MATANUSKA RIVER

EROSION CONTROL

Prepared for:

Matanuska-Susitna Borough

Prepared by:

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EXECUTIVE SUMMARY

Peratrovich, Nottingham & Drage, Inc. was commissioned by the Matanuska-Susitna Borough to produce a report addressing the prefeasibility of a proposed gravel extraction project on the Matanuska River. The extraction of gravel from the main channel of the river would serve as a control measure to keep the river from eroding its banks and destroying bordering developed properties.

The project would involve the removal of gravel from a pit located within the braided channel system of the lower Matanuska River, west of the Circle View subdivision. At the beginning of the project, channels would be constructed upstream and downstream of the pit. Natural river processes would cause the river to incise those channels. Gravel would be removed from the pit annually to ensure that the river remained incised and did not migrate toward and erode its banks. A railroad spur would be constructed to facilitate the removal of gravel. The estimated project cost is about $3 million.

This report presents a preliminary concept for the gravel extraction/bank erosion control program. Although preliminary, the report contains sufficient detail for its distribution to, and critical assessment by, potential funding sources, permitting agencies, and industry.

BACKGROUND AND STATEMENT OF PROBLEM

The Matanuska River is a braided, glacial stream. At Palmer, the drainage area of the river encompasses more than 2,000 square miles, twelve percent of which is occupied by glaciers in the rugged Talkeetna and Chugach Mountains (Freethey and Scully, 1980). The glaciers supply a steady and significant sediment load to the waters of the Matanuska River and its tributaries. The U.S. Geological Survey has estimated the annual total sediment load for the Matanuska River at Palmer to be about 5,000,000 tons. The bedload portion of that, assumed to be eight percent of the total sediment load, is 397,000 tons (257,000 cubic yards) (Reckendorf, 1989).

Flood flows on the Matanuska River are of moderate size. The two-year recurrence interval flood (a flood with a 50 percent chance of being equalled or exceeded in a given year), Q_2, has been estimated at about 24,000 ft.^{3}/sec. by the U.S. Geological Survey. The 100-year recurrence interval flood (with a one percent chance of being equalled or exceeded), Q_{100}, has been estimated at about 50,500 ft.^{3}/sec. A graph of flood magnitude versus recurrence interval for the Matanuska River is shown in Figure 1.

River channel braiding occurs as active channels are episodically abandoned and flows seek out new paths through the system. When a river's ability to carry its sediment load is decreased, it deposits the coarser portion of that load in its bed. The deposition results in the blockage of flow in the active channels. Flows are then directed to another channel or channels within the braided system. The process is repeated over and over, producing a broad, intricately braided channel system.

The river's ability to carry sediment is tied to the interaction of its fluid discharge, sediment discharge, gradient, and other factors. Fluctuations in discharge occur as a result of spring runoff, rainstorms, glacier melt, and other reasons. Increases in fluid discharge result in exponential increases in the river's ability to transport sediment. Thus, relatively small increases in fluid discharge can result in very large increases in sediment discharge. The gradient plays a major role in determining the size of material the river can transport and is dependent, for the most part, on the fluid and sediment discharge of the river.

The characteristic instability of a braided river makes prediction of its behavior difficult. Flows rapidly change from channel to channel within the braided system. When flows are directed along the edge of the river bank, serious erosion of the bank can occur. This behavior has historically caused problems along developed regions of the Matanuska River's easily erodible banks and is presently causing a great deal of bank erosion in the Circle View Subdivision. The material composing the banks is finer-grained than the material in the river bed making the river banks especially susceptible to erosion. Documentation of erosion and flooding problems on the Matanuska River can be found in U.S. Army Corps of Engineers, 1972; Lamke, 1972; Alaska Department of Highways, 1974; Hulbert, 1989; and Reckendorf, 1989.

To compound the effects of the braiding on channel instability, the Matanuska River is also aggrading in the Palmer area (Hulbert, 1989). (A braided river is not necessarily also aggrading). This gradual raising of the elevation of the river bed through deposition causes the system to be even more unstable and unpredictable. The aggradation reflects the Matanuska River's adjustment of its gradient to accommodate its large sediment discharge. The raising of the bed level also means that floods of similar magnitude will reach progressively higher elevations through time.

PROJECT DESCRIPTION

The project would consist of several parts. A pit would be constructed in the middle of the Matanuska River's braided channel system, west of the Circle View subdivision (see attached map). The pit would be roughly circular in plan view with a diameter of 1,200 feet and a maximum depth of 20 feet. The excavated volume of the pit would be approximately 600,000 yd.^{3}. This material would be used to construct work pads, haul routes and initial stockpiles associated with the project.

Two channels would be excavated. One would extend roughly 8,000 feet upstream of the pit to the control constriction, north of the Triple Crown subdivision. The other would extend about 3,000 feet downstream of the pit. These channels would function as guide channels into which the flows of the river would be diverted. As the river adjusts to the presence of the pit, it will incise and enlarge these channels. (The reasons for the incisement and enlargement will be discussed in more detail below).

The channels will be designed to accommodate the two-year flood, initially. (Design for larger flows will not be necessary since the river will begin incising the channel as soon as flows are directed down it). The excavated channels will be about 300 feet wide and five feet deep. The excavated material would be pushed to the side by bulldozer to form a berm five feet higher than the present surface's elevation, thus making a channel 10 feet deep. This would involve moving roughly 400,000 yd.^{3} of gravel. Flows would enter the channel leading into the gravel extraction pit through a flared section approximately 1,000 feet wide at the control constriction. Flows would then be restricted to the guide channel for a distance of about 8,000 feet until they entered the pit. After depositing the coarse fraction of the sediment load in the pit, flow would then leave the pit via the 3,000-foot guide channel.

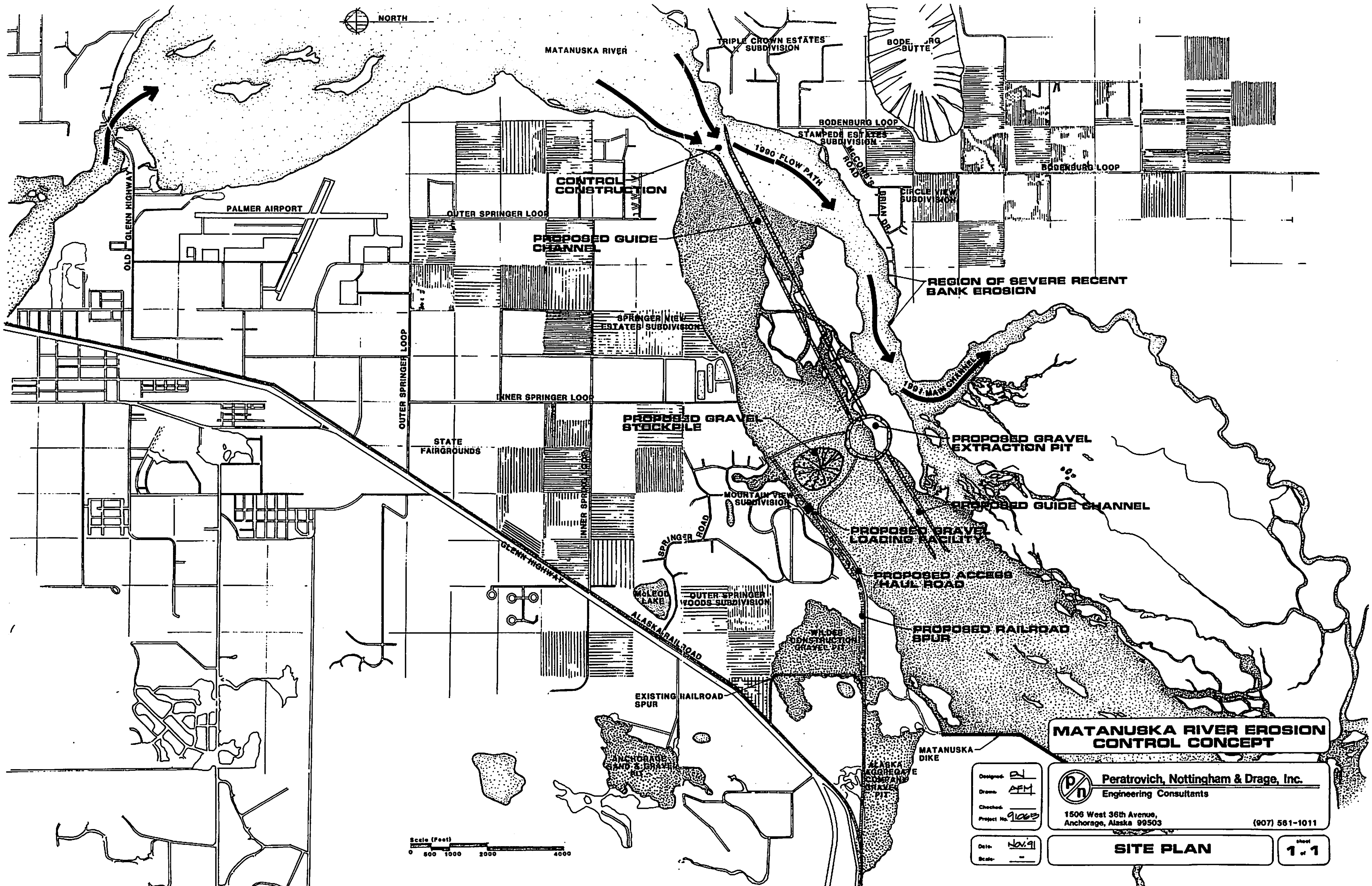
A railroad spur would be constructed to haul gravel from the site by rail car. It would be roughly 6,500 feet long and would allow a one-half section of unit train to be loaded from a gravel loading facility at the site. Also, an access road and work pad would be constructed for access to the pit.

Gravel would be stockpiled just north of the pit. The railroad spur and gravel loading facility would be located adjacent to the stockpile.

Gravel would be removed at the rate of roughly 250,000 yd.^{3}/year from the pit in order to balance the amount of gravel coming down the river each year.

EXPECTED PHYSICAL EFFECTS OF GRAVEL EXTRACTION

The Matanuska River has a relatively steep gradient. The overall gradient of the river is approximately 0.015 ft./ft. (Freethey and Scully, 1980). In the region in which this project is concerned, the gradient of the river is approximately 0.003 ft./ft. (Lipscomb, 1989). One



NORTH
MATANUSKA RIVER
TRIPLE CROWN ESTATES SUBDIVISION
BODENBURG LOOP
STAMPEDE ESTATES SUBDIVISION
McCOMBS ROAD
1990 FLOW PATH
BODENBURG LOOP
CIRCLE VIEW SUBDIVISION
BRIAN DR
CONTROL CONSTRUCTION
PALMER AIRPORT
OUTER SPRINGER LOOP
OLD GLENN HIGHWAY
PROPOSED GUIDE CHANNEL
REGION OF SEVERE RECENT BANK EROSION
SPRINGER VIEW ESTATES SUBDIVISION
1991 MAIN CHANNEL
INNER SPRINGER LOOP
OUTER SPRINGER LOOP
PROPOSED GRAVEL STOCKPILE
PROPOSED GRAVEL EXTRACTION PIT
STATE FAIRGROUNDS
INNER SPRINGER LOOP
MOUNTAIN VIEW SUBDIVISION
PROPOSED GUIDE CHANNEL
PROPOSED GRAVEL LOADING FACILITY
SPRINGER ROAD
GLENN HIGHWAY
PROPOSED ACCESS HAUL ROAD
McLEOD LAKE
OUTER SPRINGER WOODS SUBDIVISION
PROPOSED RAILROAD SPUR
WILDER CONSTRUCTION GRAVEL PIT
ALASKA RAILROAD
EXISTING RAILROAD SPUR
ANCHORAGE SAND & GRAVEL PIT
MATANUSKA DIKE
ALASKA AGGREGATE COMPANY GRAVEL PIT
Scale (Feet)
0 500 1000 2000 4000
MATANUSKA RIVER EROSION CONTROL CONCEPT
Designed
Drawn
Checked
Project No. 91063
Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
1506 West 36th Avenue,
Anchorage, Alaska 99503
(907) 561-1011
Date Nov.91
Scale
SITE PLAN
sheet 1 of 1

of the effects of a steep gradient is to increase the sediment-carrying capacity of the stream.

The effect of gravel mining would be to locally manipulate the gradient and sediment load characteristics of the river in order to control erosion along the channel banks.

The gravel pit will cause the local gradient upstream of it to become steeper by acting as a new, lower temporary base level. The response of the river flowing within the excavated channel upstream of the pit would be to incise through headcutting in order to adjust to the steeper gradient. This process has been described in relation to subarctic streams (Woodward-Clyde, 1980).

As the river enters the pit, the rapid expansion of flow and consequently low flow velocities will cause deposition of much of the river's sediment load. This loss of sediment will increase the sediment-carrying capacity of the river as it exits the pit into the excavated channel. The effect will be to degrade the excavated channel downstream of the pit. This process has been well documented for placer mining settling ponds (Madison, 1981), as well as dams (Williams and Wolman, 1984). Once the flow leaves the guide channel, its behavior will be difficult to predict so it is important that the guide channel extend downstream of access/haul road and railroad spur.

The channel incisement and thus, stability could be expected to persist as long as the gravel mining of the pit persists.

AREA GRAVEL DEMAND

Gravel excavated from the Matanuska River floodplain should ideally be used for some commercial venture or possibly stockpiled along the river edge, should no market be available.

Economics will play an important part in any river stabilization/gravel extraction plan and it is important to identify costs and material volumes.

Gravel is used for many types of construction in Alaska's central region, and over the years, numerous pits have been opened, depleted and closed. Much gravel now used is imported to Anchorage on the Alaska Railroad, and available reserves in Anchorage, estimated to be about 1.5 million cubic yards, appear only adequate for the short term. The Anchorage Municipal Landfill expects to excavate about 10 million cubic yards of gravel over its life, but will need about 14 million cubic yards, thus instead of a gravel surplus, imports will be required.

During the past two years, the Alaska Railroad has moved about 1.6 million tons from Palmer to Anchorage. This quantity came from three primary pits owned by Anchorage Sand and Gravel, Alaska Aggregate Company, and Wilder Construction, and is considerably below peak years where three to four million tons was imported.

While it appears that the major gravel companies have adequate reserves for some time, there may be some interest in developing a very long-term pit such as in the Matanuska River floodplain.

Such a development may be important should gravel exports to Pacific Rim countries become a reality. Limiting factors for this in the past has been gravel quality and delivered price. Alaska is so short of transportation infrastructure, including access to deep-draft ports and large staging areas, that to-date inquiries for four million tons on up have not resulted in any contracts. Rail transport to an accessible port would positively impact not only export of gravel, but other resources.

RECOMMENDATIONS

A project of this nature is dependent upon several variables which should be investigated in a set sequence if costs are to be minimized.

First, the quality and nature of the resource must be defined and compared to gravel desired by users.

Second, contact should be made with potential users, especially export markets, to set limits on their needs. These would include unit costs, port facilities needed, aggregate size and quality, and long-term quantity.

Following positive results of the first two tasks, a mechanism for competitive bid for the resource should be structured. For this, numerous possibilities exist for capital improvements, royalties, etc., all of which require detailed thought.

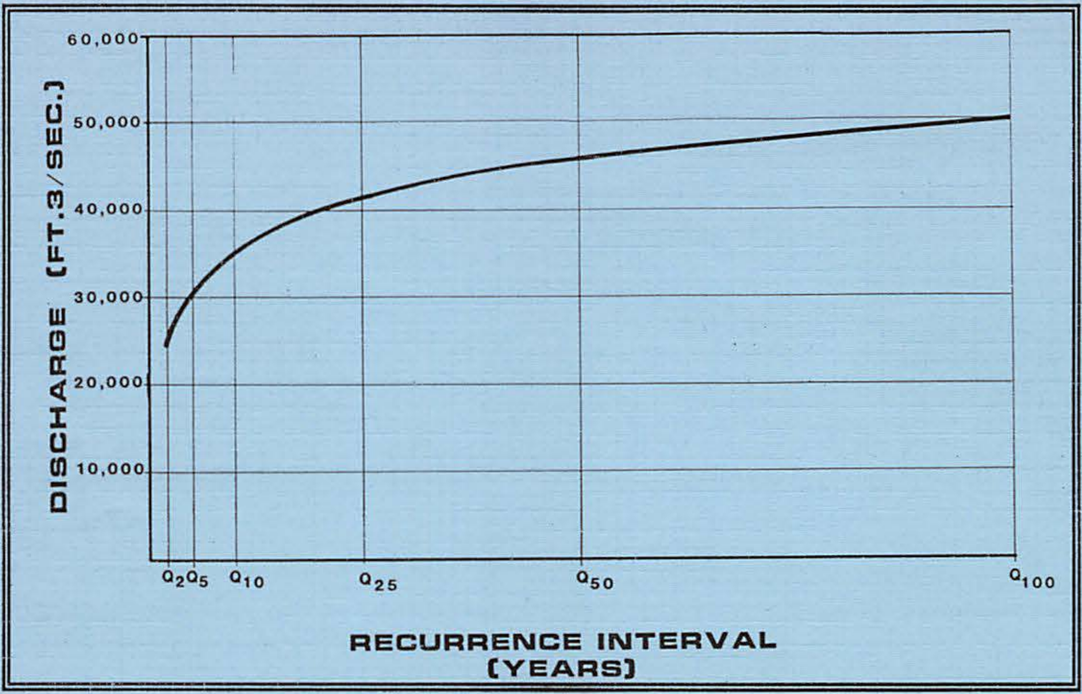


FIGURE 1.

MATANUSKA RIVER FLOOD FREQUENCY (AFTER U.S. GEOLOGICAL SURVEY).

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