A POTENTIAL ENGINEERING SOLUTION FOR EROSION CONTROL ON THE MATANUSKA RIVER

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The Alaska Department of Transportation and Public Facilities and the U.S. Army Corps of Engineers were requested to provide a design of an open channel that could be constructed in the Matanuska River bed to contain the river so as to prevent erosion of its banks, and that could be maintained by continuous gravel excavation of the incoming sediment load.
The following preliminary channel design was developed for the purpose of estimating the feasibility and cost of using a maintained open channel for bank erosion protection. This preliminary design did not take into consideration any environmental restrictions or consequences, land ownership or mineral rights, or disposal of material removed to create and maintain the channel.

The Matanuska River is a glacier-fed river carrying approximately 276,000 cubic yards (yd^3) of sediment downriver annually. Much of the sediment is composed of cobbles and rock, which tend to settle on the riverbed during low to moderate river flows. During times of high flow, some of this rock is picked up again by the fast water and redeposited elsewhere in the river; some of this bed load is eventually carried out to tidewater. As the river flow varies in depth and velocity, the smaller material tends to be carried downstream. The larger material, more difficult to move, remains to armor the riverbed. The riverbed accretes and the river channel is braided because of this action. This creates a broad, flat riverbed made up of ever-changing gravel bars and channel braids. Most of the time the entire flow of the river is contained within the braided channels, but during major floods the flow can extend from bank to bank. Most of the riverbank is fine gravels and sand that are easily erodible. The steepness of the riverbed gives the water enough velocity and energy to erode the finer materials of the bank, but not enough to erode the armored riverbed. Therefore, when a river braid meanders to the edge of the riverbed and up against the bank, the riverbank is eroded. The river braid causing the erosion will tend to stay at the bank and continue to erode it until some happenstance of the river causes that channel to fill with sediment and change course.

The purpose of the maintained open channel is to keep the river's flow in the center of the riverbed and away from the riverbank thereby protecting the riverbank from erosion. The design of the open channel was based on the following considerations:

1. The channel must be large enough to pass the 100-year flood of approximately 76,000 cubic feet per second (cfs). If an erosion protection project were in place, there would be development on the river's edge that would be fully dependent upon that project for its safety. To keep structures on the bank reasonably safe from erosion throughout their expected life, the

constructed channel must contain most flood events likely to happen during that time. Any flood that overtops the constructed channel could cause bank erosion. A 100-year flood has nearly a 50-percent chance of occurring during the life of a typical building (50 years), and is the usual design standard. A constructed channel 2,000 feet wide, 4 feet deep, with a velocity of 7.4 feet per second (fps), would be required to pass the 100-year flood. An additional 2.5 feet of freeboard was added because of the uncertainty of events and the potential high cost of project failure. This "high-flow" channel would have a total depth of 6.5 feet. The channel would need to extend from the bridge to the railroad dike, a distance of 6 miles, to protect the lower end of the river. The volume of excavation for the high-flow channel would be 13.7 million yd^3.

2. A "low-flow" channel within the larger channel would be required. Most river flows would be less than the 1-year flow event of approximately 15,700 cfs. In order to prevent braiding within the broad, flat-bottomed high-flow channel, which could cause erosion of the channel banks, a low-flow channel within the larger channel would be needed to concentrate the smaller flows. The low-flow channel would need to be 5 feet deep and 400 feet wide to pass the 1-year flood event. Most of the annual channel maintenance (channel alignment and scour protection, not sediment removal) would occur within this smaller channel. The volume of excavation for the low-flow channel would be 2.4 million yd^3.

3. A sediment basin would be required at the head of the channel. The primary purpose of the sediment basin would be to trap the huge sediment load of a major flood event that could plug the constructed channel. This overload could cause failure of the erosion control project, or at least diminish the effectiveness of the project. The secondary purpose of the basin would be to increase the efficiency of sediment removal. Most of the annual sediment load of 276,000 yd^3 is deposited during the 6 months of higher river flows. Removal costs would be less if sediment was excavated from the basin year-round. Large depositions from floods could be removed somewhat at will without a large influx of equipment to clean out the channel. Also, most of the sediment removal from the system would occur in one general location. The sediment basin was sized to settle out and to contain half the annual sediment volume (138,000 yd^3) plus the sediment volume of a 100-year flood, estimated at 250,000 yd^3. The basin would be about 2,700 feet square and 15 feet deep. The volume of excavation for the sediment basin would be 4.2 million yd^3.

In summary, an excavated channel 2,000 feet wide, 6.5 feet deep, and nearly 6 miles long, including a low-flow channel and sediment basin, would be necessary to reasonably prevent bank erosion along the lower portion of the Matanuska River. To construct this channel would require an excavation of 20.3 million yd^3 of riverbed. To maintain the channel would require the excavation of an estimated 276,000 yd^3 of sediment annually. All sediment would have to be removed from the channel, even if the material is not saleable or usable. Most of the material removed during annual maintenance would come from the sediment basin, meaning that it would be excavated in the wet, with environmental

restrictions. Equipment used to maintain the project must be dedicated solely to the project. The project operator must be able to handle all contingencies such as increased sediment loads from a major flood or a series of floods, or channel bank erosion. It is anticipated that once the erosion control project is constructed the riverbank would be developed for residential and commercial use. Therefore, the project would have to be maintained indefinitely. Public expectations may also be that the owner or operator of the erosion control project would be liable for any damages occurring in or along the river.