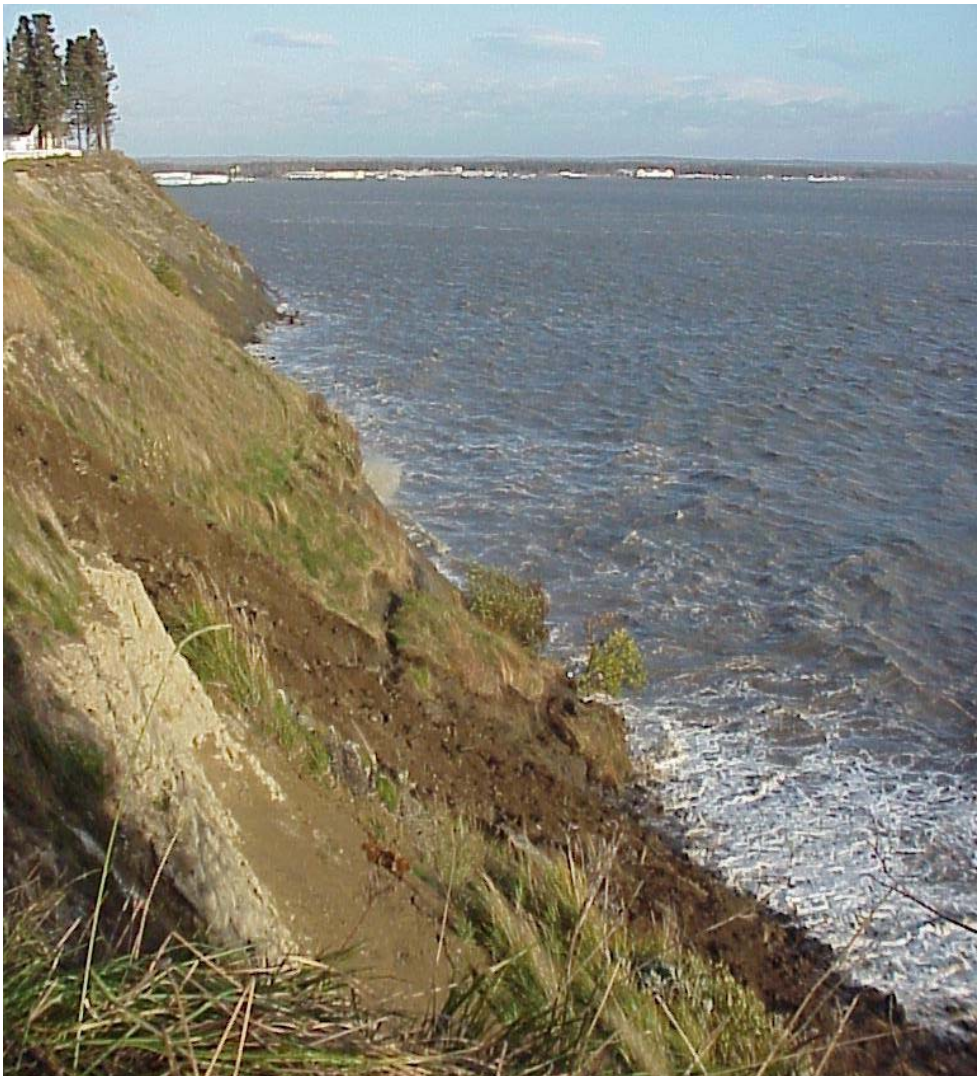
APPENDIX C

SEDIMENT IMPACT ASSESSMENT
KENAI BLUFF EROSION
TECHNICAL REPORT
KENAI, ALASKA

Kenai River Bluff Erosion Project
Sediment Impact Assessment



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For
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EXECUTIVE SUMMARY

Erosion of the Kenai Bluffs contributes an estimated 21,300 tons of sediment to the Kenai estuary annually. Sediments from the bluffs consist of a mixture of gravels, sands, silts and clays, with most of the noncohesive soils in the horizon comprising the upper half of the bank. About 50 percent of these upper horizon soils are sands in the size classes found in the Kenai Dunes. Thus, the bluffs contribute an average of 10,600 tons of noncohesive sediments to the system each year. This represents about 7 percent of the sand flux into the system. About 60,000 tons are delivered annually by the Kenai River from upland and streambank erosion upstream of the estuary, and about 100,000 tons are delivered by longshore transport in Cook Inlet. Most of these sediments pass through the estuary, but some are deposited on the tidal flats and the Kenai Dunes.

Stabilization of the Kenai Bluffs would affect the sediment dynamics in the estuary. The overall impact of the reduction in sediment load is likely to be very minor, however, as the system is aggradational and the reduction in sediment volume slight. Local impacts of note include the alteration of the substrate along the stabilized portion of the bank (although this will generally be above the waterline), and local scour at the toe of the structure. Some coarsening of the sediments at the toe can be expected over time through sorting processes associated with the increased energy environment. Changes in the morphology of the tidal flats and dunes is not expected given the net surplus of sediment in the reach.

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BACKGROUND

The city of Kenai, AK is pursuing an erosion protection project along a one-mile portion of a 55- to 70-foot high bluff fronting the city and the Kenai River (Figure 1). The bluff is subject to a number of erosion and failure mechanisms, and is receding at an estimated average rate of one to three feet per year. The Alaska District (CEPOA) is developing a Project Study Plan (PSP) for the Kenai Bluff Erosion Reduction Project, and has been tasked to study the Kenai bluffs.

Environmental Agencies reviewing a report submitted by the city of Kenai on the bluff erosion expressed concerns regarding the impacts of stabilizing the bluff, including the fate of the Kenai dunes (see Figure 2) if sediment input from the bluff erosion is removed from the system. The CEPOA sought assistance from the Engineer Research and Development Center (ERDC) in investigating existing and potential future sediment conditions on the Kenai River and at the confluence of the Kenai and Cook Inlet. Specifically, the ERDC Team was tasked with a detailed analysis of the sediment sources and transport rates on the Kenai River, with a focus on the sediment sizes found in the sand dunes and tidelands on the north side of the mouth of the Kenai River, to ascertain the impacts of stabilizing the Kenai Bluff upon the dunes.

Figure 1. Photo of the Kenai Bluffs where stabilization efforts are proposed.

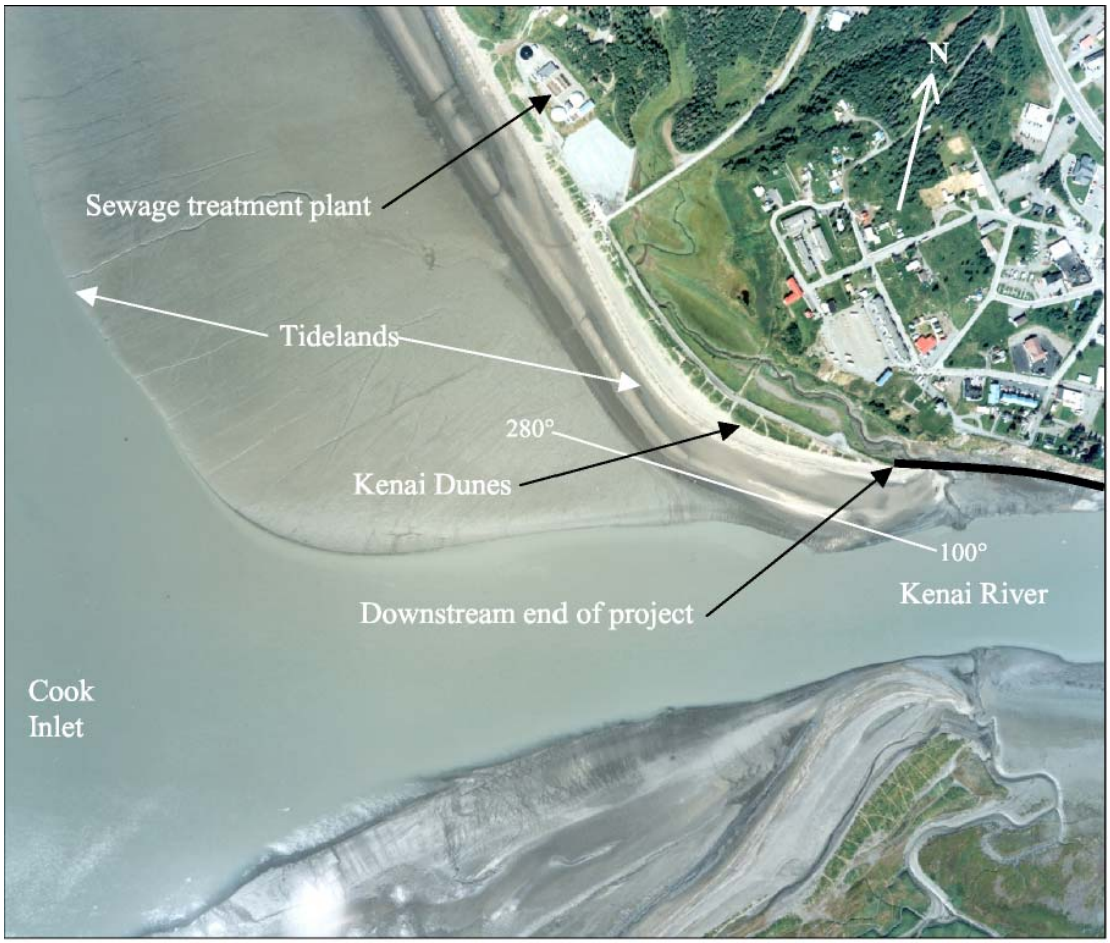

Figure 2. Aerial photograph of the area of concern (from Smith, et al. 2001).

STUDY AREA DESCRIPTION

The Kenai River is a large proglacial stream draining the Kenai Mountains and portions of the Kenai Penninsula lowlands in south-central Alaska (Figure 3). The watershed includes 2,200 mi^2 of diverse topography, extending from the Kenai Mountain icefields to Cook Inlet. The river's origin is at Kenai Lake, from which it flows generally westerly for 69 miles to Cook Inlet. The average gradient is 0.0012, and the substrates are generally coarse gravels and cobbles, except in the lower 12 miles, where sands and silts predominate due to the lower gradient and tidal influence.

Glacial landforms dominate the Kenai, influencing the character of the river and its streamflow. Four stades during the Naptowne glaciation created morainal features such as Kenai and Skilak Lakes, as well as high terraces from glacial lake deposits interspersed with coarse strata from fluvial outwash. Both the bed material and the channel pattern reflect previous glacial discharges (Scott 1982) and, except for the lower 12 miles the river, is considered "underfit". Mean annual discharge at Soldotna is about 5,400 cfs, but flow regulation by the lakes and glacial melt water create a unique seasonal variability with low fall and winter discharges and sustained high discharges throughout late spring and summer.

Figure 3. Kenai River Watershed.

The 45-mile long Cook Inlet is known for its extreme tidal range (up to 36 feet at Anchorage, and about 32 feet at Kenai), and strong currents. The effect of the Coriolis force is pronounced at this latitude, and strong currents and considerable turbulence are produced during times of peak flow (Sharma and Burrell 1970). Flow is generally inland along the southeast coast, and seaward along the northwest coast (Patchen, et. al. 1981). A constriction in the inlet known as the Forelands just north of Kenai creates increased tidal velocities and currents, so the size of sediments in the inlet tend to be a function of distance from the Forelands with coarse gravels in the region of the constriction trending to sands and silts with distance (Sharma and Burrell 1970).

The Kenai River is world-renowned for its fishery, drawing hundreds of thousands of visitors annually and contributing about $40 million to the annual economy (Dorava and Liepitz 1996). Recreation includes considerable use of motorized watercraft in the project reach. Much of the recreation is related to the fisheries of the Kenai system. The Kenai River supports 34 fish species representing 16 taxonomic families. Thirty species are native to the Kenai River and four are introduced species. Twelve species are residents of the river, 11 are anadromous, including all 5 species of Pacific salmon, and 11 species found mainly in the lower river are associated with the marine or brackish water environment. There are several marine mammal species present, at least seasonally, in the study area. The more common species are the sea otter, Steller sea lion, harbor seal, beluga whale and dall and harbor porpoises (Kenai Peninsula Borough 1990).

EROSION ASSESSMENT

The primary emphasis of this study was an assessment of the influence of stabilizing the Kenai Bluffs upon the morphology of the lower Kenai River and the adjacent sand dunes. This assessment requires the development of a sediment budget, with a focus upon the sediment sizes found in the areas of concern. The sediment budget must consider fluxes into and our of the study area, including soils eroded from the Kenai Bluffs, sediments delivered from upstream by the Kenai River, longshore transport in Cook Inlet, and local transport by wind and waves (see Figure 4). The contribution of sediments from upstream streambank erosion to the overall sediment load in the lower reaches had not been previously quantified, and was a key component of the analysis presented in this report.

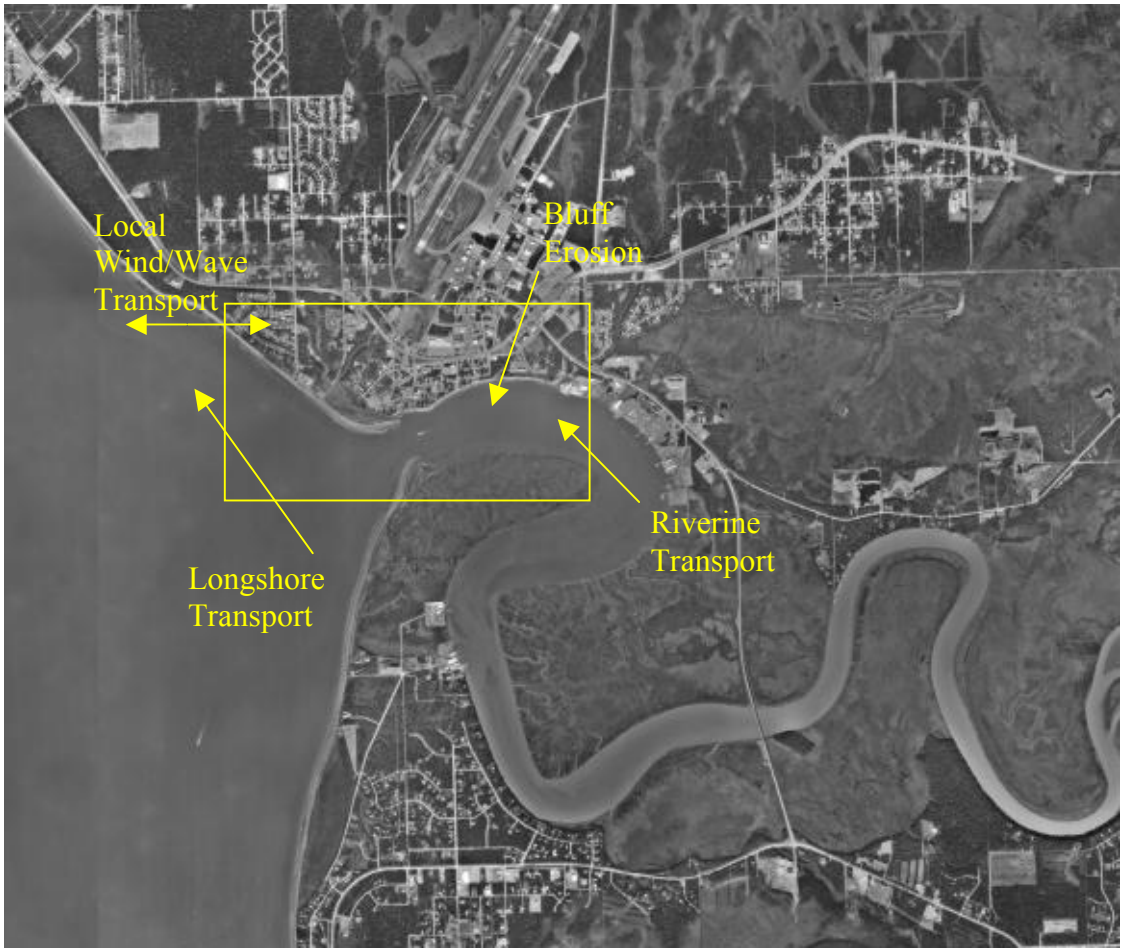

Figure 4. Area of study and factors contributing to sediment flux.

Mechanisms of Bank Failure

Several previous studies have reported upon mechanisms of bank erosion and failure along the Kenai River upstream of the study area. Scott (1982) suggested that the retreat of low banks is triggered by freeze-thaw, and that flows erode non-cohesive soil lenses of sediments at the toe of high banks, which triggers upper bank failures. Scott pointed to the loss of bank vegetation and streamside use as significant contributing factors. Barrick (1984) documented erosion rates and suggested that the loss of

vegetation, boat wakes, and improperly designed erosion control practices were the primary factors associated with rates of retreat. Inghram (1985) updated Scott's study by assessing subsequent rates of erosion, and concluded that rates had remained constant except at a few locations where erosion rates were exacerbated by development. Reckendorf (1989) and Reckendorf and Saele (1993) documented erosion along the Kenai River and determined that erosion rates were related to both natural and anthropogenic factors. Freeze-thaw, particle entrainment by flows and boat wakes, and vegetation loss through removal and trampling were listed as primary triggers of the observed erosion.

We conducted an assessment of the erosion in the lower 22 miles of the Kenai River in July, 2003. Bank erosion and failures along the lower Kenai River are common, and we found indicators of each of the factors identified by previous investigators. The predominant causes of bank retreat appear to be related to the bank materials and conditions, and the lower river can be roughly separated into two reaches based upon these characteristics. With exceptions at River Mile (RM) 8, 6.5, and 3.8, where the river contacts high terraces of till and glacial lake deposits, the banks are relatively low and consist of sands, silts and clays downstream of RM 13 (see Figure 5). Boat wakes, freeze-thaw, and piping are the predominant mechanisms of bank loss in this reach. Material loss in the lower or middle zones of the banks is often followed by translational failure of the upper bank or, where low cohesive banks are found, cantilevered failure of the upper banks.

Figure 5. Typical low eroding bank downstream of RM 13, where boat wakes, freeze-thaw, and piping are predominant failure causes.

From RM 13 to RM 22, the banks are generally higher and more likely to consist of till with a coarse talus at the toe of the bank (see Figure 6). The banks in this reach are less susceptible to wake-induced erosion due to this coarse material. Fluvial entrainment during high floods followed by upper slope failures and dry soil fall are the predominant mechanisms of failure. Banks that are well vegetated are relatively stable, but disturbed segments of the bank are generally retreating. Other contributing factors in this reach include freeze-thaw, piping, ice scour, and trampling.

Figure 6. Typical high terrace bank upstream of RM 13, where fluvial entrainment and dry soil fall are predominant mechanisms of failure.

Extent of Existing Erosion

During the site investigation, the extent of erosion was documented along the lower 22 miles of the river (see Figure 7). Table 1 presents a summary of the observed erosion sites. The location of the starting and ending points of the erosion sites was determined using a GPS unit, with coordinates converted to an equivalent River Mile along the river centerline. Length of eroding bank was determined using a laser rangefinder. Bank heights of less than 15 feet were directly measured; those in excess of this height were determined with a clinometer and laser rangefinder. The percentage of bankline actively eroding between the starting and ending points was a visual estimate. Rates of bank retreat were determined by comparing bankline positions in 1965 and 1995 aerial photography. The table presents the average annual rate of retreat over this period. The values compare favorably with those presented by Scott (1982) and Inghram (1985), and are slightly less than those presented by Barrick (1984).

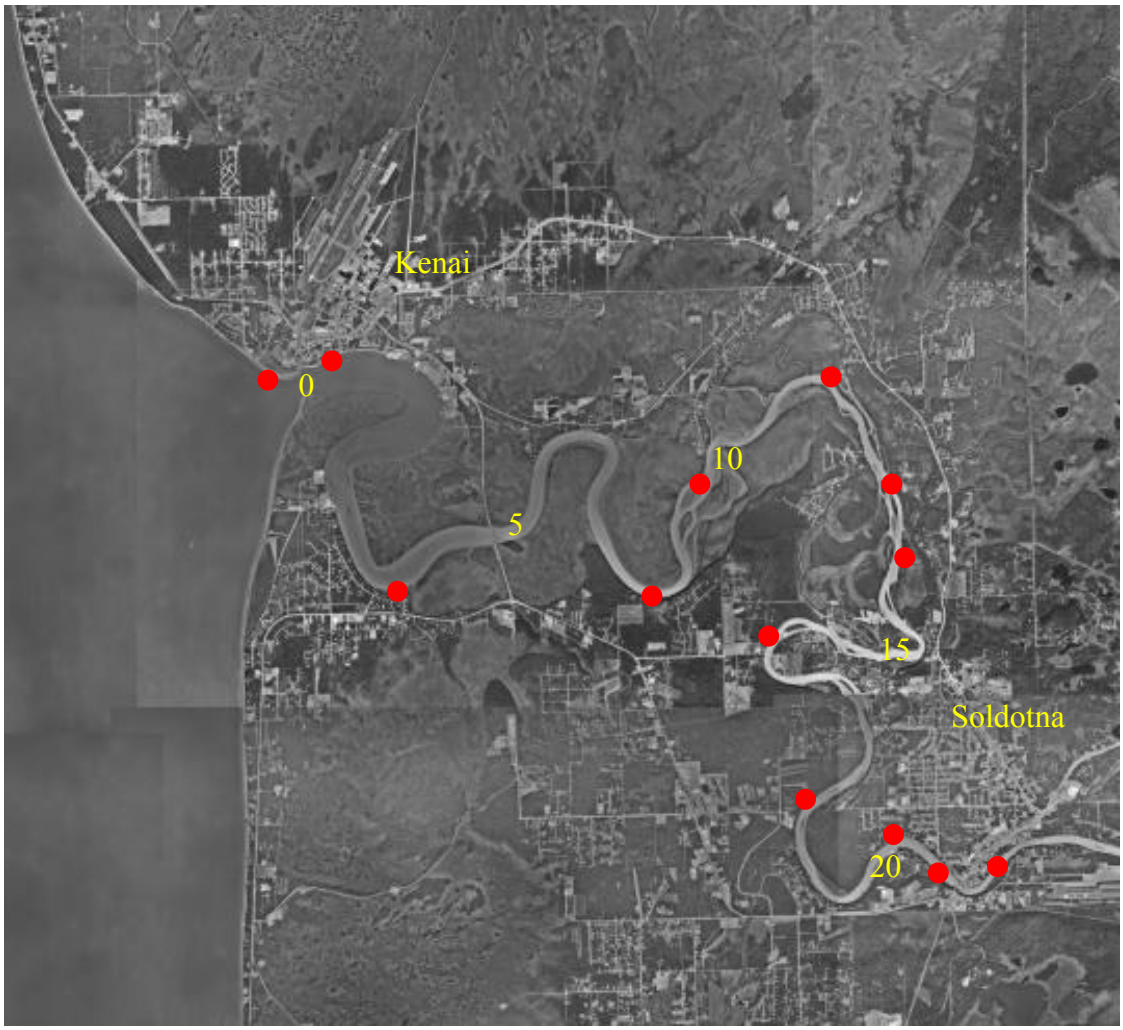

Figure 7. Erosion assessment limits (River Mile in yellow, sediment sample site in red).

Table 1. Summary of observed bank erosion, Kenai River RM 0.0 – RM 22.0.

RM Start	RM End	Bank Composition	Failure Mode(s)	Length (ft)	Height (ft)	Recession Rate (ft/yr)	% Eroding
20.8	**20.8**	till	scallop	40	30	2	100
20.6	**20.6**	till	foot trail (minor contribution)	40	40	1.2	100
20.1	**19.8**	till	toe erosion	1800	25	0.8	50
19.3	**19.3**	sand, gravel, till	boat wake, shore failure	120	30	1.6	100
19.1	**19**	cobble toe, coarse till	high flow erosion	450	6	0.8	100
18.9	**18.1**	clay, till	high flow erosion	5000	35	1.2	80
18.3	**18**	till	toe erosion	1400	15	1	80
17.7	**17.6**	till	boat wake, erosion	300	40	0.4	100
16.2	**15.9**	till	boat wake	2500	40	0.6	95
15.7	**15.4**	fine till	boat wake	2700	25	1.6	80
14	**14**	till	4 intermittent shallow slip plane failures	240	40	2.2	100
13.5	**13.3**	cobble toe, clayey upper	intermittent erosion, high flow	900	60	0.4	60
13	**13**	cobble alluvium	high flow erosion	300	5	1.6	100
11.5	**11**	sandy	boat wake	2500	4	1.2	50
11.2	**10.8**	sandy silts	boat wake	3000	6	0.6	50
11.2	**10.7**	sandy silts	boat wake	3500	5	0.6	40
10.8	**10.3**	sandy silts	boat wake	3500	5	0.6	100
10.7	**10.1**	clay banks	boat wake/ erosion	4000	6	0.4	90
10.1	**10.1**	sandy	boat wake	200	6	1	100
10	**9.9**	sandy	erosion, boat wake	500	5	0.8	100
9.8	**9.2**	clay, sand	erosion	3000	4	0.4	30
9.6	**9.2**	clay, sands	freeze/thaw, toe erosion, boat wake	1250	4	0.4	30
9.3	**9.1**	clay, sands	freeze/thaw, toe erosion, boat wake	800	6	0.6	60
9.2	**9.2**	clay, sands	freeze/thaw, toe erosion, boat wake	250	6	0.6	100
8.7	**7.5**	fine till	boat wake, piping, freeze/thaw, soil fail	7000	50	1	60
7.7	**7.2**	clay soils	freeze/thaw, wake	2700	6	0.4	100
6.8	**6.2**	gravel	erosion	4000	10	0.4	40
4	**3.7**	clay toe, till upper	internal forces and major storms	2500	60	1.2	10
1	**0**	sand	erosion	5000	60	1.2	100

In addition to the 29 specific erosion sites identified in the table, numerous other locations were observed where erosion was active, but the extent of an individual erosion unit was not sufficient to merit specific note. It was estimated that about five percent of the banks in the study reach were experiencing this intermittent erosion, and that the associated rate of recession was 0.4 ft/yr from RM 13 – 22, and 0.6 ft/yr from RM 0 – 13. Overall, about 22 percent of the banks in the study reach are eroding (25 percent from RM 0 – 13, and 18 percent from RM 13 – 22). The average weighted recession rate is 0.77 feet per year, and is somewhat higher in the upstream reach (0.89 ft/yr) than in the lower reach (0.71 ft/yr).

SEDIMENT ANALYSES

To assess the effect of stabilizing the Kenai Bluffs, a sediment budget was developed for the Kenai River. Concerns regarding the fate of the Kenai Dunes as a consequence of limiting sediment supply were the focus of this effort, so those sediment sizes found in the dunes were central to the analysis. We conducted an assessment of the sediment processes in the lower 22 miles of the Kenai River in order to document the nature and extent of bank erosion, characterize the sediments, and develop a sediment budget.

Sediment Sources and Processes

Sediments found in and around the confluence of the Kenai River and Cook Inlet are delivered by three principal processes; 1) littoral transport of sediments along the shore of Cook Inlet, 2) sediments transported by the Kenai River as suspended and bed load, and 3) sediments derived locally through wave and overland erosion and eolian processes. These sediments originate from a wide variety of sources, including upland, streambank and coastal erosion.

The relative contribution of sediments from these sources is not known, and not all of the sediments delivered to the area deposit on the tidal flats or on the Kenai Dunes. Finer sediments transported by the Kenai River pass through the estuary and further into Cook Inlet, and many of the fine sediments transported in the bay by longshore processes bypass the inlet. Some of the deposited sediments are resuspended and later transported through the study area, or are removed by winds during low tides. Thus, not all sediments are important in determining the impacts of stabilizing the bluffs; only those that historically deposit and remain in the dunes and tidal flats need be considered (see grain size distributions in Appendix B.

Sediment Characteristics

Sediments in the Kenai Dunes are very uniform fine sands (the d_{50} is 0.21 mm), with only about one percent of the sediments in the silt and clay size range, and no sediments larger than 0.5 mm. Observation of the dunes (Figure 8) suggests that energy conditions are not sufficient to transport the coarser particles onto the dunes, or that this occurs only rarely; and when this occurs, the coarse particles are subsequently covered by sands. A larger fraction of silts and clays likely deposits temporarily on the dunes, but is eroded when winds sort the sediments. The prevailing winds appear to be limited to the local transport of fine and medium sands, and are capable of removing silts and clays.

Figure 8. Photo of the Kenai Dunes with the eroding bluff in the background.

Sediments found in the tidal flats in the Kenai estuary are finer than those in the dunes. An average of 8 samples collected in the tidelands suggest that the sediments are about 30 percent sands, 48 percent silts, and 22 percent clays (Kinetic Laboratories 1998). This data also shows that sediment deposits in the tidelands are less uniform than those in the dunes. Individual samples contained sand fractions ranging from 1.51 percent to 98.09 percent. The tidelands are subject to a wide range of forces, including wind, tidal currents, river currents, waves, and ice, and these act to varying degrees with time and location to sort and distribute sediments.

Sediments found in the banks along the lower Kenai River are diverse, consisting primarily of poorly sorted glacial till on high bank terraces, and deposits of fine sands, silts and clays on lower banks below RM 13. Sediments in the upper horizon of the Kenai Bluffs are typical of the till deposits that form the terraces along the Kenai River. The d_{50} based upon sieve analyses of collected samples (see Appendix B for grain size distributions) is about 0.45 mm, but sediments range in size from silts to large gravels. The lower horizon of the bluff consists of consolidated clays, silts, and fine sands, most likely former deposits from glacial damming. The d_{50} of this material is about 0.03 mm. Between these two deposits is a thin (3 – 6 inch) layer of relatively impermeable till with a distinct seepage horizon along the upper surface. A high terrace on the left bank of the river at about RM 8.5 has a similar sediment size distribution to those found in the upper horizon of the Kenai Bluffs.

Downstream of RM 13, the banks of the Kenai River are generally low in height, and consist primarily of clays and silts, with some fine sands. Samples obtained July 8 – 10, 2003 at RM 9.6 and 11.3 are representative. The maximum sediment size found in the banks passes a 0.25 mm sieve. The d_{50} of these sediments is about 0.02 mm. Samples collected upstream (at RM 13.2, 15.9, 18.3, 19.5 and 20.2) demonstrate a coarser and more poorly sorted grain size distribution. The average d_{50} of these samples is just under 2 mm, and about 2/3 of the sediments in the banks fall within the sand classes, with the remainder consisting mostly of gravels.

Sediments on the bed of the Kenai River grade from coarse to fine with distance downstream. Wolman pebble counts of bar sediments obtained under low flow conditions (3800 cfs at Soldotna) on May 24 – 25, 2003 show that the d_{50} upstream of RM 13 is about 2 in., and a larger fraction of coarse sediments are found with distance upstream. Figure 9 presents an example grain size distribution, and Table 2 provides an average of bar samples collected upstream of RM 13. Pebble counts were not conducted downstream of RM 13 because the sediment is too fine. However, a study by Kinetic Laboratories (1998) included samples at RM 2, 3, 5, 10, and 13. The precise location of these samples is not noted in the report, but they demonstrate a d_{50} in the fine sand/coarse silt range. Lenses of gravel are present on the bed in this lower reach, particularly adjacent to high terrace/bluff features, but the bed material appears to be primarily sands.

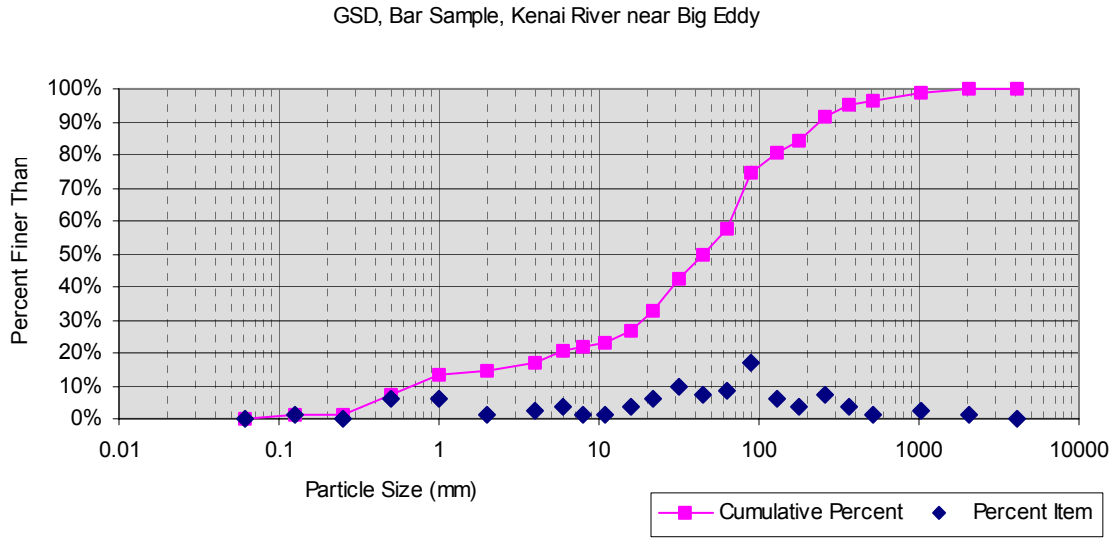

Figure 9. Grain size distribution of bar sediments – Kenai River near Big Eddy (RM 16).

Table 2. Average of bar samples collected upstream of RM 13, Kenai River.

Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
3.117	24.22	46.1	174	356	0%	14%	43%	34%	8%	0%

Sediment Budget

The University of Alaska Anchorage (UAA) conducted an assessment of the sediment budget at the mouth of the Kenai River (Smith et al. 2001). This study focused on the sand budget for the beach adjacent to the proposed project in the Kenai Dunes vicinity. The UAA study addressed wave-induced longshore transport at the dunes, northward longshore transport along Kalifornsky beach, direct contribution of sediments from the erosion of the Kenai Bluffs, and sediment delivery through riverine transport on the lower Kenai River. A summary of the study results is presented in Table3; Figure 10 shows the control volume used in the analysis.

Table 3. Summary of sediment loads presented in UAA study (Smith et al. 2001).

Source	*Total Load (tons/yr)*	*Sand Load (tons/yr)*
Kenai River	690,000	363,000
Kenai Bluffs	51,120	-
Wave-Induced	39,800	39,800
Longshore	67,700	67,700

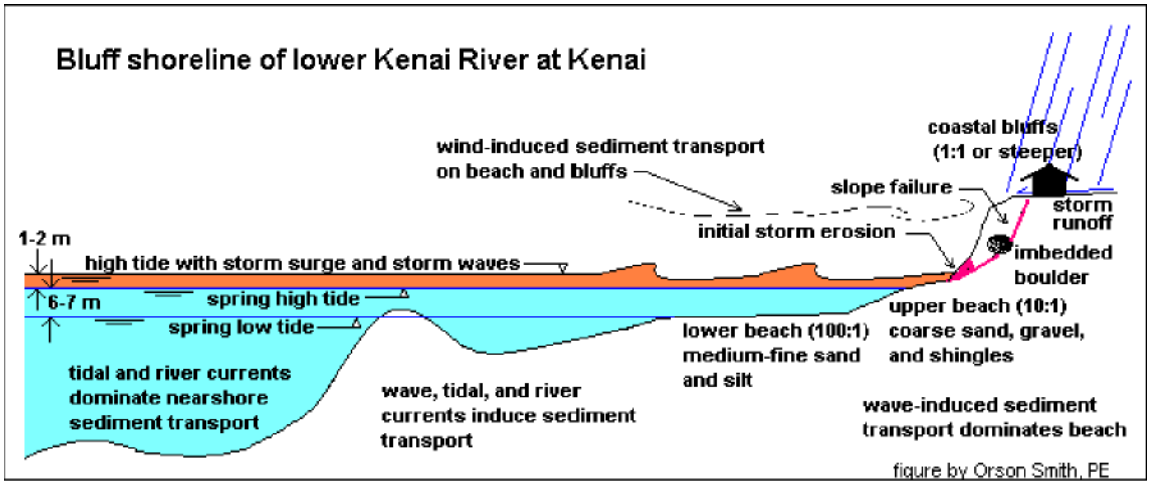

Figure 10. Control volume schematic for UAA study (Smith, et al. 2001)

The UAA study concluded that, because of a large surplus of sediment delivery to the study reach, and because the bluff erosion contributed only 7 percent to the total load from the river, the proposed stabilization effort would not adversely affect the Kenai Dunes.

The UAA sediment budget was refined based upon the data we collected in the field. Sediment sources downstream of Soldotna were included in the total sediment load from the Kenai River by documenting existing erosion and projecting the erosion rates into the future. The sediment loads were then separated into the wash and bed material components, so that the final sediment budget reflected only those sediments important to the morphology of the project area. Readers are referred to ASCE Manual 54 "Sedimentation Engineering" (ASCE 1975) for a description of terminology used in this report.

Sediment yield from sources upstream of Soldotna was determined by integrating a flow duration curve for the USGS gage at Soldotna (Figure 11) with a sediment rating curve for this site based upon suspended sediment samples obtained by the USGS between 1967 and 2001 (Figure 12). The USGS suspended sediment data showed an average concentration of fines (less than 0.063 mm) of about 67 percent. The bed material load shown in Figure 12 was determined by adjusting the total load to eliminate the fines, and an increment of 10 percent of the load was added to account for the unmeasured (bed) load, following standard convention (ASCE 1975). The UAA report assumed 53 percent of the load was bed load, but we feel this to be an unrealistic estimate upstream of RM 13, so the more conservative estimate of 10 percent was adopted.

Integrating the flow duration curve with the sediment rating curves yields an estimated annual total load of 138,000 tons. The bed material component of this is about 55,200 tons. These estimates do not include coarse substrates entrained from the bed by high flows, but these substrates are not likely significant in volume, nor do they contribute to the formation and maintenance of the dunes or tidelands near Kenai. This measured load is significantly less than that reported in the UAA study, which based its estimate on a projection of mean flow conditions and an average sediment concentration.

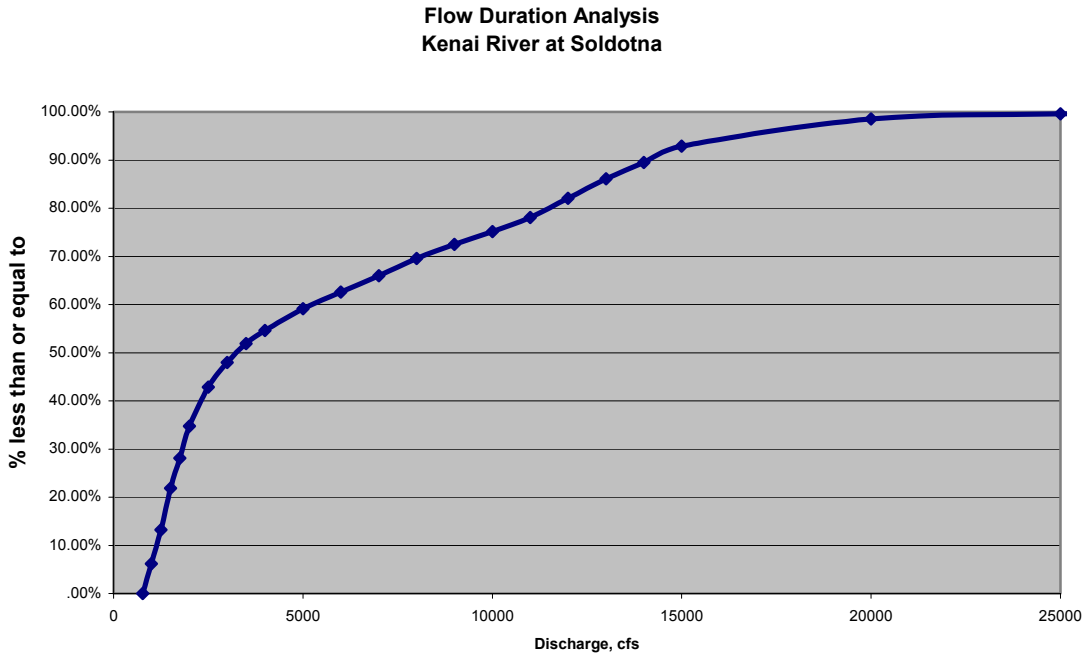

Figure 11. Flow duration curve, mean daily discharge 1965 – 2002, Kenai River at Soldotna, AK.

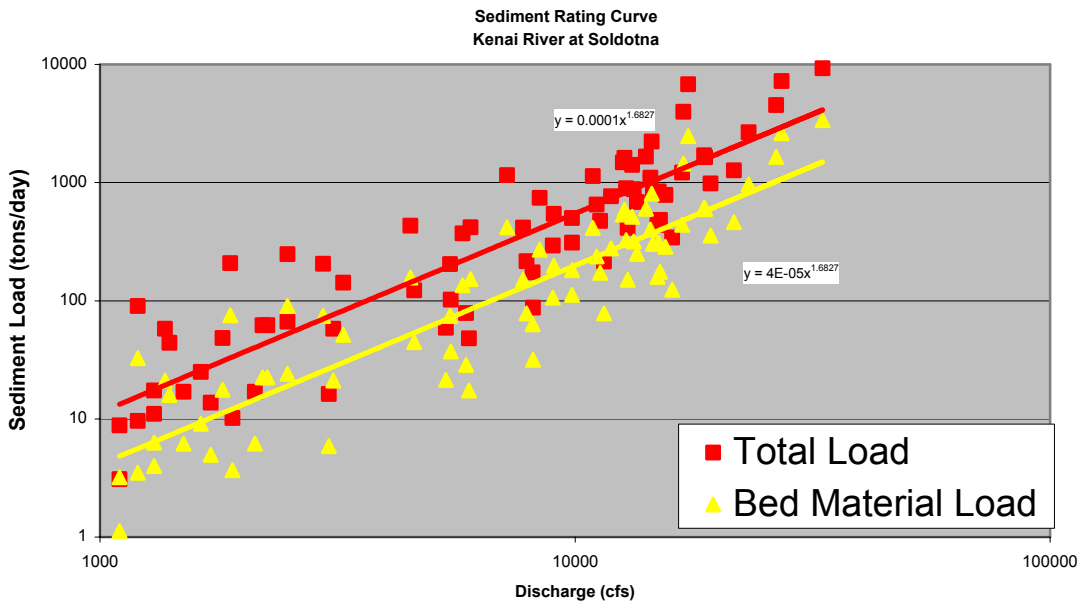

Figure 12. Sediment Rating Curve, Kenai River at Soldotna.

Total sediment yield from bank erosion downstream of the USGS gage was assessed by determining the average annual volumetric yield from the sources listed in Table 1 and assuming a specific weight of 2.7 and 30 percent porosity (1.6 tons/cubic yard). The contribution of bank erosion to the bed material load was determined by adjusting the total load to eliminate the fraction of sediments in the banks finer than 0.063 mm. Table 4 presents a summary of the sediment contribution from each of the erosion sites.

Table 5 presents a revision of the UAA sediment budget incorporating these new figures. The total bed material (sands) load into the control volume is about 210,000 tons/year. Of this, about half is derived from coastal processes, one-fourth from watershed sources above Soldotna, and the remainder is from bank erosion downstream of Soldotna. We estimated the total contribution of sediments from the Kenai Bluffs to be 21,300 tons/year, as opposed to the UAA study, which estimated 51,000 tons/year. The difference is likely attributable to a variation in estimated annual recession rates; we assumed 1.2 feet/year based on 1965 – 1995 conditions, whereas the UAA estimates were based upon recession rates between 1976 and 1999, a period that may have experienced higher than normal erosion.

The volume of sediments delivered by erosion and failure of the Kenai Bluffs was adjusted to eliminate fines by reducing the volume by the percent fines *in situ* in the bank based upon our sampling. The retreat of the bluffs contributes about 10,600 tons of sand-sized sediment per year to the system. This constitutes approximately 5 percent of the sand load of the system. The UAA study estimated the contribution to be 7 percent.

The preceding assessment assumes that all of the sediments passing the gage at Soldotna and those eroded from the downstream banks are delivered to the project area. Over the long term, this may be a reasonable assessment, as there is little evidence of significant morphologic change in the lower reaches of the channel in recent history. However, long-term aggradation of

this reach is almost certain, and a more detailed assessment that considers sediment transport capacity and deposition is warranted. The following section of the report presents a sediment budget that accounts for deposition and erosion through transport and continuity analyses. This additional analysis accounts for aggradation upstream of the project site and effectively overcomes the limitations of the general budget presented in the UAA study and refined above.

Table 4. Sediment contribution from erosion sites downstream of Soldotna.

RM Start[1]	RM End[1]	% Bed Material	Avg. Annual Total Load (cy)	Avg. Annual Total Load (tons)	Avg. Annual B.M. Load (cy)	Avg. Annual B.M. Load (tons)
22.0	**13.0[2]**	99.2	1408	2253	1397	2235
20.8	**20.8**	100.0	89	142	89	142
20.6	**20.6**	100.0	71	114	71	114
20.1	**19.8**	100.0	667	1067	666	1066
19.3	**19.3**	99.7	213	341	213	340
19.1	**19.0**	99.7	80	128	80	128
18.9	**18.1**	99.6	6222	9956	6197	9916
18.3	**18.0**	99.6	622	996	620	992
17.7	**17.6**	99.6	178	284	177	283
16.2	**15.9**	99.7	2111	3378	2105	3368
15.7	**15.4**	99.7	3200	5120	3190	5105
14.0	**14.0**	99.7	782	1252	780	1248
13.5	**13.3**	99.7	480	768	479	766
13.0	**13.0**	99.7	89	142	89	142
13.0	**0.0[2]**	50.0	1525	2441	763	1220
11.5	**11.0**	6.3	222	356	14	22
11.2	**10.8**	6.3	200	320	13	20
11.2	**10.7**	6.3	156	249	10	16
10.8	**10.3**	6.3	389	622	25	39
10.7	**10.1**	6.3	320	512	20	32
10.1	**10.1**	17.5	44	71	8	12
10.0	**9.9**	17.5	74	119	13	21
9.8	**9.2**	17.5	53	85	9	15
9.3	**9.1**	17.5	64	102	11	18
9.2	**9.6**	17.5	22	36	4	6
9.2	**9.2**	17.5	33	53	6	9
8.7	**7.5**	99.2	7778	12444	7716	12345
7.7	**7.2**	6.3	240	384	15	24
6.8	**6.2**	99.2	237	379	235	376
4.0	**3.7**	49.8	667	1067	332	531
1.0	**0.0**	49.8	13333	21333	6640	10624
	Total		**41571**	**66513**	**31984**	**51175**

1 – Overlap in river miles occurs in some instances because erosion sites on the left and right banks were treated separately.
2 – These "sites" represent small-scale, intermittent erosion occurring throughout the reach but not designated as a separate site because of scale.

Table 5. Summary of sediment loads in the study area.

Source	*Total Load (tons/yr)*	*Sand Load (tons/yr)*
Kenai River	204,500	106,200
Wave-Induced*	39,800	39,800
Longshore*	67,700	67,700
****UAA study data***		

Kenai River Erosion and Transport

An analysis of sediment transport and deposition on the lower Kenai River (downstream of RM 22) was conducted using the Sediment Impact Assessment Model (SIAM), a sediment budget model developed by the ERDC Coastal and Hydraulics Laboratory under the Regional Sediment Management Research Program. A description of SIAM is presented in Appendix A. The version of SIAM used for this assessment is a testing and evaluation compilation incorporated into HEC-RAS Beta Version 3.2.

Cross sections used to represent channel geometry were developed from an existing HEC-RAS model furnished by UAA, augmented with cross sections obtained by CEPOA for a flood insurance study. The cross sections extend from RM 0 to RM 22, at the USGS gage in Soldotna, AK. The model was calibrated by UAA (Smith, personal communication, 2003) and no additional calibrations were performed. The study reach was divided into four subreaches for analysis: RM 0 – 7; RM 7 – 13; RM 13 – 19; and RM 19 – 22.

Hydrology for the model analysis was determined using a flow duration curve developed from data for the period of record at the USGS gage at Soldotna, AK (Figure 8). The distribution of flows were represented in the model analysis by a series of five steady discharges and associated durations (Table 6), representing an average annual series of flows. The downstream boundary condition is defined by the tide, which varies semi-diurnally over a mean range of 17.7 feet at the Kenai confluence. Variations in the tidal range were represented in the model by the geometric means of the high and low tides, which were 8.6 ft msl and –9.2 ft msl, respectively. The flow durations were divided equally for these two boundary conditions, with one day per year eliminated from the flow duration series to permit full-day analyses.

Table 6. Discharges and durations used in the assessment to represent annual hydrology.

Representative Discharge (cfs)	*Days per Year*
4,000	224
9,000	76
14,000	50
19,000	14
26,000	2

Samples from the bed of the channel were used to define the bed material size distribution as well as the diameter of the largest particle moving as wash load (set at the d_{10} of the bed material). Upstream of RM 13, the bed material was determined from bar

sampling using Wolman pebble counts. This data is shown in Appendix B. Bed material gradations downstream of RM 13 were determined from samples collected during a study by Kinetic Laboratories (1998), augmented with a sample collected at the Pillars (RM 12.5). Table 7 presents the bed material gradations used for each of the four subreaches in the study. The demarcation of the wash and bed material loads was established as the d16 of the bed material, and are shown in Table 7.

Table 7. Bed material gradations, by reach.

			Percent Distribution by Reach			
Material	Size Range (mm)		RM 0 - 7	RM 7 - 13	RM 13 - 19	RM 19 - 22
silt/clay	0	0.062	76.0	0.0	0.0	0.0
very fine sand	0.062	0.13	7.0	2.1	1.2	0.0
fine sand	0.13	0.25	6.0	4.2	0.0	3.2
medium sand	0.25	0.5	5.0	6.3	6.0	6.4
coarse sand	0.5	1	4.0	5.2	6.0	3.2
very coarse sand	1	2	2.0	3.1	1.2	2.1
very fine gravel	2	4	0.0	6.3	2.4	6.4
fine gravel	4	6	0.0	5.2	3.6	3.2
fine gravel	6	8	0.0	3.1	1.2	2.1
medium gravel	8	11	0.0	2.1	1.2	1.1
medium gravel	11	16	0.0	6.3	3.6	6.4
coarse gravel	16	22	0.0	6.3	6.0	7.4
coarse gravel	22	32	0.0	8.3	9.6	6.4
very coarse gravel	32	45	0.0	5.2	7.2	6.4
very coarse gravel	45	64	0.0	7.3	8.4	7.4
small cobble	64	90	0.0	9.4	16.9	11.7
medium cobble	90	128	0.0	5.2	6.0	4.3
large cobble	128	180	0.0	4.2	3.6	4.3
very large cobble	180	256	0.0	6.3	7.2	7.4
small boulder	256	362	0.0	3.1	3.6	3.2
small boulder	362	512	0.0	1.0	1.2	3.2
medium boulder	512	1024	0.0	0.0	2.4	2.1
large boulder	1024	2048	0.0	0.0	1.2	2.1
very large boulder	2048	4096	0.0	0.0	0.0	0.0
bedrock			0.0	0.0	0.0	0.0
Wash Load (mm)			0.004	0.8	3.1	2.3

Local sediment sources include the inflowing sediment load at RM 22, and the bank erosion documented in Tables 1 and 4. The inflowing sediment load was determined using USGS data as discussed in the preceding section. To account for the load from bank sources in the SIAM model, it is necessary to categorize the types of erosion and the associated average sediment delivery by grain size. Five categories of bank loss were identified for the lower reach of the Kenai River, and are summarized below.

Type 1 erosion was assigned to the bank along the Kenai Bluffs where stabilization is proposed. Figure 13 shows the bank, which consists of a 30-foot layer of stiff clay

overlain by a 30 to 40-foot layer of till soils. Several mechanisms of bank loss were noted at this location, and occur over varying scales. The lower horizon is subject to retreat by wave erosion at the toe, freeze/thaw, and block failures associated with poor internal drainage. Each of these phenomena leads to shallow translational failures and soil fall of the upper till layer. Other mechanisms influencing bank loss of the upper horizon include dry soil fall, eolain transport, freeze/thaw, rilling and piping. Failure of the upper horizon is more rapid than the lower horizon, but is limited by the angle of repose of the materials. This type of bank is found only in the lower one-mile of the study area, the mean recession rate is 1.2 feet/year, and Type 1 erosion is affecting 5000 linear feet of bank in the study reach.

Figure 13. Photo of Type 1 Erosion.

Type 2 erosion involves high till banks with cobble material at the toe that are failing in an intermittent manner, generally from causes other than boat wakes. Included are banks experiencing limited erosion, localized rotational failures, and damage from foot traffic. Figure 14 shows an example of Type 2 erosion. This type of erosion is limited to areas upstream of RM 13, and affects about 5600 feet of bank. Average bank height is 38 feet, and the average rate of recession is 1.2 feet/year.

Figure 14. Photo of Type 2 Erosion.

Type 3 erosion involves relatively high terraces of predominately till material that are failing systemically – mainly from erosion of the toe by boat wakes followed by upper bank failures. The average bank height for these features is 35 feet, and the average rate of recession is 1.1 feet/year. These banks typically lack the coarse material at the toe found on Type 2 banks. With the exception of sites at RM 4 and 8, Type 3 erosion is limited to the reach upstream of RM 15.4. The length of eroding bank is about 15,400 feet. Figure 15 shows an example of this type of erosion.

Type 4 erosion involves erosion of relatively low banks where the material is a coarse alluvium. The primary failure mechanisms are erosion during high flow events and ice scour. The banks are not generally susceptible to wake erosion. Average bank height is 7 feet, and the average rate of recession is 0.9 feet/year. Figure 16 shows an example of Type 4 erosion. Type 4 erosion is found at three locations between RM 6.2 and 19.1, and totals about 2400 feet.

Figure 15. Photo of Type 3 Erosion.

Figure 16. Photo of Type 4 Erosion.

Type 5 erosion is found exclusively downstream of RM 13. Relatively low banks of silts, clays and sands that recede from erosion, boat wakes, freeze/thaw, piping, and cantilever failures are a common feature in the lower reach of the river. Type 5 erosion involves an average recession rate of 0.6 feet/year on banks that average less than 6 feet in height. The total length of Type 5 failures is 23,519. Figure 17 shows an example of Type 5 erosion.

The contribution of sediments from each type of erosion feature was determined by applying an average grain size distribution to the average height and recession rate. Table 8 presents a summary of the loading tables for the five types of erosion. Loads are determined by size fraction of sediments for use in the SIAM model, with sediments larger than very fine gravels excluded from the analysis because they do not contribute to the formation and maintenance of macroforms in the Kenai estuary.

Figure 17. Photo showing an example of type 5 erosion.

Table 8. Sediment loads by bank failure type.

Erosion	Load by Fraction (tons/yr/foot)							
Type	Clay	Silt	VFS	FS	MS	CS	VCS	VFG
1	2.133	0.021	0.060	0.363	0.981	0.213	0.213	0.213
2	0.005	0.005	0.019	0.127	0.459	0.432	0.419	0.649
3	0.298	0.046	0.038	0.122	0.392	0.325	0.523	0.350
4	0.001	0.002	0.006	0.024	0.101	0.064	0.045	0.045
5	0.183	0.021	0.003	0.000	0.000	0.000	0.000	0.000

HEC-RAS analyses were conducted for a high and low tide condition, using the five steady discharge values presented in Table 6. Summary output from the HEC-RAS runs for the mean conditions are presented in Appendix C. Hydraulic design functions for SIAM analyses were run for a variety of conditions, using Yang's transport function exclusively for the lower two reaches, and a combination of Yang's and Meyer-Peter and Muller's function for the upper two reaches. Both existing conditions and with-project conditions were assessed.

The 3.2 Beta version of HEC-RAS does not permit the display of sediment transport and deposition by grain size fraction when the SIAM module is utilized, and only reports the total aggradation or degradation by reach. However, the module was run for this study so as to exclude sediments not found in the bed material in the vicinity of the project area, so the values reported are predominately in the sand size range.

The results of the SIAM analysis are summarized in Table 9, and account for the aggradation occurring upstream of the area of concern. The inflowing bed material sediment loads to each of the study reaches are presented in the second column. The third and fourth columns show the average annual aggradation (or degradation, if negative) in the indicated reach. The load into the next reach downstream is determined by summing the inflowing load with the bank erosion in that reach, and subtracting aggradation (or adding degradation) in that reach.

The model suggests that only the reach from RM 22 to 19 is degradational; the remaining reaches are aggradational. The model also indicates that transport capacity is not sufficient to move the sand and larger classes of sediments through the most downstream reach, and that the entire bed material load would deposit in this reach except for the influence of tidal currents and longshore transport. The only difference in the model analyses between the existing and with-project conditions are the 10,600 tons/year of bed material sediment yielded directly from the Kenai Bluffs. This constitutes an 18 percent reduction in the river-derived sediments depositing in the area, or about 7 percent of the total sand load. These results are in close agreement with the sediment budget presented earlier in the report, and with the estimates in the UAA study.

Table 9. Summary of SIAM analysis results.

Reach (by RM)	*Inflowing Bed Material Load (tons/year)*	*Aggradation/Degradation Existing Conditions (tons/year)*	*Aggradation/Degradation With-Project Conditions (tons/year)*
22 – 19	55,200	-3,780	-3,780
19 – 13	57,700	12,400	12,400
13 – 7	68,500	34,900	34,900
7 - 0	46,700	58,700	48,100

DISCUSSION AND CONCLUSIONS

The proposed project consists of constructing a revetment of varying cross-section with geotextile and rock erosion protection on its seaward slope. The construction will protect the subject one-mile stretch of bluffs along the north bank of the Kenai River from erosion by extreme high water and waves. The lowest extent of the proposed erosion protection will lie in the upper half of the tidal zone; above the water most of the time. The upper eroding bluff will be graded to a shallower, more stable slope and planted to prevent wind- and runoff-induced erosion.

River currents apparently have little affect upon the stability of the bluff, and only affect sediments on the riverbank below the toe of the construction. Sediment lost from the bluff is carried only a short distance downstream, where wave-induced longshore transport becomes dominant.

The UAA study of the sediment dynamics in the vicinity of the project concluded that the reduction of sediment load would be minor (about 7 percent), and would be offset by the sediment surplus in the reach. We used two alternate analyses to assess the sediment budget of the system and, while we arrived at a lower overall sediment load, we found the impact of stabilizing the Kenai Bluffs to be of the same order as the UAA study. Our refinement of the UAA budget to account for bank erosion and to separate sediments into bed material and wash components suggests a 5 percent reduction in load, whereas our continuity analysis that accounts for aggradation upstream of the project site suggests a 7 percent reduction in sand load.

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APPENDIX A

Sediment Impact Assessment Model

A rapid assessment sediment transport tool is currently being developed at the Engineer Research Development Center (ERDC) that will allow for evaluation of numerous sediment management alternatives relatively quickly. The Sediment Impact Assessment Model (SIAM) provides a framework for combining watershed sediment sources, channel morphological, hydrologic, and hydraulic information in a series of reaches representing a network of channels. The algorithms use the connectivity between reaches to evaluate the sediment impact from local changes on the system from a sediment continuity perspective. The results map potential imbalances and instabilities in a channel network and provide the ability to assess the impacts of existing sediment sources such as bed and bank erosion, gullies, gravel mines, and surface erosion from the watershed, as well as the response to modifications such as bank stabilization, grade control structures, flow control (dams, stormwater management, etc.), land treatments, urbanization, land use changes, and other activities that modify the water and sediment supply to the channel system.

Introduction

As water resource projects become more and more complex, there is a growing emphasis on the ability to implement effective regional sediment management. A common goal of many regional sediment management projects is the reduction of sediment loading from the watershed. This is usually accomplished by rehabilitation features such as grade control, bank stabilization, drop pipes, dams, and land treatments. While these features are often implemented to reduce sediment yields to downstream reservoirs, flood control channels, or wetlands, the spatial and temporal response of these features are complex, and often result in unanticipated morphologic changes in the channel system. Therefore, the challenge in regional sediment management projects is to select the appropriate sediment management features that produce the desired reductions in sediment delivery while minimizing the disruption to the stability of the channel systems. In order to facilitate this decision process, ERDC is currently developing a Sediment Impact Assessment Model (SIAM), which provides for the rapid assessment of the impacts of sediment management features on downstream sedimentation trends. A brief overview of the SIAM is described below.

SIAM Overview

The SIAM provides a framework to combine channel morphological, hydrologic, and hydraulic information for a series of reaches representing a network of channels. The algorithms use sediment continuity and the connectivity between reaches to evaluate the impact from local changes on the system. The SIAM develops a map of potential

imbalances in a channel network to provide the first step in identifying design or remediation needs.

The SIAM provides the ability to assess both short- and long-term responses to changes in the watershed. The short-term impacts reflect the changes in the supply of wash load sized material, while the long-term morphologic adjustments are based on the changes in the supply of bed material. The wash load-bed material load threshold is supplied by the user for each reach of the channel system.

For each reach in the channel network, the SIAM creates a sediment budget by summing the supply from local sediment sources, estimating the annual transport capacity for bed material classes, and determining the contribution in wash load material size classes. For each reach, the results show the total contribution from local sediment sources, the annual transport capacity, wash load supply, and bed material supply.

Annual Transport Capacity

The annual transport capacity reports the quantity of bed material the stream can move over a year. Annual transport capacity applies to bed material classes. Current routines apply Yang's transport relationship (Yang 1973) to each discharge in the hydrology records. Future versions will include additional transport functions that will reflect a wider range of sediment sizes. The procedure first assumes a uniform material, and then adjusts by the fraction present in the reach (Yang 1996). Multiplying by the duration of the discharge yields the total load moved in a flow record. The annual load sums the contribution from each hydrology record. A program developed by Stevens and Yang (1989) to match sediment concentrations was used to verify these computations.

Reach to Reach Sediment Connectivity

To determine the wash load material supply and bed material supply, the program compares the transport mode in the reach to the transport mode in the supplying reaches immediately upstream. Four possible transition scenarios can occur:

1. The grain size moves as wash load locally and was wash load upstream;
2. The grain size moves as wash load locally but was bed material load upstream;
3. The grain size moves as bed material load locally but was wash load upstream; and
4. The grain size moves as bed material load locally and upstream.

The supply sums contributions from local sources and upstream reaches. At junctions of two or more streams, scenarios 1 and 2, or 3 and 4 may occur simultaneously in a grain-size class. Sources are not double counted. Irrespective of transitions, the sum of the wash load and bed material supply equals the total material entering the reach.

Wash Load Material Supply

The wash load material supply includes grain classes at or below the wash load threshold from both local sources and reaches immediately upstream. The wash load material supply also includes sediment that transitioned from wash load in an upstream supply

reach to bed material in the current reach. Figure 1 shows the program logic for determining the wash load material supply.

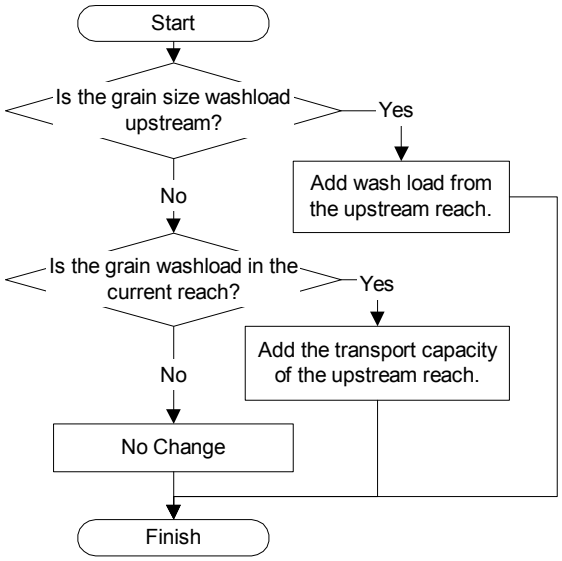


Figure 1. Wash Load Material Supply Logic

If the grain size moves as wash load upstream, the program adds the upstream load regardless of transport mode in the present reach. If the sediment was bed material in the upstream reach, but is wash load in the current reach, the upstream transport capacity is added to the supply. If the sediment was bed material in the upstream reach and is still bed material in the current reach, there is no wash load supply.

Bed Material Supply

The bed material supply includes only grain classes moving as bed material load in the current reach regardless of the transport mode upstream. Figure 2 shows the logic to determine the bed material supply.

If the grain size moves as wash load locally, the bed material supply will neglect the grain-size class regardless of upstream transport mode. If the grain size was wash load upstream, the program adds the amount to the bed material supply. If the grain size was bed material load upstream, the program adds the transport capacity of the upstream reach to the bed material supply. In the case of a supply-limited stream, finer particles not present in the bed armor layer will be considered wash load material. All particles are wash load material over bedrock. Bed material supply includes local sources.

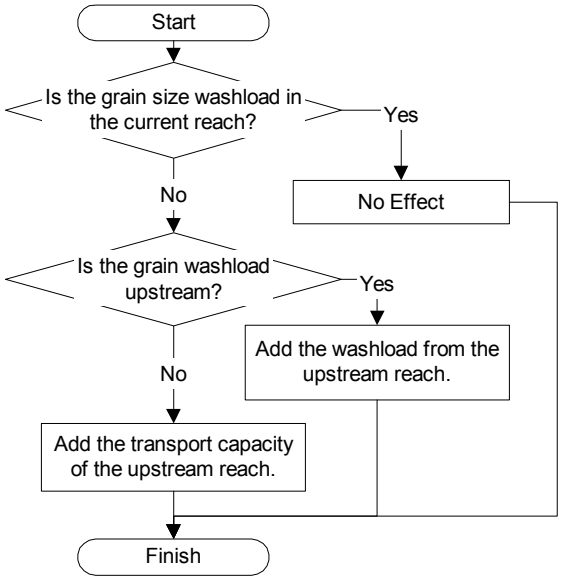


Figure 2. Bed Material Supply Logic

Input Description

The SIAM process requires developing input records describing the bed material, hydrology, hydraulics, and local sediment sources. By separating input development from synthesis, the model provides flexibility to vary techniques and procedures.

Grain-size Class Records
The grain-size classes divide all sediment gradations within the model into bins represented by a single diameter. The table of size class records applies to the entire model, providing a global template for performing grain-specific computations. Users specify the number of bins to match the anticipated resolution required for the project. Altering the grain-size classes after initial creation requires updating the tables for bed material records and the sediment sources.

Sediment Reaches and Network Topology
The SIAM treats a network of streams as a series of sediment reaches. A sediment reach divides a channel network into segments at significant changes in bed material, hydrology, hydraulics, or sediment sources. Sections upstream and downstream of a tributary junction must belong to separate reaches. Additional reaches span the length of potential projects or portions of a river with unique characteristics. Topology is defined by specifying the reach immediately downstream.

Users specify the characteristics of a stream network in six tables: bed material, sediment properties, hydrology, hydraulics, sediment sources, and loading templates. Each table

stores data as a series of records grouped into named sets. Tables function independently of each other and the network of sediment reaches. Figure 3 shows a reach associated with a set of records from the different tables. Specifying local sediment sources requires two tables, one for loading templates and another for the location and quantity of each source.

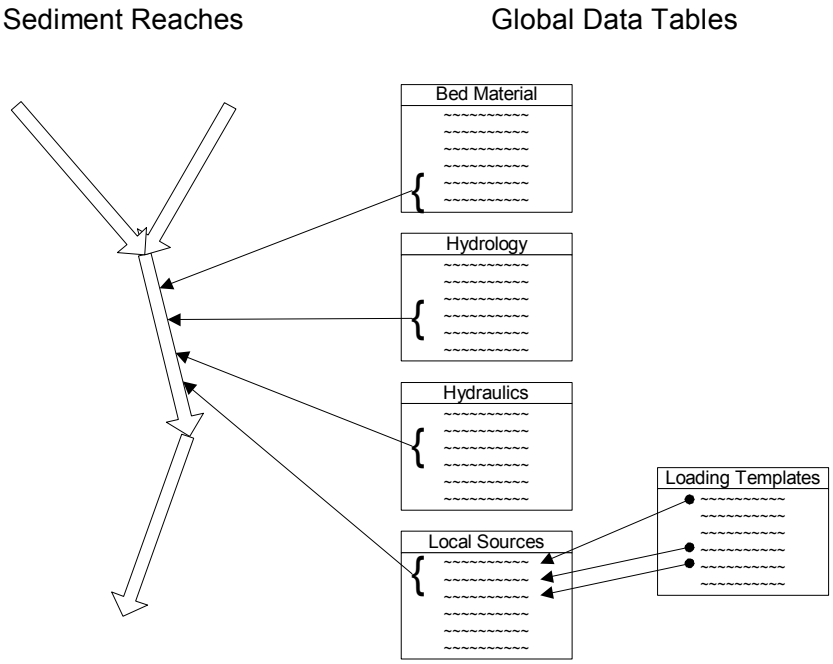


Figure 3. Sets of Records Associated with a Sediment Reach

The same set of tables may apply to multiple reaches, allowing reusable collections of values rather than duplicating data entry. Modifications to a record apply to all reaches associated with the set. A record can only belong to one set. The following sections describe each table. The fields in the network table include:

- **Name**: text identifier for the reach
- **Stream**: name of the stream
- **Downstream Reach**: name of the stream and reach immediately downstream from the element
- **Bed Material**: name of the set containing bed material records for the reach
- **Sediment Properties**: name of the record describing properties of the sediment including the wash load threshold
- **Hydraulics**: name of the set describing the hydraulic performance of the reach
- **Hydrology**: name of the set specifying the flow duration curve for the reach
- **Local Sediment Sources**: name of the set identifying sediment inputs
- **Bed Slope**: profile slope of the channel bed
- **Comment**: text notes for the reach

Bed Material Records
The bed material table specifies the decimal fraction of sediment present for each grain-size class in the size class records. The values can not exceed unity, but the model will accept smaller sums to allow scenarios where a user wishes to exclude fractions from the model. Order does not affect computations. If no record is entered for a particular grain-size class, the model assumes none is present.

Sediment Property Records
A sediment property record contains the diameter of the largest material moving as wash load through a reach. Future versions may use sediment property records to define parameters required for scour and deposition of cohesive material.

Hydrology Records
Hydrology records define an annual flow duration curve by a series of discharges and the corresponding decimal number of days that the flow occurs. The sum of the duration fields within a set of records should not exceed an average year, 365.25 days. The model accepts smaller sums to allow scenarios where the user wishes to exclude discharges of negligible impact. Order does not affect computations.

Hydraulic Records
Sets of hydraulic records describe the flow properties of the channel over a range of discharges. Sediment transport computations estimate the hydraulic performance of each hydrology record using a discharge-based rating curve. Equilibrium computations use the records to estimate a depth-based rating curve. Hydraulic records should bracket the range of discharges in the hydrology records for the reach. To minimize the number of backwater runs required to define channel hydraulics, discharges in the hydraulic records do not need to match discharges in the hydrology table. In transport capacity computations, intermediate values are estimated by a linear transformed log interpolation between the nearest points. Values outside the range interpolate from the nearest two points and generate a warning. Equilibrium computations fit a power function to the depth-area and depth-hydraulic radius relationships using least squares regression.

Local Sediment Sources and Sediment Loading Records
Local sediment sources include all material supplied to a reach from sources outside of the channel bed or upstream of the model boundary. Sources include inflows to the most upstream reaches, bank failure, surface erosion, gravel mining, gully formation, and any other production. Sediment sources do not include material hydraulically transferred between modeled reaches. Specifying a sediment source requires a set of records in two tables. The local sediment source set is associated with a reach and specifies the annual quantity of sediment supplied by records in the sediment loading table. Table 1 shows the table for local sediment sources.

Table 1. Local Sediment Source Record Fields

Name	Multiplier	Loading	Comment
⋮	⋮	⋮	⋮

The loading table contains a field for each grain-size class in the global template. Table 2 shows the headings for a loading table.

Table 2. Sediment Loading Record Fields

Name	Class 1	Class 2	Class …	Class n	Comment
⋮	⋮	⋮	⋮	⋮	⋮

The two-table method allows the user to define generic load values and then apply the source to any reach. The multiplier scales loads based on the magnitude or number of sources contributing to a reach. Each record in the loading table must have a unique name. Users must ensure units of the loading record and the multiplier result in mass per year. Order does not affect computations. Some anticipated loading-multiplier pairings include:

- **Upstream Boundary Sediment Load**: discharge and duration
- **Gully Supply Rate**: number of contributing gullies
- **Bank Failure Block**: length of bank within the reach
- **Surface Erosion Rate**: drainage area

Output Description

For each reach and each grain-size class the output table displays the total supply from sediment sources, upstream hydraulic wash load material, upstream hydraulic bed material, and the transport capacity. Table 3 shows the format.

Output from the SIAM can be summarized in both tabular and graphical format. In tabular format, an "answer quit" provides the ability to view the stability of multiple scenarios simultaneously over all reaches. A quilt displays scenarios in the columns and the reaches in rows with the equilibrium parameter filling in the matrix. Color-coding identifies significant trends. Bar and scatter charts focus on specific streams or reaches to show more detailed observations. A typical plot covers a single reach or a single stream. The chart may show data for any combination of the output variables including summations over all classes or differences between parameters.

Table 3. Format of an Output Table

Stream	Reach	Sediment Sources Supply			Transport Capacity			Wash Material Supply			Bed Material Supply		
		Class 1	Class 2	…	Class 1	Class 2	…	Class 1	Class 2	…	Class 1	Class 2	…
Stream 1	Reach 1												
	Reach 2												
	⋮												
Stream 2	Reach 1												
	Reach 2												
	⋮												
⋮	⋮												

Summary

The SIAM aims to integrate watershed-scale sediment continuity concepts into stream rehabilitation and management. The analysis will provide an intermediate step between qualitative evaluations and a mobile boundary numerical model. The SIAM provides a framework to combine hydrology, hydraulics, and sediment supply into a geomorphic assessment and rehabilitation design. With sediment as the number one ranking pollutant in streams and a contributing agent in many others, the addition of the SIAM into the river-engineering toolkit will empower designers and planners to more easily consider sediment supply and transport in management and rehabilitation of channel systems. The SIAM is currently under development with initial tests on a demonstration watershed in northern Mississippi. Plans for FY 03 include application to the Hickahala and Yalobusha Watersheds in Mississippi, and the Judy's Branch Watershed in Illinois. Other watersheds are also being considered as part of reimbursable activities.

References

Stevens, Jr., H. H. and Yang, C. T. (1989). "Summary and use of selected fluvial sediment-discharge formulas." U.S. Geological Survey Water Resources Investigations Report 80-4026.

Yang, C. T. (1996). *Sediment Transport Theory and Practice.* The McGraw-Hill Companies, Inc., New York, NY.

Yang, C. T. (1973). "Incipient motion and sediment transport." *J. Hydraulics Division,* ASCE, 98, 1679-1704.

APPENDIX B

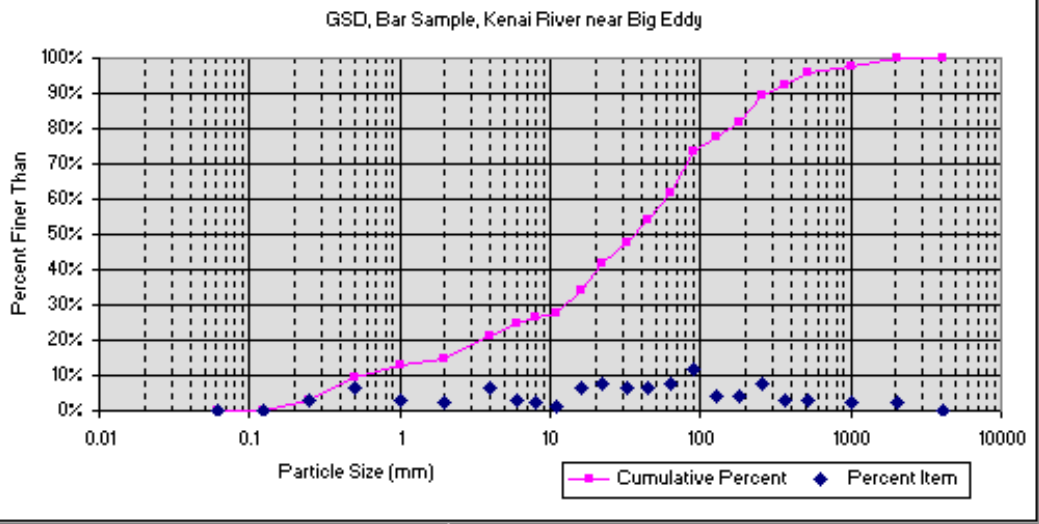
Sediment Sampling Data

Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	0
very fine sand	0.062	0.13	0
fine sand	0.13	0.25	3
medium sand	0.25	0.5	6
coarse sand	0.5	1	3
very coarse sand	1	2	2
very fine gravel	2	4	6
fine gravel	4	6	3
fine gravel	6	8	2
medium gravel	8	11	1
medium gravel	11	16	6
coarse gravel	16	22	7
coarse gravel	22	32	6
very coarse gravel	32	45	6
very coarse gravel	45	64	7
small cobble	64	90	11
medium cobble	90	128	4
large cobble	128	180	4
very large cobble	180	256	7
small boulder	256	362	3
small boulder	362	512	3
medium boulder	512	1024	2
large boulder	1024	2048	2
very large boulder	2048	4096	0
bedrock			0
Total Particle Count:			94

stream: Kenai River Centennial Park Bar Sample

Note:



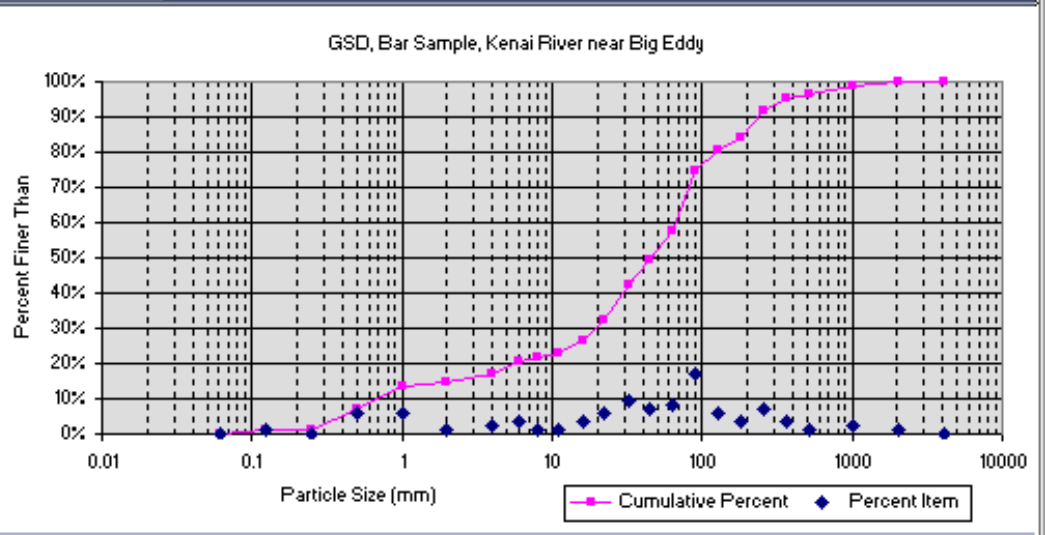
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
2.255	16.67	35.9	199	472	0%	15%	47%	28%	11%	0%

Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	0
very fine sand	0.062	0.13	1
fine sand	0.13	0.25	0
medium sand	0.25	0.5	5
coarse sand	0.5	1	5
very coarse sand	1	2	1
very fine gravel	2	4	2
fine gravel	4	6	3
fine gravel	6	8	1
medium gravel	8	11	1
medium gravel	11	16	3
coarse gravel	16	22	5
coarse gravel	22	32	8
very coarse gravel	32	45	6
very coarse gravel	45	64	7
small cobble	64	90	14
medium cobble	90	128	5
large cobble	128	180	3
very large cobble	180	256	6
small boulder	256	362	3
small boulder	362	512	1
medium boulder	512	1024	2
large boulder	1024	2048	1
very large boulder	2048	4096	0
bedrock			0
	Total Particle Count:		83

Pebble Count,

stream: Kenai River
Big Eddy
Bar Sample
Note:



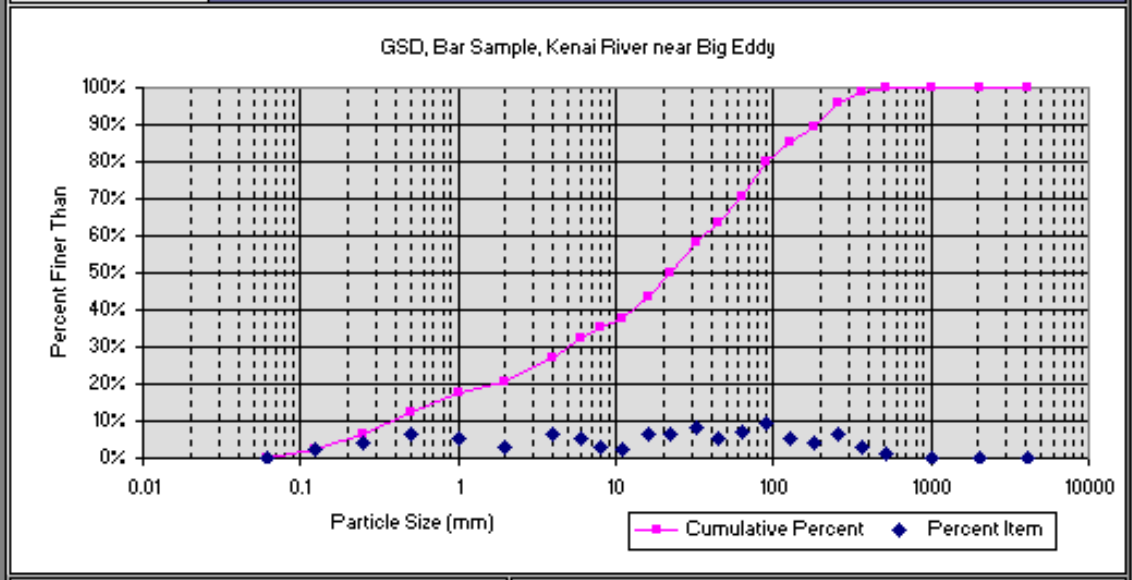
Size percent less than (mm)				
D16	D35	D50	D84	D95
3.117	24.22	46.1	174	356

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	14%	43%	34%	8%	0%

Pebble Count

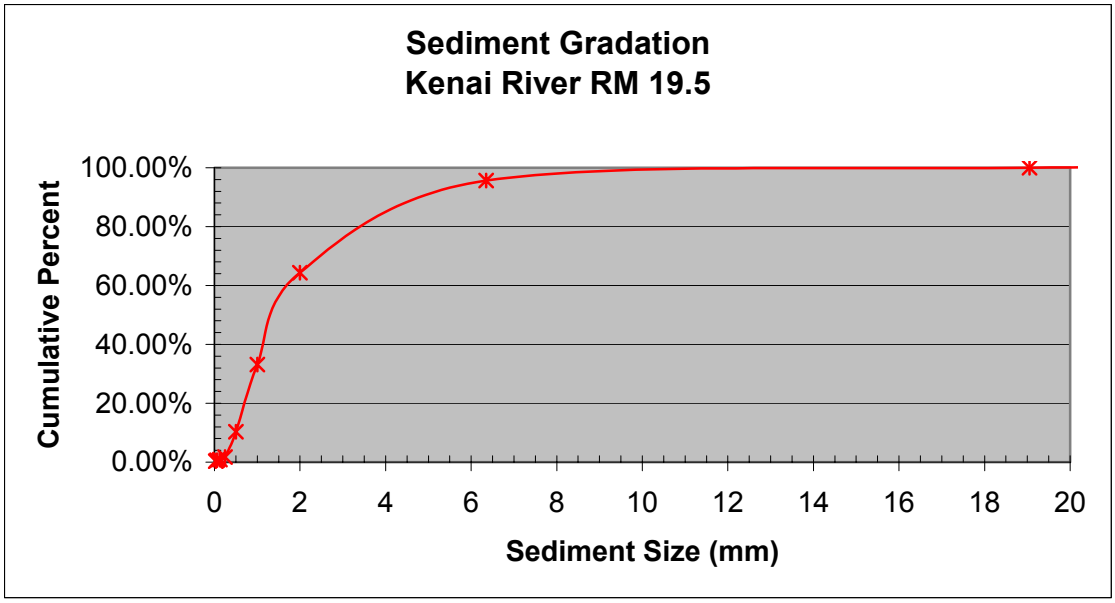
Material	Size Range (mm)		Count
silt/clay	0	0.062	0
very fine sand	0.062	0.13	2
fine sand	0.13	0.25	4
medium sand	0.25	0.5	6
coarse sand	0.5	1	5
very coarse sand	1	2	3
very fine gravel	2	4	6
fine gravel	4	6	5
fine gravel	6	8	3
medium gravel	8	11	2
medium gravel	11	16	6
coarse gravel	16	22	6
coarse gravel	22	32	8
very coarse gravel	32	45	5
very coarse gravel	45	64	7
small cobble	64	90	9
medium cobble	90	128	5
large cobble	128	180	4
very large cobble	180	256	6
small boulder	256	362	3
small boulder	362	512	1
medium boulder	512	1024	0
large boulder	1024	2048	0
very large boulder	2048	4096	0
bedrock			0
	Total Particle Count:		96

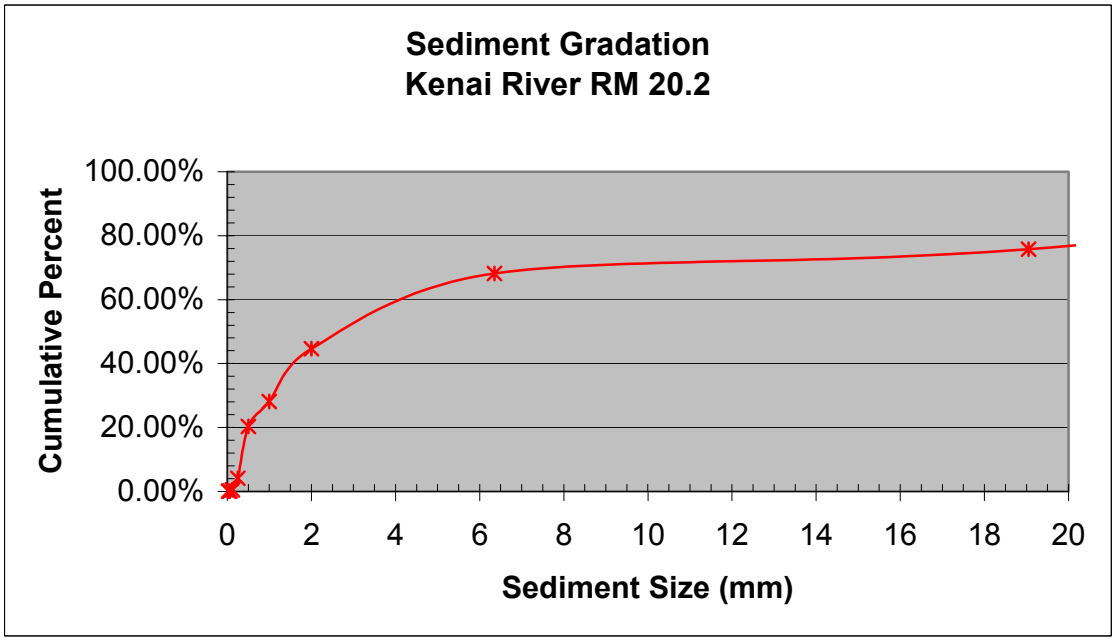
stream:	Kenai River
	Pillars
	Bar Sample
Note:	

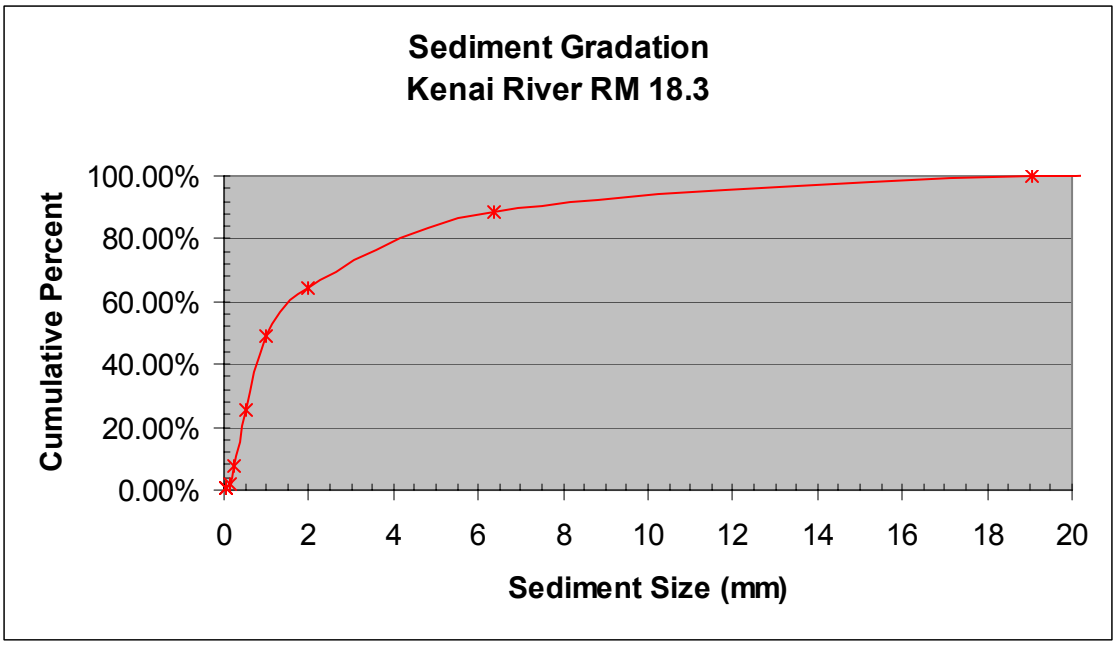


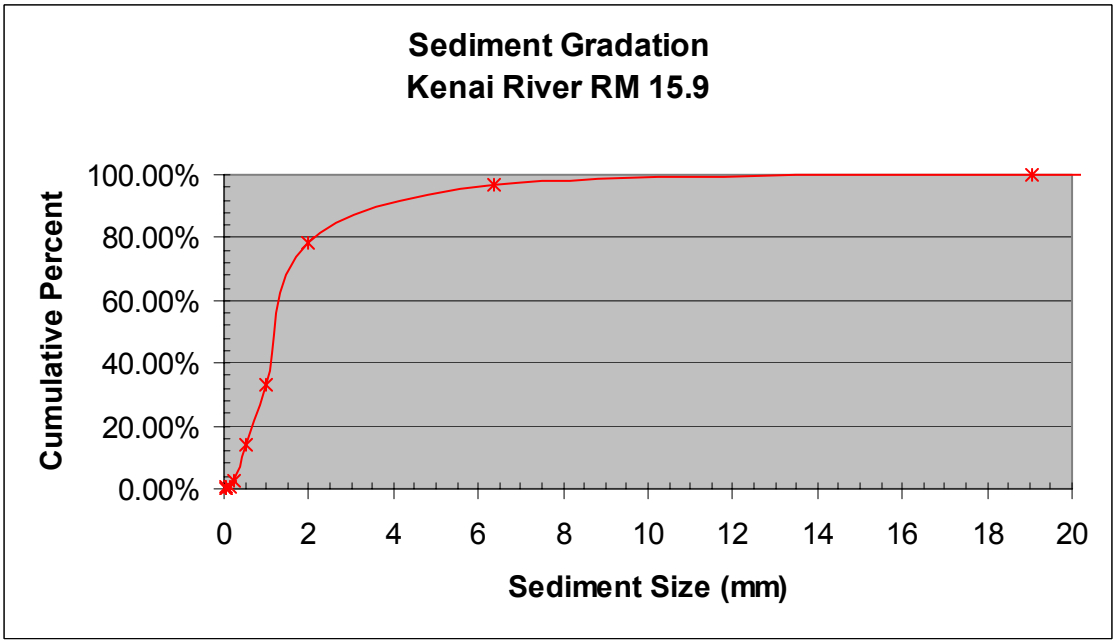
Size percent less than (mm)				
D16	D35	D50	D84	D95
0.797	7.70	22.0	116	244

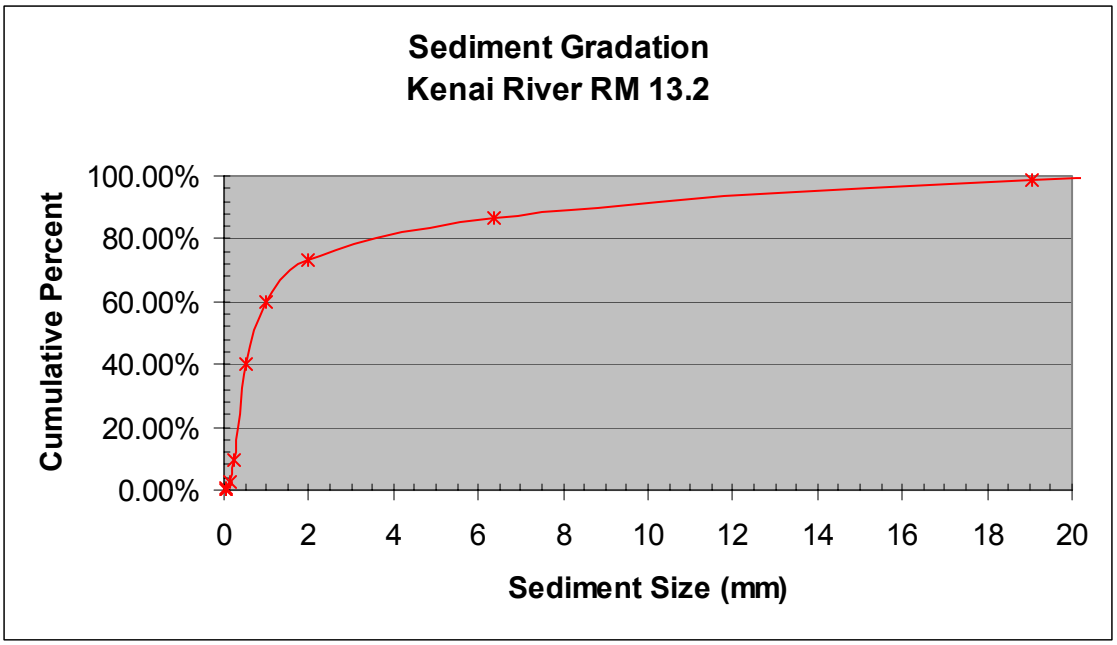
Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	21%	50%	25%	4%	0%

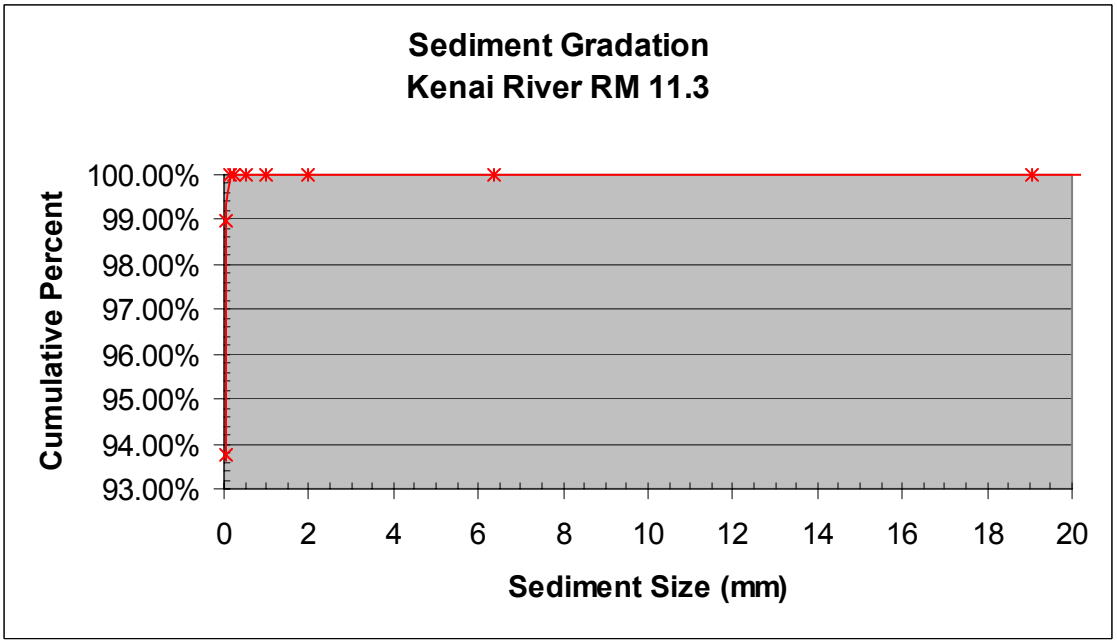

Sediment Gradation
Kenai River RM 19.5
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)

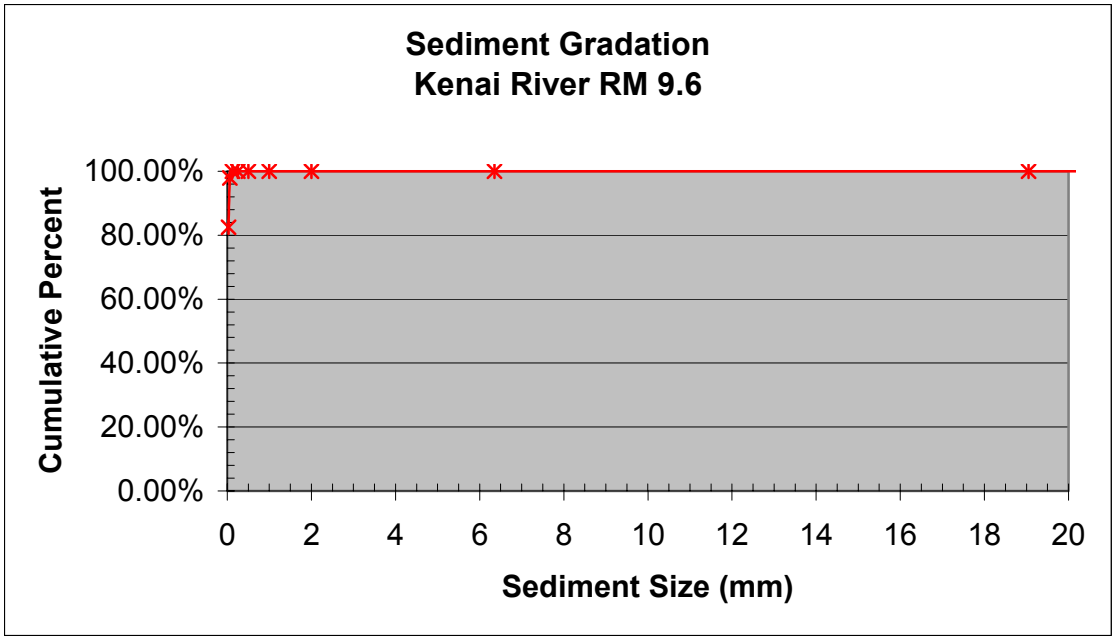

Sediment Gradation
Kenai River RM 20.2
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)

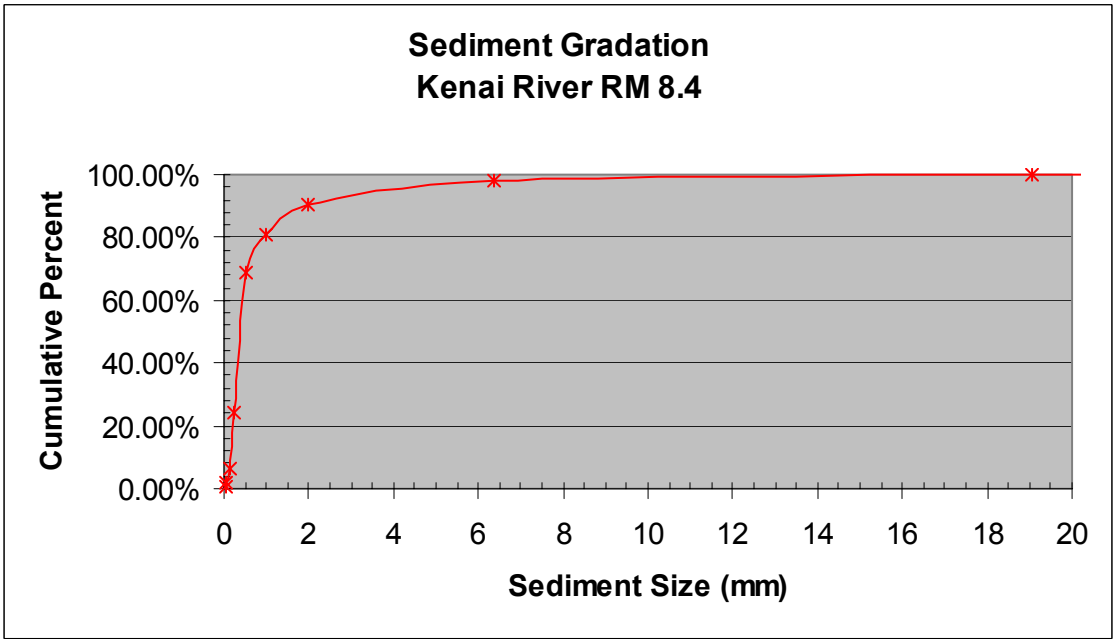

Sediment Gradation
Kenai River RM 18.3
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)

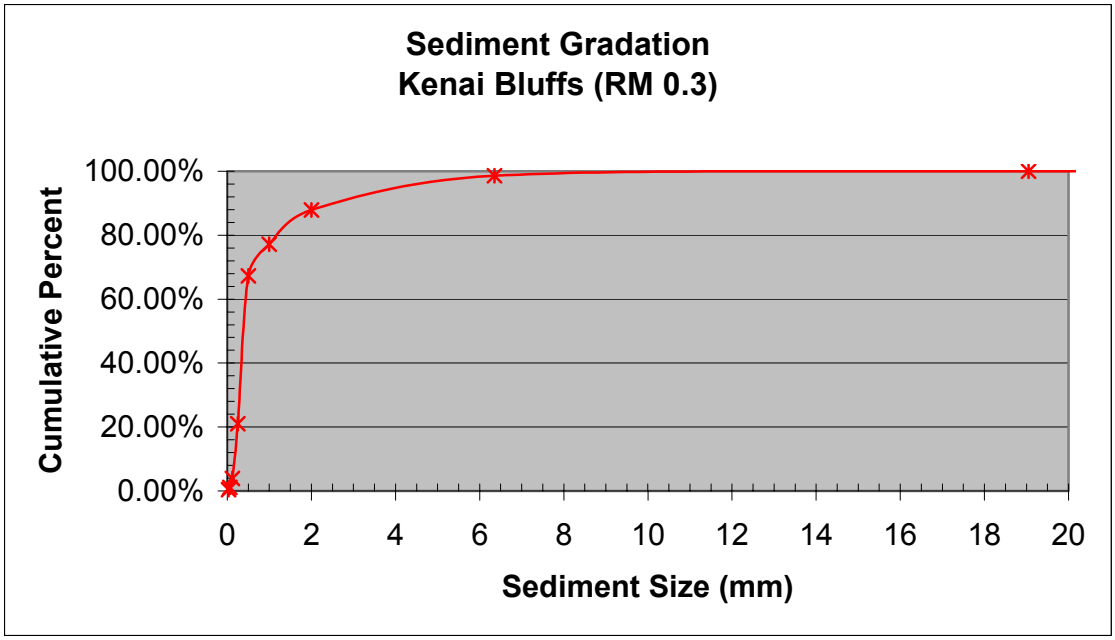

Sediment Gradation
Kenai River RM 15.9
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)

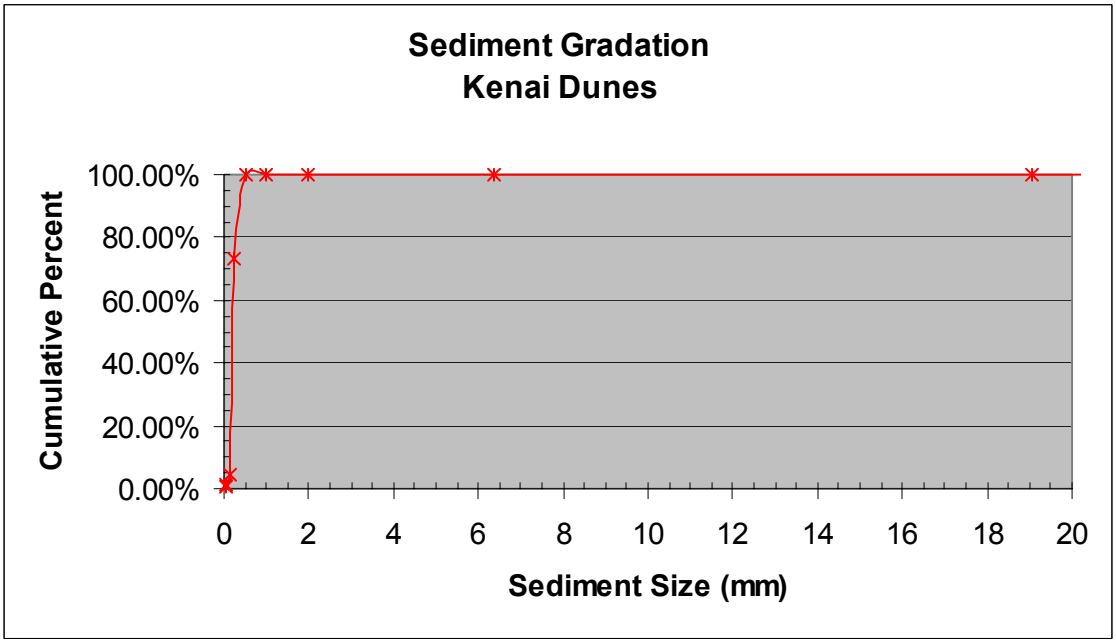

Sediment Gradation
Kenai River RM 13.2
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)


Sediment Gradation
Kenai River RM 11.3
Cumulative Percent
100.00%
99.00%
98.00%
97.00%
96.00%
95.00%
94.00%
93.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)


Sediment Gradation
Kenai River RM 9.6
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)


Sediment Gradation
Kenai River RM 8.4
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)


Sediment Gradation
Kenai Bluffs (RM 0.3)
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)


Sediment Gradation
Kenai Dunes
Cumulative Percent
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
0
2
4
6
8
10
12
14
16
18
20
Sediment Size (mm)

APPENDIX C

HEC-RAS Output

High Tide Condition:

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	Shear Chan	Power Chan
		(cfs)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(lb/sq ft)	(lb/ft s)
22	PF 1	4000	47.7	52.5	0.012187	7.88	507.68	265.58	1.91	1	1.45	11.42
22	PF 2	9000	47.7	53.92	0.010524	9.73	925.11	315.7	2.92	1	1.92	18.65
22	PF 3	14000	47.7	55.94	0.004574	8.76	1598.87	341.32	4.66	0.71	1.33	11.64
22	PF 4	19000	47.7	57.78	0.002867	8.5	2235.83	351.06	6.32	0.59	1.13	9.61
22	PF 5	26000	47.7	59.95	0.002065	8.63	3012.1	359.45	8.27	0.53	1.07	9.21
21.6666*	PF 1	4000	45.33	50.45	0.009196	7.76	515.49	223.37	2.3	0.9	1.32	10.25
21.6666*	PF 2	9000	45.33	53.56	0.002762	6.76	1332.04	287.94	4.61	0.55	0.79	5.37
21.6666*	PF 3	14000	45.33	55.77	0.001915	6.99	2002.03	311.91	6.38	0.49	0.76	5.34
21.6666*	PF 4	19000	45.33	57.64	0.001565	7.32	2594.88	323.73	7.96	0.46	0.78	5.69
21.6666*	PF 5	26000	45.33	59.82	0.001361	7.84	3317.01	334.95	9.79	0.44	0.83	6.52
21.3333*	PF 1	4000	42.96	50.61	0.000893	3.82	1048.43	228.87	4.56	0.31	0.25	0.97
21.3333*	PF 2	9000	42.96	53.52	0.000938	5.13	1753.63	253.94	6.86	0.34	0.4	2.06
21.3333*	PF 3	14000	42.96	55.69	0.001	6.02	2326.54	278.23	8.29	0.37	0.52	3.12
21.3333*	PF 4	19000	42.96	57.54	0.001006	6.65	2856.8	294.86	9.6	0.38	0.6	4.01
21.3333*	PF 5	26000	42.96	59.71	0.001015	7.4	3515.74	310.46	11.17	0.39	0.71	5.24
21.1		Bridge										
21	PF 1	4000	40.58	48	0.001111	4.37	915.2	191.84	4.74	0.35	0.33	1.44
21	PF 2	9000	40.58	51.04	0.00116	5.87	1532.13	211.87	7.16	0.38	0.52	3.04
21	PF 3	14000	40.58	53.3	0.0012	6.91	2027.2	224.96	8.89	0.41	0.67	4.6
21	PF 4	19000	40.58	55.25	0.001209	7.68	2475.27	235.09	10.36	0.42	0.78	6.01
21	PF 5	26000	40.58	57.55	0.001319	8.55	3041.13	261.97	11.41	0.44	0.94	8.04
20.8*	PF 1	4000	37.84	44.81	0.001065	4.15	962.83	211.33	4.54	0.34	0.3	1.25
20.8*	PF 2	9000	37.84	47.72	0.001121	5.56	1618.03	237.52	6.77	0.38	0.47	2.63
20.8*	PF 3	14000	37.84	49.92	0.001138	6.48	2160.57	254.43	8.42	0.39	0.6	3.87
20.8*	PF 4	19000	37.84	51.71	0.001247	7.2	2637.91	283.75	9.21	0.42	0.72	5.16
20.8*	PF 5	26000	37.84	53.67	0.001375	8.07	3221.92	314.18	10.15	0.44	0.87	7.03
20.6*	PF 1	4000	35.1	41.72	0.001046	3.95	1012.33	236.65	4.27	0.34	0.28	1.1
20.6*	PF 2	9000	35.1	44.52	0.001078	5.22	1724.52	271.03	6.33	0.36	0.43	2.22
20.6*	PF 3	14000	35.1	46.5	0.001226	6.09	2298.48	315.28	7.25	0.4	0.56	3.38
20.6*	PF 4	19000	35.1	47.99	0.001323	6.81	2789.63	342.3	8.1	0.42	0.67	4.56
20.6*	PF 5	26000	35.1	49.75	0.001331	7.64	3404.15	352.64	9.57	0.43	0.8	6.08

20.4*	PF 1	4000	32.36	38.87	0.000918	3.58	1117.59	274.94	4.06	0.31	0.23	0.83
20.4*	PF 2	9000	32.36	41.12	0.00126	4.97	1810.33	344.5	5.24	0.38	0.41	2.05
20.4*	PF 3	14000	32.36	42.85	0.001281	5.75	2434.67	376.92	6.43	0.4	0.51	2.96
20.4*	PF 4	19000	32.36	44.38	0.001183	6.29	3018.72	383.59	7.83	0.4	0.58	3.64
20.4*	PF 5	26000	32.36	46.39	0.001057	6.85	3797.67	389.21	9.65	0.39	0.64	4.36
20.2*	PF 1	4000	29.61	35.25	0.001686	3.85	1038.87	361.6	2.87	0.4	0.3	1.16
20.2*	PF 2	9000	29.61	38.05	0.000916	4.21	2136.09	410.26	5.19	0.33	0.3	1.25
20.2*	PF 3	14000	29.61	40.23	0.000709	4.61	3037.44	419.69	7.2	0.3	0.32	1.47
20.2*	PF 4	19000	29.61	42.1	0.000615	4.96	3829.01	423.62	8.94	0.29	0.34	1.7
20.2*	PF 5	26000	29.61	44.4	0.000549	5.41	4803.68	423.62	11.1	0.28	0.38	2.06
20	PF 1	4000	26.87	34.01	0.000212	1.9	2105.6	446.11	4.7	0.15	0.06	0.12
20	PF 2	9000	26.87	37.04	0.00021	2.59	3480.65	458.04	7.54	0.17	0.1	0.26
20	PF 3	14000	26.87	39.29	0.000216	3.1	4511.59	458.04	9.68	0.17	0.13	0.41
20	PF 4	19000	26.87	41.21	0.000223	3.53	5387.87	458.04	11.47	0.18	0.16	0.56
20	PF 5	26000	26.87	43.54	0.000232	4.03	6455.85	458.04	13.6	0.19	0.2	0.79
19.75*	PF 1	4000	26.27	33.5	0.000207	1.89	2121.88	446.77	4.74	0.15	0.06	0.12
19.75*	PF 2	9000	26.27	36.54	0.000207	2.57	3505.91	463.11	7.52	0.16	0.1	0.25
19.75*	PF 3	14000	26.27	38.78	0.000215	3.08	4540.57	463.11	9.65	0.17	0.13	0.4
19.75*	PF 4	19000	26.27	40.67	0.000222	3.51	5419.12	463.11	11.42	0.18	0.16	0.55
19.75*	PF 5	26000	26.27	42.99	0.000231	4.01	6489.3	463.11	13.55	0.19	0.19	0.78
19.5*	PF 1	4000	25.67	33.01	0.000201	1.87	2141.94	447.12	4.78	0.15	0.06	0.11
19.5*	PF 2	9000	25.67	36.05	0.000206	2.55	3528.61	468.18	7.49	0.16	0.1	0.25
19.5*	PF 3	14000	25.67	38.26	0.000214	3.07	4566.29	468.18	9.6	0.17	0.13	0.39
19.5*	PF 4	19000	25.67	40.14	0.000221	3.49	5446.51	468.18	11.36	0.18	0.16	0.55
19.5*	PF 5	26000	25.67	42.43	0.00023	3.99	6518.24	468.18	13.47	0.19	0.19	0.77
19.25*	PF 1	4000	25.07	32.54	0.000194	1.85	2167.22	447.28	4.83	0.15	0.06	0.11
19.25*	PF 2	9000	25.07	35.55	0.000205	2.54	3547.88	473.25	7.45	0.16	0.1	0.24
19.25*	PF 3	14000	25.07	37.75	0.000213	3.05	4587.85	473.25	9.55	0.17	0.13	0.39
19.25*	PF 4	19000	25.07	39.61	0.000221	3.47	5469.15	473.25	11.29	0.18	0.16	0.54
19.25*	PF 5	26000	25.07	41.88	0.000231	3.97	6541.77	473.25	13.38	0.19	0.19	0.77
19	PF 1	4000	24.48	32.09	0.000185	1.82	2199.29	447.38	4.89	0.14	0.06	0.1
19	PF 2	9000	24.48	35.06	0.000205	2.53	3562.74	478.31	7.4	0.16	0.09	0.24
19	PF 3	14000	24.48	37.24	0.000214	3.04	4604.32	478.31	9.47	0.17	0.13	0.38
19	PF 4	19000	24.48	39.08	0.000222	3.46	5486.08	478.31	11.2	0.18	0.16	0.54
19	PF 5	26000	24.48	41.33	0.000232	3.96	6558.94	478.31	13.27	0.19	0.19	0.76
18.8333*	PF 1	4000	24.07	31.59	0.000186	1.82	2202.85	452.41	4.85	0.15	0.06	0.1
18.8333*	PF 2	9000	24.07	34.5	0.000208	2.53	3552.16	479.52	7.36	0.16	0.1	0.24
18.8333*	PF 3	14000	24.07	36.65	0.000217	3.05	4583.89	479.52	9.42	0.17	0.13	0.39

18.8333*	PF 4	19000	24.07	38.47	0.000226	3.48	5456.57	479.52	11.13	0.18	0.16	0.55
18.8333*	PF 5	26000	24.07	40.69	0.000237	3.99	6518.07	479.52	13.18	0.19	0.2	0.78
18.6666*	PF 1	4000	23.67	31.08	0.000189	1.82	2203.52	457.37	4.8	0.15	0.06	0.1
18.6666*	PF 2	9000	23.67	33.94	0.000212	2.55	3535.38	480.73	7.32	0.17	0.1	0.25
18.6666*	PF 3	14000	23.67	36.06	0.000222	3.07	4555.95	480.73	9.35	0.18	0.13	0.4
18.6666*	PF 4	19000	23.67	37.85	0.000232	3.51	5418.32	480.73	11.03	0.18	0.16	0.56
18.6666*	PF 5	26000	23.67	40.03	0.000244	4.02	6467.17	480.73	13.05	0.19	0.2	0.8
18.5*	PF 1	4000	23.26	30.57	0.000192	1.82	2199.83	462.26	4.75	0.15	0.06	0.1
18.5*	PF 2	9000	23.26	33.36	0.000217	2.56	3511.56	481.71	7.25	0.17	0.1	0.25
18.5*	PF 3	14000	23.26	35.45	0.000229	3.1	4519.12	481.94	9.25	0.18	0.13	0.41
18.5*	PF 4	19000	23.26	37.21	0.00024	3.54	5369.82	481.94	10.91	0.19	0.16	0.58
18.5*	PF 5	26000	23.26	39.36	0.000252	4.06	6404.63	481.94	12.91	0.2	0.2	0.83
18.3333*	PF 1	4000	22.86	30.04	0.000198	1.83	2189.49	467.11	4.67	0.15	0.06	0.11
18.3333*	PF 2	9000	22.86	32.76	0.000225	2.59	3477.53	482.51	7.17	0.17	0.1	0.26
18.3333*	PF 3	14000	22.86	34.81	0.000238	3.13	4469.93	483.15	9.13	0.18	0.14	0.43
18.3333*	PF 4	19000	22.86	36.54	0.00025	3.58	5307.49	483.15	10.76	0.19	0.17	0.6
18.3333*	PF 5	26000	22.86	38.65	0.000264	4.11	6326.74	483.15	12.72	0.2	0.21	0.86
18.1666*	PF 1	4000	22.45	29.49	0.000207	1.84	2168.92	471.94	4.58	0.15	0.06	0.11
18.1666*	PF 2	9000	22.45	32.13	0.000236	2.62	3429.27	483.51	7.05	0.17	0.1	0.27
18.1666*	PF 3	14000	22.45	34.14	0.000252	3.18	4403.78	484.36	8.97	0.19	0.14	0.45
18.1666*	PF 4	19000	22.45	35.84	0.000264	3.64	5226.73	484.36	10.57	0.2	0.17	0.63
18.1666*	PF 5	26000	22.45	37.91	0.000279	4.17	6228.96	484.36	12.49	0.21	0.22	0.91
18	PF 1	4000	22.05	28.91	0.000224	1.88	2129.7	476.8	4.44	0.16	0.06	0.12
18	PF 2	9000	22.05	31.46	0.000255	2.68	3358.37	484.66	6.87	0.18	0.11	0.29
18	PF 3	14000	22.05	33.43	0.000271	3.25	4313.56	485.56	8.74	0.19	0.15	0.48
18	PF 4	19000	22.05	35.09	0.000285	3.71	5120.48	485.56	10.31	0.2	0.18	0.68
18	PF 5	26000	22.05	37.12	0.0003	4.26	6104.25	485.56	12.19	0.21	0.23	0.97
17.6666*	PF 1	4000	21.6	28.5	0.000257	1.95	2052.89	483.61	4.23	0.17	0.07	0.13
17.6666*	PF 2	9000	21.6	31.01	0.000281	2.75	3275.43	490.77	6.63	0.19	0.12	0.32
17.6666*	PF 3	14000	21.6	32.96	0.000293	3.31	4231.09	491.89	8.48	0.2	0.16	0.51
17.6666*	PF 4	19000	21.6	34.6	0.000305	3.77	5037.95	491.89	10.03	0.21	0.19	0.72
17.6666*	PF 5	26000	21.6	36.6	0.000318	4.32	6022.33	491.89	11.9	0.22	0.24	1.02
17.3333*	PF 1	4000	21.15	28.03	0.00031	2.05	1951.55	490.17	3.97	0.18	0.08	0.16
17.3333*	PF 2	9000	21.15	30.51	0.000317	2.83	3175.52	496.69	6.35	0.2	0.13	0.36
17.3333*	PF 3	14000	21.15	32.44	0.000322	3.39	4135.67	498.21	8.19	0.21	0.16	0.56
17.3333*	PF 4	19000	21.15	34.06	0.00033	3.84	4944.65	498.21	9.73	0.21	0.2	0.77
17.3333*	PF 5	26000	21.15	36.04	0.00034	4.38	5931.57	498.21	11.58	0.22	0.25	1.08
17	PF 1	4000	20.7	27.42	0.000418	2.23	1794.24	496.67	3.6	0.21	0.09	0.21

17	PF 2	9000	20.7	29.93	0.00037	2.95	3047.09	502.43	6.01	0.21	0.14	0.41
17	PF 3	14000	20.7	31.86	0.00036	3.48	4020.37	504.53	7.85	0.22	0.18	0.62
17	PF 4	19000	20.7	33.47	0.000362	3.93	4835.42	504.53	9.39	0.22	0.21	0.83
17	PF 5	26000	20.7	35.44	0.000367	4.46	5827.97	504.53	11.23	0.23	0.26	1.15
16.6666*	PF 1	4000	19.31	26.49	0.000468	2.32	1721.02	488.65	3.52	0.22	0.1	0.24
16.6666*	PF 2	9000	19.31	29.16	0.000368	2.96	3045.55	501.53	6.04	0.21	0.14	0.41
16.6666*	PF 3	14000	19.31	31.12	0.000356	3.47	4031.94	505.97	7.89	0.22	0.18	0.61
16.6666*	PF 4	19000	19.31	32.73	0.000358	3.92	4847.75	505.97	9.43	0.22	0.21	0.83
16.6666*	PF 5	26000	19.31	34.68	0.000364	4.45	5836.61	505.97	11.27	0.23	0.26	1.14
16.3333*	PF 1	4000	17.92	25.51	0.000475	2.4	1665.91	455.39	3.65	0.22	0.11	0.26
16.3333*	PF 2	9000	17.92	28.4	0.00036	2.94	3056.89	499.35	6.11	0.21	0.14	0.4
16.3333*	PF 3	14000	17.92	30.38	0.000348	3.45	4055.58	507.42	7.95	0.22	0.17	0.6
16.3333*	PF 4	19000	17.92	31.99	0.000351	3.9	4871.35	507.42	9.49	0.22	0.21	0.81
16.3333*	PF 5	26000	17.92	33.93	0.00036	4.44	5854.79	507.42	11.32	0.23	0.25	1.13
16	PF 1	4000	16.54	24.6	0.000401	2.36	1692.38	417.07	4.05	0.21	0.1	0.24
16	PF 2	9000	16.54	27.69	0.000326	2.89	3109.79	484.45	6.41	0.2	0.13	0.38
16	PF 3	14000	16.54	29.67	0.000338	3.42	4094.7	508.86	8.02	0.21	0.17	0.58
16	PF 4	19000	16.54	31.27	0.000343	3.87	4908.66	508.86	9.56	0.22	0.2	0.79
16	PF 5	26000	16.54	33.19	0.000354	4.42	5884.04	508.86	11.37	0.23	0.25	1.11
15.5*	PF 1	4000	15.76	23.77	0.000343	2.52	1586.25	366.06	4.33	0.21	0.09	0.23
15.5*	PF 2	9000	15.76	26.98	0.000303	3.12	2886.41	440.42	6.54	0.21	0.12	0.39
15.5*	PF 3	14000	15.76	28.91	0.000326	3.73	3757.91	463.99	8.08	0.23	0.16	0.61
15.5*	PF 4	19000	15.76	30.48	0.000337	4.23	4490.15	466.73	9.54	0.24	0.2	0.85
15.5*	PF 5	26000	15.76	32.35	0.000353	4.85	5361.8	466.73	11.31	0.25	0.25	1.21
15	PF 1	4000	14.99	22.94	0.000367	3.13	1278.45	279.7	4.56	0.26	0.1	0.33
15	PF 2	9000	14.99	26.15	0.000391	3.83	2350.34	398.63	5.88	0.28	0.14	0.55
15	PF 3	14000	14.99	28.02	0.000395	4.5	3112.89	417.35	7.43	0.29	0.18	0.82
15	PF 4	19000	14.99	29.55	0.000399	5.05	3760.05	424.61	8.78	0.3	0.22	1.11
15	PF 5	26000	14.99	31.36	0.000406	5.74	4528.62	424.61	10.49	0.31	0.27	1.53
14.75*	PF 1	4000	14.08	21.89	0.000381	3.17	1260.2	277.47	4.53	0.26	0.11	0.34
14.75*	PF 2	9000	14.08	25.01	0.000412	3.92	2295.51	390.36	5.86	0.28	0.15	0.59
14.75*	PF 3	14000	14.08	26.86	0.000415	4.61	3035.43	407.05	7.43	0.3	0.19	0.89
14.75*	PF 4	19000	14.08	28.37	0.000427	5.2	3655.9	417.34	8.71	0.31	0.23	1.21
14.75*	PF 5	26000	14.08	30.14	0.000436	5.91	4397.55	417.34	10.39	0.32	0.28	1.67
14.5*	PF 1	4000	13.16	20.77	0.000413	3.27	1222	273	4.46	0.27	0.11	0.38
14.5*	PF 2	9000	13.16	23.78	0.000454	4.09	2201.74	378.79	5.8	0.3	0.16	0.67
14.5*	PF 3	14000	13.16	25.61	0.000459	4.8	2917.74	397.05	7.32	0.31	0.21	1.01
14.5*	PF 4	19000	13.16	27.07	0.000476	5.43	3501.19	406.85	8.56	0.33	0.25	1.38
14.5*	PF 5	26000	13.16	28.79	0.000491	6.18	4209.55	410.07	10.15	0.34	0.31	1.92

14.25*	PF 1	4000	12.24	19.46	0.000505	3.53	1134.19	263.69	4.29	0.3	0.14	0.48
14.25*	PF 2	9000	12.24	22.33	0.000557	4.44	2027.85	359.11	5.63	0.33	0.2	0.87
14.25*	PF 3	14000	12.24	24.13	0.000566	5.17	2710.12	386.54	6.98	0.34	0.25	1.27
14.25*	PF 4	19000	12.24	25.51	0.000586	5.85	3249.74	394.53	8.2	0.36	0.3	1.75
14.25*	PF 5	26000	12.24	27.16	0.000611	6.65	3908.47	402.81	9.63	0.38	0.37	2.45
14	PF 1	4000	11.32	17.3	0.00109	4.72	848.05	227.04	3.73	0.43	0.25	1.2
14	PF 2	9000	11.32	19.88	0.001193	5.86	1535.35	317.31	4.83	0.47	0.36	2.11
14	PF 3	14000	11.32	21.66	0.001158	6.54	2140.3	366.73	5.82	0.48	0.42	2.75
14	PF 4	19000	11.32	23.05	0.001083	7.15	2658.49	378.92	6.99	0.48	0.47	3.37
14	PF 5	26000	11.32	24.63	0.001053	7.96	3265.06	386.9	8.39	0.48	0.55	4.39
13.8333*	PF 1	4000	8.95	14.39	0.000997	4.4	908.8	252.7	3.59	0.41	0.22	0.98
13.8333*	PF 2	9000	8.95	16.69	0.001078	5.82	1545.15	299.12	5.16	0.45	0.35	2.02
13.8333*	PF 3	14000	8.95	18.39	0.001136	6.73	2081.58	337.54	6.15	0.48	0.44	2.93
13.8333*	PF 4	19000	8.95	19.79	0.001195	7.36	2580.01	379.18	6.79	0.5	0.51	3.73
13.8333*	PF 5	26000	8.95	21.44	0.00121	8	3250.68	426.12	7.61	0.51	0.57	4.6
13.6666*	PF 1	4000	6.57	11.56	0.001023	4.21	950.81	288.53	3.29	0.41	0.21	0.88
13.6666*	PF 2	9000	6.57	13.77	0.001019	5.48	1642.82	334.39	4.91	0.44	0.31	1.71
13.6666*	PF 3	14000	6.57	15.34	0.001057	6.39	2192.52	364.4	6.01	0.46	0.4	2.53
13.6666*	PF 4	19000	6.57	16.62	0.001081	7.11	2670.95	383.85	6.94	0.48	0.47	3.33
13.6666*	PF 5	26000	6.57	18.16	0.001128	7.92	3284.51	414.83	7.9	0.5	0.56	4.4
13.5*	PF 1	4000	4.2	9.52	0.00057	3.29	1214.35	343.19	3.54	0.31	0.13	0.41
13.5*	PF 2	9000	4.2	11.17	0.000873	4.97	1810.9	379.83	4.76	0.4	0.26	1.29
13.5*	PF 3	14000	4.2	12.59	0.000946	5.91	2367.55	406.31	5.82	0.43	0.34	2.03
13.5*	PF 4	19000	4.2	13.78	0.000988	6.63	2865.59	427.81	6.69	0.45	0.41	2.73
13.5*	PF 5	26000	4.2	15.21	0.001025	7.44	3493.21	450.68	7.73	0.47	0.5	3.68
13.3333*	PF 1	4000	1.83	8.96	0.000122	1.89	2114.73	432.14	4.89	0.15	0.04	0.07
13.3333*	PF 2	9000	1.83	9.66	0.000411	3.71	2424	447.34	5.41	0.28	0.14	0.52
13.3333*	PF 3	14000	1.83	10.57	0.000619	4.93	2838.33	465.15	6.09	0.35	0.24	1.16
13.3333*	PF 4	19000	1.83	11.5	0.000739	5.8	3278.46	481.85	6.79	0.39	0.31	1.82
13.3333*	PF 5	26000	1.83	12.72	0.000833	6.7	3881.9	502.05	7.72	0.42	0.4	2.69
13.1666*	PF 1	4000	-0.55	8.83	0.00003	1.15	3487.11	530.11	6.57	0.08	0.01	0.01
13.1666*	PF 2	9000	-0.55	9.13	0.000134	2.47	3648.03	536.32	6.79	0.17	0.06	0.14
13.1666*	PF 3	14000	-0.55	9.6	0.000264	3.59	3902.75	544.22	7.16	0.24	0.12	0.42
13.1666*	PF 4	19000	-0.55	10.18	0.000384	4.5	4219.16	553.57	7.61	0.29	0.18	0.82
13.1666*	PF 5	26000	-0.55	11.06	0.000514	5.51	4714.45	568.05	8.28	0.34	0.27	1.46
13	PF 1	4000	-2.92	8.79	0.00001	0.76	5240.25	625.21	8.37	0.05	0.01	0
13	PF 2	9000	-2.92	8.96	0.000046	1.68	5344.65	627.95	8.5	0.1	0.02	0.04
13	PF 3	14000	-2.92	9.24	0.000102	2.54	5518.8	632.51	8.71	0.15	0.06	0.14

13	PF 4	19000	-2.92	9.6	0.000165	3.3	5750.97	638.54	8.99	0.19	0.09	0.31
13	PF 5	26000	-2.92	10.21	0.000253	4.23	6144.47	647.56	9.47	0.24	0.15	0.63
12	PF 1	4000	-8.86	8.78	0.000006	0.65	6140.93	643.95	9.51	0.04	0	0
12	PF 2	9000	-8.86	8.91	0.000029	1.45	6221	645.91	9.61	0.08	0.02	0.03
12	PF 3	14000	-8.86	9.12	0.000066	2.2	6356.64	648.53	9.77	0.12	0.04	0.09
12	PF 4	19000	-8.86	9.4	0.000111	2.9	6541.6	651.49	10.01	0.16	0.07	0.2
12	PF 5	26000	-8.86	9.89	0.000178	3.79	6863.49	656.61	10.42	0.21	0.12	0.44
11.875*	PF 1	4000	-8.56	8.78	0.000006	0.63	6304.42	664.18	9.47	0.04	0	0
11.875*	PF 2	9000	-8.56	8.91	0.000028	1.41	6386.88	666.18	9.56	0.08	0.02	0.02
11.875*	PF 3	14000	-8.56	9.12	0.000063	2.15	6526.63	669.15	9.73	0.12	0.04	0.08
11.875*	PF 4	19000	-8.56	9.4	0.000106	2.83	6717.35	672.34	9.97	0.16	0.07	0.19
11.875*	PF 5	26000	-8.56	9.89	0.00017	3.69	7049.59	677.86	10.37	0.2	0.11	0.41
11.75*	PF 1	4000	-8.25	8.78	0.000005	0.62	6485.15	686.43	9.43	0.04	0	0
11.75*	PF 2	9000	-8.25	8.91	0.000026	1.37	6570.26	688.18	9.53	0.08	0.02	0.02
11.75*	PF 3	14000	-8.25	9.12	0.00006	2.09	6714.49	690.99	9.69	0.12	0.04	0.08
11.75*	PF 4	19000	-8.25	9.4	0.0001	2.75	6911.35	693.96	9.94	0.15	0.06	0.17
11.75*	PF 5	26000	-8.25	9.89	0.000161	3.58	7254.24	699.1	10.35	0.2	0.1	0.37
11.625*	PF 1	4000	-7.95	8.78	0.000005	0.6	6685.35	707.39	9.43	0.03	0	0
11.625*	PF 2	9000	-7.95	8.91	0.000025	1.33	6773.03	709.08	9.53	0.08	0.01	0.02
11.625*	PF 3	14000	-7.95	9.12	0.000056	2.02	6921.59	711.93	9.7	0.11	0.03	0.07
11.625*	PF 4	19000	-7.95	9.4	0.000094	2.67	7124.45	714.97	9.94	0.15	0.06	0.16
11.625*	PF 5	26000	-7.95	9.89	0.000152	3.48	7477.95	720.2	10.36	0.19	0.1	0.34
11.5*	PF 1	4000	-7.64	8.78	0.000005	0.58	6904.02	728.36	9.46	0.03	0	0
11.5*	PF 2	9000	-7.64	8.91	0.000023	1.29	6994.29	730	9.56	0.07	0.01	0.02
11.5*	PF 3	14000	-7.64	9.12	0.000052	1.96	7147.26	732.76	9.73	0.11	0.03	0.06
11.5*	PF 4	19000	-7.64	9.4	0.000088	2.58	7356.19	735.97	9.97	0.14	0.05	0.14
11.5*	PF 5	26000	-7.64	9.89	0.000142	3.37	7720.62	742.23	10.38	0.18	0.09	0.31
11.375*	PF 1	4000	-7.34	8.78	0.000004	0.56	7141.68	750.5	9.5	0.03	0	0
11.375*	PF 2	9000	-7.34	8.91	0.000021	1.24	7234.74	752.24	9.6	0.07	0.01	0.02
11.375*	PF 3	14000	-7.34	9.12	0.000049	1.89	7392.47	755.17	9.77	0.11	0.03	0.06
11.375*	PF 4	19000	-7.34	9.4	0.000082	2.5	7608.02	758.66	10.01	0.14	0.05	0.13
11.375*	PF 5	26000	-7.34	9.89	0.000132	3.26	7983.94	764.35	10.42	0.18	0.09	0.28
11.26		Bridge										
11.25*	PF 1	4000	-7.04	8.63	0.000004	0.55	7281.03	769.53	9.44	0.03	0	0
11.25*	PF 2	9000	-7.04	8.75	0.000021	1.22	7374.28	771.04	9.54	0.07	0.01	0.02
11.25*	PF 3	14000	-7.04	8.96	0.000047	1.86	7532.85	773.59	9.72	0.1	0.03	0.05
11.25*	PF 4	19000	-7.04	9.23	0.00008	2.45	7747.45	777.02	9.95	0.14	0.05	0.12
11.25*	PF 5	26000	-7.04	9.71	0.000129	3.2	8121.86	782.45	10.36	0.18	0.08	0.27

11.125*	PF 1	4000	-6.74	8.63	0.000004	0.53	7550.5	789.14	9.55	0.03	0	0
11.125*	PF 2	9000	-6.74	8.75	0.000019	1.18	7646.21	790.55	9.65	0.07	0.01	0.01
11.125*	PF 3	14000	-6.74	8.96	0.000043	1.79	7808.93	792.95	9.82	0.1	0.03	0.05
11.125*	PF 4	19000	-6.74	9.23	0.000073	2.37	8029.13	796.18	10.06	0.13	0.05	0.11
11.125*	PF 5	26000	-6.74	9.72	0.000118	3.09	8413.26	801.56	10.47	0.17	0.08	0.24
11	PF 1	4000	-6.43	8.63	0.000004	0.51	7833.91	807.87	9.67	0.03	0	0
11	PF 2	9000	-6.43	8.75	0.000017	1.13	7931.98	809.21	9.78	0.06	0.01	0.01
11	PF 3	14000	-6.43	8.96	0.00004	1.73	8098.72	811.48	9.95	0.1	0.02	0.04
11	PF 4	19000	-6.43	9.23	0.000067	2.28	8324.3	814.55	10.19	0.13	0.04	0.1
11	PF 5	26000	-6.43	9.72	0.000108	2.98	8717.77	819.87	10.6	0.16	0.07	0.21
10	PF 1	4000	-6.46	8.61	0.000005	0.56	7131.96	778.4	9.15	0.03	0	0
10	PF 2	9000	-6.46	8.64	0.000023	1.26	7156.1	779.52	9.17	0.07	0.01	0.02
10	PF 3	14000	-6.46	8.69	0.000056	1.94	7198.73	781.49	9.2	0.11	0.03	0.06
10	PF 4	19000	-6.46	8.77	0.0001	2.62	7259.72	784.3	9.24	0.15	0.06	0.15
10	PF 5	26000	-6.46	8.92	0.000179	3.53	7375.08	789.58	9.33	0.2	0.1	0.37
9	PF 1	4000	-6.46	8.6	0.000005	0.56	7129.11	778.27	9.15	0.03	0	0
9	PF 2	9000	-6.46	8.62	0.000023	1.26	7141.68	778.85	9.15	0.07	0.01	0.02
9	PF 3	14000	-6.46	8.65	0.000056	1.95	7163.89	779.88	9.17	0.11	0.03	0.06
9	PF 4	19000	-6.46	8.69	0.000102	2.64	7195.69	781.35	9.19	0.15	0.06	0.16
9	PF 5	26000	-6.46	8.77	0.000187	3.58	7255.98	784.13	9.24	0.21	0.11	0.39
8	PF 1	4000	-11.98	8.6	0.000001	0.39	10344.4	805.85	12.81	0.02	0	0
8	PF 2	9000	-11.98	8.62	0.000007	0.87	10355.78	806.12	12.82	0.04	0.01	0
8	PF 3	14000	-11.98	8.64	0.000017	1.35	10375.85	806.6	12.84	0.07	0.01	0.02
8	PF 4	19000	-11.98	8.68	0.000031	1.83	10404.53	807.28	12.86	0.09	0.03	0.05
8	PF 5	26000	-11.98	8.75	0.000058	2.49	10458.93	808.56	12.91	0.12	0.05	0.12
7	PF 1	4000	-13.75	8.6	0	0.2	19575.76	1277.95	15.27	0.01	0	0
7	PF 2	9000	-13.75	8.61	0.000002	0.46	19586.13	1278.11	15.28	0.02	0	0
7	PF 3	14000	-13.75	8.62	0.000004	0.71	19604.45	1278.39	15.29	0.03	0	0
7	PF 4	19000	-13.75	8.64	0.000007	0.97	19630.67	1278.8	15.3	0.04	0.01	0.01
7	PF 5	26000	-13.75	8.68	0.000013	1.32	19680.51	1279.56	15.33	0.06	0.01	0.02
6	PF 1	4000	-11.91	8.6	0	0.2	19841.55	1306.16	15.15	0.01	0	0
6	PF 2	9000	-11.91	8.61	0.000002	0.45	19851.17	1306.28	15.16	0.02	0	0
6	PF 3	14000	-11.91	8.62	0.000004	0.7	19868.18	1306.5	15.17	0.03	0	0
6	PF 4	19000	-11.91	8.64	0.000007	0.96	19892.53	1306.82	15.19	0.04	0.01	0.01
6	PF 5	26000	-11.91	8.68	0.000013	1.3	19938.83	1307.41	15.21	0.06	0.01	0.02
5	PF 1	4000	-17.36	8.6	0	0.17	23585.61	1518.29	15.5	0.01	0	0
5	PF 2	9000	-17.36	8.61	0.000001	0.38	23595.63	1518.37	15.51	0.02	0	0
5	PF 3	14000	-17.36	8.62	0.000003	0.59	23613.33	1518.52	15.52	0.03	0	0

5 PF 4	19000	-17.36	8.64	0.000005	0.8	23638.66	1518.72	15.53	0.04	0	0
5 PF 5	26000	-17.36	8.67	0.000009	1.1	23686.9	1519.11	15.56	0.05	0.01	0.01
4 PF 1	4000	-13.42	8.6	0	0.13	30100.01	1924.65	15.62	0.01	0	0
4 PF 2	9000	-13.42	8.61	0.000001	0.3	30109.63	1924.75	15.62	0.01	0	0
4 PF 3	14000	-13.42	8.62	0.000002	0.46	30126.63	1924.93	15.63	0.02	0	0
4 PF 4	19000	-13.42	8.63	0.000003	0.63	30151.02	1925.2	15.64	0.03	0	0
4 PF 5	26000	-13.42	8.65	0.000005	0.86	30197.49	1925.7	15.66	0.04	0.01	0
3 PF 1	4000	-13.12	8.6	0	0.12	33703.56	1910.89	17.61	0	0	0
3 PF 2	9000	-13.12	8.61	0	0.27	33712.52	1910.97	17.61	0.01	0	0
3 PF 3	14000	-13.12	8.61	0.000001	0.42	33728.38	1911.13	17.62	0.02	0	0
3 PF 4	19000	-13.12	8.63	0.000002	0.56	33751.09	1911.34	17.63	0.02	0	0
3 PF 5	26000	-13.12	8.65	0.000004	0.77	33794.39	1911.69	17.65	0.03	0	0
2 PF 1	4000	-25.53	8.6	0	0.14	28472.54	1874.52	15.15	0.01	0	0
2 PF 2	9000	-25.53	8.6	0.000001	0.32	28477.8	1874.55	15.16	0.01	0	0
2 PF 3	14000	-25.53	8.61	0.000002	0.49	28487.11	1874.62	15.16	0.02	0	0
2 PF 4	19000	-25.53	8.62	0.000003	0.67	28500.46	1874.71	15.17	0.03	0	0
2 PF 5	26000	-25.53	8.63	0.000006	0.91	28525.95	1874.89	15.18	0.04	0.01	0.01
1 PF 1	4000	-29.56	8.6	0	0.2	20109.01	918.23	21.8	0.01	0	0
1 PF 2	9000	-29.56	8.6	0.000001	0.45	20107.41	918.2	21.8	0.02	0	0
1 PF 3	14000	-29.56	8.59	0.000002	0.7	20104.57	918.15	21.8	0.03	0	0
1 PF 4	19000	-29.56	8.59	0.000004	0.95	20100.52	918.08	21.79	0.04	0.01	0.01
1 PF 5	26000	-29.56	8.58	0.000008	1.29	20092.75	917.93	21.79	0.05	0.01	0.01
0 PF 1	4000	-118.24	8.6	0	0.03	116328.4	1618.29	70.78	0	0	0
0 PF 2	9000	-118.24	8.6	0	0.08	116328.3	1618.29	70.78	0	0	0
0 PF 3	14000	-118.24	8.6	0	0.12	116328.1	1618.29	70.78	0	0	0
0 PF 4	19000	-118.24	8.6	0	0.16	116327.9	1618.29	70.78	0	0	0
0 PF 5	26000	-118.24	8.6	0	0.22	116327.5	1618.29	70.77	0	0	0
-1 PF 1	4000	-236.48	8.6	0	0.01	437781.1	3167.21	136.14	0	0	0
-1 PF 2	9000	-236.48	8.6	0	0.02	437781.1	3167.21	136.14	0	0	0
-1 PF 3	14000	-236.48	8.6	0	0.03	437781.1	3167.21	136.14	0	0	0
-1 PF 4	19000	-236.48	8.6	0	0.04	437781	3167.21	136.14	0	0	0
-1 PF 5	26000	-236.48	8.6	0	0.06	437781	3167.21	136.14	0	0	0

-2 PF 1	4000	-354.72	8.6	0	0	964662.1	4711.16	201.7	0	0	0
-2 PF 2	9000	-354.72	8.6	0	0.01	964662.1	4711.16	201.7	0	0	0
-2 PF 3	14000	-354.72	8.6	0	0.01	964662.1	4711.16	201.7	0	0	0
-2 PF 4	19000	-354.72	8.6	0	0.02	964662.1	4711.16	201.7	0	0	0
-2 PF 5	26000	-354.72	8.6	0	0.03	964662.1	4711.16	201.7	0	0	0

Low Tide Condition:

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	Shear Chan	Power Chan
		(cfs)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(lb/sq ft)	(lb/ft s)
22	PF 1	4000	47.7	52.5	0.012187	7.88	507.68	265.58	1.91	1	1.45	11.42
22	PF 2	9000	47.7	53.92	0.010524	9.73	925.11	315.7	2.92	1	1.92	18.65
22	PF 3	14000	47.7	55.94	0.004574	8.76	1598.87	341.32	4.66	0.71	1.33	11.64
22	PF 4	19000	47.7	57.78	0.002867	8.5	2235.83	351.06	6.32	0.59	1.13	9.61
22	PF 5	26000	47.7	59.95	0.002065	8.63	3012.1	359.45	8.27	0.53	1.07	9.21
21.6666*	PF 1	4000	45.33	50.45	0.009196	7.76	515.49	223.37	2.3	0.9	1.32	10.25
21.6666*	PF 2	9000	45.33	53.56	0.002762	6.76	1332.04	287.94	4.61	0.55	0.79	5.37
21.6666*	PF 3	14000	45.33	55.77	0.001915	6.99	2002.03	311.91	6.38	0.49	0.76	5.34
21.6666*	PF 4	19000	45.33	57.64	0.001565	7.32	2594.88	323.73	7.96	0.46	0.78	5.69
21.6666*	PF 5	26000	45.33	59.82	0.001361	7.84	3317.01	334.95	9.79	0.44	0.83	6.52
21.3333*	PF 1	4000	42.96	50.61	0.000893	3.82	1048.43	228.87	4.56	0.31	0.25	0.97
21.3333*	PF 2	9000	42.96	53.52	0.000938	5.13	1753.63	253.94	6.86	0.34	0.4	2.06
21.3333*	PF 3	14000	42.96	55.69	0.001	6.02	2326.54	278.23	8.29	0.37	0.52	3.12
21.3333*	PF 4	19000	42.96	57.54	0.001006	6.65	2856.8	294.86	9.6	0.38	0.6	4.01
21.3333*	PF 5	26000	42.96	59.71	0.001015	7.4	3515.74	310.46	11.17	0.39	0.71	5.24
21.1		Bridge										
21	PF 1	4000	40.58	48	0.001111	4.37	915.2	191.84	4.74	0.35	0.33	1.44
21	PF 2	9000	40.58	51.04	0.00116	5.87	1532.13	211.87	7.16	0.38	0.52	3.04
21	PF 3	14000	40.58	53.3	0.0012	6.91	2027.2	224.96	8.89	0.41	0.67	4.6
21	PF 4	19000	40.58	55.25	0.001209	7.68	2475.27	235.09	10.36	0.42	0.78	6.01
21	PF 5	26000	40.58	57.55	0.001319	8.55	3041.13	261.97	11.41	0.44	0.94	8.04
20.8*	PF 1	4000	37.84	44.81	0.001065	4.15	962.83	211.33	4.54	0.34	0.3	1.25
20.8*	PF 2	9000	37.84	47.72	0.001121	5.56	1618.03	237.52	6.77	0.38	0.47	2.63
20.8*	PF 3	14000	37.84	49.92	0.001138	6.48	2160.57	254.43	8.42	0.39	0.6	3.87
20.8*	PF 4	19000	37.84	51.71	0.001247	7.2	2637.91	283.75	9.21	0.42	0.72	5.16
20.8*	PF 5	26000	37.84	53.67	0.001375	8.07	3221.92	314.18	10.15	0.44	0.87	7.03
20.6*	PF 1	4000	35.1	41.72	0.001046	3.95	1012.33	236.65	4.27	0.34	0.28	1.1
20.6*	PF 2	9000	35.1	44.52	0.001078	5.22	1724.52	271.03	6.33	0.36	0.43	2.22
20.6*	PF 3	14000	35.1	46.5	0.001226	6.09	2298.48	315.28	7.25	0.4	0.56	3.38
20.6*	PF 4	19000	35.1	47.99	0.001323	6.81	2789.63	342.3	8.1	0.42	0.67	4.56
20.6*	PF 5	26000	35.1	49.75	0.001331	7.64	3404.15	352.64	9.57	0.43	0.8	6.08
20.4*	PF 1	4000	32.36	38.87	0.000918	3.58	1117.59	274.94	4.06	0.31	0.23	0.83
20.4*	PF 2	9000	32.36	41.12	0.00126	4.97	1810.33	344.5	5.24	0.38	0.41	2.05
20.4*	PF 3	14000	32.36	42.85	0.001281	5.75	2434.67	376.92	6.43	0.4	0.51	2.96

20.4*	PF 4	19000	32.36	44.38	0.001183	6.29	3018.72	383.59	7.83	0.4	0.58	3.64
20.4*	PF 5	26000	32.36	46.39	0.001057	6.85	3797.67	389.21	9.65	0.39	0.64	4.36
20.2*	PF 1	4000	29.61	35.25	0.001686	3.85	1038.87	361.6	2.87	0.4	0.3	1.16
20.2*	PF 2	9000	29.61	38.05	0.000916	4.21	2136.09	410.26	5.19	0.33	0.3	1.25
20.2*	PF 3	14000	29.61	40.23	0.000709	4.61	3037.44	419.69	7.2	0.3	0.32	1.47
20.2*	PF 4	19000	29.61	42.1	0.000615	4.96	3829.01	423.62	8.94	0.29	0.34	1.7
20.2*	PF 5	26000	29.61	44.4	0.000549	5.41	4803.68	423.62	11.1	0.28	0.38	2.06
20	PF 1	4000	26.87	34.01	0.000212	1.9	2105.6	446.11	4.7	0.15	0.06	0.12
20	PF 2	9000	26.87	37.04	0.00021	2.59	3480.65	458.04	7.54	0.17	0.1	0.26
20	PF 3	14000	26.87	39.29	0.000216	3.1	4511.59	458.04	9.68	0.17	0.13	0.41
20	PF 4	19000	26.87	41.21	0.000223	3.53	5387.87	458.04	11.47	0.18	0.16	0.56
20	PF 5	26000	26.87	43.54	0.000232	4.03	6455.85	458.04	13.6	0.19	0.2	0.79
19.75*	PF 1	4000	26.27	33.5	0.000207	1.89	2121.88	446.77	4.74	0.15	0.06	0.12
19.75*	PF 2	9000	26.27	36.54	0.000207	2.57	3505.91	463.11	7.52	0.16	0.1	0.25
19.75*	PF 3	14000	26.27	38.78	0.000215	3.08	4540.57	463.11	9.65	0.17	0.13	0.4
19.75*	PF 4	19000	26.27	40.67	0.000222	3.51	5419.12	463.11	11.42	0.18	0.16	0.55
19.75*	PF 5	26000	26.27	42.99	0.000231	4.01	6489.3	463.11	13.55	0.19	0.19	0.78
19.5*	PF 1	4000	25.67	33.01	0.000201	1.87	2141.94	447.12	4.78	0.15	0.06	0.11
19.5*	PF 2	9000	25.67	36.05	0.000206	2.55	3528.61	468.18	7.49	0.16	0.1	0.25
19.5*	PF 3	14000	25.67	38.26	0.000214	3.07	4566.29	468.18	9.6	0.17	0.13	0.39
19.5*	PF 4	19000	25.67	40.14	0.000221	3.49	5446.51	468.18	11.36	0.18	0.16	0.55
19.5*	PF 5	26000	25.67	42.43	0.00023	3.99	6518.24	468.18	13.47	0.19	0.19	0.77
19.25*	PF 1	4000	25.07	32.54	0.000194	1.85	2167.22	447.28	4.83	0.15	0.06	0.11
19.25*	PF 2	9000	25.07	35.55	0.000205	2.54	3547.88	473.25	7.45	0.16	0.1	0.24
19.25*	PF 3	14000	25.07	37.75	0.000213	3.05	4587.85	473.25	9.55	0.17	0.13	0.39
19.25*	PF 4	19000	25.07	39.61	0.000221	3.47	5469.15	473.25	11.29	0.18	0.16	0.54
19.25*	PF 5	26000	25.07	41.88	0.000231	3.97	6541.77	473.25	13.38	0.19	0.19	0.77
19	PF 1	4000	24.48	32.09	0.000185	1.82	2199.29	447.38	4.89	0.14	0.06	0.1
19	PF 2	9000	24.48	35.06	0.000205	2.53	3562.74	478.31	7.4	0.16	0.09	0.24
19	PF 3	14000	24.48	37.24	0.000214	3.04	4604.32	478.31	9.47	0.17	0.13	0.38
19	PF 4	19000	24.48	39.08	0.000222	3.46	5486.08	478.31	11.2	0.18	0.16	0.54
19	PF 5	26000	24.48	41.33	0.000232	3.96	6558.94	478.31	13.27	0.19	0.19	0.76
18.8333*	PF 1	4000	24.07	31.59	0.000186	1.82	2202.85	452.41	4.85	0.15	0.06	0.1
18.8333*	PF 2	9000	24.07	34.5	0.000208	2.53	3552.16	479.52	7.36	0.16	0.1	0.24
18.8333*	PF 3	14000	24.07	36.65	0.000217	3.05	4583.89	479.52	9.42	0.17	0.13	0.39
18.8333*	PF 4	19000	24.07	38.47	0.000226	3.48	5456.57	479.52	11.13	0.18	0.16	0.55
18.8333*	PF 5	26000	24.07	40.69	0.000237	3.99	6518.07	479.52	13.18	0.19	0.2	0.78
18.6666*	PF 1	4000	23.67	31.08	0.000189	1.82	2203.52	457.37	4.8	0.15	0.06	0.1

18.6666*	PF 2	9000	23.67	33.94	0.000212	2.55	3535.38	480.73	7.32	0.17	0.1	0.25
18.6666*	PF 3	14000	23.67	36.06	0.000222	3.07	4555.95	480.73	9.35	0.18	0.13	0.4
18.6666*	PF 4	19000	23.67	37.85	0.000232	3.51	5418.32	480.73	11.03	0.18	0.16	0.56
18.6666*	PF 5	26000	23.67	40.03	0.000244	4.02	6467.17	480.73	13.05	0.19	0.2	0.8
18.5*	PF 1	4000	23.26	30.57	0.000192	1.82	2199.83	462.26	4.75	0.15	0.06	0.1
18.5*	PF 2	9000	23.26	33.36	0.000217	2.56	3511.56	481.71	7.25	0.17	0.1	0.25
18.5*	PF 3	14000	23.26	35.45	0.000229	3.1	4519.12	481.94	9.25	0.18	0.13	0.41
18.5*	PF 4	19000	23.26	37.21	0.00024	3.54	5369.82	481.94	10.91	0.19	0.16	0.58
18.5*	PF 5	26000	23.26	39.36	0.000252	4.06	6404.63	481.94	12.91	0.2	0.2	0.83
18.3333*	PF 1	4000	22.86	30.04	0.000198	1.83	2189.49	467.11	4.67	0.15	0.06	0.11
18.3333*	PF 2	9000	22.86	32.76	0.000225	2.59	3477.53	482.51	7.17	0.17	0.1	0.26
18.3333*	PF 3	14000	22.86	34.81	0.000238	3.13	4469.93	483.15	9.13	0.18	0.14	0.43
18.3333*	PF 4	19000	22.86	36.54	0.00025	3.58	5307.49	483.15	10.76	0.19	0.17	0.6
18.3333*	PF 5	26000	22.86	38.65	0.000264	4.11	6326.74	483.15	12.72	0.2	0.21	0.86
18.1666*	PF 1	4000	22.45	29.49	0.000207	1.84	2168.92	471.94	4.58	0.15	0.06	0.11
18.1666*	PF 2	9000	22.45	32.13	0.000236	2.62	3429.27	483.51	7.05	0.17	0.1	0.27
18.1666*	PF 3	14000	22.45	34.14	0.000252	3.18	4403.78	484.36	8.97	0.19	0.14	0.45
18.1666*	PF 4	19000	22.45	35.84	0.000264	3.64	5226.73	484.36	10.57	0.2	0.17	0.63
18.1666*	PF 5	26000	22.45	37.91	0.000279	4.17	6228.96	484.36	12.49	0.21	0.22	0.91
18	PF 1	4000	22.05	28.91	0.000224	1.88	2129.7	476.8	4.44	0.16	0.06	0.12
18	PF 2	9000	22.05	31.46	0.000255	2.68	3358.37	484.66	6.87	0.18	0.11	0.29
18	PF 3	14000	22.05	33.43	0.000271	3.25	4313.56	485.56	8.74	0.19	0.15	0.48
18	PF 4	19000	22.05	35.09	0.000285	3.71	5120.48	485.56	10.31	0.2	0.18	0.68
18	PF 5	26000	22.05	37.12	0.0003	4.26	6104.25	485.56	12.19	0.21	0.23	0.97
17.6666*	PF 1	4000	21.6	28.5	0.000257	1.95	2052.89	483.61	4.23	0.17	0.07	0.13
17.6666*	PF 2	9000	21.6	31.01	0.000281	2.75	3275.43	490.77	6.63	0.19	0.12	0.32
17.6666*	PF 3	14000	21.6	32.96	0.000293	3.31	4231.09	491.89	8.48	0.2	0.16	0.51
17.6666*	PF 4	19000	21.6	34.6	0.000305	3.77	5037.95	491.89	10.03	0.21	0.19	0.72
17.6666*	PF 5	26000	21.6	36.6	0.000318	4.32	6022.33	491.89	11.9	0.22	0.24	1.02
17.3333*	PF 1	4000	21.15	28.03	0.00031	2.05	1951.55	490.17	3.97	0.18	0.08	0.16
17.3333*	PF 2	9000	21.15	30.51	0.000317	2.83	3175.52	496.69	6.35	0.2	0.13	0.36
17.3333*	PF 3	14000	21.15	32.44	0.000322	3.39	4135.67	498.21	8.19	0.21	0.16	0.56
17.3333*	PF 4	19000	21.15	34.06	0.00033	3.84	4944.65	498.21	9.73	0.21	0.2	0.77
17.3333*	PF 5	26000	21.15	36.04	0.00034	4.38	5931.57	498.21	11.58	0.22	0.25	1.08
17	PF 1	4000	20.7	27.42	0.000418	2.23	1794.24	496.67	3.6	0.21	0.09	0.21
17	PF 2	9000	20.7	29.93	0.00037	2.95	3047.09	502.43	6.01	0.21	0.14	0.41
17	PF 3	14000	20.7	31.86	0.00036	3.48	4020.37	504.53	7.85	0.22	0.18	0.62
17	PF 4	19000	20.7	33.47	0.000362	3.93	4835.42	504.53	9.39	0.22	0.21	0.83
17	PF 5	26000	20.7	35.44	0.000367	4.46	5827.97	504.53	11.23	0.23	0.26	1.15

16.6666*	PF 1	4000	19.31	26.49	0.000468	2.32	1721.02	488.65	3.52	0.22	0.1	0.24
16.6666*	PF 2	9000	19.31	29.16	0.000368	2.96	3045.55	501.53	6.04	0.21	0.14	0.41
16.6666*	PF 3	14000	19.31	31.12	0.000356	3.47	4031.94	505.97	7.89	0.22	0.18	0.61
16.6666*	PF 4	19000	19.31	32.73	0.000358	3.92	4847.75	505.97	9.43	0.22	0.21	0.83
16.6666*	PF 5	26000	19.31	34.68	0.000364	4.45	5836.61	505.97	11.27	0.23	0.26	1.14
16.3333*	PF 1	4000	17.92	25.51	0.000475	2.4	1665.91	455.39	3.65	0.22	0.11	0.26
16.3333*	PF 2	9000	17.92	28.4	0.00036	2.94	3056.89	499.35	6.11	0.21	0.14	0.4
16.3333*	PF 3	14000	17.92	30.38	0.000348	3.45	4055.58	507.42	7.95	0.22	0.17	0.6
16.3333*	PF 4	19000	17.92	31.99	0.000351	3.9	4871.35	507.42	9.49	0.22	0.21	0.81
16.3333*	PF 5	26000	17.92	33.93	0.00036	4.44	5854.79	507.42	11.32	0.23	0.25	1.13
16	PF 1	4000	16.54	24.6	0.000401	2.36	1692.38	417.07	4.05	0.21	0.1	0.24
16	PF 2	9000	16.54	27.69	0.000326	2.89	3109.79	484.45	6.41	0.2	0.13	0.38
16	PF 3	14000	16.54	29.67	0.000338	3.42	4094.7	508.86	8.02	0.21	0.17	0.58
16	PF 4	19000	16.54	31.27	0.000343	3.87	4908.66	508.86	9.56	0.22	0.2	0.79
16	PF 5	26000	16.54	33.19	0.000354	4.42	5884.04	508.86	11.37	0.23	0.25	1.11
15.5*	PF 1	4000	15.76	23.77	0.000343	2.52	1586.25	366.06	4.33	0.21	0.09	0.23
15.5*	PF 2	9000	15.76	26.98	0.000303	3.12	2886.41	440.42	6.54	0.21	0.12	0.39
15.5*	PF 3	14000	15.76	28.91	0.000326	3.73	3757.91	463.99	8.08	0.23	0.16	0.61
15.5*	PF 4	19000	15.76	30.48	0.000337	4.23	4490.15	466.73	9.54	0.24	0.2	0.85
15.5*	PF 5	26000	15.76	32.35	0.000353	4.85	5361.79	466.73	11.31	0.25	0.25	1.21
15	PF 1	4000	14.99	22.94	0.000367	3.13	1278.45	279.7	4.56	0.26	0.1	0.33
15	PF 2	9000	14.99	26.15	0.000391	3.83	2350.34	398.63	5.88	0.28	0.14	0.55
15	PF 3	14000	14.99	28.02	0.000395	4.5	3112.89	417.35	7.43	0.29	0.18	0.82
15	PF 4	19000	14.99	29.55	0.000399	5.05	3760.05	424.61	8.78	0.3	0.22	1.11
15	PF 5	26000	14.99	31.36	0.000406	5.74	4528.61	424.61	10.49	0.31	0.27	1.53
14.75*	PF 1	4000	14.08	21.89	0.000381	3.17	1260.21	277.47	4.53	0.26	0.11	0.34
14.75*	PF 2	9000	14.08	25.01	0.000412	3.92	2295.51	390.36	5.86	0.28	0.15	0.59
14.75*	PF 3	14000	14.08	26.86	0.000415	4.61	3035.43	407.05	7.43	0.3	0.19	0.89
14.75*	PF 4	19000	14.08	28.37	0.000427	5.2	3655.9	417.34	8.71	0.31	0.23	1.21
14.75*	PF 5	26000	14.08	30.14	0.000436	5.91	4397.55	417.34	10.39	0.32	0.28	1.67
14.5*	PF 1	4000	13.16	20.77	0.000413	3.27	1222.01	273	4.46	0.27	0.11	0.38
14.5*	PF 2	9000	13.16	23.78	0.000454	4.09	2201.74	378.79	5.8	0.3	0.16	0.67
14.5*	PF 3	14000	13.16	25.61	0.000459	4.8	2917.74	397.05	7.32	0.31	0.21	1.01
14.5*	PF 4	19000	13.16	27.07	0.000476	5.43	3501.19	406.85	8.56	0.33	0.25	1.38
14.5*	PF 5	26000	13.16	28.79	0.000491	6.18	4209.54	410.07	10.15	0.34	0.31	1.92
14.25*	PF 1	4000	12.24	19.46	0.000505	3.53	1134.23	263.69	4.29	0.3	0.14	0.48
14.25*	PF 2	9000	12.24	22.33	0.000557	4.44	2027.85	359.11	5.63	0.33	0.2	0.87
14.25*	PF 3	14000	12.24	24.13	0.000566	5.17	2710.12	386.54	6.98	0.34	0.25	1.27

14.25*	PF 4	19000	12.24	25.51	0.000586	5.85	3249.74	394.53	8.2	0.36	0.3	1.75
14.25*	PF 5	26000	12.24	27.16	0.000611	6.65	3908.45	402.81	9.63	0.38	0.37	2.45
14	PF 1	4000	11.32	17.3	0.001088	4.71	848.41	227.07	3.73	0.43	0.25	1.19
14	PF 2	9000	11.32	19.88	0.001193	5.86	1535.34	317.3	4.83	0.47	0.36	2.11
14	PF 3	14000	11.32	21.66	0.001157	6.54	2140.32	366.73	5.82	0.48	0.42	2.75
14	PF 4	19000	11.32	23.05	0.001083	7.15	2658.51	378.92	6.99	0.48	0.47	3.37
14	PF 5	26000	11.32	24.63	0.001053	7.96	3265.01	386.9	8.39	0.48	0.55	4.39
13.8333*	PF 1	4000	8.95	14.37	0.001009	4.42	905.25	252.4	3.58	0.41	0.23	1
13.8333*	PF 2	9000	8.95	16.69	0.001078	5.82	1545.27	299.12	5.16	0.45	0.35	2.02
13.8333*	PF 3	14000	8.95	18.39	0.001136	6.73	2081.48	337.54	6.15	0.48	0.44	2.93
13.8333*	PF 4	19000	8.95	19.79	0.001195	7.37	2579.41	379.11	6.79	0.5	0.51	3.73
13.8333*	PF 5	26000	8.95	21.44	0.00121	8	3250.84	426.13	7.61	0.51	0.57	4.6
13.6666*	PF 1	4000	6.57	11.63	0.000959	4.12	971.56	290.13	3.35	0.4	0.2	0.82
13.6666*	PF 2	9000	6.57	13.77	0.001019	5.48	1643.2	334.41	4.91	0.44	0.31	1.71
13.6666*	PF 3	14000	6.57	15.33	0.001062	6.39	2189.29	364.27	6	0.46	0.4	2.54
13.6666*	PF 4	19000	6.57	16.61	0.001088	7.13	2665.29	383.62	6.93	0.48	0.47	3.36
13.6666*	PF 5	26000	6.57	18.15	0.001134	7.93	3278.06	414.63	7.89	0.5	0.56	4.43
13.5*	PF 1	4000	4.2	8.99	0.00093	3.87	1033.3	330.87	3.12	0.39	0.18	0.7
13.5*	PF 2	9000	4.2	10.99	0.000981	5.17	1741.07	375.92	4.63	0.42	0.28	1.46
13.5*	PF 3	14000	4.2	12.46	0.001012	6.05	2314.82	404	5.72	0.45	0.36	2.19
13.5*	PF 4	19000	4.2	13.67	0.001038	6.74	2818.84	425.99	6.61	0.46	0.43	2.88
13.5*	PF 5	26000	4.2	15.11	0.001064	7.54	3449.36	448.94	7.67	0.48	0.51	3.84
13.3333*	PF 1	4000	1.83	6.43	0.000894	3.65	1097.3	373.26	2.94	0.37	0.16	0.6
13.3333*	PF 2	9000	1.83	8.29	0.000953	4.92	1830.19	416.76	4.39	0.41	0.26	1.28
13.3333*	PF 3	14000	1.83	9.7	0.000975	5.74	2439.7	448.02	5.44	0.43	0.33	1.9
13.3333*	PF 4	19000	1.83	10.87	0.000986	6.38	2979.4	470.91	6.32	0.45	0.39	2.48
13.3333*	PF 5	26000	1.83	12.28	0.000994	7.11	3659.11	494.73	7.38	0.46	0.46	3.26
13.1666*	PF 1	4000	-0.55	3.84	0.000947	3.56	1123.78	413.65	2.72	0.38	0.16	0.57
13.1666*	PF 2	9000	-0.55	5.69	0.000909	4.66	1930.08	459.19	4.2	0.4	0.24	1.11
13.1666*	PF 3	14000	-0.55	7.16	0.000867	5.33	2628.25	494.31	5.31	0.41	0.29	1.53
13.1666*	PF 4	19000	-0.55	8.36	0.000852	5.87	3238.96	520.3	6.22	0.41	0.33	1.94
13.1666*	PF 5	26000	-0.55	9.79	0.000843	6.49	4003.17	547.17	7.3	0.42	0.38	2.5
13	PF 1	4000	-2.92	1.64	0.000675	3.07	1301.85	463.78	2.81	0.32	0.12	0.36
13	PF 2	9000	-2.92	3.88	0.000517	3.75	2402.7	520.34	4.61	0.31	0.15	0.56
13	PF 3	14000	-2.92	5.4	0.000515	4.34	3225.73	558.53	5.77	0.32	0.19	0.81
13	PF 4	19000	-2.92	6.6	0.000532	4.86	3910.97	585.34	6.67	0.33	0.22	1.08
13	PF 5	26000	-2.92	8.03	0.000547	5.45	4767.03	612.6	7.77	0.34	0.27	1.45
12	PF 1	4000	-8.86	1.24	0.000143	2.11	1895.67	370.28	5.11	0.16	0.05	0.1

12	PF 2	9000	-8.86	3.23	0.000328	3.2	2809.17	546.21	5.13	0.25	0.11	0.34
12	PF 3	14000	-8.86	4.73	0.000357	3.83	3657.93	580.37	6.29	0.27	0.14	0.54
12	PF 4	19000	-8.86	5.88	0.000388	4.38	4339.32	598.27	7.24	0.29	0.18	0.77
12	PF 5	26000	-8.86	7.26	0.000422	5.02	5181.27	620.04	8.34	0.31	0.22	1.1
11.875*	PF 1	4000	-8.56	1.23	0.000155	2.11	1892.52	391.36	4.83	0.17	0.05	0.1
11.875*	PF 2	9000	-8.56	3.22	0.000327	3.14	2863.05	572	5	0.25	0.1	0.32
11.875*	PF 3	14000	-8.56	4.72	0.000345	3.74	3739.1	596.98	6.25	0.26	0.13	0.5
11.875*	PF 4	19000	-8.56	5.87	0.000373	4.28	4441.03	616.11	7.19	0.28	0.17	0.72
11.875*	PF 5	26000	-8.56	7.26	0.000405	4.9	5309.87	639.09	8.29	0.3	0.21	1.03
11.75*	PF 1	4000	-8.25	1.22	0.000167	2.11	1892.34	414.1	4.56	0.17	0.05	0.1
11.75*	PF 2	9000	-8.25	3.2	0.000317	3.08	2923.71	588.24	4.96	0.24	0.1	0.3
11.75*	PF 3	14000	-8.25	4.71	0.000332	3.66	3826.94	615.73	6.2	0.26	0.13	0.47
11.75*	PF 4	19000	-8.25	5.86	0.000359	4.17	4552.18	636.33	7.14	0.28	0.16	0.67
11.75*	PF 5	26000	-8.25	7.25	0.000387	4.77	5451.82	661.03	8.23	0.29	0.2	0.95
11.625*	PF 1	4000	-7.95	1.22	0.000177	2.11	1895.47	434.55	4.35	0.18	0.05	0.1
11.625*	PF 2	9000	-7.95	3.19	0.000306	3.01	2990.84	607.1	4.92	0.24	0.09	0.28
11.625*	PF 3	14000	-7.95	4.7	0.00032	3.57	3925.97	637.69	6.15	0.25	0.12	0.44
11.625*	PF 4	19000	-7.95	5.86	0.000344	4.06	4678.83	660.43	7.07	0.27	0.15	0.62
11.625*	PF 5	26000	-7.95	7.25	0.000368	4.63	5614.75	685	8.18	0.29	0.19	0.87
11.5*	PF 1	4000	-7.64	1.21	0.000187	2.1	1901.54	456.94	4.16	0.18	0.05	0.1
11.5*	PF 2	9000	-7.64	3.18	0.000296	2.93	3068.51	630.43	4.86	0.23	0.09	0.26
11.5*	PF 3	14000	-7.64	4.69	0.000307	3.46	4043.35	665.41	6.07	0.25	0.12	0.4
11.5*	PF 4	19000	-7.64	5.85	0.000325	3.93	4829.28	685.67	7.03	0.26	0.14	0.56
11.5*	PF 5	26000	-7.64	7.24	0.000345	4.48	5798.43	706.31	8.19	0.28	0.18	0.79
11.375*	PF 1	4000	-7.34	1.2	0.000224	2.08	1927.39	540.86	3.56	0.19	0.05	0.1
11.375*	PF 2	9000	-7.34	3.17	0.000284	2.84	3166.62	662.27	4.78	0.23	0.08	0.24
11.375*	PF 3	14000	-7.34	4.68	0.000286	3.34	4187.87	689.97	6.06	0.24	0.11	0.36
11.375*	PF 4	19000	-7.34	5.85	0.000302	3.8	5000.74	707.14	7.06	0.25	0.13	0.51
11.375*	PF 5	26000	-7.34	7.24	0.00032	4.33	6001.26	727.64	8.23	0.27	0.16	0.71
11.26		Bridge										
11.25*	PF 1	4000	-7.04	1.19	0.000236	2.02	1976.57	598.93	3.3	0.2	0.05	0.1
11.25*	PF 2	9000	-7.04	3.16	0.000263	2.74	3289.22	687.21	4.78	0.22	0.08	0.21
11.25*	PF 3	14000	-7.04	4.61	0.000271	3.25	4306.71	710.61	6.05	0.23	0.1	0.33
11.25*	PF 4	19000	-7.04	5.75	0.000289	3.71	5121.7	727.21	7.03	0.25	0.13	0.47
11.25*	PF 5	26000	-7.04	7.1	0.00031	4.25	6122.31	747.53	8.17	0.26	0.16	0.67
11.125*	PF 1	4000	-6.74	1.18	0.00023	1.93	2072.96	662.09	3.13	0.19	0.04	0.09
11.125*	PF 2	9000	-6.74	3.15	0.000237	2.62	3438.45	708.59	4.85	0.21	0.07	0.19
11.125*	PF 3	14000	-6.74	4.61	0.000246	3.12	4488.44	732.23	6.12	0.22	0.09	0.29

11.125*	PF 4	19000	-6.74	5.74	0.000264	3.57	5328.89	748.97	7.1	0.24	0.12	0.42
11.125*	PF 5	26000	-6.74	7.1	0.000283	4.09	6360.54	768.55	8.26	0.25	0.15	0.6
11	PF 1	4000	-6.43	1.17	0.000204	1.82	2197.17	699.88	3.14	0.18	0.04	0.07
11	PF 2	9000	-6.43	3.15	0.00021	2.5	3606.77	729.98	4.93	0.2	0.06	0.16
11	PF 3	14000	-6.43	4.61	0.000221	2.99	4689.28	753.83	6.21	0.21	0.09	0.26
11	PF 4	19000	-6.43	5.74	0.000238	3.42	5554.72	769.55	7.2	0.22	0.11	0.37
11	PF 5	26000	-6.43	7.1	0.000257	3.93	6614.72	788.04	8.38	0.24	0.13	0.53
10	PF 1	4000	-6.46	-0.67	0.000586	3.01	1329.94	439.72	3.02	0.3	0.11	0.33
10	PF 2	9000	-6.46	0.99	0.000767	4.21	2139.24	523.07	4.09	0.37	0.2	0.82
10	PF 3	14000	-6.46	2.24	0.000863	4.92	2846.49	601.3	4.73	0.4	0.25	1.25
10	PF 4	19000	-6.46	3.18	0.000894	5.56	3417.21	616.95	5.53	0.42	0.31	1.72
10	PF 5	26000	-6.46	4.3	0.000934	6.31	4119.23	635.3	6.48	0.44	0.38	2.38
9	PF 1	4000	-6.46	-2.49	0.008007	6.97	574.14	382.74	1.5	1	0.75	5.22
9	PF 2	9000	-6.46	-1.4	0.006837	8.84	1017.53	421.15	2.41	1	1.03	9.12
9	PF 3	14000	-6.46	-0.56	0.006451	10.17	1376.7	442.43	3.11	1.02	1.25	12.73
9	PF 4	19000	-6.46	0.26	0.006037	10.77	1764.68	495.26	3.56	1.01	1.34	14.45
9	PF 5	26000	-6.46	1.17	0.005728	11.66	2229.66	533.71	4.17	1.01	1.49	17.4
8	PF 1	4000	-11.98	-5.75	0.000348	2.84	1407.88	343.13	4.1	0.25	0.09	0.25
8	PF 2	9000	-11.98	-3.38	0.000445	3.83	2351.88	440.71	5.33	0.29	0.15	0.57
8	PF 3	14000	-11.98	-2.14	0.000619	4.77	2935.73	506.51	5.79	0.35	0.22	1.07
8	PF 4	19000	-11.98	-1.19	0.00077	5.51	3448.64	564.55	6.1	0.39	0.29	1.62
8	PF 5	26000	-11.98	-0.04	0.000894	6.3	4127.2	617.85	6.67	0.43	0.37	2.35
7	PF 1	4000	-13.75	-7.59	0.000473	2.63	1522.31	523.94	2.9	0.27	0.09	0.22
7	PF 2	9000	-13.75	-5.93	0.000749	3.2	2809.73	1014.67	2.76	0.34	0.13	0.41
7	PF 3	14000	-13.75	-4.77	0.000579	3.46	4048.43	1074.56	3.76	0.31	0.14	0.47
7	PF 4	19000	-13.75	-3.58	0.000429	3.56	5339.23	1084.42	4.91	0.28	0.13	0.47
7	PF 5	26000	-13.75	-2.44	0.000405	3.95	6583.23	1093.84	6	0.28	0.15	0.6
6	PF 1	4000	-11.91	-8.25	0.001962	3.74	1069.85	631.71	1.69	0.51	0.21	0.78
6	PF 2	9000	-11.91	-6.6	0.001121	3.95	2280.97	815.93	2.79	0.42	0.2	0.77
6	PF 3	14000	-11.91	-5.32	0.00096	4.08	3430.47	1038.73	3.3	0.4	0.2	0.81
6	PF 4	19000	-11.91	-3.93	0.000559	3.88	4891.84	1063.74	4.59	0.32	0.16	0.62
6	PF 5	26000	-11.91	-2.76	0.000502	4.23	6147.66	1085.25	5.66	0.31	0.18	0.75
5	PF 1	4000	-17.36	-8.32	0.000055	1.4	2852.49	505.06	5.64	0.1	0.02	0.03
5	PF 2	9000	-17.36	-6.91	0.00015	2.5	3605.49	566.52	6.36	0.17	0.06	0.15
5	PF 3	14000	-17.36	-5.78	0.000229	3.28	4270.97	612.43	6.96	0.22	0.1	0.33
5	PF 4	19000	-17.36	-4.51	0.000403	3.63	5234.92	986.58	5.3	0.28	0.13	0.48
5	PF 5	26000	-17.36	-3.37	0.000488	3.97	6543.79	1242.15	5.26	0.31	0.16	0.64
4	PF 1	4000	-13.42	-8.68	0.000261	1.85	2162.07	807.09	2.68	0.2	0.04	0.08

4 PF 2	9000	-13.42	-7.78	0.000553	3.04	2962.21	923.76	3.21	0.3	0.11	0.34
4 PF 3	14000	-13.42	-7.05	0.000742	3.81	3676.11	1018.34	3.61	0.35	0.17	0.64
4 PF 4	19000	-13.42	-6.41	0.000849	4.37	4347.9	1084.54	4.01	0.38	0.21	0.93
4 PF 5	26000	-13.42	-5.59	0.000915	4.94	5267.6	1157.32	4.55	0.41	0.26	1.28
3 PF 1	4000	-13.12	-9.06	0.000487	1.7	2353.46	1595.6	1.47	0.25	0.04	0.08
3 PF 2	9000	-13.12	-8.54	0.000915	2.82	3193.03	1625.75	1.96	0.35	0.11	0.32
3 PF 3	14000	-13.12	-7.87	0.000845	3.27	4275.96	1638.53	2.61	0.36	0.14	0.45
3 PF 4	19000	-13.12	-7.2	0.000728	3.53	5387.71	1651.55	3.26	0.34	0.15	0.52
3 PF 5	26000	-13.12	-6.29	0.000605	3.77	6902.77	1669.12	4.13	0.33	0.16	0.59
2 PF 1	4000	-25.53	-9.17	0.000015	0.91	4399.99	551.86	7.95	0.06	0.01	0.01
2 PF 2	9000	-25.53	-9.07	0.000072	2.02	4457.04	553.32	8.03	0.13	0.04	0.07
2 PF 3	14000	-25.53	-8.89	0.000162	3.07	4556.53	555.85	8.17	0.19	0.08	0.25
2 PF 4	19000	-25.53	-8.64	0.000273	4.05	4696.05	559.39	8.37	0.25	0.14	0.58
2 PF 5	26000	-25.53	-8.19	0.000435	5.25	4951.57	565.82	8.72	0.31	0.24	1.24
1 PF 1	4000	-29.56	-9.2	0.000004	0.61	6540.12	595.77	10.94	0.03	0	0
1 PF 2	9000	-29.56	-9.22	0.000022	1.38	6530.26	595.37	10.94	0.07	0.02	0.02
1 PF 3	14000	-29.56	-9.25	0.000054	2.15	6512.66	594.66	10.92	0.11	0.04	0.08
1 PF 4	19000	-29.56	-9.29	0.000101	2.93	6487.13	593.63	10.9	0.16	0.07	0.2
1 PF 5	26000	-29.56	-9.38	0.000192	4.04	6437.35	591.61	10.85	0.22	0.13	0.53
0 PF 1	4000	-118.24	-9.2	0	0.04	88927.97	1456	60.22	0	0	0
0 PF 2	9000	-118.24	-9.2	0	0.1	88927.86	1456	60.22	0	0	0
0 PF 3	14000	-118.24	-9.2	0	0.16	88927.62	1455.99	60.22	0	0	0
0 PF 4	19000	-118.24	-9.2	0	0.21	88927.29	1455.99	60.22	0	0	0
0 PF 5	26000	-118.24	-9.2	0	0.29	88926.68	1455.99	60.22	0.01	0	0
-1 PF 1	4000	-236.48	-9.2	0	0.01	382898.6	2998.5	125.85	0	0	0
-1 PF 2	9000	-236.48	-9.2	0	0.02	382898.6	2998.5	125.85	0	0	0
-1 PF 3	14000	-236.48	-9.2	0	0.04	382898.5	2998.5	125.85	0	0	0
-1 PF 4	19000	-236.48	-9.2	0	0.05	382898.5	2998.5	125.85	0	0	0
-1 PF 5	26000	-236.48	-9.2	0	0.07	382898.5	2998.5	125.85	0	0	0
-2 PF 1	4000	-354.72	-9.2	0	0	882313.1	4541.55	191.45	0	0	0
-2 PF 2	9000	-354.72	-9.2	0	0.01	882313.1	4541.55	191.45	0	0	0
-2 PF 3	14000	-	-9.2	0	0.02	882313.1	4541.55	191.45	0	0	0

		354.72									
		-									
-2	PF 4	19000	354.72	-9.2	0	0.02	882313.1	4541.55	191.45	0	0	0
		-									
-2	PF 5	26000	354.72	-9.2	0	0.03	882313.1	4541.55	191.45	0	0	0