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*For Hudson*

# United States Senate

COMMITTEE ON APPROPRIATIONS  
WASHINGTON, DC 20510-6025

RECEIVED  
JAN 24 1992  
CLERKS OFFICE

January 14, 1992

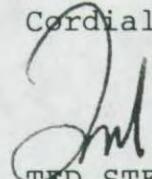
The Honorable Dorothy Jones  
Mayor  
Matanuska-Susitna Borough  
350 East Dahlia Avenue  
Palmer, Alaska 99645-6488

Dear Dorothy:

Enclosed is a copy of the response I received from the Army Corps of Engineers regarding assistance for flooding along the Matanuska River. I wish the response were more positive -- it seems that until a cost-sharing partner can be identified, no Federal funds can be requested. If I can be of any further assistance, please contact me.

With best wishes,

Cordially,

  
TED STEVENS

Matanuska - Susitna Borough  
Code Compliance  
JAN 27 1992  
RECEIVED BY: LDX



REPLY TO  
ATTENTION OF:

DEPARTMENT OF THE ARMY  
U.S. ARMY ENGINEER DISTRICT, ALASKA  
P.O. BOX 898  
ANCHORAGE, ALASKA 99506-0898

District Engineer

Honorable Ted Stevens  
United States Senate  
Washington, DC 20510-0201

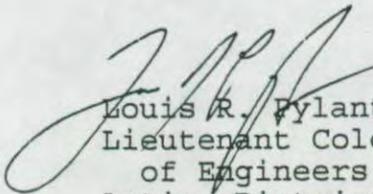
Dear Senator Stevens:

This is in response to your letter of November 12, 1991, concerning the Matanuska-Susitna Borough's request for assistance for the declared disaster along the Matanuska River. The disaster declaration by both the Matanuska-Susitna Borough and the State of Alaska came as a result of severe erosion along the east bank of the Matanuska River which has already destroyed and continues to threaten homes within the Circle View Estates Subdivision.

The Corps of Engineers does not have any existing authority to provide erosion protection for privately owned land. However, my regulatory staff worked very closely with the Borough to issue an emergency permit last August so that they could perform bank stabilization work before freeze-up. That work has not been accomplished. As we have stated in previous correspondence to you, we could perform a comprehensive study of the Matanuska River under Section 22 of Public Law 93-251. That study would require a cost-sharing partner. The State of Alaska has previously indicated an interest in participating but has not recently expressed an interest. We cannot request Federal funds until we identify a cost-sharing partner.

Please contact me directly if I can be of further assistance. Detailed information can be obtained by contacting Mr. Carl Borash, Chief of Plan Formulation Section, at (907) 753-2632.

Sincerely,

  
Louis R. Fylant  
Lieutenant Colonel, Corps  
of Engineers  
Acting District Engineer

## Alaska Task Force Erosion Control of the Matanuska River

Task Force On Erosion Control Problems of the Matanuska River, the Task Force assigned the Alaska Department of Transportation and Public Facilities, and the U. S. Army Corps of Engineers were to draft a general outline of the possible engineering solutions, with a general discussion of the practicability of these solutions. To come up with an engineering solution we must first look at history of the erosion control problem that exists along the Matanuska River's banks.

The COE's report in summary found the following:

*The District Engineer finds that bank erosion and flooding have occurred along the Matanuska River below Bodenbug Butte; and that seasonal flooding..... Both areas studied are rural lands with woods, pastures, and scattered farmlands. Because of marginal economics, farming has decreased or been abandoned and only scattered homesites remain occupied.*

*The District Engineer concludes that economic justification does not exist for structural solutions to flooding or bank erosion in either area studied; and that local interests should avail themselves of technical information regarding non-structural alternatives for wise management of the flood plain.*

### Section IV

#### 23. General

*Matanuska River rises in the glacier fields of the Chugach Mountains and flows westerly about 68 miles to empty into the head of Cook Inlet through Knik Arm. In its upper reaches the channel of the Matanuska River is confined within high banks, but, in its downstream reaches the stream meanders over a bed more than a mile in width. Soils in the lower limits of the river are loosely consolidated alluvial gravel and silt. Banks of the river are low, readily erode, and course changes are common. The effective drainage area considered herein is 2,070 square miles. Recorded flows in the lower reaches (at the Old Glenn Highway erosion near Palmer) range from 300 to 24,000 cubic feet per second. However, maximum discharge in the lower reaches during flood flow is estimated at 40,000 cubic feet per second, which is out of bank conditions.*

#### 24. Flood Problems and Local Desires.

*Flooding of the Matanuska River in the Bodenbug Loop area was emphasized at a meeting held in Palmer 27 February 1964 to discuss the feasibility of flood control on the Knik River. As a result of the interest expressed, a subsequent reconnaissance was conducted relative to this specific area. Minor flooding have occurred during the fall of 1937, 1949, 1967, and in August 1971.*

*During the later two periods Corps observers were in the field to determine cause and extent of high waters. The following is an analysis of the problem. The Matanuska and Knik Rivers flow out of high mountain ranges, onto the floor of the broad flat Matanuska Valley, across which they flow to discharge into the head of the Knik Arm and Cook Inlet. At their mouths, the two rivers have converged to a point where*

*Attachment # A*

they are separated by only 1/4 mile of marsh land and swampy ground. Lower limits of the rivers are under tidal influence and slope of the delta is so flat that tidal backwaters are observed to the study area. The locale reviewed herein is triangular in shape. It extends two miles above the river confluence so where the two rivers are separated by 2 1/2 to 3 miles of delta land. Elevation of farmland at this point averages 115 MSL. Bed elevation of Matanuska River averages 95 feet, whereas the bed of the Knik River averages 80 feet. These elevations establish a relative drainage from Matanuska River towards Knik River obstructed only by the shallow bank heights (10-25 feet) of the intervening farmlands. Subsurface percolation through the porous glacial silt, and all over-bank flows, have established a dendritic drainage pattern across these lowlands, leading into the Knik River. It is this drainage and erosion preference from which local residents seek relief. Specific problem areas are defined below.

- a. Matanuska River over the years gradually washed away the bank adjacent to a small acreage of farmland near Bodenbug Butte about 4 miles (7 1/2 miles by road) south of Palmer, Alaska. Since 1916, in the present critical area, this erosion has amounted to about 860 feet or an average of 19 feet per year. During this 55 year period the bench land lost has amounted to 160 acres or 3 acres per year.
- b. The fear has been expressed by local residents that Matanuska River will divert across the total breadth of the Bodenbug Loop area at the southern base of the butte and hence on to join the Knik River above or near the present site of the highway bridge. Such flooding, it is feared, would destroy the agricultural value of the area and would constitute a direct threat to life and personal property of local residents. In recent years, less emphasis has been placed on agricultural values by abandonment of farms and active cultivation. Use of lands for homesites has, however, increased.
- c. Local interests anticipate that the continuing erosion of the left bank of Matanuska River will soon create a new channel and request that the cutting bank be protected, either by bank paving or by the construction of protective groins. A field survey was made to determine relative elevations in the problem area. This survey indicates very little likelihood that the river will breach the existing high ground and endanger major portions of the existing farm area or the main highway as presently anticipated by local interests. The elevations on the left bank west of Bodenbug Butte are high enough to forestall a direct overflow of Matanuska River in this area.

The river bed is approximately 1 mile wide at this location. During the maximum recorded flood, an average depth of 2 feet is all that is required to pass the flow. The river must therefore rise 12 feet above flood stage to threaten property in this way. In general this is considered extremely improbable. However, localized over-bank flows may occur due to riverbed obstructions. This is particularly true and has occurred in the low saddle area one half mile southwest of the butte.

- d. Recent surveys of the area in question have been conducted. Stream gradients, historic and anticipated flood stages, and current drainage patterns have been studied to determine the potential that exists for a major change occurring in the river channel. This office concludes that while some acres will continue to be flooded occasionally, the development of a major channel across the area is not supported by available data. Further, a recent channel change within the bed of the river has shifted major flows to the north bank of the river and away from the erosion area described in paragraph c above.

#### 25. Areas Subject to Flooding.

- a. Lands of 120 acres extent have been cleared in a flood plain area that is historically demonstrated to be subject to frequent flooding by high waters of the Matanuska River. Once cleared, these acres show more plainly the presence of waters during flood stages and give greater emphasis to the flooding conditions. In dry years these acres can be farmed and a partial crop realized.
- b. There are 240 acres additionally subject to only occasional flooding, and then, the extent is limited to well defined channels involving only a small part of the total area. All improvements of value access roads, and personal property within this Bodenbug Butte area are located adjacent to the Bodenbug Loop Road which follows higher ground, and are not within the area of frequent flooding.
- c. In establishing areas involved, 80 acres within the Bodenbug Loop area are subject to frequent flooding by Knik River and to some extent by both rivers. Areas that are threatened by the Knik River are excluded from this analysis since they would be subject to flooding even with complete control of Matanuska River.

#### 23. Improvements considered.

a. *Training Dike.* The present erosion of the left bank of Matanuska River west of Bodenbug Butte could be controlled by paving, construction of groins or a protective training dike. Paving would require extensive dressing of the present bank and more riprap would be required than for the dike construction from riverbed sand and gravel. Due to the extent of erosion, and deep curvature of the riverbed, it is considered that a straight training dike would be more economical and effective than groins. Besides protecting the bank from erosion, the dike would divert the water to forestall cutting a new channel near the Matanuska Electric Association power line right of way which crosses the river. The proposed training dike is indicated on Plate 4. The dike would be constructed from riverbed gravel with a protective armor or quarry rock. A 2 foot layer of dumped riprap is derived, based upon an estimated maximum current velocity of 16 feet per second. During low water periods, heavy earth moving equipment could be used to construct the dike. Riprap may be quarried from rock formations comprising Bodenbug Butte and hauled to the site by truck. (This site is no longer available) The top width of 10 feet would facilitate initial placement of subsequent maintenance of the dike,

b. *Overflow Dike.* The present overflow pattern into low lying areas of section 28 and 29, 32 and 33 could be controlled by construction of an overflow dike. Presently, floodwaters of Matanuska River spill over into woodlands at a point approximately 1 mile southwest of McKenley Airstrip. This low-lying area, approximately 4,000 feet wide, lies between a natural rock butte 100 feet in height and a natural bluff line 30 feet in height. Floodwater movement through this gap, and natural ground water percolation have induced a natural dendritic drainage pattern southeasterly toward Knik River. A natural drainage gradient approximating 20 feet per mile extends along this pattern toward Knik River. Present surface overflow through this area could be controlled by construction of an overflow dike. In addition to diverting water, the dike would forestall any possible cutting of a new river channel through an old power line right of way. The proposed overflow dike and old power line location are shown on Plate 4. The dike would be constructed from riverbed sand and gravel with a protective armor of quarry rock available at the south end of the dike section. A 2 foot layer of dumped riprap is based on a need for protection

from floating debris. During normal low water the construction site is dry and would allow heavy earth moving equipment to be used. The dike has a projected top width of 5 feet, including width of riprap. Heavy maintenance on this dike is not anticipated.

27. Projected Cost Estimate

The following estimates are based on January 1972 (1991) price levels.

- a. *Training Dike.* The following cost estimate is based upon construction of a training dike extending from the point where North Bodenburg Loop turns south to the southwest for a distance of approximately 10,000 feet, as shown on Plate 4. A detailed survey of the river bottom was not made; however, the estimate is believed to be adequate to provide the required protection. Location interest have made no indication of their capability to meet requirements for local contribution,

<i>Description</i>	<i>Quantity</i>	<i>1972</i>
<i>River Gravel</i>	<i>88,000</i>	<i>\$352,000.00</i>
<i>Quarry Rock</i>	<i>39,000</i>	<i>\$585,000.00</i>
<i>Sub Total</i>		<i>\$937,000.00</i>
<i>Engineering and Design</i>		<i>\$155,000.00</i>
<i>Supervision and Administration</i>		<i>\$135,000.00</i>
<i>Contingencies</i>		<i>\$90,000.00</i>
<i>Total Federal Cost</i>		<i>\$1,317,000.00</i>
<i>Non-Federal Costs</i>		
<i>Lands, Easements, Right of Way and Quarry Rights</i>		<i>\$15,000.00</i>
<i>Total Project First Cost</i>		<i>\$1,332,000.00</i>

- b. *Overflow Dike.* The following cost estimate is based upon construction of an overflow dike along the center-line station 60+50 (bluff point) southeasterly 3,500 feet to station 95+50 (small butte). Location of this and construction interest are as reflected for the training dike.

<i>Description</i>	<i>Quantity</i>	<i>1972</i>
<i>Earth Excavation</i>	<i>3,850</i>	<i>\$10,587.50</i>
<i>River Gravel</i>	<i>16,000</i>	<i>\$64,000.00</i>
<i>Finish Grading</i>	<i>3,500</i>	<i>\$1,750.00</i>
<i>Quarry Rock</i>	<i>6,390</i>	<i>\$95,850.00</i>
<i>Subtotal</i>		<i>\$172,187.50</i>
<i>Engineering and Design</i>		<i>\$28,500.00</i>
<i>Supervision and Administration</i>		<i>\$20,000.00</i>
<i>Contingencies</i>		<i>\$20,000.00</i>
<i>Total Federal Cost</i>		<i>\$240,687.50</i>
<i>Lands, Easements, Right of Way and Quarry Rights</i>		<i>\$5,000.00</i>
<i>Total Federal Cost</i>		<i>\$245,687.50</i>

#### 29. Estimate of Benefits.

- a. *Benefits to be derived from flood protection, in the case of occasional flooding, would be the difference in value between land subject to flooding and land not subject to flooding. There are 120 acres flooded frequently and 240 acres flooded only occasionally. Land values were established through the coordinated efforts of farm agencies and the local estimator through the coordinated efforts of farm agencies and the local borough tax assessor and are for September 1971. This value, \$325.00 per acre, represents the raw price of land, \$100.00 plus the average cost of land clearing, \$225.00. The lack of comparative land sale records showing net profit per acre discouraged efforts to establish land values by capitalization methods. For the purpose of this report the value of \$325.00 per acre will be used. Land that is flooded frequently is assessed by the local assessor at \$125.00 per acre as the benefit to be gained by flood protection of this area. Land that is flooded only occasionally show an evaluation of \$275.00, leaving a benefit to be gained by flood control of \$50.00 per acre.*
- b. *Annual benefits for increased land values are determine by multiplying the in threatened areas in "a" above by the per acre value of flood protection. For 120 acres x \$200.00 per acre + 240 acres x \$50.00 per acre the total value of protecting these acres = \$24,000.00 + \$12,000.00 or \$36,000.00. Annual benefits for land improvement are determined by*

applying a capital recovery factor for 25 years at 5 3/8 percent to the value of protection. This value is  $\$36,000.00 \times 0.0736 = \$2,650.00$ . Annual benefits attributable to an overflow dike which prevents flooding only are estimated to be: increase in land value  $\$2,650.00$ , plus other preventable damages of  $\$1,000.00$  for an annual total benefit of  $\$3,650.00$

- c. In addition to prevention of flooding ( $\$3,650.00$  average annual benefit), construction of a training dike would prevent further loss to erosion. On the basis of the estimated 3 acres per year loss, an additional savings of  $3 \times \$325.00$  or  $\$1,000.00$  per year benefit for losses prevented is derived. Total average annual benefit for prevention of a training dike which prevents both flooding and erosion is therefore  $\$4,650.00$ .

### 30. Economic Justification.

#### Training Dike

Annual Benefit/Annual Cost =	\$4,650.00	\$101,000.00	0.05	to 1	\$1,000.00	\$4,000.00	0.25	to 1
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#### Overflow Dike

Annual Benefit/Annual Cost =	\$3,650.00	\$19,000.00	0.19	to 1	\$1,000.00	\$4,000.00	0.25	to 1
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### 31. Summary.

- a. The annual cost of a training dike providing flood and erosion protection from the Matanuska River far exceeds the annual benefits realized from such protection.
- b. The major re-channeling of the Matanuska River feared by local interests is not supported by recent surveys, making need for an overflow dike questionable.
- c. Clearing within the flood plain, for agricultural purposes, other than pasture lands, should be discouraged on the grounds that flood protection is not economically justified.
- d. However, should Matanuska River deviate from its present course and form a new confluence with Knik River, localized bank erosion will occur periodically. These isolated cases will call for individual attention and corrective measures.

In January 1974, the Alaska Department of Highways (DOT/PF) reviewed the COE above report and came to the same conclusions.

## Current Evaluation of the Erosion Control Problem at Bodenburg Butte

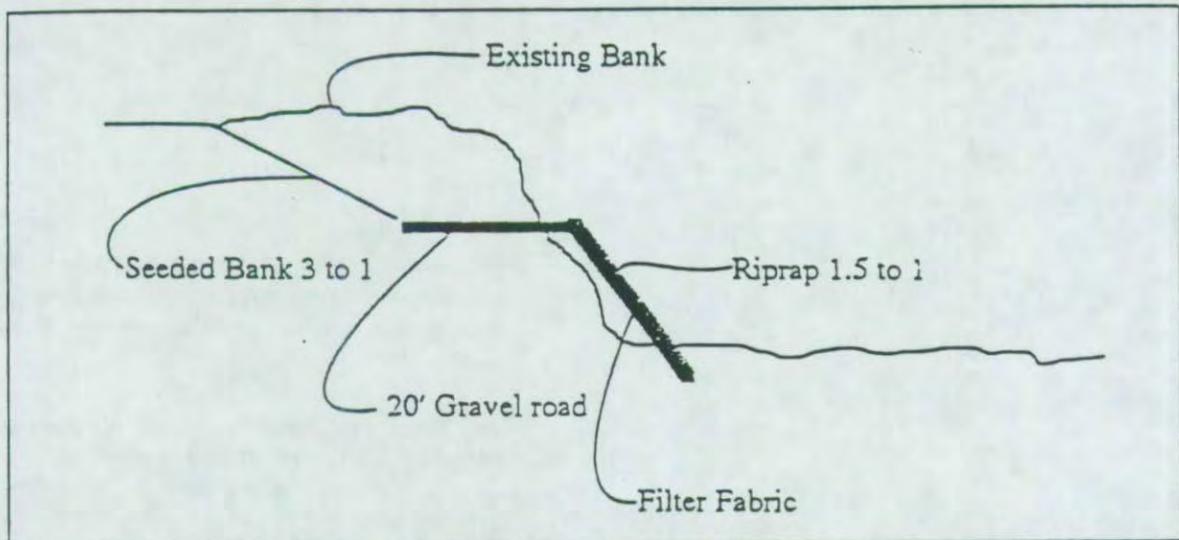
It is the opinion of the COE and the DOT/PF that there is little that has changed since the 1972 report. In this report we have outlined several possible design solutions that have been considered:

### Possible Solution Reviewed

### Discussion

Flexible Revetment, Riprap

Rock Riprap. Dumped rock riprap is the most widely used revetment. Its effectiveness is well established where adequate size, of suitable size gradation, and properly installed. A cost general review of this design and cost analysis was done using the following typical section:



Typical Section

### Assuming:

- Average bank height 20 feet above channel bed elevation
- Scour depth 4 feet below channel bed elevation
- Riprap height 10 feet above channel bed elevation

### Cost Estimate per Linear Foot of Bank Protection

Description	Quantity	Unit	Unit Cost	Cost
Mobilization		L/S		\$101.00
Excavation	19	cu/yds	\$13.00	\$247.00
Land	1	feet	\$100.00	\$100.00
Road	1	foot	\$177.00	\$177.00
Seed	3.9	sq yd	\$1.00	\$3.90
Filter fabric	3.9	sq yd	\$2.50	\$9.75
Riprap	3.32	cu yd	\$40.00	\$132.80
Engineering		L/S		\$100.00
<b>Sub Total</b>				<b>\$871.45</b>
Contigencies				\$130.72
<b>Total Costs per linear foot of protection</b>				<b>\$1,002.17</b>
<b>Total Cost per mile</b>				<b>\$5,291,444.40</b>
<b>Total Cost for 3 miles of protection</b>				<b>\$15,874,333.20</b>

Based on the above cost estimate the estimated capital improvement cost for protection of approximately 3 miles of the Matanuska River would be \$5,291,444.40 per mile or \$15,874,333.20 for this area of the Matanuska River. Plus general maintenance and inspection costs which have not been estimated for this report.

#### Selective Gravel Mining

We felt that this solution had some merit. In general some questions that would need to be answered are: 1. Who will purchase a dredge capable of mining in excess of 276,000 cubic yards of material? 2. Would the costs for transportation and removal of this material be competitive. 3. Is there a market? 4. What are the environmental problems? 5. What methodology can be used? (scrapers, or dredge)

A cost analysis was computed using a mechanical dredge system:

Description	Quantity	Unit	Unit Cost	Cost
Dredge (capital cost)	1	ea	\$10,735,000.00	\$10,735,000.00
Contigencies		L/S		\$2,683,750.00
				\$13,418,750.00
Average Annual Dredge Cost	50	year	\$1,145,000.00	\$57,250,000.00
Annual Repair and Replacement Cost	50	yr	\$1,350,000.00	\$67,500,000.00
Annual Operation	50	yr	\$3,150,000.00	\$157,500,000.00
<b>Total cost for 50 years</b>				<b>\$295,668,750.00</b>

Total yearly cost in 1991 dollars

\$5,913,375.00

Cost per cu/yd of material on bank

\$21.43

A review of the costs of local suppliers show that the estimated \$21.43 cost per cubic yard would be unrealistic for the market forces.

Another methodology which was considered was the use of scrapers to remove the material. It was generally felt that this method would cause excess environmental damage and the costs would be similar because the location where the work would have to be completed in the river.

Dam at the Old Glenn Highway

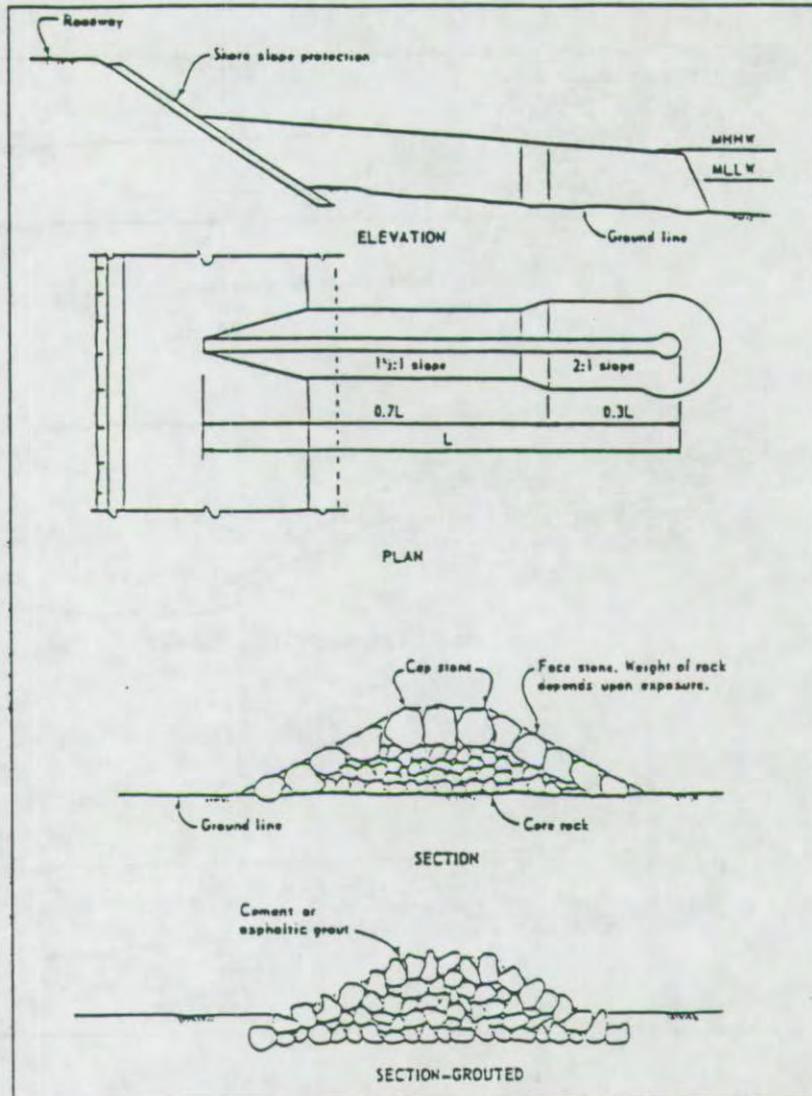
We felt that this solution was not viable because of the general topography of the Matanuska River at the proposed location and because it would fill with bed load material in a very short period. The Matanuska River generates approximately 276,000 cubic yards of material annually.

Re-channeling of the Matanuska River

We felt that this was not either an engineering or an economically sound solution. The costs to maintain this solution (even unless there was an complex dredging operation) would be excessive. Other areas of concern were the environmental costs.

Riprap Spur Dikes

It should be noted that this solution would provide the needed protection. Care must be made in the design to insure that the design solution does not move the problem either up or down stream of the currently affected area. In general it is felt that these structures would not work in this area because of the Matanuska Rivers instability, and the possibility that the spur dikes would encourage the river to move to the opposite bank.



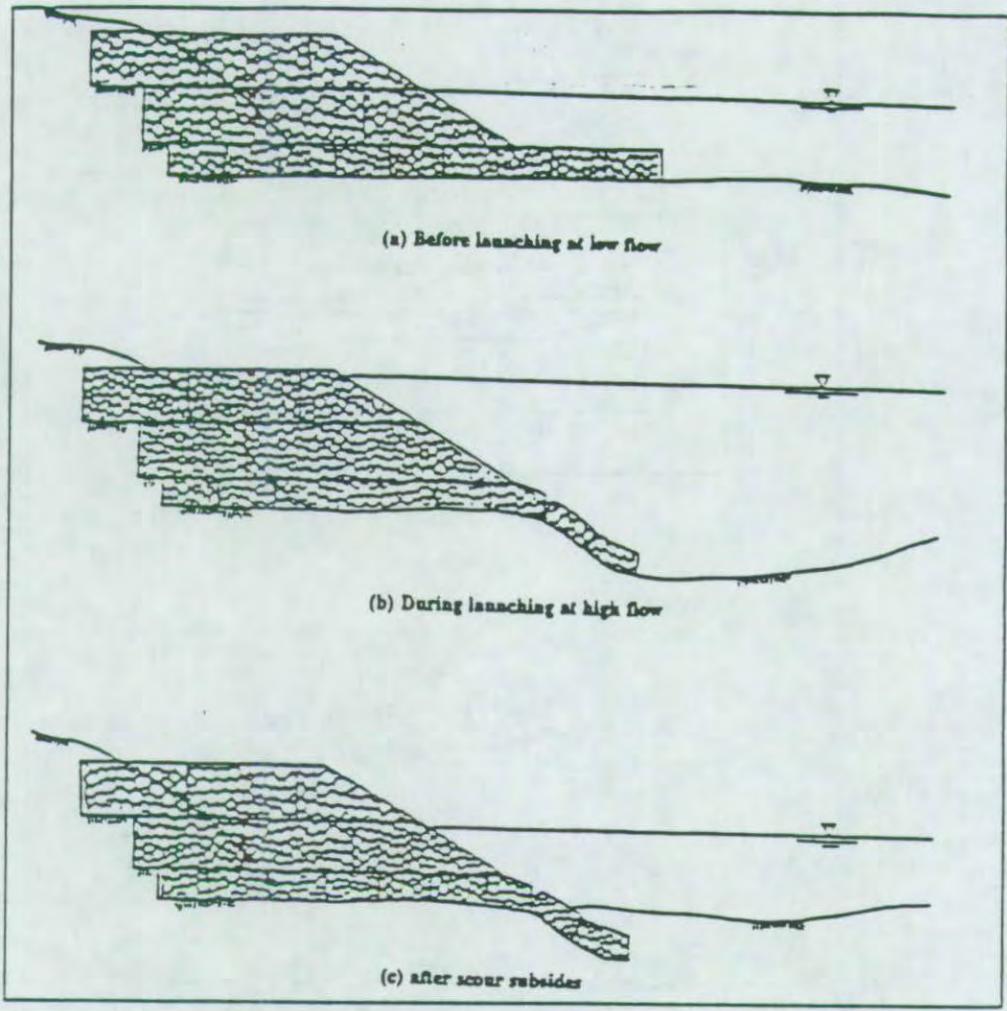
Typical Groin

Broken Concrete

Broken concrete is used in emergencies. A review of the performance of this type of structure is generally unsatisfactory.

Gabions

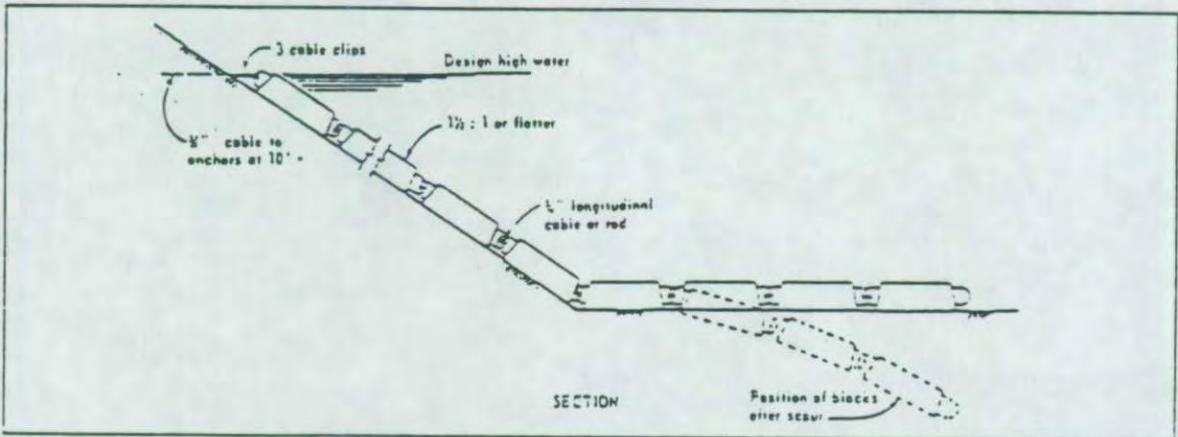
Gabions are in the dimensions of the devices. Gabions rigid structures therefore requiring regular inspection, maintenance, and are subject extremely susceptible to scour failure.

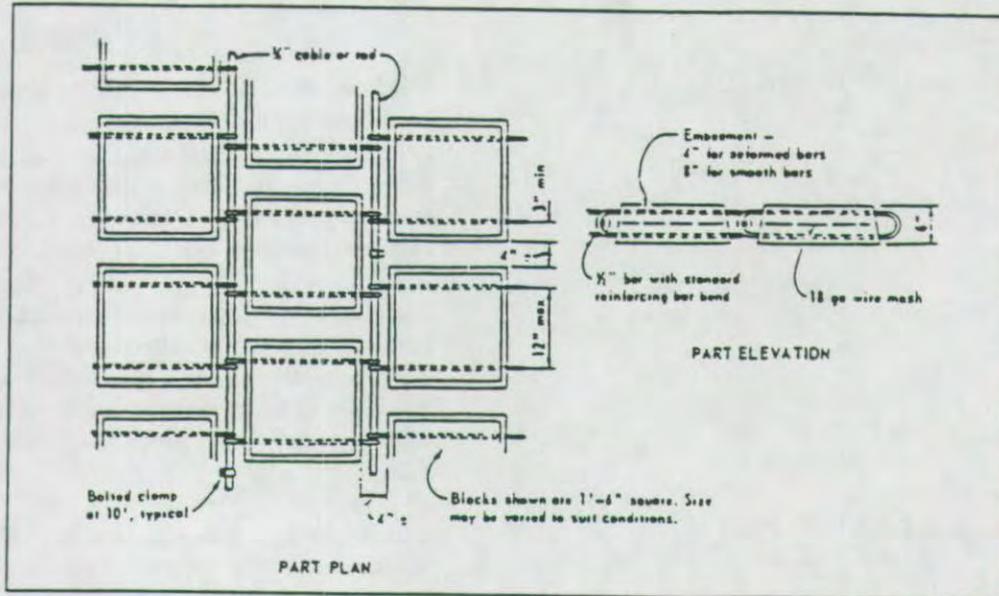


Gabions

Precast Concrete Blocks

Precast concrete blocks such as Armor Teck have a good track record if they are properly designed. In general, they are more costly than a riprap solution unless riprap of size and gradation is not available.



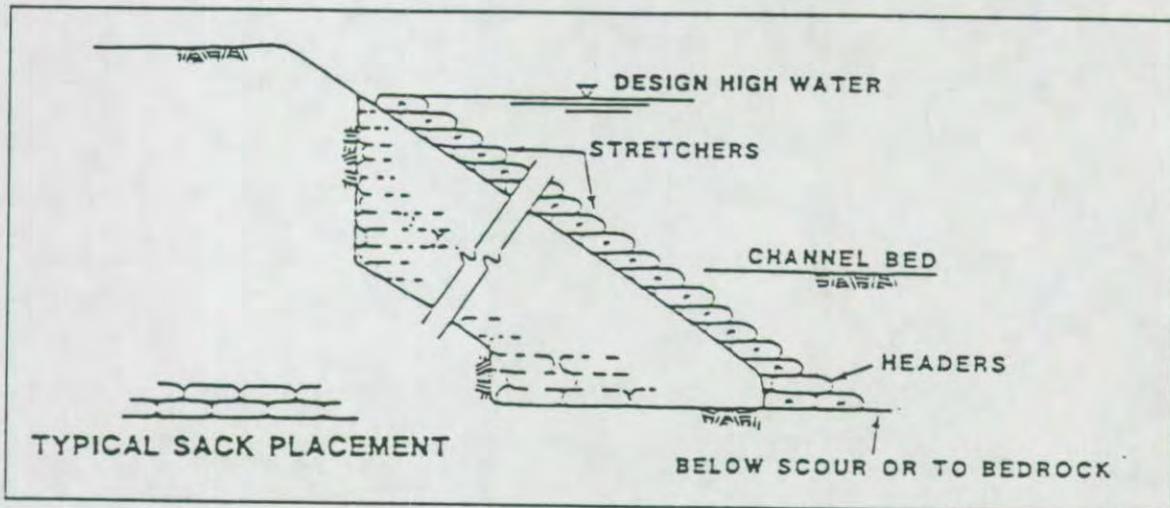


### Rigid Revetments Concrete Pavement

Well designed concrete is satisfactory providing considerable care insuring that the leading edges and toe are not subject to the river. We have found this solution to be impractical in Alaska. Failure can be catastrophic should it be undermined.

### Sacked Concrete

This solution is very susceptible to undermining. If any section of the protected area should become undermined the entire structure can fail.



Typical sand-cement bag revetment

### Concrete Grouted Riprap

Concrete grouted riprap allows use of smaller rock, a lesser thickness, and more latitude in gradation of rock than dumped riprap. This type of structure requires an inspection and maintenance program.

### Concrete filled Fabric Mat

Concrete filled fabric mat is a patented product (Fabriform) consisting of porous, pre-assembled nylon fabric forms that are placed on the surface to be protected and then filled with high strength mortar by injection. Variations of Fibriform and Fabricast consist of nylon bags similarly filled.

### Soil Cement

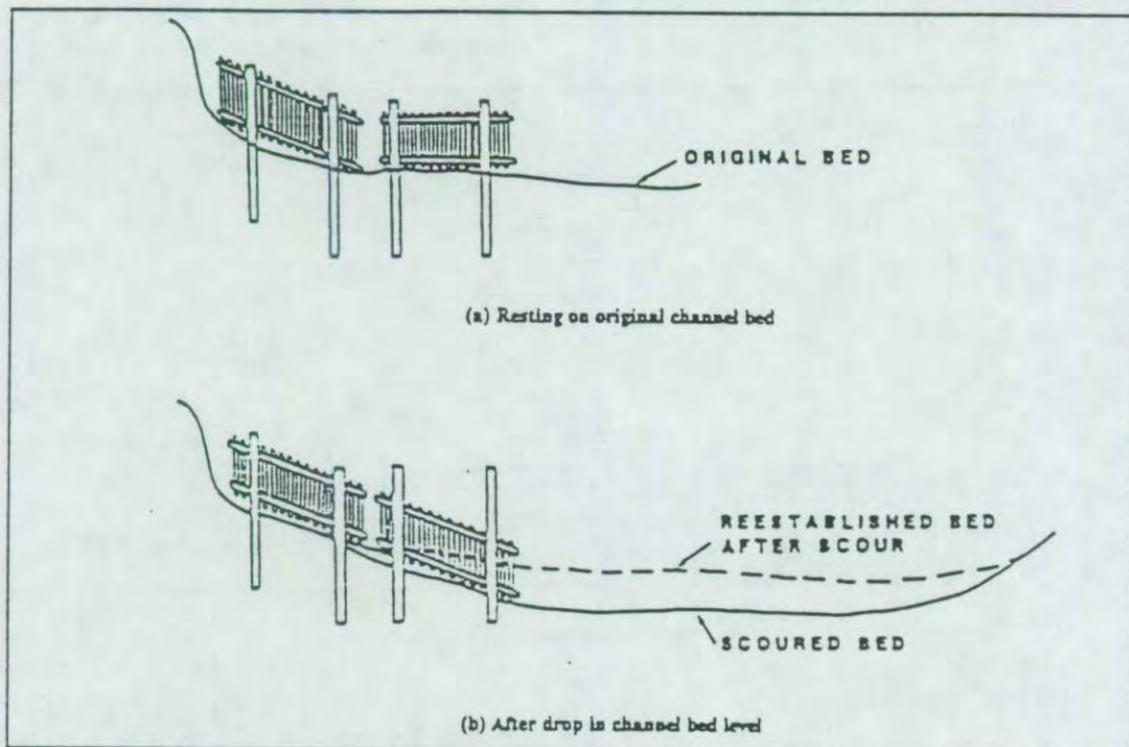
The use of in place soil combined with cement provides a practical alternative. The resulting mixture, soil cement, has been used as bank protection in many areas of the Southwest. To my knowledge we have never used this solution in Alaska.

### Bulkheads

A bulkhead is a steep or vertical wall to support effected area. This solution is extremely expensive. There are several typical design solutions such as the patented Reinforced Earth, sheet piling, and the standard concrete bulkheads.

### Permeable Spurs

A variety of permeable spur designs are also shown to control bank erosion. There are several case histories where failures experienced at a site that is highly unstable with rapid lateral migration, abundant debris, and extreme scour depths.



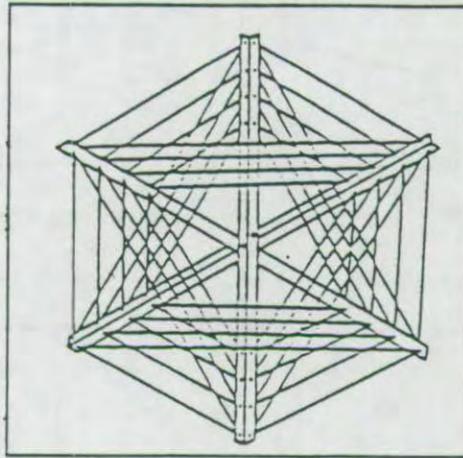
### Henson Spurs

Sheet pile vanes in the river

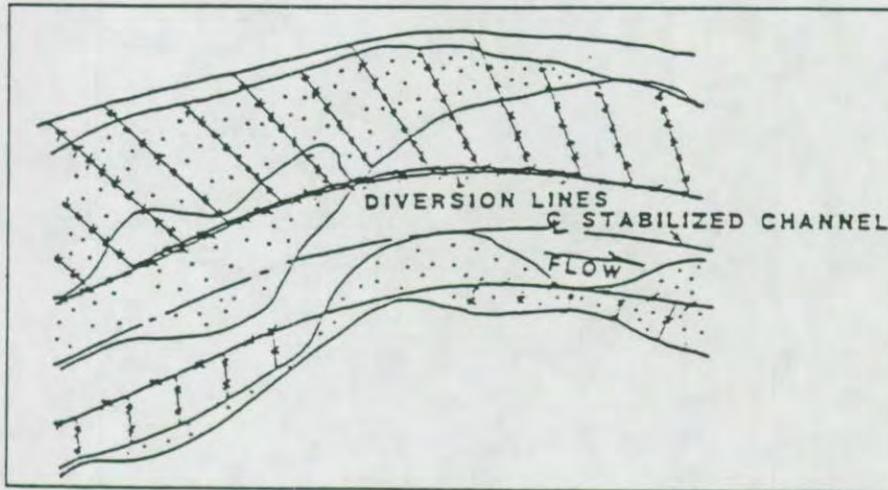
This solution would require the placing of vanes in the river that would interrupt and change the hydraulic forces in the water column. This method has not proven to be effective under conditions such as we have in the Matanuska River. The vanes tend to work in well defined channels. The Matanuska River is generally a braided shallow river in the subject area.

Retarder Field

This system works well in general in grading rivers. The system has been used only works well in "light debris" conditions.



Typical Jack Unit

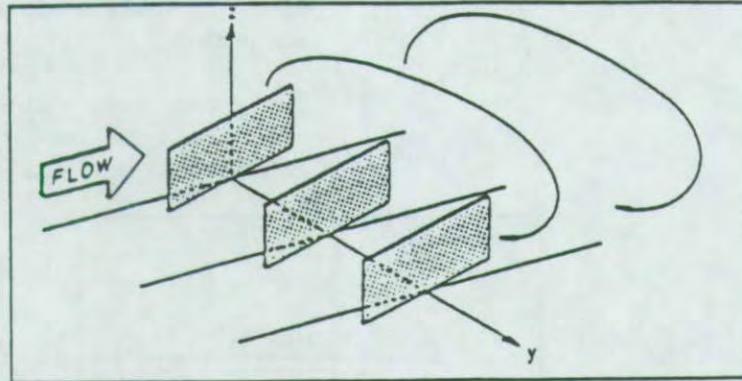


Retarder field schematic

Vane Dikes "Iowa Vane"

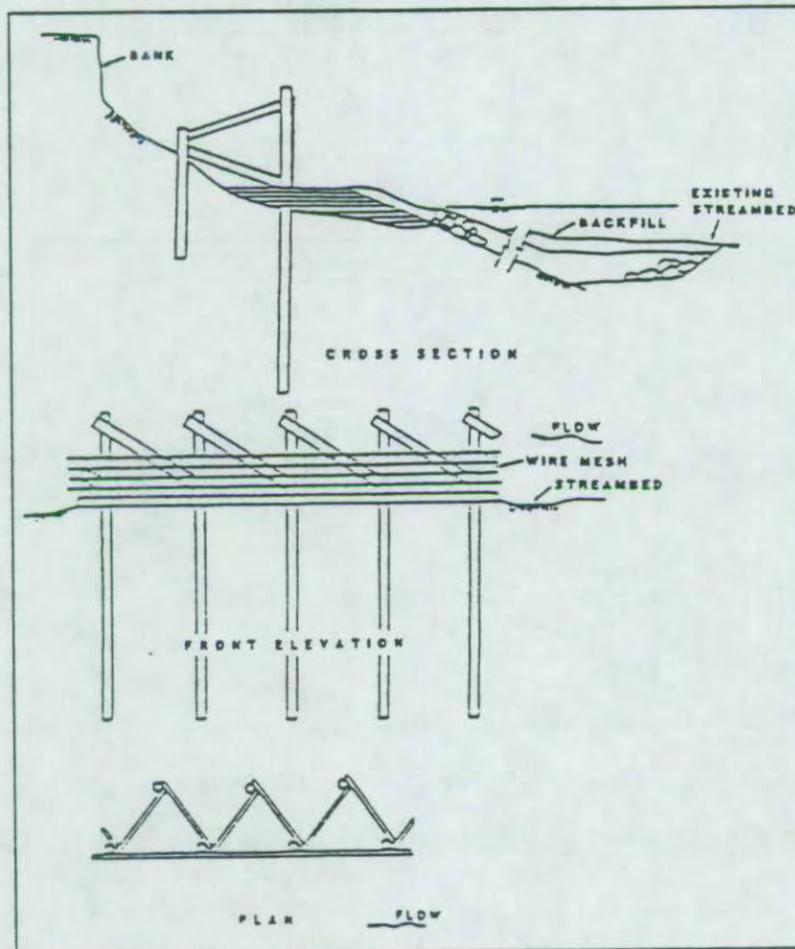
Vane Dikes are a series of low elevation structures designed to guide flow away from the eroding bank line. The structures can be constructed of rock or other erosion resistant material such as sheet pile. The crests are below the design water elevation and

flow can pass over or around the structures, with the main thread of flow directed away from the eroding bank. These structures have a mixed success history.



Perspective of an Iowa Vane layout

Heavy timber pile and wire fence retarder structures



Heavy Timber pile wire fence retarder structures