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	0	
C. Armoring "yes" for either wetted channel or bars	1	
D. Particle Size Distribution = c	0	
E. Particle Size = e or f or g		1
F. Angularity = c		1
G. Particle Packing = c or d		0
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	0	
location = f, g		0
B. Culverts or Bridges Appear Inadequate		0
Total Score =	2	~~6~~ 4

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 103 Date 2/18/93 Analyst(s) G. Pess, K. Beardslee, J. Metzler

from G. Phelps gradient % of Segment Sampled 2,050'/4000' 51% Stream Order/Type 1-2 LC

Flow: High Moderate (Low) Ice!

Average Bankfull Width 80' / Depth 5'

Wetted w = 44' d = 1.5'
Bkfl w = 76' d = 5'
(side channel ~8' wide)

Valley Width 400' Channel Gradient 1.5%

Channel Morphology: Dune-riffle, (Riffle-pool (meandering)), Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100 /size gravel/cobble	- but very angular	
% of Channel Banks	" "		
% of Banks Eroding	100%		

Describe composition of bank material: Lg gravel/cobble w/ matrix of fines - unconsolidated

Bank destabilization from: (In-channel) Upslope Conifers + alder 6-10" dbh

Alluvial channel pattern: Straight (Braided) Meandering

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	~~IIII~~ ~~IIII~~ III (13)	III (3)
Non-functional	~~IIII~~ ~~IIII~~ I (11)	~~IIII~~ I (6)

Number of Pools
∅

33 pieces/621 m = 0.5 pieces/10 m

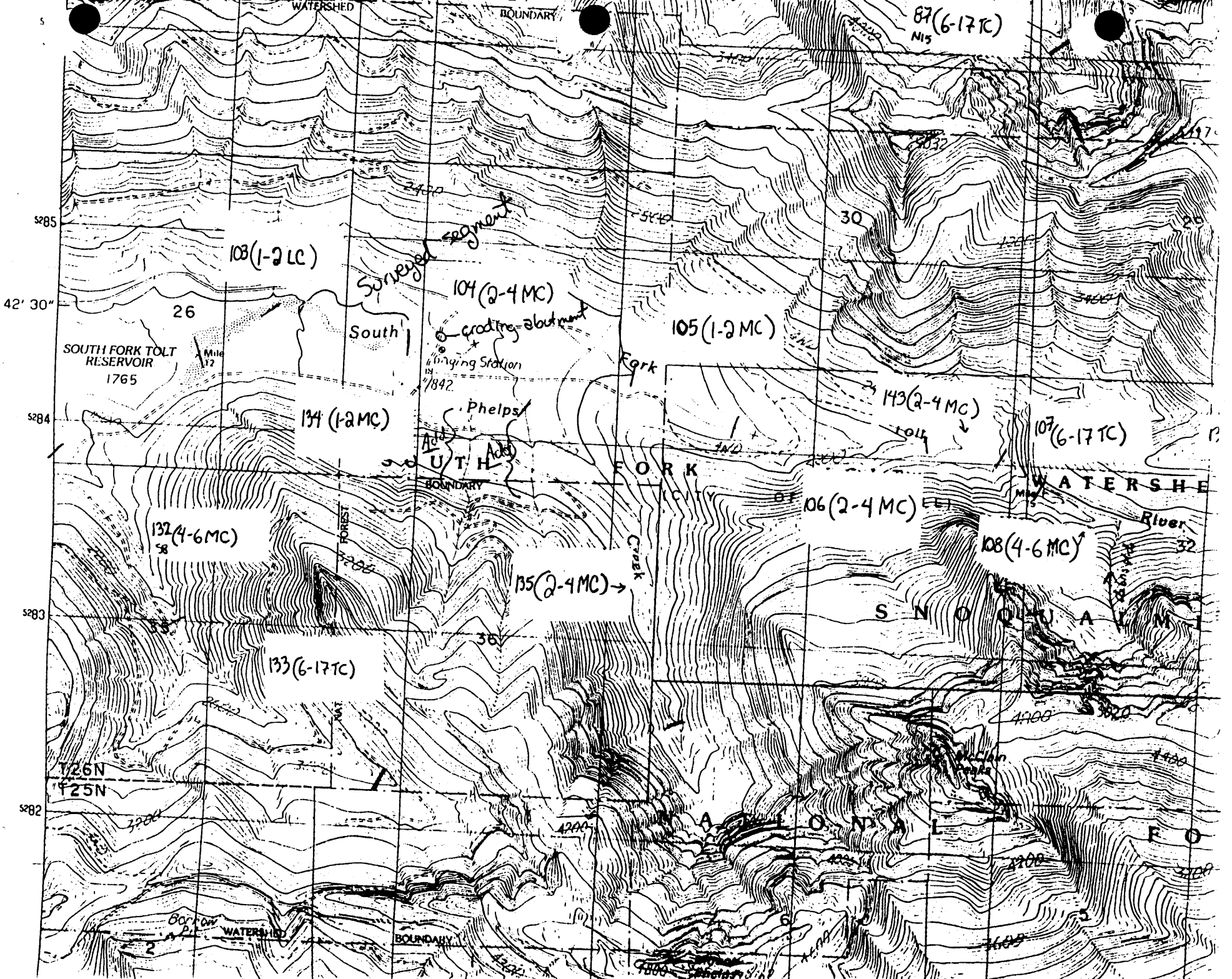
V* Calculation	Pool	Pool	Pool
Depth to fines Depth to gravel Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

no pools

d_{50s}/d_{50i} _____ = d. _____ = q. _____ → n/a - braided

Comments: Similar to Seg 15 but not as wide - perhaps widening there can't be attributed to just riparian veg removal
Ends where ↑ gradient + larger boulders in channel

Bridge above segment - ee-33 ending Elbow rd bridge
On RB - caused by road runoff? (surface tod.)


WATERSHED
BOUNDARY
87(6-17TC)
N15
30
25
S285
103(1-2LC)
Surveyed segment
104(2-4MC)
42' 30"
26
South
grading abutment
105(1-2MC)
SOUTH FORK TOLT RESERVOIR
1765
Mile
Ringing Station
1842
Fork
143(2-4MC)
S284
134(1-2MC)
Phelps
107(6-17TC)
Add
SOUTH
FORK
BOUNDARY
CITY OF
106(2-4MC)
WATERSHE
River
132(4-6MC)
FOREST
Creek
108(4-6MC)
32
135(2-4MC)
S283
35
36
S N O Q U A L M I
133(6-17TC)
T26N
T25N
S282
N A T I O N A L F O
Barton
WATERSHED
BOUNDARY
2
6
5

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: South Fork Tolt WRIA#: _____ Sub-WRIA#: _____ WAU: Tolt Reach #: 103
Surveyors: T. Mohler Reach length: _____ ft/m Average wetted width: _ ft/m
K. Beardslee Date: _____ Flow today is: High Moderate Low
G. Ross
Reach location: From confluence of Phelps Creek upstream to ~100' below bridge

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = 80 (feet/meters)
Average valley bottom width = 400 (feet/meters) VBW/ACW = 5

Sinuosity: a. straight (= 1) (b.) slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

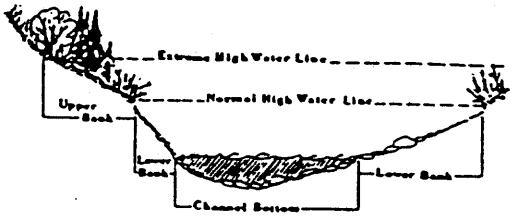
Source of material: (alluvial) (glacial till) colluvial lacustrine sediments bedrock unknown
other _____ outwash

Can the stream move the majority of the bed material sizes during high flows? (Yes) No

Can the stream erode the banks during high flows? (Yes) No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = <10 %
Can the stream undercut the upper banks? (Yes) No
If yes, would this result in mass wasting? Yes (No) flat



D. Stream Energy

Average channel gradient = 1-2 %
Is the profile "stairstepped"? Yes (No)
If yes, what forms the steps? Bedrock Boulders Woody debris
Do the steps appear stable? Yes No
Position in drainage network: a. 1st order headwater stream (c.) 4th order mainstem
b. 2nd or 3rd order tributary d. 5th order or larger river

From flow chart, response category is:
(Type A:) unconstrained
Type B: slightly constrained, unconsolidated bottom
Type C: laterally constrained, unconsolidated bottom
Type D: constrained, bedrock/large boulder
Type E: boulder/bedrock stairstep
Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channels with floodplains):
   a. active channel carries average annual flood, larger events spread across floodplain
   b. active channel has downcut or widened, so peak flows rarely spread over the floodplain
   (c.) active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blowout" channel area, marking a new active channel
   d. a major flood has passed through and caused obvious damage in this channel

2. Response Category Type C, D, E, F (channels without floodplains)
   a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
   b. active channel area shows signs of enlargement, raw banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
   c. channel appears "blownout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
   d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting
1. Length of reach affected:
   a. none
   b. 1-10%
   c. 11-30%
   d. 31-50%
   e. 51-75%
   f. 75-90%
   g. >90%

2. Location of bank cutting:
   a. nowhere in reach
   b. in expected places, such as outside of corners and constrictions
   c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:
   a. vertical: |_| b. angled back: \/ c. undercut: /_\

C. Degree of Bank Protection
1. Predominant type of vegetation along the banks: (circle more than one if mixed)
   a. mature coniferous trees
   b. mature hardwood trees
   c. immature conifers 20-60 feet tall
   d. immature conifers 10-20 feet tall
   e. immature conifers 5-10 feet tall
   f. recent clearcut, trees <5 feet tall
   g. immature hardwood trees
   h. shrubs
   i. grass

2. Vegetation density:
   a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
   b. banks are fairly well protected by deep roots with several open areas
   c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
   d. banks are poorly protected by a shallow root network with numerous openings
   e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material
1. Bank rock content:
   a. 90-100% rock
   b. 65-90% rock
   c. 40-65% rock
   d. 20-40% rock
   e. <20% rock

2. Bank cohesion (kick the bank!)
   a. resistant bedrock
   b. erodible bedrock
   c. cohesive silt/clay resistant to erosion
   d. cemented matrix of fine material containing rock particles
   e. cohesive but erodible silt/clay
   f. noncohesive assortment of mostly cobble and larger sizes
   g. noncohesive assortment of mostly cobble to gravel-size rocks
   h. noncohesive assortment of mostly gravel-size rocks
   i. noncohesive assortment of mostly fine material

Particle Size Classes:

Large boulder: >24"
Small boulder: 12-24"
Cobble: 3-12"
Gravel: 0.2-3"
Fines: <0.2"

E. Flow Deflection into Banks (focus on thalweg)
   a. little or no deflection of flows into banks
   b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
   c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):
   a. very few fresh deposits
   b. 5-20% of bottom affected by deposition, mostly isolated pockets behind large boulders or small point bars
   c. 20-50% of bottom covered with fresh deposits, such as several small point bars or pockets behind boulders or woody debris
   d. 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
   e. >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits:
   a. most particles cobble-size and larger
   b. most particles are gravel to cobble-size
   c. particles are mostly gravel with some finer material
   d. particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

a. in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
b. throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
c. mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
d. nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

braided

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles?
Yes No

D. Particle Size Distribution

a. substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
b. slight reduction in distribution of smaller particles
c. smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

a. bedrock/large boulder
b. large and small boulders
c. large and small boulders, some cobble
d. mostly cobble with some boulders
e. cobble/gravel
f. mostly gravel
g. mostly fines

F. Angularity

a. substrate consists mostly of flat or angular rocks resistant to rolling
b. substrate consists mostly of subangular rocks, some flat or rounded rocks present
c. substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottom!)

a. larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
b. some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
c. larger particles are surrounded by a loose matrix of smaller particles
d. bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

a. individual logs within or adjacent to the wetted channel area
b. clumps or jams within or adjacent to the wetted channel area
c. clumps or jams along the outer margin of the active channel area
d. individual logs along the outer margin of the active channel area
e. most of the logs have been deposited above and outside of the active channel area
f. a debris jam blocks the channel
g. numerous debris jams block the channel
h. most logs have been transported to a lower reach of the channel
i. numerous logs have been deposited within this reach from upstream
j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust line on culvert, capability for handling flood flows and debris)

Bridge just upstream - right bank abutment is eroding - probably due to road surface drainage

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

E. Other Observations

Upstream of reservoir, but appears to be above area of influence from Δ base level.

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the column indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		1
II. Channel Banks		
A. Channel Capacity = b, c, or d	1	
B. Bank Cutting		
1. (1. Length) >30% and (2. Location) = c	1	
2. (1. Length) >50%	1	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		1
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		0
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		1
E. Flow Deflection = c		0
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	0	
2. (1. Extent) = d or e	1	
B. Recent Bed Mobility = d	1	
C. Armoring "yes" for either wetted channel or bars	0	
D. Particle Size Distribution = c	1	
E. Particle Size = e or f or g		1
F. Angularity = c		0
G. Particle Packing = c or d		1
IV. Other Indicators		
A. Woody Debris		
location = e, h, or i	0	
location = f, g		0
B. Culverts or Bridges Appear Inadequate		0
Total Score =	6	5

Interpretation - "Existing" Column

- ≤1 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- ≥4 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- ≤1 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- ≥4 Channel conditions indicate the channel has a high potential for damage if peak flows increase

TOLT RIVER WATERSHED ANALYSIS

FIELD ASSESSMENT OF CHANNEL CONDITIONS

Segment #: 119
Stream: Trib to Lynch Creek
Type: (<1 LC)
Length: 3,500 feet
Surveyed Length: 1,000 feet

Date: 1/21/93
Surveyors: J. Metzler
G. Pess

This very low gradient segment is controlled mostly by a series of beaver dams. The stream meanders through a broad, flat, wet valley bottom vegetated with alder and western hemlock. Considerable sediment is trapped in the pools created by beaver dams. While some of the sediment is due to the finely textured, alluvial material in the valley bottom, there could also be an upstream source of fine sediment. Segments 122 & 124, which show signs of widening and channel shift, are the likely source of additional sediment.

Woody debris, mostly in the form of beaver dams, is very important in creating pools and trapping sediment. There is a relatively high potential for channel damage from peak flows if one of the beaver dams was to fail. However, the broad floodplain provides a large area for floodwaters to spread and dissipate energy.

At the downstream end of the segment, there is a beaver dam built under an old log stringer bridge that could create a potentially dangerous debris dam during high flows. Below this point, the channel is more confined, so that water backed up behind the bridge could cause damage if suddenly released. Since this road is no longer in use, and the bridge is no longer driveable, the bridge should be pulled. A new and higher bridge could be constructed if the road is needed in the future.

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 126 Date 1/19/93 Analyst(s) G. Ross, J. Mehler

% of Segment Sampled 100% - 750' Stream Order/Type >17 TC

Flow: High (Moderate) Low

Average Bankfull Width 15-34 ft (↑ downstream) / Depth 2 ft

Valley Width same as bkfl ws Channel Gradient 25%

Channel Morphology: Dune-riffle, ~~Riffle-pool~~ (meandering), Riffle-pool (obstruction), Cascade, (Step-pool) → Boulders

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% /size	100% boulders	
% of Channel Banks		100% boulders	
% of Banks Eroding		60% (especially in lower ½)	

Describe composition of bank material: large boulders w/ matrix of sandy loam

Bank destabilization from: (In-channel) Upslope

Alluvial channel pattern: (Straight) Braided Meandering

LOD Count	20 -50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage		
Non-functional	too numerous to count Pre-comm thin felled trees into channel - many bridged, hi debris dam potential	

Number of Pools
Step pools small & shallow (<0.5' deep)

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

d_{50s}/d_{50i} N/A = d. _____ = q. _____

no - step pool high gradient

Comments: Many 2-4" dbh hemlock felled into & across channel channel - high debris dam potential - should clean. Channel widening probably in '90 storm. Also - fall away in future.
Roots are holding unconsolidated boulders/sdy loam - important to retain for future stability - retain ~50% of trees in 50' in future

Form ee-4. Channel Assessment Field Data Side 2 of 2

Grain Size Measurements

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

Size Class	# Surface Meas.	# Subsurface Meas.
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Location: _____

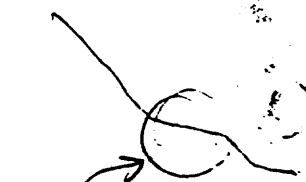
Size Class	# Surface Meas.	# Subsurface Meas
<2		
2		
4		
5.6		
8		
11		
16		
22		
32		
45		
64		
90		
128		
180		
256		
360		
>512		
D_{50}		

Seg 126

Culvert under main rd - top of segment

6' hi x 8' wide CMP, flat bottom

appears oversized - looks new



ACC ≈ 15' wide; ↑ to 34' at bench above S Fk - scour during high flow; BC exposes cobble

PCT in lands adjacent

25% gradient

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. Phelps Cr 134 Date 9/18/93 Analyst(s) G. Pess, J. Mobley, K. Beardslee

from bridge upstream to where ↑gradient → % of Segment Sampled 2000'/4750' = 42% Stream Order/Type 1-2 MC

Flow: High Moderate (Low) (Ice)

Average Bankfull Width 80' / Depth 5'

Valley Width 200' Channel Gradient 1.5%

Channel Morphology: Dune-riffle, (Riffle-pool (meandering)), Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% (10)% /size gravel/cobble/bldr (more angular than S Fork)		
% of Channel Banks	" " " "		
% of Banks Eroding	(10)%		

Describe composition of bank material:

Bank destabilization from: (In-channel) Upslope

Alluvial channel pattern: Straight Braided Meandering

LOD Count	20 -50 cm Diameter	> 50 cm Diameter	Jam
Functional: Pools, keyed to wood, sediment storage	~~IIII~~ II (7)	~~IIII~~ I (6)	II (2)
Non-functional	~~IIII~~ IIIII (9)	IIII (4)	

Number of Pools
11

1 jam = pieces from recent BC

26 pieces + 1 jam of 20 + 1 jam of 6 = (52)

7 largest upper

54 51
77 51
56 61
47 61
50 80

wetted w. 16', d = 16"
Bkfl: 26'; 63"

V* Calculation	Pool	Pool	Pool
Depth to fines			
Depth to gravel			
Depth of riffle crest			
$V^* = V_f/(V_f+V_r)$			

NO fines observed, not enough in margins

7 largest lower on bar

cm
63 80
62 62
73 63
63 ~~64~~
40 45

wetted w. 17'
d = 15"

Bankful w. 106'
d = 66"

d_{50s}/d_{50i} _____ = d. _____ = q. _____ -w/a - braided

Comments: Significant widening - moves large mtl in bars

Recent widening has recruited numerous 6-10" dbh sub-/pine fir (most too small to function) ~~small~~ some larger pieces in jam

Add to braided areas seq cluster

Very stable! Alluvial is blurr braided + non

LOD deflects flow, creates [illegible]

Form ee-4. Channel Assessment Field Data Side 1 of 2

Segment No. 141 Date 1/26/93 Analyst(s) J.M; GP, KB

% of Segment Sampled 100% Stream Order/Type 1-2 MC

Flow: (High) Moderate Low

Average Bankfull Width 8' / Depth 0.1'

Valley Width 40-100' Channel Gradient _____

Channel Morphology: Dune-riffle, (Riffle-pool) (meandering), Riffle-pool (obstruction), Cascade, Step-pool

	Alluvium	Colluvium	Bedrock
% of Channel Bed	% 100% /size gravel/sand		
% of Channel Banks	" "		
% of Banks Eroding	10-20%		

Describe composition of bank material: Alluvial mtl - fine textured

Bank destabilization from: (In-channel) Upslope - Very little bank cutting

Alluvial channel pattern: Straight Braided Meandering

-reduced size because function down to 10cm

LOD Count	10 ~~20~~-50 cm Diameter	> 50 cm Diameter
Functional: Pools, keyed to wood, sediment storage	~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ III (13)	III (3)
Non-functional	~~IIII~~ ~~IIII~~ (5)	

Number of Pools
~~IIII~~ ~~IIII~~ ~~IIII~~ II

Inches →

V* Calculation	Pool 1		Pool 2	3	4		Pool 5				6		Pool 7		8		9		10			
Depth to fines	13⅓	12½	16	12	15	10	6	13	12	8	9	12	9	12	9	13	11	12	13	18	16	26½
Depth to gravel	17¼	17	19	15	17½	17¼	14	13	12¾	10½	10	15	13	13½	14	13	14	16	21½	29	25½	29
Depth of riffle crest	6	6	8	7	7	7	7	11	11	11	11	7	7	8	8	9½	9½	10	10	14½	14½	14½
$V^* = V_l/(V_l+V_r)$	4/11	5/11	3/11	3/8	4/7	3/10	8/7	0	0	2/1	1/1	3/8	4/6	1/5	5/6	0	3/5	4/6	8/11	11/15	9/11	3/15
	0.4	0.4	0.3	0.4	0.3	0.7	1.1	Ø	Ø	2	1	0.4	0.7	0.2	0.8	Ø	0.6	0.7	0.7	0.7	0.8	0.2

d_{50s}/d_{50i} ____/____ = d_* ____/____ = q_* ____/____ – Little gravel; no bars suitable

Comments: See notes

V^* - Pool #	avg V^*	Pool #	avg V^*
1	0.4	6	0.6
2	0.3	7	0.5
3	0.4	8	0.3
4	0.7	9	0.7
5	0.8	10	[illegible]

Range - 0.3 → 0.8

1/21/93

Giant left, rep
- Grib-ring in, passable
- Predominately boulders + white water
- No evidence of downcutting
- LB slide → US of giant slide
- near 101 signal
- Δ in material, dry, red tinge
- Approx 200' high

Glacial Lake -
75' wetted Depth approx 4'
86' active

RB - 39 US, 49 DS

USGS -
Due to 1976 slide (Stolen) 5'2" of fine sediment at USGS gage, creation of a bar.

Grey - 2nd slide, under rock

(5)

1/21/93

Segment 119 - Grib to Lynch Creek, Beaver
bankfull depth - 4' wetted
bankfull width - 98'
active channel - 22'
wetted - 17'

wetland / beaver dam system
- Pools of fine sediment

1/26/93

Salt River WA
Conley Creek - Seg 141
Overcast, warm

DS of Culvert to Stonch Creek

Pool - width - 9'
Riffle crest 3'
Depth of fine 6' 1½'
Depth of fine 3'
Meandering
<1%

Bankfull width 4'

Carcasses - 3 in wetland
1 live coho
Willow, alder, cedar

US of Culvert - 1/26/93

RB - Rock to prevent undermining during low flows.

BF (wetted) width - 8½'
Depth - 6"

1 - 12' no-run cutthroat

- LOD in place creating plunge pools
- Old culvert throws down
- Evidence of diver
- Cementation behind LOD

Riffles	Pools	LOD
11 (long)	1	1) Root wad - alder
		2) Cross-stream - stability for bank, potential → Bridged
Long riffle run		3) Root wad
		4) dry channel ≤ 20cm
dry channel recruitment of fines from banks		vine maple

- dry stream - channel Morgan] Typical LOD
- Bridged - James

6
1/26/93

R	P	LOD
	1 (23 inches deep)	5) Bridged
Cedar (?)	17¼	vine maple
1	13⅔	
	17	
	12½	
	6 - crest	
	9	
Bank cutting - 10 ft long 2 ft high		RB - outside of bend; source of fine bank loam
1		
		6) Bridged vine maple
1		
	1 (19 inches)	7) SWD - vine maple
	16, 19	
	8 inches } crest	
	13 inches	
	1 Plug	8) Debris dam - plunge pool
	12, 15	
	crest - 7	
		9) SWD

R	P	LOD 1/26/93
	1	
	15 in	
	17½ in	
	10 in	
	17¼ in	
	~~crest~~ 6 in	
	17	
	crest 7	
	10	1 Bridged
11		Rock obstruction
1		at bend
		1 SWD on rock
	Bankcutting	
	Gradient - <1%	
1	1 at bend	
	13, 13	
	LB 12, 2¾ / 8, 10½ / 9, 10 RB	
	crest	
	11, 13½	13"
		1 SWD in-channel
		1 SWD " "
		1 Bridged

R	P	Slope - US/road influence - .18 ⑦ DS - 1½% LOD 1/26/93
	Road influence	-
	1 12, 15	
	9, 13	
	crest 7, 16 - not fixed unconsolidated	
		1 cedar tree
		1 bridged 13"
		~~1 SWD in-channel~~
	1	1 jam
	12, 13½"	(crosslitis plug
	9, 14	pool)
	8, 13½	
		1 jam below culv
	1 plug pool bedrock	1 SOD - in-chann
	13, 13	Culvert -
	11, 14	Chronic overtopping
	crest 9½, 11½	some slumping
	1 rock pool	
	12, 16	
	15, 21½	
	crest 10, 15½	

1/26/93

R		P	LOD
		18, 29	
		16, 25½ N.S. 18	4 in channel
		26½ 29	
		Lochet Pool Cedar Mouring	1 in-channel
1			
		17, 20	3 in-channel
		18½, 22	
		10, 15 (crest)	
1			
		14, 19	1 pin
1			
		13, 17	
		11, 13	1 log in-channel
		8½ (crest)	
			1 concave in log jam
		22, 25	

1/26/93 (8)

R		P	LOD
		1 20", 45"	1 in-channel
		14, 17"	20"
		Barrel pool	(Dan)
		Fibro mulch	Counterpoised - evidence of sediment coming off slope trapped by jam

INDEX

Evidence of overbank flow DS of culvert

141

Index Cr - w/ GP & KB 1/26/93 - High Flow
below Rd

Fine sed dep - 3", 1.5 ft, 3" - sed depths
9' wide (bankful)
1 ft 9" - crest depth

1 male coho; 2 carcasses
- <1% UC (wetland) - below Rd

~~Above Rd~~
Culvert - ~4' hi x 6' wide CMP
gravel in bottom, no lip
some water going underneath -
Could send bog to ↑ flow during
low pds
Above Culvert:
8.5' wetted w upstrm; 6" deep

Flow not very high compared to other
streams - large wetland area
in valley bottom & upstream dampens
peak flow

Beavers active - mostly below culvert
1 season CT sited
- GP has notes

No. 302

Tolt R. - High Flow 1/25/93

Date	Time	Height	Comments	A Te
1/25	9:45	5 sticks, bottom of tin	Very turbid, logs 4 moving, NFk higher than SFk	
1/26	9:45	appears to have crested ~ 1' above yestere measurement. Dropped ~ 3' since yesterday mor		

Also: Tolt RE Confluence ~ 1' below top of riprap at 203 bridge at 1500 hrs 1/25

Segment 1 - MAIN STEM OF TOLT RIVER

Segment 1 - Downstream end of bar below footbridge

Surface

D50 (mm) 43

D84 (mm) 70

Size (mm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	5	5%
11	0	5%
16	8	13%
22	14	27%
32	15	42%
45	30	72%
64	18	90%
90	8	98%
128	2	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 3.9

q* = 0.13

Subsurface

D50 (mm) 11

D84 (mm) 18

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	41	41%
11	0	41%
16	45	86%
22	11	97%
32	3	100%
45	0	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 1 - Bar on right bank, approximately 600feet umpstream of foot bridge

Surface

D50 (mm) 25

D84 (mm) 39

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	4	4%
11	0	4%
16	11	15%
22	22	37%
32	23	60%
45	26	86%
64	8	94%
90	4	98%
128	2	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 2.1

q* = 0.18

Subsurface

D50 (mm) 12

D84 (mm) 18

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	38	38%
11	0	38%
16	47	85%
22	11	96%
32	1	97%
45	1	98%
64	2	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 1 - Middle of bar, near solarium house. Upper end of segment

Surface

D50 (mm) 39

D84 (mm) 79

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	3	3%
11	0	3%
16	13	16%
22	17	33%
32	9	42%
45	17	59%
64	21	80%
90	11	91%
128	5	96%
180	4	100%
256	0	100%
Total	100	100%

d* = 3.9

q* = 0.13

Subsurface

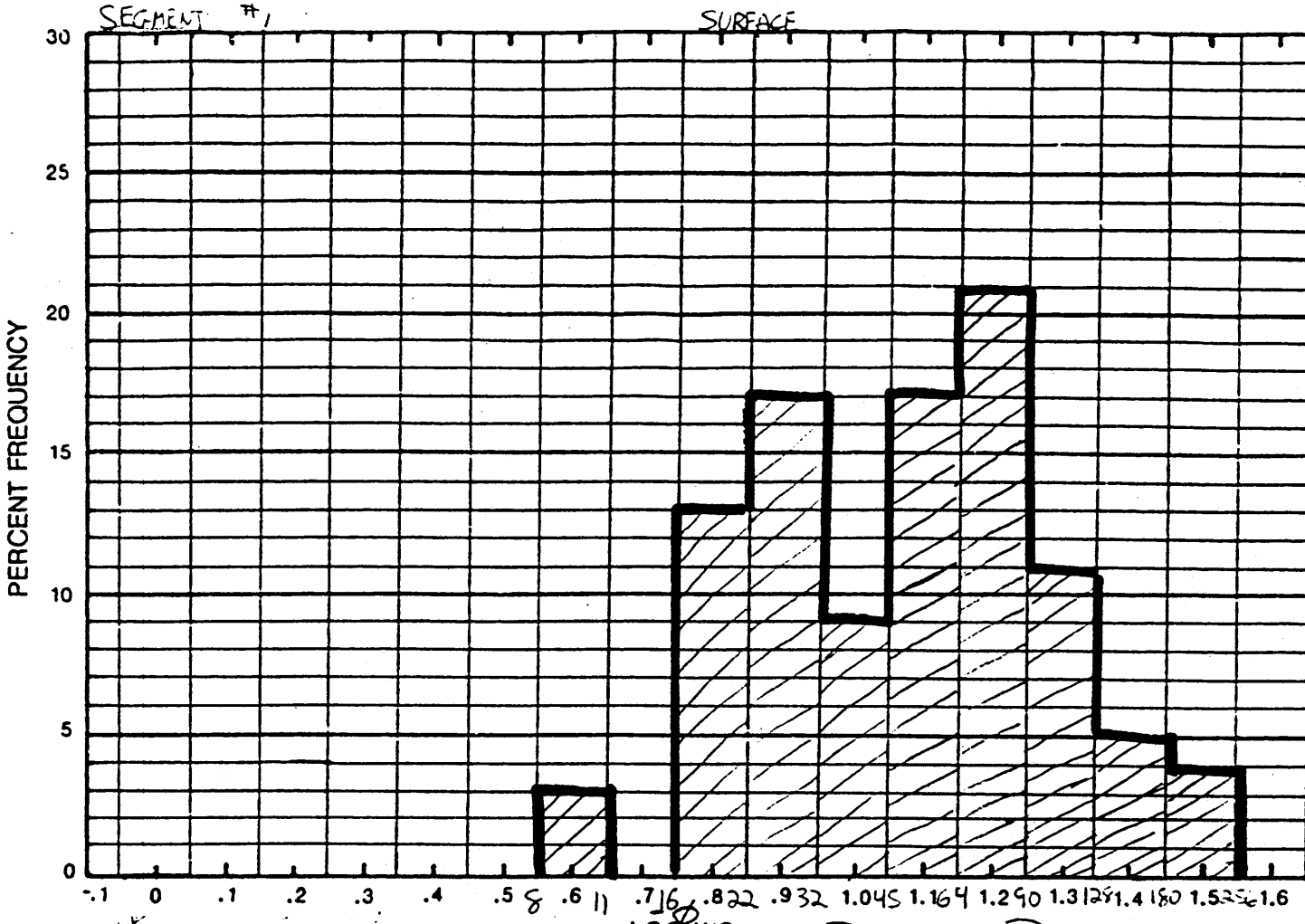
D50 (mm) 10

D84 (mm) 18

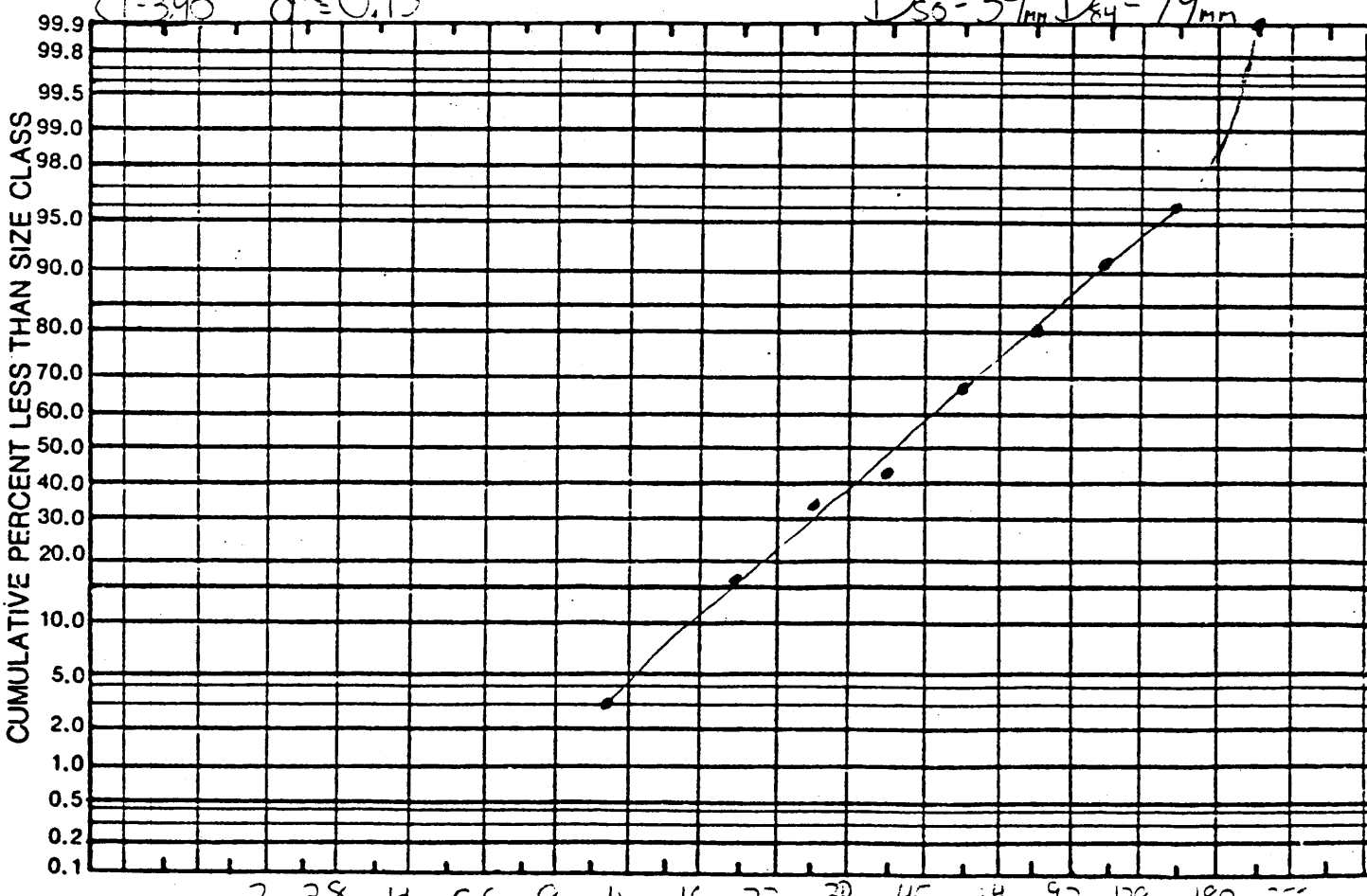
Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	55	55%
11	21	76%
16	12	88%
22	5	93%
32	4	97%
45	3	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

SAMPLE

SEGMENT #1 SURFACE

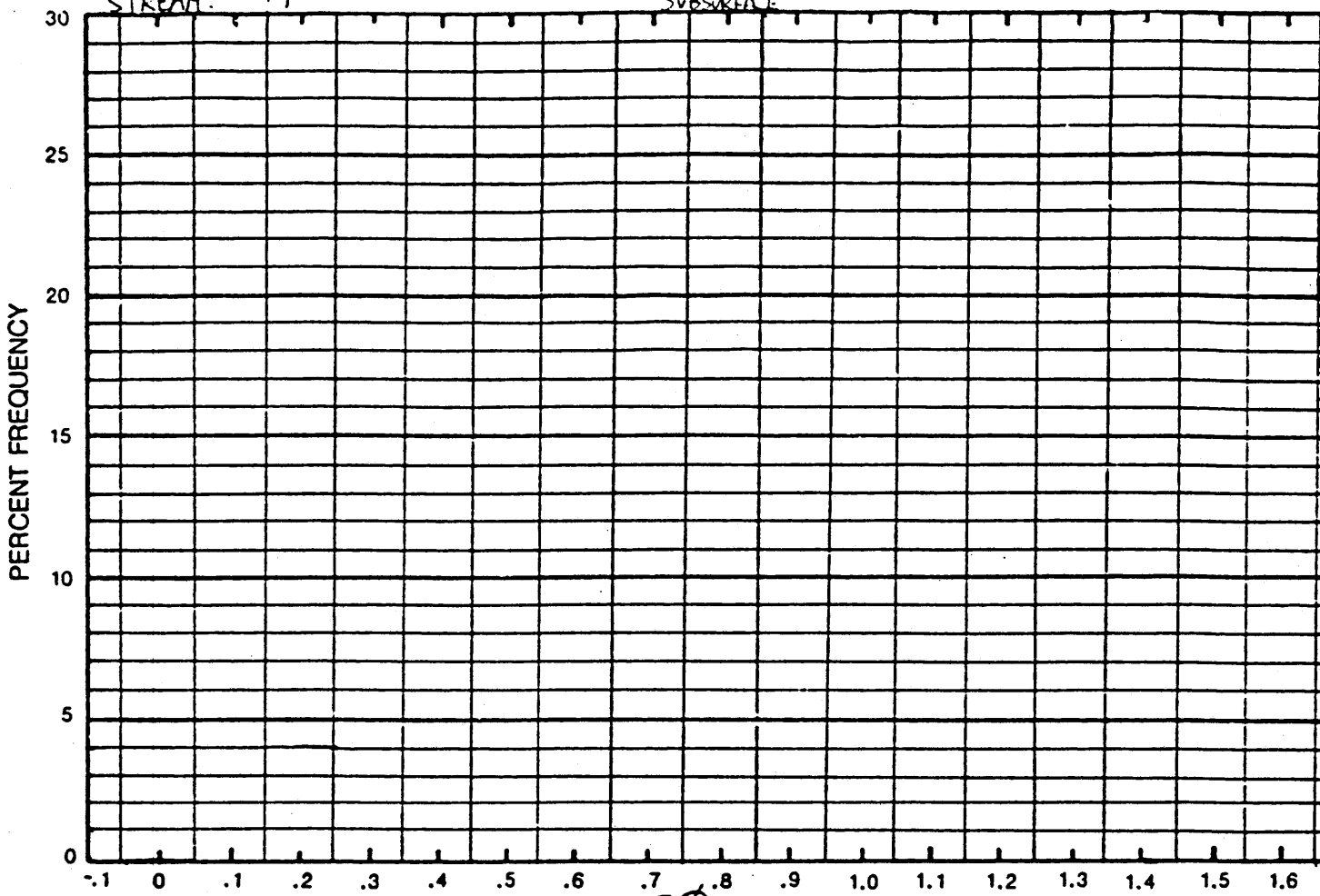


$\sigma^* = 3.90$ $\sigma^* = 0.13$ $D_{50} = 39mm$ $D_{84} = 79mm$

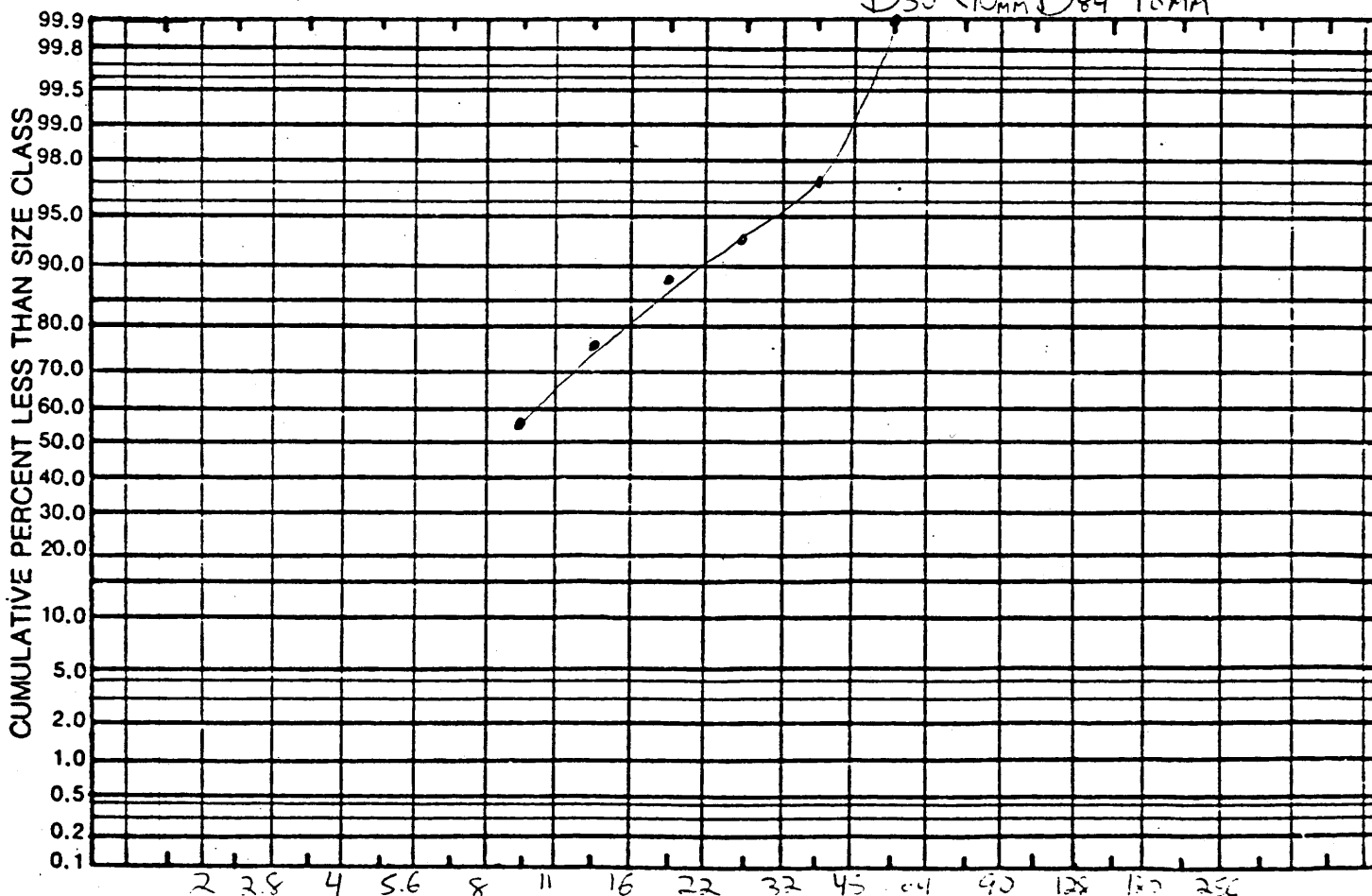


SEGMENT: MIDDLE OF BAR, NEAR SOLARIUM HOUSE SAMPLE

STREAM: #1 SUBSURFACE



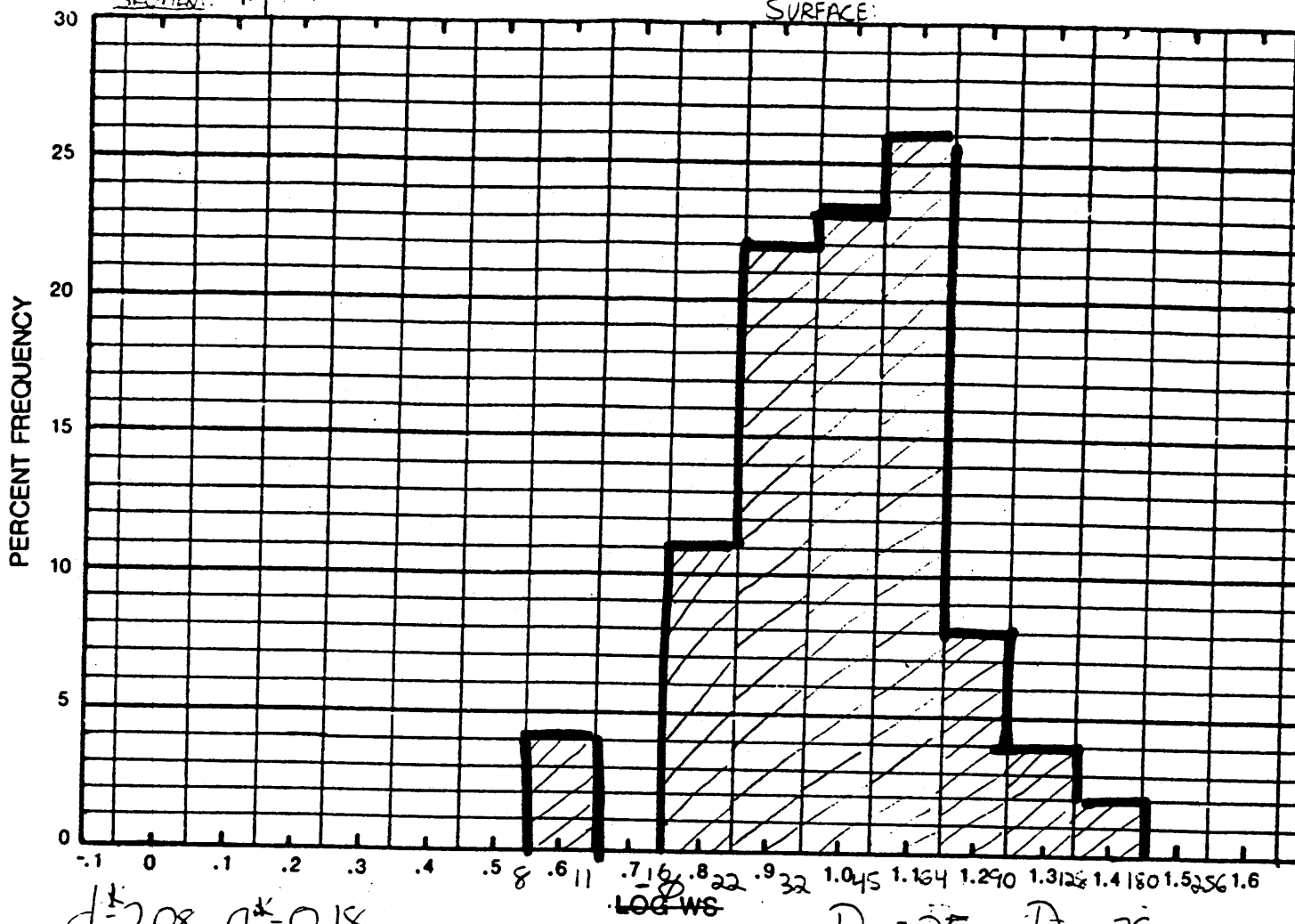
D_{50} = <10mm D_{84} = 18mm



SEGMENT: 7

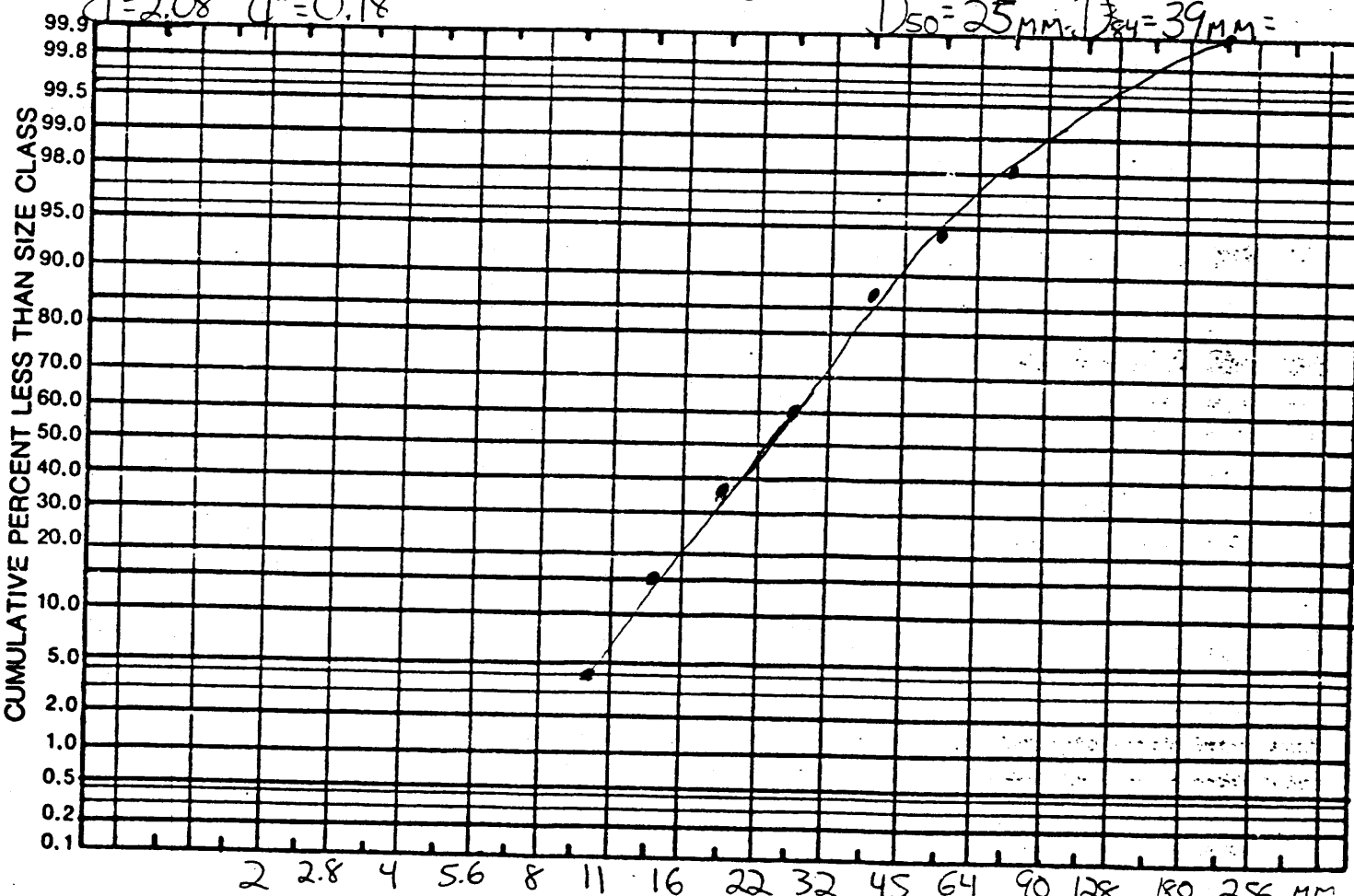
SURFACE:

SAMPLE



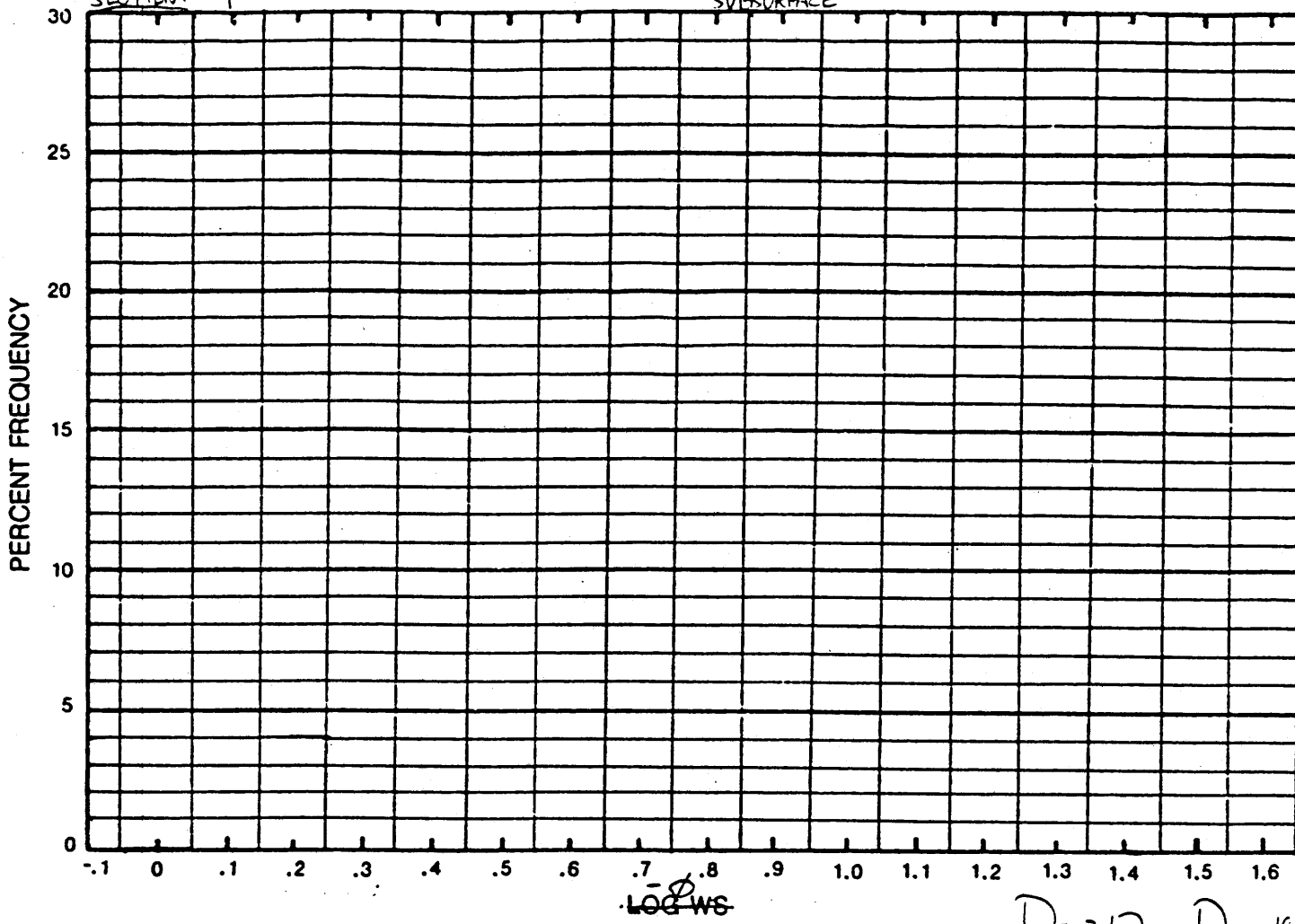
$\sigma^* = 2.08$ $\alpha^* = 0.18$

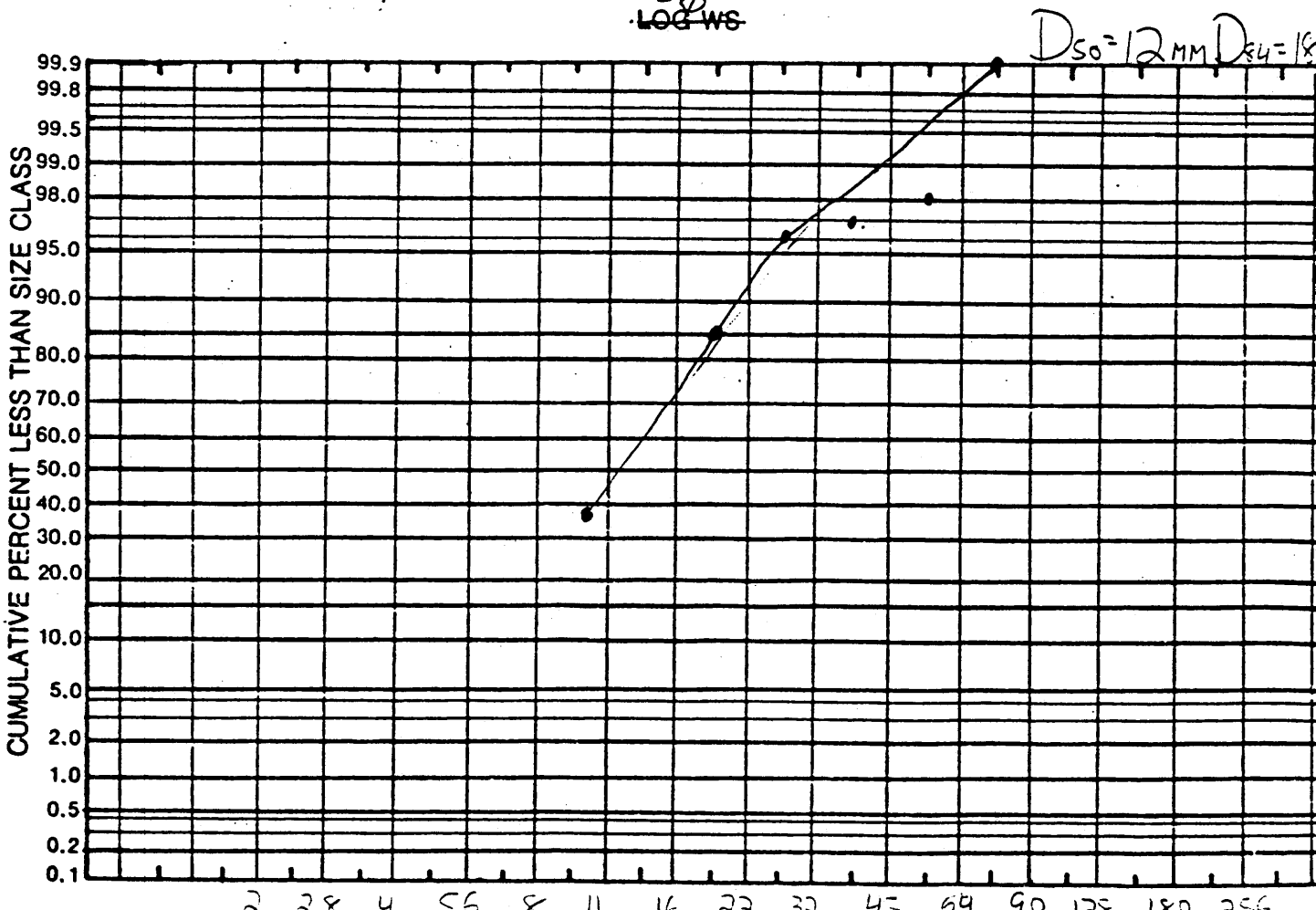
$D_{50} = 25$ mm $D_{84} = 39$ mm



SAMPLE

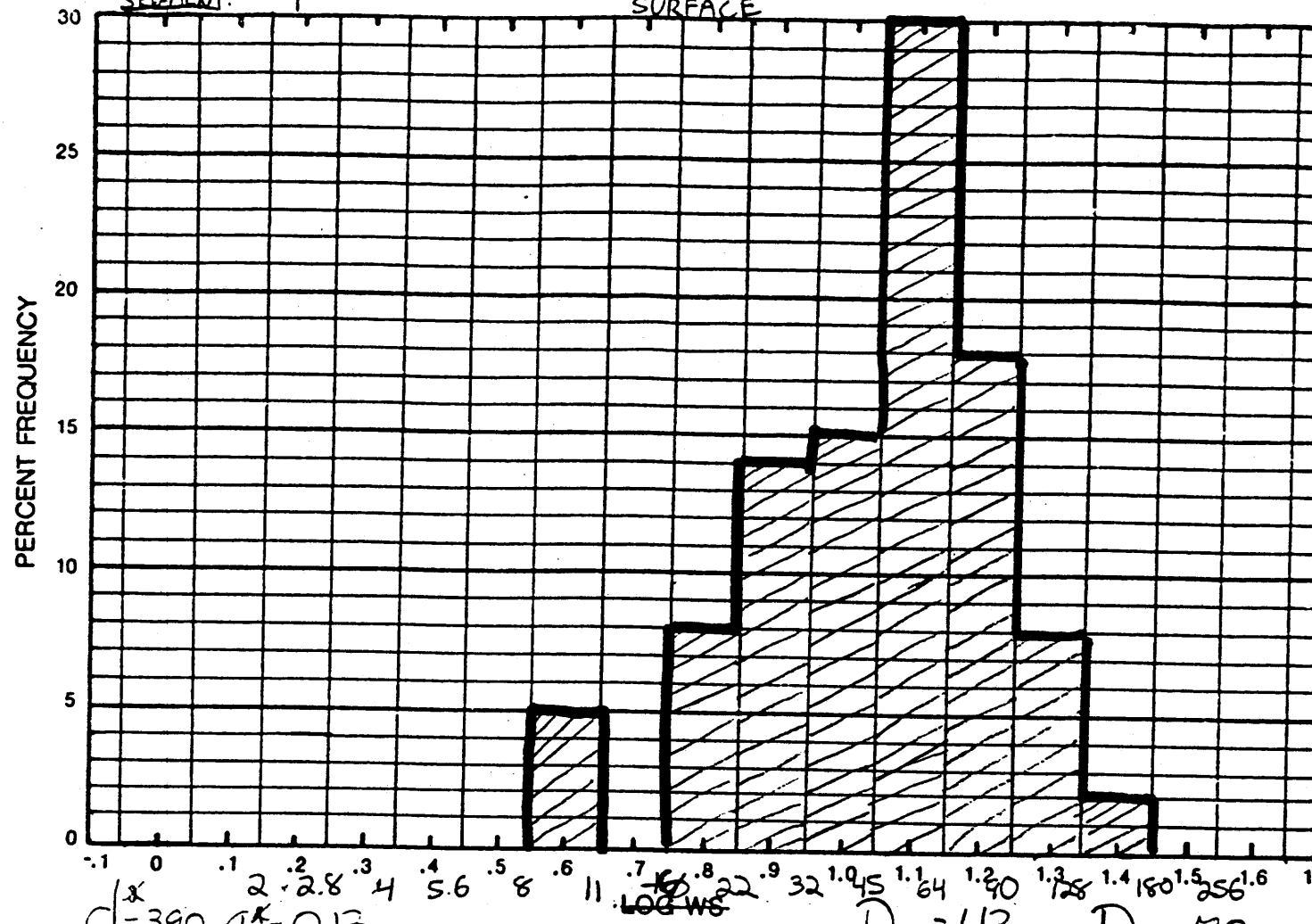
SEGMENT #1 SUBSURFACE 600FT UPSTREAM OF BRIDGE





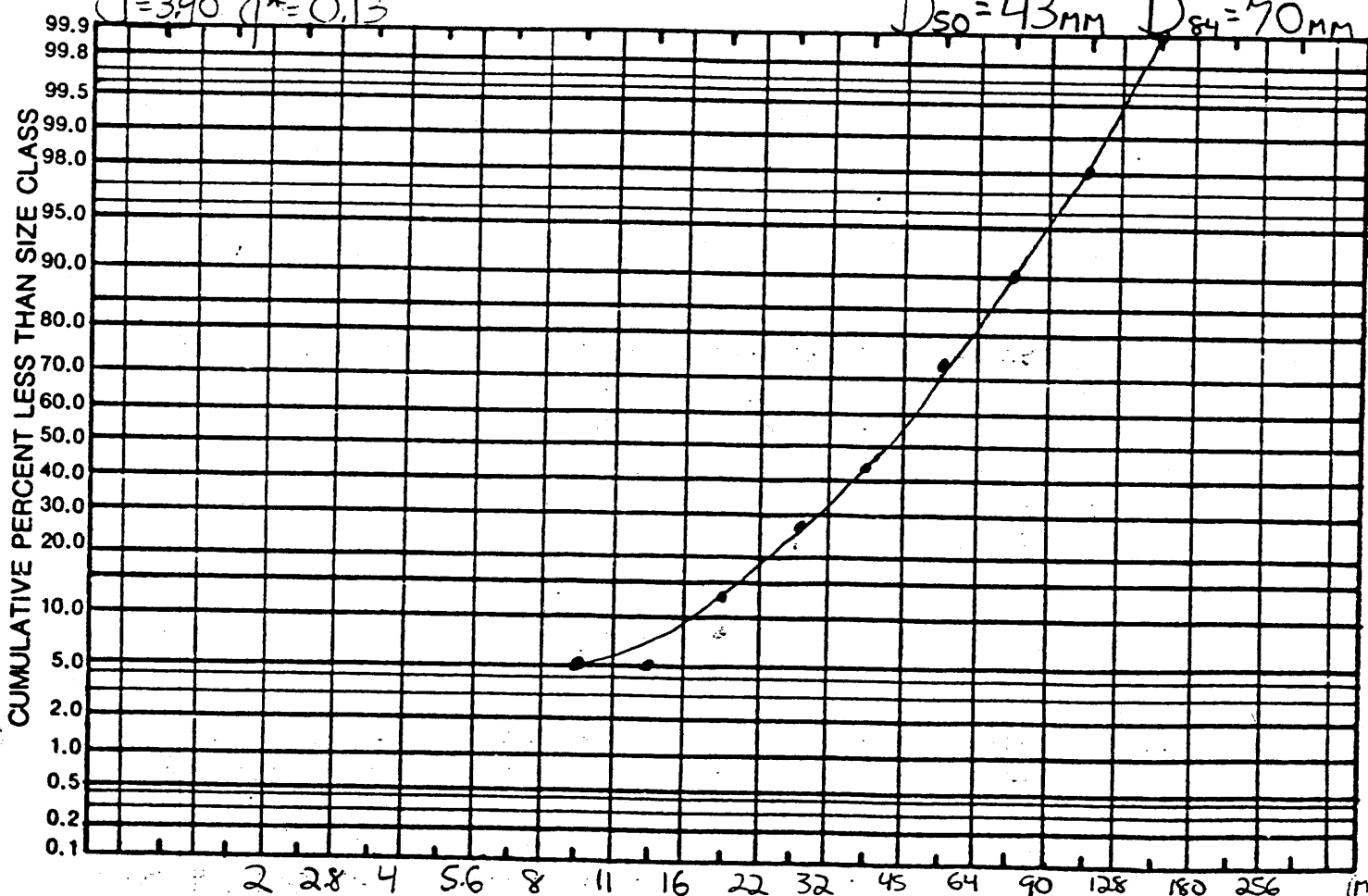
END OF BAR SAMPLE

SEGMENT: #1 SURFACE

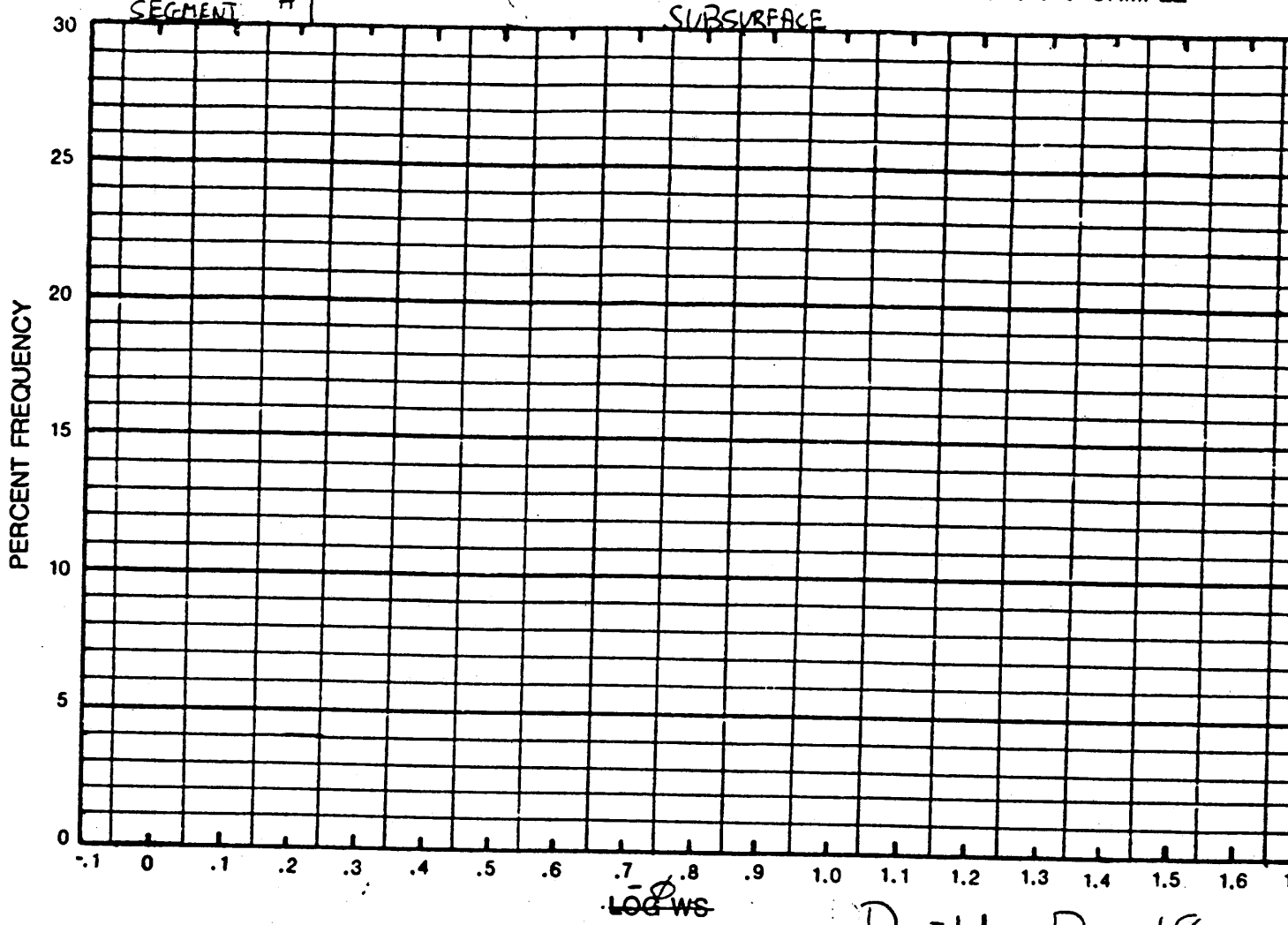


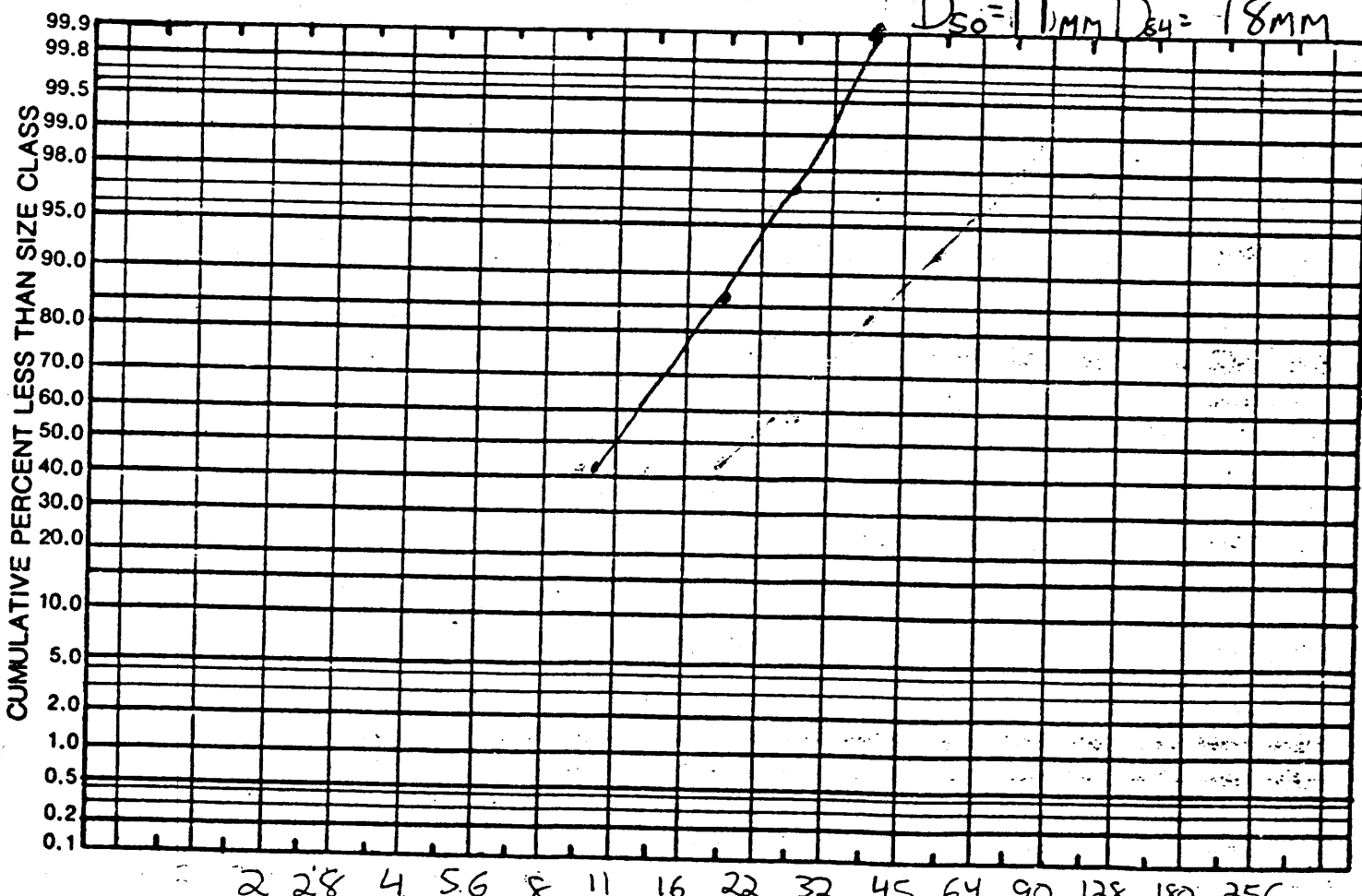
$C_u^* = 3.90$ $C_c^* = 0.13$

$D_{50} = 43mm$ $D_{84} = 70mm$



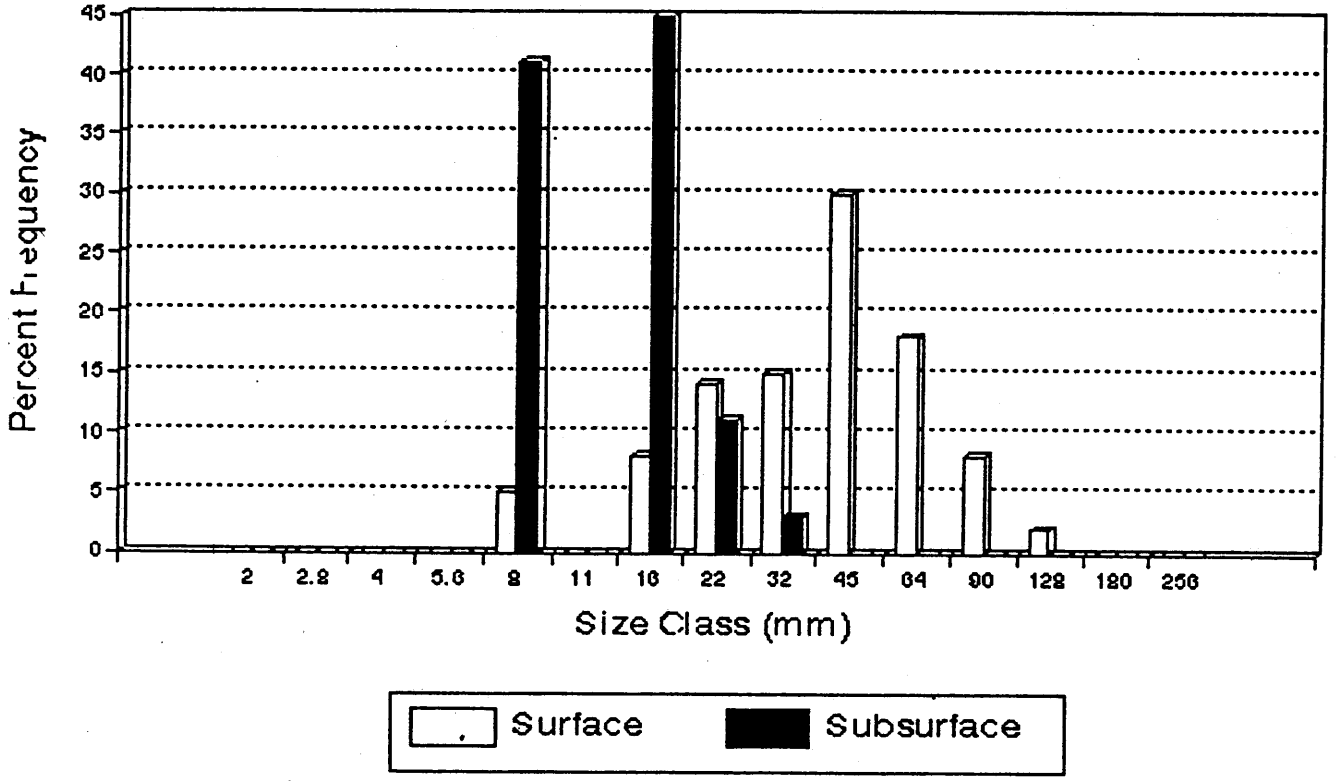
SEGMENT #1 SUBSURFACE DOWNSTREAM END OF BAR SAMPLE





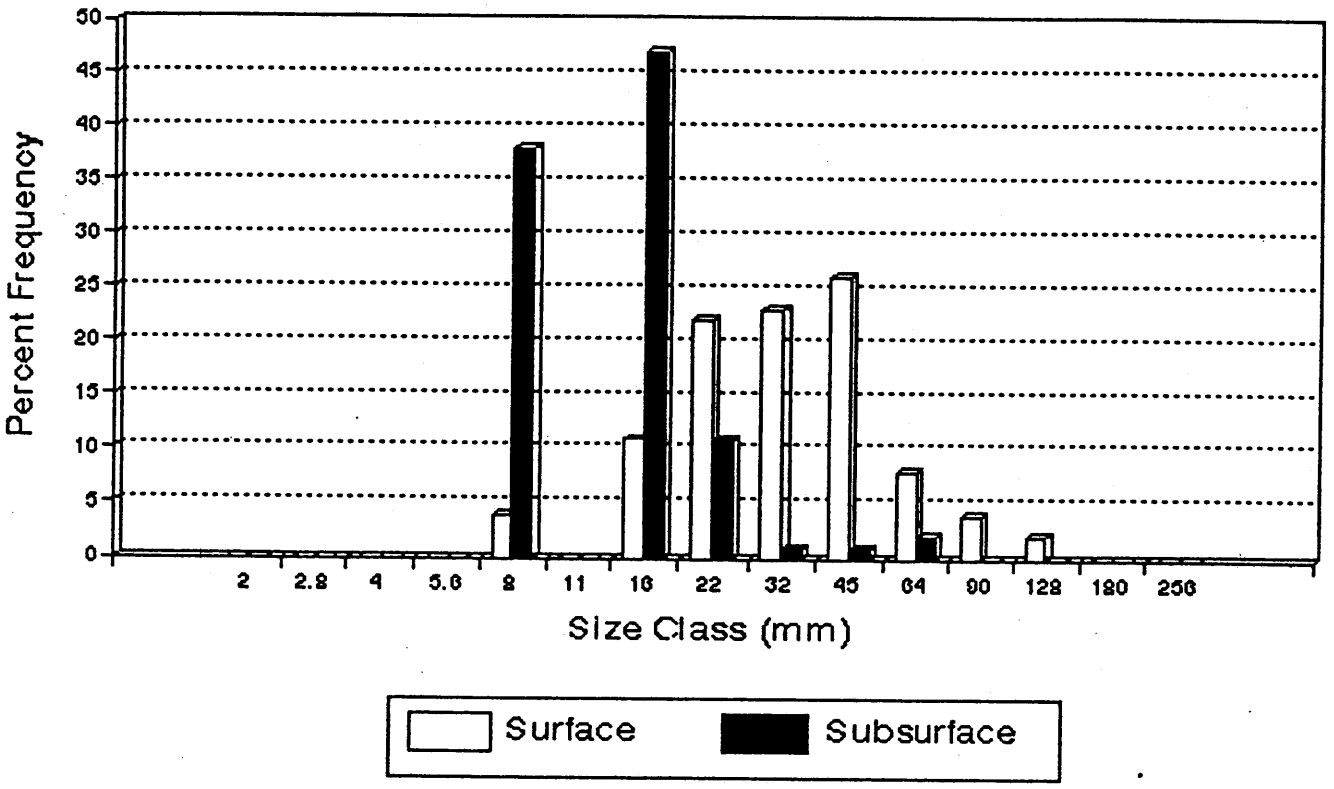
MAINSTEM OF TOLT RIVER

Segmen 1 (DS - Surface v. Subsurface)



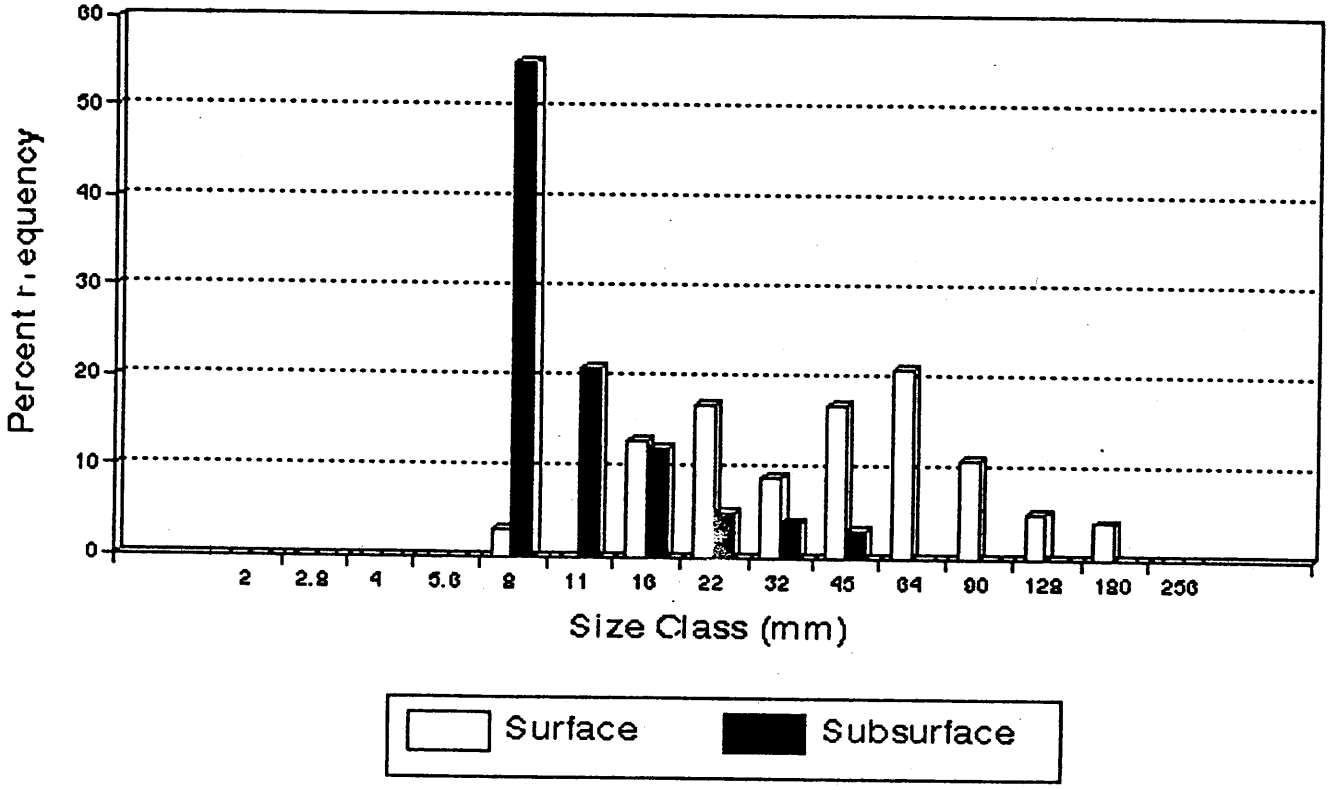
MAINSTEM OF TOLT RIVER

Segmen 1 (MS - Surface v. Subsurface)



MAINSTEM OF TOLT RIVER

Segmen 1 (US - Surface v. Subsurface)



SEGMENT 3 - MAINSTEM OF TOLT RIVER

Segment 3 - Farthest pebble count downstream in segment.
Low bar, approximately 300ft downstream of big bend near left bank.
Bar not frozen, seems mobile, signs of embircation.
Location of count - midchannel, middle of bar, just above water surface.
Gradient - 2% upestream, 1.5% downstream

Surface

D50 (mm)	18
D84 (mm)	33

Size (mm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	1	1%
8	3	4%
11	18	22%
16	30	52%
22	15	67%
32	21	88%
45	7	95%
64	5	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 1.64
q* = 0.24

Subsurface

D50 (mm)	11
D84 (mm)	18

Size (mm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	6	6%
5.6	8	14%
8	18	32%
11	34	66%
16	21	87%
22	10	97%
32	3	100%
45	0	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 3 - Mid channel bar just upstream of Stossel Creek and large bend
Mid-channel bar, downstream end pebble count, near water level right-bank.
Easy to remove surface layer of bar, not armored

Surface

D50 (mm) 39
D84 (mm) 76

Size (mm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	3	3%
5.6	0	3%
8	4	7%
11	8	15%
16	8	23%
22	19	42%
32	9	51%
45	18	69%
64	16	85%
90	11	96%
128	4	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 2.78
q* = 0.15

Subsurface

D50 (mm) 14
D84 (mm) 26

Size (mm)	Count	Cumulative % less than size class
2	1	1%
2.8	1	2%
4	8	10%
5.6	1	11%
8	22	33%
11	10	43%
16	24	67%
22	18	85%
32	6	91%
45	7	98%
64	2	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 3 - First bar, downstream of confluence, right bank, upstream of gage station
Mid-channel bar, downstream end pebble count, near water level right-bank.

Surface

D50 (mm)	31
D84 (mm)	42

Size (mm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	3	3%
11	8	11%
16	10	21%
22	25	46%
32	32	78%
45	19	97%
64	3	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 2.06

q* = 0.19

Subsurface

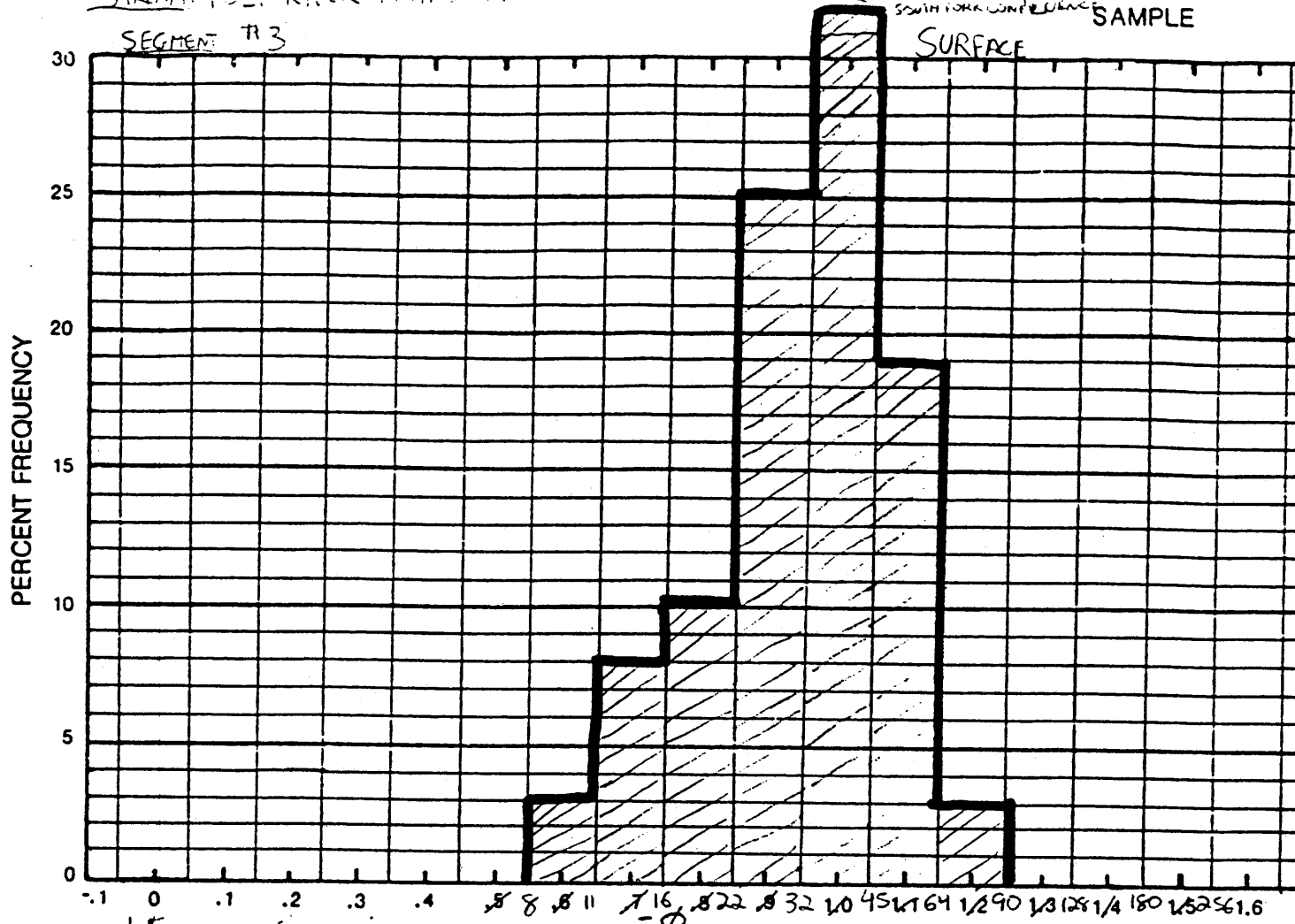
D50 (mm)	15
D84 (mm)	24

Size (mm)	Count	Cumulative % less than size class
2	0	0%
2.8	1	1%
4	4	5%
5.6	3	8%
8	11	19%
11	26	45%
16	25	70%
22	22	92%
32	4	96%
45	4	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

SEGMENT #3

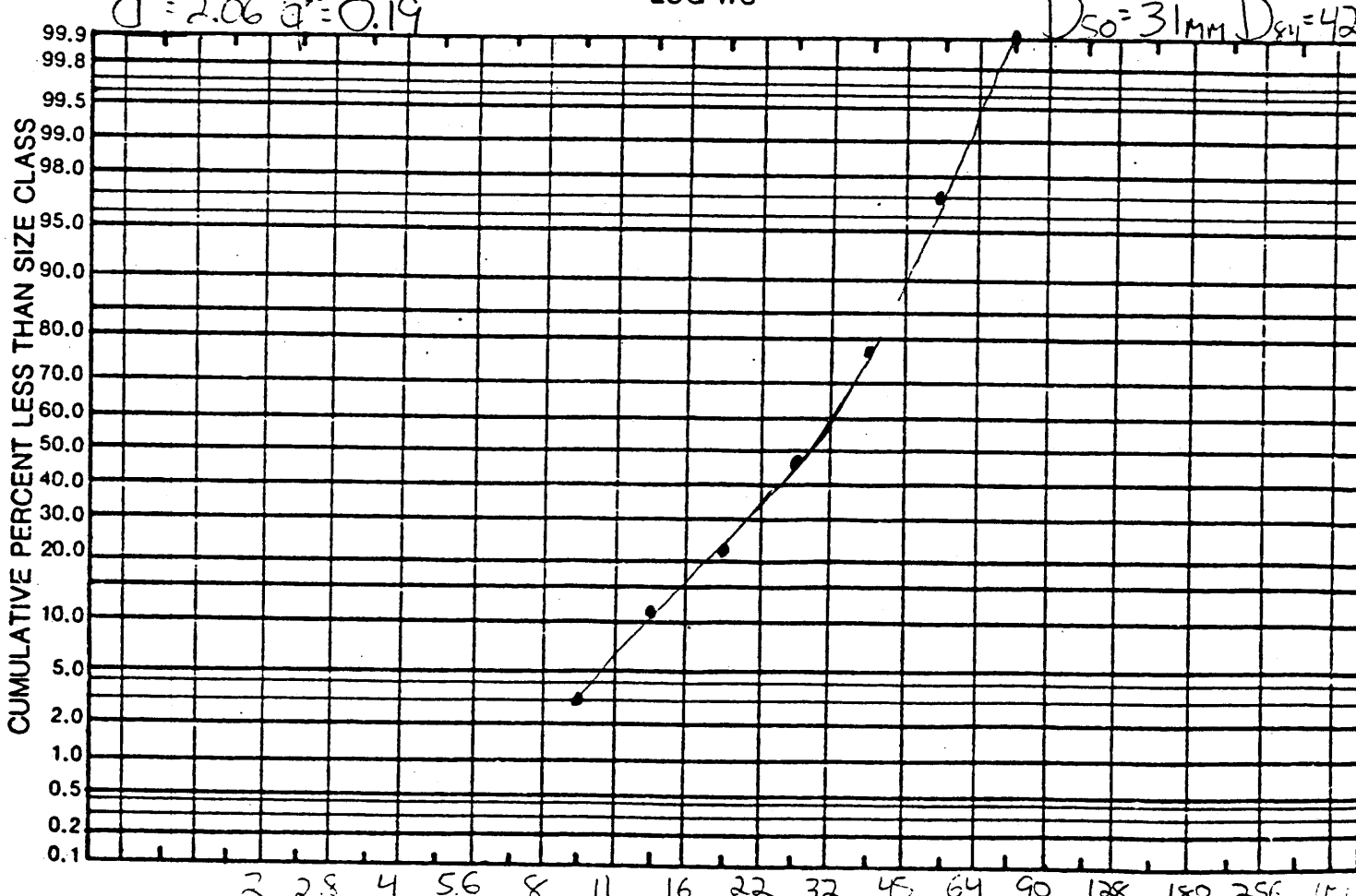
SOUTH FORK CONFLUENCE SAMPLE

SURFACE



$d^* = 2.06$ $\sigma^* = 0.19$

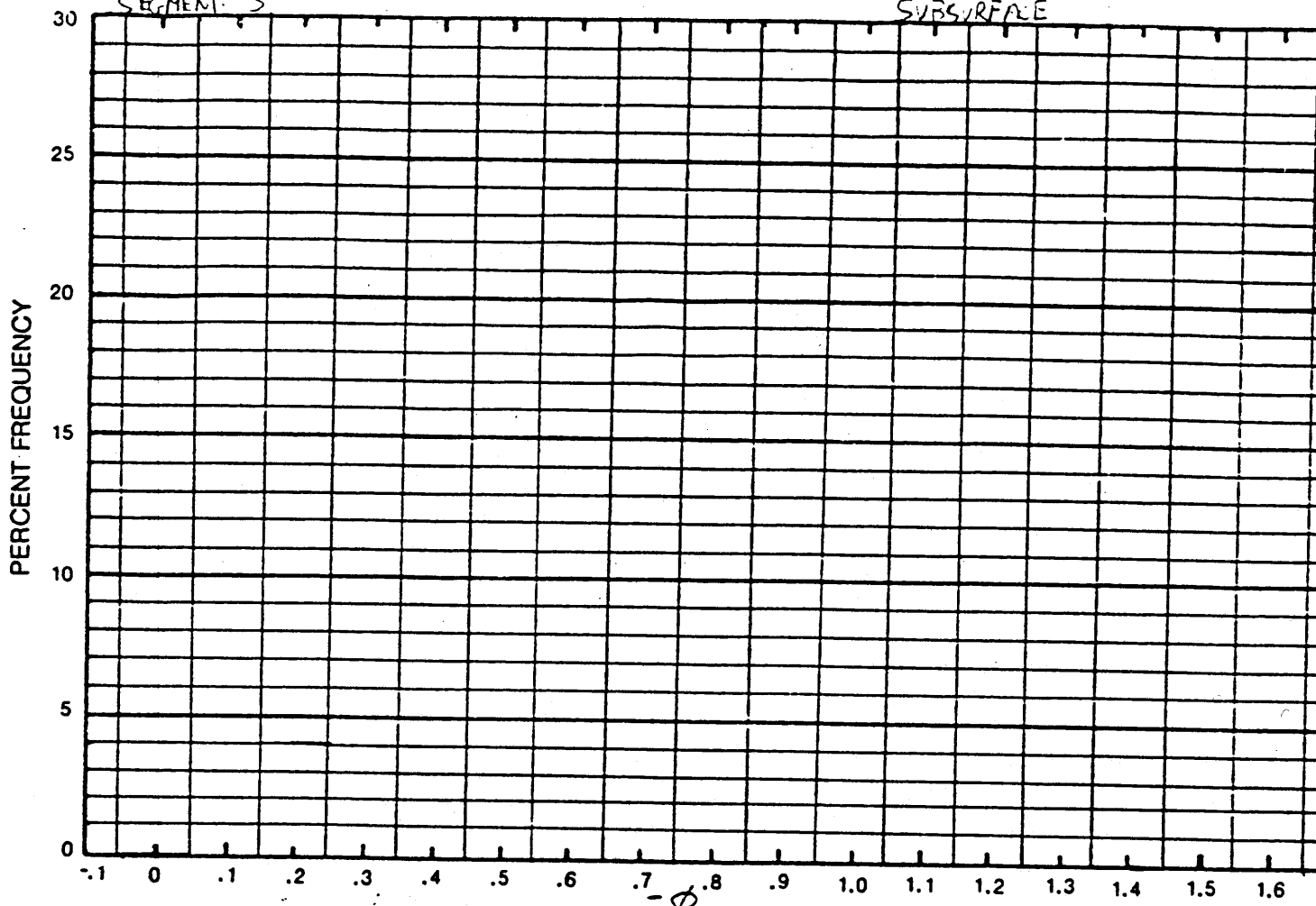
$D_{50} = 31$ MM $D_{84} = 42$



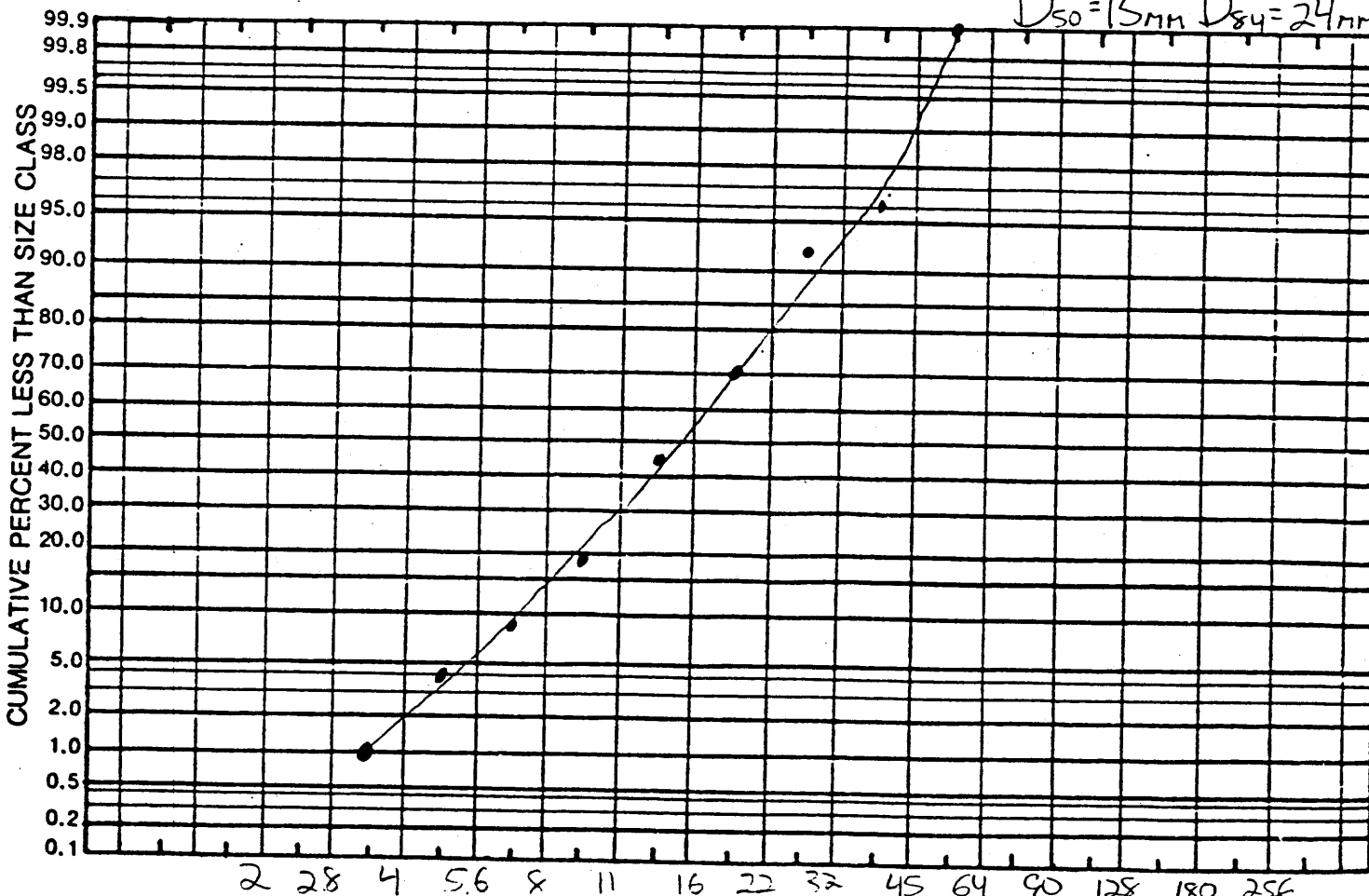
SOUTH FORK COLFAX SAMPLE

SEGMENT: #3

SUBSURFACE



D_{50}=15mm D_{84}=24mm



STREAM: [illegible]

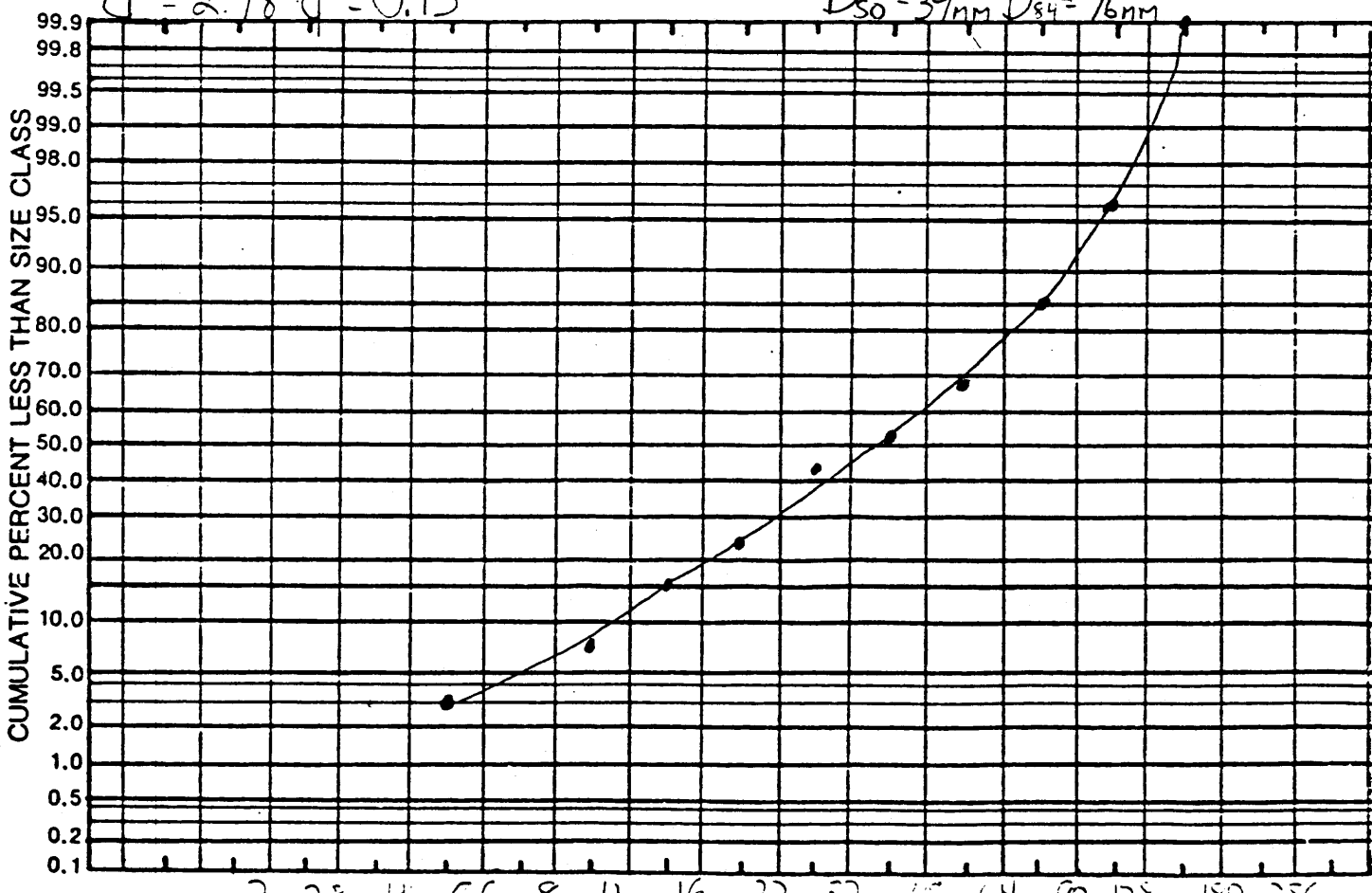
SAMPLE

SEGMENT: F3

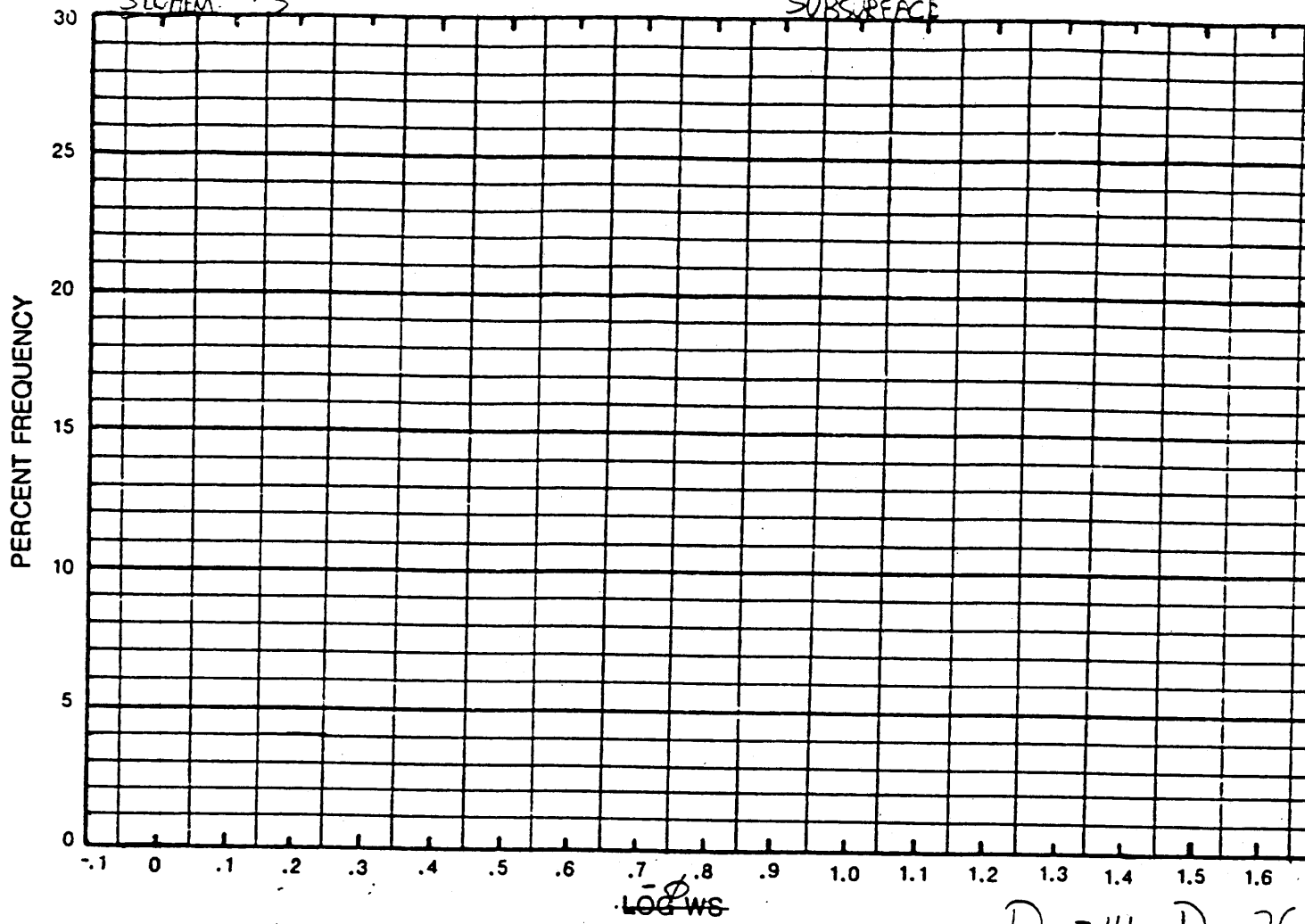
SURFACE

$d^* = 2.78$ $\sigma^* = 0.15$

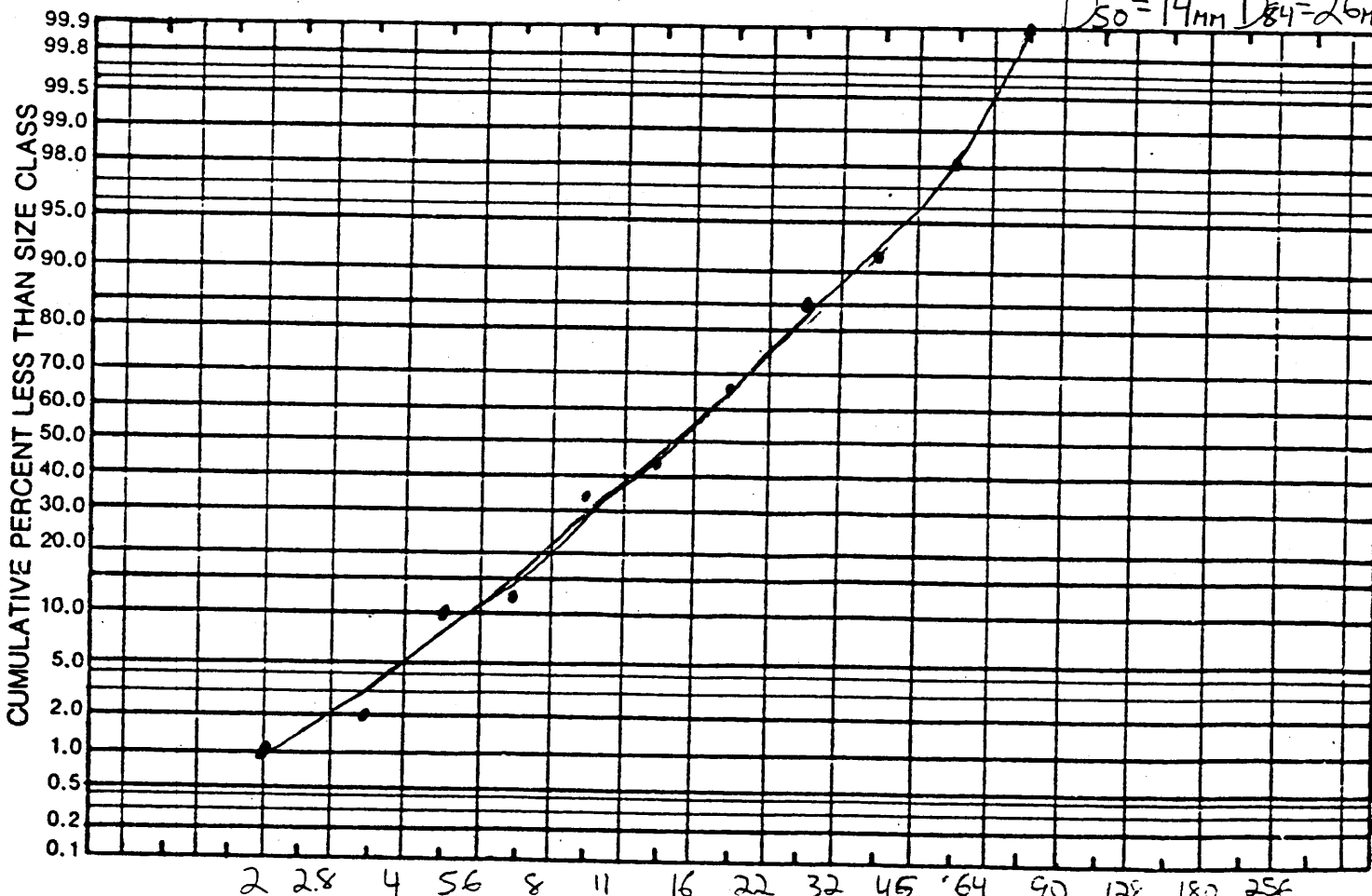
$D_{50} = 39mm$ $D_{84} = 76mm$



SEGMENT #3 SUBSURFACE SAMPLE



$D_{50} = 14mm$ $D_{84} = 26m$



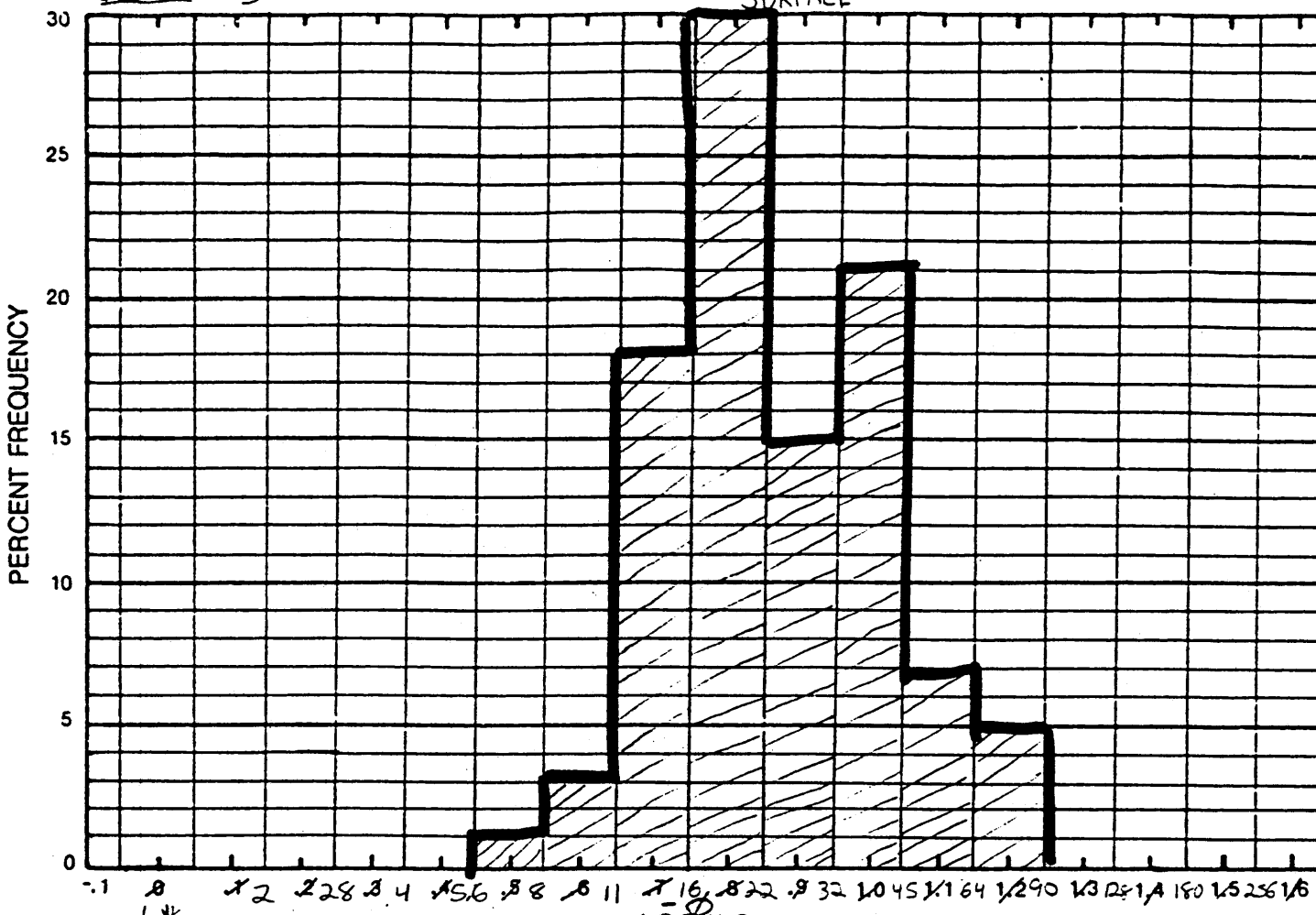
STREAM: [illegible]

SEGMENT: #3

300FT OF BIG BEND LB, MID CHANNEL, MID-BAR

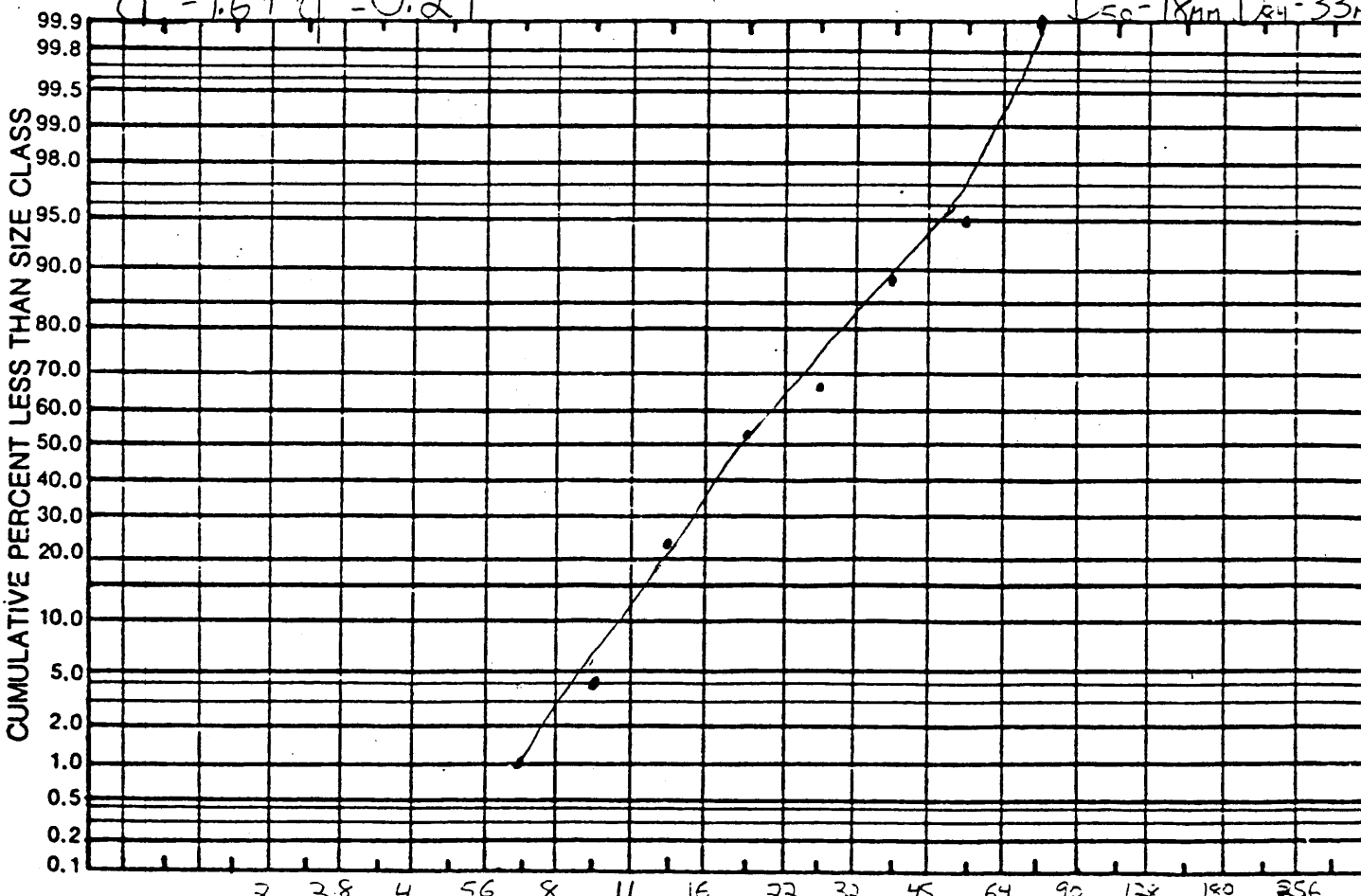
SAMPLE

SURFACE



$d^* = 1.64$ $\sigma^* = 0.24$

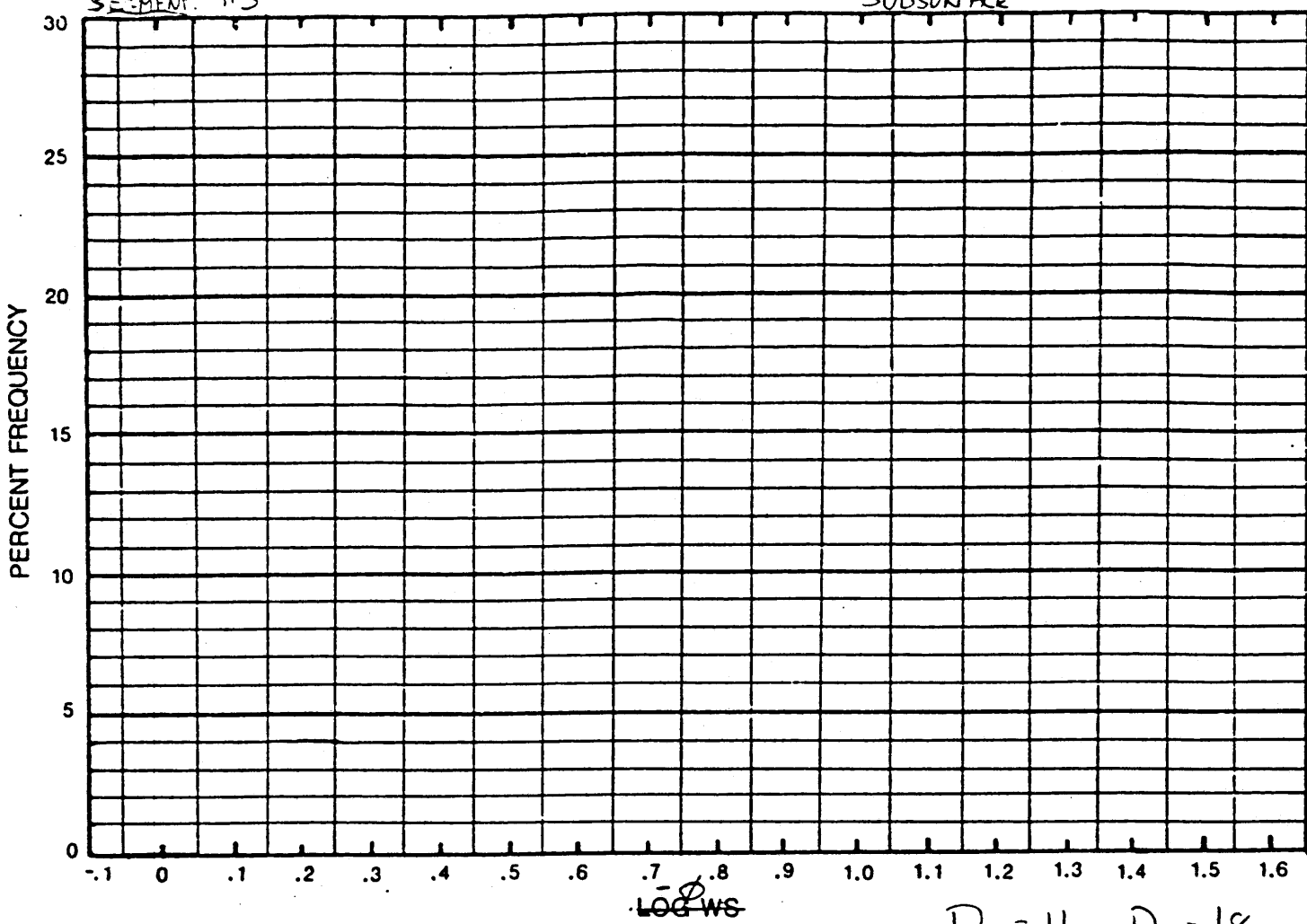
$D_{50} = 18mm$ $D_{84} = 33m$



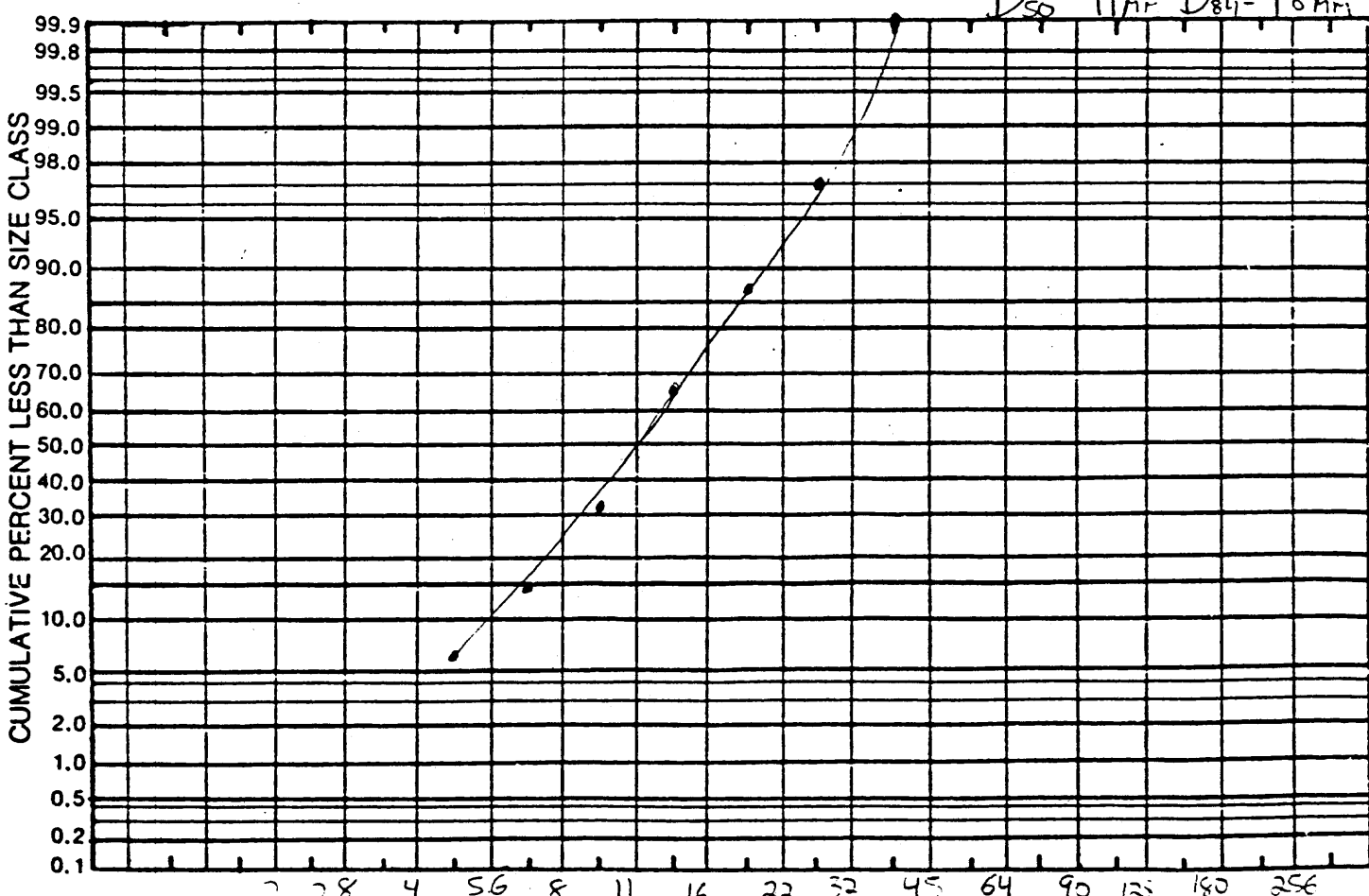
SAMPLE

SEGMENT: #3

SUBSURFACE

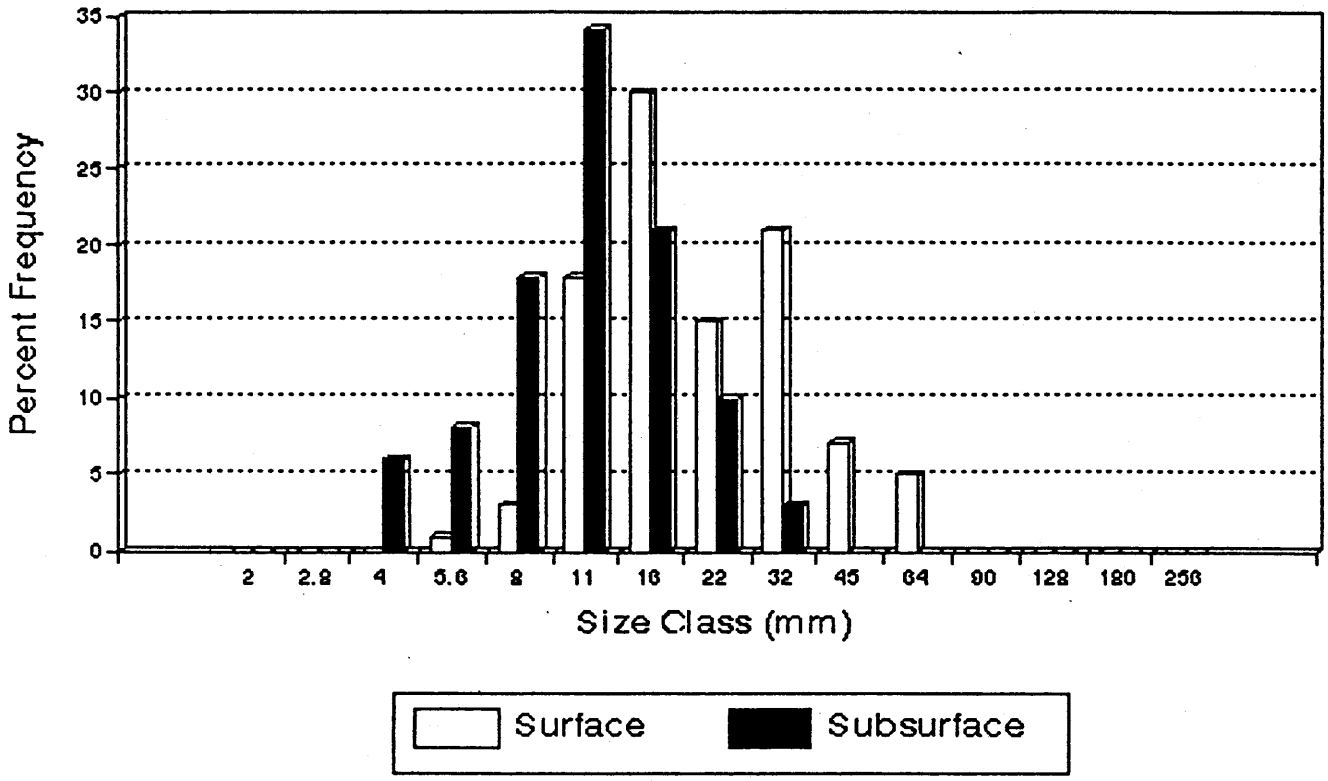


D_{50} = 11mm D_{84} = 18mm



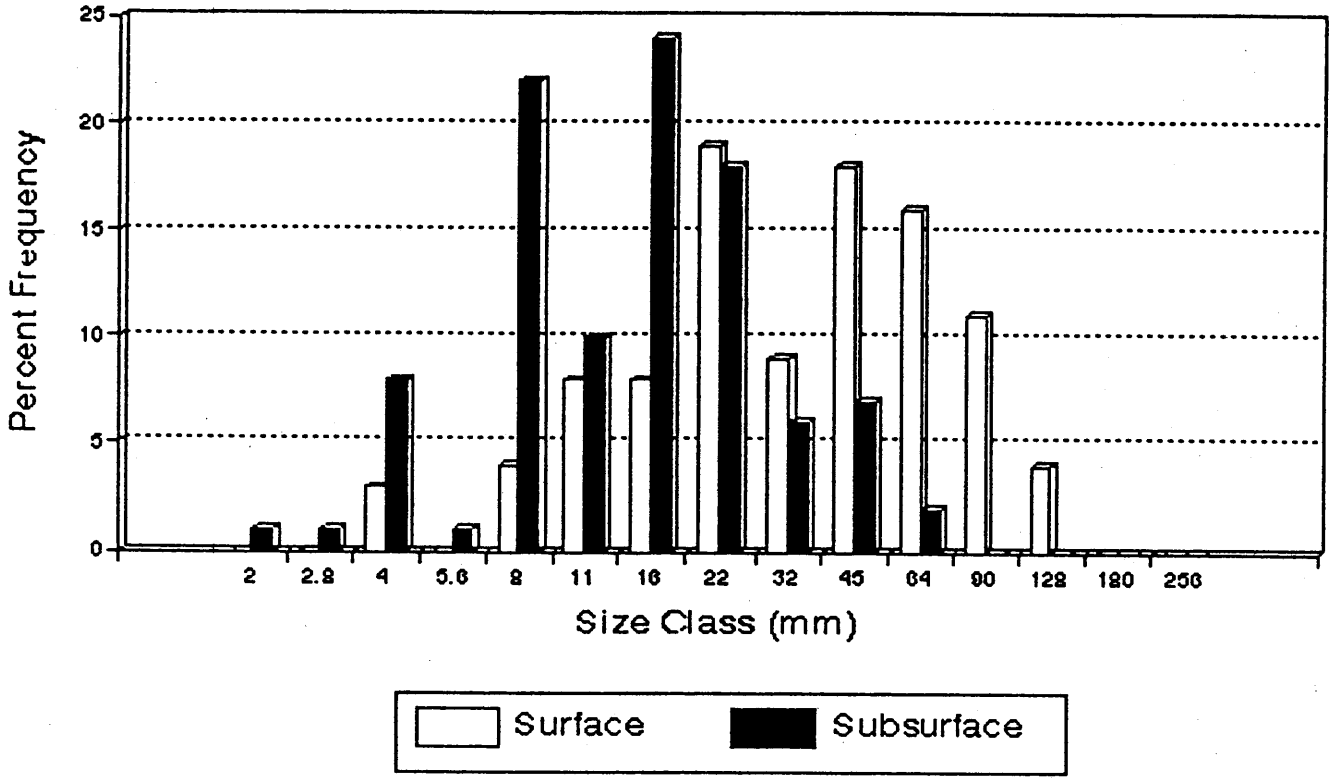
MAINSTEM OF TOLT RIVER

Segment 3 (DS - Surface v. Subsurface)



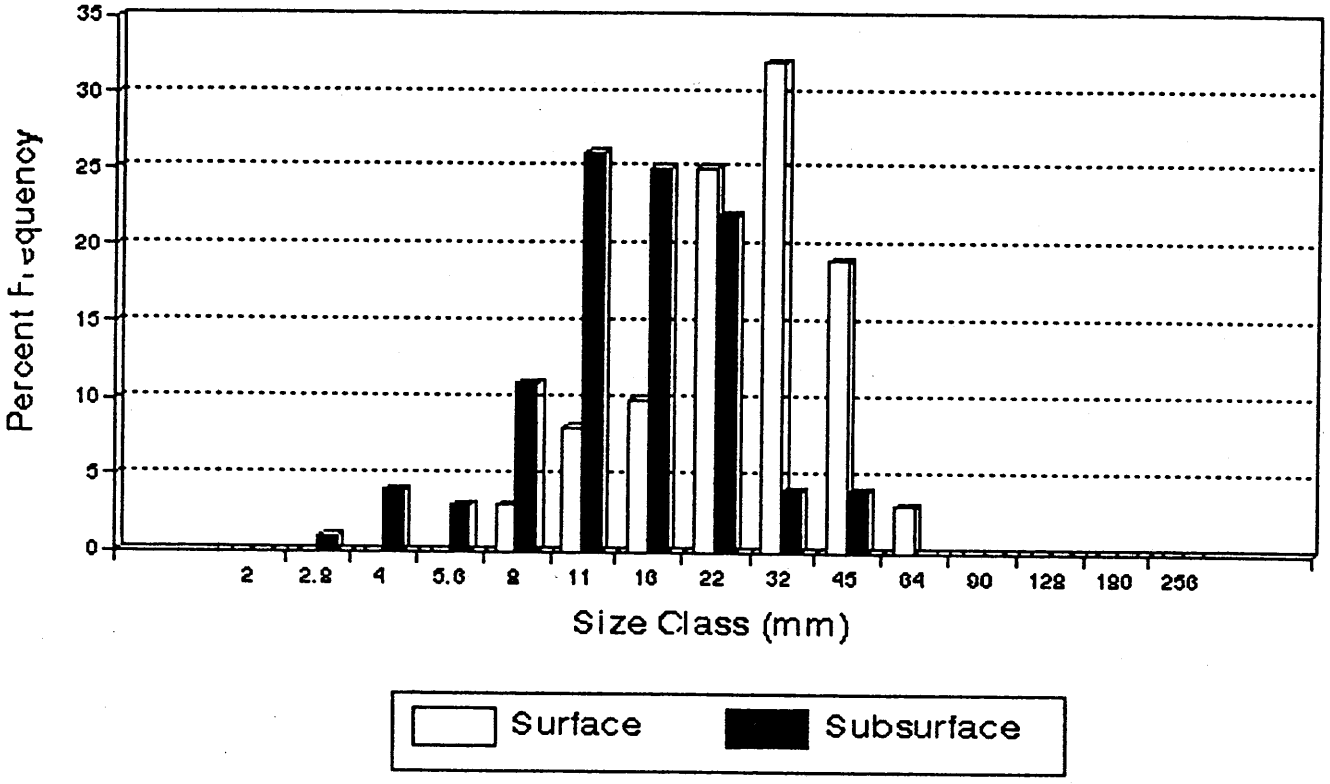
MAINSTEM OF TOLT RIVER

Segment 3 (MS - Surface v. Subsurface)



MAINSTEM OF TOLT RIVER

Segment 3 (US - Surface v. Subsurface)



Segment 5 - NORTH FORK TOLT RIVER

Segment 5 - farthest pebble count downstream.
Midchannel bar: lower end of segment

Surface

D50 (mm) 40
D84 (mm) 78

Size (cm)	Count	Cumulative % less than size class
2	1	1%
2.8	0	1%
4	0	1%
5.6	0	1%
8	1	2%
11	5	7%
16	11	18%
22	11	29%
32	19	48%
45	15	63%
64	15	78%
90	14	92%
128	4	96%
180	3	99%
256	1	100%
Total	100	100%

d* = 1.82
q* = 0.21

Subsurface

D50 (mm) 22
D84 (mm) 77

Size (cm)	Count	Cumulative % less than size class
2	6	6%
2.8	7	13%
4	4	17%
5.6	8	25%
8	5	30%
11	9	39%
16	10	49%
22	11	60%
32	11	71%
45	7	78%
64	7	85%
90	4	89%
128	6	95%
180	2	97%
256	3	100%
Total	100	100%

Segment 5 - Midstream

Area of gravel deposits and pool infilling.

Surface

D50 (mm) 47

D84 (mm) 91

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	0	0%
11	3	3%
16	8	11%
22	7	18%
32	18	36%
45	19	55%
64	23	78%
90	11	89%
128	8	97%
180	3	100%
256	0	100%
Total	100	100%

d* = 1.47

q* = 0.29

Subsurface

D50 (mm) 32

D84 (mm) 63

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	1	1%
8	1	2%
11	6	8%
16	12	20%
22	19	39%
32	20	59%
45	23	82%
64	8	90%
90	6	96%
128	3	99%
180	1	100%
256	0	100%
Total	100	100%

Segment 5 - Mistream

Large Gravel bar, river mile 1.2

Surface

D50 (mm) 54

D84 (mm) 106

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	2	2%
11	3	5%
16	6	11%
22	10	21%
32	17	38%
45	9	47%
64	16	63%
90	21	84%
128	14	98%
180	2	100%
256	0	100%
Total	100	100%

d* = 2.00

q* = 0.19

Subsurface

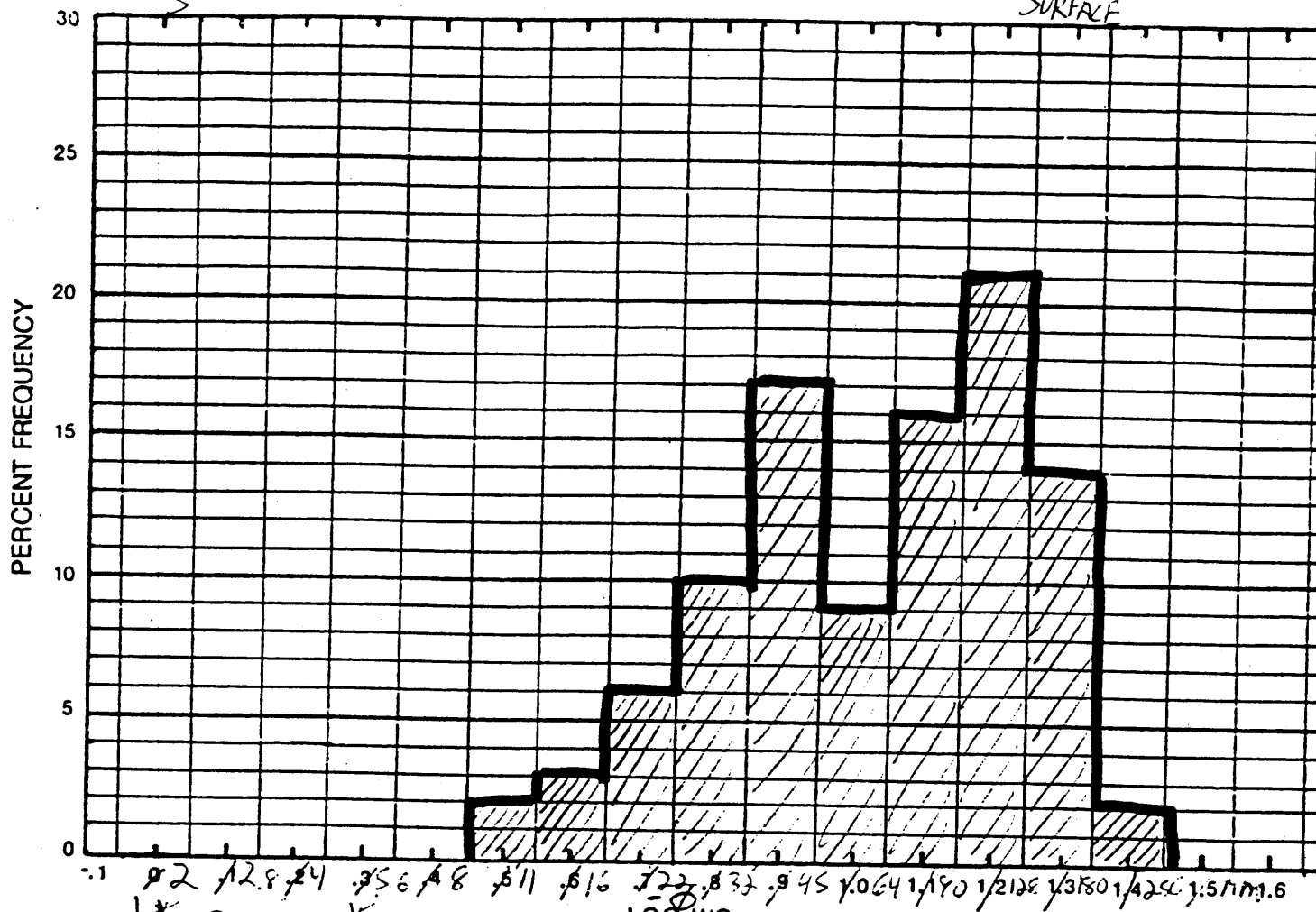
D50 (mm) 27

D84 (mm) 77

Size (cm)	Count	Cumulative % less than size class
2	1	1%
2.8	2	3%
4	1	4%
5.6	1	5%
8	4	9%
11	7	16%
16	17	33%
22	26	59%
32	11	70%
45	14	84%
64	5	89%
90	7	96%
128	4	100%
180	0	100%
256	0	100%
Total	100	100%

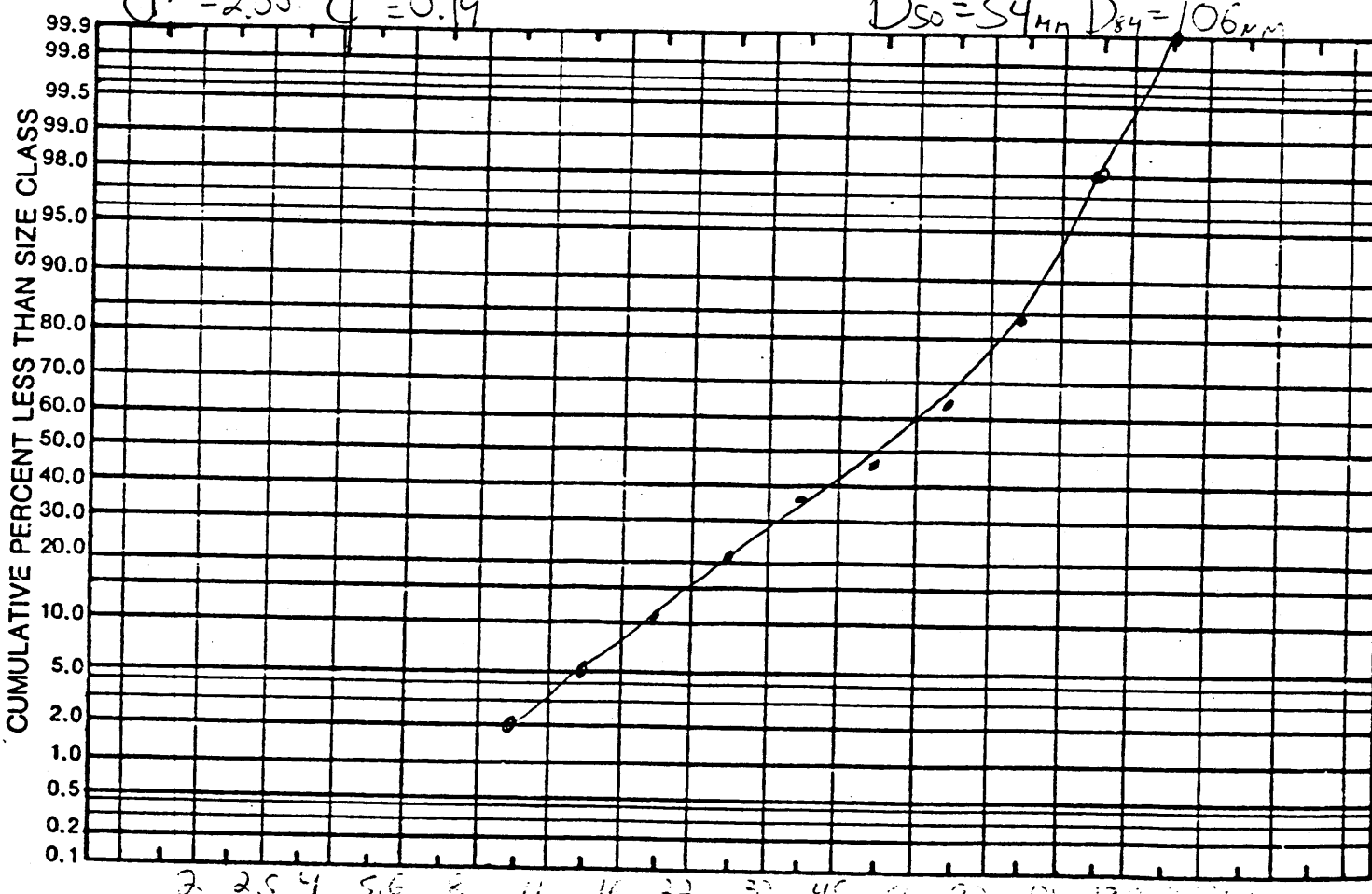
SAMPLE

SURFACE

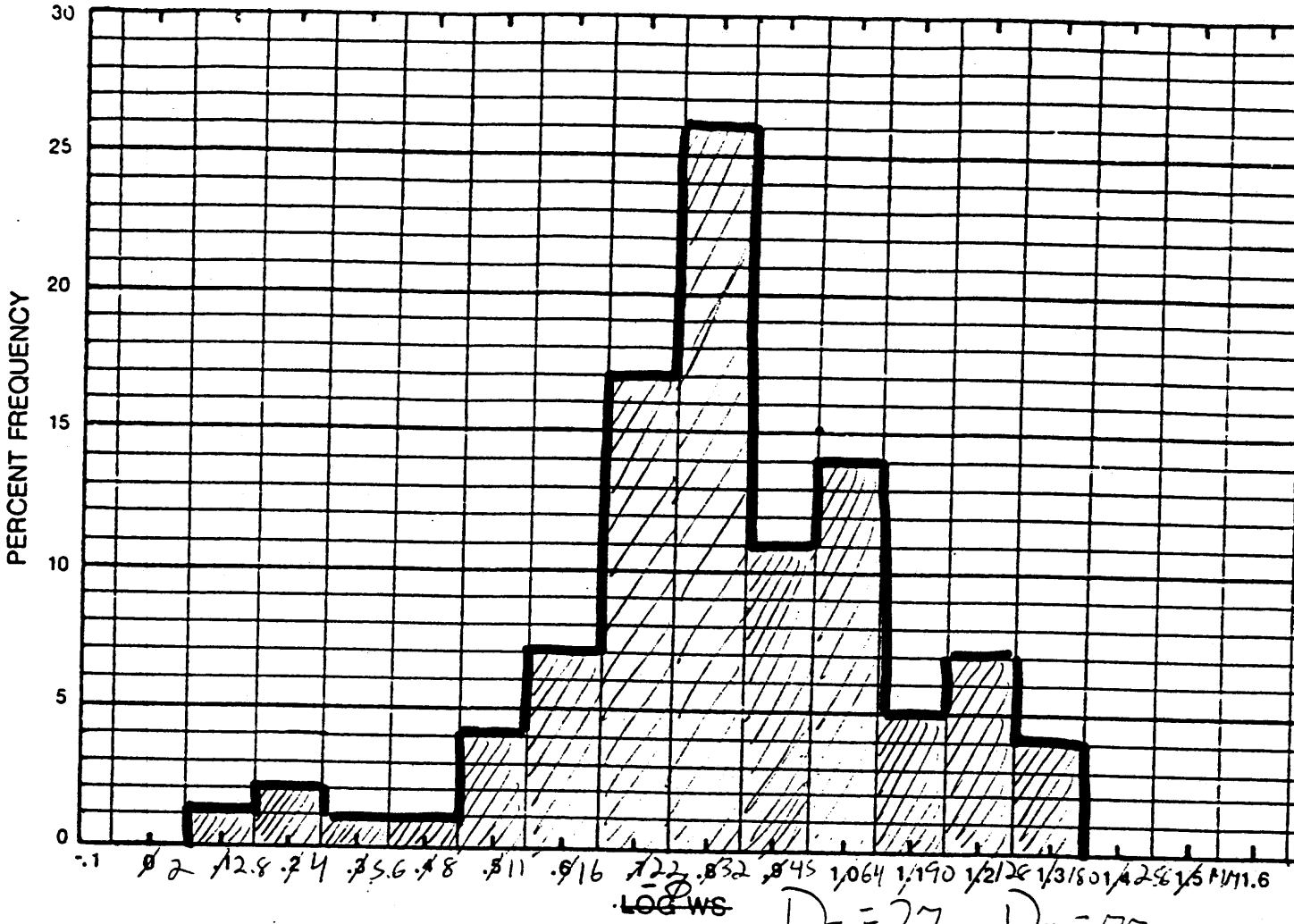


$d^* = 2.00$ $\sigma^* = 0.19$

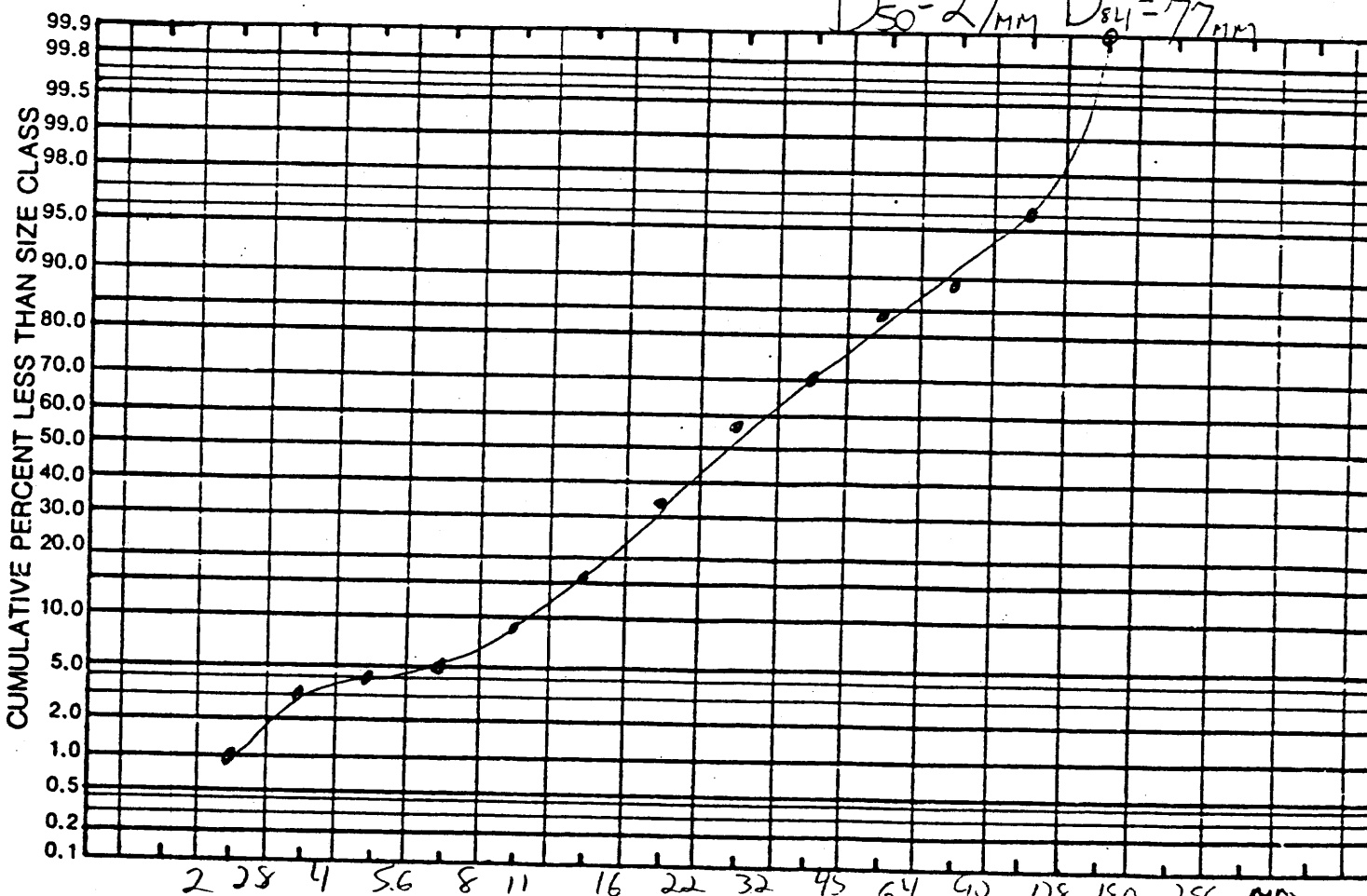
$D_{50} = 54\,mm$ $D_{84} = 106\,mm$



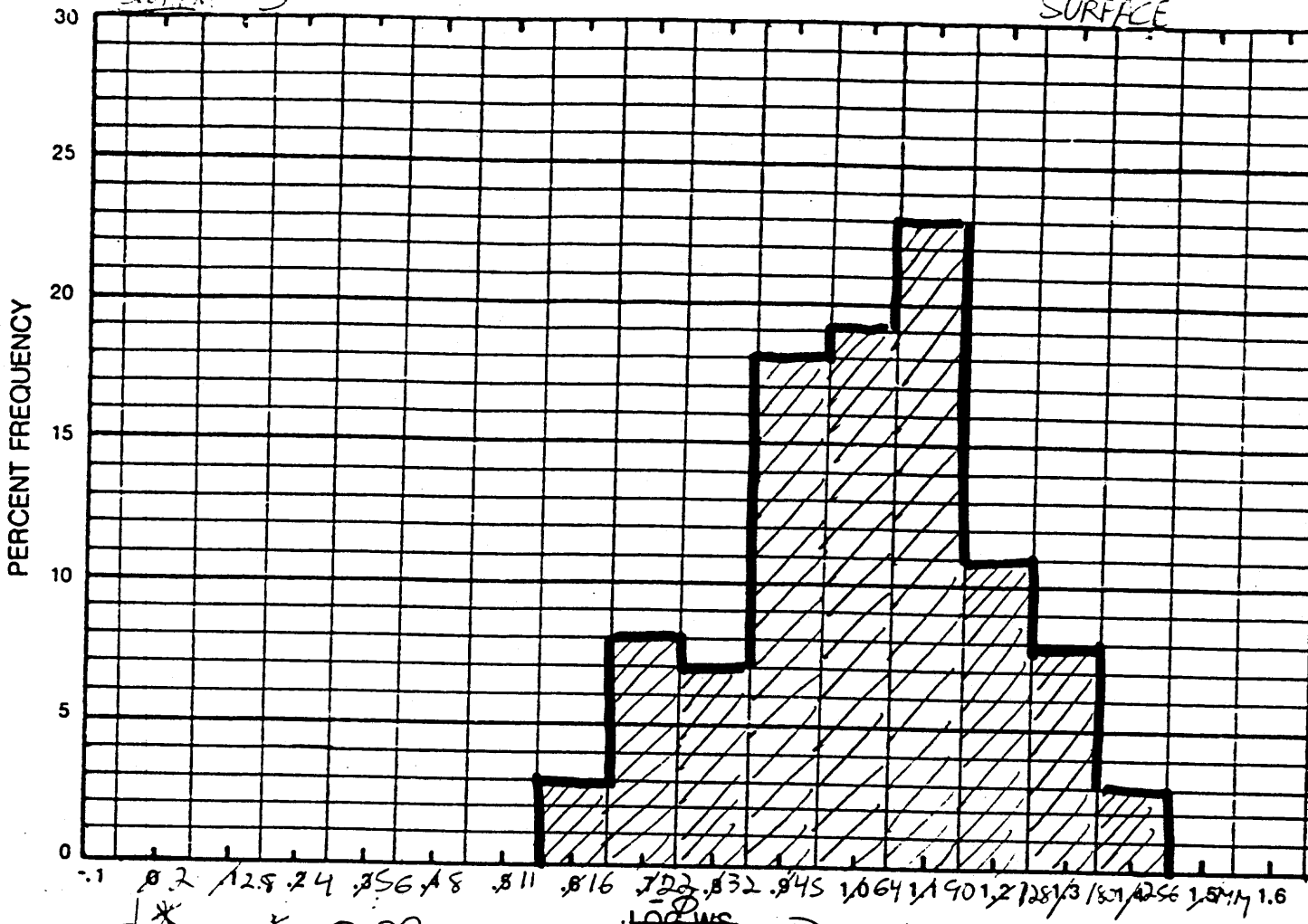
SAMPLE



$D_{50} = 27$ MM $D_{84} = 77$ MM

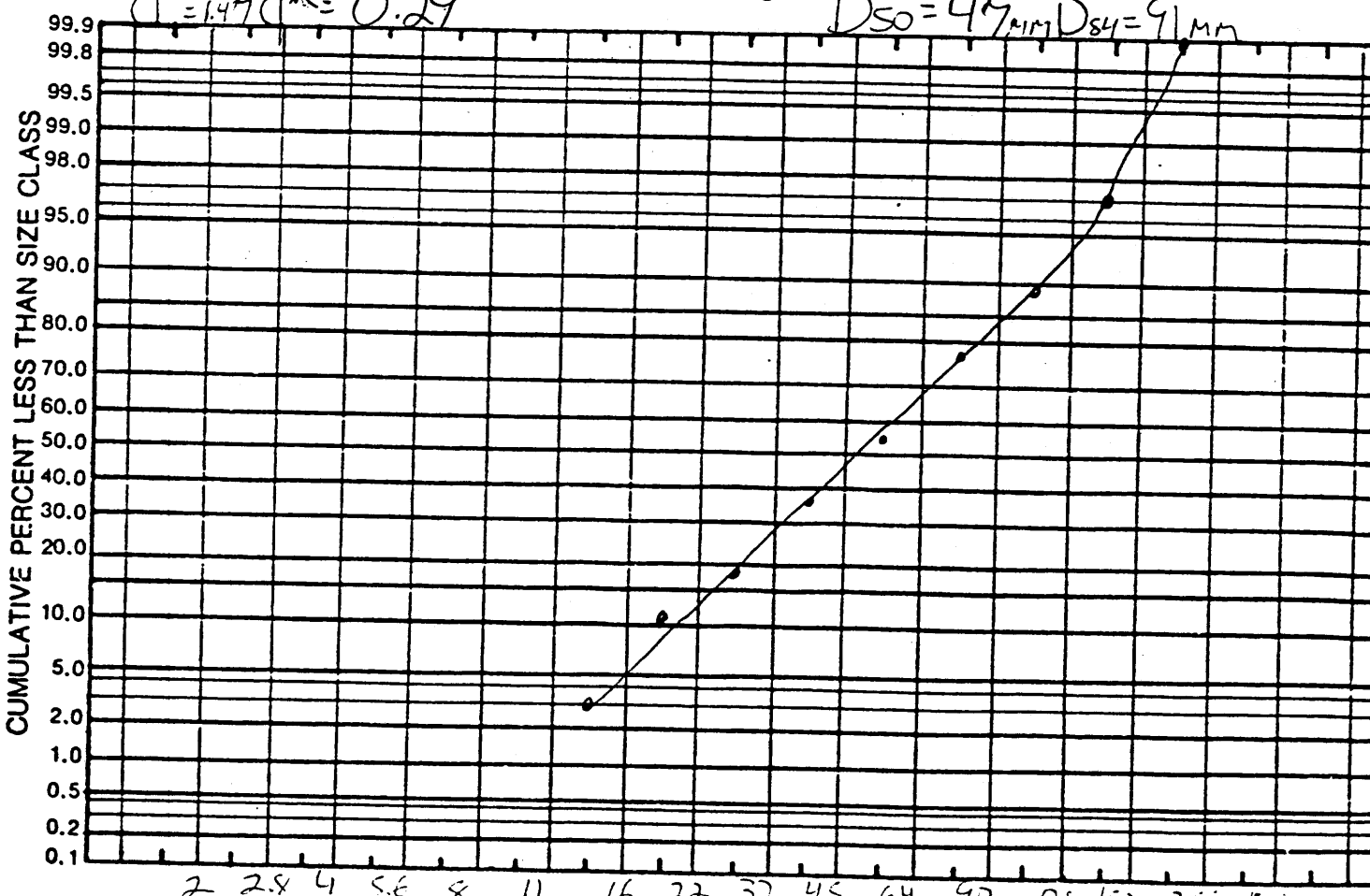


SAMPLE
SURFACE



$d^* = 1.47$ $\sigma^* = 0.29$

$D_{50} = 47$ mm $D_{84} = 91$ mm



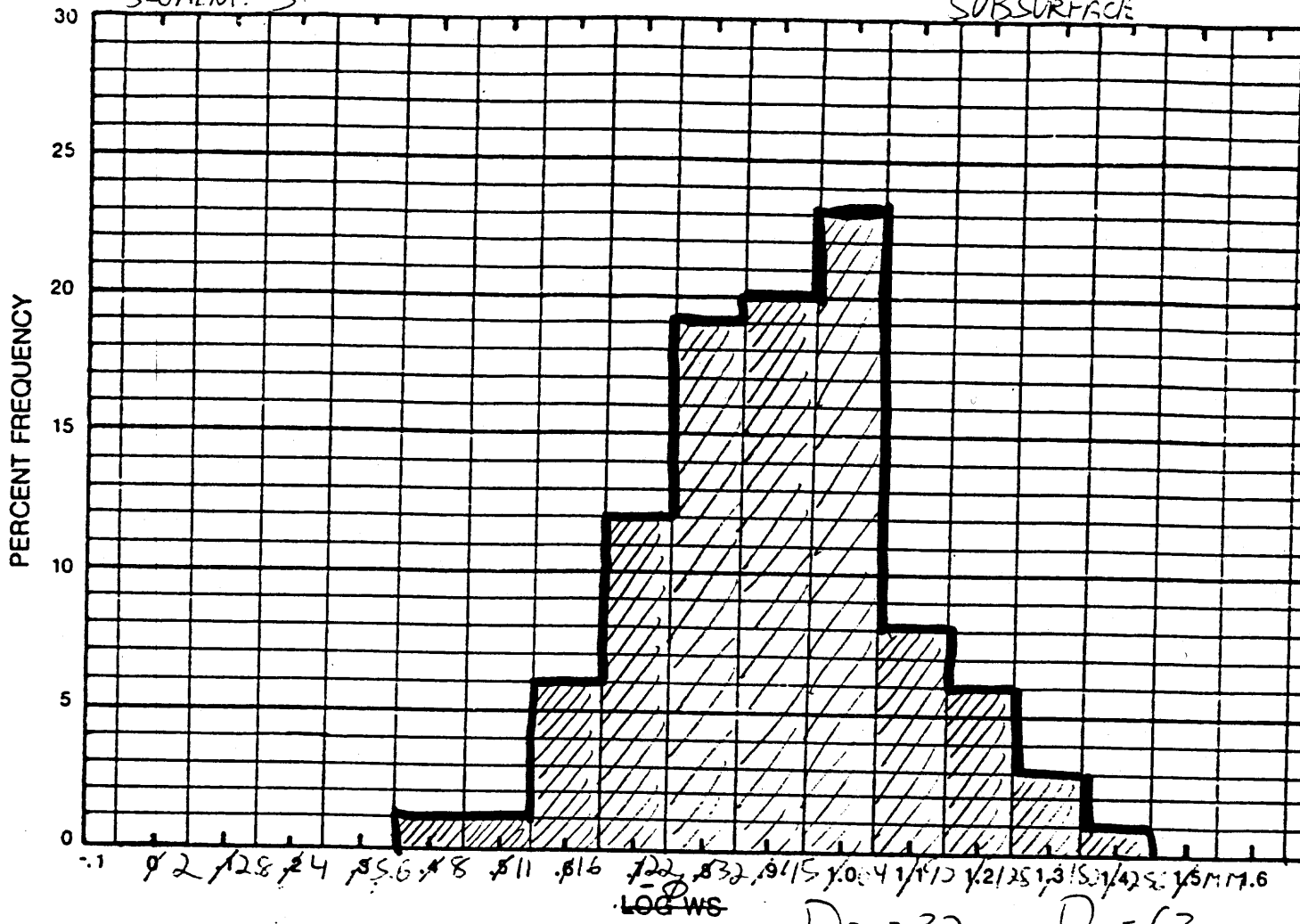
STREAM: NY [illegible]

SEGMENT: 5

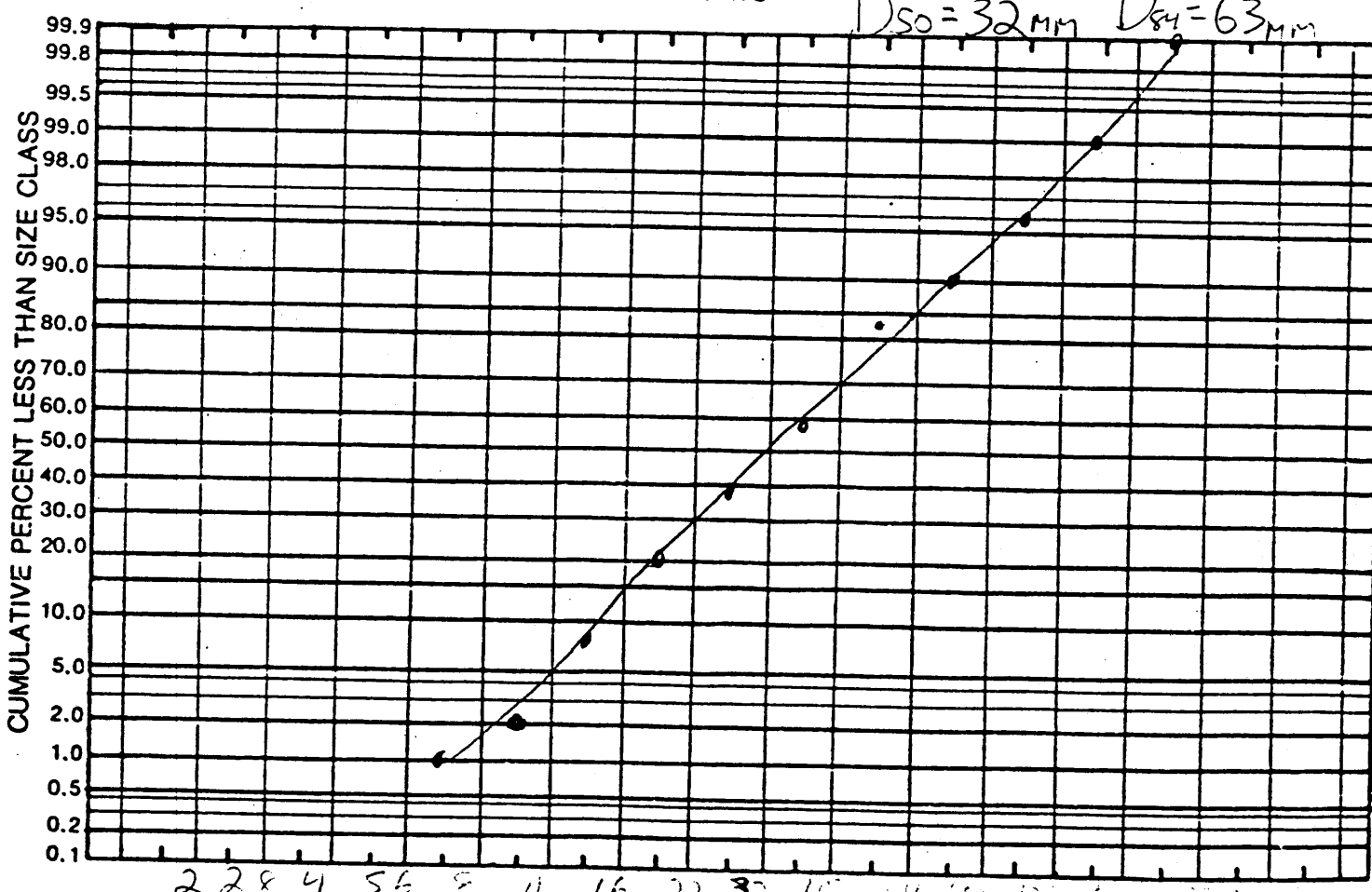
LOCATION: MIDSTREAM-[illegible]

SAMPLE

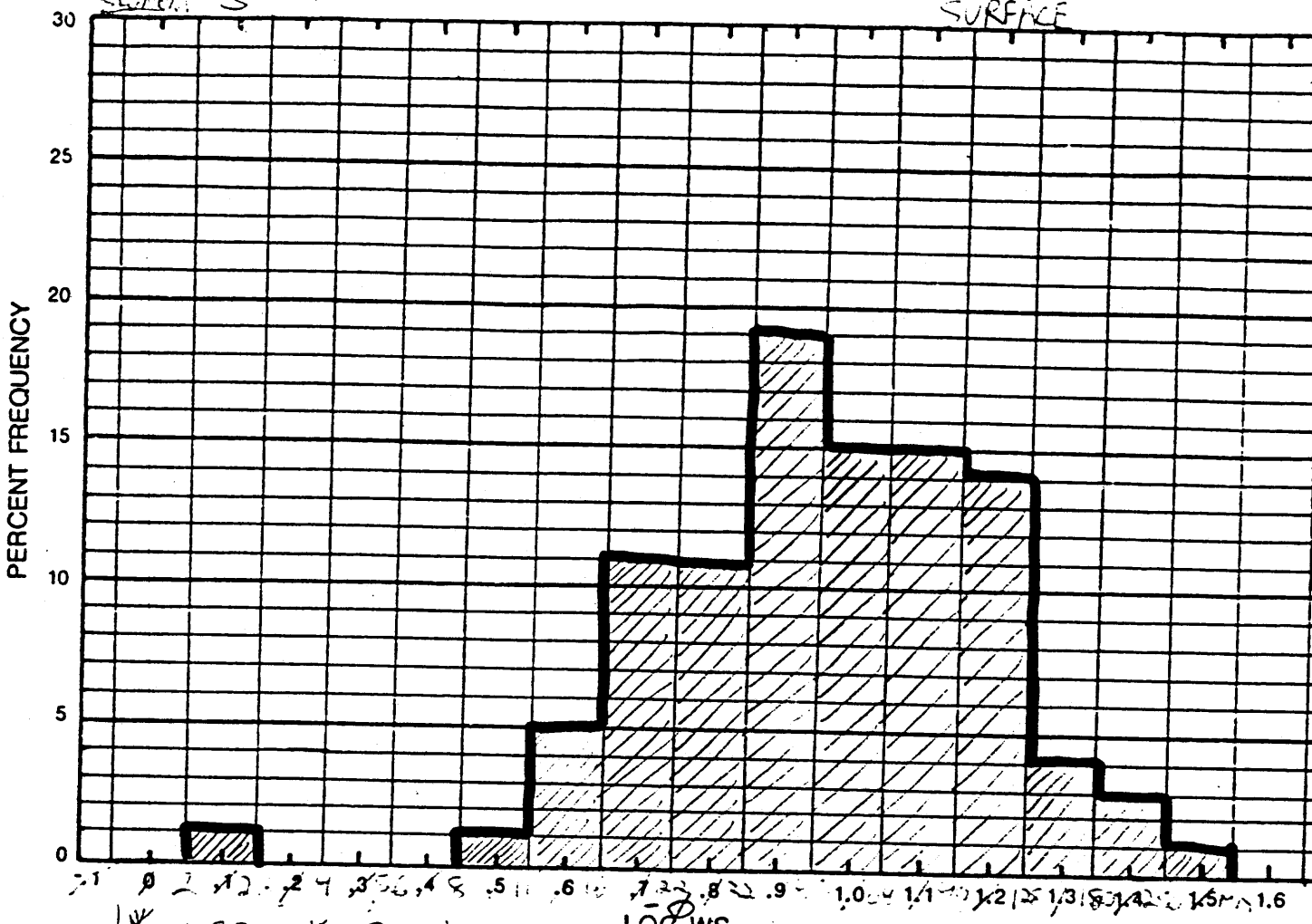
SUBSURFACE



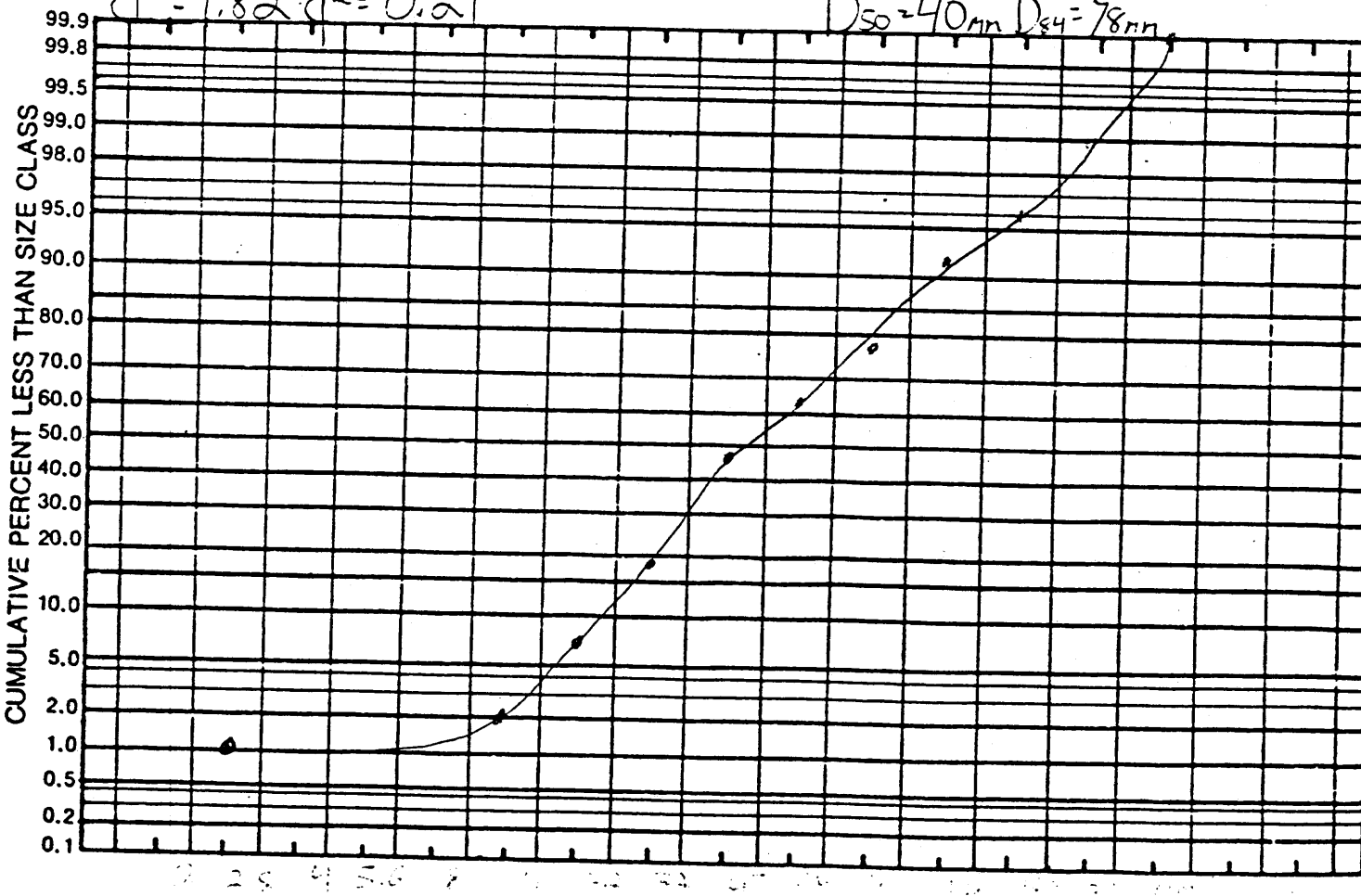
$D_{50} = 32$ MM $D_{84} = 63$ MM



SEGMENT 5 SURFACE SAMPLE

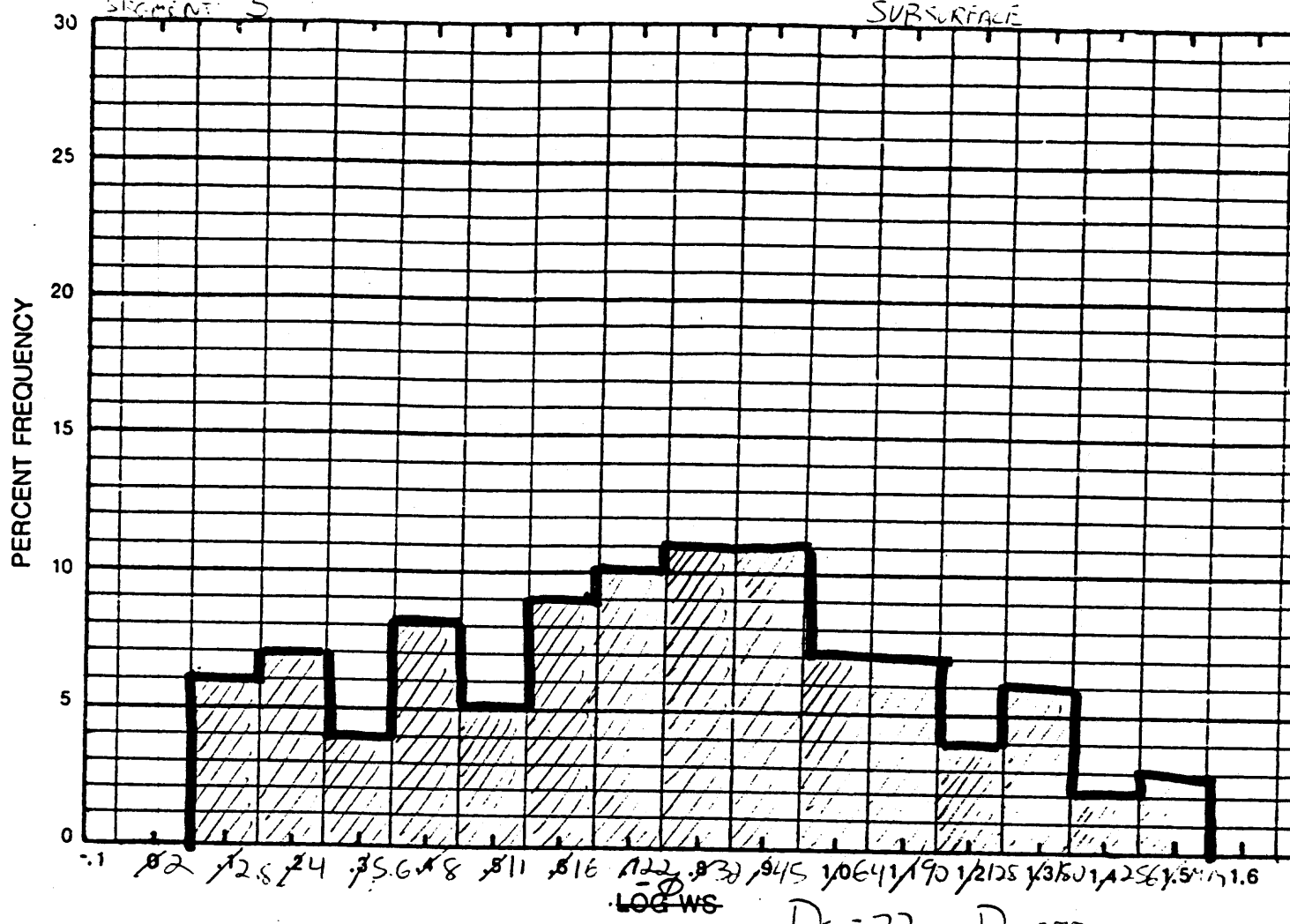


$d^* = 1.82$ $\sigma^* = 0.21$ $D_{50} = 40mm$ $D_{84} = 78mm$

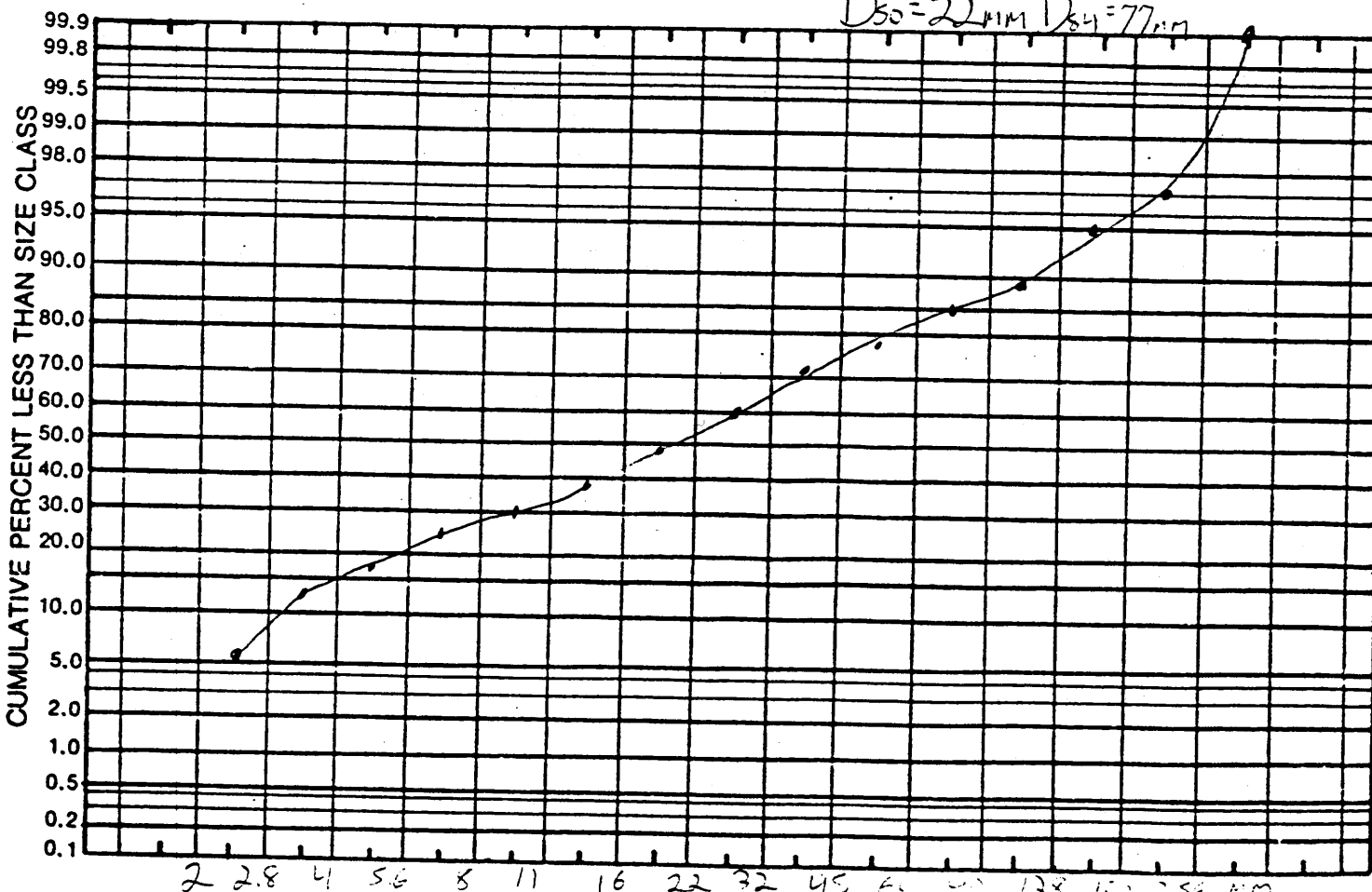


SAMPLE

SEGMENT 5 SUBSURFACE

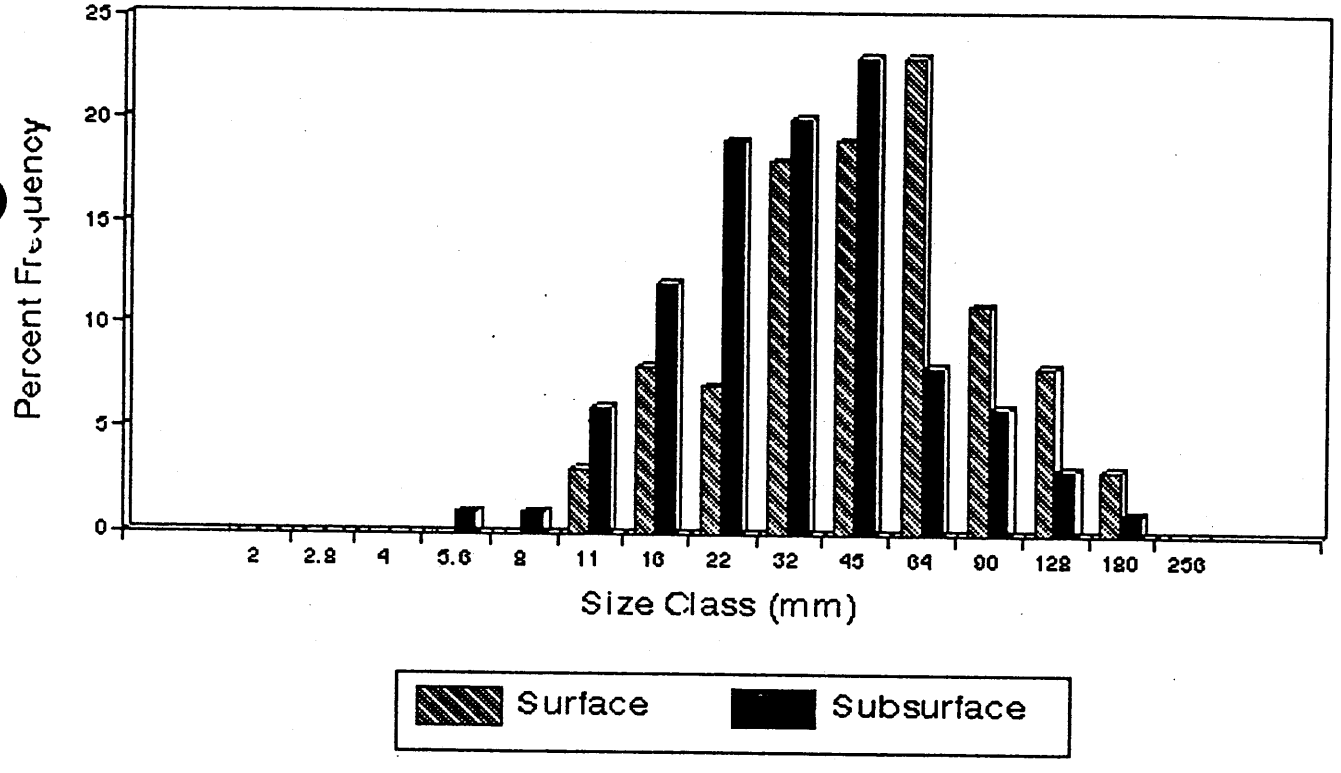


D_{50}=22mm D_{84}=77mm



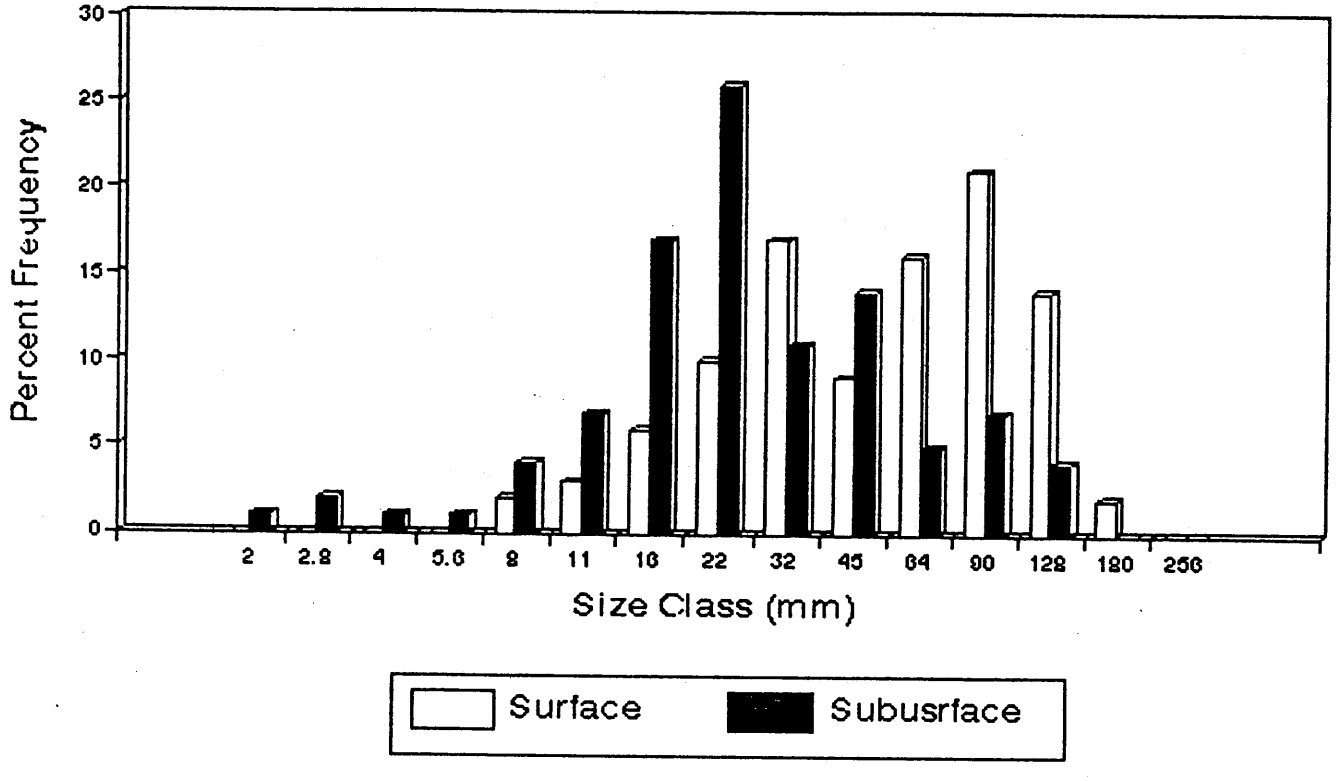
NORTH FORK TOLT RIVER

Segment 5 (MS - Surface v. Subsurface)



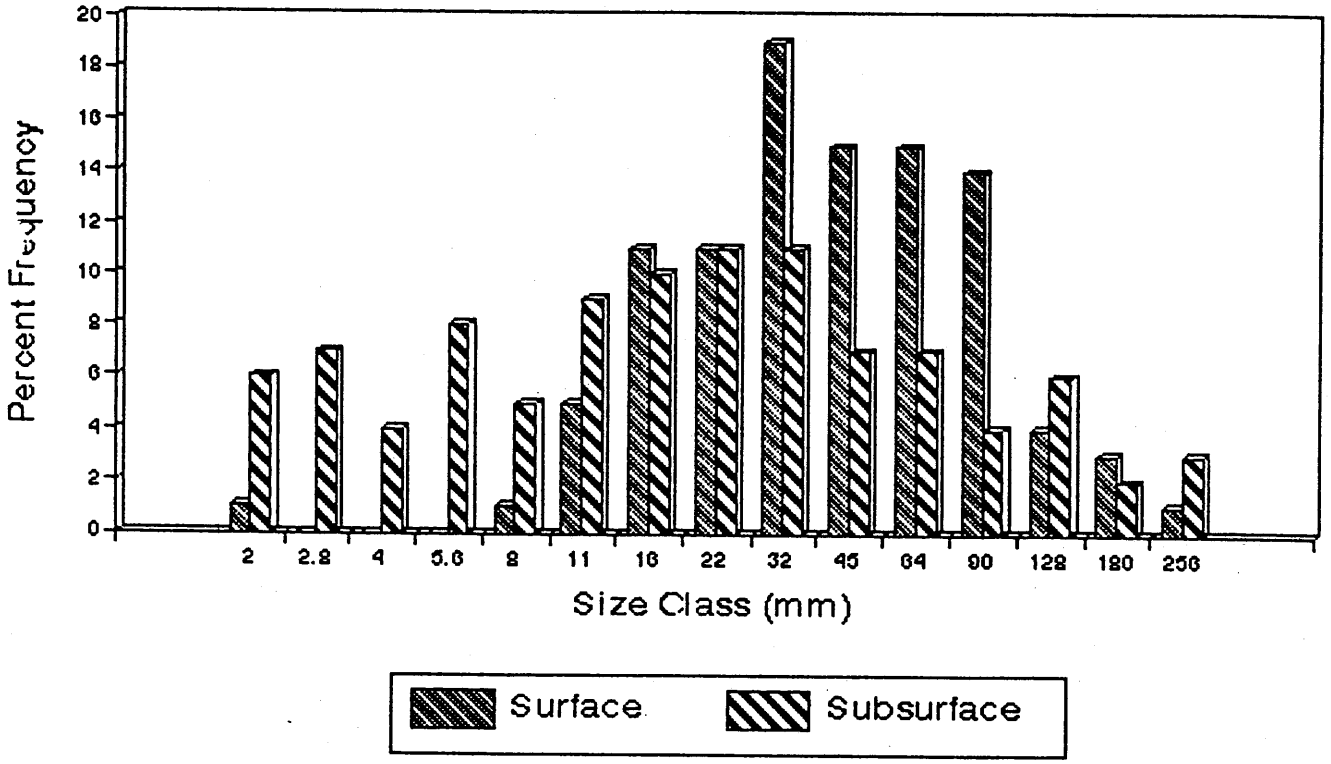
NORTH FORK TOLT RIVER

Segment 5 (MS bar-Surface v Subsurface)



NORTH FORK TOLT RIVER

Segment 5 (DS - Surface v. Subsurface)



SEGMENT 15 - NORTH FORK OF THE TOLT RIVER

Segment 15 - downstream near change in gradient
Surface aggregates, large amouuints of sand.
Braided large amounts of gravels and fines.

Surface

D50 (mm)	40
D84 (mm)	80

Size (mm)	Count	Cumulative percent less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	2	2%
11	3	5%
16	8	13%
22	17	30%
32	21	51%
45	19	70%
64	11	81%
90	11	92%
128	4	96%
180	1	97%
256	3	100%
Total	100	100%

d* = 3.64
q* = 0.14

Subsurface

D50 (mm)	11
D84 (mm)	23

Size (mm)	Count	Cumulative percent less than size class
2	7	7%
2.8	3	10%
4	9	19%
5.6	11	30%
8	17	47%
11	13	60%
16	13	73%
22	18	91%
32	6	97%
45	0	97%
64	1	98%
90	0	98%
128	1	99%
180	0	99%
256	1	100%
Total	100	100%

Segment 15 - North Fork Tolt

Upstream location

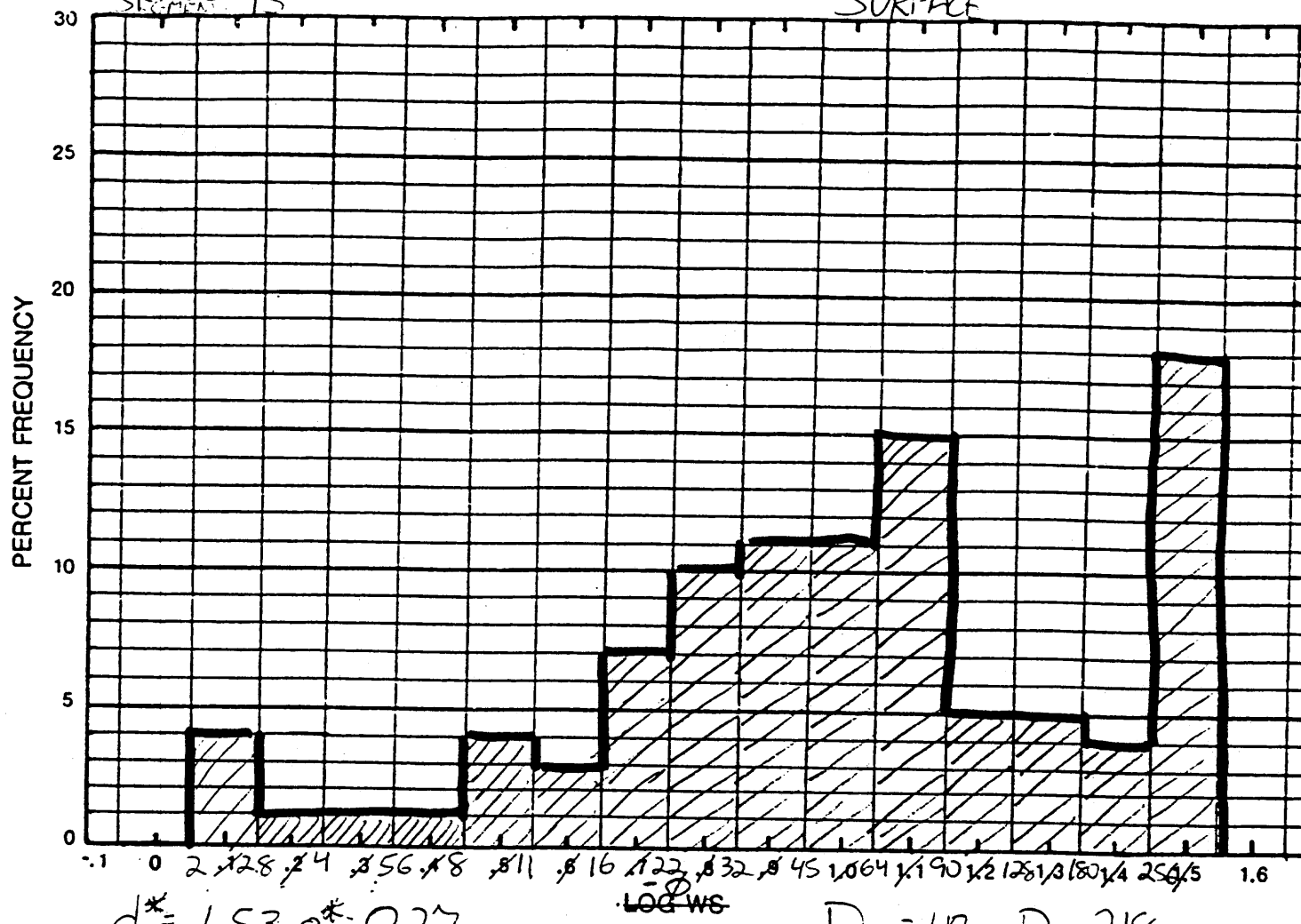
Surface			Subsurface		
D50 (mm)	45		D50 (mm)	28	
D84 (mm)	218		D84 (mm)	53	
Size (mm)	Count	Cumulative percent less than size class	Size (mm)	Count	Cumulative percent less than size class
2	4	4%	2	6	6%
2.8	1	5%	2.8	0	6%
4	1	6%	4	0	6%
5.6	1	7%	5.6	0	6%
8	4	11%	8	3	9%
11	3	14%	11	9	18%
16	7	21%	16	21	39%
22	10	31%	22	14	53%
32	11	42%	32	16	69%
45	11	53%	45	17	86%
64	15	68%	64	11	97%
90	5	73%	90	3	100%
128	5	78%	128		100%
180	4	82%	180		100%
256	18	100%	256		100%
Total	100	100%	Total	100	100%

d* = 1.53

q* = 0.27

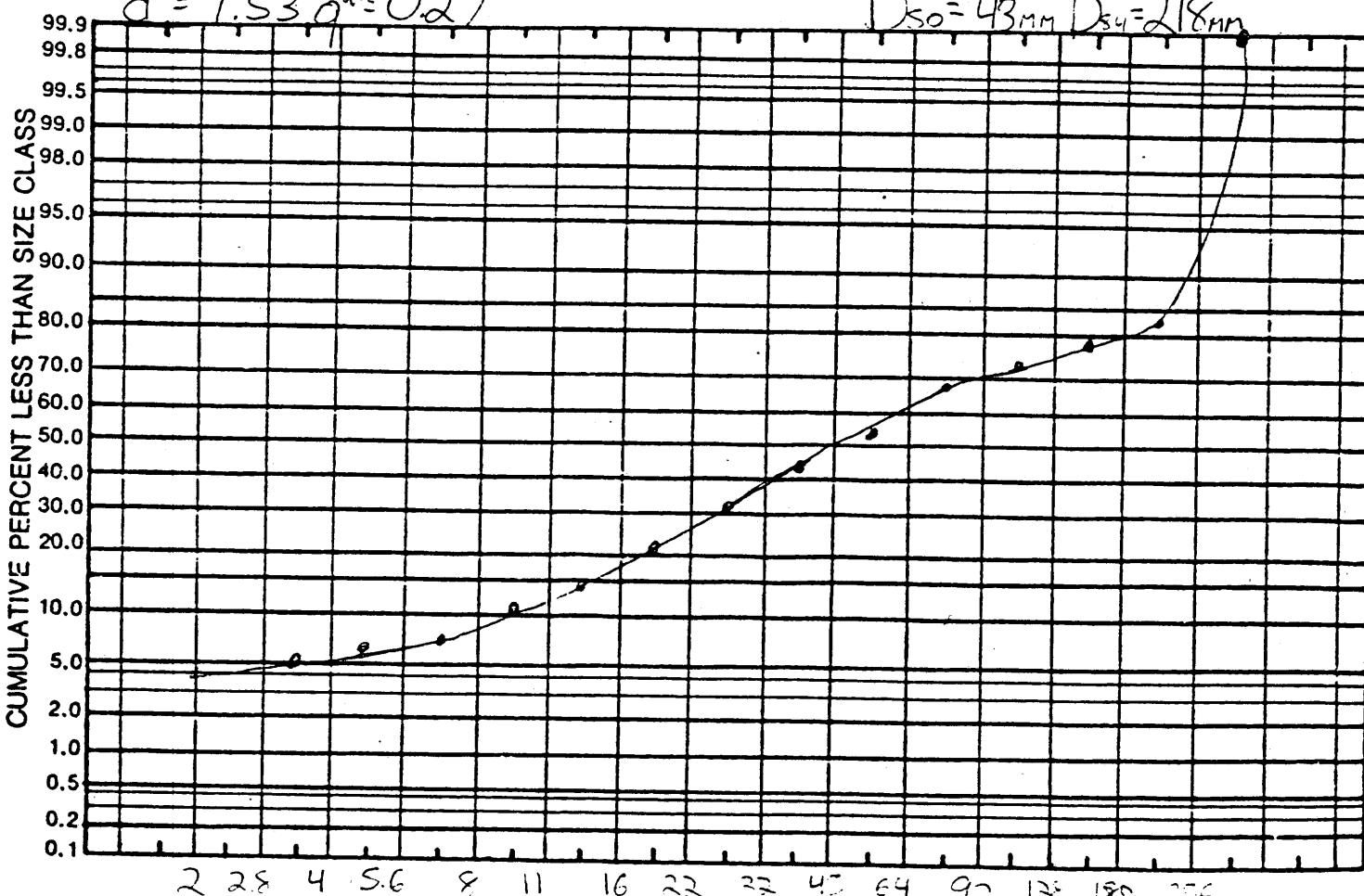
SAMPLE

SEGMENT 15 SURFACE



$d^* = 1.53$ $\sigma^* = 0.27$

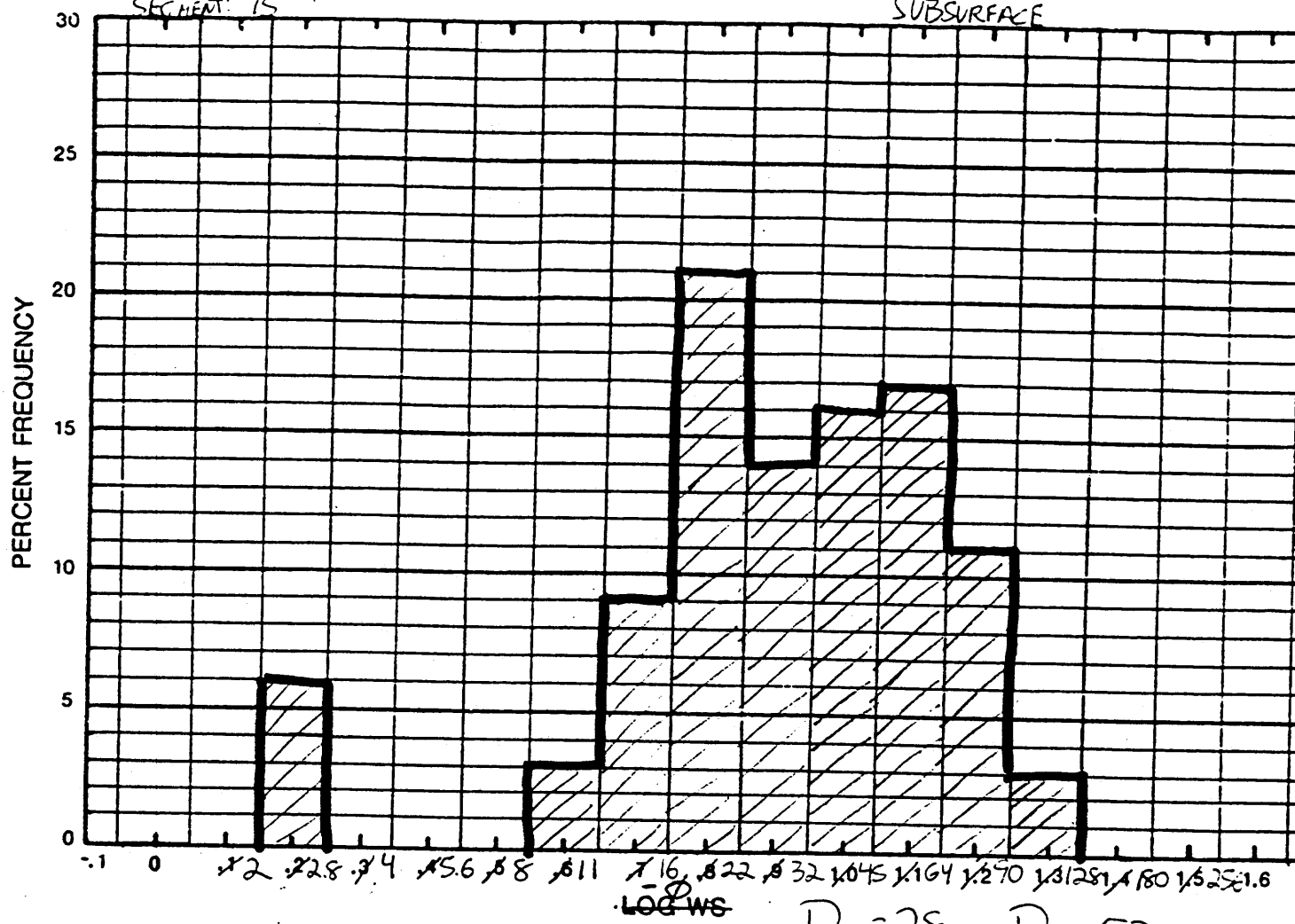
$D_{50} = 43mm$ $D_{84} = 218mm$



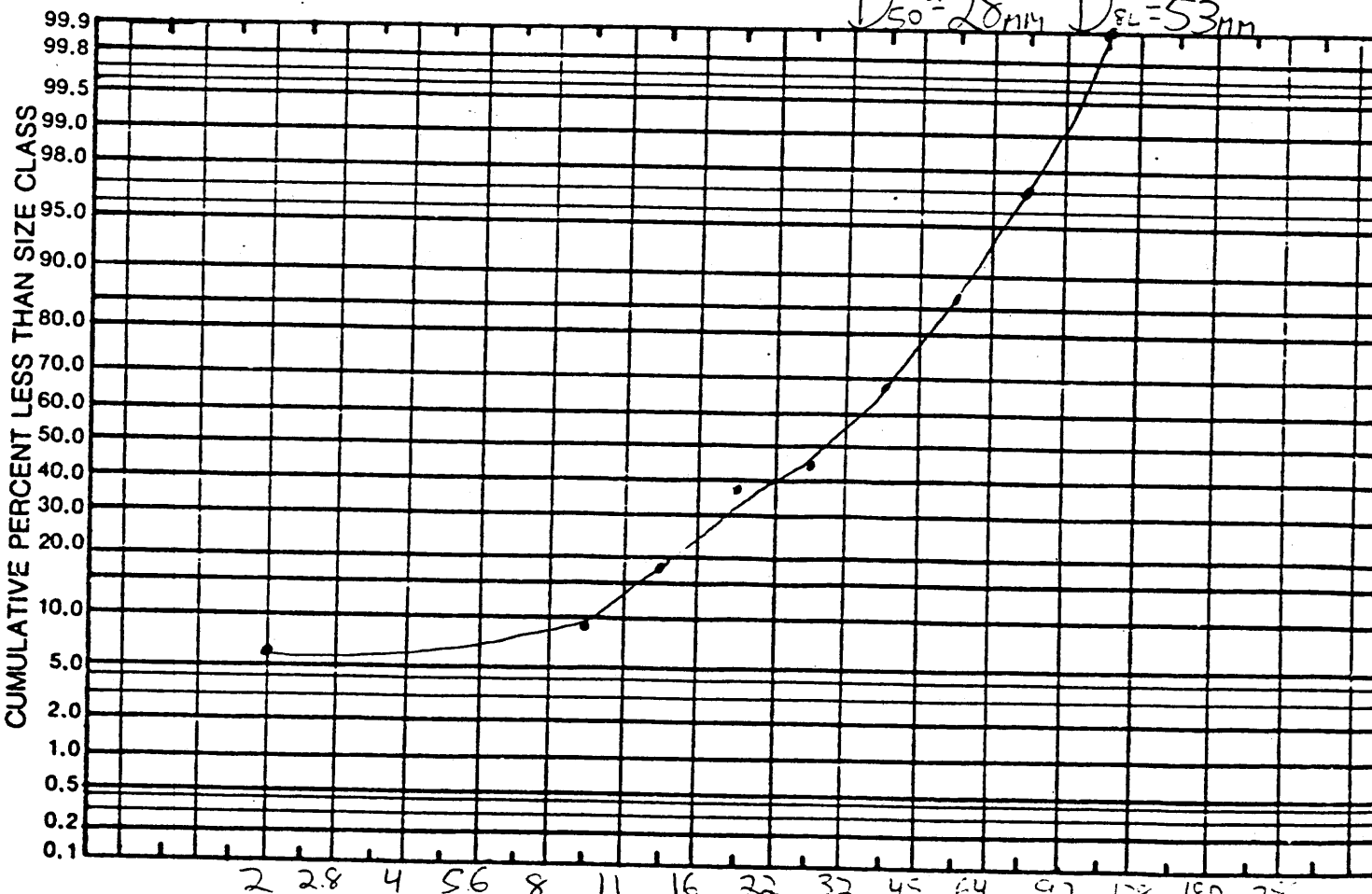
STREAM SEGMENT: IS

SAMPLE

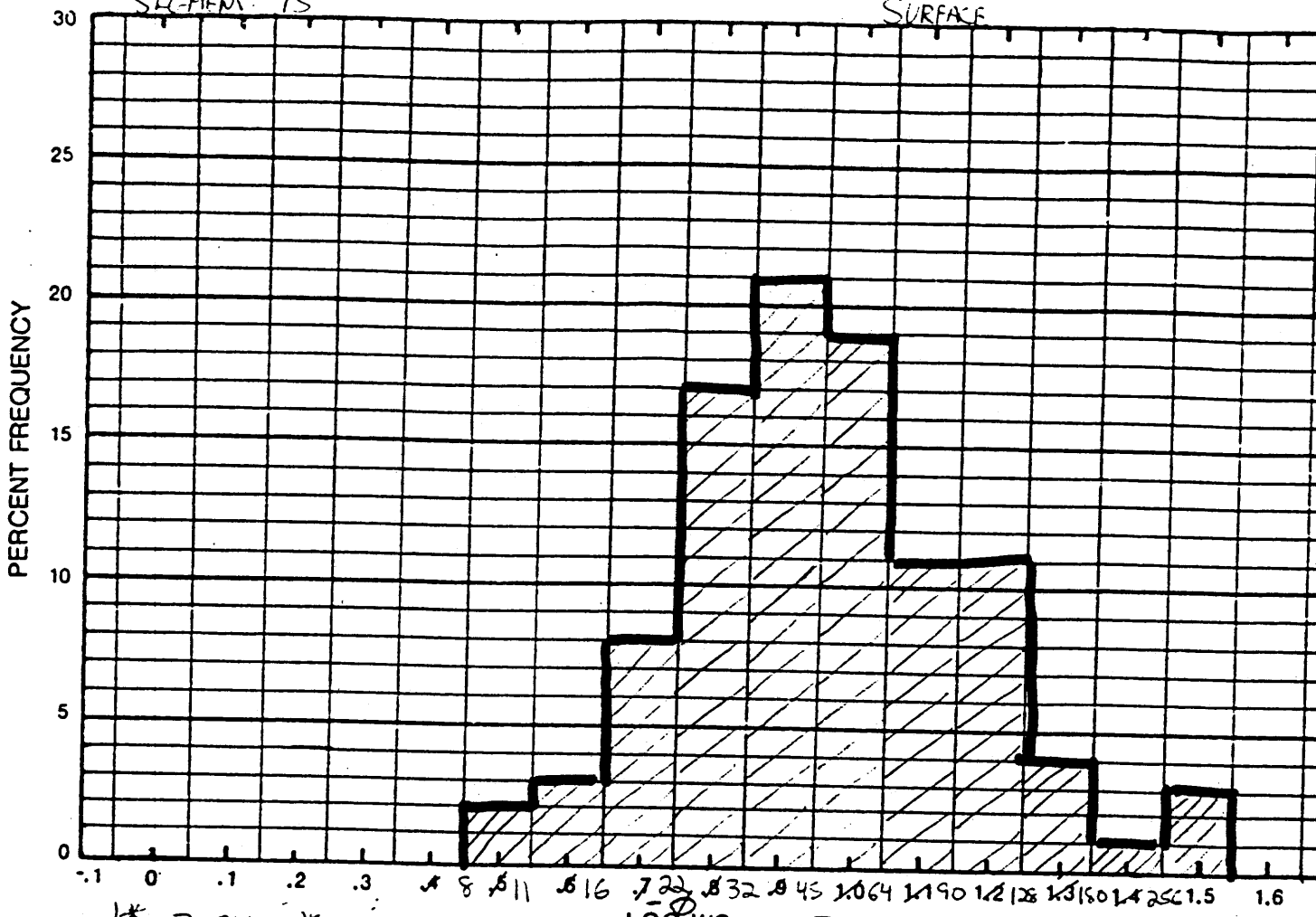
SUBSURFACE



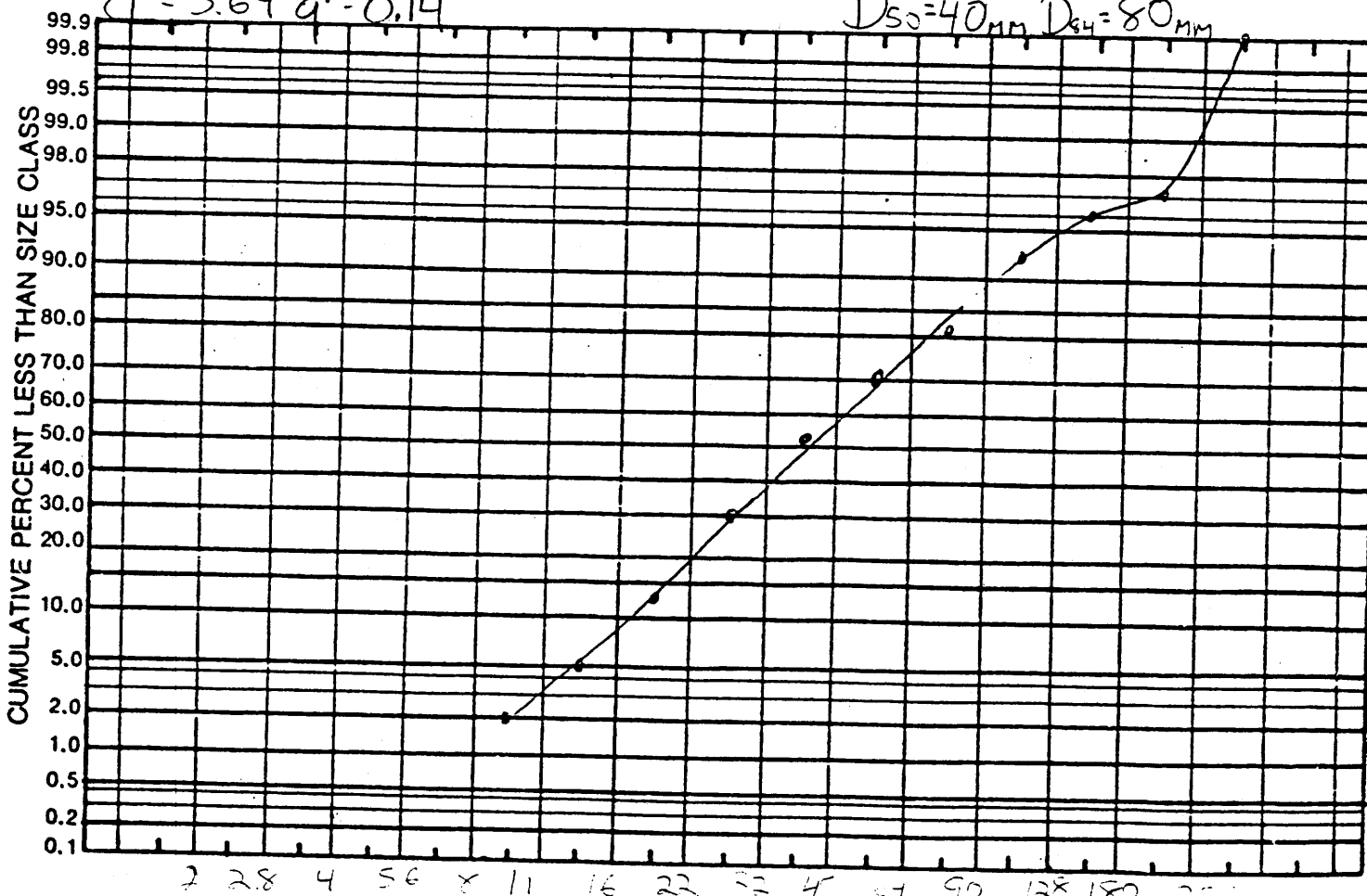
D_{50}=28mm D_{84}=53mm



SEGMENT 15 SURFACE SAMPLE

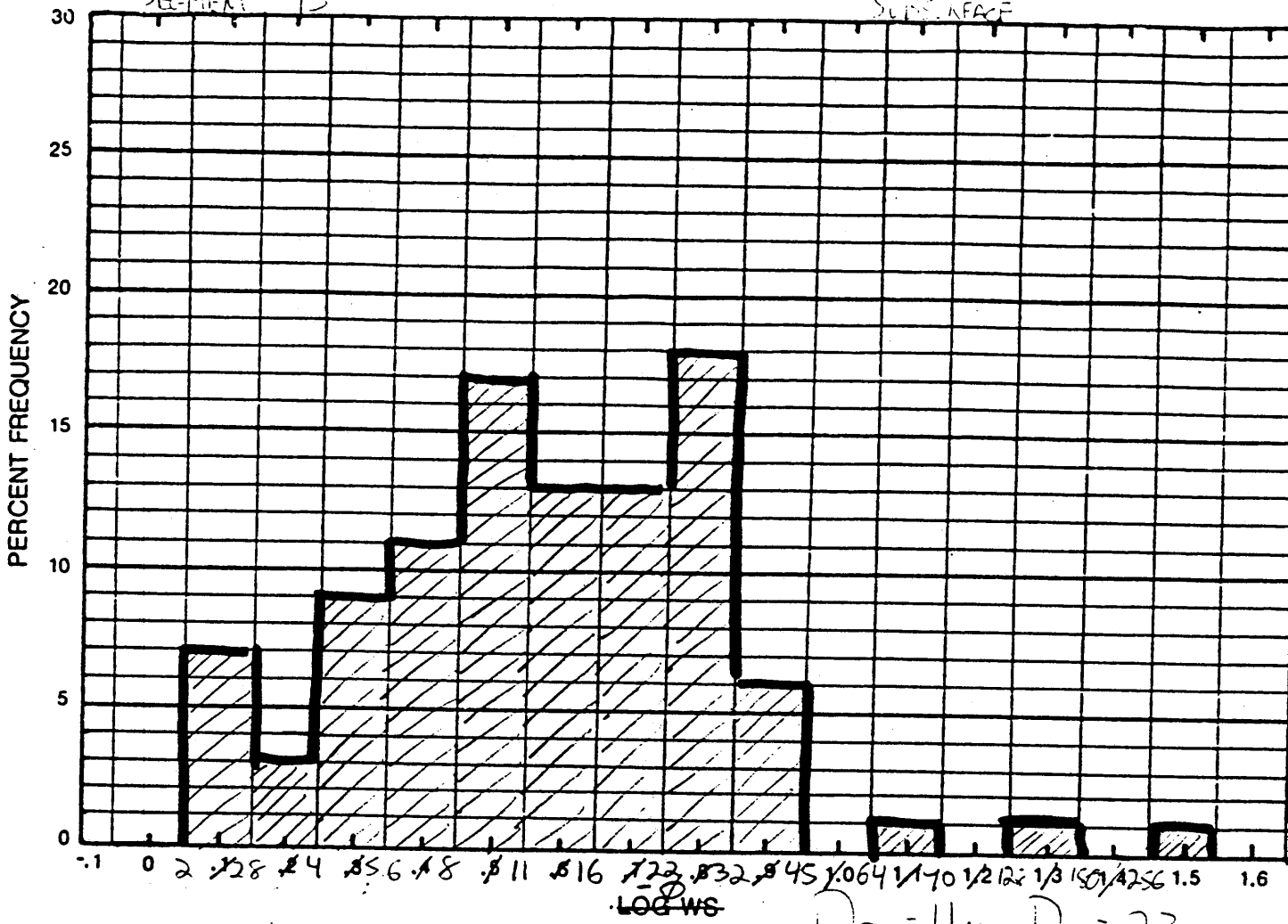


$\sigma^* = 3.64$ $\sigma^* = 0.14$ $D_{50} = 40$ mm $D_{84} = 80$ mm

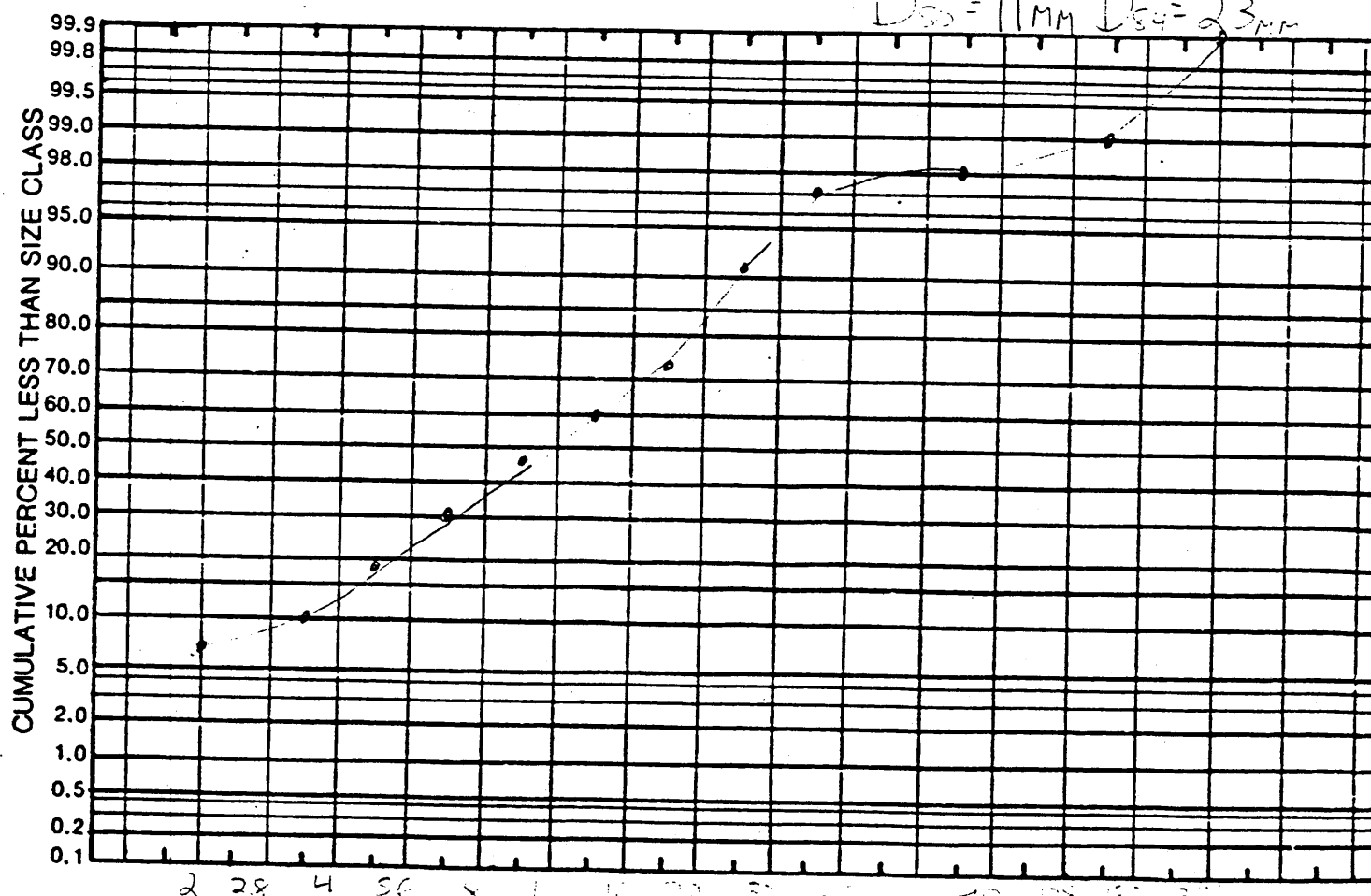


SAMPLE

SEGMENT 15 SURFACE

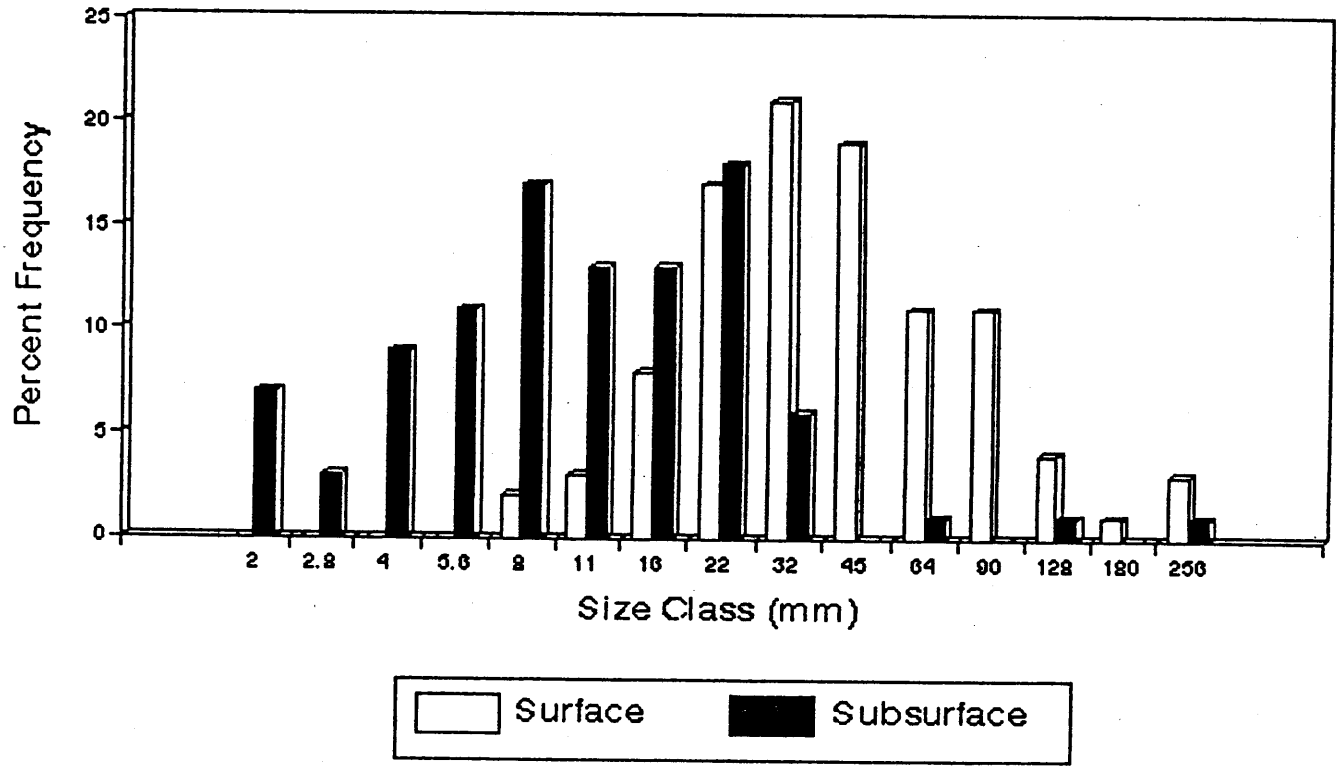


$D_{50} = 11$ MM $D_{84} = 23$ MM



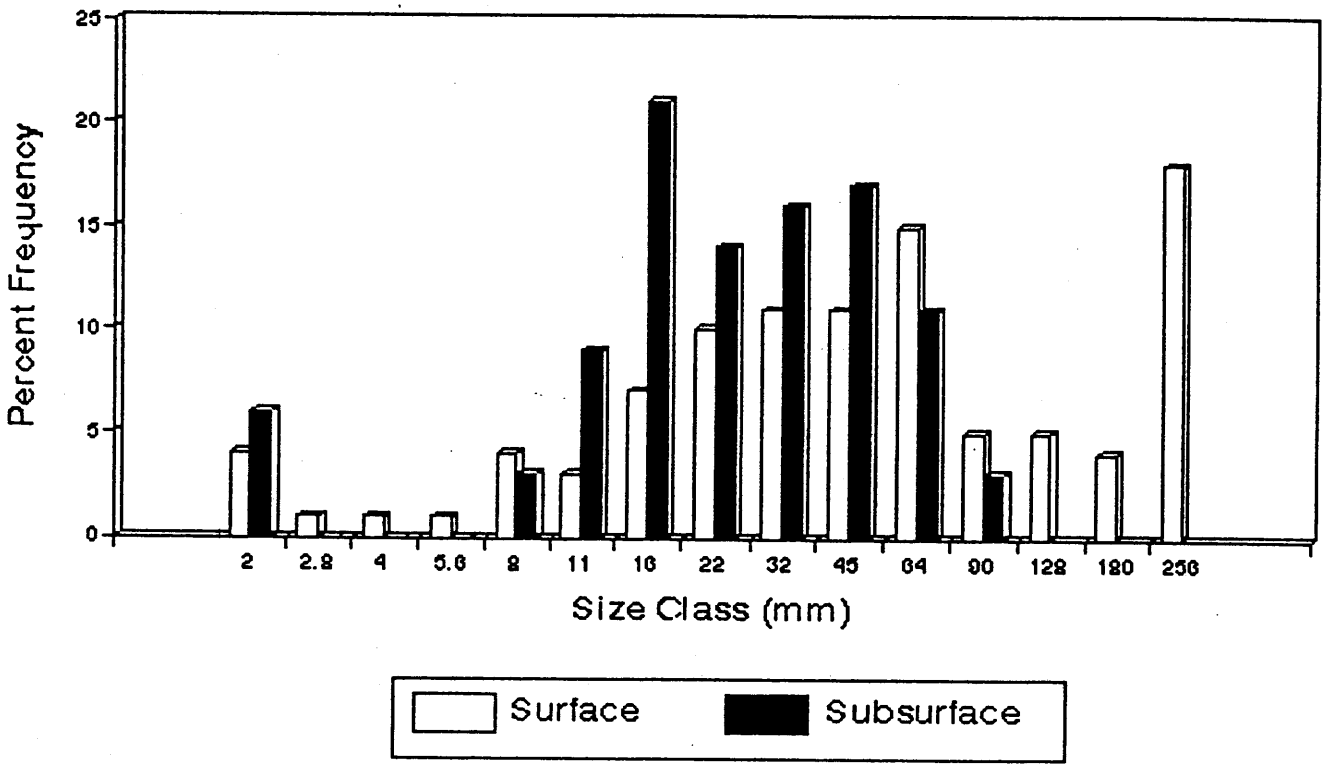
NORTH FORK TOLT RIVER

Segment 15 (DS - Surface v. Subsurface)



NORTH FORK TOLT RIVER

Segment 15 (US - Surface v. Subsurface)



SEGMENT 63 - DRY CREEK, TRIB OF NORTH FORK TOLT

Segment 63 - downstream of culvert, upstream of debris dam
Right bank, mid-bar, near water level
Less transport capacity due to blaockage from North Fork

Surface			Subsurface		
D50 (mm)	20		D50 (mm)	15	
D84 (mm)	38		D84 (mm)	24	
Size (mm)	Count	Cumulative percent less than size class	Size (mm)	Count	Cumulative percent less than size class
2	0	0%	2	0	0%
2.8	3	3%	2.8	1	1%
4	1	4%	4	2	3%
5.6	2	6%	5.6	2	5%
8	6	12%	8	13	18%
11	6	18%	11	26	44%
16	24	42%	16	21	65%
22	32	74%	22	24	89%
32	9	83%	32	7	96%
45	9	92%	45	4	100%
64	6	98%	64	0	100%
90	2	100%	90	0	100%
128	0	100%	128	0	100%
180	0	100%	180	0	100%
256	0	100%	256	0	100%
Total	100	100%	Total	100	100%

$d^* = 1.33$

$q^* = 0.36$

Segment 63 - Dry Creek

Just below culvert, bar along left bank, mid-bar, near water

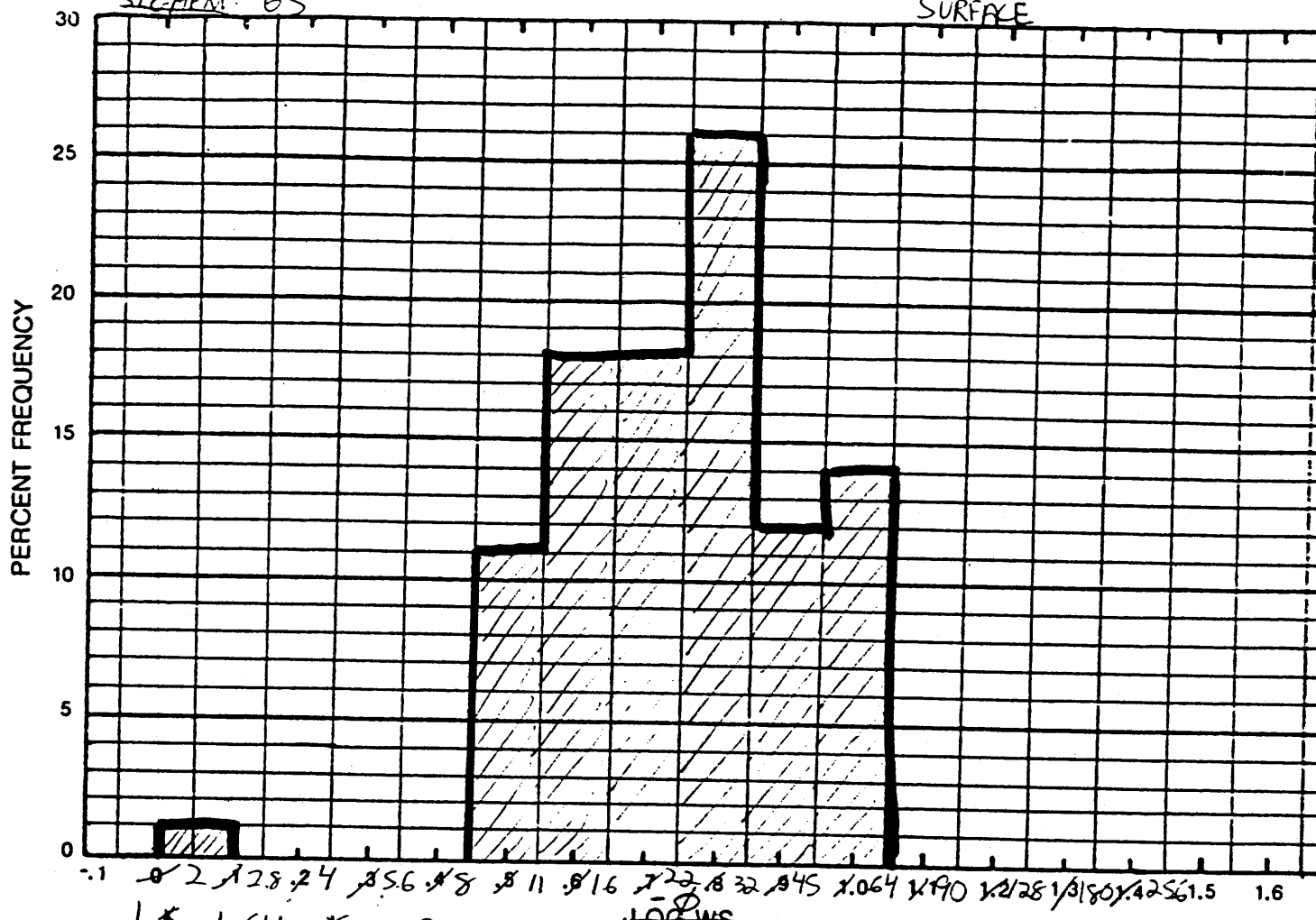
Surface			Subsurface		
D50 (mm)	23		D50 (mm)	14	
D84 (mm)	34		D84 (mm)	23	
Size (mm)	Count	Cumulative percent less than size class	Size (mm)	Count	Cumulative percent less than size class
2	1	1%	2	0	0%
2.8	0	1%	2.8	1	1%
4	0	1%	4	1	2%
5.6	0	1%	5.6	3	5%
8	11	12%	8	7	12%
11	18	30%	11	35	47%
16	18	48%	16	17	64%
22	26	74%	22	23	87%
32	12	86%	32	9	96%
45	14	100%	45	4	100%
64	0	100%	64	0	100%
90	0	100%	90	0	100%
128	0	100%	128	0	100%
180	0	100%	180	0	100%
256	0	100%	256	0	100%
Total	100	100%	Total	100	100%

d* = 1.64

q* = 0.24

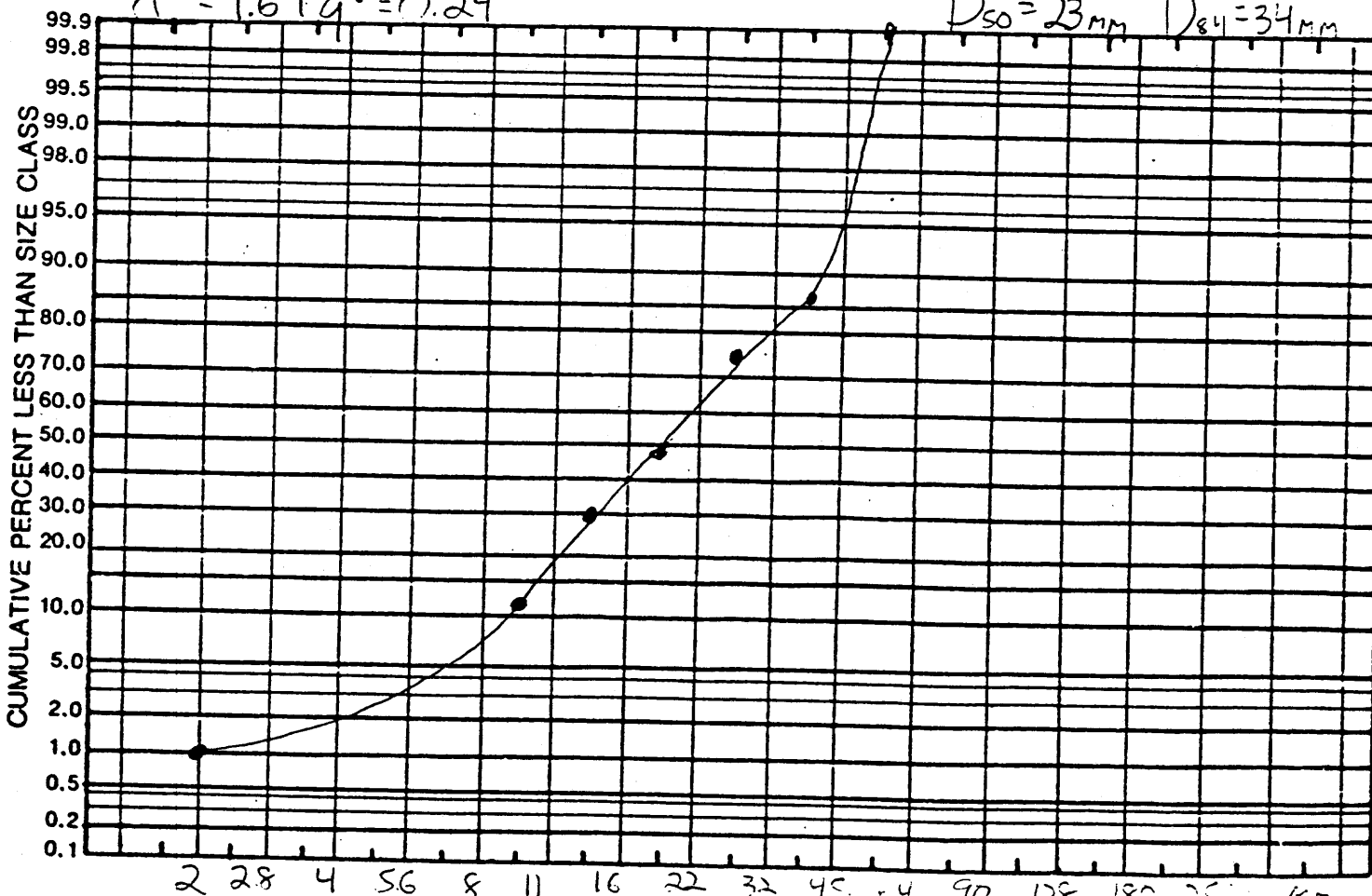
SEGMENT: 63

SURFACE SAMPLE



$d^* = 1.64$ $a^* = 0.24$

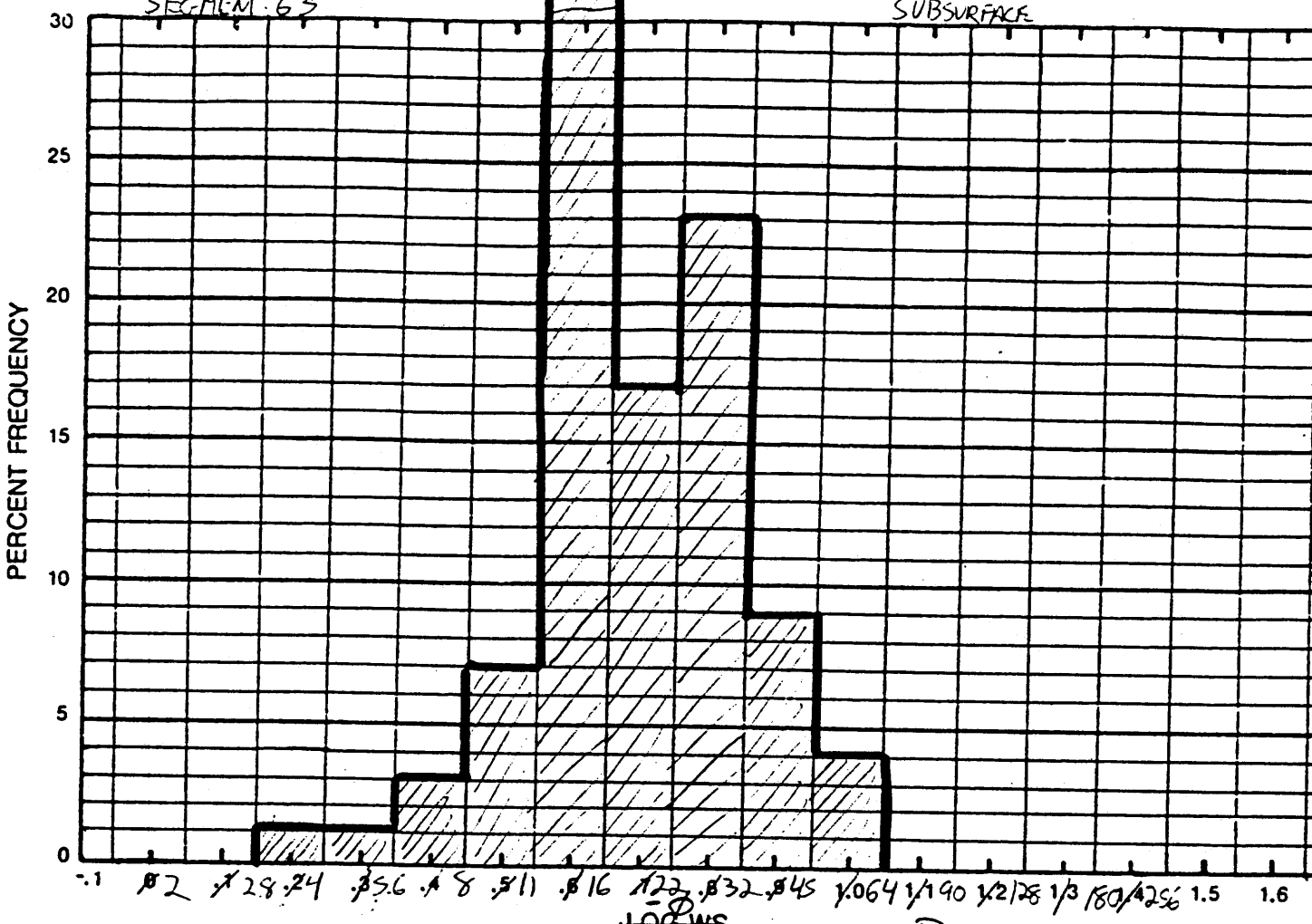
$D_{50} = 23$ mm $D_{84} = 34$ mm



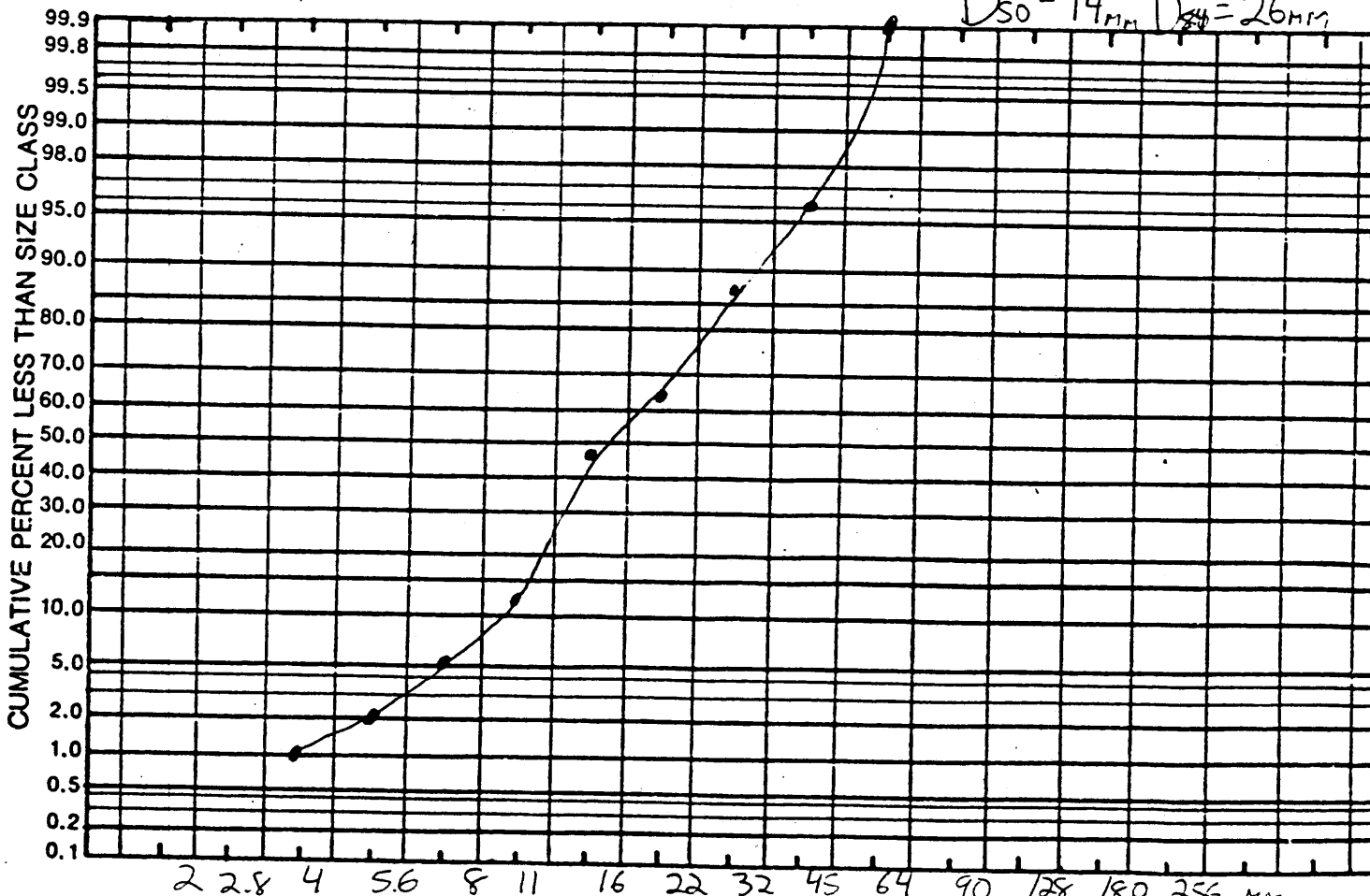
SEGMENT: 63

SAMPLE

SUBSURFACE

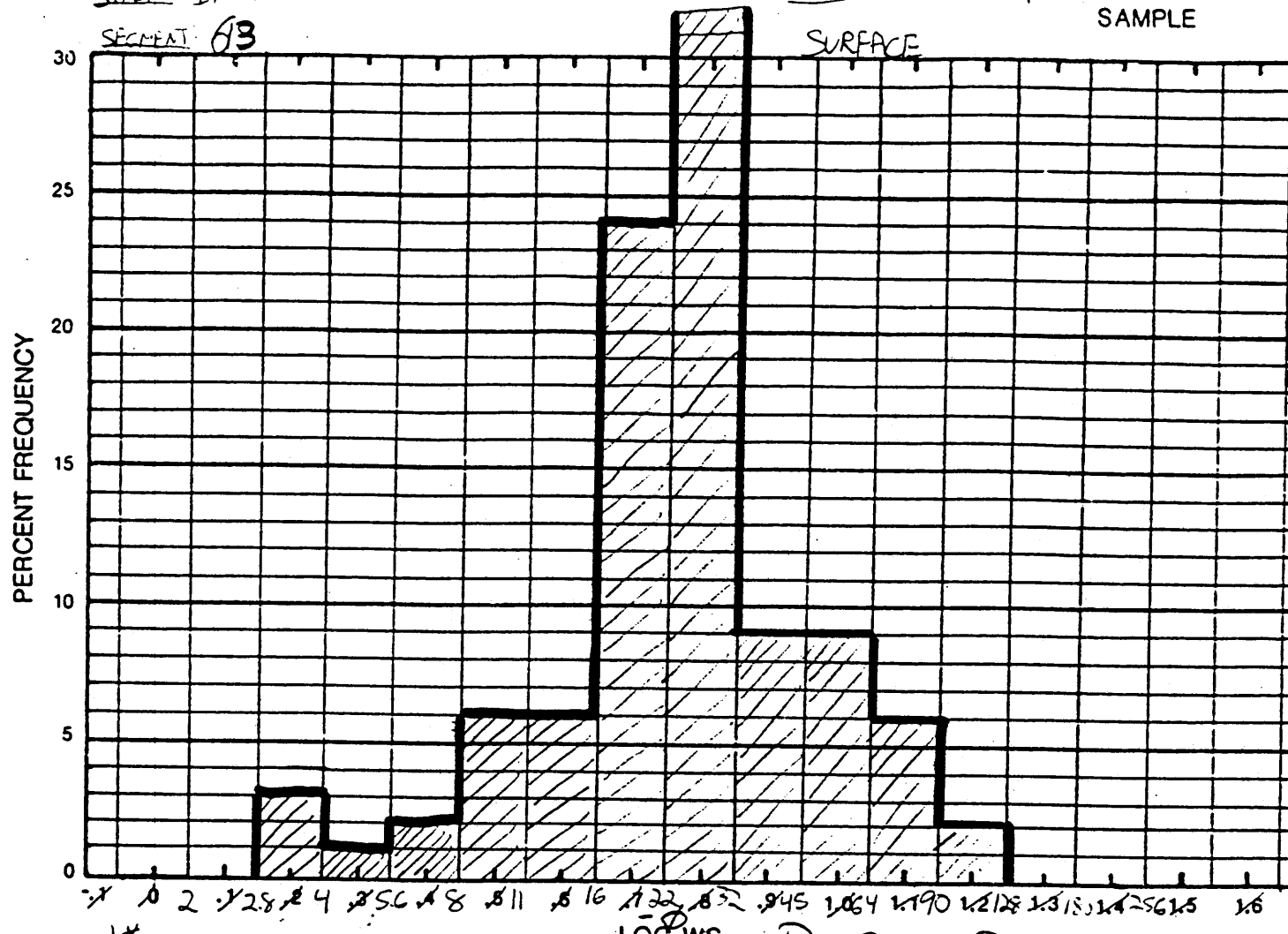


$D_{50} = 14_{mm}$ $D_{84} = 26_{mm}$

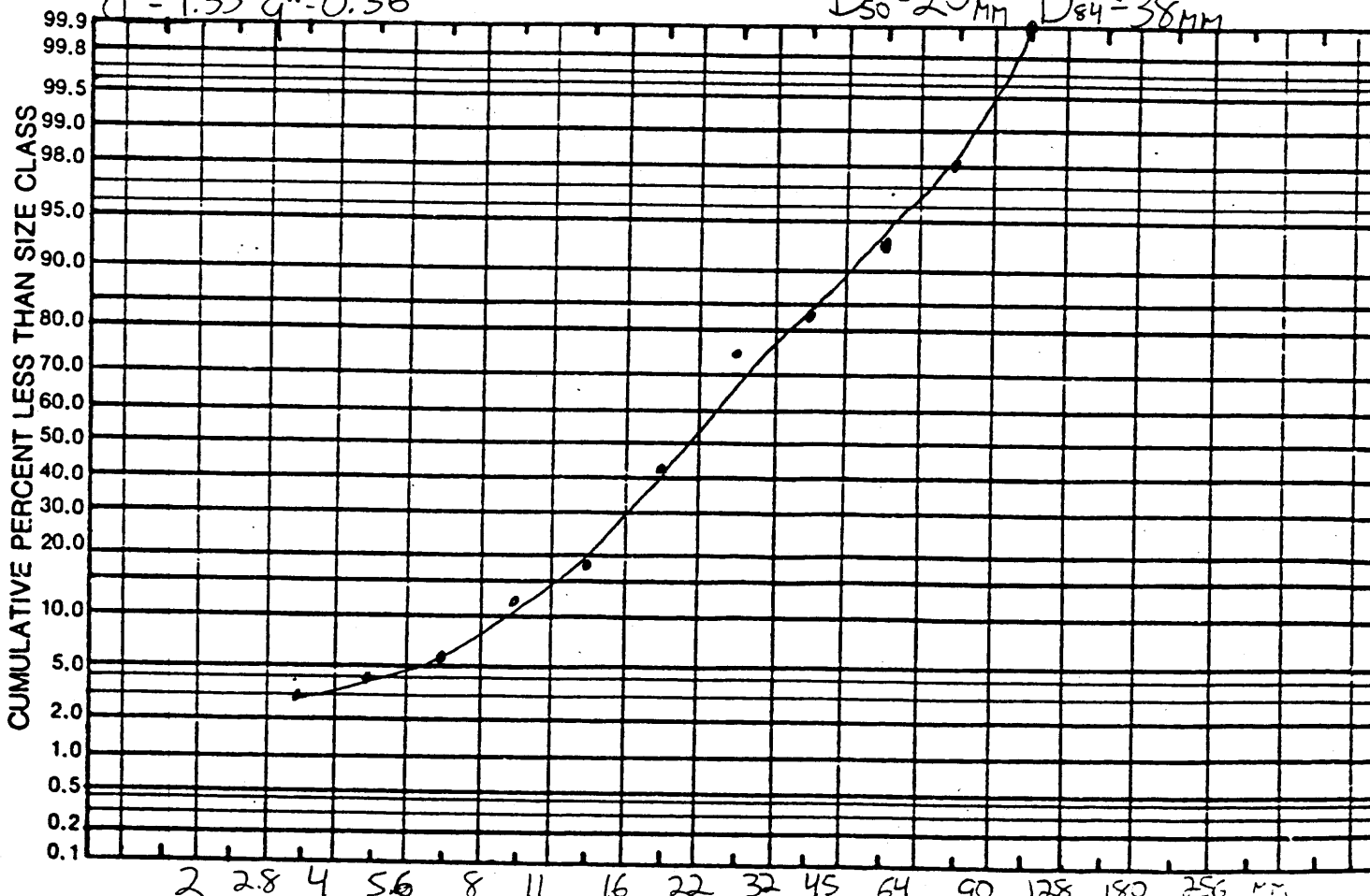


SAMPLE

SEGMENT 63 SURFACE



$d^* = 1.33$ $\sigma^* = 0.36$ $D_{50} = 20$ MM $D_{84} = 38$ MM

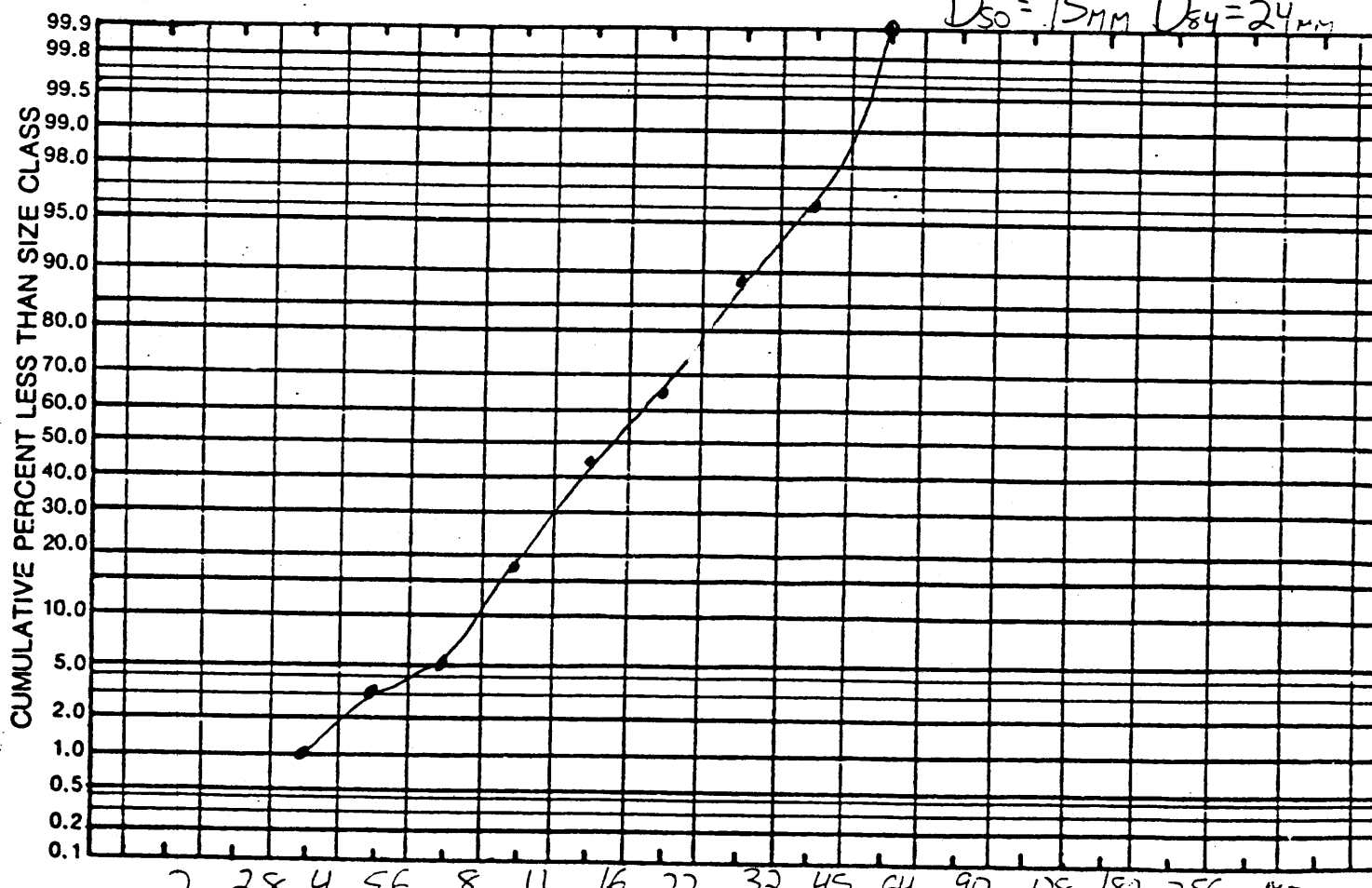


SEGMENT 63

SUBSURFACE

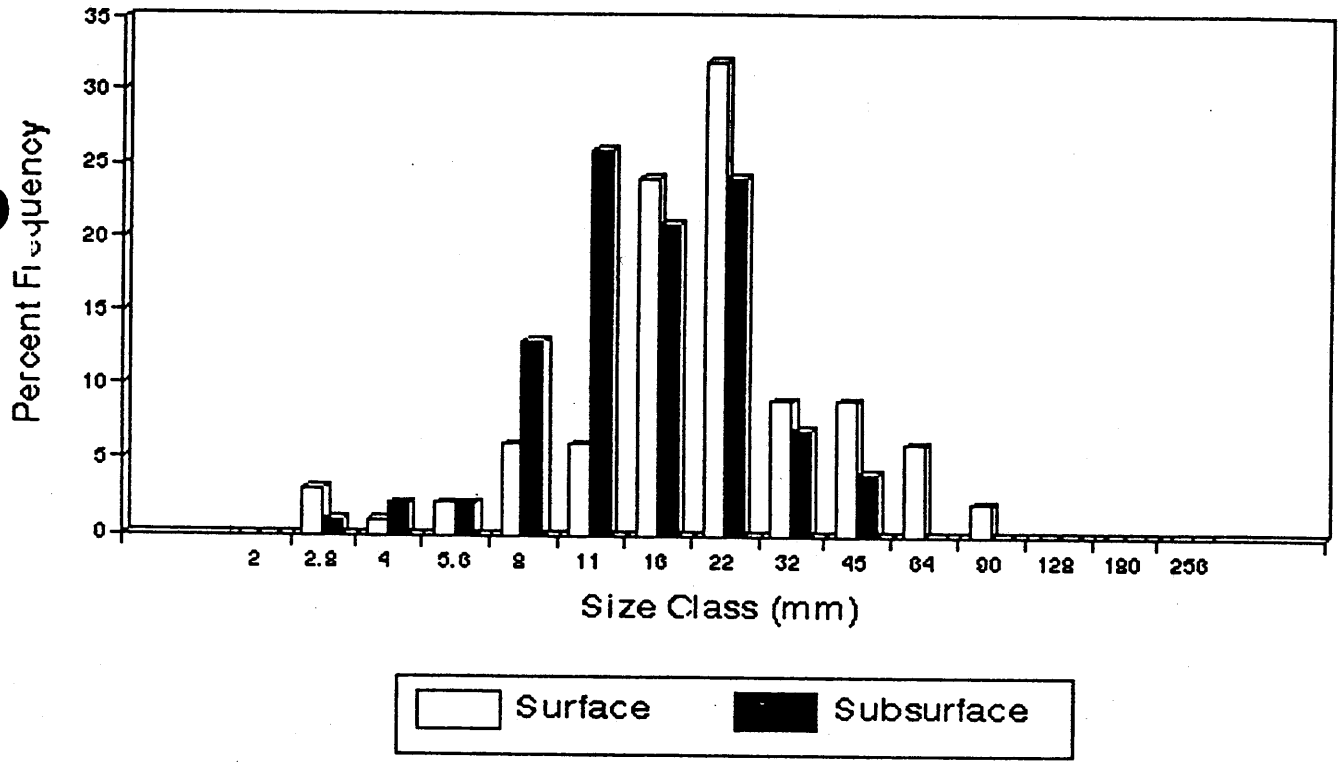
SAMPLE

$D_{50} = .15$ MM $D_{84} = 24$ MM



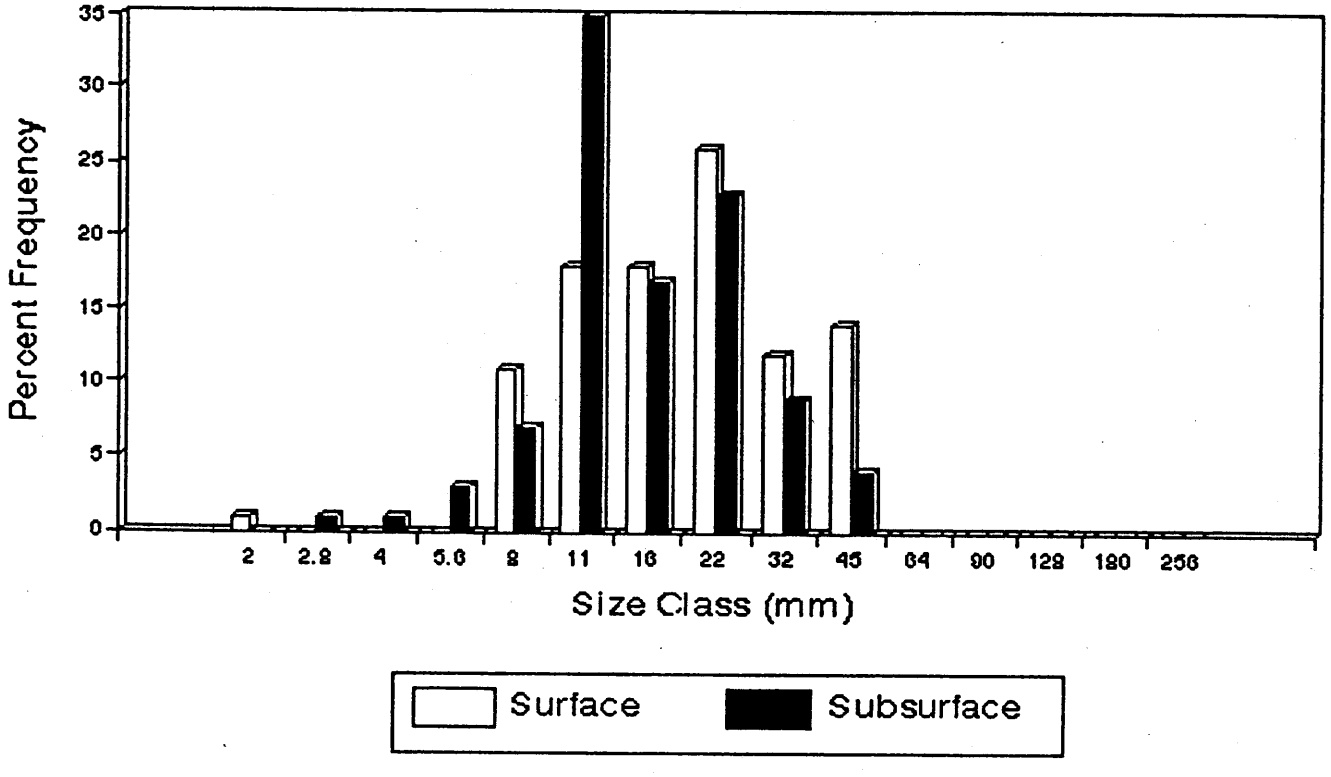
DRY CREEK, TRIB OF NORTH FORK TOLT

Segment 63 (DS - surface v. Subsurface)



DRY CREEK, TRIB OF NORTH FORK TOLT

Segment 63(Culvert-Surface/Subsurface)



Segment 64 - DRY CREEK, UPSTREAM OF CULVERT TO CONLFUENCE WITH NORTH FORK

Segment 64 - Farthest pebble count downstream in segment.
Upstream of culvert, below bank cut. Mid-bar, towards water.
Alot of coarse sediment moving through segment

Surface

D50 (mm) 27
D84 (mm) 44

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	1	1%
5.6	0	1%
8	1	2%
11	7	9%
16	15	24%
22	31	55%
32	20	75%
45	17	92%
64	7	99%
90	1	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 1.42
q* = 0.31

Subsurface

D50 (mm) 19
D84 (mm) 33

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	1	1%
5.6	1	2%
8	9	11%
11	20	31%
16	19	50%
22	23	73%
32	17	90%
45	10	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 64 - Upstream, bar on right bank above lake deposit

Surface

D50 (mm) 27

D84 (mm) 47

Size (cm)	Count	Cumulative % less than size class
2	1	1%
2.8	0	1%
4	0	1%
5.6	0	1%
8	3	4%
11	7	11%
16	11	22%
22	35	57%
32	17	74%
45	15	89%
64	11	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 1.5

q* = 0.28

Subsurface

D50 (mm)= 15

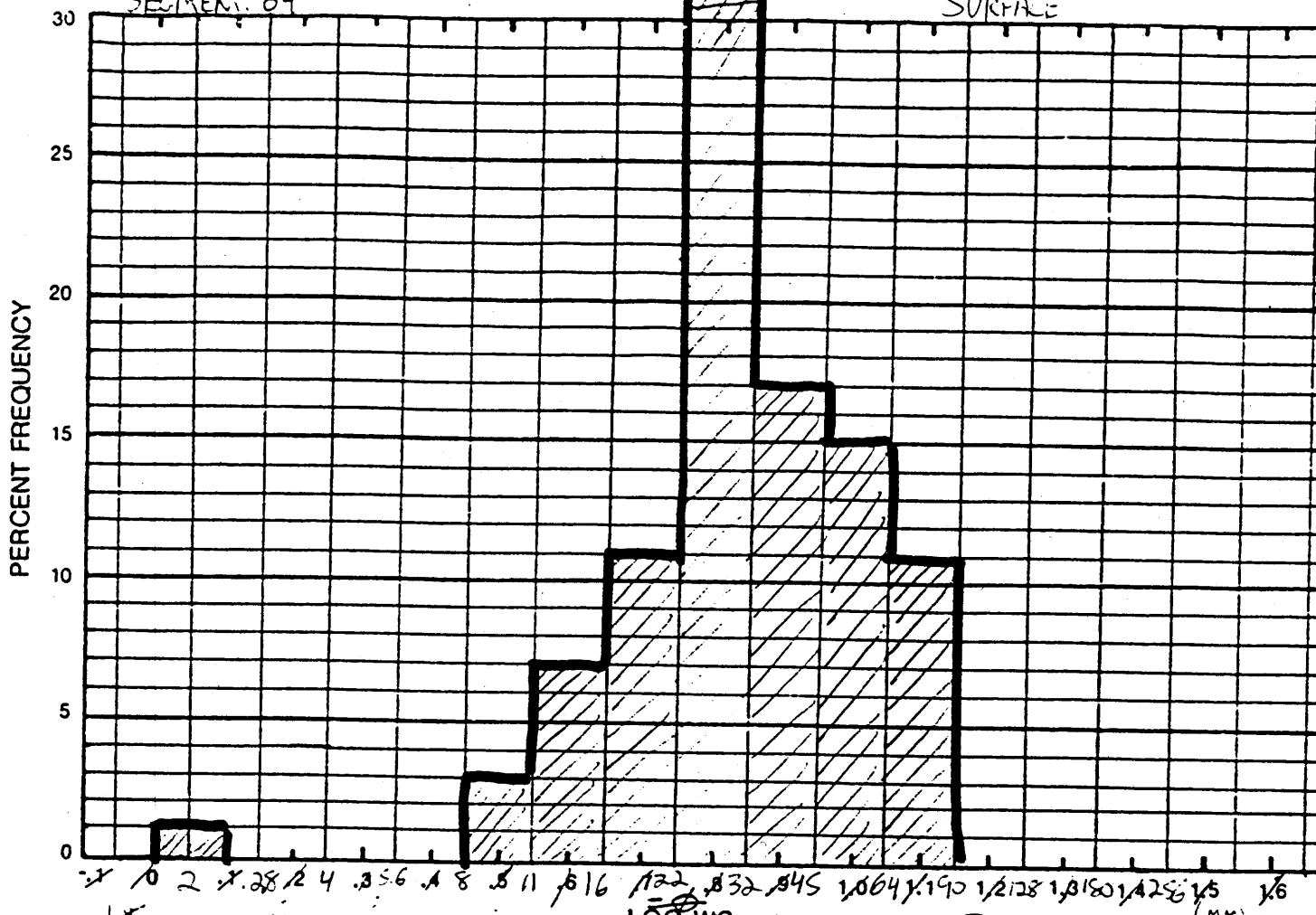
D84 (mm)= 32

Size (cm)	Count	Cumulative % less than size class
2	1	1%
2.8	0	1%
4	0	1%
5.6	1	2%
8	9	11%
11	21	32%
16	21	53%
22	24	77%
32	7	84%
45	16	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

SEGMENT: 64

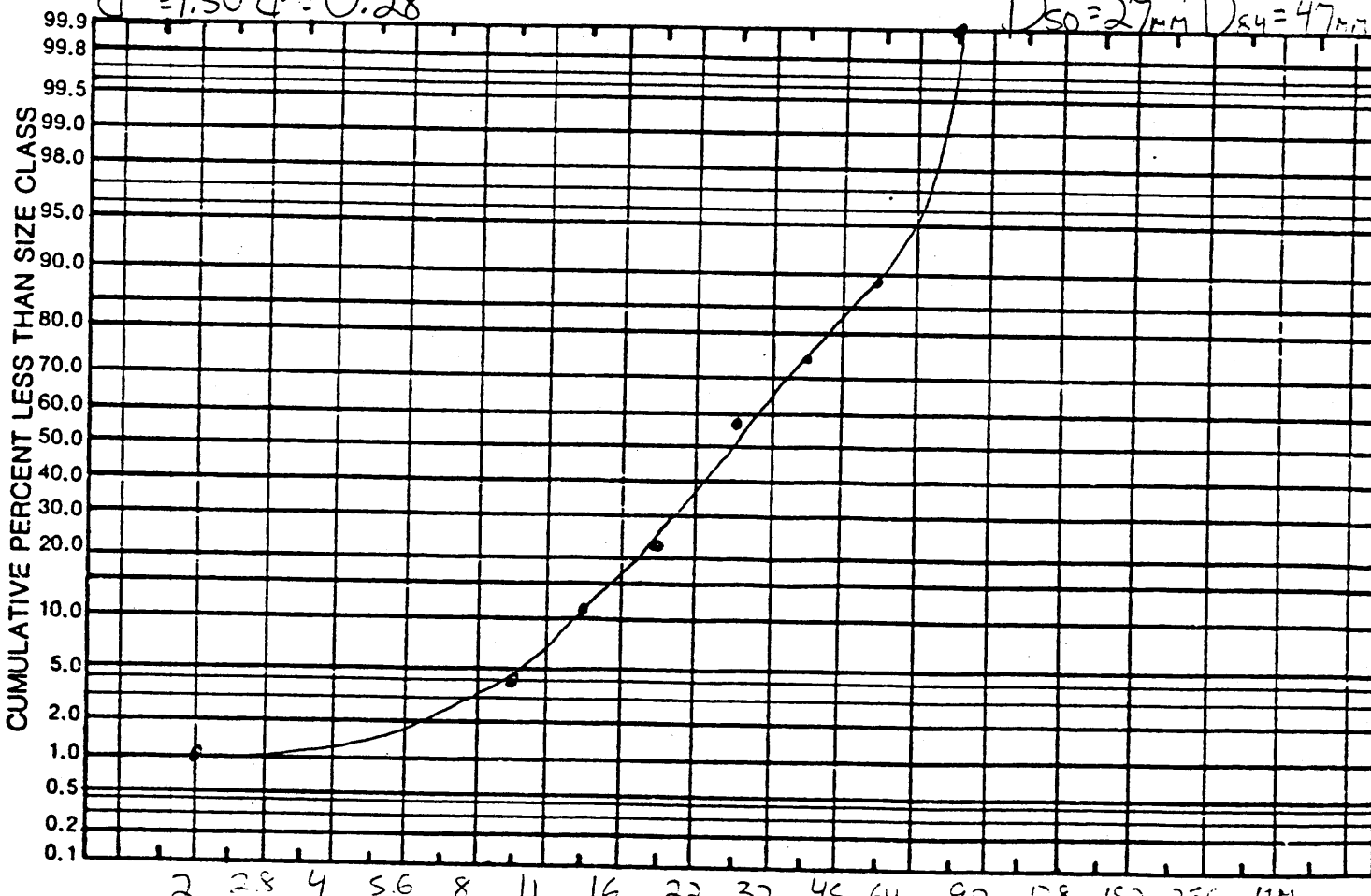
SAMPLE

SURFACE



$d^* = 1.50$ $\sigma^* = 0.28$

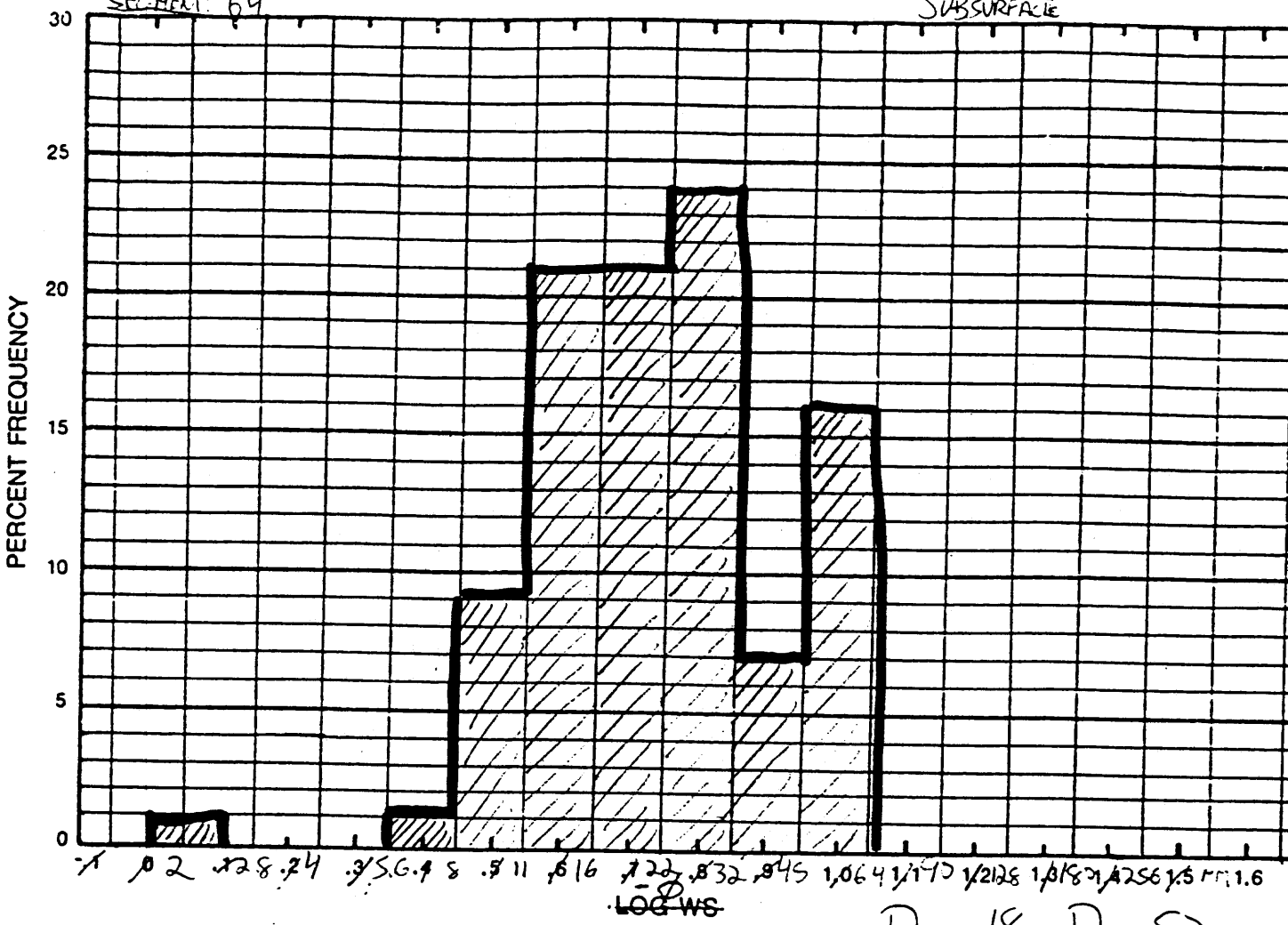
$D_{50} = 27$ mm $D_{84} = 47$ mm



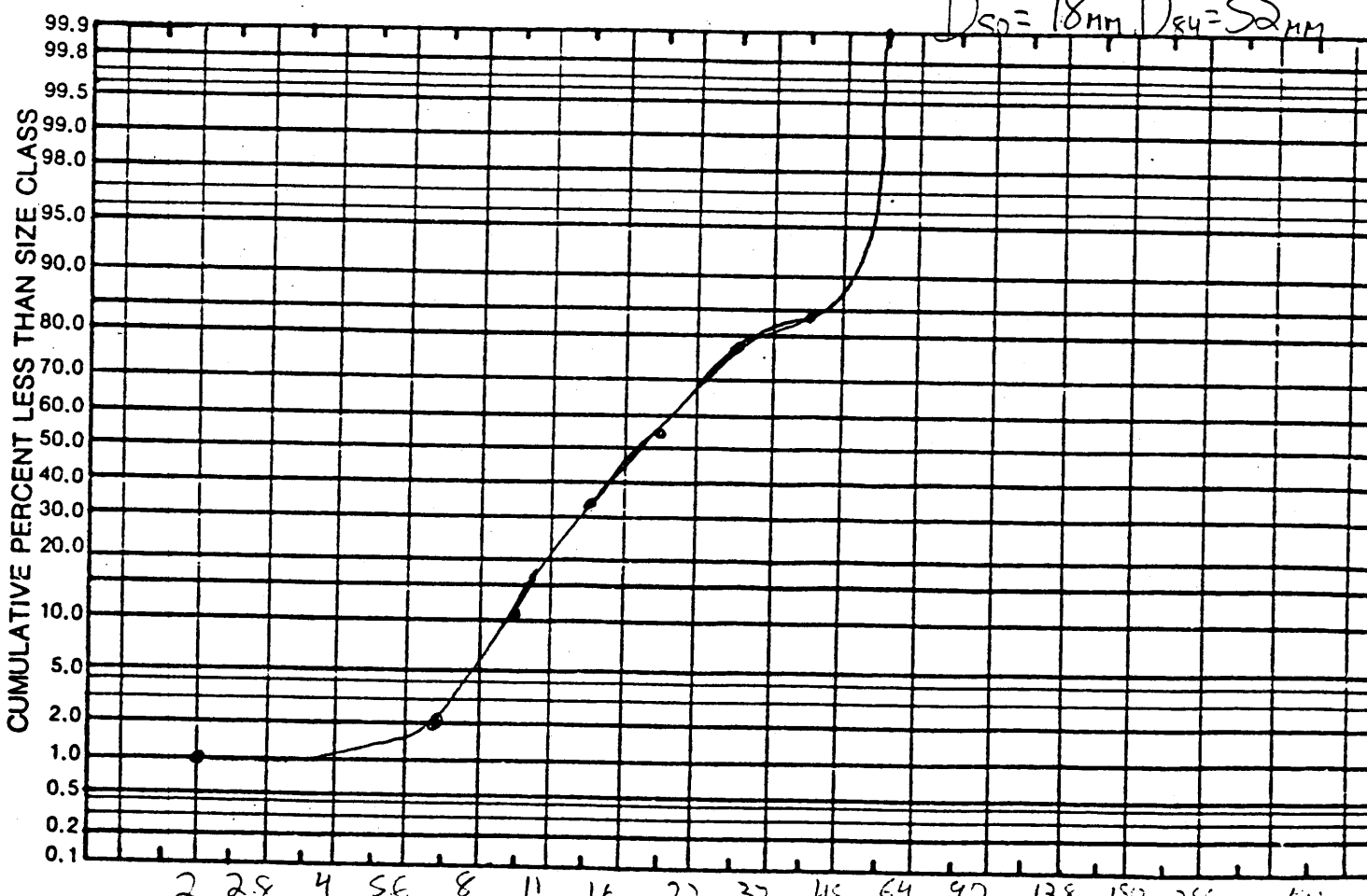
SAMPLE

SEGMENT: 64

SUBSURFACE



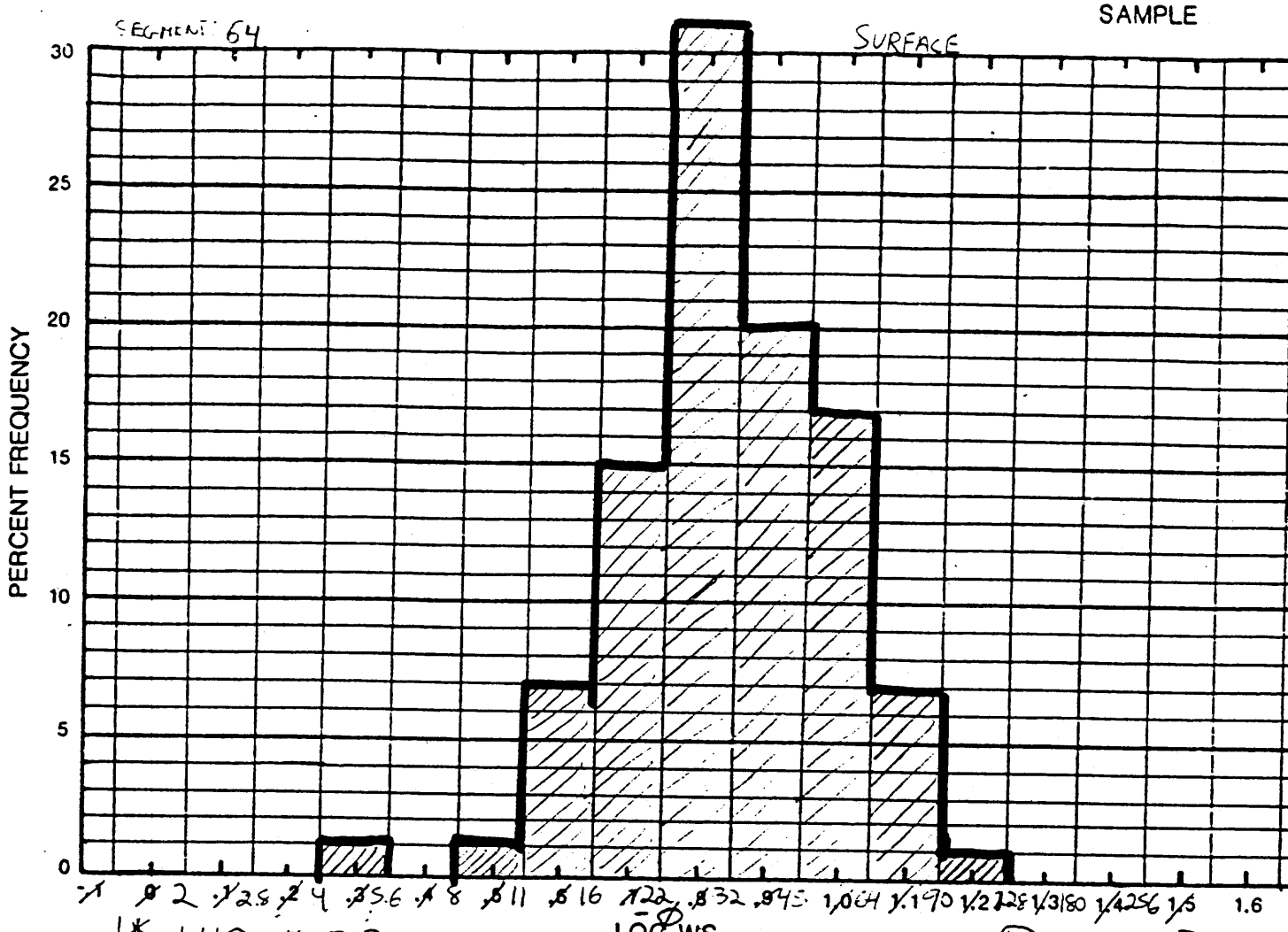
$D_{50} = 18mm$ $D_{84} = 52mm$



SAMPLE

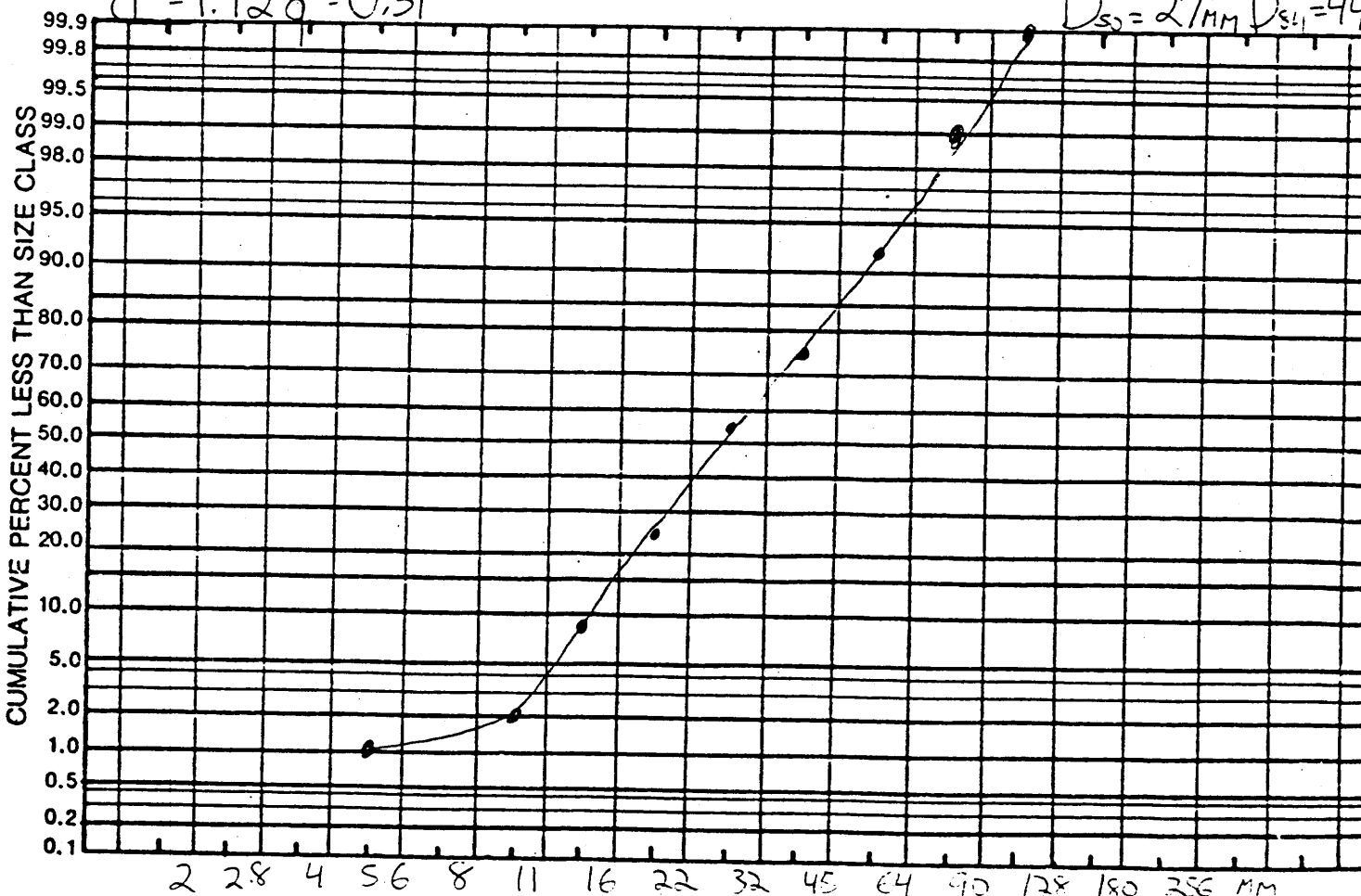
SEGMENT: 64

SURFACE



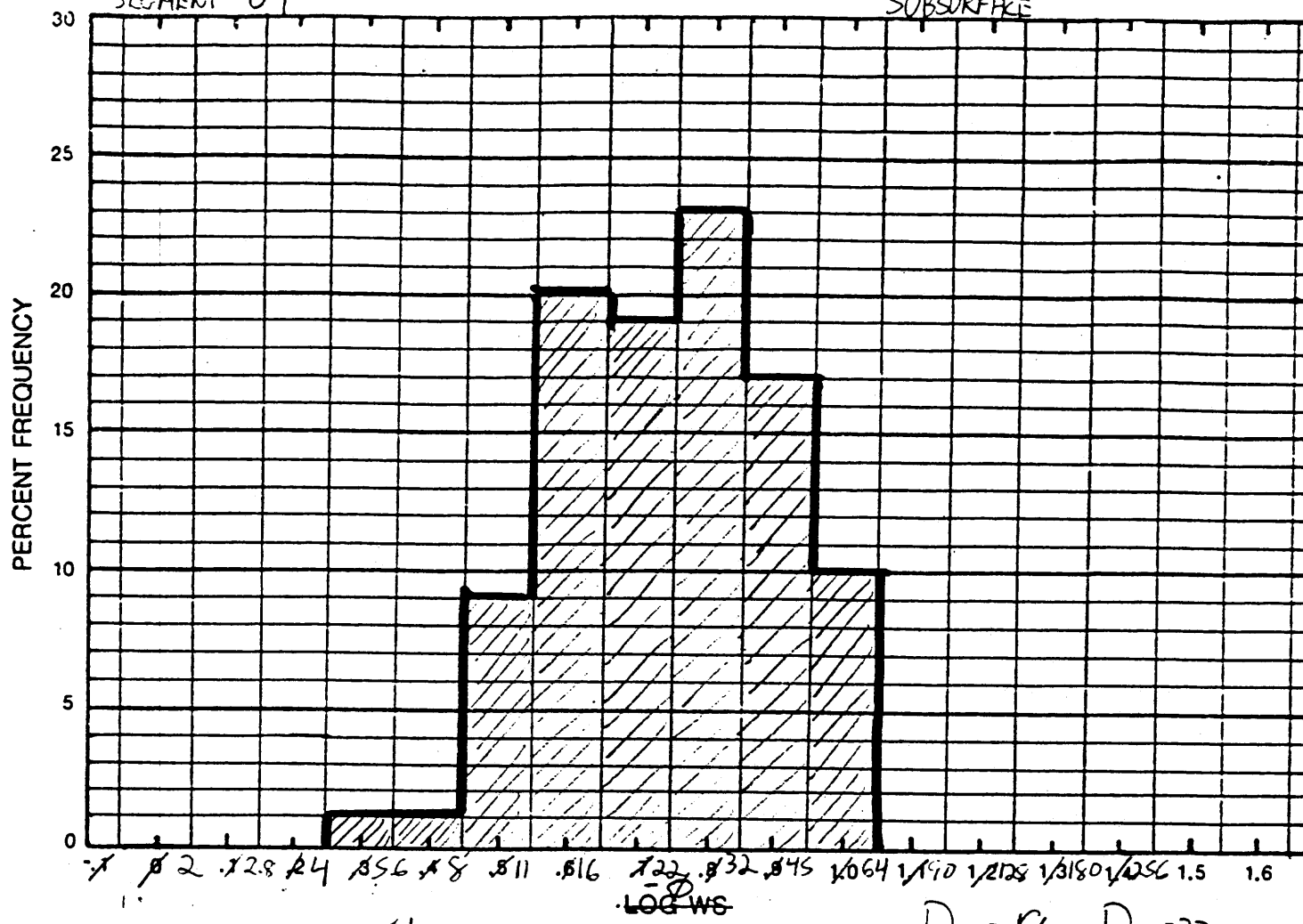
$d^* = 1.42$ $\sigma^* = 0.31$

$D_{50} = 27$ MM $D_{84} = 44$

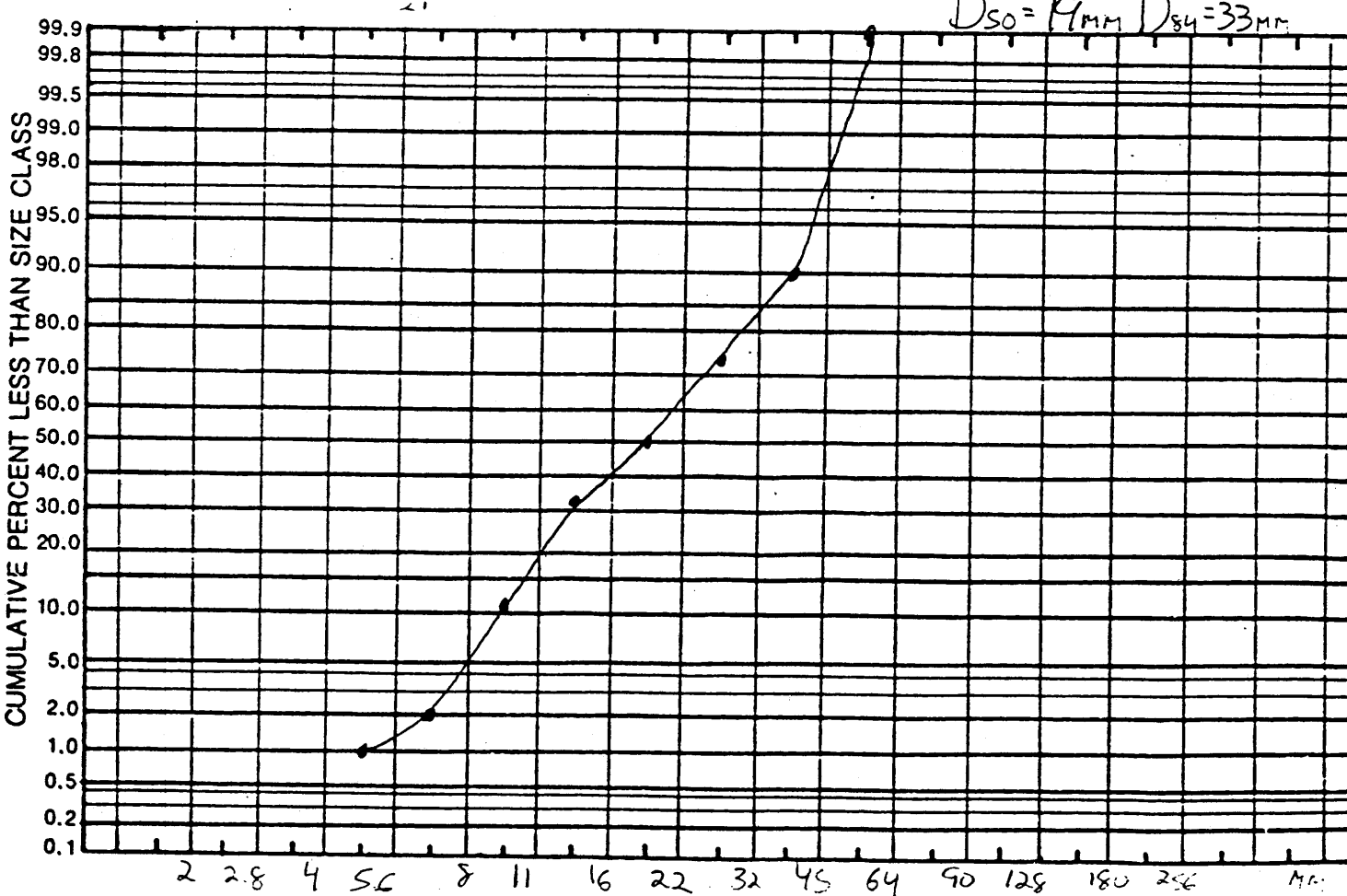


SAMPLE

SEGMENT 64 SUBSURFACE

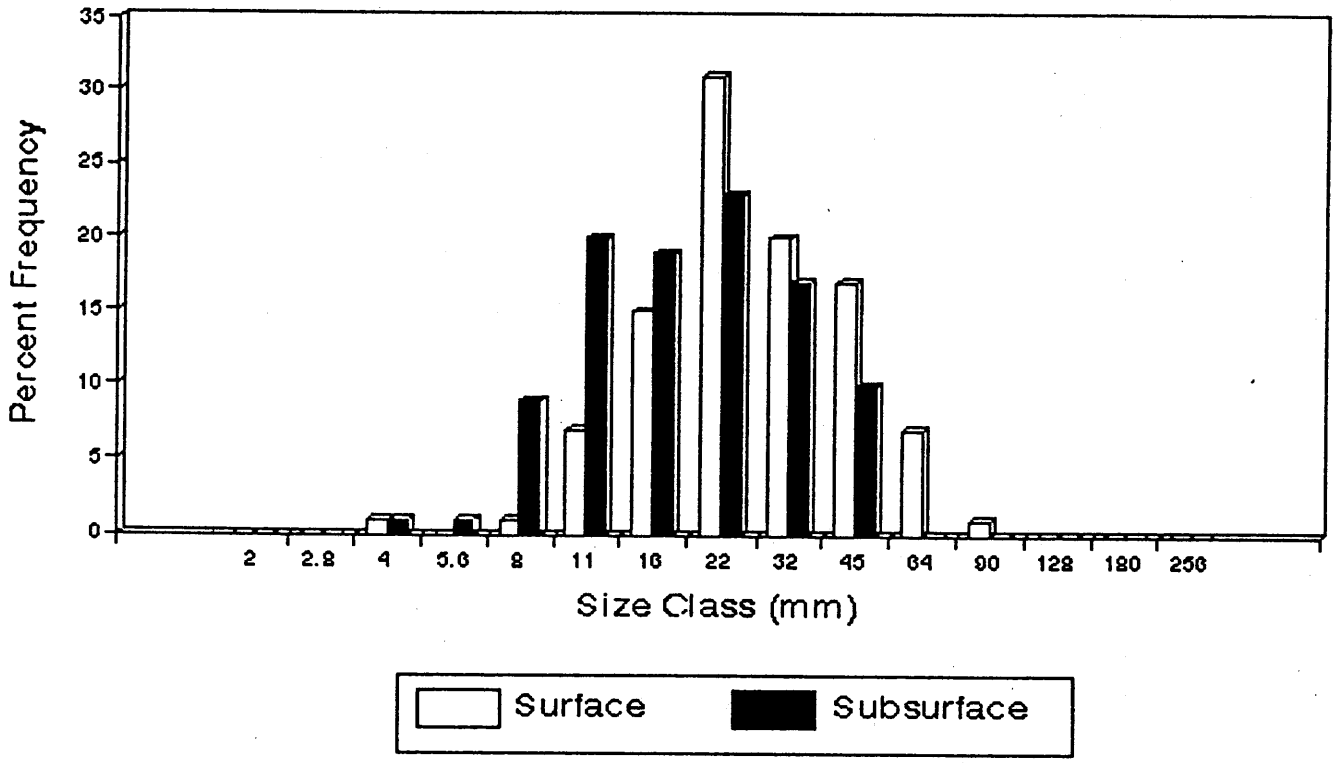


D_{50} = 19mm D_{84} = 33mm



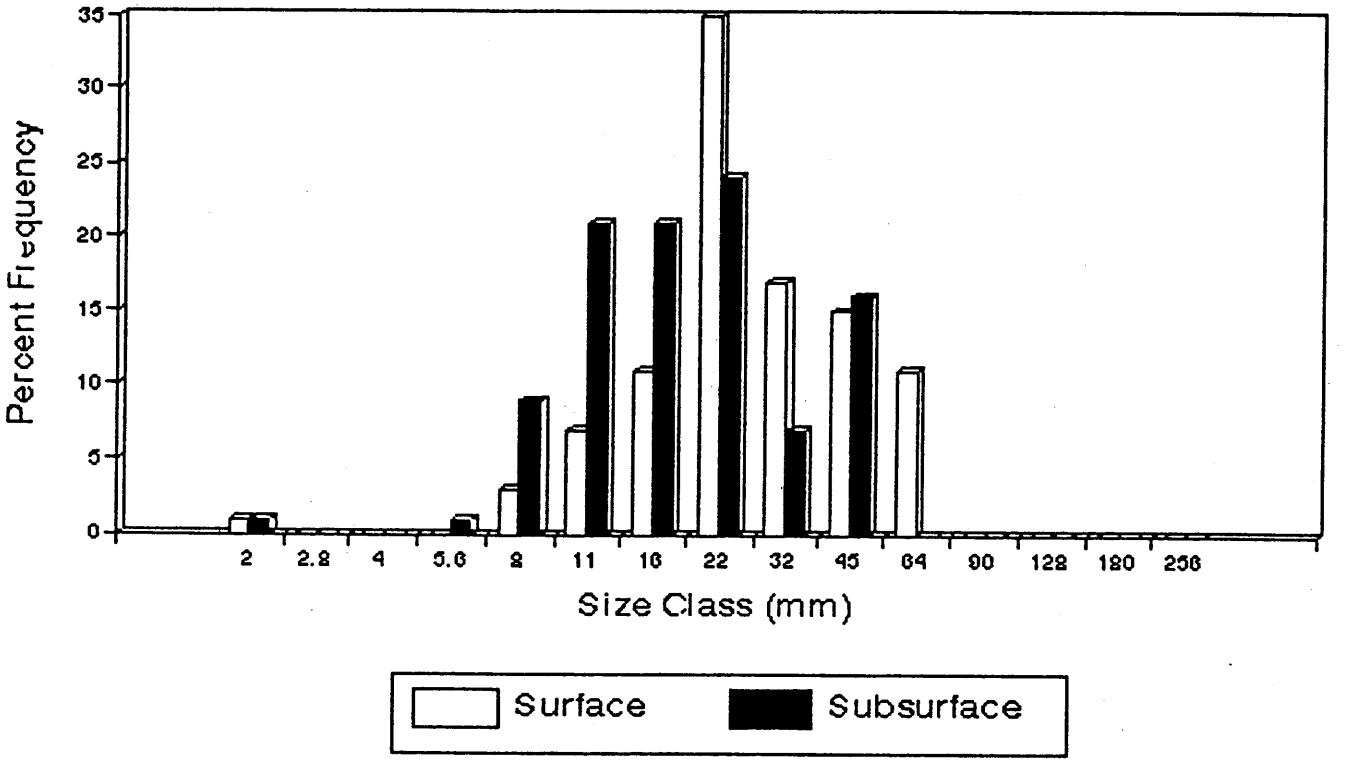
DRY CREEK

Segment 64 (Down Surface v. Subsurface)



DRY CREEK

Segment 64 (Up - Surface v. Subsurface)



Segment 94 - SOUTH FORK TOLT, BELOW GAGE STATION

Segment 94 - Bar in mid-channel
Large amount of fine sediment in interstices

Surface
D50 (mm) 33
D84 (mm) 66

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	3	3%
11	8	11%
16	12	23%
22	16	39%
32	16	55%
45	17	72%
64	15	87%
90	10	97%
128	2	99%
180	1	100%
256	0	100%
Total	100	100%

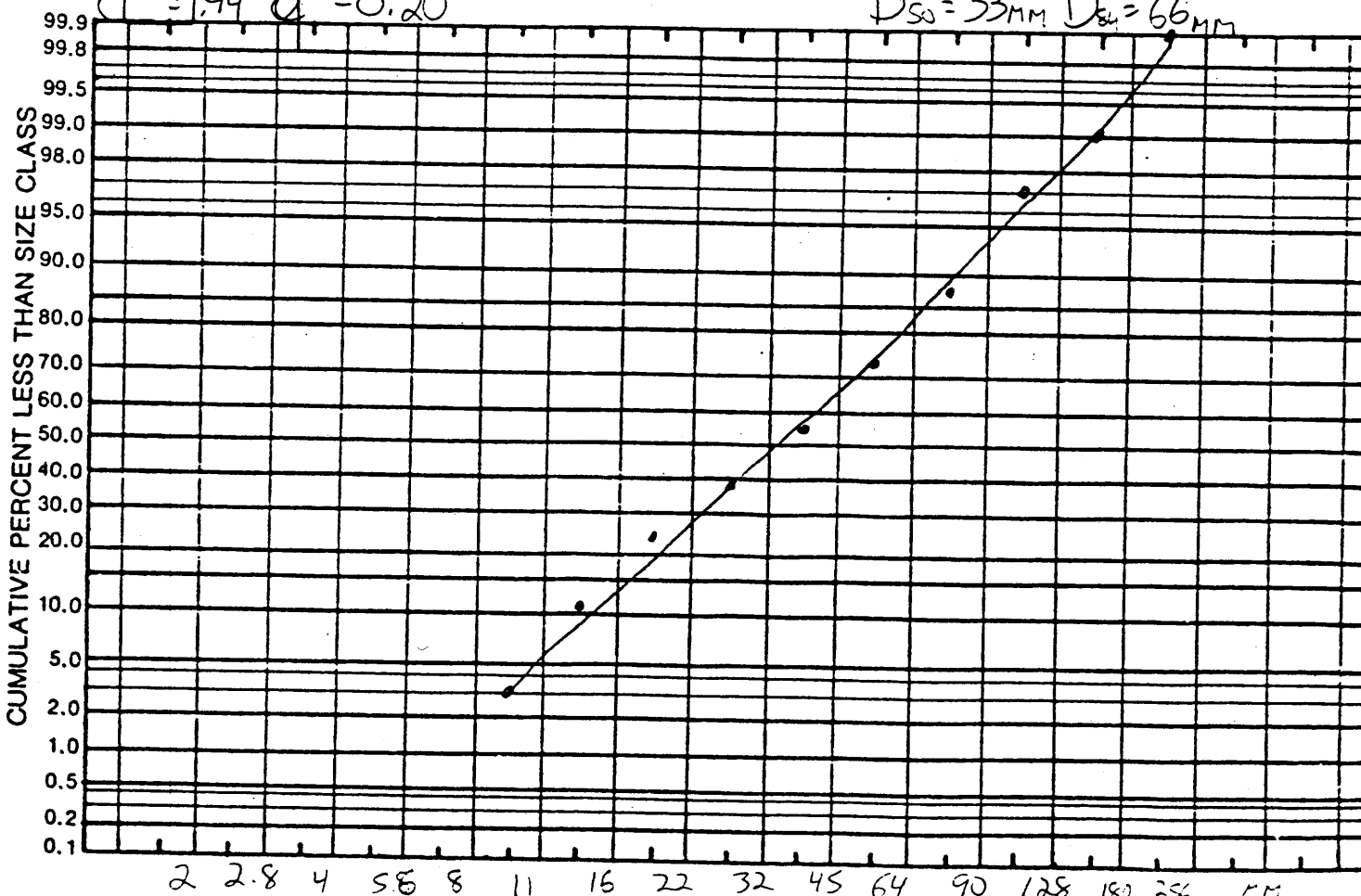
d* = 1.94
q* = 0.20

Subsurface
D50 (mm) 17
D84 (mm) 39

Size (cm)	Count	Cumulative % less than size class
2	9	9%
2.8	0	9%
4	3	12%
5.6	5	17%
8	12	29%
11	14	43%
16	15	58%
22	15	73%
32	7	80%
45	10	90%
64	6	96%
90	4	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

SEGMENT 94 SURFACE SAMPLE

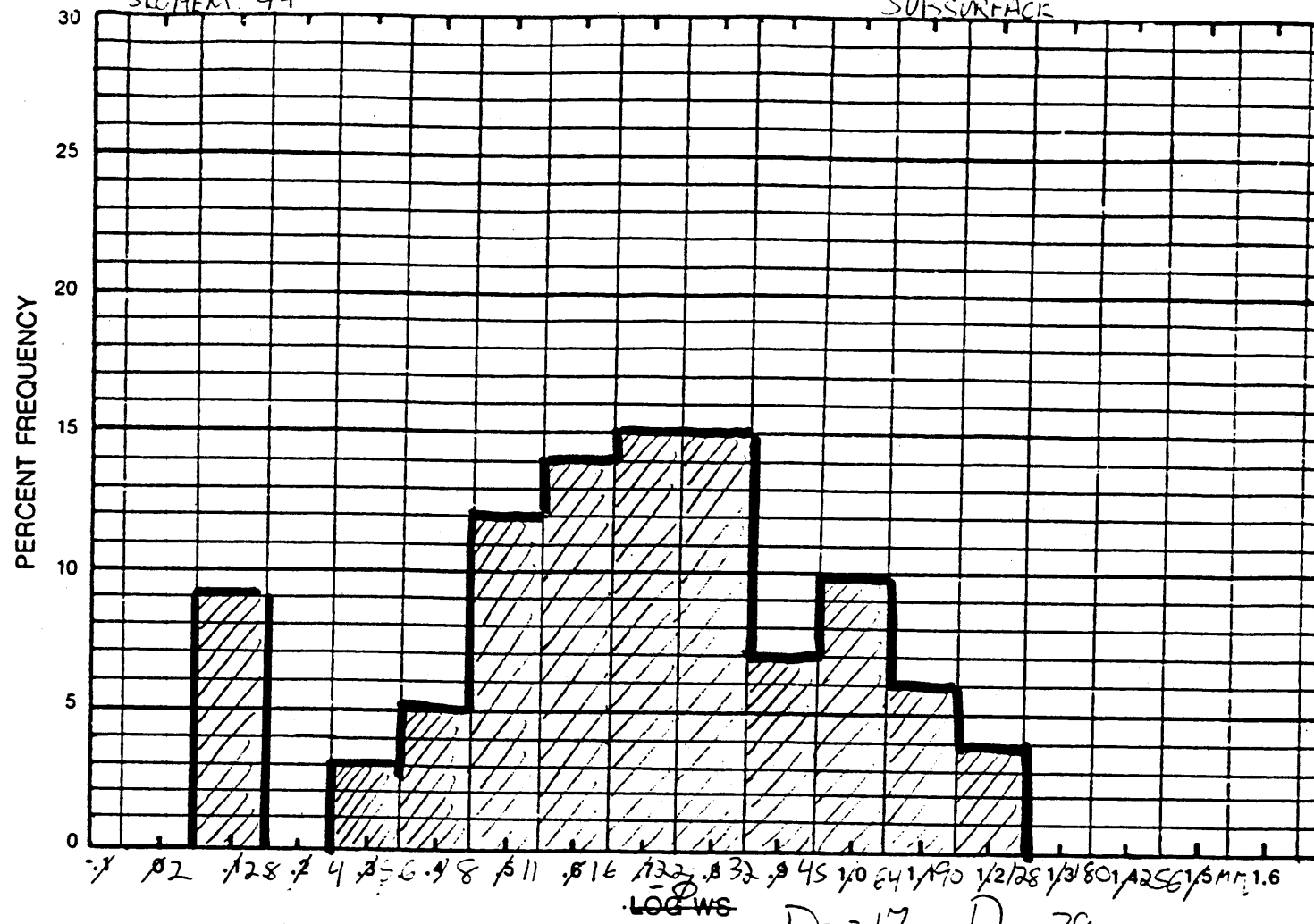
$d^* = 1.94$ $\sigma^* = 0.20$ $D_{50} = 33mm$ $D_{84} = 66mm$



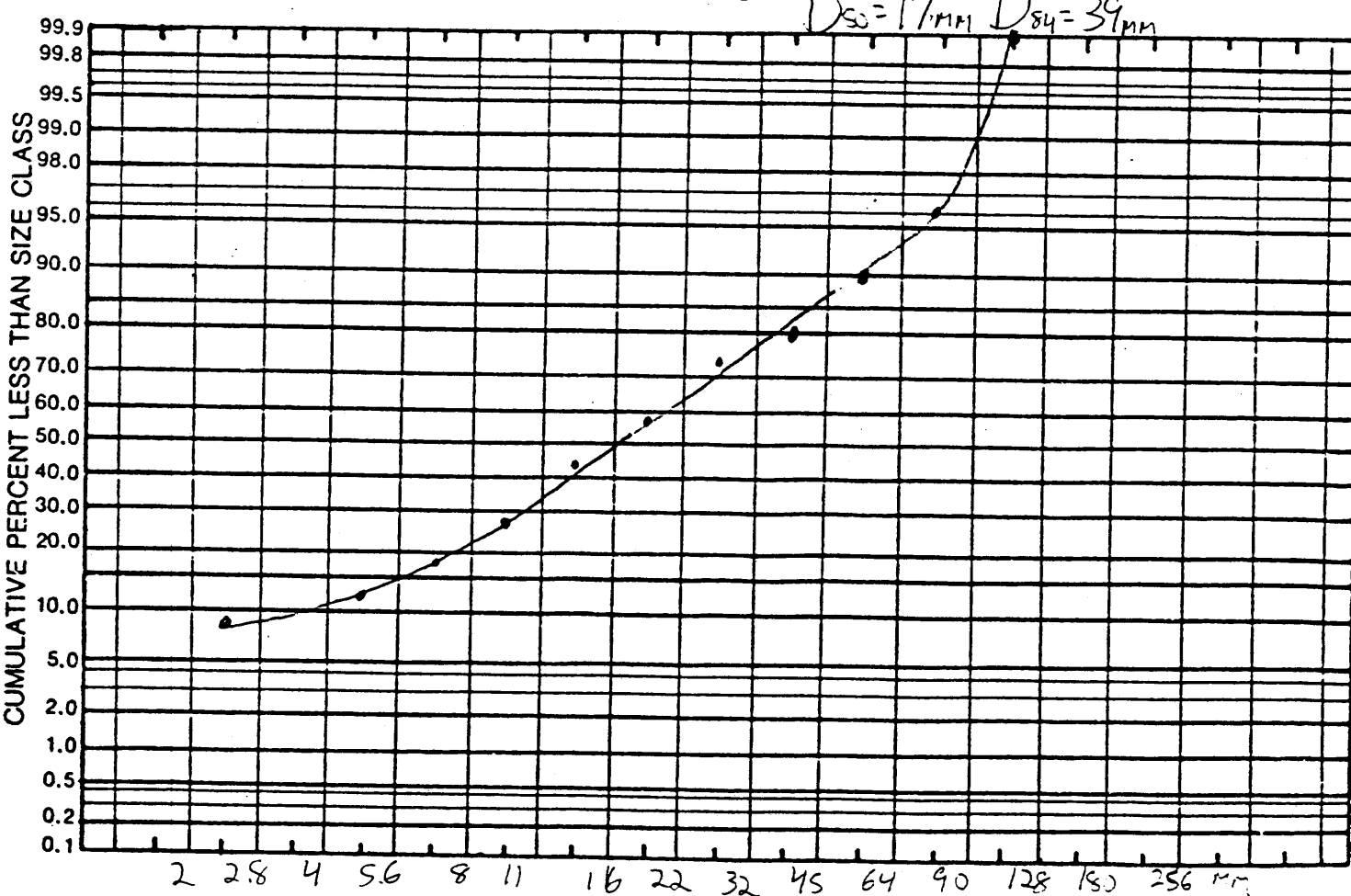
SAMPLE

SEGMENT: 94

SUBSURFACE

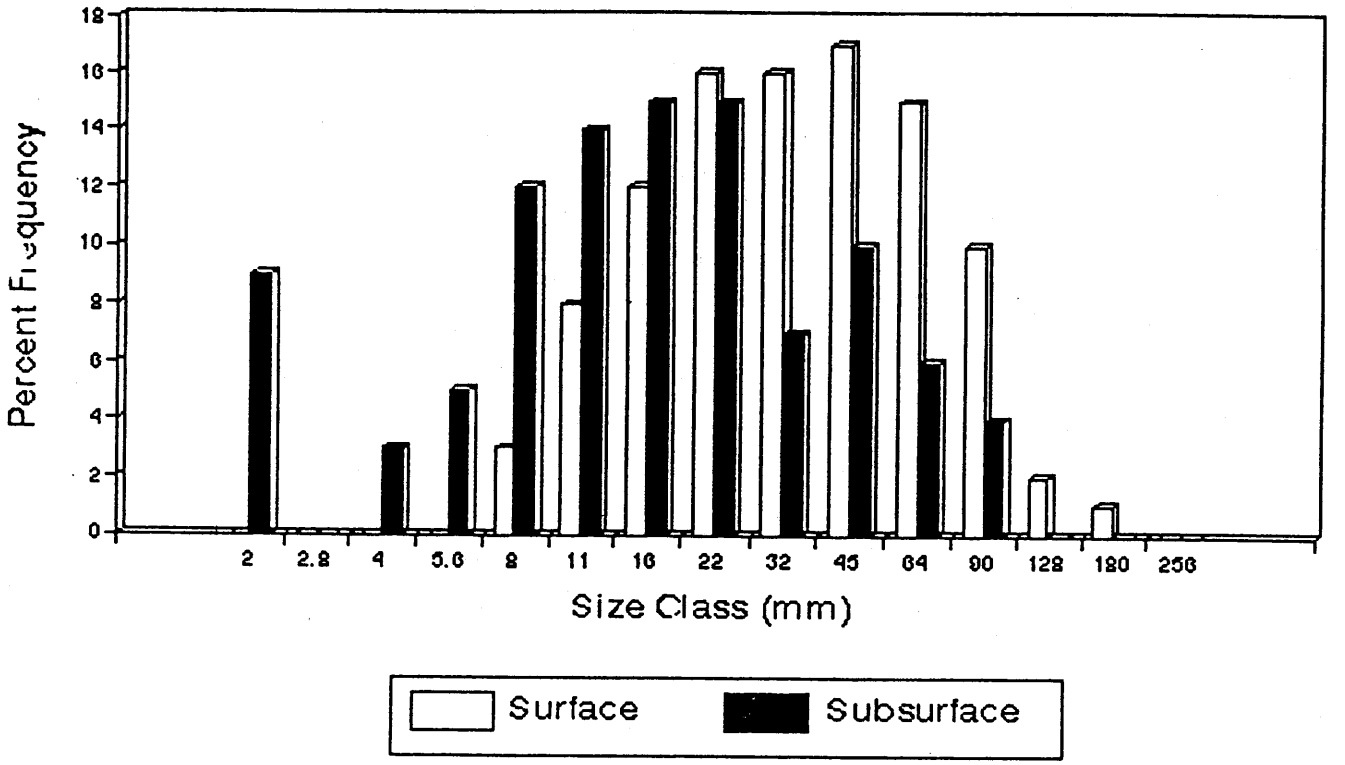


$D_{50} = 17$ mm $D_{84} = 39$ mm



SOUTH FORK TOLT RIVER

Segment 94 (Surface v. Subsurface)



Segment 95 - SOUTH FORK TOLT, BELOW GAGE STATION

Segment 95 - Downstream of terrace/colluvial hollow/slide area

Surface

D50 (mm)= 42

D84 (mm)= 78

Size (cm)	Count	Cumulative % less than size class
2	3	3%
2.8	1	4%
4	0	4%
5.6	1	5%
8	0	5%
11	1	6%
16	5	11%
22	17	28%
32	14	42%
45	25	67%
64	16	83%
90	10	93%
128	5	98%
180	1	99%
256	1	100%
Total	100	100%

d* =2.80

q* =0.15

Subsurface

D50 (mm)= 15

D84 (mm)= 33

Size (cm)	Count	Cumulative % less than size class
2	2	2%
2.8	3	5%
4	4	9%
5.6	5	14%
8	9	23%
11	20	43%
16	18	61%
22	17	78%
32	10	88%
45	5	93%
64	4	97%
90	3	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

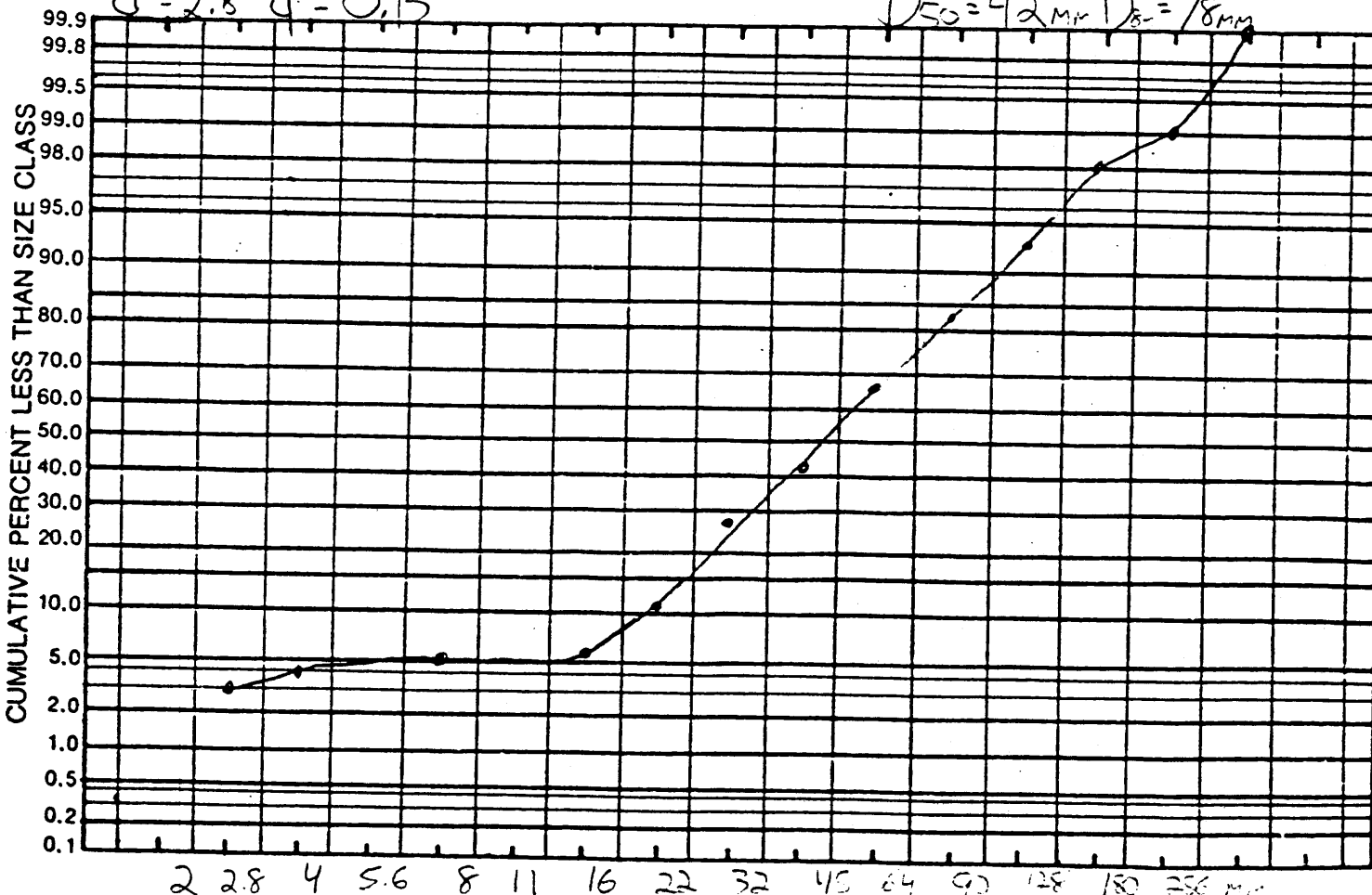
SEGMENT 9S

SAMPLE

SURFACE

$d^* = 2.8$ $q^* = 0.15$

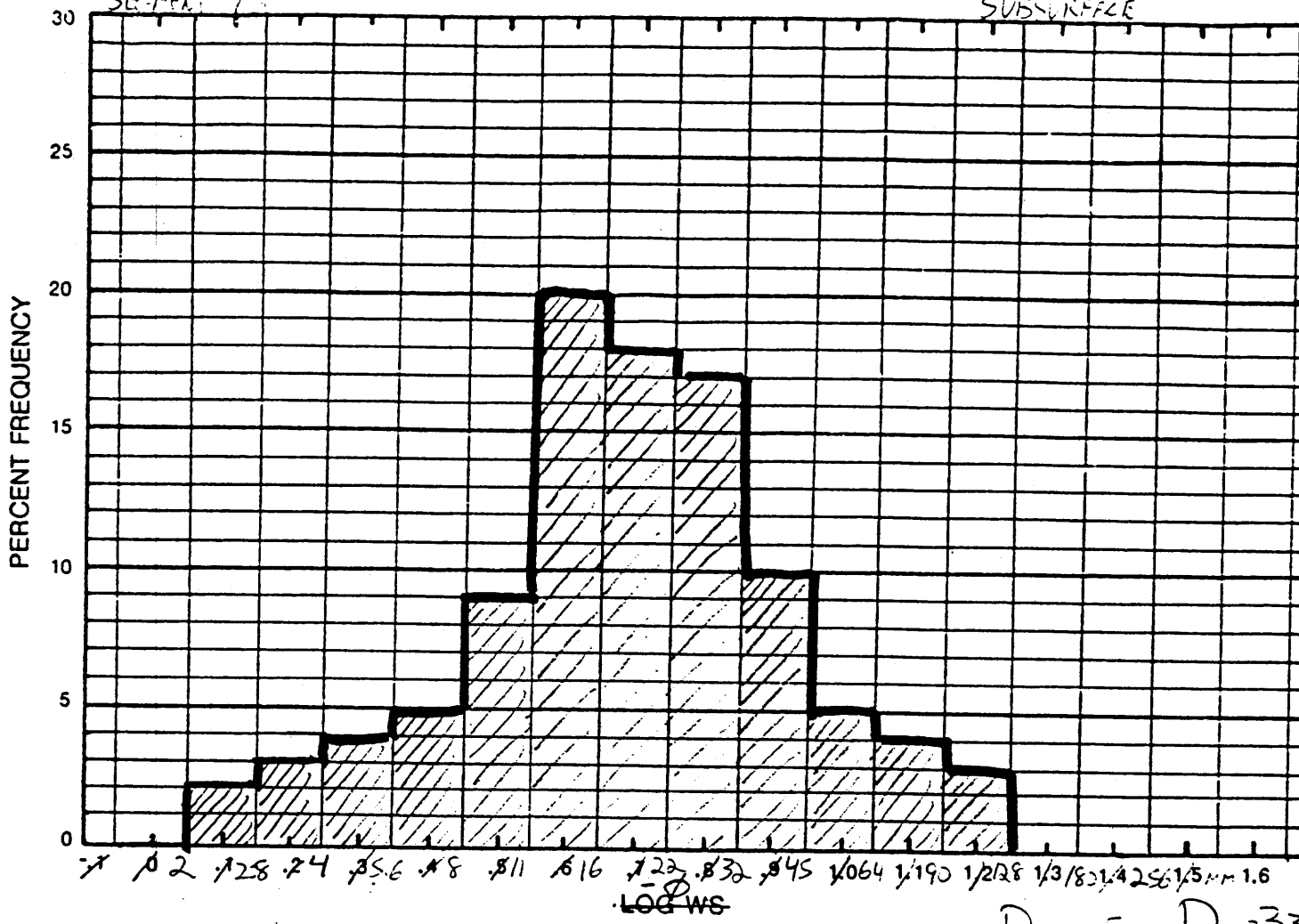
$D_{50} = 42$ mm $D_{90} = 78$ mm

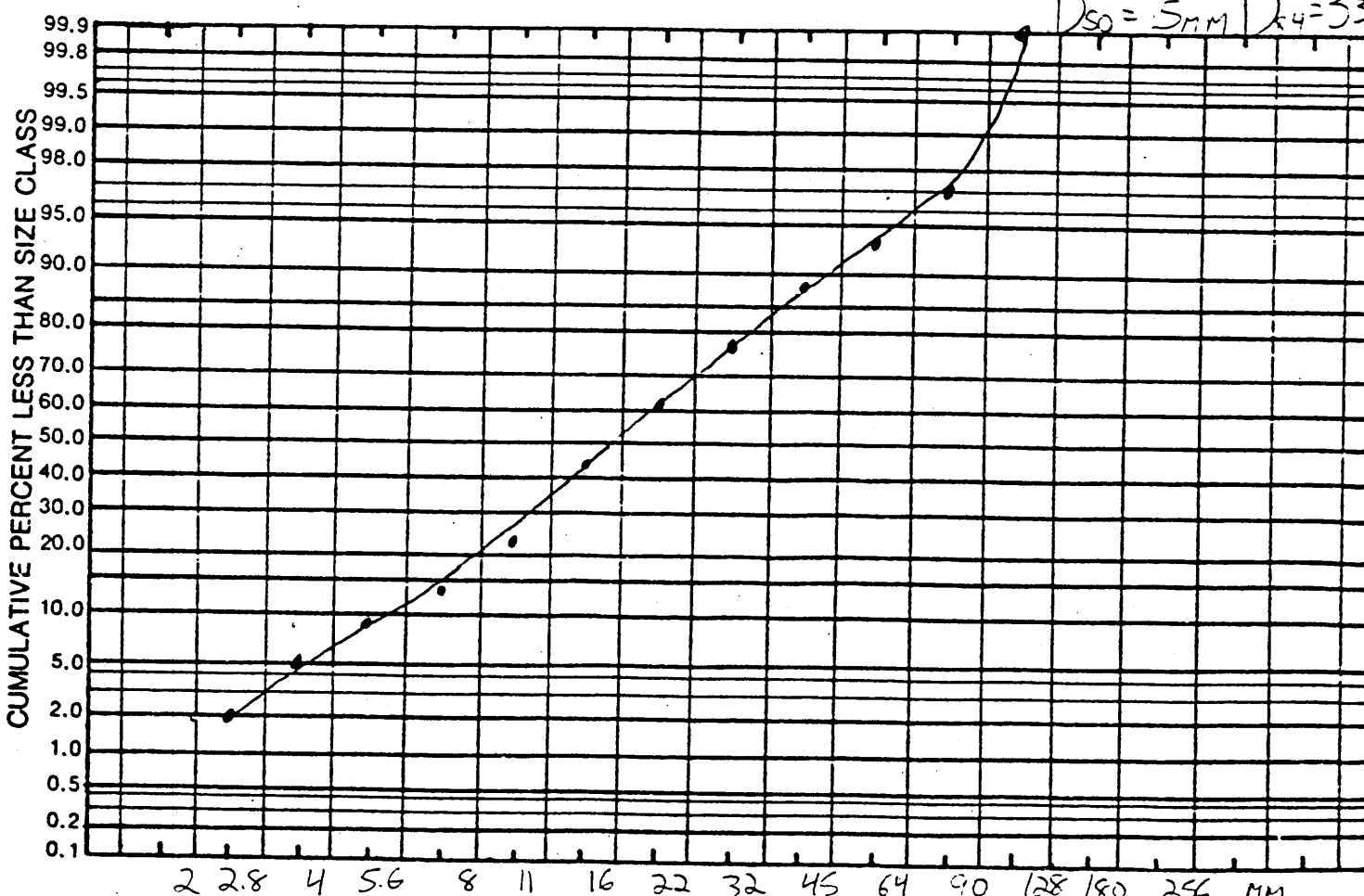


SAMPLE

SEGMENT 9

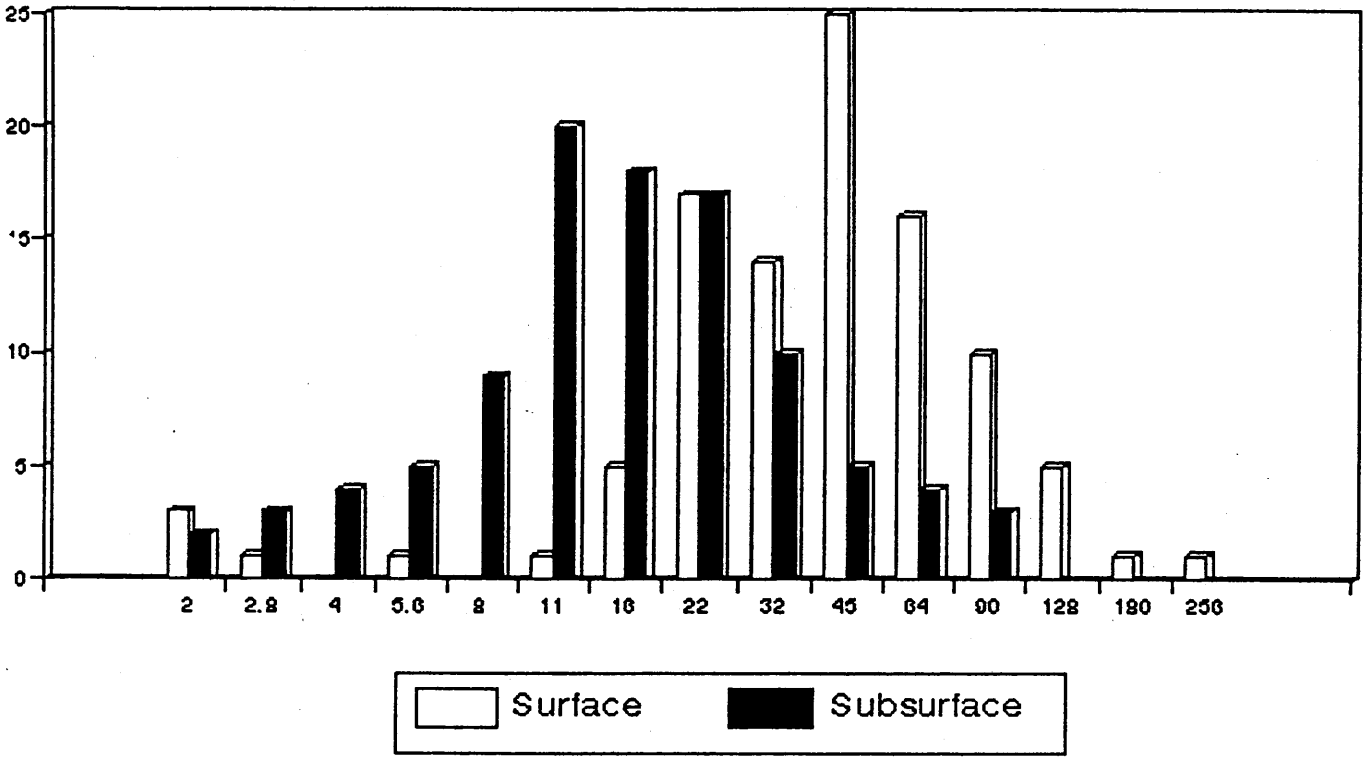
SUBSURFACE





SOUTH FORK TOLT, BELOW GAGE STATION

Segment 95(Surface v. Subsurface)



Segment 100 - SOUTH FORK TOLT RIVER - DOWNSTREAM PAST BRIDGE AND UPSTREAM OF SLIDE

Segment 100 - Farthest pebble count downstream in segment.
Just downstream of bridge on bar, left bank, downstream end, snow on bar

Surface

D50 (mm) 25
D84 (mm) 55

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	4	4%
11	12	16%
16	17	33%
22	25	58%
32	15	73%
45	10	83%
64	8	91%
90	6	97%
128	3	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 1.40
q* = 0.32

Subsurface

D50 (mm) 18
D84 (mm) 32

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	1	1%
5.6	2	3%
8	12	15%
11	18	33%
16	24	57%
22	21	78%
32	11	89%
45	8	97%
64	2	99%
90	1	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 100 - Bar on left bank, approx 100ft upstream of gage, near head of bar, towards water level.

Surface

D50 (mm)	28
D84 (mm)	56

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	0	0%
11	9	9%
16	16	25%
22	21	46%
32	23	69%
45	10	79%
64	10	89%
90	9	98%
128	2	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 1.75

q* = 0.22

Subsurface

D50 (mm)	16
D84 (mm)	27

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	3	3%
5.6	1	4%
8	9	13%
11	25	38%
16	25	63%
22	21	84%
32	7	91%
45	4	95%
64	3	98%
90	0	98%
128	2	100%
180	0	100%
256	0	100%
Total	100	100%

Segment 100 - Approx 300ft downstream of giant slide, glacial lake area.
Right bank, mid-bar, towards water level

Surface

D50 (mm)	37
D84 (mm)	53

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	2	2%
11	4	6%
16	6	12%
22	16	28%
32	28	56%
45	30	86%
64	14	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 2.64

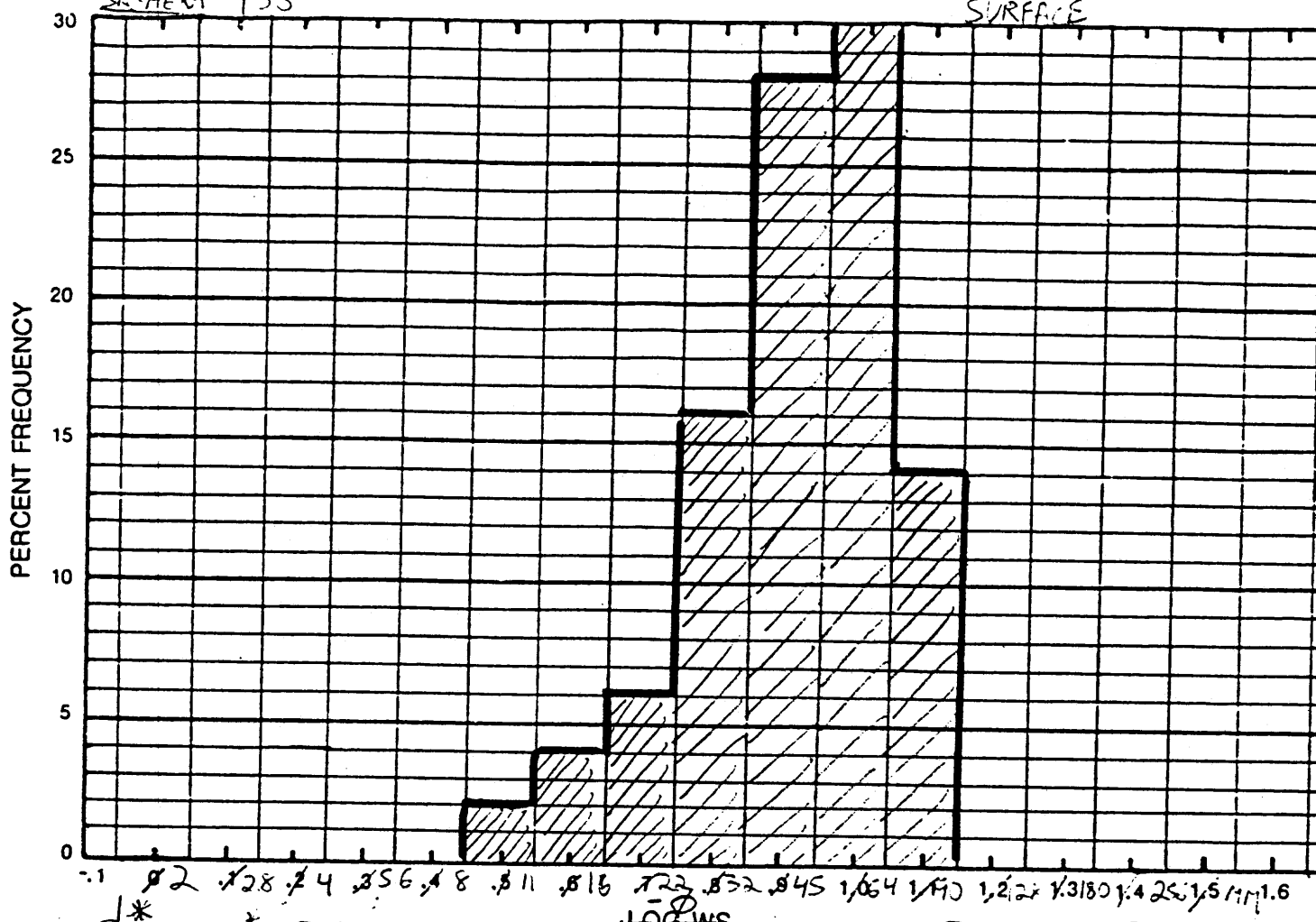
q* = 0.15

Subsurface

D50 (mm)	14
D84 (mm)	27

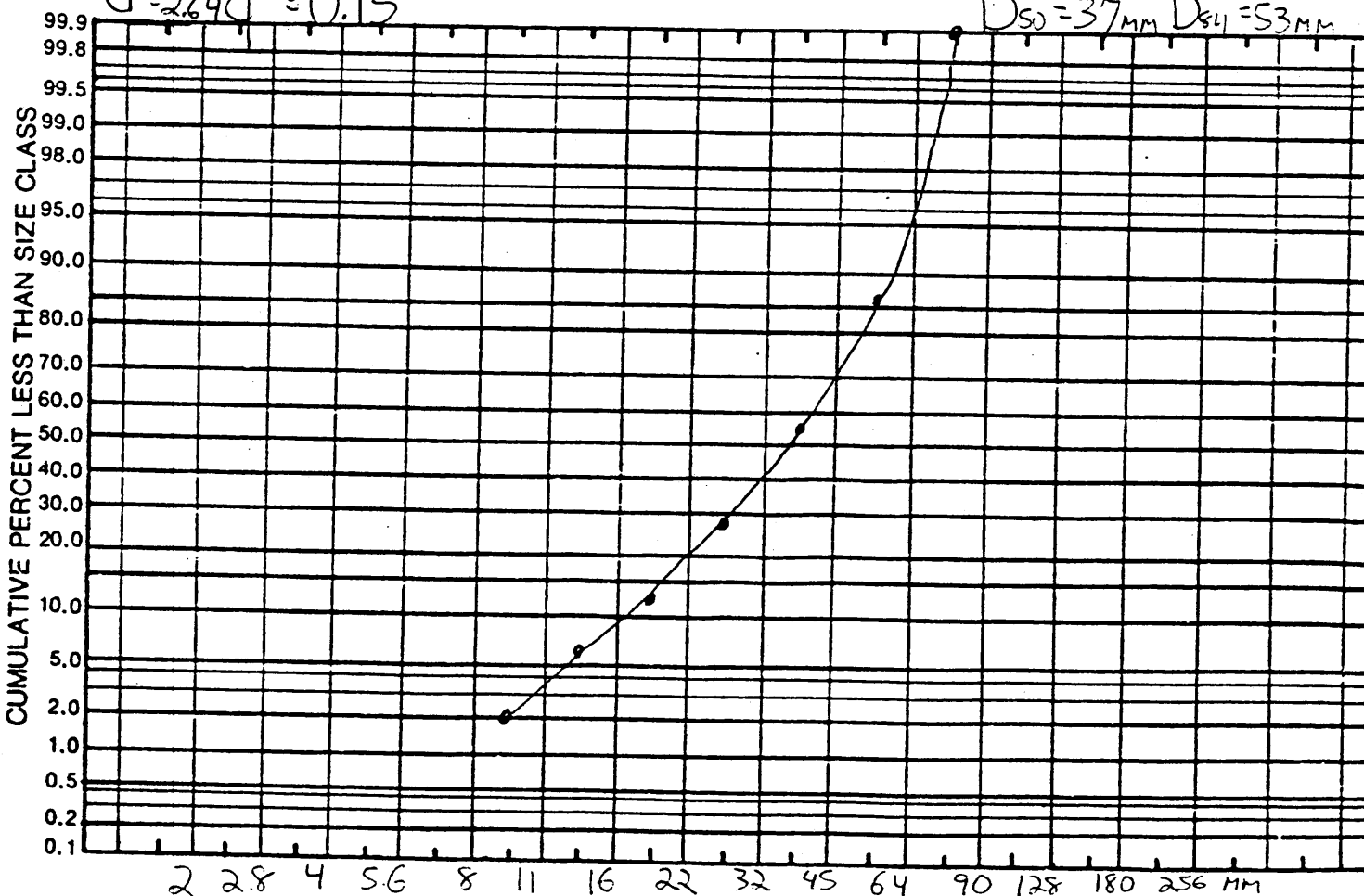
Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	1	1%
4	6	7%
5.6	2	9%
8	13	22%
11	23	45%
16	22	67%
22	17	84%
32	12	96%
45	4	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

SEGMENT 100 SURFACE SAMPLE



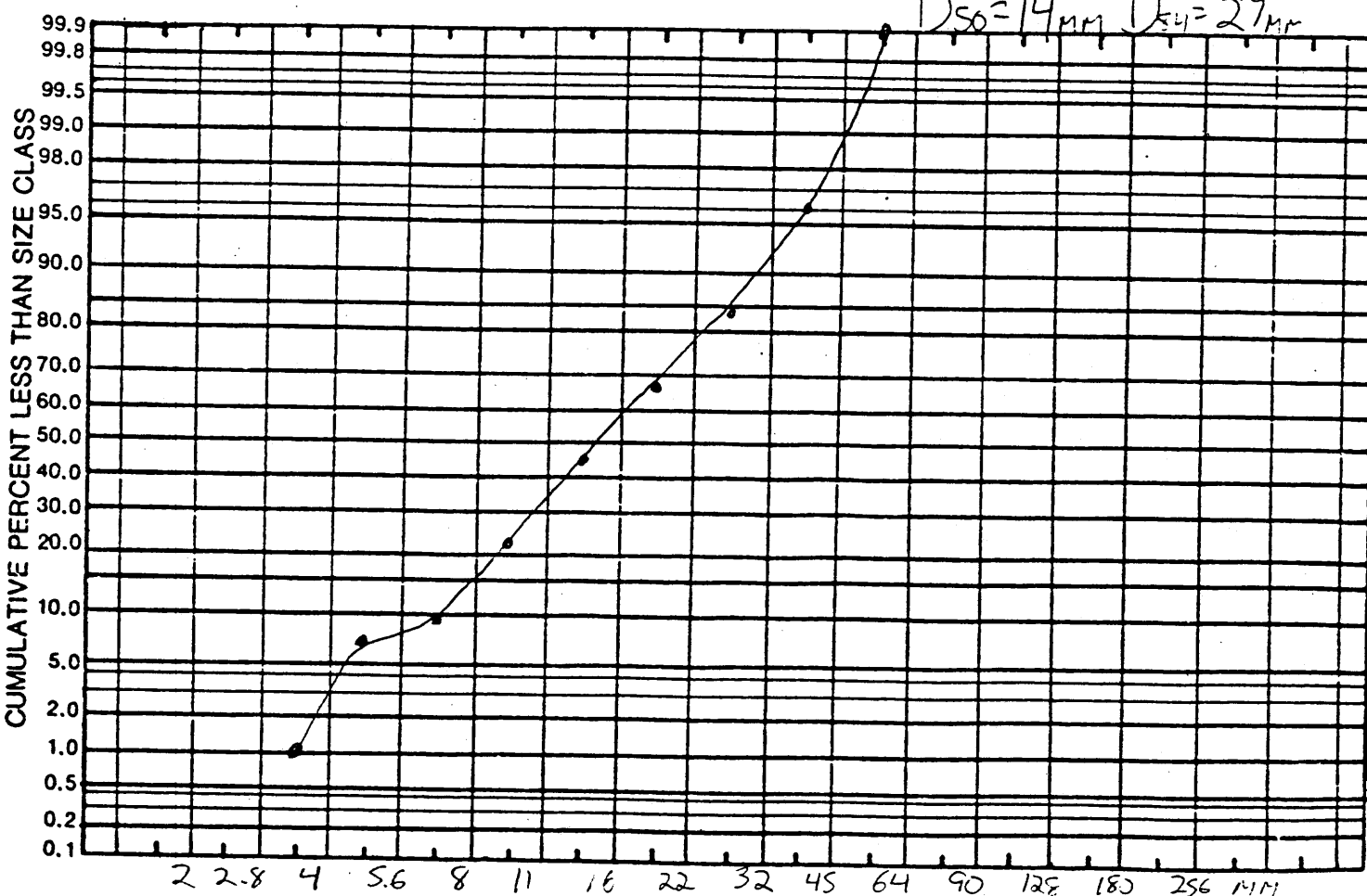
$d^* = 2.64$ $\sigma^* = 0.15$

$D_{50} = 37$ MM $D_{84} = 53$ MM



SAMPLE

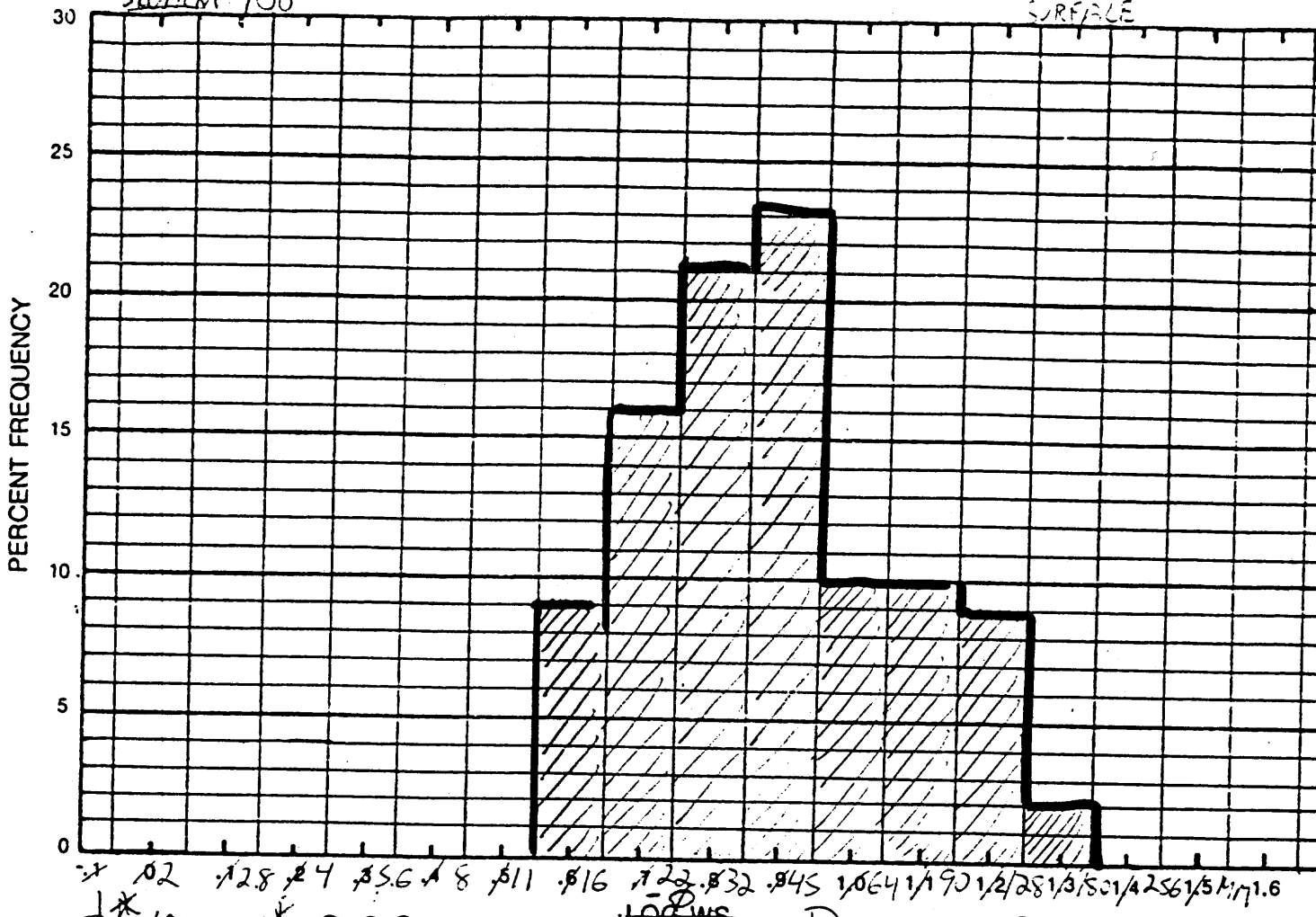
SUBSURFACE



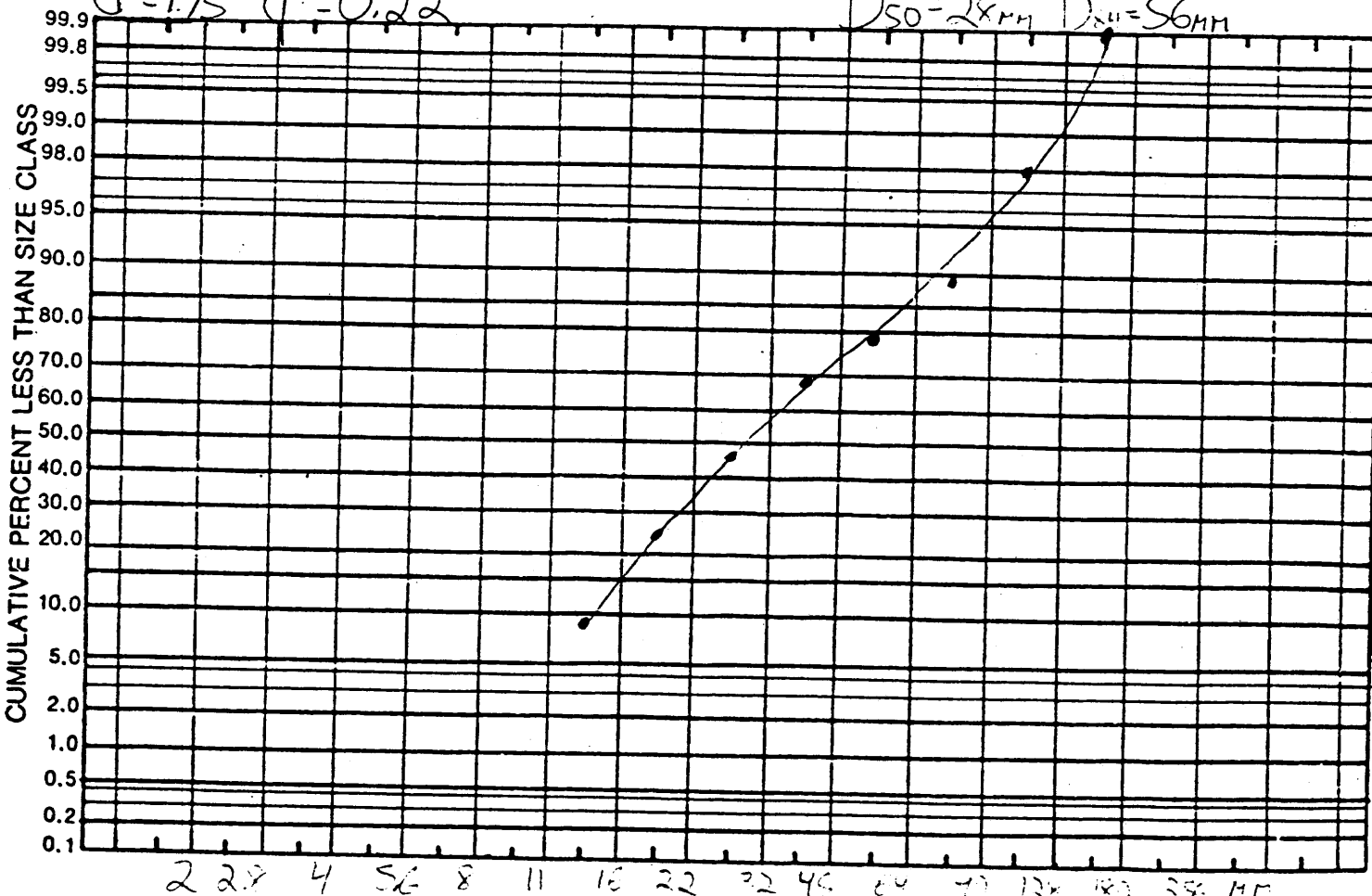
SEGMENT 100

SAMPLE

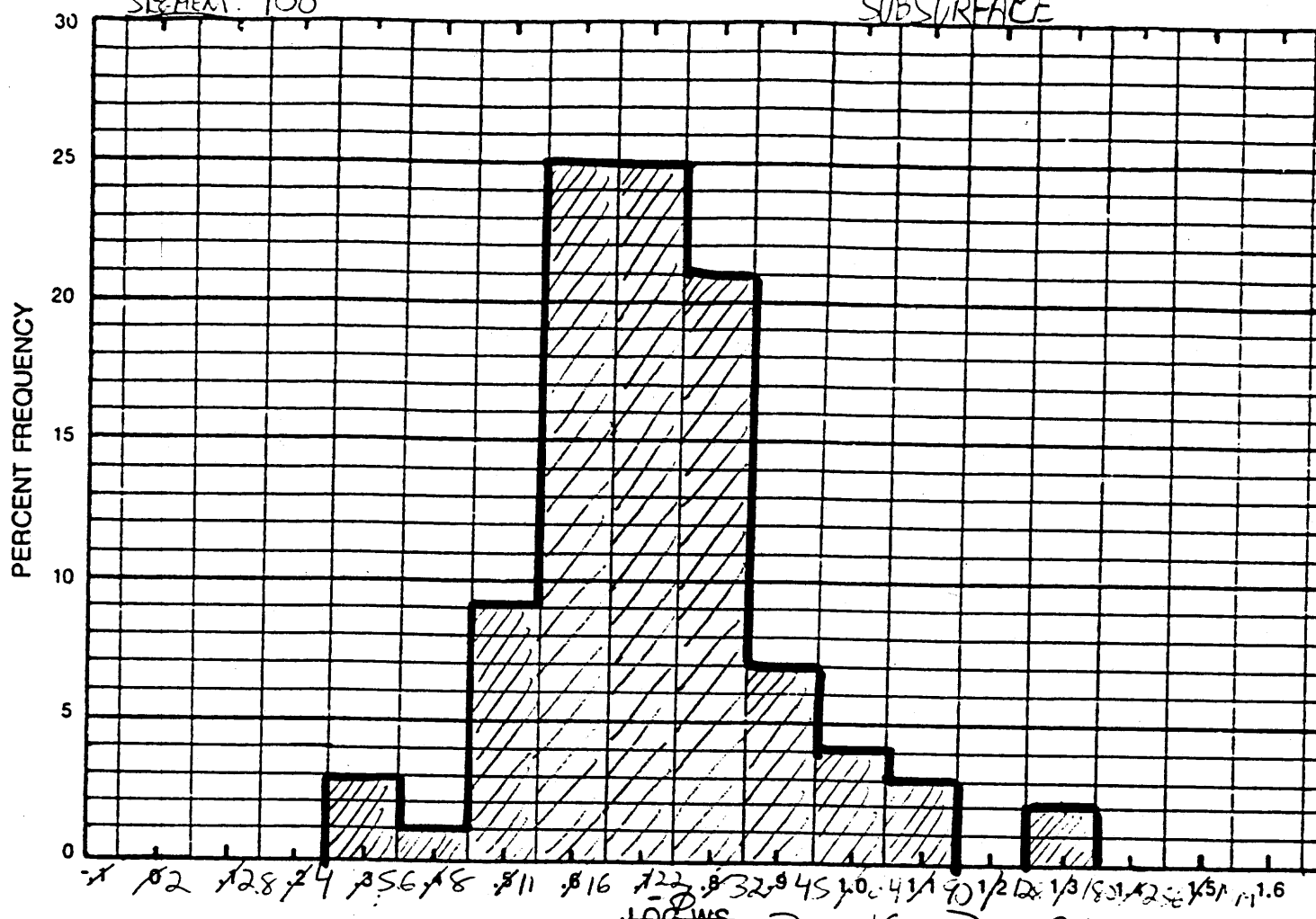
SURFACE



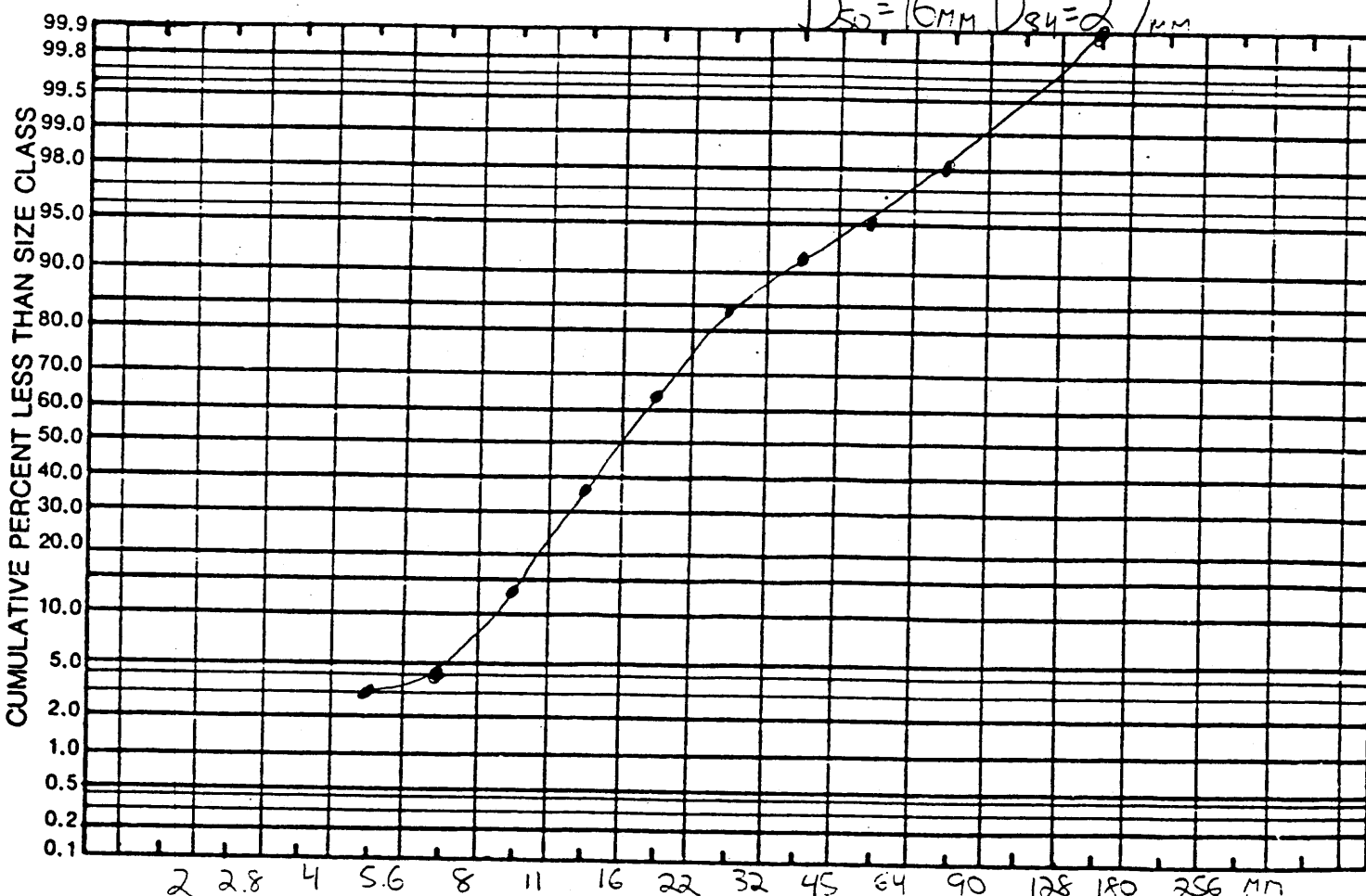
$d^* = 1.75$ $\sigma^* = 0.22$ $D_{50} = 28mm$ $D_{84} = 56mm$



SEGMENT: 100 SUBSURFACE SAMPLE

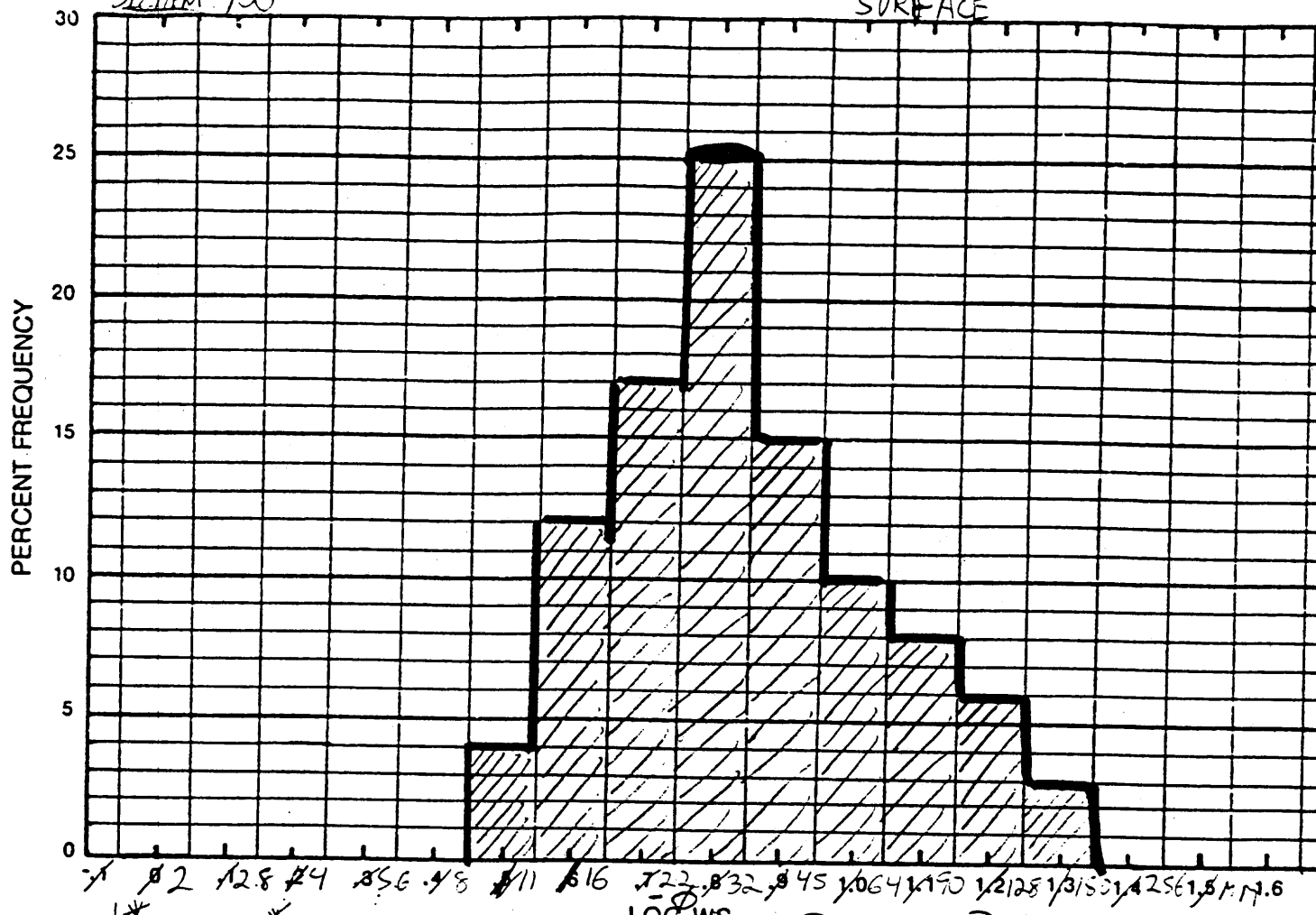


$D_{50} = 16$ MM $D_{84} = 27$ MM



SAMPLE

SEGMENT 120 SURFACE


PERCENT FREQUENCY
30
25
20
15
10
5
0
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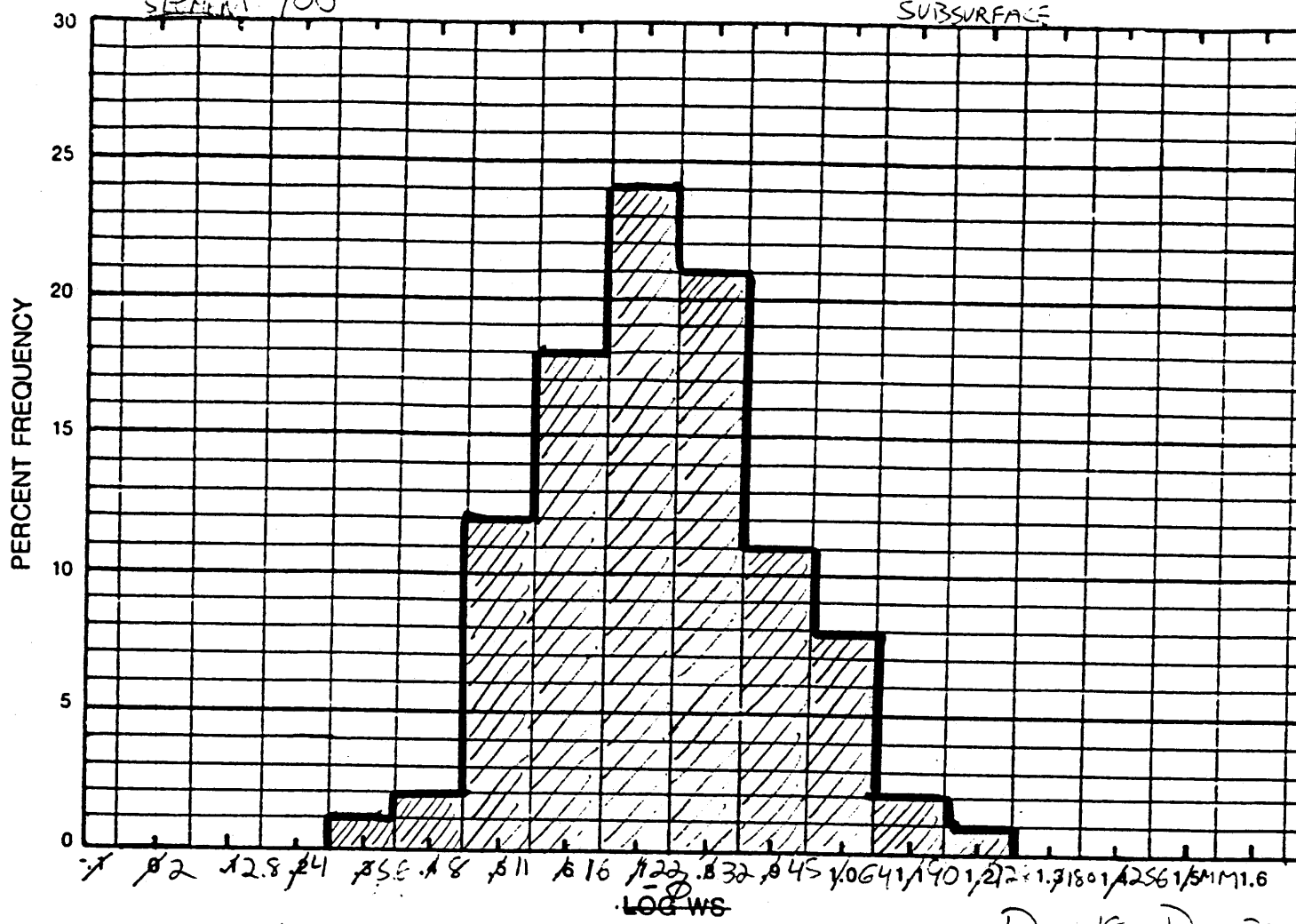
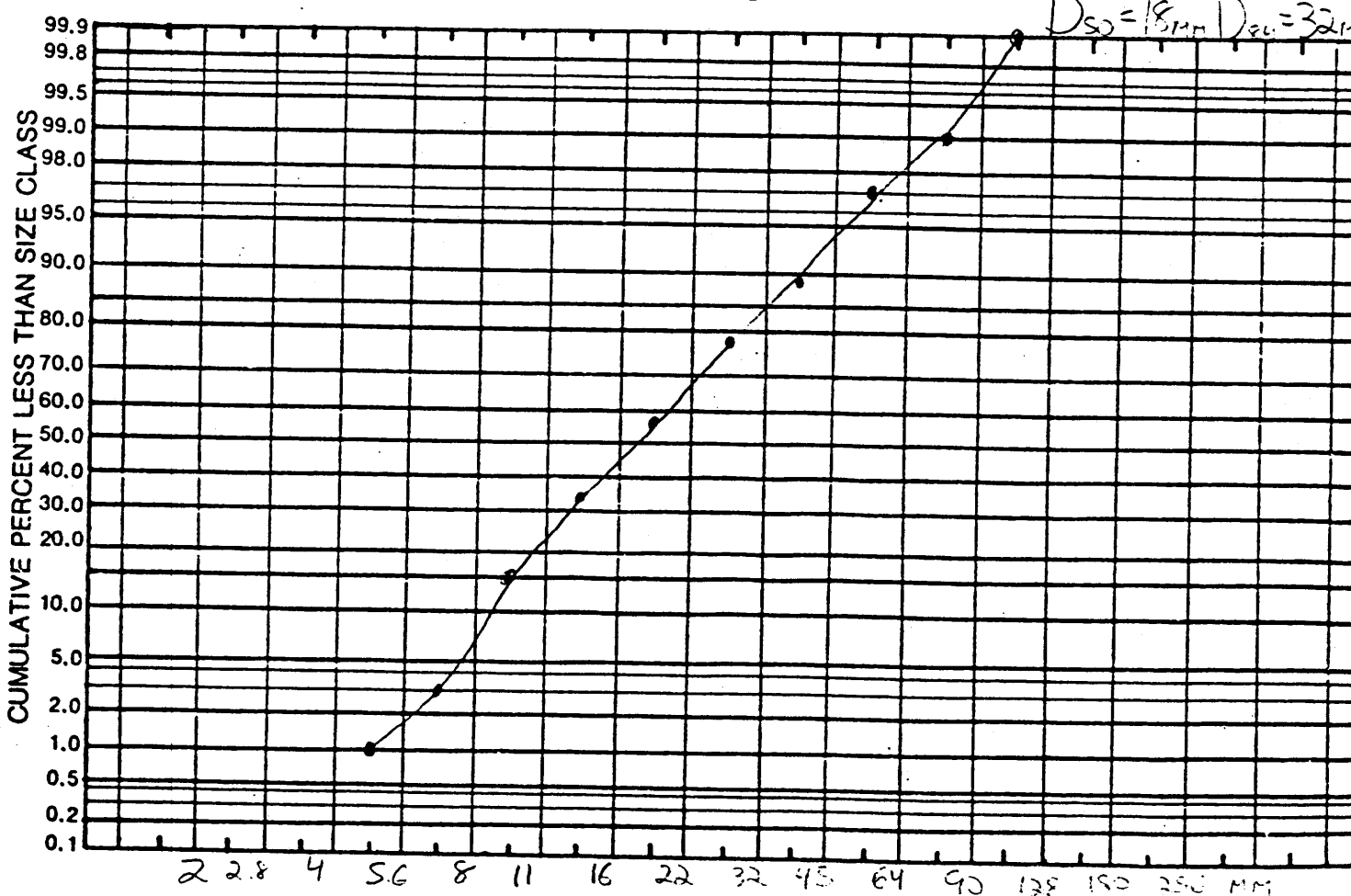
SAMPLE

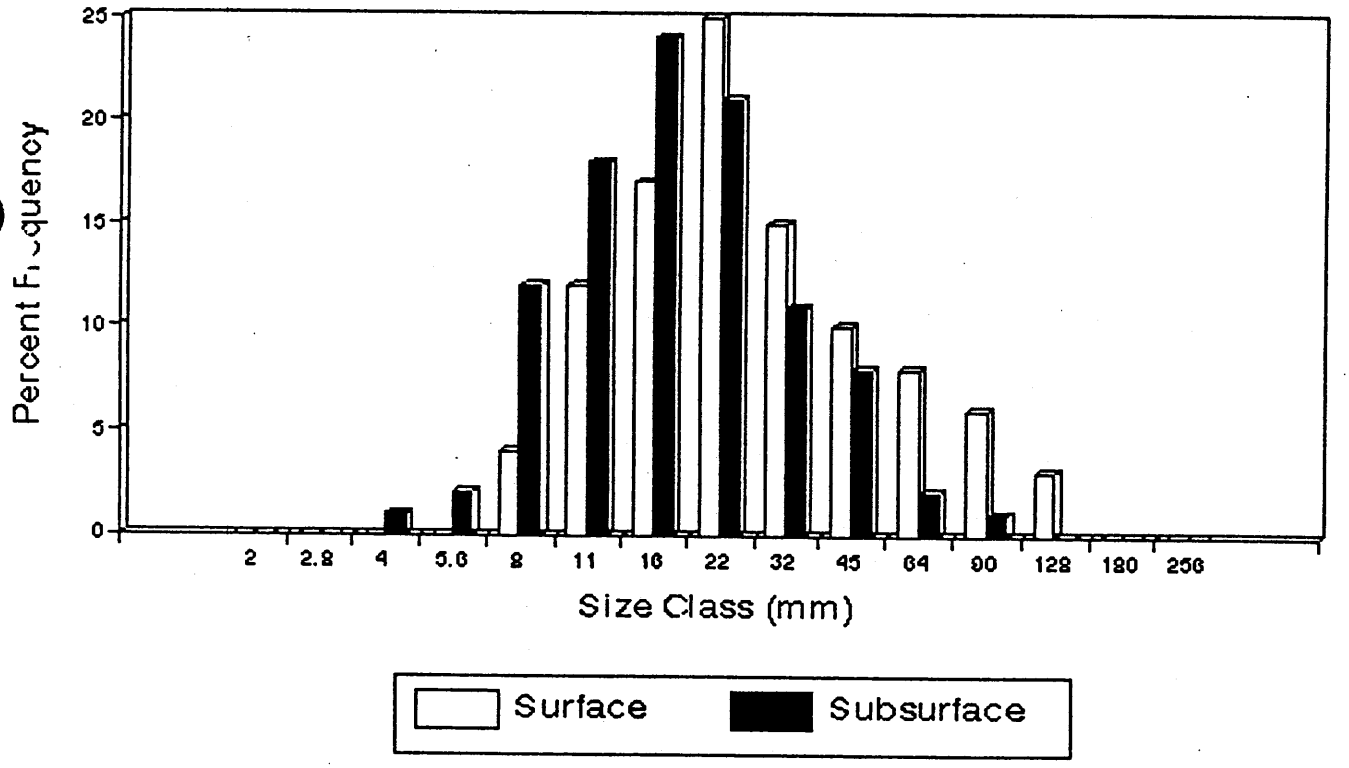
SEGMENT 100 SUBSURFACE





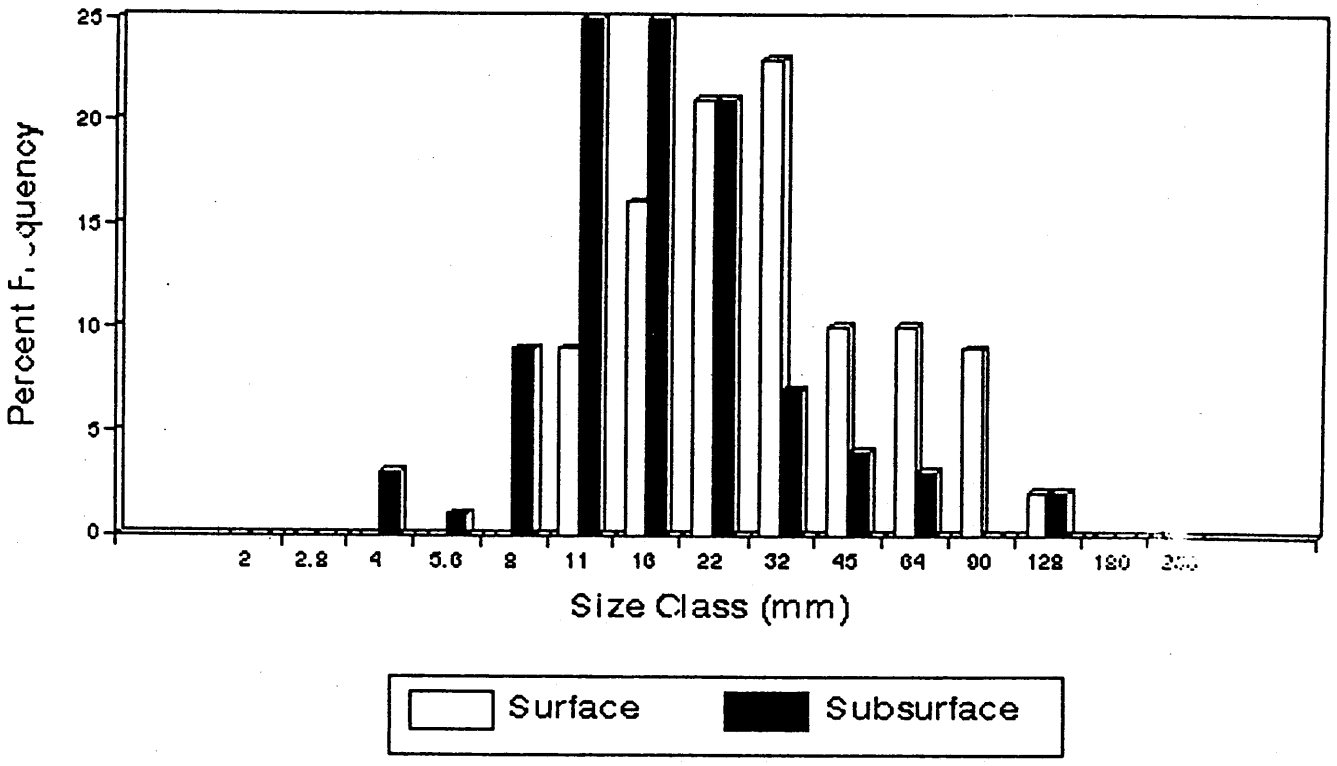
SOUTH FORK TOLT RIVER

Segment 100 (DS Surface v. Subsurface)



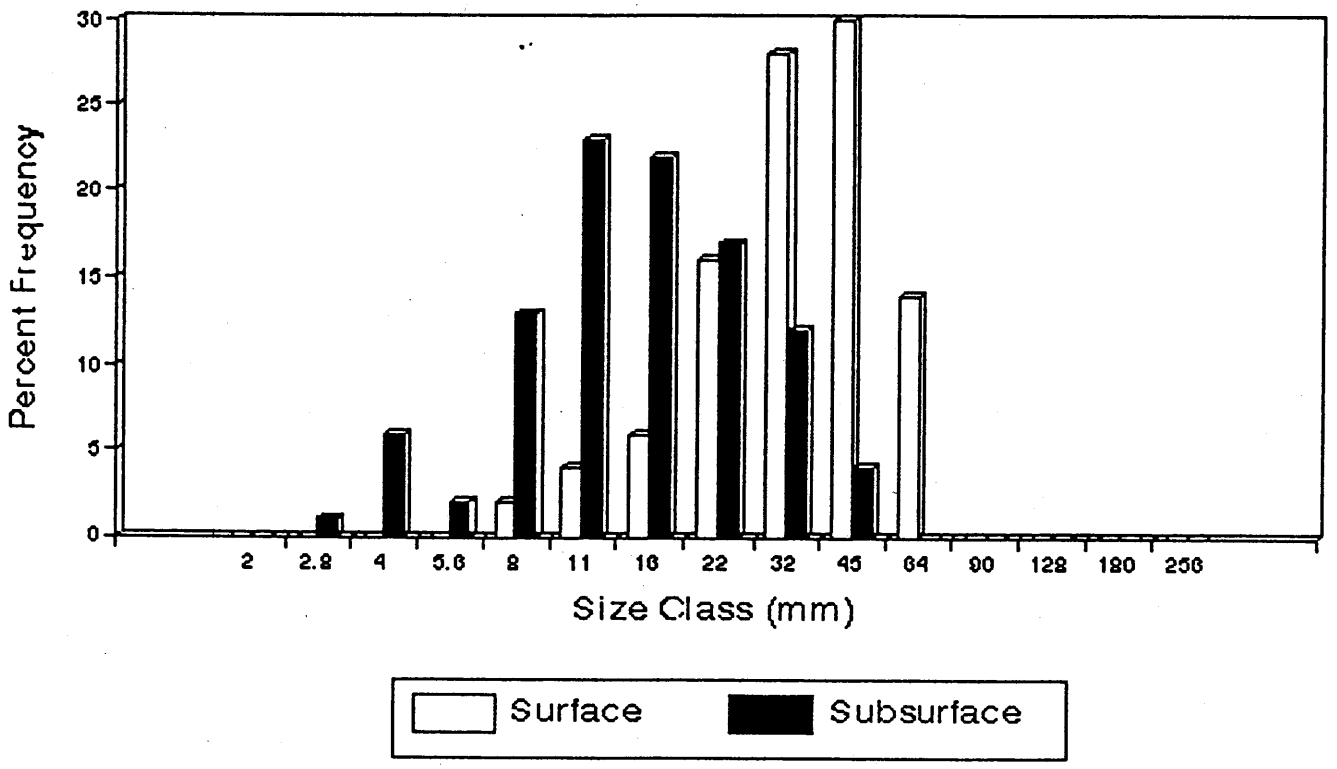
SOUTH FORK TOLT RIVER

Segment 100 (Mid Surface v. Subsurface)



SOUTH FORK TOLT RIVER

Segment 100 (Up Surface v. Subsurface)



Segment 119 - CRAZY CREEK - UPSTREAM OF LOG STRING BRIDGE

Segment 119 - Farthest pebble count downstream in segment.
Approximately 200ft upstream of brdige

Surface

D50 (mm) 10
D84 (mm) 14

Size (cm)	Count	Cumulative % less than size class
2	1	1%
2.8	7	8%
4	9	17%
5.6	6	23%
8	17	40%
11	39	79%
16	18	97%
22	3	100%
32	0	100%
45	0	100%
64	0	100%
90	0	100%
128	0	100%
180	0	100%
256	0	100%
Total	100	100%

d* = 1.25
q* = 0.41

Subsurface

D50 (mm) 8
D84 (mm) 10

Size (cm)	Count	Cumulative % less than size class
2	0	0%
2.8	0	0%
4	0	0%
5.6	0	0%
8	0	0%
11	0	0%
16	0	0%
22	0	0%
32	0	0%
45	0	0%
64	0	0%
90	0	0%
128	0	0%
180	0	0%
256	0	0%
Total	0	0%

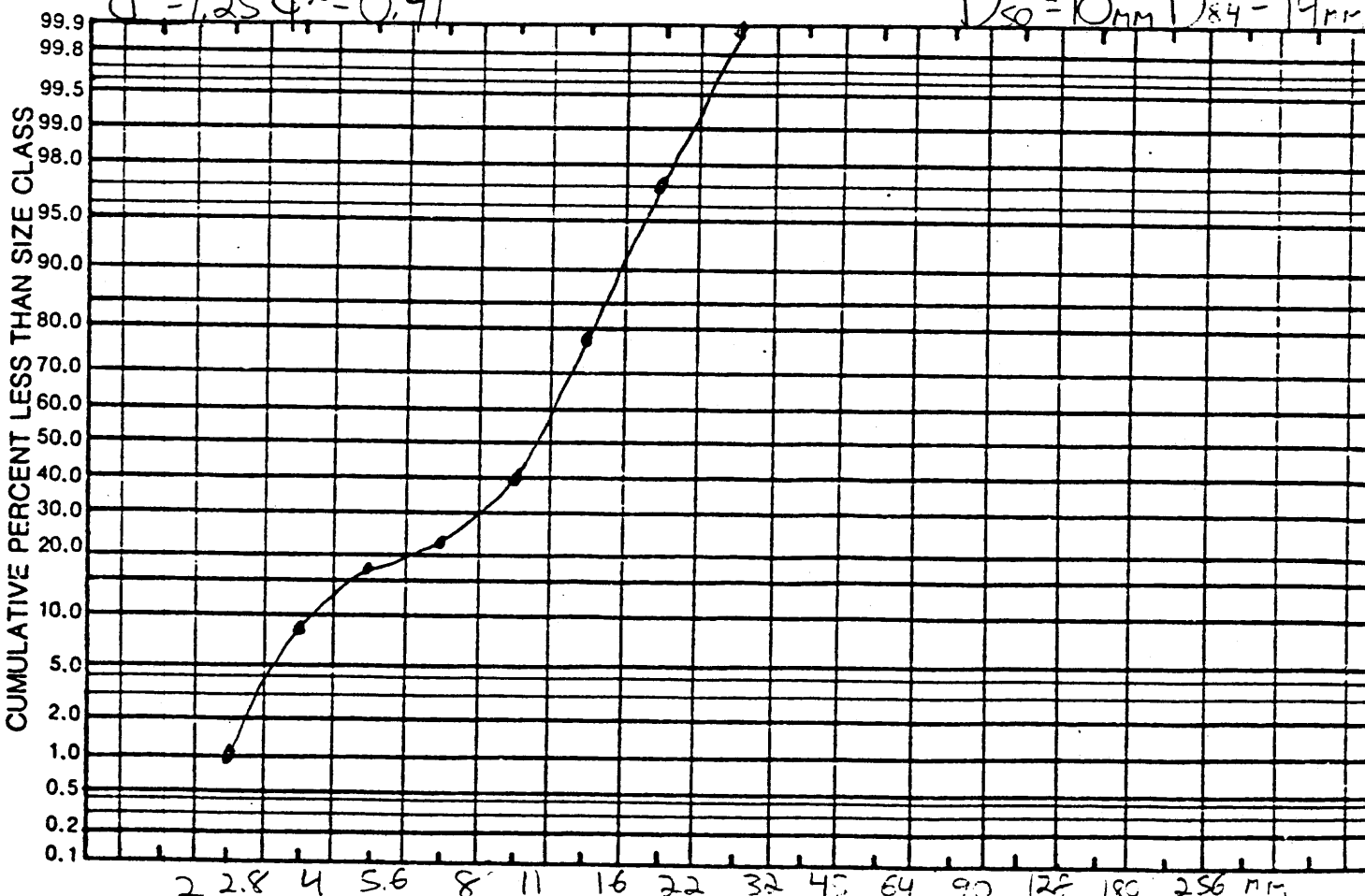
SAMPLE

SEGMENT 19

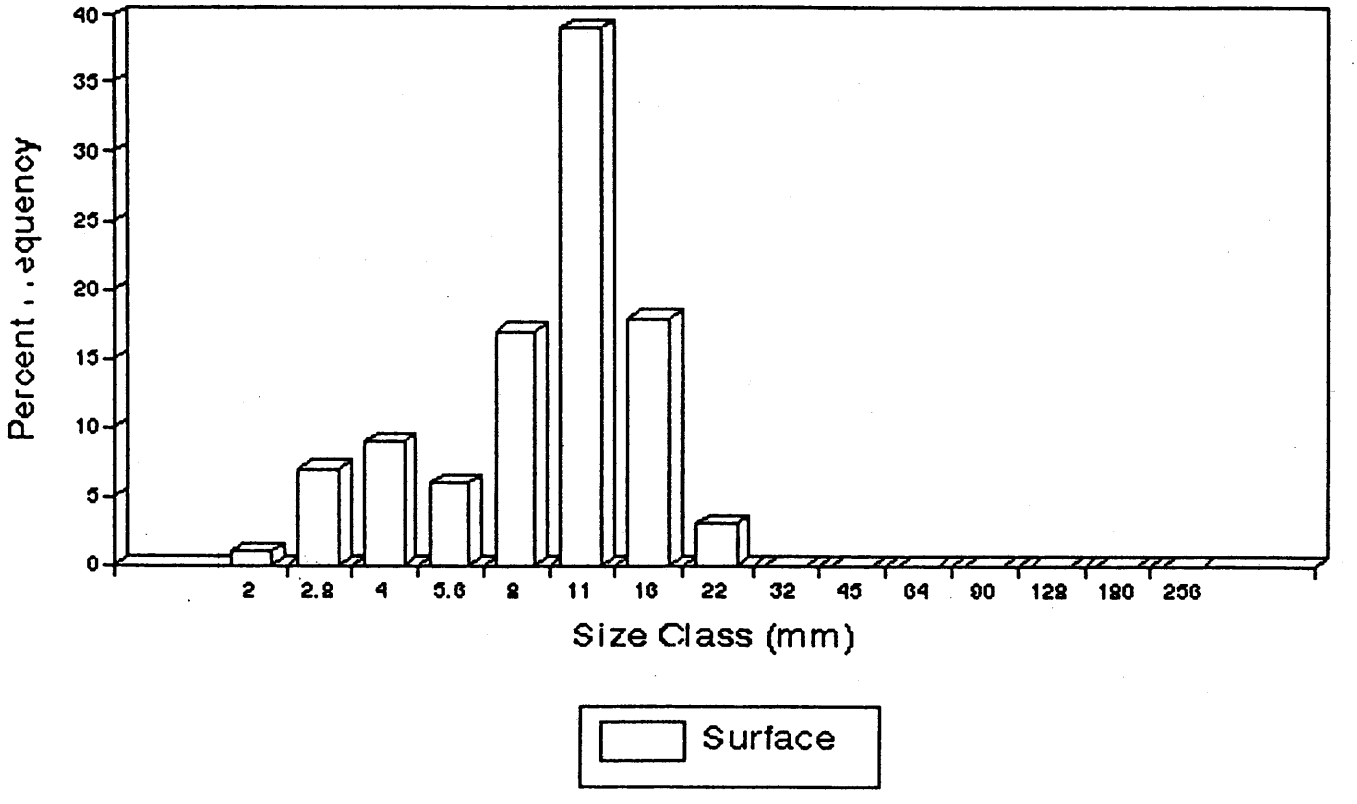
SURFACE

$d^* = 1.25$ $\sigma^* = 0.41$

$D_{50} = 10mm$ $D_{84} = 14mm$



CRAZY CREEK, TRIBUTARY OF LYNCH CREEK
Segment 119 (Surface)



Bed Surface Movement Flow Estimates

Segment #1 - Mainstem Of Toit River

Bankfull Dimensions -

Depth = 5 ft Width = 170 ft S = 0.0005

$g = 9.81\ m/sec^2 = 981\ cm/$

$\rho = 1\ g/cm^3$

Particle Size -

$D_{50} = 36mm = 3.6cm$ $D_{84} = 63mm = 6.3cm$

$\tau_c = 80(D_{50})$

$\tau_c = 80(3.6cm)$

$\tau_c = 288\ dynes/cm^2$

$\tau_c \approx \tau_b$

$\tau_b = \rho g h S$

$h = \frac{\tau_c}{\rho g S}$

$h = \frac{288\ dynes/cm^2}{(1\ g/cm^3)(981\ cm/sec^2)(0.0005)}$

$h = 5.87cm = 5.87m$

$\mu_* = \sqrt{\tau_b/\rho}$

$\mu_* = 16.97cm/sec$

$\bar{\mu} = \mu_* \times 2.5 \ln 3.14 \frac{h}{D_{84}}$

$\bar{\mu} = (16.97cm/sec) \times 2.5 \times \ln 3.14 \frac{(5.87cm)}{(6.3cm)}$

$\bar{\mu} = 241\ cm/sec = 2.41\ m/sec = 7.90\ ft/sec$

$Q = A\bar{\mu}$

$Q = (850\ ft^2)(7.9\ ft/sec)$

$\boxed{Q = 6,715\ CFS}$

SEGMENT 5 - NORTH FORK TOLT RIVER

BANKFULL

WIDTH = 165 FT DEPTH = 5.5 FT $S = 0.002$

PARTICLE SIZE: $D_{50} = 47\,mm = 4.7\,cm$ $D_{84} = 92\,mm = 9.2\,cm$

$\tau_c = 80\,(4.7\,cm)$

$\tau_c = 376\ dynes/cm^2$

$\tau = \rho g h S$

$h = \dfrac{376\ dynes/cm^2}{(1\,gr/cm^3)(981\,cm/sec^2)(0.002)}$

$u_* = \sqrt{\tau/\rho}$

$u_* = 19.39\,cm/sec$

$h = 191\,cm = 1.91\,m = 6.2\,ft$

$\bar{u} = (19.39\,cm/sec) \times 2.5 \times \ln 3.14 \dfrac{191\,cm}{9.2\,cm}$

$\bar{u} = 202\,cm/sec = 2.02\,m/sec = 6.64\,ft/sec$

$Q = A\bar{u}$

$Q = (990\,ft^2)(6.64\,ft/sec)$

$\boxed{Q = 6{,}573\ CFS}$

SEGMENT 63 - DRY CREEK, UPSTREAM OF CULVERT

BANKFULL -

WIDTH = 40 FT DEPTH = 2.29 FT $S = 0.0015$

PARTICLE SIZE: $D_{50} = 22\,mm = 2.2\,cm$ $D_{84} = 36\,mm = 3.6\,cm$

$$\tau_c = (80)(2.2\,cm)$$

$$\tau_c = 176 \text{ dynes/cm}^2$$

$$\tau_b = \rho g h S$$

$$h = \frac{(176 \text{ dynes/cm}^2)}{(1 \text{ g/cm}^3)(981 \text{ cm/sec}^2)(0.0015)} = 119\,cm = 1.19\,m = 3.9\,ft$$

$$u_* = \sqrt{\frac{176 \text{ dynes/cm}^2}{1 \text{ g/cm}^3}} = 13.26 \text{ cm/sec}$$

$$\bar{u} = (13.26 \text{ cm/sec}) \times 2.5 \times \ln 3.14 \frac{119\,cm}{3.6\,cm}$$

$$\bar{u} = 153.89 \text{ cm/sec} = 1.54 \text{ m/sec} = 5.04 \text{ ft/sec}$$

$$Q = A\bar{u}$$

$$Q = (92\,ft^2)(5.04\,ft/sec)$$

$$\boxed{Q = 464\,CFS}$$

Segment 64 - Dry Creek, Downstream Of Culvert

Bankfull -

Width = 25 ft Depth = 3 ft $S = 0.0015$

Particle Size -

$D_{50} = 27\,mm = 2.7\,cm$ $D_{84} = 46\,mm = 4.6\,cm$

$$\tau_c = 80(2.7\,cm)$$
$$\tau_c = 216\,dynes/cm^2$$

$$u_* = \sqrt{\tau_c/\rho} = \sqrt{216\,dynes/cm^2} = 14.69\,cm/sec$$

$$\tau_c = \rho g h S$$

$$h = \frac{\tau_c}{\rho g S} = \frac{216\,dynes/cm^2}{(1\,g/cm^3)(981\,cm/sec^2)(0.0015)}$$

$$h = 147\,cm = 1.47\,m = 4.82\,ft$$

$$\bar{u} = (14.69\,cm/sec) \times 2.5 \times \ln 3.14\left(\frac{147\,cm}{4.6\,cm}\right)$$

$$\bar{u} = 169\,cm/sec = 1.69\,m/sec = 5.55\,ft/sec$$

$$Q = A\bar{u}$$
$$Q = (75\,ft^2)(5.55\,ft/sec)$$
$$\boxed{Q = 416\,CFS}$$

Segment 94 - South Fork Tolt River

Bankfull -

Width = 105 ft Depth = 3 ft S = 0.003

$\tau_c = 80(3.3cm)$

$\tau_c = 264 \, dynes/cm^2$

$u_* = \sqrt{\tau_c/\rho} = \sqrt{264 \, dynes/cm^2 / 1 \, gm/cm^3} = 16.24 \, cm/sec$

$\bar{u} = (16.24 \, cm/sec) \times 2.5 \times \ln 3.14 \left(\frac{897 \, cm}{66 \, cm}\right)$

$\bar{u} = 152 \, cm = 1.52 \, m = 5 \, ft/sec$

$Q = A\bar{u}$

$Q = (315 \, ft^2)(5 \, ft/sec)$

$\boxed{Q = 1575 \, CFS}$

Segment 95 - South Fork Tolt River

Bankfull -

Width - 92 ft Depth - 1.96 ft S = 0.003

1990 Event - Width = 110 ft

Depth = 3.28 ft

Particle Size -

$D_{50} = 42 \, mm = 4.2 \, cm$ $D_{84} = 78 \, mm = 7.8 \, cm$

$\tau_c = 80(4.2cm)$

$\tau_c = 336 \, dynes/cm^2$

$h = \frac{336 \, dynes/cm^2}{(1 \, gm/cm^3)(981 \, cm/sec^2)(0.003)} = 86 \, cm = 0.86 \, m = 2.8 \, ft$

$u_* = \sqrt{336/1} = 18.33 \, cm/sec$

$\bar{u} = (18.33 \, cm/sec) \times 2.5 \times \ln 3.14 \left(\frac{86 \, cm}{7.8 \, cm}\right)$

$\bar{u} = 162 \, cm/sec = 1.62 \, m/sec = 5.32 \, ft/sec$

$Q = A\bar{u} = (180 \, ft^2)(5.32 \, ft/sec) = \boxed{959 \, CFS}$

Segment 100 - South Fork Tolt River

Bankfull:

Width = 80 ft Depth = 4 ft S = 0.004

Particle Size: $D_{50} = 30\,mm = 3.0\,cm$ $D_{84} = 55\,mm = 5.5\,cm$

$\tau_c = 80(3.0\,cm)$

$\tau_c = 240\ dynes/cm^2$

$$h = \frac{\tau_c}{\rho g h S}$$

$$h = \frac{240\ dynes/cm^2}{(1\,g/cm^3)(981\,cm/sec^2)(0.0}$$

$h = 61\,cm = .61\,m = 2\,ft$

$\mu_* = \sqrt{240\ dynes/cm^2} = 15.49\,cm/sec$

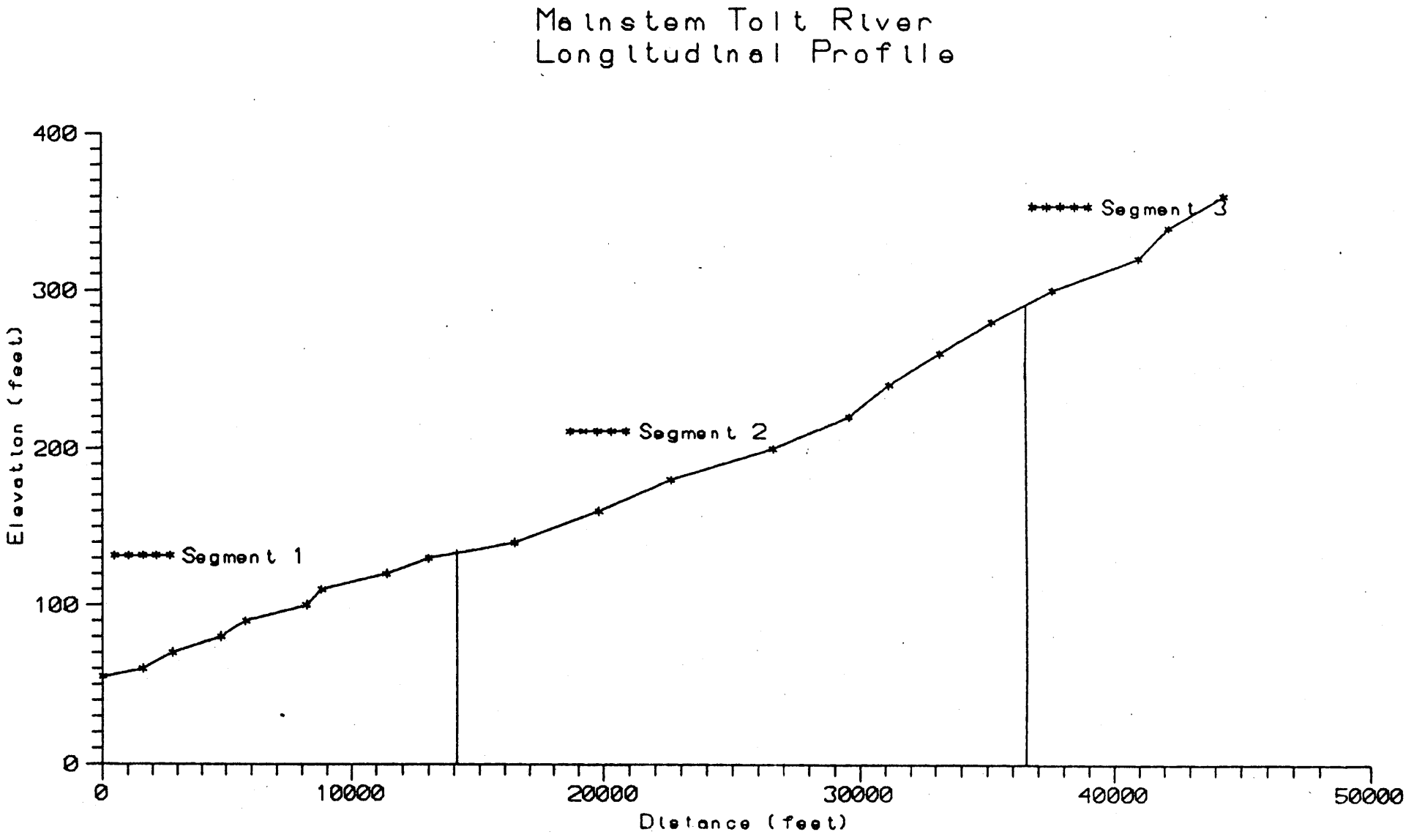
$\bar{u} = (15.49\,cm/sec) \times 2.5 \times \ln 3.14\left(\frac{61\,cm}{5.5\,cm}\right)$

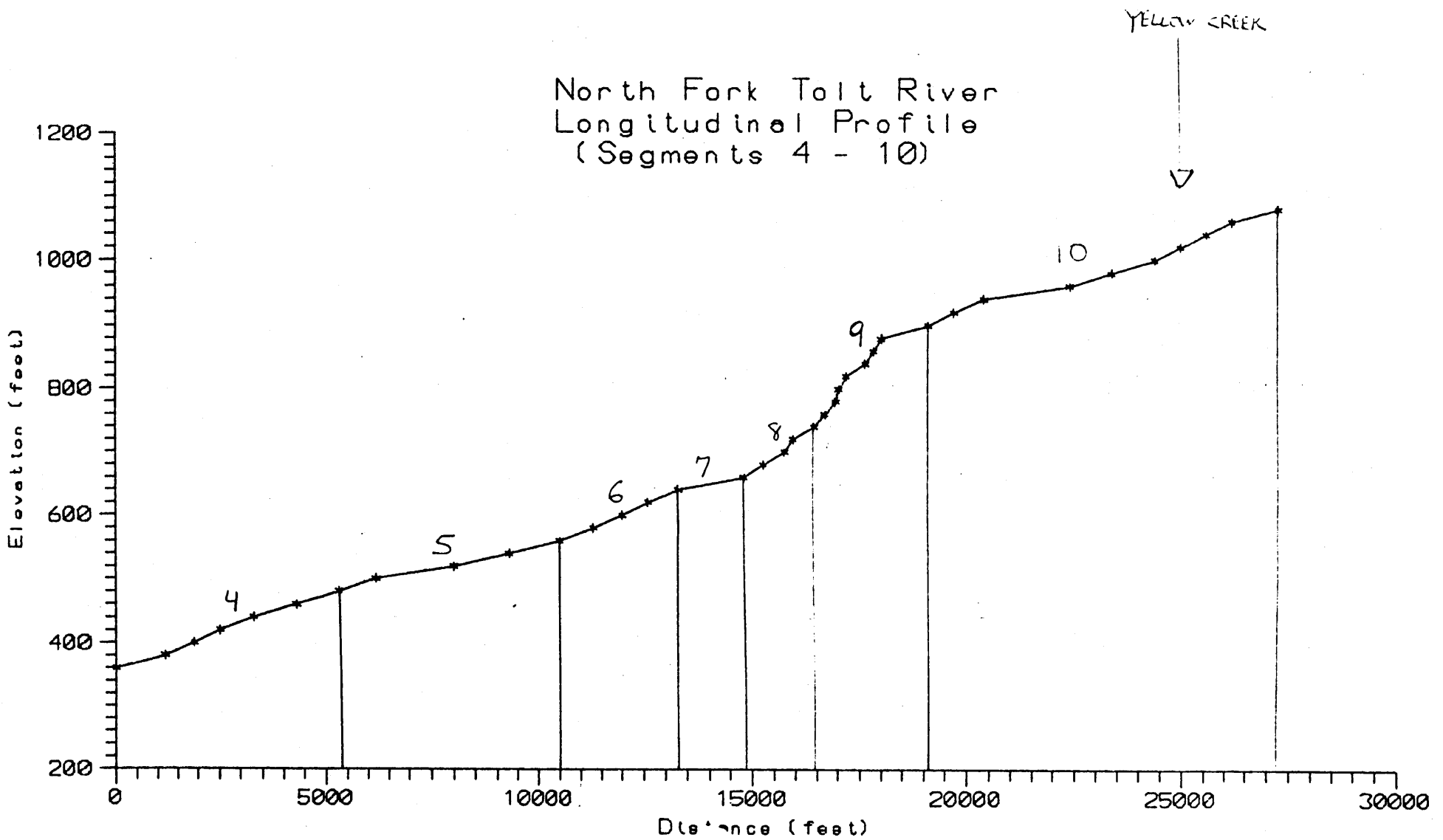
$\bar{u} = 138\,cm/sec = 1.38\,m/sec = 4.53\,ft$

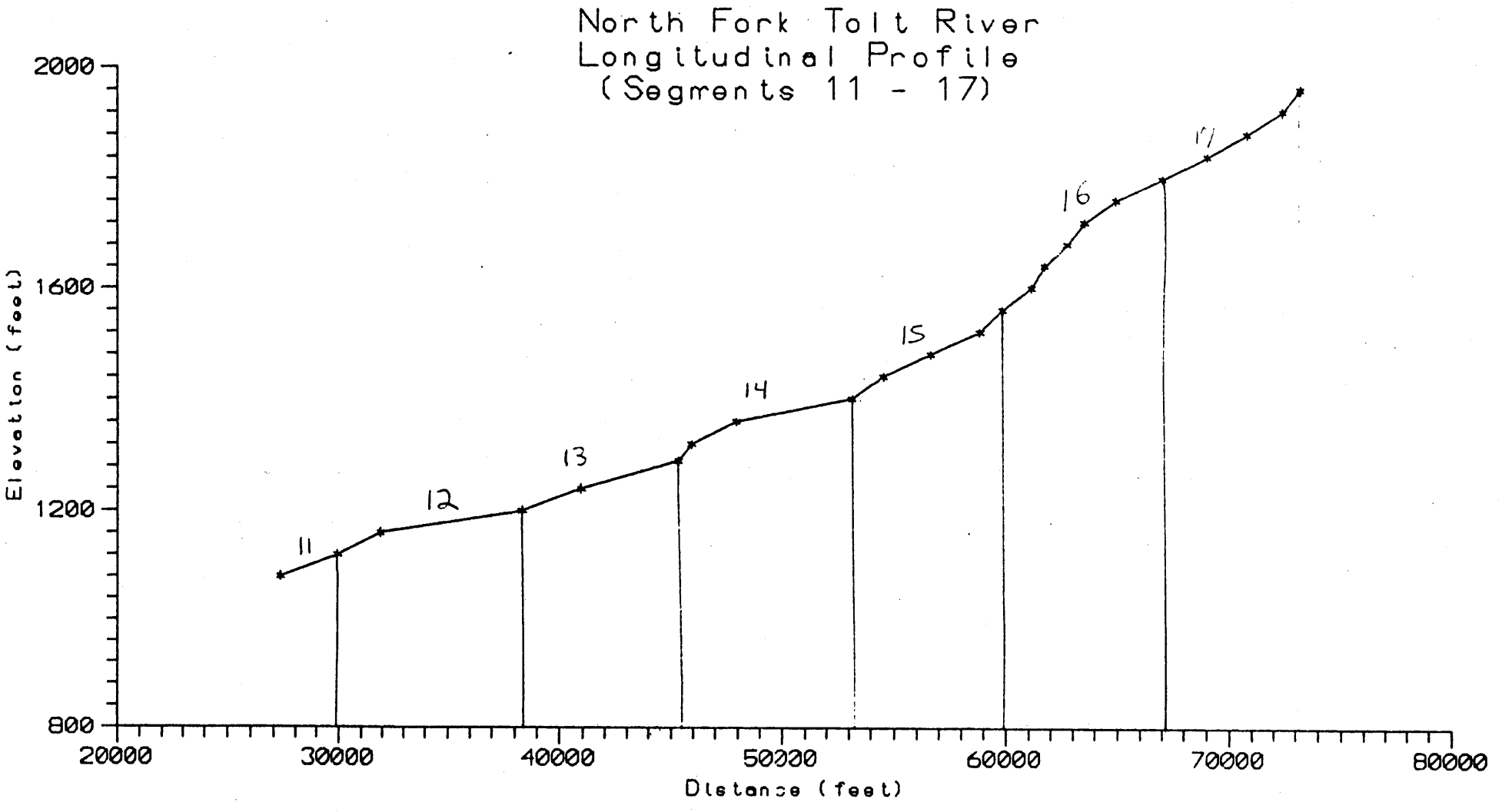
$Q = (320\,ft^2)(4.53\,ft/sec)$

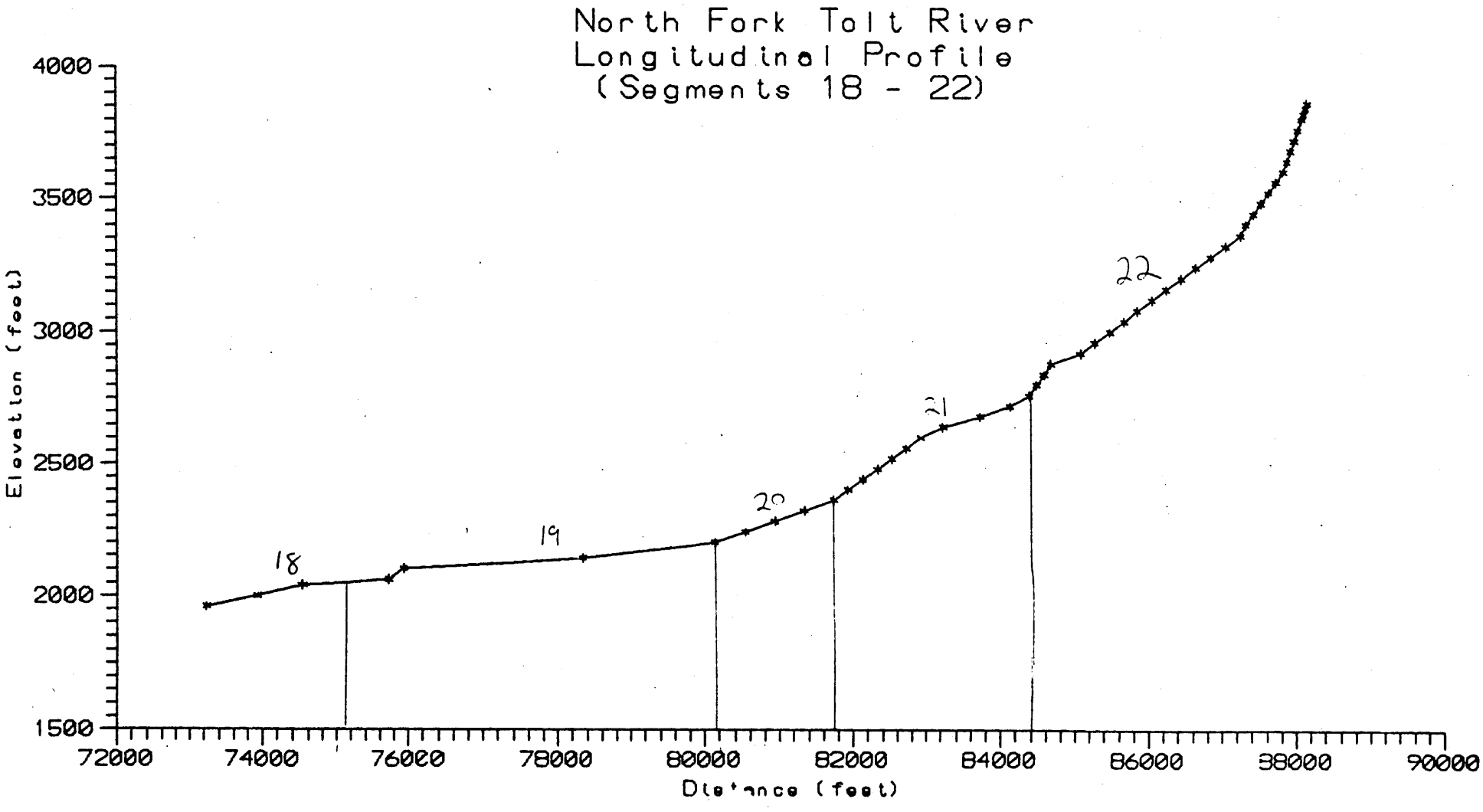
$Q = 1{,}450\,CFS$

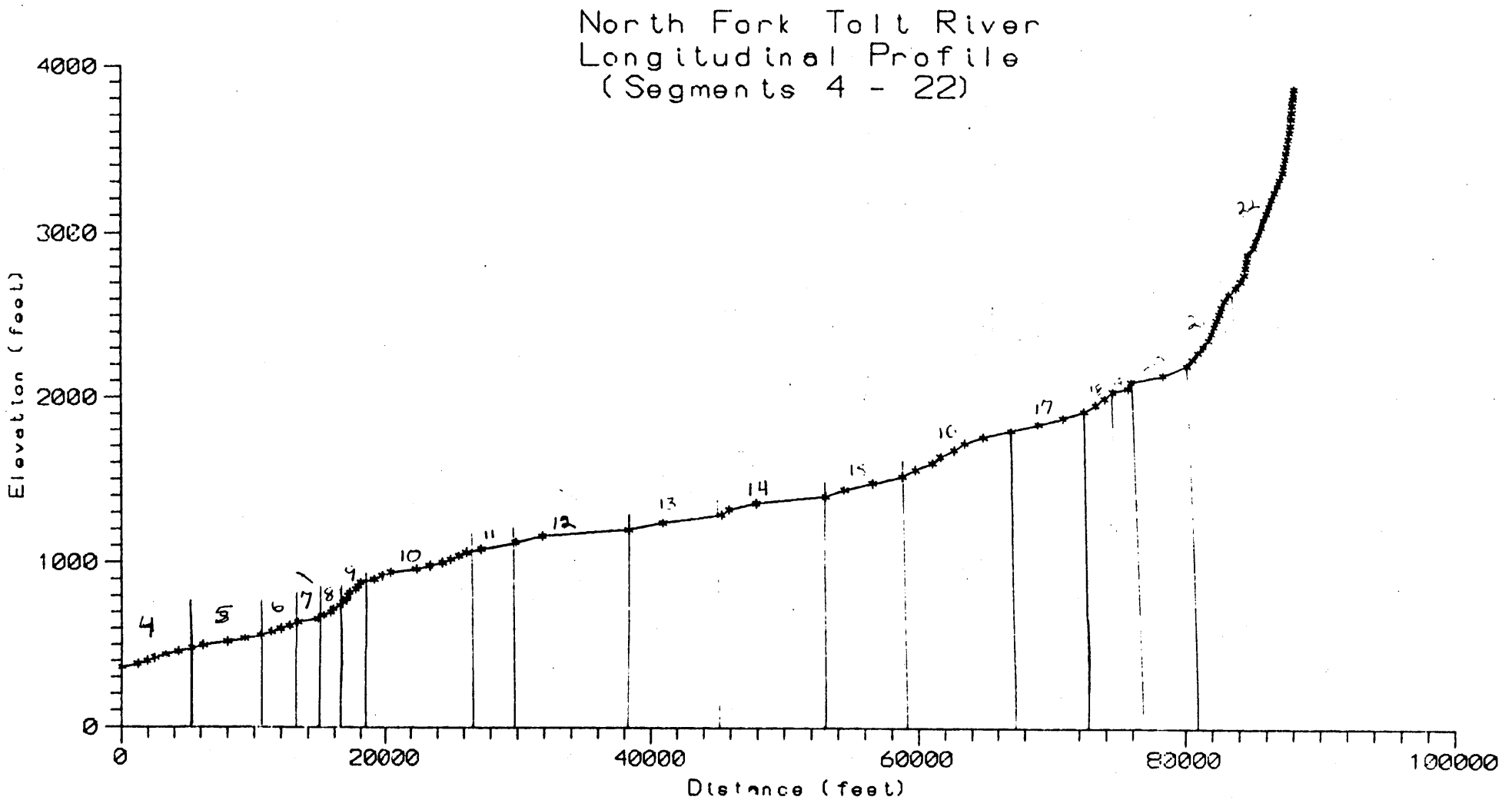
[illegible]	Q (CFS)
1	6,715
3	2,513
5	6,573
63	461
64	416
94	1,575
95	959
100	1,450


Mainstem Tolt River
Longitudinal Profile
Elevation (feet)
400
300
200
100
0
Segment 1
Segment 2
Segment 3
0
10000
20000
30000
40000
50000
Distance (feet)


YELLOW CREEK
North Fork Tolt River
Longitudinal Profile
(Segments 4 - 10)
1200
1000
800
600
400
200
Elevation (feet)
4
5
6
7
8
9
10
0
5000
10000
15000
20000
25000
30000
Distance (feet)


North Fork Tolt River
Longitudinal Profile
(Segments 11 - 17)
2000
1600
1200
800
Elevation (feet)
20000
30000
40000
50000
60000
70000
80000
Distance (feet)
11
12
13
14
15
16
17


North Fork Tolt River
Longitudinal Profile
(Segments 18 - 22)
Elevation (feet)
4000
3500
3000
2500
2000
1500
72000
74000
76000
78000
80000
82000
84000
86000
88000
90000
Distance (feet)
18
19
20
21
22


North Fork Tolt River
Longitudinal Profile
(Segments 4 - 22)
Elevation (feet)
Distance (feet)
0
1000
2000
3000
4000
0
20000
40000
60000
80000
100000
4
5
6
7
8
9
10
11
12
13
14
15
16
17
22

Estimated Sediment from Channel Widening
Segments 13, 15, 17 - North Fork Tolt

Actual widening occurred between 1942 → 1976. Following this period, bars were vegetated & future widening is mostly associated with loss of vegetation on bars during peak flows.

	Δ Area 42→76 (ft^2)	x 8 ft bank (ft^3)	Cubic Yds	CY/yr
Seg. 13	226,512	1,812,096	67,115	1,974
Seg 15	1,012,857	8,102,856	300,106	8,827
Seg 17	762,300	6,098,400	225,867	6,643
Total			~590,000 cy	17,000 cy/year w/ 8' bank height
			445,000 cy	13,000 cy/year w/ 6' bank height

- Much greater sediment contribution than from natural + harvest-related MW

Segment 15 - N Fk Tolt (from RAPID by C. Nelson) & "WegCo 3" from RAPID

Photo Year

Attributes	42	58	64	70	76	82	89	91
Canopy Open Area ft²	505,000 (not very open)	750,000	816,000	1,010,000	1,060,000	830,000	710,000	
% Riparian cut	none	37%	60%	100%	100% 5-16yrs	100% 11-27yrs	100% 17-33y	
Length (ft)*		5,015	5,207	5,247	5,303	5,085	4,844	
Avg Width		145	155	191	198	162	145	no photos but Seg 17 upstream saw width change from 162'→185' in the upper end & 134'→139' in lower end btwn 87-91
Floods		Highest flow in area in '35	Highest flow on record in '59 + 2nd major event	3rd highest flow on record	4th highest event.	unknown, but S Fk Tolt indicates lg events		
Titicaca		some opening no harvest	no change	no change	opens significantly 100% harvest	still open	still open (87)	
Trib E of Titicaca		some opening no harvest	no opening 100% harvest	opens significantly	continued opening	some recovery	narrowing due to veg (87)	
Pattern	Meandering, open	Meandering 1 split 4 bends	Meandering no splits 4 bends	Braided 2 bends	Braided, straighten 2 bends	More active braiding	More active braiding (87) Reduced sinuosity	
Comments		widening evident ... logs yarded across channel in places	loss of veg on bar + minor widening	Major widening at confluence w/ Dry Cr - actual widening rather than loss of veg on bars	Some recovery of veg on bars. Widens just downstream of Titicaca & of E of Titicaca	Increased veg near Dry Cr confl. & on bars	Area below Dry Cr widens (loss of veg on bars)	Probably due to '90 flood & loss of veg on bars

* Our analyses contradicts those lengths - this may include length of all splits in channels rather than length of the segment. Overall, channel has straightened concurrent with widening

Sediment from Bank cutting: '42 → '76 increase of 555,000 ft² open × 10 ft banks = 5,550,000 ft³ / 34 years
= 205,555 cy / 34 years
= 6,046 cy / year
from "WegCo 3"

if all sediment stays in segment = 5 feet of aggradation since '42

	Segment 103: South Fork Above Reservoir	Segment 13: (Wayco #4) North Fork	Segment 15: (upper 1/2 of segment coincides with Wayco 3) North Fork	Segment 17: (Wayco 1) North Fork
1942	A= 325,260. L= 5,004. $\bar{w}$= 65. %cut= 0.	535,788 5,600 96 0	1,287,111 11,000 117 0	849,420 ft² 8,000 106 0
1958	A= 300,000. L= 5,000. $\bar{w}$= 60. %cut: 100%	inadequate photo coverage	inadequate photo coverage %cut: 50% (North side)	inadequate photo coverage
1964	A= 758,000. L= 4,219. $\bar{w}$= 180. %cut: 100%, reservoir filled	453024 4750 95 100% - some leave trees		
1970	A: 682,440. L: 4,088 $\bar{w}$: 167. %cut:	483516 4750 102		892,980 6500 137
1976	A: L: $\bar{w}$: %cut:	762300 5475 139	2,299968 12,384. 186	1611720 8164 197
1982	A = 662,112 L: 3750 $\bar{w}$: 177 %cut:			1981980 9587 207
1987	A = 635,976 L = 3750 $\bar{w}$ = 169 %cut:	574992 4550 126	1089000. 9575 114	980100 6575 149
1989	A: L: $\bar{w}$: %cut:			
1990	A: L: $\bar{w}$: %cut:	514008. 4750 108.	1,123,848. 9350. 120	
1991	A: L: $\bar{w}$: %cut:			958320. 5875 163

King County Surface Water Management
Everyone lives downstream

TOLT NORTH FORK SEDIMENT BUDGET

Date 3-26-93

Project

Sediment Delivered to N. Fk. Tolt
Volume in cubic yards

Drainage area @ gage = 40 mi²
Use 1.5 T = 1 cu yd

	1950 - 1964	1964 - 1977X6	1977X6 - 1982	1982 - 1992	1950 - 1992	T/mi²/yr
A. NATURAL COARSE-SEDIMENT SOURCES [2]						
Slides into river	18,000	0	0	0	18,000	
Slides into tribs [1]	3,000	0	3000	0	6,000	
Total	21,000	0	3,000	0	24,000	21
B. HARVEST-RELATED COARSE-SEDIMENT SOURCES [2]						
Slides into river	4,000	30,000	8,000	7,000	49,000	86 → on the low side for [illegible]
Slides into tribs [1]	14,500	12,000	11,250	9,750	47,500	
Total from HCU	18,500	42,000	19,250	16,750	96,500	
Bank erosion in [3] Segs 13, 15, 17		590,000 (btwn 76→92)	some bar erosion, much less sediment, general reduction in erosion →		590,000	

Bottom line: Harvest-related sources of sediment in the N. Fk. appear to be a significant part of the bedload at the mouth of the Tolt River. However, ~~from~~ aerial photos taken in the 30's and 60's clearly show that there was abundant sediment deposition then, before harvest activities on the N. Fork would have delivered any coarse sediment to the mouth. So, harvest-related sed. is probably aggravating the problems at the mouth, but by no mean is the cause.

1 landslide volumes have been multiplied by a Sediment Delivery Ratio of 50%
2 These are total volumes, including fine sediment
3 Assuming a 8-foot depth of erosion.

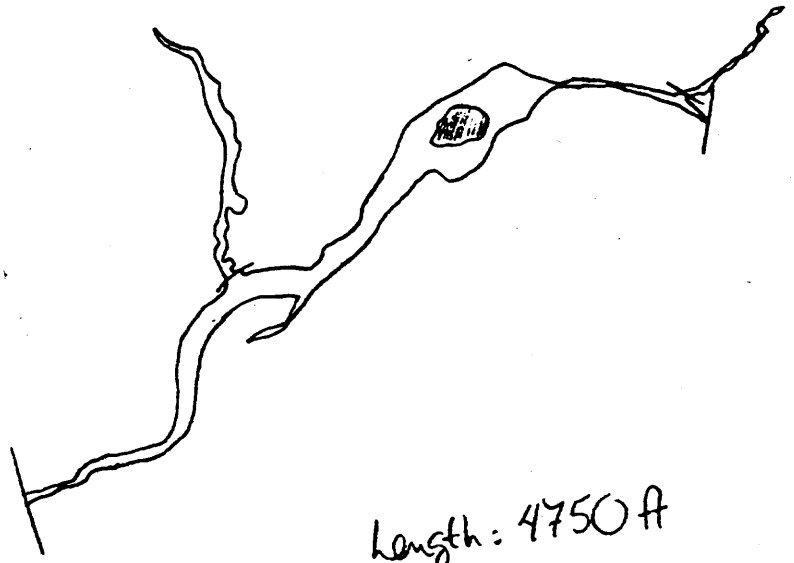
Segment 13 - North Fork Tolt
Aug. 1942 (Sheet 18-30 & 19-30 COE)
1:20,000

Length = [redacted] ft
Area = 12.9 acres = 535,788 ft²
Avg w = [redacted] 96 ft

1:12:000(?)

53-36

North Fork Tolt
Segment 13
Active channel area in 1964

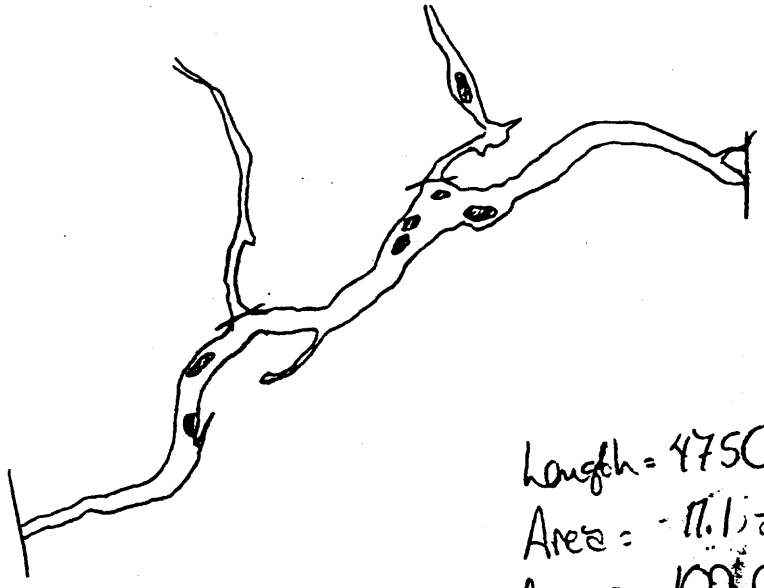


Length: 4750 ft
Area: 10.4 acres
Avg w = 95 ft

1:12:000 (?)

54D-1

North Fork Tolt
Segment 13
Active channel area in 1970



Length = 4750 ft
Area = 11.1 acres
Avg w = 102 ft

7-18-76 1:14,600

66B-43

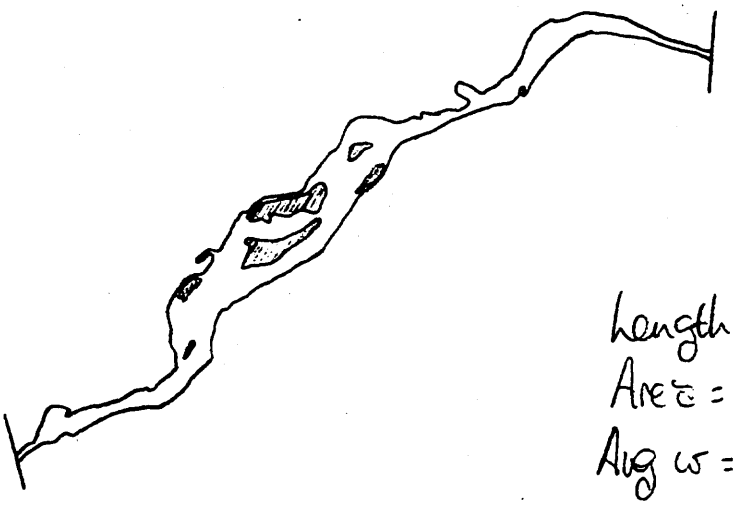
North Fork Toh
Segment 13
Active channel area in 1976

Length = 5475 ft
Area = 17.5 acres
Avg w = 139 ft

1:12,000

52A-133

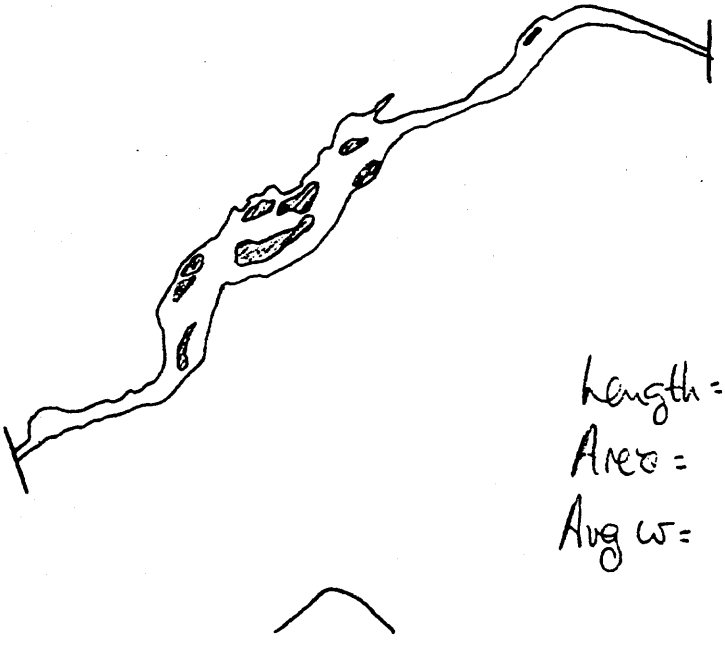
North Fork Tolt
Segment 13
Active channel area in 1987



Length = 4550 ft
Area = 13.2 acres
Avg w = 126 ft

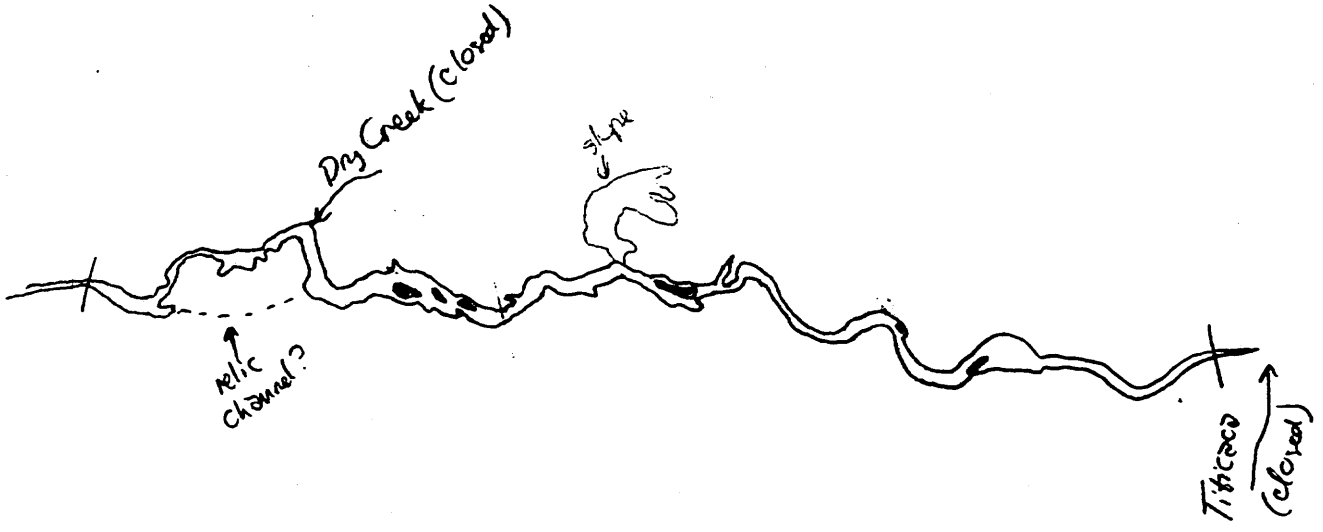
88-27

North Fork Toutt
Segment 13
Active channel area in 1990



Length = 4750 ft
Area = 11.8 acres
Avg w = 108 ft

Seg 15 - North Fork Tolt
Aug 1942 (Sheet 18-30 COE)
1:20,000

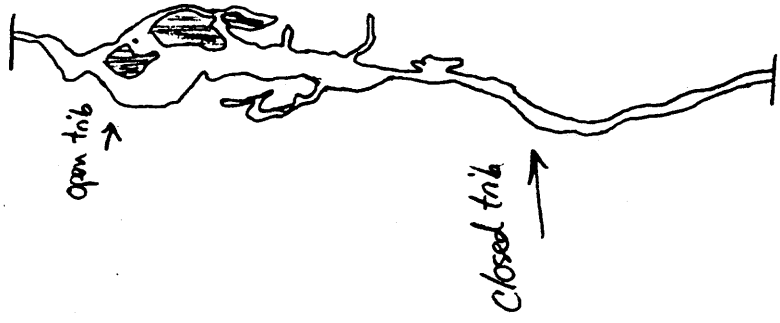


Length = ~~12,600 ft~~ 11,000 ft
Area = 16.6 acres = 723,096 ft² + 12.9 acres = 564,015 = 1,287,111
Avg w = [illegible] ft

1:15,200

670-2

North Fork Tolt
Segment 15 (lower ½)
Active channel area in 1996

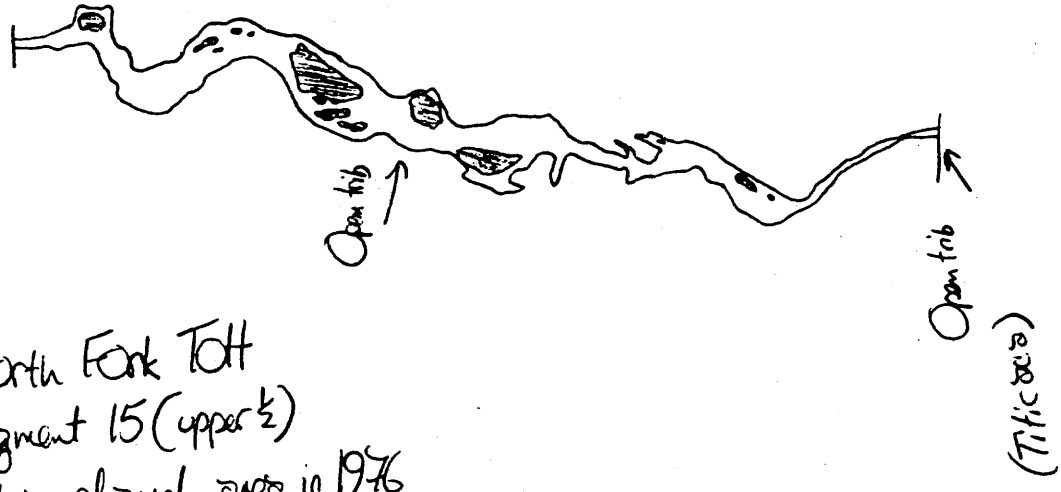


Length = 5416 ft
Area = 22.8 acres
Avg w = 183 ft

7 20 76

1:15,200

68D-20

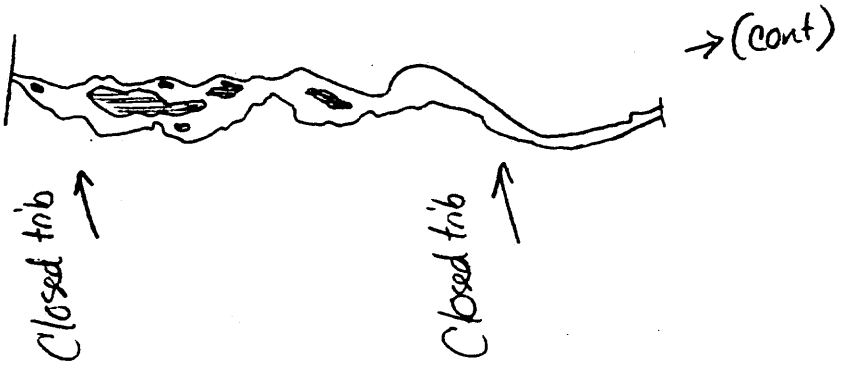


North Fork Toit
Segment 15 (upper ½)
Active channel area in 1976

Length: 6968 ft
Area: 30 acres
Avg w: 188 ft

1:12:000

North Fork Toll
Segment 15 (lower ½)
Active channel area in 1987



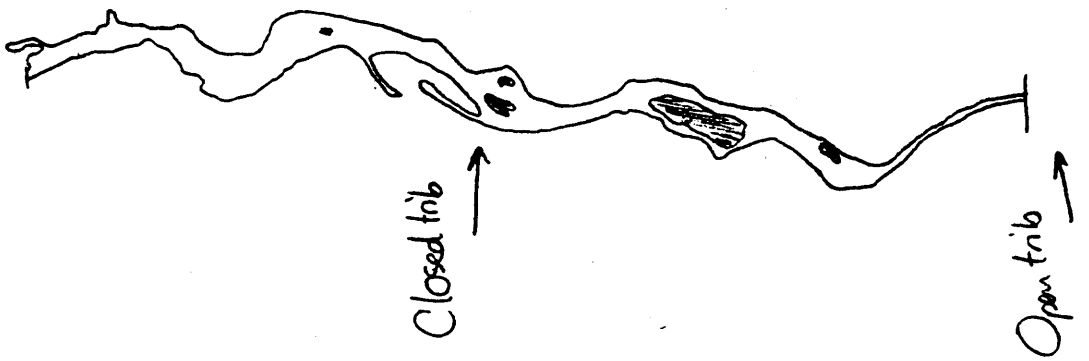
Length = 3750 ft
Area = 10 acres
Avg w = 116 ft

1:12:000

254B-250

North Fork Tolt
Segment 15 (upper ½)
Active channel area in 1987

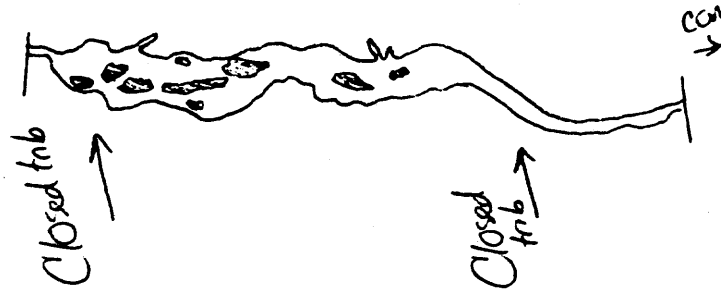
(Cont) ←



Length = 5825 ft
Area = 15 acres
Avg w = 112 ft

1:12:000 (?)

North Fork Tolt
Segment 15 (lower ½)
Active channel area in 1990

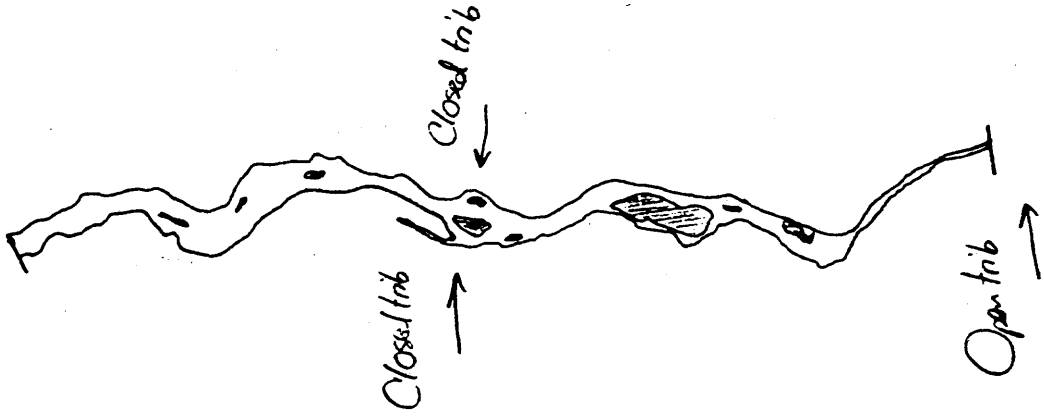


Length = 3675 ft
Area = 11.5 acres
Avg w = 136 ft

8-5-90

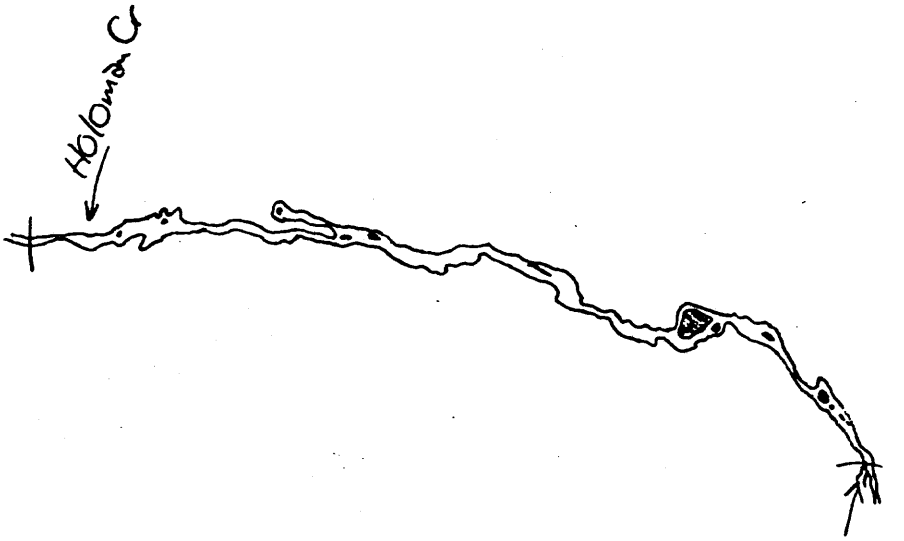
1:12:000(?)

North Fork Toft
Segment 15 (upper ½)
Active channel area in 1990



Length = 5675 ft
Area = 14.3 acres
Avg w = 110 ft

Seg 17 - North Fork Tolt
Aug 1942 (Sheet 18-31 COE)
1:20,000

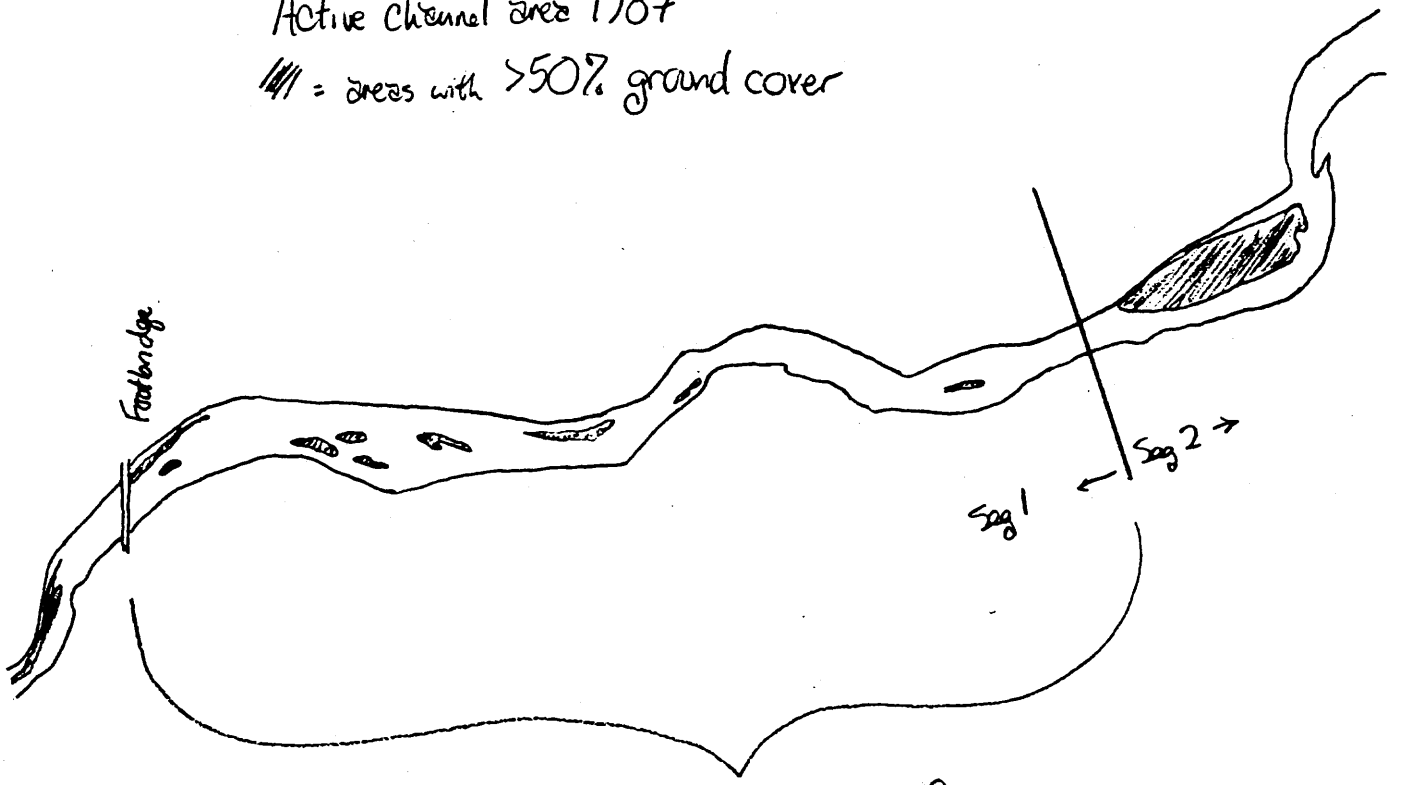


Length = 8,000 ft
Area = 19.5 acres = 849,420 ft²
Avg w = 106'

1:12,000

243A-91

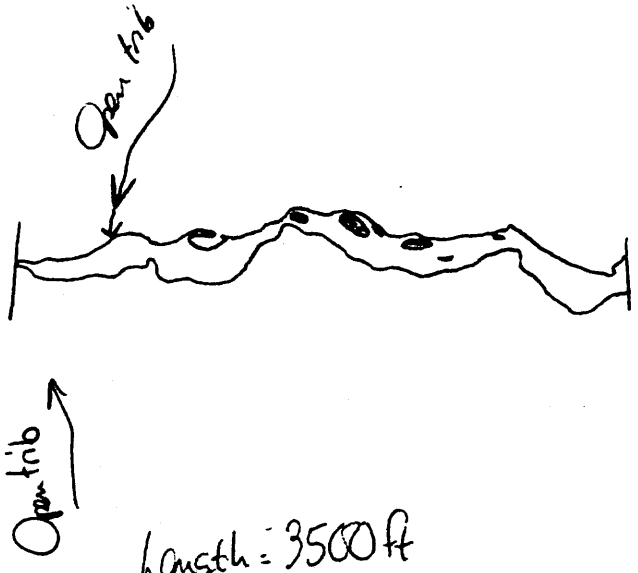
Mainstem Toft River
Segment 1
Active channel area 1987
/// = areas with >50% ground cover



Length = 5,500 ft
Area = 27 acres
Avg w = 214 ft

1:12,000

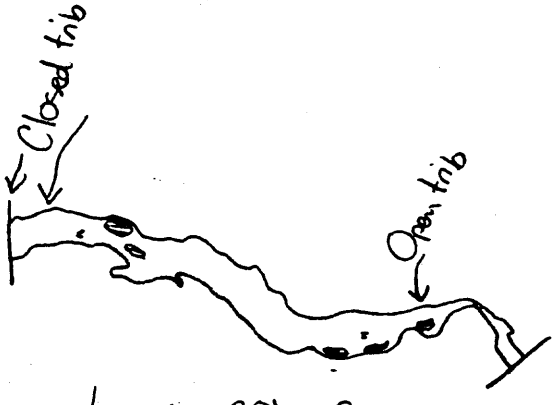
North Fork Toll
Segment 17 (lower ½)
Active channel area in 1987



Length = 3500 ft
Area = 13 acres
Avg w = 162 ft

1:12,000

North Fork Toit
Segment 17 (upper ½)
Active channel area in 1987



Length = 3075 ft
Area = 9.5 acres
Avg w = 134 ft

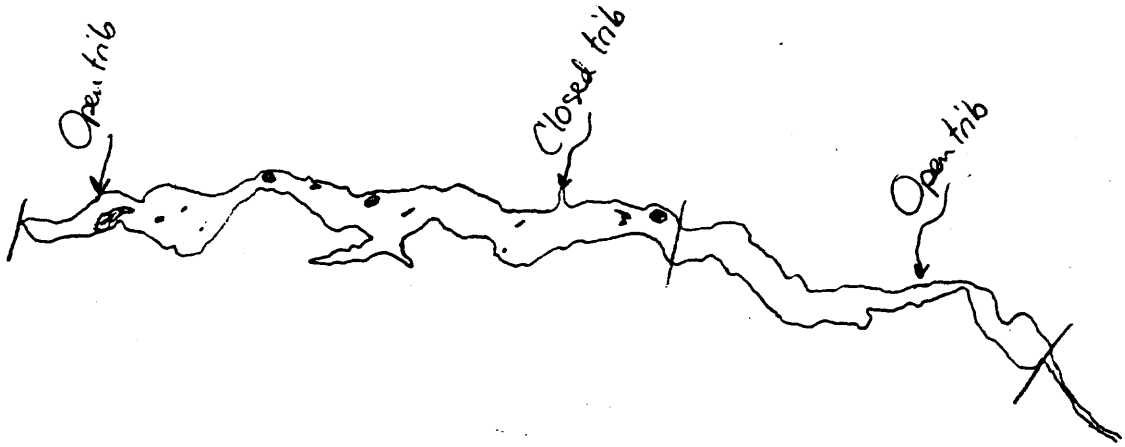
8-17-91

1:12,000

1591-197

(USFS photo)

North Fork Tolt
Segment 17
Active channel area in 1991



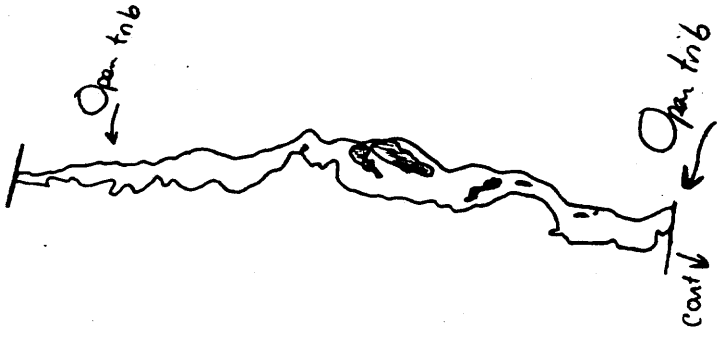
Lower ½:
Length = 3625 ft
Area = 15 acres
Avg w = 185 ft

Upper ½:
Length = 2250 ft
Area = 7 acres
Avg w = 139 ft

(1:12,000?)

21-58C-19

North Fork Toll
Segment 17 (lower ½)
Active Channel area in 1970



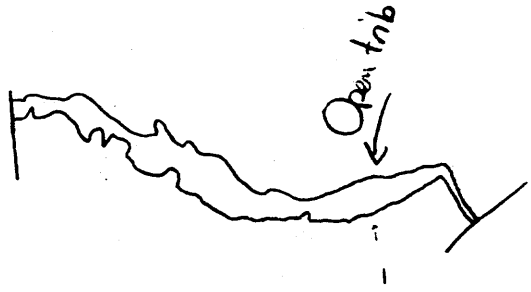
Length = 3750 ft
Area = 12 acres
Avg w = 139 ft

6-5-70

(1:12,000?)

21-59D-18

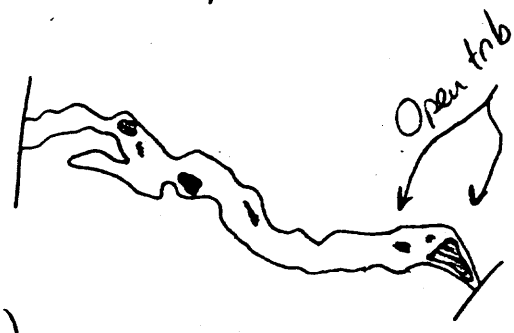
North Fork Tolt
Segment 17 (Upper ½)
Active channel area in 1970



Length = 2750 ft
Area = 8.5 acres
Avg w = 135 ft

1:16,000

~~EO~~-19
71D-



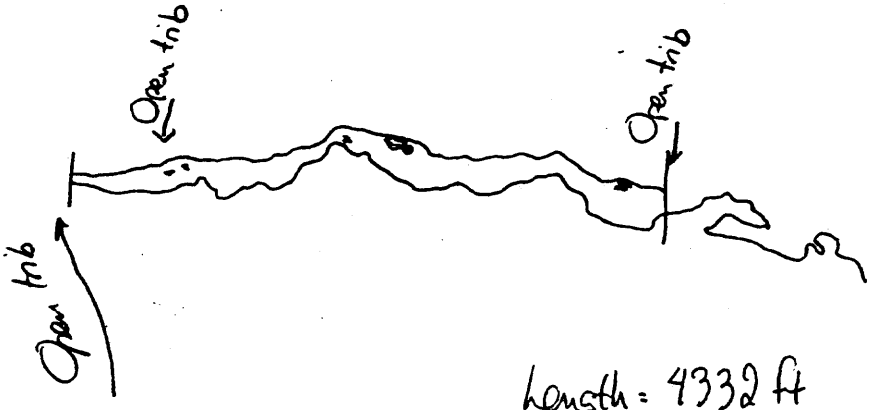
North Fork Toft
Segment 17 (upper ½)
Active channel area in 1976

Length = 3832 ft
Area = 17.5 acres
Avg w = 199 ft

1:16,000

7OD·22

North Fork Toft
Segment 17 (lower ½)
Active channel area in 1976



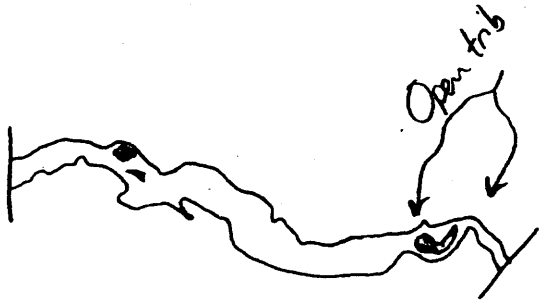
Length = 4332 ft
Area = 19.5 acres
Avg w = 196 ft

8-20-82

1:17,700

75C-18

North Fork Toll
Segment 17 (upper ½)
Active channel area in 1982



Length = 4425 ft
Area = 22.5 acres
Avg w = 221 ft

8-20-82

1:17,700

74C-17

North Fork Tolt
Segment 17 (lower ½)
Active channel area in 1982

Length = 5162 ft
Area = 23 acres
Avg w = 194 ft

South Fork Tolt - Segment 103
- from bridge Xing downstream to reservoir

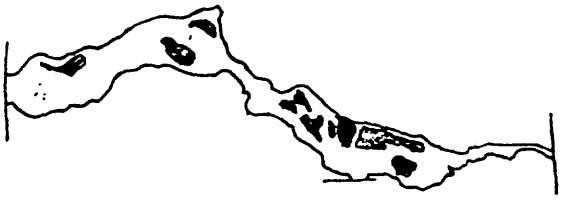
Aerial photo interps:

Year	Scale	Area ft²	Length (ft)	Avg w (ft)	Riparian Veg & Condi
1942	1:20,000	325,260	5,004	65	Intact - closed, channel
1958	1:15,000	300,000	5,000	60	100% logged, yarded across channel
1964		758,000	4,219	180'	Reservoir filled in '62 Braided, open
1970	1:14,000	682,440	4,088	167'	Braided, open
1982	1:15,000	662,110	3,750'	177'	" "
1987		635,976	3,750'	169'	" "

Widening between '58-64 Δ area = 458,000 ft² × 5' bank ht = 2,290,000 ft²
= 85,000 cy
14,000 cy/year over
6 years

1964
~~1968~~
South Fork Tolt
Seg 103

Area = 757,944 ft²
Scale 1:15,000



8-5-70

South Fork Toll 1970
Seg 103
Area = 682,440'
Length = 4,088'
Avg w = 167'

23
25
28

SOUTH FORK TOLT
SEGMENT 103
1982

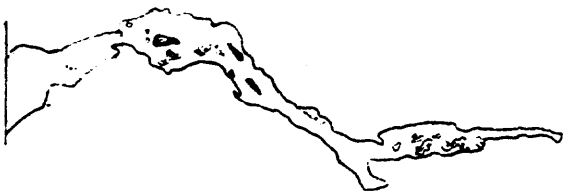
SCALE: 1" = 15,000

LENGTH = 3750 FT
WIDTH = 177 FT
AREA = 662,112 FT²

662,112 ft²

SEGMENT 103
SOUTH FORK TOLT
1987

LENGTH: 3750 FT
WIDTH: 169 FT
AREA: 635,976 FT²

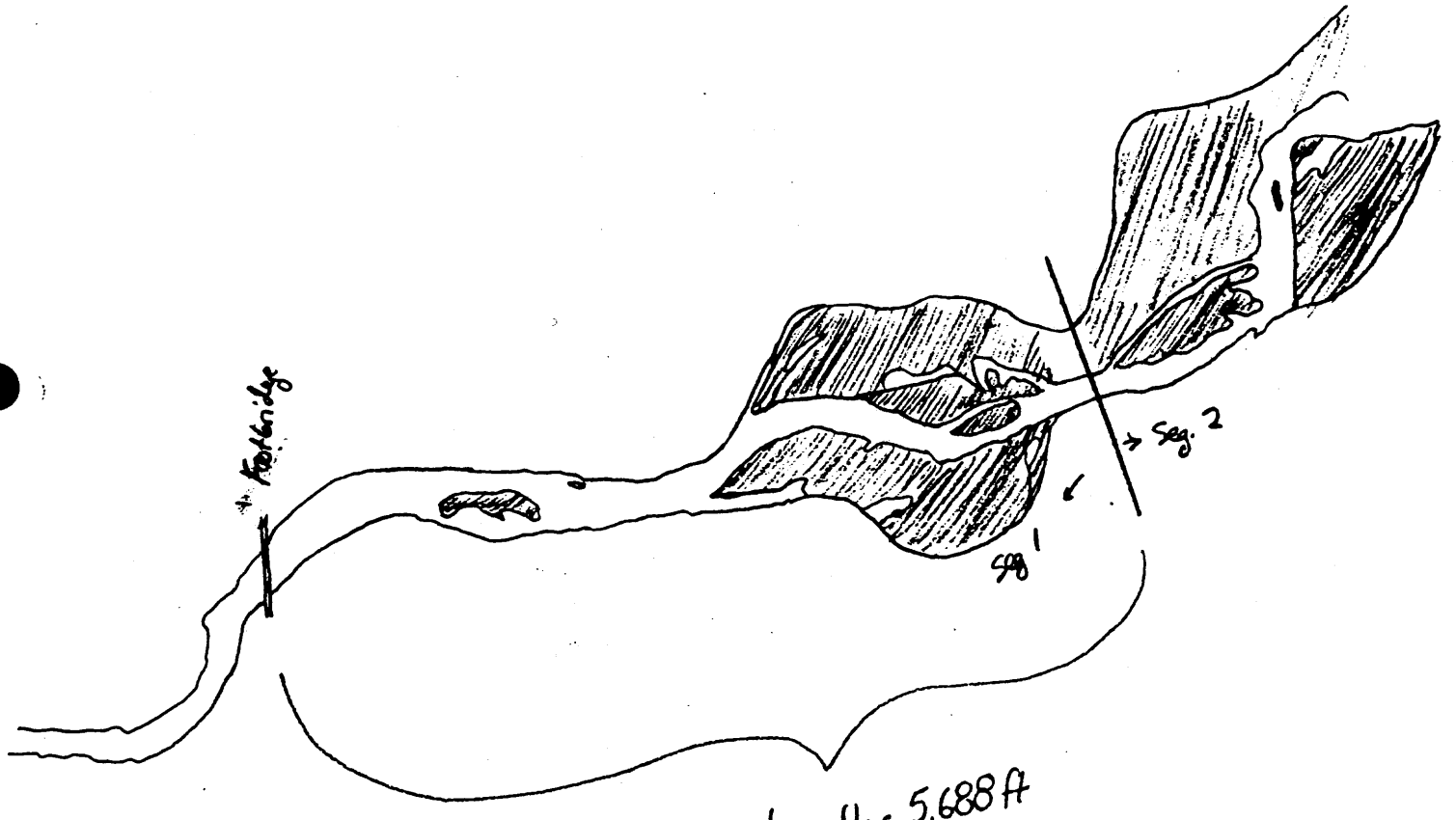


7-25-76

1:14,000.

57C-22

Mainstem Tolt River
Segment 1
Active channel area 1976
▨ = areas with >50% ground cover



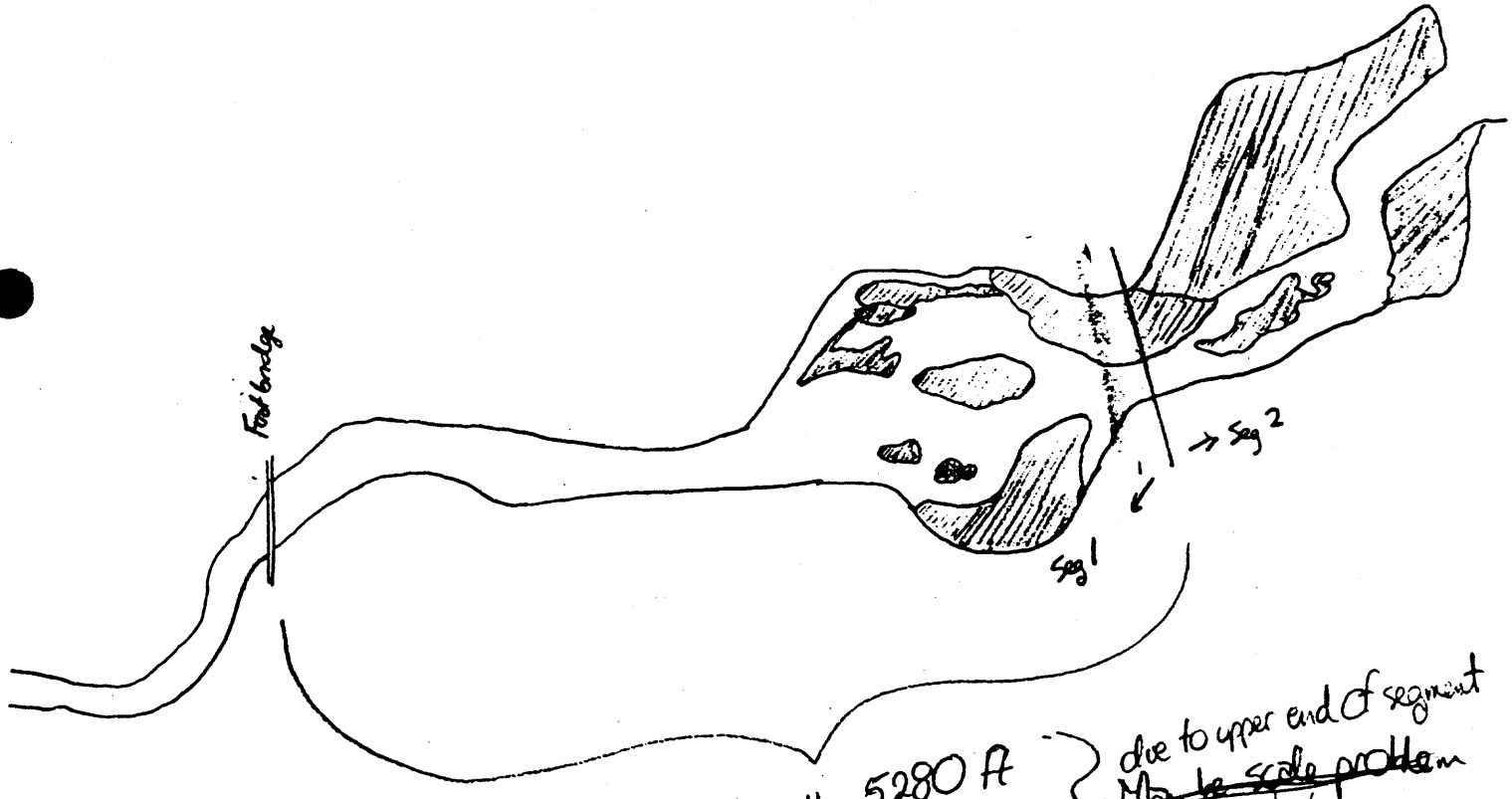
Length = 5,688 ft
Area = 37 acres
Avg w = 283 ft

6-2-70

~~1:12,000~~ 1:13,000?

15-45-80

Mainstem Tolt River
Segment 1
Active channel area 1970
/// = areas with >50% ground cover



Length = 5280 ft
Area = 59 acres
Avg w = 486

due to upper end of segment
~~May be scale problem~~

Form ee-5 Channel Segment Condition Worksheet

Segment Number	Gradient-Confinement Class		Sediment Supply			Transport Capacity		Historical Changes	Channel Sensitivities					
	Remote	Field	V*	Coarse Input Level	Fine Input Level	q.	d.		CS MS	FS	Peak Flow	LOD	DT	Confidence
1 (mainstem)	<1 UC	<1 UC	too deep to measure est. .10-.20	n/a	balanced (or slightly under-supplied) moderate sensitivity	0.13-0.18	well-developed armor	-ΔW 70-87 +ΔW 87-92 (90 flood) gradual narrowing, then slight increase following 90 flood.	n/a	moderate	moderate	low	low	
3 (mainstem)	1-2 TC	1-2 TC	High- 0.72-0.95 in eddy pool behind large boulder; represents ≈20% of pools observed	n/a	n/a	0.15-0.24	well-developed armor	little change in width; increased veg on some bars; two bars established post 90 flood in upstream end.					low	
6 (North Fork)	2-4 TC	2-6 TC	too deep est. <.10	under-supplied - coarse bed (cobble/boulder) - small particles scarce - armoring	n/a	0.135-0.16 low sensitivity low sed supply relative to transport capacity	2.5-3.5	little change gradual increase in vegetation on bars	low	n/a	moderate in upper ½ (alluvial & non-cohesive banks); low in lower ½	low (mostly on bars but dominant sources (story banks))	mod	

* Did not fill this form out for all segments redundant with form ee-6. Page 2 of ee-6 was designed to replace form ee-5 *

Form ee-6. Segment summary sheet of input factor indicators

Segment 1(<1UC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Lg cobble / gravel, fines in backwater areas, some boulders on bars			Fines largely absent from scour pools - in backwater areas & patches on bars
	Bed armoring	Bars & riffle areas well-armored			—
	Q*	0.13 0.14 0.13			
Active Channel	W/D ratio	Controlled by riprap & levees on both banks (9)	Cut off from floodplain		
	Bars and Deposits	Numerous midchannel & point bars; 50-75% of bottom affected		Deposited on upstream end of bars in clumps & single pieces.	Increased veg on midchannel & pt bars up to '90 flood, then decrease; now recovering
	Pool Dimensions	Scour pools ≈ ½-¾ of ACW; several fully span the channel		Does not contribute to pool formation	
	Ratio P:R			40:60	
	V*	Couldn't measure (too deep)			
	Channel Pattern	Some braiding; frequent splitting - 'normal' for mouth of large river where it exits confined valley			Gradual reduction in braiding & splitting
	Bank Material	Riprap - large angular boulders	Riprap & levees mostly intact after '90 flood-earthquake		
	Bank Erosion	n/a	n/a	n/a	Riprap & levees mostly intact after '90 flood
	Obstructions			Does not obstruct channel - pools from bedform	n/a
Flood-plain	Historic	Evidence of narrowing, increased veg on bars	Riprap, levees reduce overbank flows		No evidence
	Terrace Features	No change evident			No evidence
	Deposits	No overbank deposits evident			Wood deposited overbank during '90 flood
	Disturbance				Overbank flows in '90 flood damaged floodplain structures (road)

Interpretation

Zone of coarse sediment deposition as channel widens after exiting more confined segments upstream. Fines flushed from thalweg & deposited in backwater areas. } Sediment

Extensive deposition & armoring indicate moderate damage from peak flows; trise, unconsolidated bottom indicates moderate potential for damage from peak flows. Diked banks may result in more bottom scour. } Flow

LOD mostly in clumps & individual pieces on bars. Little } Wood

Segment Diagnostic Form

Segment Number: 1 (<1 UC) (Mainstem) **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Gradual reduction until '90 flood; then increase.	Zone of deposition due to position in drainage network. Armoring & increasing veg on bars indicates ↓ sed load btwn 90-92. Evidence of aggradation also	High (Overrode n/a coll - despite low gradient this is a 5th order stream, greater energy than in smaller, low gradient channels)	None - 5th order stream
Fine Sediment	No change - well-armored	Well-armored indicates under-supply (capable of transporting fine sed load)	Low V* estimated = .1-.2	"
Peak Flow	Riprap & levees installed along outer edge of active channel area to protect floodplain developments	Riprap & levees limit channel migration or widening; results in scour of bed during high flows	~~Moderate~~ - High alluvial segment loose bottom floodplain structures	"
Large Organic Debris	Riparian trees have been removed >70 yrs ago; riprap prevents recruitment. Wood comes from upstream during high flows.	Minor role - 5th order stream >50 m wide active channel	Low	Seg 2 (also 5th order)
Catastrophic Damage	No evidence - low gradient	Flat valley, low gradient No steep trib. zones Landslides do not affect this segment.	Low	All <1 UC & LC with no steep trib Segs 2, 25, 90, 114, 116, 119

Form ee-6. Segment summary sheet of input factor indicators

Segment 3(1-2TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder with large gravel bars - limited fines			no evidence
	Bed armoring	bars are well armored; thalweg is loose			mostly loose mixture of cobble/gravel around boulders
	Q*	0.19 0.15 0.24			
Active Channel	W/D ratio	highly confined valley; (30) wide active channel	Confined channel - cannot widen		
	Bars and Deposits	numerous midchannel bars, increasing frequency downstream where channel width increases. mostly coarse material		very little LOD, all functional - on bars	Little change over time until '90 flood → increase in bar deposits
	Pool Dimensions	Few pools ≥ ½ ACW - only 2 observed in field. Scour pools behind lg blders were filled w/ gravel		LOD does not affect pool formation	
	Ratio P:R			20:80	
	V*	0.72-0.95 = high supply; but this represents ≈ 20% of pools observed			
	Channel Pattern	slightly sinuous due to lateral confinement; splitting around mid-channel bars in lower ½ of surveyed sg			limited to scour & fill due to lateral confinement; no evidence of change
	Bank Material	Mostly boulders with cobbles & fines deposited - alluvium & till	Very little bank erosion observed - dense root network helps stabilize		
	Bank Erosion	One area of BC at big band, undercut slump, is chronic source of fines	Fines from slump are deposited as a film on boulders downstream	Does not contribute to erosion or protection of banks	Slump at big band is being continually undercut - chronic source of fines
	Obstructions			Insignificant due to large size - 5th order of stream	n/a
Flood-plain	Historic	No evidence of widening	little or no floodplain - tightly confined		no evidence
	Terrace Features	n/a - tightly confined valley			n/a
	Deposits	patchy deposits of sand in small floodplain area			no evidence
	Disturbance				Small floodplain is well-vegetated w/ older/conifers no evidence
	Interpretation	Point bars, mid-channel bars, scour pools & eddy pools all indicate that this is a zone of deposition, primarily coarse sediment. Pool filling evident.			

> sedime

Extensive deposition, armoring & lack of wood indicates moderate damage from peak flows, Noncohesive banks, fine unconsolidated bottom, indicate high potential for damage from increased peak flows.

> flo

LOD has mostly been transported downstream & does

> wo

Segment Diagnostic Form

Segment Number: 3(1-2 TC) (Mainstem) **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Little change observed 70-87. Enlargement of bars & pool filling post '90 flood	Zone of deposition downstream of higher gradient segments. Filling of eddy pools observed.	High - pool filling observed $q^* \sim 0.2$	Segs 5,7,24,14, 30,39 (Same gradient/confine downstream of segments capable of transporting coarse sediment.)
Fine Sediment	No change - well armored	Slump is contributing fine sediment, capable of flushing due to TC. Fine sed. deposits mostly along channel margin; fines in ≈20% of eddy pools.	Moderate $v^* > 0.5$ in ≈20% of pools	Segs 5,7,14,30 (Same gradient/confine on 3rd-5th order channel)
Peak Flow	No change - no evidence of enlargement	Armoring & downstream transport of LOD indicate moderate damage from peak flow. Several high banks are undermined during high flows.	High - alluvial channel; non-cohesive banks in some areas; loose, rounded substrate	Segs 14,24,27,30, 39,50,115 (Same gradient/confine & non-cohesive banks, not bedrock)
Large Organic Debris	Very low amounts. May be decrease from historic or normal for 5th order stream.	LOD transported out of segment.	Low - due to large channel width (>100 ft)	Segs 5 & 7 (Same gradient/confine & large width (4th order) 5th order)
Catastrophic Damage	No evidence of past debris flows/dam break floods.	Only 2 tributaries - both mostly low gradient/stable.	Low - low gradient	Segs 5,7,14,24,27, 30,39,50,115

Form ee-6. Segment summary sheet of input factor indicators

Segment 5(1-2 TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel/cobble w/ large boulders			
	Bed armoring	Bars armored.			
	Q*	.19 .29 .21			
Active Channel	W/D ratio	18-tightly confined but wide	adequate except for 2 large bars		
	Bars and Deposits	Two large bars upstream of constriction -redistributed in last high water => pool filling		LOD protects banks; numerous jams on bars	2 very large bars w/ extensive LOD jams - source?
	Pool Dimensions	Few large pools; filling evident near bars		LOD + big boulders scour pools .56/10m; 45 m:w	
	Ratio			30:70	
	V*	Only 1 pool - to deep fines in margins			
	Channel Pattern	Straight - meandering			Splitting, almost braided w/ 2 big bars
	Bank Material	Gravel/cobble in till	banks finer than bottom		
	Bank Erosion	Extensive - 100% of LB (pre-Fraser)	zone of transport except for at two bars	LOD protects banks	—
	Obstructions			most LOD swung ⊥ to bank, does not obstruct	-
Flood-plain n/a tightly confined	Historic				
	Terrace Features				
	Deposits				
	Disturbance				

Interpretation Tightly confined, but till on banks is undercut during high flows; bed material scoured as evidenced by 2 large bars. Zone of transport overall; but deposition of coarse material from upstream & in-channel. > water > Sed > LOD

Segment Diagnostic Form

Segment Number: 5(1-2TC) **WAU:** Tolt

North Fork Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Increase in size of 2 large bars in 87 & 90 photos - located at sharp bends upstream of constrictions	Two bars continue to enlarge; localized areas of channel shift & pool filling.	High Continued enlargement of bars is causing accelerated BC & pool filling	
Fine Sediment	No evidence	Zone of transport - silt/clay/boulders from till banks fall into channel & erode - very turbid	Low source of fines for downstream segments - transported through here	
Peak Flow	No evidence	Mostly armored except at large bars. Tightly confined Till banks can be undercut	~~Low~~ Moderate	
Large Organic Debris	Mature trees available on banks in much of segment	LOD protects banks; helps to scour pools 0.5 pieces/10m w=33m - unknown what adequate levels are	Moderate levels adequate to low plays role in pool forming & bank protection	
Catastrophic Damage	No evidence	Confined canyon - could have dam-break; but relatively low levels of LOD	Low - low gradient - no sizeable tribs	

Form ee-6. Segment summary sheet of input factor indicators

Segment 6(2-4TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder with some fines on margins. (Boulder/bedrock in canyon)			no evidence
	Bed armoring	moderately armored; rounded rocks, very loose			moderately armored; large boulders surrounded by loose matrix
	Q*	0.135-0.16 no evidence of change low sensitivity			
Active Channel	W/D ratio	7 (less in canyon portion)	Narrowing in places; degrade		
	Bars and Deposits	Increasing veg on bars; mostly cobble. Small, fresh bars are gravel. 5-20% of bottom has fresh deposits		Nonfunctional - Clumps & pieces on outer edge of active channel margin. 3/ur 21 [illegible]	Deposits in normal places
	Pool Dimensions	Mostly eddy pools <½ ACW behind boulders. Channel-width in bedrock canyon portion		Minor role - not in active channel area	
	Ratio P:R			30:70	
	V*	too deep to measure est <.10			
	Channel Pattern	Straight to sinuous			no evidence
	Bank Material	Bedrock in canyon portion. Colluvium/alluvium/till otherwise	Bank cutting appears to be shift rather than enlargement		
	Bank Erosion	0 in bedrock canyon 11-30% in upper portion	Bank cutting on outside of bends, opposite veg. bars	Does not deflect flow	no evidence
	Obstructions			Minor - does not deflect flow	large debris dam spans channel in upper portion of segment
Flood-plain	Historic	No evidence of widening	no floodplain - tightly confined		no evidence
	Terrace Features	n/a			n/a
	Deposits	n/a			n/a
	Disturbance				n/a
	Interpretation	No evidence of major Δ's in coarse sediment bed (not sensitive to Δ's in fines); slightly armored, no pool filling, no pattern changes; slight reduction possible as indicated by increased vegetation on bars & relatively low q*.			

sedime

Little or no damage from peak flows; moderate potential if increased peak flows in upper ½ of segment due to loose, rounded substrate & erodible banks. >f

Woody debris largely removed from active channel area, minor role in creating >(

Segment Diagnostic Form

Segment Number: 6(2-4TC) North Fork **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Increased vegetation on bars; otherwise no change evident	Some armoring, low q^* supply - balanced or slightly under-supplied	Low - $V^* < .1$ stream energy sufficient to transport sed during high flows in balance with supply	Segs 4, 10, 18, 35, 83, ~~95, 98, 100~~, 118 - same gradient/confinement & unregulated peak flows to flush sediment.
Fine Sediment	No change evident	Few fines - mostly flushed due to high energy	Low	same as above
Peak Flow	No signs of damage from peak flows	Some bank cutting where non-bedrock; but on outside of bends, does not indicate enlargement.	Moderate where alluvium & till creates erodible banks, alluvial reach. Low in bedrock canyon	same as above
Large Organic Debris	LOD plays minor role due to large channel width	LOD plays minor role in alluvial portions no role in bedrock canyon. (Exception is large debris dam at upper end that traps sediment)	Low - large channel width & high energy.	Segs 4, 10, 95, 98 (same gradient/confinement & large width) (4th order)
Catastrophic Damage	No photo evidence of dam break flood; channel narrowing indicates disturbance pre-70.	Large debris dam spans entire active channel width, upper end of segment.	High - large debris dam - probable dam break flood caused widening. Confinement & gradient conducive for transport/deposition	Segs 4, 10, 18; 35, 83, 95, 98, 100, 118 (same gradient/confine)

Form ee-6. Segment summary sheet of input factor indicators

Segment 11(1-2TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder			no evidence
	Bed armoring	Armored			" "
	Q*				
Active Channel	W/D ratio	16 - tightly confined			
	Bars and Deposits	Few bars or deposits - tightly confined		Some gravel deposits behind LOD jams	Most stable segment assessed on N. Fork!
	Pool Dimensions	numerous pocket pools behind large boulders - no filling		LOD jam forms only large pool in segment	
	Ratio P:R			~30:70	
	V*	Few pools; little fines observed			
	Channel Pattern	Straight to sinuous			
	Bank Material	Large cobble/boulders (recessional outwash)	Little bank erosion		
	Bank Erosion	Banks protected by boulders held together by root matrix	"	LOD protects banks	—
	Obstructions			Few obstructions little LOD in channel	—
Flood-plain	Historic				
	Terrace Features				
	Deposits				
	Disturbance				

n/a - tightly confined no floodplain

Interpretation No evidence of pool filling or aggradation. Numerous gravel patches, very stable banks & bed.
LOD protects banks, provides cover over pools & jams create large pool. Little LOD in channel. Thin buffer on both banks.

Segment Diagnostic Form

Segment Number: 11(1-2)TC **WAU:** Tolt

North Fork Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Little change; slight ↓w due to vegetation on bars ↑.	No evidence of aggradation or pool filling. Numerous gravel patches.	Low	Seg 10 - slightly steeper - more MW in inner gorge (deeper incised) - but otherwise, zone of transport
Fine Sediment	No evidence	Fines along margin but flushed from thalweg. Few sources of fines in segment.	Low	"
Peak Flow	No evidence of change	Large cobble/boulder banks are well-protected by dense root network. Relatively large material in bed.	Low - relatively resistant bed & banks.	"
Large Organic Debris	0.8 pieces/10m - relatively low but no data on channel >30m wide.	LOD protects banks & forms pools & provides cover when present. Thin buffer on both banks of relatively smaller trees (<20")	Moderate 2nd ary role in pool forming & banks - also done by large boulders. Some reduction in #'s & input	"
Catastrophic Damage	No evidence	No tributaries or steep side slopes. Little LOD to form into "dam".	Low low gradient	"

Form ee-6. Segment summary sheet of input factor indicators

Segment 15(1-2 MC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder			Braided Channel
	Bed armoring	Evident on bars			" "
	Q*	0.27 0.14			
Active Channel	W/D ratio	50 - very broad & shallow	Inadequate for sediment supply		
	Bars and Deposits	Extensive deposits of mostly coarse material but some sand in pools & behind boulders		LOD deposited in jams & as pieces on bars	Extensive deposits & bars cover >75% of channel
	Pool Dimensions	Few large pools. Sediment in tailouts		LOD sticking out from bar causes some scour; otherwise little role	
	Ratio P:R			10:90	
	V*	1 scour pool measured; avg = 0.3; most pools less			
	Channel Pattern	Braided			Braided ⇒ high sediment supply
	Bank Material	Cobble/boulder w/ frequent till & lakebed deposits	Bank cutting nearly 100% of segment		
	Bank Erosion	Bank cutting nearly 100% of segment	Inadequate to transport high input load	LOD plays minor role	Extensive widening
	Obstructions			LOD does not obstruct	—
Flood-plain	Historic	Bank composition similar to bed	Little change in capacity from size		
	Terrace Features	Vegetated terraces at upper end of segment where ↑ gradient			
	Deposits	Channel actively works most of floodplain			
	Disturbance				

Interpretation: Zone of scour & deposition. Sediment mostly from bank cutting but signif contribution from cutting against till/lakebed deposits also. Supply exceeds transport capacity. } Sedim

Extensive BC, enlargement; deposition indicates signif channel damage from peak flows. } Flow

LOD important for bank } Wood

Segment Diagnostic Form

Segment Number: 15(1-2MC) North Fork **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Greatest ↑w btwn 58-76 (50% rip veg harvested pre-64; 50% btwn 64-70). Then widening ↓ in upper ½; ↑ in lower ½. '90 flood caused renewed widening	Coarse textured but braiding indicates over-supply - Major changes	Moderate from V^* but High due to extensive existing damage (braiding)	Other braided segments: 13, 17
Fine Sediment	No evidence	Fine sediment mostly on margins w/ greater amounts in lower ½ - in pools & behind boulders - Fits balanced description	Moderate $V^* = 0.3$	Other braided segments: 13 & 17
Peak Flow	Highest flow in record in 1959. 7% increase in width between 58-64 (3m avg) '90 flood caused renewed widening	Bed & bank of similar size material Increased channel area due to widening ⇒ large capacity	High due to extensive existing damage - braiding - sedimentation - eroded banks - aggradation } +Q & +Qs	Same as above
Large Organic Debris	Relatively large amount of LOD but too small to be stable	LOD plays minor role - too small	High - wood loss evident - new wood lacking - plays 2nd ary role in pool forming	Same as above
Catastrophic Damage	Gradient too low + broad valley bottom keeps debris torrent in tribs from directly entering	—	Low	Same as above

- Consider planting bars to ↑ stabilization process

Segment 15 - North Fork Tolt

Two areas of widening:

	Upper	Lower
Length	5000'	2250'
Avg bank ht	5'	5'
tw 87-90	Ø	20' (from photos)
bank vol 87-90	Ø	8,333 cubic yards - from banks (mostly coarse)

terrace/deep-seated 150' × 300'; est 1%/year erosion × 3 yrs

5,000 cubic yards (mostly fines) from deep-seated just below Titicaca Creek

Form ee-6. Segment summary sheet of input factor indicators

Segment 19 (2-4 MC) - Segment 1 of USFS data
Reach 1 " " "

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/small boulder			
	Bed armoring	NO data			
	Q*	NO subsurface data			
Active Channel	W/D ratio	12			
	Bars and Deposits	Extensive braiding suggests high input of coarse sediment			
	Pool Dimensions	Few large pools, but numerous pocket pools & side channels		Dominant influence in forming pools, pocket pools (wf = 3m) 0.8 pools/10m	
	Ratio P:R			1:10	
	V*				
	Channel Pattern	Braided			Braiding, aggradation ⇒ intermittent flow
	Bank Material	Cobble/boulder	Barely contains floods; occasional overbank		
	Bank Erosion	Intermittent cutting on outside of bends	Minor widening - riparian veg has kept intact		
	Obstructions				
Flood-plain	Historic		No logging has occurred		
	Terrace Features				
	Deposits				
	Disturbance				Moderate stages - low debris flow potential

Interpretation Zone of deposition of coarse sediment downstream of very high gradient segments. Landslides from Red Mtn source of input (natural). > sed

Widening caused by ↑Qs rather than ↑Qp (no logging upstream & only minor widening) > flow

↑Qs is point in forming pools, terrace sol. Pools are

Segment Diagnostic Form

Segment Number: 19(2-4MC) North Fork Tolt **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Widened in pre-07, then narrowing. Braided condition not 'normal' for 2-4% type reaches of a river. Major changes	Low pool: riffle ratio; braiding indicate over supply of sediment - transport limited	Moderate infer well armored (very coarse surface substrate) & only moderate pool filling - *width increase & braiding not as dramatic as in Seg 13, 15, 17	40, 57, 89, 104, 106, 135, 144 (same gradient/confine & only minor changes in W evident from photos)
Fine Sediment	No change evident	Few fines evident in pebble count	Low - adequate energy to flush fines	40, 54, 69, 89, 94, 102, 104, 106, 121, 123, 135, 143, 144 (same gradient/confine)
Peak Flow	Some bank cutting but in 'usual' places. Enlargement through widening. No terraces - Minor changes	Braided pattern from ↑Qs; could be ↑ or ↓ Qp.	Moderate - alluvial - non-cohesive banks (potentially) - moderate constrained	same as above
Large Organic Debris	Riparian vegetation intact - low count compared to table	LOD plays dominant role in forming pools & trapping sediment	High most pools formed by LOD signif sediment storage	same as above
Catastrophic Damage	Upstream sources evident - widening due to deposition from landslides/debris flows	Braiding due to high sediment input from steeper gradient areas upstream	High - zone of deposition below higher gradient segments w/ demonstrated debris flow potential	40, 69, 106, 121, 123, 143, 135 (same grad/confine & steeper segments immediately upstream)

Form ee-6. Segment summary sheet of input factor indicators

Segment 20(4-6 TC) - Lower ½ of Seg 2 USFS data
Upper ½ of Reach 1 & lower ½ of Seg 2 USFS data

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/small boulders			
	Bed armoring	Assume armored - very few small particles in surface pebble count			
	Q*				
Active Channel	W/D ratio	6	peak flows contained		
	Bars and Deposits	little deposition - zone of transport		w = 7m 0.6 pieces/10m	
	Pool Dimensions				
	Ratio P:R			1:5	
	V*				
	Channel Pattern	straight			
	Bank Material	boulders/bedrock			
	Bank Erosion	little bank cutting			
	Obstructions				
Flood-plain	Historic	n/a - no floodplain	No logging has occurred		–
	Terrace Features	n/a			–
	Deposits	n/a			–
	Disturbance				–
	Interpretation	Zone of sediment transport			

No evidence of damage from ↑Qp; low potential
LOD may be important for energy dissipation + pool forming of 2ndary

Segment Diagnostic Form

Segment Number: 30(4-6TC) North Fork Tolt **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Bed armored - cobble/boulder w/ very few fines Zone of transport "Under" supplied No evidence of change	(Large bed) Armoring indicates under supply - able to transport sediment supplied	Low - Stream energy sufficient to transport coarse & mixed sediment	3, 23, 33, 41, 44, ~~48~~, 56, 57, 101, 112, 139 (same gradient/confinement)
Fine Sediment	No change evident	~~Few~~ No fines in pebble count (none <8 mm out of 200)	Low - adequate energy to flush fines	same as above
Peak Flow	No change evident (appears widened in 64 photos but no management activities; Ø64-90)	Adequate capacity; little overbank flow	Low little bank erosion - resistant banks; not alluvial; constrained	same as above
Large Organic Debris	Low count - compared to chart (0.6/10m compared to 2.28) - Riparian vegetation intact (old-growth)	?	?	see results from Seg 65
Catastrophic Damage	Zone of transport - debris slides off Red Mountain No evidence of dam-break flood/debris flow	No evidence	Moderate steeper gradient; stable side slopes; no management activity upstream	44 (same gradient/confinement/shear gradient upstream and with no of land management activity, etc.)

Form ee-6. Segment summary sheet of input factor indicators

* From USFS data

Segment 21(6-17 TC) Upper ½ of Seg 2 USFS data
Upper ½ of Reach 2* entire reach 3 USFS data

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Bedrock			
	Bed armoring	n/a - bedrock			—
	Q*	n/a			
Active Channel	W/D ratio	9			
	Bars and Deposits	little deposition - zone of transport			
	Pool Dimensions				
	Ratio P:R			1:5	
	V*				
	Channel Pattern	straight			
	Bank Material	bedrock			
	Bank Erosion	little erosion due to bedrock			
	Obstructions				
Flood-plain n/a - no floodplain	Historic	—	No logging has occurred		—
	Terrace Features	—			—
	Deposits	—			—
	Disturbance				—
	Interpretation	Zone of sediment transport			

No evidence of damage from ↑Qp; low potential due to bedrock
LOD of 2nd ary importance in forming stairsteps

Segment Diagnostic Form

Segment Number: 21 (6-17 TC) North Fork Tolt **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	No evidence	Mostly bedrock - zone of transport	Low - zone of transport	Segs 9, 29, 34, 36, 38, 43, 45, 47, 51, 53, 60, 66, 68, 70, 81, 82, 87, 88, 96, 107, 122, 129, 133, 136 & Segs 75, 77, 79, 91, 120
Fine Sediment	—	—	Low - zone of transport	same as above (6-17 & TC/MC)
Peak Flow	No change	Mostly bedrock - not alluvial	Low - not alluvial - tightly constrained	Segs 9, 29, 34, 38, 53, 60, 81, 87, 96, 107, (same gradient/confinement mostly bedrock)
Large Organic Debris	No change - no harvest	LOD #'s low; 2nd ary role in forming structures for energy dissipation & sediment trapping	Moderate	same as above
Catastrophic Damage	Slides off Red Mtn upstream - natural	Zone of transport for landslide material from upstream	Moderate steep gradient conducive to transport; limited mgmt activity upstream; headwater area	81, 87 (same grad/confinement, steeper upstream but little or no harvest, no evidence of past debris flow)

Form ee-6. Segment summary sheet of input factor indicators

Segment 44(4-6 MC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder			Numerous active & inactive channels in alluvial fan
	Bed armoring	Yes			
	Q*				
Active Channel	W/D ratio	10	Frequent overbank flows & shift		
	Bars and Deposits	Bars related to old log jams ⇒ channel splitting		LOD jams causes channel to split	
	Pool Dimensions	Step pool - small pools formed by boulders		Little LOD - may have been removed during 1st entry	
	Ratio P:R			40:60	
	V*				
	Channel Pattern	Straight → meandering step-pool			Frequent shift across alluvial fan
	Bank Material	Cobble/boulder	transports boulders up to ½ m D		
	Bank Erosion	little erosion due to large material & dense roots	"	LOD traps gravel/cobble	
	Obstructions			LOD jams cause splitting	
Flood-plain	Historic	evidence of shift across fan			
	Terrace Features				
	Deposits				
	Disturbance				
	Interpretation	This is an alluvial fan segment - the channel frequently splits & inactive channels are evident. LOD is important in trapping large gravel/cobble. Change in peak flows could accelerate shift. Flows mostly through outwash deposits, but lakebed [illegible] and creates unstable bank.			

Segment Diagnostic Form

Segment Number: 44(4-6 MC) **WAU:** Tolt

Yellow Creek

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	No evidence of change. Hardwoods in valley bottom.	Channel splitting + shift typical of alluvial fan segments.	Low Zone of transport for up to .5m size	Other tributary alluvial fan & mod. gradient segments
Fine Sediment	No evidence	Few fines - zone of transport.	Low Zone of transport	"
Peak Flow	Hardwoods in bottom indicate past instability	Frequent channel shift + splitting	High 100 yr's will likely accelerate channel shift	"
Large Organic Debris	0.8 pieces/10m w = 9m Bilby & Ward = 2.22 - Reduced levels	Appears that LOD was removed during 1st entry. Mostly 4-8" dbh older in valley bottom.	High - levels are reduced - important for trapping gravel & dissipating energy	"
Catastrophic Damage	No evidence	4-6% gradient below >6% canyon - zone of deposition for debris flow or dam break	High - deposition zone downstream of steeper "canyon" Low for initiation	"

Form ee-6. Segment summary sheet of input factor indicators

Segment 63(1-2 LC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel/cobble			Fresh deposits on >75% of bottom
	Bed armoring	Poorly armored bars; riffle areas cemented in places rather than armored			" " "
	Q*	0.24 0.36			
Active Channel	W/D ratio	40	High flows spread over floodplain		
	Bars and Deposits	Numerous point bars & fresh deposits in pools; >75% of bottom		LOD creates dam near mouth ⇒ dammed pool w/ extensive fine deposits	LOD count is low
	Pool Dimensions	Pool filling w/ gravel & fines is evident. Pools shallow & mostly < ½ ACW		LOD pieces cause scour & form pools.	
	Ratio P:R			20:80	
	V*	0-18. Avg = 1.8 mostly fines; some gravels			
	Channel Pattern	Meandering - influenced by braided N Fk Tolt			Extensive fresh deposits
	Bank Material	Alluvium - gravel w/ some cobble in matrix of fines	Channel is pushed N & W by N Fk Tolt		
	Bank Erosion	Extensive bankcutting - nearly 100% of segment.	Recent overbank flows have caused BC & shift	LOD does not protect banks	BC on straight stretches & inside of bends
	Obstructions			Debris dam near mouth caused channel shift	N Fk Tolt transports debris & influences channel
Flood-plain	Historic	In N Fk Tolt floodplain where extensive widening occurred	Zone of deposition		—
	Terrace Features	n/a			—
	Deposits	Fresh silt deposits in floodplain			—
	Disturbance				—
	Interpretation	Zone of coarse & fine sediment deposition - channel aggradation evident			> Sediment

Extensive bank cutting, deposition, indicate damage from peak flows and/or ↑ sed load. High potential for further damage due to erodible banks, debris dam, open floodplain vegetation > Water

Little LOD except at mouth. LOD does aid in pool formation > LOD

Segment Number: 63 (1-2LC) (Dry Creek) **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Increased width btwn '64-'70; some recovery '70-'90. Evidence of major changes (widening, pool filling, port. buried trunks, etc)	Over-supplied - due to extensive deposition (>75% of bottom); dune bed forms in dammed pool; loose bottom pool filling	High $v^* > 0.5$	17, 103 (Same gradient/confine w/ history of widening)
Fine Sediment	Fine sediment covers riffle areas in places	Oversupplied - fine seds at downstream end of pools; dune/ripple bed form	High $v^* > 0.5$	Same as above
Peak Flow	Bank cutting in straight reaches & inside of bends - Minor changes	Extensive sedimentation, eroded banks indicate damage from ↑Qp and/or ↑Qs	High - noncohesive banks - alluvial - unarmored - unconstrained - LOD deflection	17, 103, 127, 138 (same gradient/confine)
Large Organic Debris	100% riparian vegetation cut pre-64. LOD is decaying. Major reduction from historic.	LOD amount is very low (0.7 compared to 2.14 pieces/10m) LOD plays dominant role - forms most pools; traps sediment.	High LOD plays major role Wood loss evident.	17, 103 (same gradient/confine & harvest in riparian area)
Catastrophic Damage	No evidence of debris flow	Low gradient - no evidence	Low - low gradient unconfined	17, 103, 127, 138 (same gradient/confine)

Form ee-6. Segment summary sheet of input factor indicators

Segment 64(1-2)MC

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel w/ some cobble			Aggradation; pool filling evident.
	Bed armoring	Not armored....			–
	Q*	0.28 0.31			
Active Channel	W/D ratio	8.3	Sediment supply > transport		
	Bars and Deposits	Recent deposits of gravel/fines affect >75% of bottom; pool filling evident.		LOD causes scour & traps large amt of coarse sediment.	Recent deposits partially bury standing trees. Plug of gravel extends 150' above culvert
	Pool Dimensions	Many pools filled. Only 1 pool > ½ ACW		" " "	
	Ratio P:R			20:80	
	V*	0-0.87; avg=0.41 (mostly gravel - not fines)			
	Channel Pattern	meandering			Stream went dry 6 days after bankfull flow!
	Bank Material	till; lacustrine sed; delta deposits	erosion, enlargement evident		
	Bank Erosion	BC in 75-90% of banks	" " "	LOD deflects flow into banks causes erosion	BC on straight stretches & inside of bends
	Obstructions			LOD causes jams that trap extensive sediment	Culvert has partially plugged - potential problem
Flood-plain	Historic	No evidence	Widening evident on historic photos		Eroding tributary videos in '76.
	Terrace Features	Stream cuts thru glacial till over old labeled deposits			no evidence
	Deposits	Fresh gravel deposits partially bury standing trees			—
	Disturbance				Riparian veg harvested pre-64 to '76
	Interpretation	Extensive pool filling, widening, aggradation due to coarse sediment deposition. Stream dry <1 week after bkfull flow			> Sed

Channel enlargement, deposition results from ↑Qp and/or > Flow ↑Qs.

LOD important in trapping sediment & creating scour > LOD for pool recovery.

Segment Number: 64(1-2MC) Dry Creek **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Channel widening '64-76 Some recovery 76-90. Partially buried trees in floodplain; local pool filling ⇒ major changes	Oversupplied loose bottom little armoring extensive deposits	High gravel bed; $v^* > 0.25$	55, 120, 134 (same gradient/confined evidence of widening small/moderate stream size)
Fine Sediment	Minor changes	Supply balanced - gravel w/ mixtures of sand/silt; little armor. Fines deposited on channel margin	High ?? (check q^*) $v^* = 0.41$ but gravel; not fines $q^* =$	26, 31, 55, 105, 113, 117, 120, 125, 134, 140, 141 (same gradient/confined small-med size)
Peak Flow	Extensive bank cutting on straight stretches & inside of bends; overhanging banks ⇒ Major changes	Sedimentation, aggradation, ⇒ ↑Q_p and/or ↑Q_s	High - noncohesive banks - alluvial - unarmored - LOD deflection	26, 31, 55, 105, 113, 117, 120, 125, 134, 140, 141 (same gradient/confined small to med size)
Large Organic Debris	Significant reduction (0.38/10m compared to 2.26 from chart)	Dominant role - traps sediment causes scour	High	Same as above
Catastrophic Damage	No evidence	Low gradient	Low	11, 16, 19, 26, 31, 55, 93, 97, 99, 105, 113, 117, 120, 125, 134, 140, 141

Form ee-6. Segment summary sheet of input factor indicators

Segment 68(6-17 TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder			–
	Bed armoring	n/a - stairstep profile			–
	Q*	" "			
Active Channel	W/D ratio	10 - Widening has occurred	Channel shows some downcutting & aggrading		
	Bars and Deposits	Large boulders form steps & trap cobble/gravel		LOD creates splits traps sediment	Large deposits of LOD & gravel above active channel
	Pool Dimensions	Plunge pools below steps are channel-width		LOD-created pools are deeper than boulder-created pools	
	Ratio P:R			40:60	
	V*	n/a - stairstep			
	Channel Pattern	straight w/ some splitting			Channel splits around debris jams deposited by debris torrent
	Bank Material	Cobble/boulder - colluvium	Banks are eroded - evidence of debris flow		
	Bank Erosion	Banks eroded on both sides; ~80% of segment	" "	LOD causes scour but also protects banks in other places	Enlarged active channel area from debris torrent
	Obstructions			Several jams deposited above debris torrent stopped	Channel splits around several jams
Flood-plain n/a - no floodplain	Historic				
	Terrace Features				
	Deposits				
	Disturbance				

Interpretation Zone of sediment transport. Material from debris torrent deposited ~400' upstream from N. Fk. No alluvial fan at N Fork indicates that N Fk can transport all sediment from Titicaca. > Sed

Active channel is enlarged; bank cutting on both sides. Jams at lower end & road crossing at upper end suggest dam break flood. > flow

LOD plays role in trapping sediment & creating stairsteps. > Wood

[illegible] also see this role.

Segment Diagnostic Form

Segment Number: 68(6-17 TC) **WAU:** ToH

Titicaca Creek

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Channel widening began between 70-76. ±1-3' of sediment over buried logs adjacent to channel. ⇒ major changes	Coarse textured. Extensive bank cutting. Enlarged active channel area. Large transport capacity	Low - high gradient zone of transport	(All 6-17% segs (MC & TC) 75, 77, 79, 91, 130 9, 21, 29, 34, 36, 38, 43, 45, 47, 51, 53, 60, 66, 68, 70, 81, 82, 87, 88, 96, 107, 128, 129, 133, 137
Fine Sediment n/a	–	–	Low - zone of transport	same as above
Peak Flow	Channel enlarged, but evidence suggest debris torrent	Banks mostly cobbled, but can be eroded	Moderate unconsolidated banks LOD deflects flow	(Same gradient & MC/TC & not primarily bedrock) (75, 77, 79, 91, 130 36, 43, 45, 47, 51, 66, 70, 81, 82, 88, 128, 129, 133, 137
Large Organic Debris	2.47 pieces/10 m compared to 2.08 from Bilby & Ward - Relatively high but mostly in jams along channel margin - No change in # but Δ in distribution	LOD plays important role - forms stairsteps which trap sediment; create scour pools & dissipate energy	Moderate - wood plays 2° storage role - new wood is lacking	same as above
Catastrophic Damage	Debris torrent between 70-76. Old bridge has been filled w/ sediment & channel cut thru road fill. Possible dam-break flood.	Debris deposited ~400' upstream from mouth	High - zone of scour & transport with zone of deposition upstream of mouth. - steeper gradient upstream	(same gradient, steeper upstream & mgmt upstream) 75, 77, 79, 91, 130, 36, 47, 51, 60, 66, 70, 128, 129, 133

Form ee-6. Segment summary sheet of input factor indicators

Segment 94(2-4 MC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel/cobble w/some boulders			—
	Bed armoring	Armoring evident on bars			—
	Q*	0.20			
Active Channel	W/D ratio	35	Adequate. Little evidence of overbank flow		
	Bars and Deposits	Several gravel deposits along margins + behind big boulders		LOD important in trapping gravel + some pool zone	—
	Pool Dimensions	Few pools > ½ ACW but numerous pocket pools		LOD forms some pools but mostly formed by big boulders	
	Ratio P:R			40:60	
	V*	0.2 avg in 1 pool - mixed gravel + fines			
	Channel Pattern	meandering 2 active side channels			—
	Bank Material	Cobble/gravel	Stream bed slightly finer; ↓TC		
	Bank Erosion	~30% on outside of bends	" "	LOD does not obstruct flow	—
	Obstructions			"	—
Flood-plain	Historic	Bars are lg cobble - larger than bed	↓TC due to ↓Qp from dam		—
	Terrace Features	Two active side channels			—
	Deposits	Bars are mostly veg w/ older 2-6" dbh one bar not vegetated			—
	Disturbance				—

Interpretation Reduced peak flows since '62 have resulted in stabilization of previously active bars.
Abundant gravel patches (& redds). Sources of gravel in upstream reach where large till layers being eroded.
Some very large LOD available & effective in trapping gravel. Smaller LOD largely ineffective.

Segment Diagnostic Form

Segment Number: 94(2-4 MC) South Fork **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Somewhat under-supplied - Coarse textured - Little mobile bed - Limited bar devel. - Bed material slightly smaller than banks	Gravels mostly in small patches behind boulders - minor changes	Moderate ? $v^* = 0.2$ (or less) $\tau^* =$	?
Fine Sediment	No evidence	Fines mixed in gravel; some deposition in pools; bed is armored. Adequate energy to flush fines.	Low (Overrode $v^* = 0.2$ because represents gravel also)	40, 54, 69, 89, 102, 104, 106, 121, 123, 135, 143, 144, 16 (same grad/confin)
Peak Flow	Vegetation on most bars suggest ↓Qp adequate capacity Minor changes	High flows to move bars & LOD appear rare. Only 1 un-vegetated bar observed.	Moderate-Low alluvial reach loose substrate in places (Low due to dam)	same as above
Large Organic Debris	~40% of rip veg harvested (pre-80) - Relatively little LOD in channel	LOD, where present, important for trapping gravel & forming pools	~~Mod~~ Mod Wood loss evident Plays major role where present Large channel width; decreasing role	(same as above & similar position in drainage network) 102 (high for others - smaller stream, more important)
Catastrophic Damage	No evidence	No evidence - lower gradient zone of deposition	Low no historic torrent - low gradient upstream	54, 89, 102, 104, 16, 144

Form ee-6. Segment summary sheet of input factor indicators

Segment 95 (2-4TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Cobble/boulder			—
	Bed armoring	Bars + riffles ... well armored			—
	Q*	0.1			
Active Channel	W/D ratio	46 - tightly confined but broad ACW	Zone of transport		
	Bars and Deposits	Bars of cobble/boulder almost all veg w/ 4-8" dbh alder?. Little deposition.		LOD piled in jams at head of bars	-
	Pool Dimensions	Moderate amount of large pools >½ ACW + numerous pocket pools		LOD plays minor role in pool-forming	
	Ratio P:R			40:60	
	V*	Varies from 0.1 → 9.0 in 5 pools measured.			
	Channel Pattern	Meandering but tightly confined			—
	Bank Material	Large boulders/bedrock + some till layers with fines	Bed material finer than banks		
	Bank Erosion	Bank cutting common ~40%	BC mostly on outside of bends	LOD plays minor role	-
	Obstructions			" "	—
Flood-plain n/a - tightly confined, little floodplain	Historic				
	Terrace Features				
	Deposits				
	Disturbance				
	Interpretation	Surprising amount of fine sediment in pools for tightly confined segment of this gradient. Zone of bank erosion as well as deposition. Moderate potential for damage from Qp due to alluvium + loose substrate. LOD is mostly "stranded" + has not moved in awhile, [illegible] since '62.			

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Segment Diagnostic Form

Segment Number: 95(2-4 TC) South Fork Tolt **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	No widening; some narrowing due to alder growth on bars. - minor changes	Coarse-textured; limited bar development - slight under-supply - Must erode banks to get gravel	Moderate (despite some v* >0.5, no evidence of aggrd.)	Segs 100, 98 - Same grad/confine & regulated river
Fine Sediment	No evidence of change. Very long, exposed till/lakebed layer is source of fines	Fines along margins & deep in some pools.	Moderate (altho v*'s in some pools >0.5, little fines in thalweg; able to flush due to gradient)	same as above.
Peak Flow	Slight ↓w due to alder colonizing gravel bars that were active in past.	Dam dampens Nov-Dec peak flows (which is when highest flows occur)	Moderate-Low allowed in many places but well-armored, non cohesive banks. Low in canyon section - esp in canyon	Segs 4, 6, 10, 18, 35, 83, 98, 100, 110 (same grad/confine)
Large Organic Debris	Major change - low #'s & many nonfunctional on gravel bars. No sources of LOD on banks (too small)	LOD plays minor role. Newly recruited material too small to form stable features.	Low large stream - 90% wood loss evident plays 2nd ary role in pool forming. Bedrock, large boulders form obstructions	4, 6, 10, 98 (same grad/confine & position in drainage network)
Catastrophic Damage	No evidence	No evidence of dam-break flood; but gradient/confinement could create one	High - inferred from Seg 6 & 100 - mass wasting potential from banks is high - could block channel.	see seg 6 & 100

Form ee-6. Segment summary sheet of input factor indicators

Segment 100(2-4TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Boulder/cobble			Big slide in '76 dumped large amount of fine & coarse sediment
	Bed armoring	Bars & riffle areas well-armored			Most of fines flushed through segment
	Q*	0.15 0.22 0.32			
Active Channel	W/D ratio	(21) - relatively wide channel occupies most of valley	Widened post-slide & currently narrowing large capacity		
	Bars and Deposits	Numerous mid-channel & point bars, most are vegetated. Indicates ↓ sediment supply.		LOD is mostly in large jams at head of bars & along channel margin	Most LOD has been transported to nonfunctional areas. Braiding in upper end assoc. w/ big slide
	Pool Dimensions	Mostly small pocket pools behind boulders. Only 4 pools ≥ ½ ACW in 6,000 ft length		Few functional pieces that affect pools	
	Ratio P:R			20:80	
	V*	.01 - .22 in the larger scour pools.			
	Channel Pattern	Meandering; with channel splitting, almost braiding in upper 300' below big slide			Braiding in upper 300' following big slide
	Bank Material	Alluvium (boulder/cobble) w/ pockets of till & lacustrine sediments. Some Bedrock	Banks mostly finer than bed	mostly older	
	Bank Erosion	4 actively eroding slumps & 1 large bank cutting area contribute fines & coarse sed	Bank cutting indicates channel shift rather than enlargement	LOD is recruited from slumps. Does not provide bank protection	1 very large slump at upper end of segment blocked channel in past
	Obstructions	[illegible]		LOD mostly transported does not obstruct	LOD is piled on bars
Flood-plain	Historic		Alder on bars increasing; -ΔW past 20 yrs		
	Terrace Features	n/a - tightly confined			—
	Deposits				
	Disturbance				Debris dam at upper end of segment from slump; was breached, resulting in large amount of sediment

Interpretation

Numerous sources of fine & coarse sediment from mass wasting within segment. Fines mostly flushed through; coarse sediment stored in bars. > Sediment

Segment has high potential for damage from peak flow due to erodible banks. Appears to have widened in past & now narrowing. Upstream dam appears to reduce peak during 1/25/93 storm. > Flow

Wood has been transported to nonfunctional areas & plays minor role in pool forming & sediment trapping. During 1/25/93 storm, no LOD was being > Wood

Segment Diagnostic Form

Segment Number: 100(2-4TC) South Fork **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Large slide at upper end of segment dammed channel & broke, releasing large quantities of sediment. Increased vegetation in bars indicates gradual healing. Major changes are healing.	Splitting, aggradation in upper end of segment for ~300' below big slide. No evidence of pool filling or unusual bank cutting, aggradation in rest of segment.	Moderate .1<v*<.5	Segs 95, 98 same gradient/confine & regulated river
Fine Sediment	Other than large slide, there are several additional, chronic sources of fine sediment, but these are historic, long-term.	Fines along channel margins (5.2' at gage); not in thalweg. Eddy pools show some deposition of fines.	Moderate .1<v*<.5	Same as above
Peak Flow	Appears to have widened in past & now decreasing width indicated by increasing vegetation on bars.	Dam upstream appears to dampen peak flows (1/25/73)	Moderate - alluvial reach - non-cohesive banks	Segs 4, 6, 10, 18, 35, 83, 95, 98, 100, 118
Large Organic Debris	Major change - low #'s and nonfunctional old. May have been flushed during big slide.	LOD plays minor role; mostly on bars & along channel margin. Recruitment assoc w/ MW is alder 1-5" dbh	High - wood loss evident important for pool forming & sediment trapping	Segs 18, 35, 83, 118 (Same gradient/confine & position in network)
Catastrophic Damage	Large debris slide caused temporary dam & breach.	Splitting, aggradation for ~300' below slide; rest of segment has healed	High - confinement & gradient conducive to dam break flood & deposition	Segs 4, 6, 10, 18, 35, 83, 95, 98, 118

Form ee-6. Segment summary sheet of input factor indicators

Segment 103 (1-2LC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel/cobble			No fines in surveyed portion -all downstream
	Bed armoring	n/a - braided			–
	Q*	–			
Active Channel	W/D ratio	16	Transport fines + small gravel		
	Bars and Deposits	Extensive deposition of large material		Little LOD to channel; does provide bank protection	Braided
	Pool Dimensions	No pools! (some small pocket pools assoc w/ boulders)		LOD mostly too small to scour pools - does trap gravel	
	Ratio P:R			~10:90	
	V*	No pools, no fines			
	Channel Pattern	Braided			Braided = high coarse sed load
	Bank Material	Lg gravel/cobble w/ matrix of fines	bank material transported by stream		
	Bank Erosion	100% of both banks being cut	enlarged active channel area	LOD protects banks	Enlarged channel area
	Obstructions			LOD does not obstruct flow	–
Flood-plain	Historic	Floodplain material smaller than in-channel			
	Terrace Features	100% clearcut pre-64			
	Deposits				
	Disturbance				

Interpretation Transports fine sediment & small gravel. Very large coarse sediment load ⇒ braiding, but not as widened as similar segments on N. Fork despite riparian harvest.

Segment Diagnostic Form

Segment Number: 103(1-2LC) **WAU:** Tolt

South Fork Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Channel appears widened pre-64; Little change 64-76, then loss of veg on bars 76-87.	Enlarge active channel area; braided, coarse-textured	High - braided	Other braided segments
Fine Sediment	No change evident	Lack of fines - mostly transported to lower end	~~Low~~ Moderate - fines deposited in lower end, below surveyed area	" "
Peak Flow	Widening evident	Enlarged active channel area Extensive bank cutting	High	Other braided segments
Large Organic Debris	100% riparian veg harvested pre-64.	0.5 pieces/10m w= 24 m - larger than Bilby & Ward but low #'s, new sources lacking	High	"
Catastrophic Damage	Low gradient + broad valley bottom - keeps tribs from directly reaching stream	–	Low	"

Form ee-6. Segment summary sheet of input factor indicators

Segment 119(<1LC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Sand/silt with a few small gravel bars			No evidence
	Bed armoring	Not armored - zone of deposition			No evidence
	Q*	0.41			
Active Channel	W/D ratio	5.5	Flows frequently spread onto floodplain		
	Bars and Deposits	75-100% of channel covered w/ deposits of fine material		Beaver dams & LOD important in trapping sediment	A lot of fines - may be normal for this system, or upstream source
	Pool Dimensions	Numerous pools span entire channel width		LOD & beaver dams create backwater, plunge, scour pools	
	Ratio P:R			60:40	
	V*	0.38-0.34			
	Channel Pattern	Meandering			No evidence - normal migration
	Bank Material	Fine material - alluvial deposits	High flows spread onto floodplain & create little bank erosion		
	Bank Erosion	Some cutting due to channel shift	" "	LOD causes some deflection	No evidence
	Obstructions			LOD & beaver dams create numerous obstructions	No evidence
Flood-plain	Historic	Valley bottom is same material as streambed			
	Terrace Features	n/a			n/a
	Deposits	No fresh floodplain deposits evident thru dense leaf litter.			Probably frequent overbank flows
	Disturbance				No evidence

Interpretation

Abundant fine sediment deposits in pools - zone of deposition. Source of sediment is banks + upstream tributaries (seg 122 & 129) which are very unstable. > Sediment

Dammed pools have large sediment trapping capacity

High potential for damage from peak flows due to finely-textured deposits, numerous obstructions, loosely confined valley. Floodplain important for energy dissipation. > Water

LOD & beaver dams highly important in trapping sediment + creating > Wood

Segment Diagnostic Form

Segment Number: 119(<1LC) (Trib to Lynch Creek) **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	No evidence of change	Very little coarse sediment - mostly fines	n/a High	Seg 25, 114, 116, 28, 32, 109 (low gradient; moderately loose or unconfined, small streams w/ beaver dams) (or wetland valley bottom)
Fine Sediment	No evidence of change - banks & bed both pre-dominately sand/silt	Over-supplied - no bed armor >1' of fines in pools $v^* > 0.5$	High - sand bed $v^* > 0.5$	same as above
Peak Flow	No evidence of change	No evidence of damage - high flows spread over floodplain which dissipates energy	~~High~~ - LOW alluvial reach beaver dams fine sediment unconstrained grassy banks flow deflection	same as above
Large Organic Debris	No evidence of change	Major role in forming pools (SOD also in form of beaver dams) & trapping sediment	High	same as above
Catastrophic Damage	No evidence of past damage	No evidence of catastrophic damage	LOW *	same as above

*Log stringer bridge w/ beaver dam at bottom of reach (where channel more confined) presents potential hazard & should be removed. Bridge is no longer driveable.

Form ee-6. Segment summary sheet of input factor indicators

Segment 122 & 124 (>17 TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	boulder/cobble			–
	Bed armoring	n/a			–
	Q*	n/a			
Active Channel	W/D ratio	5	Enlargement evident -extensive BC		
	Bars and Deposits	cobble/gravel deposits behind large boulder stair steps		LOD mostly absent traps sediment & dissipates energy where present	–
	Pool Dimensions	small step pools, mostly filled w/ cobble/gravel		Where present, LOD forms shallow, small plunge pools	
	Ratio P:R			20:80	
	V*	n/a			
	Channel Pattern	straight -stairstepped			Active shift occurring
	Bank Material	Colluvium & till -unconsolidated	Actively enlarging XC area		
	Bank Erosion	Nearly 100% of length	" "	LOD does not protect banks	Debris slides occurred btwn 70-82 + pre-64
	Obstructions			LOD does not create dams	n/a
Flood-plain n/a -no floodplain	Historic	–	–		–
	Terrace Features	–			–
	Deposits	–			–
	Disturbance				–
	Interpretation	Zone of sediment transport & recruitment			- Sed

Channel widening & downcutting - probably from debris flow - Flow

LOD sources mostly absent; where present they dissipate energy. LOD does not function to form steps - too easily moved. > LOD

Segment Number: 122 & 124 (>17TC) **WAU:** TOH
(Tribs to Lynch Creek)

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	—	—	Low - zone of transport	22, 37, 42, 48, 52, 58, 59, 61, 62, 67, 71, 72, 74, 76, 78, 80, 84, 85, 86, 92, 111, 126, 131, 137 (>17TC)
Fine Sediment	—	—	Low - zone of transport	same as above
Peak Flow	Channel enlargement evident - but probably due to debris flow & active shift	Bank cutting in straight reaches Enlargement of channel area	Moderate - ?? non cohesive banks numerous obstructions	same as above
Large Organic Debris	Little LOD present Riparian harvest pre-64	Little LOD present forms steps & dissipates energy where present	Moderate important for energy dissipation - but also done by large boulders.	same as above
Catastrophic Damage	Evidence of debris flows	High potential for future debris flows	High	same as above

Form ee-6. Segment summary sheet of input factor indicators

Segment 126(>17TC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Boulders			No evidence
	Bed armoring	Well armored mostly boulders			No evidence
	Q*	n/a			
Active Channel	W/D ratio	10	Large capacity. Enlarged in lower 200'		
	Bars and Deposits	Very little due to high gradient		Minor role	No evidence
	Pool Dimensions	Step pools - <0.5 slope		Minor role - pools formed by boulders	
	Ratio P:R			30:70	
	V*	n/a			
	Channel Pattern	Straight, stairstep			No evidence
	Bank Material	Colluvium - boulders	Some widening & downcutting in lower 200'		
	Bank Erosion	Bank erosion in lower 200'	" " "	LOD plays minor role	Some widening in lower ½
	Obstructions			Little LOD; abundant LOD due to PCT	PCT trees have high potential for debris dam
Flood-plain n/a	Historic	—	—		—
	Terrace Features	—			—
	Deposits	—			—
	Disturbance				—

Interpretation Zone of sediment transport. Transports fine & coarse material from banks & road (berm of sidecast at top of segment) to S. Fk. > Sedim

Little sediment comes from upstream due to large wetland.

Some enlargement from peak flows. High potential for damage due > Water to noncohesive banks & numerous obstructions (PCT).

LOD scarce, minor role. Boulders form pools & create steps for energy > (...)

Segment Number: 126 (>17 TC) **WAU:** Tolt
(S Fk Tributary - undisturbed)

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	—	—	Low - zone of transport	Segs 22, 37, 42, 48, 52, 58, 59, 61, 62, 67, 71, 72, 74, 76, 78 80, 84, 85, 86, 92, 111, 122, 124, 126, 131, 137 (>17 TC)
Fine Sediment	—	—	Low - zone of transport	same as above
Peak Flow	No changes evident in 70-90 photos.	Some post-90 widening in lower 300'. Tree roots critical in holding banks together	Moderate noncohesive banks numerous obstructions	same as above
Large Organic Debris	Numerous pieces of SOD due to PCT. Little LOD, not previously harvested.	LOD & SOD play minor role in pool forming - steps formed mostly by boulders.	Moderate lacking LOD (but not SOD) plays 2ndary role	same as above
Catastrophic Damage	No evidence of past disturbance	Numerous trees across & in channel due to PCT.	High abundant SOD tightly confined steep	same as above

Form ee-6. Segment summary sheet of input factor indicators

Segment 134(1-2 MC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel/cobble/ boulder - quite angular			No fines in segment
	Bed armoring	mostly N/o - braided			Braided reaches
	Q*	–			
Active Channel	W/D ratio	16	Transports fines & small gravel.		
	Bars and Deposits	Extensive deposits of very coarse material		LOD too small mostly - some older pieces protect banks	Braided
	Pool Dimensions	Very few pools - 2 present in surveyed portion		Only 2 pools are associated w/ old jams	
	Ratio P:R			20:80	
	V*	no fines			
	Channel Pattern	Alternates between braided & non-braided stretches.			Braided & widened
	Bank Material	Same as bed - gravel/cobble/boulder -outwash	Transports boulders up to 0.8m!		
	Bank Erosion	100% of both banks eroded	Able to move bank mtl	LOD traps some gravel, mostly too small	Enlarged active channel area
	Obstructions			" "	
Flood-plain	Historic	Floodplain mtl similar to in-channel			
	Terrace Features	50% rip veg harvested pre-64; 100% by '70			
	Deposits	Cut-off from floodplain due to enlarged area.			
	Disturbance				

Interpretation: Enlarged active channel area & braided stretches make this segment similar to those on N. Fork, but at smaller scale. Fines have been flushed thru this segment; substrate is quite angular. Lacks large LOD to aid in stabilization.

Segment Diagnostic Form

Segment Number: 134(1-2MC) Phelps Creek **WAU:** Tolt

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	Widened pre-64 & active shift; then increased vegetation on bars & little change	Enlarged active channel area, braided, coarse textured	High - braided	Other braided segments 13, 15, 17, 103
Fine Sediment	No change evident	Absence of fine material	Moderate - low gradient potential deposition area	"
Peak Flow	Widening evident	Enlarged active channel area, extensive bank cutting	High	"
Large Organic Debris	Riparian vegetation harvested pre 64 & 64-70.	0.8 pieces/10m w = 24 - larger than Bilby & Ward but low #'s, new sources lacking	High	"
Catastrophic Damage	Low gradient + broad valley bottom - tribs would not directly deposit		Low	"

Form ee-6. Segment summary sheet of input factor indicators

Segment 141(1-2 MC)

Indicator Location	Parameter	Sediment Supply	Transport Capacity	LOD Function	Catas-trophic
Stream-bed	Dominant particle size	Gravel			No evidence
	Bed armoring	Not armored - loose			No evidence
	Q*	(flow too high)			
Active Channel	W/D ratio	17	Adequate - bed & bank similar size		
	Bars and Deposits	Mostly gravel w/ ~50% fines. Not cemented		Wood critical in trapping sediment. Mostly <20cm D	No evidence
	Pool Dimensions	Appear normal; several pools = channel width.		Wood is critical in pool forming. Mostly <20cm D	
	Ratio P:R			50:50	
	V*				
	Channel Pattern	Sinuous			No evidence
	Bank Material	Gravel & fines - alluvium	Adequate - bed & bank same size		
	Bank Erosion	Some cutting in exposed places	" "	LOD plays significant role in protecting banks	No evidence
	Obstructions			LOD causes scour. Small debris dams also create pools	No evidence
Flood-plain	Historic				
	Terrace Features				
	Deposits				
	Disturbance				Large wetland area dampens peak flows

Interpretation Zone of sediment deposition - mostly fines, some coarse. Scour created by woody debris keeps pools from filling. Culvert inlet is eroding but does not appear to be significant contribution. > Sed

Low potential for damage from increased peak flows due to large wetland system & ample floodplain storage area. > Water

SOD critical in pool forming & sed trapping. Little LOD due to logging of valley bottom. > Wood

Segment Diagnostic Form

Segment Number: 141 (1-2 MC) **WAU:** Tolt
(Index Creek - trib to Stossel Cr)

Input Factor	Change from Historic	Existing Condition	Sensitivity	Extrapolate Results To:
Coarse and Mixed Sediment	No evidence of widening but some deposition of fines over coarse sediments - Minor changes	Numerous pools with $v^* > 0.25$; low energy for transport - zone of deposition	High	Segs 26, 31, 55, 64, 113, 117, 120, 125, 134, 140 (same gradient/confine & small stream)
Fine Sediment	No evidence of change	Over-supplied - fine sediment at downstream end of pools $v^* 0.3 - 0.8$	High	same as above
Peak Flow	No evidence of change	Adequate capacity - no evidence of enlargement. Peak flows spread over wetland/floodplain	High - alluvial reach - unarmored bed - LOD deflects flow	Same as above
Large Organic Debris	Little LOD (riparian area harvested ~20 yrs ago). Major change.	SOD has taken role of LOD & critical in forming pools & trapping sediment.	High - SOD responsible for pools & sediment trapping (but will decay back) - LOD largely absent	Segs 16, 26, 55, 64, 105, 120, 125, 134 (Same gradient/confine & riparian vegetation removed)
Catastrophic Damage	No evidence of damage	No debris flows/ dam break floods	Low (low gradient)	Segs 11, 16, 19, 26, 31, 55, 64, 93, 97, 99, 105, 113, 117, 120, 125, 134, 140

Toft Watershed Analysis
LOD Status from field assessments

Seg #	Width (m)	observed pieces/10m	Bilby & Ward pieces/10m - target # developed for channels 4-20m w	
1	55	0.2	channel too wide, but low #'s - defic	
3	33	<.01	" " " "	
5	45	0.56	" " " "	
6	21	0.6	" " " "	
11	31	0.8	" " " "	
15	91	19.8	"	adequate amt but mo[illegible] non-functional on b[illegible] in large jams. Highly thru-out segment
63	12	0.07	2.14 - deficient	
64	8	0.38	2.25 - deficient	
68	15	2.48	2.08 - adequate - dam-break flood deposition area	
94	32	0.90	channel too wide, but low #'s - deficient	
95a	30	0.80	" " " "	
100	26	1.55	channel too wide; mostly non-functional bars & margins	
103	24	0.5	channel too wide, low #'s - deficient	
119	7	too many to count	adequate	
122	12	0-6.0 (rest of seg) lower 200'	2.28 - abundant in lower 200', defi in rest of segment	
124	12	" "	" " " "	
126	8	too many to count	2.25 abundant	
134	24	0.86	too wide (203 for 20m) low #'s, defic	
141	3	31/1500 0.68	2.5 - deficient	

TOLT RIVER WATERSHED ANALYSIS

STREAM CHANNEL ASSESSMENT MODULE

SEGMENT CLUSTER DESCRIPTIONS

The following report summarizes the results of the stream channel assessment module conducted in the Tolt River watershed. The description of the segment cluster types and sensitivities has been reviewed by channel module participants and comments from interested parties have been incorporated. This report replaces the previous version of March 10, 1993.

JoAnn Metzler, Module Leader

April 1, 1993
Date

Prepared for Weyerhaeuser Company

In accordance with
Standard Methodology for Conducting Watershed Analysis
Chapter 222-22 WAC, Version 1.10
Washington Forest Practice Act Board Manual

April 1, 1993

Form B 3-2

Causal Mechanism Report Summary

WAU: *TOLT*

RESOURCE SENSITIVITY NUMBER:

Channel Hazard Area #1 (Bank cutting areas not covered by mass wasting module)

SITUATION SENTENCE:

Bank cutting within braided segments is contributing coarse and fine sediment to the channel, leading to continued aggradation and channel instability. This has resulted in degraded summer and winter rearing habitat for cutthroat (and possibly dolly varden and rainbow trout). Map Units 1-6 and 1-7 (from Map E-3) also contribute coarse sediment to the reservoir.

TRIGGERING MECHANISM(s) (Be as precise as possible):

Removal of riparian vegetation has resulted in reduced root strength and accelerated bank erosion. Peak flow events contribute to further erosion and redistribution of sediment within and between the segments. Map Units 1-1 through 1-4 appear to have downstream controls associated with ancient landslides that make them prone to deposition. The lower half of map Unit 1-6 is also influenced by the reservoir level.

RULE CALL FOR MANAGEMENT RESPONSE:

Prevent or Avoid

ADDITIONAL COMMENTS:

The delineated map units include areas prone to future bank cutting based on historic channel patterns. Recovery of these areas will require (1) recovery of root strength along the banks to reduce the rate of bank erosion; (2) input of <u>large</u> organic debris to stabilize bars, create a meandering thalweg, reduce the channel gradient, and develop a pool/riffle sequence; and (3) establishment of vegetation on bars. See channel hazard area #2 report for areas that contribute LOD to these hazard areas.

Form B 3-2. Continued

Causal Mechanism Report Summary Page 2 of 2

Situation Sentence Component	Result	Location in Assessment Products
Input variable	Coarse sediment / fine sediment	
Watershed Process	Bank erosion	Map E-3; Hazard area 1-1 through 1-7
Conditions and Modifiers	Braided segments + adjacent floodplain areas containing historic channels.	Segment 'story' for segment cluster #7, Map E-2
Contributing Activities	Removal of riparian vegetation leading to reduced root strength making banks more vulnerable to erosion during peak flows.	
Routing	Direct input to North Fork, South Fork + Phelps Creek. Routed downstream over time.	
Channel effects	Braiding, widening, instability, aggradation. Loss of pool habitat. Unstable channel conditions create poor spawning conditions	
Public resource locator		
Resource effects - Cutthroat trout (possibly Dolly Varden + rainbow) - Reservoir	Increased delivery of sediment to reservoir from units 1-6 + 1-7	

Form B 3-2

Causal Mechanism Report Summary

WAU: *TOLT*

RESOURCE SENSITIVITY NUMBER:

Channel Hazard Area #2 (This is not really a hazard area - it is important to the recovery of hazard area #1)

SITUATION SENTENCE:

Recruitment of LOD is needed for recovery of braided ares (channel hazard Unit #1) downstream of these units. Trees within these areas potentially could reach the channel through blowdown, bank cutting, or mass wasting and be transported to the braided segments as LOD.

TRIGGERING MECHANISM(s) (Be as precise as possible):

(See channel Unit #1 report - these areas are not "hazards" per se, but are important sources of LOD required for recovery of braided areas)

RULE CALL FOR MANAGEMENT RESPONSE:

Prevent of Avoid (Riparian harvest)

ADDITIONAL COMMENTS:

Future management should consider these as source areas of LOD that is vital to recovery of hazard Unit #1. These units are delineated to include 200' on each side of the stream on the North Fork (where slopes are generally steep and trees could roll downhill into the channel) and 100' on each side of the South Fork and Phelps Creek (where slopes are flatter). Small tributaries were not delineated, because LOD tends to catch in the fans before entering the mainstem. If transported, it is generally in pieces rather than whole trees. This is not to say, however, that LOD is not important within the small tributaries.

Form B 3-2. Continued

Causal Mechanism Report Summary Page 2 of 2

Situation Sentence Component	Result	Location in Assessment Products
Input variable	LOD	
Watershed Process	Recruitment of LOD	Map E-3, Hazard areas 2-1 through 2-7.
Conditions and Modifiers	Needed for recovery of braided segments downstream.	Map E-3, Hazard areas 1-1 through 1-7.
Contributing Activities	Timber harvest	
Routing	Routed to channel by bank cutting, blowdown, or mass wasting. Transported to braided segments through tightly confined, high energy segments.	
Channel effects	Lack of LOD prevents bars from stabilizing & a meandering thalweg from developing	
Public resource locator		
Resource effects		