

Prepared in cooperation with the Alaska Department of Transportation and Public Facilities

Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

Scientific Investigations Report 2006–5282

U.S. Department of the Interior U.S. Geological Survey

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By Thomas A. Heinrichs, Dustin E. Langley, Robert L. Burrows, and Jeffrey S. Conaway

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey

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Suggested citation:

Heinrichs, T.A., Langley, D.E., Burrows, R.L., and Conaway, J.S., 2007, Hydraulic survey and scour assessment of Bridge 524, Tanana River at Big Delta, Alaska: U.S. Geological Survey Scientific Investigations Report 2006-5282, 66 p.

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Conversion Factors, Datum, and Abbreviations and Acronyms

Conversion Factors

| Multiply | Ву | To obtain |
|--|---------|------------------------|
| cubic foot per second (ft ³ /s) | 0.02832 | cubic meter per second |
| foot (ft) | 0.3048 | meter |
| foot per second (ft/s) | 0.3048 | meter per second |
| inch (in.) | 2.54 | centimeter |
| inch (in.) | 25.4 | millimeter |
| mile (mi) | 1.609 | kilometer |
| pounds per square foot (lb/ft ²) | 0.04788 | kilopascal |
| square foot (ft ²) | 929.0 | square centimeter |
| square mile (mi ²) | 2.590 | square kilometer |

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C = (°F - 32)/1.8

Vertical Datum

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—A geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviations and Acronyms

| Abbreviations and Acronyms | Meaning |
|-------------------------------|---|
| ADOT&PF | Alaska Department of Transportation and Public Facilities |
| USGS | U.S. Geological Survey |
| WSPRO | Computer model for water-surface profile |

Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

By Thomas A. Heinrichs, Dustin E. Langley, Robert L. Burrows, and Jeffrey S. Conaway

Abstract

Bathymetric and hydraulic data were collected August 26–28, 1996, on the Tanana River at Big Delta, Alaska, at the Richardson Highway bridge and Trans-Alaska Pipeline crossing. Erosion along the right (north) bank of the river between the bridge and the pipeline crossing prompted the data collection. A water-surface profile hydraulic model for the 100- and 500-year recurrence-interval floods was developed using surveyed information. The Delta River enters the Tanana immediately downstream of the highway bridge, causing backwater that extends upstream of the bridge. Four scenarios were considered to simulate the influence of the backwater on flow through the bridge. Contraction and pier scour were computed from model results. Computed values of pier scour were large, but the scour during a flood may actually be less because of mitigating factors. No bank erosion was observed at the time of the survey, a low-flow period. Erosion is likely to occur during intermediate or high flows, but the actual erosion processes are unknown at this time.

Introduction

Alaska Department of Transportation and Public Facilities' (ADOT&PF) bridge 524 crosses the Tanana River, a major tributary of the Yukon River, at milepost 275.4 on the Richardson Highway (fig. 1). The Delta River flows into the Tanana immediately downstream of the highway bridge, and the Trans-Alaska Pipeline crosses the river about 500 ft upstream (fig. 2). Backwater on the Tanana River from the confluence with the Delta River can extend upstream of bridge 524. The extent of backwater and its effects on river hydraulics through the bridge depends on the discharge in both rivers. The ADOT&PF commissioned the U.S. Geological Survey (USGS) to complete a bathymetric and hydraulic survey of the Tanana River at Big Delta, Alaska, simulate the river hydraulics, and investigate streambed-scour problems at the site. The USGS initially identified a potential streambedscour problem at bridge 524 in 1975 (Norman, 1975). Norman (1975) was able to observe the site at high flows, and some findings are contained in the analysis in section, "<u>Scour</u> <u>Computations</u>." Potential scour was investigated again for a statewide scour assessment (Heinrichs and others, 2001). Pier-scour computations from this preliminary study for the 100-year recurrence-interval flood were more than 35 ft. In the spring of 1996, the right (north) bank of the river began to erode substantially. About 10 ft of the bank had sloughed into the river by mid-April 1996, and the concern was that the continued erosion could affect both the highway bridge and the pipeline crossing. Hydraulic data and computations were needed to design a proposed protective dike on the north bank.

Background

The Tanana River is a glacier-fed river that carries large sediment loads. The basin area upstream of the bridge is 13,500 mi² with an average elevation of 3,440 ft. Six percent of the basin is glaciated; 2 percent is lakes, ponds, and swamps; and 50 percent is forest. Mean annual precipitation is 22 in. and mean January minimum temperature is -14°F (Jones and Fahl, 1994.)

A slough of the Tanana branches off the main channel approximately 8,000 ft upstream of the bridge and then reenters approximately 500 ft upstream of the bridge. The Delta River enters the Tanana River immediately downstream of the bridge on river left. The Delta River has formed a braided delta at this confluence and forces the majority of the flow in the Tanana River towards its right bank, thus accelerating flow and exacerbating streambed scour. The confluence with the Delta River also creates backwater that propagates upstream through the bridge reach. The shape of the delta and extent of backwater are constantly changing and influencing the hydraulics at the bridge.





Base from U.S. Geological Survey digital data, 1:63,360 Universal Transverse Mercator projection

Figure 1. Location of the Tanana River at Big Delta study unit, Alaska.



Figure 2. Surveyed cross sections at the Tanana River at Big Delta, Alaska. Cross sections are referred to in text by name and corresponding number in the figure.



Bridge 524 was constructed in 1966. It consists of a 399-ft, steel-through truss span and 4 steel-girder spans, each about 95 ft long (fig. 3). The piers are not aligned directly with the flow, therefore the river strikes them at an angle. This "angle of attack" of the flow at the piers has the potential to increase the local scour at the piers significantly and is discussed in the Scour Computations section.

Purpose and Scope

This report presents the results of a field survey of the Tanana River at Big Delta, Alaska, water-surface profile hydraulic-model computations, and bridge-scour computations. Some interpretation is made of the scour results, and erosion processes are considered. The report's primary purposes are to present the actual observations made during the field survey and the hydraulic and scour results that follow from the observations. These observations and computations are intended to support the planning and design efforts of all parties who have an interest in this reach of the Tanana River. The Tanana and Delta Rivers are very dynamic; therefore, the survey, hydraulic models, and scour computations are representative of the conditions during the time of the survey.

Bathymetric and hydraulic data were collected during August 26-28, 1996, by the USGS as a cooperative effort with ADOT&PF. Eighteen channel cross sections were surveyed, velocity profiles and discharge were measured, soundings were made at the piers, and bed material was sampled. Cross-sectional and other surveyed data were used as input to the step-backwater watersurface profile (WSPRO) model (Shearman, 1990). Using this model, the water-surface profiles for the 100- and 500-year recurrence-interval floods were computed, and potential scour at the bridge was calculated.

Figure 3. Upstream cross sections and pier soundings at bridge 524, Tanana River at Big Delta, Alaska. Pier soundings were made on August 26, 1996.

Data Collection

A total station was used to survey points on the bank, road, and bridge, and to locate the ends of the cross sections measured in the river channel. Distance across the channel was measured using a microwave-frequency distance meter and depths were measured with a fathometer or sounding weight.

All surveyed points and channel soundings were referenced to a single arbitrary coordinate system. The origin of this system is (Easting, Northing)=(10,000 ft, 10,000 ft) at the center of the south end of the bridge. The system was aligned with north using the bridge azimuth listed on the asbuilt plans (S36°26'52''E). The elevation was referenced to a brass cap listed on the plans as 998.94 ft (location E=9,986.6, N=9,991.4).

Eighteen river cross sections were surveyed. Four of these cross sections were located downstream of the bridge, one each at the upstream and downstream sides of the bridge, five upstream of the bridge, and four in the slough near its mouth. The remaining two cross sections were about 8,000 ft upstream—one across the mouth at the head of the slough and the other across the main channel just upstream of the head of the slough (fig. 2).

The two sections surveyed about 8,000 ft upstream were made only to evaluate channel capacity at the head of the slough and the main channel, as well as to document existing conditions. These sections were not referenced to the same coordinate system as the other surveyed points and channel soundings. Two discharge measurements were made on August 26, 1996—one measuring the full flow of the Tanana River just upstream of the bridge (21,500 ft³/s), and the second measuring the flow in the slough (2,570 ft³/s). Depth soundings were made around the piers (fig. 3). Debris obstructed some areas around the piers, making some soundings unfeasible. Sounding elevations indicated the downstream left end of the pier 5 footing was exposed.

Water velocity was measured at several locations using a current meter (fig. 4A-F). The current was extremely slow along the right bank upstream of the bridge abutment and downstream of the mouth of the slough—the section of bank that was eroding at the time of this study. At the time of the survey, a silt bar was forming 50–100 ft off the bank in this reach. The velocity profile measured near the right bank several hundred feet downstream of the bridge had the largest average velocity (6.5 ft/s) (fig. 4A-F). Water velocity along the right bank of cross section Slough 4 was too slow to be measured

Bed material was sampled under the bridge and in the channel about 700 ft upstream of the bridge (table 1). A sieve analysis was not performed because the samples were too small to give a statistically valid distribution. Norman (1975) also sampled the bed material under the bridge in the scour hole on the left side of pier 5 and found a median diameter (D_{50}) of 30 mm (coarse gravel) and a 90th percentile diameter (D_{90}) of 50 mm (very coarse gravel). He suggested that the streambed material probably is generally coarser at the other scour holes under the bridge that had swifter, deeper flow. He also sampled the bed upstream of the bridge and found a D_{50} of 14 mm (medium gravel) and D_{90} of 58 mm (very coarse gravel).

| Ta | ble | e 1 | I. I | Bed | material | sample | es, 1 | anana | Ri | ver at | Bi | g E | Delta, | AI | asl | ka |
|----|-----|-----|------|-----|----------|--------|-------|-------|----|--------|----|-----|--------|----|-----|----|
|----|-----|-----|------|-----|----------|--------|-------|-------|----|--------|----|-----|--------|----|-----|----|

[Sieve analysis not performed; this data to be used only as an estimate of material size. Sizes were measured along the B-axis using calipers. (B-axis is the mid-length axis—the one that limits the passage through a sieve.)]

| Location | Material | | | | | |
|---|---|--|--|--|--|--|
| Bridge cross section | | | | | | |
| Right one-half of Span 1 (abutment 1 to pier 2) |) Gravel and cobble (largest clast: 65 millimeters) | | | | | |
| Left one-half of Span 1 (abutment 1 to pier 2) | Sand | | | | | |
| Span 2 (pier 2 to pier 3) | Sand and gravel (largest clast: 35 millimeters) | | | | | |
| Span 3 (pier 3 to pier 4) | Small amount of sand and one 40-millimeter piece of gravel | | | | | |
| Span 4 (pier 4 to pier 5) | Obtained no sample - bed is armored | | | | | |
| Span 5 (pier 5 to abutment 6) | Obtained no sample - bed is armored | | | | | |
| Арр | roach cross section | | | | | |
| Right one-third of channel | Sand and gravel (largest clast: 40 millimeters) | | | | | |
| Middle one-third of channel | Gravel and cobble (largest clast: 70 millimeters) | | | | | |
| Left one-third of channel | Small amount of fine gravel (~3 millimeters) and one piece of coarse gravel (55 millimeters) | | | | | |



Figure 4. Depth-velocity profiles (*A*) near bluff downstream of bridge, (*B*) at cross section Slough 1, 10 feet from right edge of water, (*C*) at cross section Slough 1, 20 feet from right edge of water, (*D*) at cross section Slough 2, 10 feet from right edge of water, (*E*) at cross section Slough 3, 10 feet from right edge of water, and (*F*) at cross section Slough 4, 10 feet from right edge of water, Tanana River at Big Delta.

Computation of Water-Surface Profiles

The magnitudes of the 100- and 500-year recurrenceinterval discharges were computed for both the Tanana River at the bridge and for the Delta River. The discharges for the Tanana River were computed as a weighted average of: (1) flood-frequency analysis of discharge data from 1948 to 1957 by use of techniques described in the Interagency Advisory Committee on Water Data Bulletin 17B (1982), and (2) from regression equations based on basin characteristics developed by Jones and Fahl (1994). The recurrence-interval discharges for the Delta River were computed entirely from a regression of basin characteristics because limited discharge information was available. The computed 100- and 500-year recurrence-interval discharges for the Tanana River at the bridge are 86,700 and 95,600 ft³/s, respectively, and 36,300 and 41,300 ft³/s, respectively, for the mouth of the Delta River.

Two WSPRO models were created using some of the surveyed cross sections—the first was for the main channel through the bridge and the second was for the slough. Surveyed cross sections used to generate the model of the main channel were: Exits 2, 3, and 4, the upstream bridge section, the discharge measurement section, and the approach section upstream of the mouth of the slough (cross section Approach 8000) (fig. 2).

Measured discharge in the slough during the field survey was 12 percent of the total discharge in the Tanana. This percentage likely varies with discharge, but was used in the models of the high discharges because it was the only available observation. The volume and distribution of the flow entering from the Delta River affected the WSPRO computations upstream on the Tanana River. These results in turn affected the scour computations at the bridge. Four scenarios were modeled to account for a range of backwater effects on the Tanana River:

- Scenario 1: 18 percent of the Delta River flow enters upstream of Exit 2, 47 percent upstream of Exit 3, 65 percent upstream of Exit 4, and the remainder enters downstream of Exit 4. This scenario represents hydraulic conditions at the time of the field survey.
- Scenario 2: 100 percent of the Delta River flow enters upstream of Exit 2. This scenario would create the most backwater in the Tanana River through the bridge, and hence the highest water surface and lowest velocities upstream.

- Scenario 3: 100 percent of the Delta River flow enters between Exit 3 and Exit 4. This scenario would create moderately high backwater.
- Scenario 4: no flow entering, and therefore, no backwater caused by the Delta River, resulting in the lowest water surface and highest velocities. This is a worst-case scenario, because the Delta River will contribute some flow for all likely scenarios.

For each scenario, a corresponding model was run in the slough, using the water surface in the main channel at the mouth of the slough to start the profile computations. The model was calibrated using the discharge measurement of 21,500 ft³/s and influence from the Delta River described by Scenario 1. Discharge of the Delta River was not measured. A discharge of 9,150 ft³/s was estimated for the Delta River at the time of the discharge measurement of the Tanana by applying the ratio (43 percent) of the calculated 500-year recurrence interval flows for the Delta and Tanana Rivers. The surveyed water surface at the cross section Exit 4 was used as the initial water surface for profile computations and resulted in good agreement between modeled and observed watersurface elevations (table 2).

An important input parameter to WSPRO is the initial water surface at the farthest downstream cross section (Exit 4). The WSPRO model determined the initial water surface at the downstream-most section by solving the Manning's equation for depth, given user-defined energy slope, discharge, and geometry at cross section Exit 4. Roughness values were calibrated from measured discharge (21,500 ft³/s) by matching the modeled water surface to the observed water surface. The energy slope (0.0005) was computed from the calibrated model, when water surfaces were within 0.6 ft (table 2 and appendix A).

Model results for all four scenarios for both the 100- and 500-year flood flows indicate there would be a significant ponding upstream of bridge 524. Downstream, the braided channel of the Delta River would be submerged for nearly 0.5 mile up the delta. Upstream, the banks would be under several feet of water and the downstream end of the island formed by the slough would be submerged. The Richardson Highway would be submerged about 1,000 ft south of the end of the bridge, but the model indicates a very low water-surface slope, so the flow over the road would be minor. The water-surface elevations are summarized in table 2, and the output from the WSPRO model runs is attached in <u>appendix A</u>.

Table 2. Water-surface profiles computed with WSPRO, Tanana River at Big Delta, Alaska.

[Abbreviations: ft³/s, cubic foot per second; DS, downstream; Q mmt, discharge measurement]

| Surveyed v for me | Test Case A water surface at Ex easured discharge | kit 4; | Test Case B Water surface computed using friction slope at Exit 4; for measured discharge | | | | |
|--------------------------------------|---|---------------------------------|---|----------------------|---------------------------------|--|--|
| Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | | |
| Exit 4 | 27,400 | 979.7 | Exit 4 | 27,400 | 980.3 | | |
| Exit 3 | 25,800 | 979.9 | Exit 3 | 25,800 | 980.5 | | |
| Exit 2 | 23,100 | 980.6 | Exit 2 | 23,100 | 981.1 | | |
| Bridge (DS) | 21,500 | 980.9 | Bridge (DS) | 21,500 | 981.2 | | |
| Q mmt | 21,500 | 981.1 | Q mmt | 21,500 | 981.5 | | |
| Approach 1 Case 1: 100-year flood | 18,900 | 981.5 | Approach 1 Case 1: 500-year flood | 18,900 | 981.5 | | |
| Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | | |
| Exit 4 | 110,000 | 991.3 | Exit 4 | 122,000 | 992.1 | | |
| Exit 3 | 104,000 | 991.6 | Exit 3 | 115,000 | 992.3 | | |
| Exit 2 | 93,200 | 992.3 | Exit 2 | 103,000 | 993.0 | | |
| Bridge (DS) | 86,700 | 992.1 | Bridge (DS) | 95,600 | 992.8 | | |
| O mmt | 86,700 | 992.6 | Q mmt | 95,600 | 993.3 | | |
| Approach 1 | 76.300 | 992.9 | Approach 1 | 84.200 | 993.7 | | |
| Case 2: 100-year flood | | | Case 2: 500-year flood | - , | | | |
| Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | Cross section Discharg (ft³/s) | | Water-surface elevation (ft) | | |
| Exit 4 | 123,000 | 992.1 | Exit 4 | 136,900 | 992.1 | | |
| Exit 3 | 123,000 | 992.3 | Exit 3 | 136,900 | 993.1 | | |
| Exit 2 | 123,000 | 993.0 | Exit 2 | 136,900 | 993.7 | | |
| Bridge (DS) | 86,700 | 993.0 | Bridge (DS) | 95,600 | 993.7 | | |
| Q mmt | 86,700 | 993.4 | Q mmt | 95,600 | 994.1 | | |
| Approach 1 | 76,300 | 993.7 | Approach 1 | 84,200 | 994.5 | | |
| Case 3: 100-year flood | | | Case 3: 500-year flood | | | | |
| Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | | |
| Exit 4 | 123,000 | 992.1 | Exit 4 | 136,900 | 992.9 | | |
| Exit 3 | 86,700 | 992.7 | Exit 3 | 95,600 | 993.5 | | |
| Exit 2 | 86,700 | 993.0 | Exit 2 | 95,600 | 993.8 | | |
| Bridge (DS) | 86,700 | 992.8 | Bridge (DS) | 95,600 | 993.5 | | |
| Q mmt | 86,700 | 993.2 | Q mmt | 95,600 | 994.0 | | |
| Approach 1 | 76,300 | 993.5 | Approach 1 | 84,200 | 994.3 | | |
| Case 4: 100-year flood | | | Case 4: 500-year flood | | | | |
| Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | Cross section | Discharge (ft³/s) | Water-surface elevation (ft) | | |
| Exit 4 | 86,700 | 989.6 | Exit 4 | 95,600 | 990.3 | | |
| Exit 3 | 86,700 | 989.8 | Exit 3 | 95,600 | 990.5 | | |
| Exit 2 | 86,700 | 990.6 | Exit 2 | 95,600 | 991.3 | | |
| Dridge (DC) | 86 700 | 990 5 | Bridge (DS) | 95.600 | 991.1 | | |
| bridge (DS) | 80,700 | JJ0.5 | 8 () |) | | | |
| Q mmt | 86,700 | 991.0 | Q mmt | 95,600 | 991.7 | | |

Scour Computations

Pier scour was calculated according to procedures outlined in HEC–18 (Richardson and Davis, 1995) for the 100- and 500-year floods for all four scenarios described in tables 3–6. The USGS scour-evaluation procedure is outlined in detail by Heinrichs and others (2001) and summarized here. Flow at the bridge was divided into 20 stream tubes of equal conveyance by using an option in the WSPRO model program. The highest-velocity stream tube was selected and assumed to be directed at the widest pier. This assumption provides the maximum estimate of pier scour. This worst-case analysis is useful for screening purposes, whereas actual scour events may have mitigating factors that would reduce the actual scour.

The HEC-18 pier-scour equation (Richardson and Davis, 1995) is recommended for both live-bed and clearwater sediment-transport conditions and is relatively sensitive to changes in pier geometry and angle of attack. Scour was computed using model results from the 100-year recurrenceinterval discharge and a 35° angle of attack over a range of water-surface elevations from 985.0 to 993.5 ft. A range of starting water-surface elevations was used in the model to evaluate this variable's effect on pier-scour computations. Computed pier scour varied in magnitude from 43.3 to 35.9 ft (fig. 5, table 7) or about 20 percent for the range of starting water-surface elevations. The reference surface for these computations was the streambed elevation determined from the as-built survey plans. Of the four scenarios considered to represent the input from the Delta River, Scenario 4, with no modeled backwater and consequently higher flow velocities at the bridge, resulted in the greatest computed pier scour (tables 3-6). Because the pier-scour values computed at the Tanana River at Big Delta are large, the bridge may be in need of scour countermeasures. Therefore, the factors that may mitigate the actual scour at piers must be considered.

Mitigating factors that affect scour depths include reduced effective pier length, reduced angle of attack, and bed armor. If the entire length of the pier is not subject to the flow attacking from an angle, the length used for the scour computations must be reduced to an "effective length" or the scour may be over-predicted significantly (Richardson and Davis, 1995). The angle of attack may differ across the width of the bridge and be lower at some piers. The bed may be armored, resulting in a possible reduction of pier scour by as much as 30 percent (Richardson and Davis, 1995). At bridge 524, all three factors may apply, but caution is needed applying field observations made at relatively low flow (21,500 ft³/s) to 100- and 500-year recurrence-interval floods. An important factor for pier-scour computations is pier alignment relative to the flow direction. The piers at bridge 524 are as much as 35° misaligned with the flow. Applying the pier-scour computation equations using this angle, without considering possible mitigating factors, increases computed scour by a factor of 3.2 more than the scour computed for a 0° angle of attack. This 35° angle of attack was observed at higher flows by Norman (1975) and confirmed by the August 1996 survey. Considering effective flow length, at the time of this survey, only the front 50 percent of the pier was subject to this angle of attack. The vortex near the nose deflected the flow that otherwise would have struck at an angle farther back on the pier, and the flow was aligned with the pier from the midpoint back.

During the field survey, the angle of attack was the full 35° at the left piers, but it decreased to the right with an angle of about 20° at pier 2, the largest pier. At higher flows, this situation is different. A discharge measurement of 51,600 ft³/s made on August 13, 1971, indicates the angle of attack of the flow near all the piers was approximately 32°. Norman (1975) found that at high stages, the angle of attack varies between 35° and 40°.

Bed armoring also occurs to some extent at the bridge site. Bed material sampled during the field survey showed the left half of the channel through the bridge was substantially armored, and the right portion of the channel consisted of sand and gravel. A pipe dredge consisting of a 20-pound cylinder with an 8-inch-diameter opening surrounded by teeth to rip material from the bed was not able to drag up a sample from the armored sections of the bed. The quantitative formulas presented by Richardson and Davis (1995) apply a bed armor correction factor (K_4) for median particle diameters coarser than 2 mm. Norman (1975) found a D_{50} of 30 mm on the left side of pier 5, but could not sample at other piers.

The depths observed at the time of the survey at a flow of 21,500 ft³/s also can be used to check the validity of the scour computations. The average bed elevation for the cross section on the upstream side of the bridge was 973 ft. The channel was deepest on the left side of pier 5. Soundings at the upstream end of the pier found an average bed elevation of 967 ft, indicating about 6 ft of pier scour. The effects of various combinations of mitigating factors are shown in table 8. A 35° angle of attack with a 50-percent effective pier length and maximum armoring (30-percent scour reduction) gives a computed pier scour of 11.4 ft—an over-estimate of 5.4 ft compared to the observation.

Additional observations at higher flows would give more information about present conclusions. Although it is unlikely the information about the angle of attack would change substantially from Norman's (1975) result, it would be possible to get a better estimate of the effective pier length and better description of the flow pattern through the bridge.

Table 3. Bridge-scour computations, Scenario 1, Tanana River at Big Delta, Alaska, Bridge 524.

[Flow from the Delta River is added in proportion to channel width above the exit section. Exit 2: 18 percent; Exit 3: 45 percent; Exit 4: 65 percent. The remaining 35 percent of the flow enters downstream of Exit 4. **Abbreviations:** ft, foot; ft/ft, foot per foot; lbs/ft², pounds per square foot; ft/s, foot per second; ft/s^2 , cobic foot per second; guared; s, second; deg, degree; g, gravity (32.2 ft/s²)]

LIVE-BED CONTRACTION SCOUR

| $\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{K_1}$ y_1 = y_2 - y_1 = (average scour depth) | 100 Year | 500 Year | |
|--|-------------------------------------|----------|--------|
| Computed floods: total discharge (ft³/s) | 0 | 86,700 | 95,600 |
| Hydraulic radius of approach section (ft) | R | 16.66 | 17.29 |
| Friction slope (ft/ft) | S | .001 | .001 |
| Average shear stress at bed (lbs/ft^2) | $\tau = \rho g R S$ | .52 | .54 |
| Shear velocity (ft/s) | $V^* = (\tau / \rho)^{\frac{1}{2}}$ | .52 | .53 |
| Fall velocity of bed material (ft/s) | w | 2.60 | 2.60 |
| Ratio | $V^{*/W}$ | .20 | .20 |
| Exponent determined from mode of bed material transport | $k_1 = f(V^*/w)$ | .59 | .59 |
| Discharge in main channel of approach section (ft ³ /s) | Q_1 | 86,700 | 95,600 |
| Percentage of total discharge | -1 | 100 | 100 |
| Discharge in main channel of contracted (bridge) section (ft ³ /s) | Q_{2} | 86,700 | 95,600 |
| Percentage of total discharge | - 2 | 100 | 100 |
| Width of main channel of approach section (ft) | W_1 | 666 | 666 |
| Width of main channel of contracted (bridge) section (ft) | $W_2^{'}$ | 603 | 608 |
| Average depth of main channel of approach section (ft) | y ₁ ² | 20.2 | 21.1 |
| Average depth in contracted (bridge) section (ft) | y ₂ | 21.4 | 22.2 |
| CONTRACTION SCOUR (ft) | Ycs | 1.2 | 1.1 |

PIER SCOUR

| $\frac{y_{ps}}{y_1} = 2.0K_1K_2K_3\left(\frac{a}{y_1}\right)^{0.65} Fr^{0.43}$ | | 100 Year | 500 Year |
|--|-----------------------------------|------------|----------|
| Speed of maximum velocity stream tube (ft/s) | V ₁ | 8.77 | 9.39 |
| Depth of maximum velocity stream tube (ft/s) | y_1 | 18.4 | 18.4 |
| Froude number of maximum velocity stream tube | $Fr = v_1 / (gy_1)^{\frac{1}{2}}$ | .37 | .39 |
| Pier shape | 1 1 | round nose | |
| Pier shape correction factor | K_1 | 1.0 | 1.0 |
| Angle of attack (deg) | AÅ | 35 | 35 |
| Pier width (ft) | а | 5.0 | 5.0 |
| Pier length (ft) | L | 47 | 47 |
| Ratio | L/a | 9 | 9 |
| Angle of attack correction factor | $K_{2}=f(AA,L/a)$ | 3.3 | 3.3 |
| Bed condition (dunes) correction factor | <i>K</i> ₃ | 1.1 | 1.1 |
| PIER SCOUR (ft) | Yps | 36.4 | 37.9 |
| TOTAL SCOUR | | | |
| $T_s = y_{cs} + y_{ps}$ | | 100 Year | 500 Year |
| | | 1.0 | |

| Contraction scour (ft) | Ycs | 1.2 | 1.1 |
|------------------------|---------|------|------|
| Pier scour (ft) | Yps | 36.4 | 37.9 |
| TOTAL SCOUR (ft) | T_{s} | 37.6 | 39.0 |

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Table 4. Bridge-scour computations, Scenario 2, Tanana River at Big Delta, Alaska, Bridge 524.

[Entire flow from the Delta River is added above the farthest upstream exit section. This creates the most backwater. Exit 2: 100 percent, Exit 3: 0 percent, Exit 4: 0 percent. Abbreviations: ft, foot; ft/ft, foot per foot; lbs/ft², pounds per square foot; ft/s, foot per second; ft³/s, cubic foot per second; ft/s², ft/s²,

LIVE-BED CONTRACTION SCOUR

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{5}{p}} \left(\frac{W_1}{W_2}\right)^{K_1}$$

$$y_{cs} = y_2 - y_1 = (average scour depth)$$

$$\frac{y_{cs} = y_2 - y_1 = (average scour depth)}{\frac{W_1}{W_2}}$$

$$\frac{100 \text{ Year}}{W_2}$$

$$\frac{500 \text{ Year}}{W_2}$$

$$\frac{100 \text{ Ye$$

$$\frac{y_{ps}}{y_1} = 2.0K_1K_2K_3\left(\frac{a}{y_1}\right)^{0.65} Fr^{0.43}$$

| Speed of maximum velocity stream tube (ft/s) | v_1 | 8.41 | 8.92 |
|---|---------------------------|------------|------|
| Depth of maximum velocity stream tube (ft/s) | y ₁ | 18.6 | 18.8 |
| Froude number of maximum velocity stream tube | $Fr = v_1 / (gy_1)^{1/2}$ | .34 | .36 |
| Pier shape | 1 1 | round nose | |
| Pier shape correction factor | K_1 | 1.0 | 1.0 |
| Angle of attack (deg) | AÀ | 35 | 35 |
| Pier width (ft) | а | 5.0 | 5.0 |
| Pier length (ft) | L | 47 | 47 |
| Ratio | L/a | 9 | 9 |
| Angle of attack correction factor | $K_2 = f(AA, L/a)$ | 3.3 | 3.3 |
| Bed condition (dunes) correction factor | K_3 | 1.1 | 1.1 |
| PIER SCOUR (ft) | Yps | 35.9 | 36.9 |
| | | | |

100 Year

500 Year

TOTAL SCOUR

| $T_s = y_{cs} + y_{ps}$ | | 100 Year | 500 Year |
|-------------------------|-----|----------|----------|
| Contraction scour (ft) | Ycs | 1.1 | 1.1 |
| Pier scour (ft) | Yps | 35.9 | 36.9 |
| TOTAL SCOUR (ft) | Ts | 37.0 | 38.0 |

500 Year

100 Year

Table 5. Bridge scour computations, Scenario 3, Tanana River at Big Delta, Alaska, Bridge 524.

[Entire flow from the Delta River is added in above the farthest downstream exit section. Exit 2: 0 percent; Exit 3: 0 percent; Exit 4: 100 percent. **Abbreviations:** ft, foot; ft/ft, foot per foot; lbs/ft², pounds per square foot; ft/s, foot per second; ft³/s, cubic foot per second; ft/s², foot per second; deg, degree; g, gravity (32.2 ft/s²)]

LIVE-BED CONTRACTION SCOUR

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{K_1}$$

 $y_{cs} = \dot{y}_2 - \dot{y}_1 =$ (average scour depth)

| Computed floods: total discharge (ft³/s) | 0 | 86,700 | 95,600 |
|---|-------------------------------------|--------|--------|
| Hydraulic radius of approach section (ft) | R | 17.21 | 17.86 |
| Friction slope (ft/ft) | S | .001 | .001 |
| Average shear stress at bed (lbs/ft ²) | $\tau = \rho g R S$ | .54 | .56 |
| Shear velocity (ft/s) | $V^{*} = (\tau/\rho)^{\frac{1}{2}}$ | .53 | .54 |
| Fall velocity of bed material (ft/s) | W | 2.60 | 2.60 |
| Ratio | $V^*/_W$ | .20 | .21 |
| Exponent determined from mode of bed material transport | $k_1 = f(V^*/w)$ | .59 | .59 |
| Discharge in main channel of approach section (ft ³ /s) | Q_1 | 86,700 | 95,600 |
| Percentage of total discharge | 1 | 100 | 100 |
| Discharge in main channel of contracted (bridge) section (ft ³ /s) | Q_{2} | 86,700 | 95,600 |
| Percentage of total discharge | 2 | 100 | 100 |
| Width of main channel of approach section (ft) | W_1 | 666 | 666 |
| Width of main channel of contracted (bridge) section (ft) | W_2 | 608 | 612 |
| Average depth of main channel of approach section (ft) | y, | 21.0 | 21.9 |
| Average depth in contracted (bridge) section (ft) | y_2 | 22.1 | 23.0 |
| CONTRACTION SCOUR (ft) | Ycs | 1.1 | 1.1 |

PIER SCOUR

| $\frac{y_{ps}}{y_1} = 2.0K_1K_2K_3 \left(\frac{a}{y_1}\right)^{0.65} Fr^{0.43}$ | | 100 Year | 500 Year |
|---|---------------------------|------------|----------|
| Speed of maximum velocity stream tube (ft/s) | V ₁ | 8.52 | 9.01 |
| Depth of maximum velocity stream tube (ft/s) | y ₁ | 18.4 | 18.6 |
| Froude number of maximum velocity stream tube | $Fr = v_1 / (gy_1)^{1/2}$ | .35 | .37 |
| Pier shape | 1 1 | round nose | |
| Pier shape correction factor | K_1 | 1.0 | 1.0 |
| Angle of attack (deg) | AÀ | 35 | 35 |
| Pier width (ft) | а | 5.0 | 5.0 |
| Pier length (ft) | L | 47 | 47 |
| Ratio | L/a | 9 | 9 |
| Angle of attack correction factor | $K_2 = f(AA, L/a)$ | 3.3 | 3.3 |
| Bed condition (dunes) correction factor | - K ₂ | 1.1 | 1.1 |
| PIER SCOUR (ft) | Yps | 36.2 | 37.2 |

TOTAL SCOUR

| $T_s = y_{cs} + y_{ps}$ | | 100 Year | 500 Year |
|-------------------------|------------|----------|----------|
| Contraction scour (ft) | Ycs | 1.1 | 1.1 |
| Pier scour (ft) | Yps | 36.2 | 37.2 |
| TOTAL SCOUR (ft) | $\hat{T}s$ | 37.3 | 38.3 |

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Table 6. Bridge-scour computations, Scenario 4, Tanana River at Big Delta, Alaska, Bridge 524.

[No flow from the Delta River is added to the exit sections. No backwater—worst case assumption for pier scour. Exit 2: 0 percent; Exit 3: 0 percent; Exit 4: 0 percent. **Abbreviations:** ft, foot; ft/ft, foot per foot; lbs/ft², pounds per square foot; ft/s, foot per second; ft³/s, cubic foot per second; ft/s², foot per second squared; s, second; deg, degree; g, gravity (32.2 ft/s²)]

500 Year

95,600

15.88

.001

.50

.51

2.60

.19

.59

95,600 100 95,600 100

666

595

100 Year

19.2

20.5

500 Year

1.3

LIVE-BED CONTRACTION SCOUR

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{K_1}$$
100 Year $y_{cs} = y_2 - y_1 = (average scour depth)$ Q 86,700Hydraulic radius of approach section (ft) R 15.29Friction slope (ft/ft) S .001Average shear stress at bed (lbs/ft²) $\tau = \rho g R S$.48Shear velocity (ft/s) $V^* = (\tau/\rho)^{V_2}$.50Fall velocity of bed material (ft/s) W .260Ratio V^*/W .19Exponent determined from mode of bed material transport $k_1 = f(V^*/W)$.59Discharge in main channel of approach section (ft³/s) Q_2 86,700Percentage of total discharge.100With of main channel of approach section (ft) W_1 Width of main channel of approach section (ft) W_1 .666

Width of main channel of contracted (bridge) section (ft) W_2 591Average depth of main channel of approach section (ft) y_1 18.3Average depth in contracted (bridge) section (ft) y_2 19.7CONTRACTION SCOUR (ft) Y_{CS} 1.3PIER SCOUR

| | $\langle \rangle$ | 0.65 |
|-----------------------------------|--------------------|-------------|
| $\frac{y_{ps}}{2} = 2.0K_1K_2K_2$ | <u>a</u> | $Fr^{0.43}$ |
| y_1 | (y ₁) | 17 |

| Speed of maximum velocity stream tube (ft/s) | V ₁ | 9.64 | 10.26 |
|---|--------------------------------|------------|-------|
| Depth of maximum velocity stream tube (ft/s) | <i>y</i> ₁ | 16.1 | 16.6 |
| Froude number of maximum velocity stream tube | $Fr = v_1 / (gy_1)^{v_2}$ | .42 | .44 |
| Pier shape | 1 1 | round nose | |
| Pier shape correction factor | K_1 | 1.0 | 1.0 |
| Angle of attack (deg) | AÀ | 35 | 35 |
| Pier width (ft) | а | 5.0 | 5.0 |
| Pier length (ft) | L | 47 | 47 |
| Ratio | L/a | 9 | 9 |
| Angle of attack correction factor | $K_2 = f(AA, L/a)$ | 3.3 | 3.3 |
| Bed condition (dunes) correction factor | - K ₂ | 1.1 | 1.1 |
| Submerged low steel multiplier | <i>f</i> (<i>Fr</i> approach) | | |
| PIER SCOUR (ft) | $oldsymbol{Y}_{ps}$ | 37.5 | 38.7 |

TOTAL SCOUR

| $T_s = y_{cs} + y_{ps}$ | | 100 Year | 500 Year |
|---|---------------------|-------------|-------------|
| Contraction scour (ft) Pier scour (ft) | Y_{cs} | 1.3 37 5 | 1.3 38 7 |
| TOTAL SCOUR (ft) | T_{ps} T_{s} | 38.8 | 40.0 |

Table 7.Estimated pier-scour depths for the 100-year-flooddischarge computed from model output with starting water-
surface elevations from 985.0 to 993.5 feet at the Tanana River at
Big Delta, Alaska.

[Abbreviations: ft, foot; ft/s, foot per second]

| Water- surface elevation (ft) | Average velocity of entire section (ft/s) | Stream tube depth (ft) | Stream tube velocity (ft/s) | Froude number | Pier scour for 35° angle of attack (ft) |
|--|---|---------------------------------|--------------------------------------|------------------|--|
| 985.0 | 12.6 | 12.1 | 14.8 | 0.8 | 43.3 |
| 985.5 | 12.1 | 12.5 | 13.9 | .7 | 42.4 |
| 986.0 | 11.6 | 12.9 | 13.5 | .7 | 42.0 |
| 986.5 | 11.2 | 13.2 | 12.9 | .6 | 41.4 |
| 987.0 | 10.8 | 13.6 | 12.4 | .6 | 40.8 |
| 987.5 | 10.4 | 14.1 | 11.9 | .6 | 40.4 |
| 988.0 | 10.0 | 14.4 | 11.4 | .5 | 39.7 |
| 988.5 | 9.7 | 14.8 | 11.0 | .5 | 39.3 |
| 989.0 | 9.4 | 15.2 | 10.6 | .5 | 38.8 |
| 989.5 | 9.1 | 15.7 | 10.3 | .5 | 38.5 |
| 990.0 | 8.8 | 16.1 | 10.0 | .4 | 38.1 |
| 990.5 | 8.5 | 16.1 | 9.6 | .4 | 37.5 |
| 991.0 | 8.3 | 16.5 | 9.4 | .4 | 37.2 |
| 991.5 | 8.0 | 16.9 | 9.1 | .4 | 36.8 |
| 992.0 | 7.8 | 17.8 | 8.9 | .4 | 36.7 |
| 992.5 | 7.6 | 18.4 | 8.8 | .4 | 36.4 |
| 993.0 | 7.4 | 18.4 | 8.5 | .4 | 36.2 |
| 993.5 | 7.2 | 18.6 | 8.4 | .3 | 35.9 |



Figure 5. Estimated pier-scour magnitudes for the 100year-flood discharge computed from model output with starting water-surface elevations from 985.0 to 993.5 feet at the Tanana River at Big Delta, Alaska.

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Table 8. Pier-scour computations for discharge measurements, Tanana River at Big Delta, Alaska, August 26, 1996.

[Assessment of effective pier length, angle of attack, and bed armor factors; Bridge 524: Tanana River at Big Delta. **Abbreviations:** ft^{3/}s, cubic foot per second; ft, foot; ft/s, foot per second. (pier-scour equation is presented in <u>tables 3–6</u>)]

| Stream tube depth, y^{1} (ft)8.7Pier shape factor, K_{1} Stream tube velocity (ft/s)5.79Bed condition factor, K_{3} Pier No.Pier length, L (ft)Effective pier length, (percent)Effective (ft)Angle of (ft)Angle of attack (degrees)Angle of attack factor, K_{2} Bed condition factor, K_{3} 24710047.05.09.4353.32475023.55.04.7352.32473315.55.03.1351.924710047.05.09.4353.32473315.55.03.1351.924710047.05.09.4252.32473315.55.03.1351.92473315.55.03.1251.72473315.55.03.1251.72473315.55.03.1251.72473315.55.03.1251.72473315.55.03.1251.72473315.55.03.1251.72473315.55.03.1251.72473315.55.03.1251.72475023.5 <t< th=""><th>1 1.1</th><th>1</th><th>v</th><th></th><th></th><th></th><th></th><th></th><th colspan="2">Discharge (ft³/s)</th></t<> | 1 1.1 | 1 | v | | | | | | Discharge (ft³/s) | |
|--|---|---|--|---------------------------------|------------------------------------|--------------------------|--------------------------------------|--|---------------------------|-------------|
| Stream tube velocity (ft/s) 5.79 Bed condition factor, K ₃ Pier No. Pier length, L(ft) Effective pier length, (percent) Effective pier length, (ft) Pier width, a (ft) Effective length/width ratio Angle of attack (degrees) Angle of attack factor, K ₂ Be con attack 2 47 100 47.0 5.0 9.4 35 3.3 2 47 50 23.5 5.0 4.7 35 2.3 2 47 33 15.5 5.0 3.1 35 1.9 2 47 100 47.0 5.0 9.4 35 3.3 2 47 33 15.5 5.0 3.1 35 1.9 2 47 100 47.0 5.0 9.4 35 3.3 2 47 100 47.0 5.0 9.4 35 2.3 2 47 33 15.5 5.0 3.1 25 2.8 2 47 33 | 1.1 | | n ₁ | r shape factor, i | Pier | | 8.7 | Stream tube depth, y¹ (ft) | | Stre |
| Pier No.Pier length, L (ft)Effective pier length, (percent)Effective pier length, (ft)Pier width, a (ft)Effective length/width ratioAngle of attack (degrees)Angle of attack factor, K2Be col attack (degrees)Be col attack (degrees)Be attack factor, K2Be col attack factor, K2Be col attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack (degrees)Be attack attack | d armor | 1.1 | ; K 3 | ondition facto | Bed c | | ity (ft/s) | am tube veloc | Stre | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | rection ctor, K ₄ Pier scou | Bed armor correction factor, <i>K</i> 4 | Angle of attack factor, K ₂ | Angle of attack (degrees) | Effective length/width ratio | Pier width, a (ft) | Effective pier length, (ft) | Effective pier length (percent) | Pier length, L (ft) | Pier No. |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 1.0 27.9 | 1.0 | 3.3 | 35 | 9.4 | 5.0 | 47.0 | 100 | 47 | 2 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 1.0 19.2 | 1.0 | 2.3 | 35 | 4.7 | 5.0 | 23.5 | 50 | 47 | 2 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 1.0 15.8 | 1.0 | 1.9 | 35 | 3.1 | 5.0 | 15.5 | 33 | 47 | 2 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | .7 19.5 | .7 | 3.3 | 35 | 9.4 | 5.0 | 47.0 | 100 | 47 | 2 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | .7 13.5 | .7 | 2.3 | 35 | 4.7 | 5.0 | 23.5 | 50 | 47 | 2 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | .7 11.1 | .7 | 1.9 | 35 | 3.1 | 5.0 | 15.5 | 33 | 47 | 2 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 1.0 23.8 | 1.0 | 2.8 | 25 | 9.4 | 5.0 | 47.0 | 100 | 47 | 2 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 1.0 17.0 | 1.0 | 2.0 | 25 | 4.7 | 5.0 | 23.5 | 50 | 47 | 2 |
| 24710047.05.09.4252.82475023.55.04.7252.02473315.55.03.1251.724710047.05.09.4152.22475023.55.04.7151.7 | 1.0 14.3 | 1.0 | 1.7 | 25 | 3.1 | 5.0 | 15.5 | 33 | 47 | 2 |
| 2475023.55.04.7252.02473315.55.03.1251.724710047.05.09.4152.22475023.55.04.7151.7 | .7 16.7 | .7 | 2.8 | 25 | 9.4 | 5.0 | 47.0 | 100 | 47 | 2 |
| 2 47 33 15.5 5.0 3.1 25 1.7 2 47 100 47.0 5.0 9.4 15 2.2 2 47 50 23.5 5.0 4.7 15 1.7 | .7 11.9 | .7 | 2.0 | 25 | 4.7 | 5.0 | 23.5 | 50 | 47 | 2 |
| 2 47 100 47.0 5.0 9.4 15 2.2 2 47 50 23.5 5.0 4.7 15 1.7 | .7 10.0 | .7 | 1.7 | 25 | 3.1 | 5.0 | 15.5 | 33 | 47 | 2 |
| 2 47 50 23.5 5.0 4.7 15 1.7 | 1.0 18.8 | 1.0 | 2.2 | 15 | 9.4 | 5.0 | 47.0 | 100 | 47 | 2 |
| | 1.0 14.1 | 1.0 | 1.7 | 15 | 4.7 | 5.0 | 23.5 | 50 | 47 | 2 |
| 2 47 33 15.5 5.0 3.1 15 1.4 | 1.0 12.3 | 1.0 | 1.4 | 15 | 3.1 | 5.0 | 15.5 | 33 | 47 | 2 |
| 2 47 100 47.0 5.0 9.4 15 2.2 | .7 13.2 | .7 | 2.2 | 15 | 9.4 | 5.0 | 47.0 | 100 | 47 | 2 |
| 2 47 50 23.5 5.0 4.7 15 1.7 | .7 9.9 | .7 | 1.7 | 15 | 4.7 | 5.0 | 23.5 | 50 | 47 | 2 |
| 2 47 33 15.5 5.0 3.1 15 1.4 | .7 8.6 | .7 | 1.4 | 15 | 3.1 | 5.0 | 15.5 | 33 | 47 | 2 |
| 3-5 36 100 36.0 4.0 9.0 35 3.2 | 1.0 23.5 | 1.0 | 3.2 | 35 | 9.0 | 4.0 | 36.0 | 100 | 36 | 3-5 |
| 3-5 36 50 18.0 4.0 4.5 35 2.2 | 1.0 16.3 | 1.0 | 2.2 | 35 | 4.5 | 4.0 | 18.0 | 50 | 36 | 3-5 |
| 3-5 36 33 11.9 4.0 3.0 35 1.8 | 1.0 13.4 | 1.0 | 1.8 | 35 | 3.0 | 4.0 | 11.9 | 33 | 36 | 3-5 |
| 3-5 36 100 36.0 4.0 9.0 35 3.2 | .7 16.5 | .7 | 3.2 | 35 | 9.0 | 4.0 | 36.0 | 100 | 36 | 3-5 |
| 3-5 36 50 180 40 4.5 35 2.2 | .7 11.4 | .7 | 2.2 | 35 | 4.5 | 4.0 | 18.0 | 50 | 36 | 3-5 |
| 3-5 36 33 11.9 4.0 3.0 35 1.8 | .7 9.4 | .7 | 1.8 | 35 | 3.0 | 4.0 | 11.9 | 33 | 36 | 3-5 |
| 3-5 36 100 36.0 4.0 9.0 25 2.7 | 1.0 20.1 | 1.0 | 2.7 | 25 | 9.0 | 4.0 | 36.0 | 100 | 36 | 3-5 |
| 3-5 36 50 180 40 4.5 25 2.0 | 1.0 14.4 | 1.0 | 2.0 | 25 | 4.5 | 4.0 | 18.0 | 50 | 36 | 3-5 |
| 3-5 36 33 11.9 4.0 3.0 25 1.7 | 1.0 12.1 | 1.0 | 1.7 | 25 | 3.0 | 4.0 | 11.9 | 33 | 36 | 3-5 |
| 3-5 36 100 360 40 90 25 27 | .7 14.1 | .7 | 2.7 | 25 | 9.0 | 4.0 | 36.0 | 100 | 36 | 3-5 |
| 3-5 36 50 180 4.0 4.5 25 2.0 | .7 10.1 | .7 | 2.0 | 25 | 4.5 | 4.0 | 18.0 | 50 | 36 | 3-5 |
| 3-5 36 33 11.9 4.0 3.0 25 1.7 | .7 85 | ., 7 | 17 | 25 | 3.0 | 4.0 | 11.9 | 33 | 36 | 3-5 |
| 3-5 36 100 360 40 90 15 22 | 1.0 160 | 1.0 | 2.2 | 15 | 9.0 | 4.0 | 36.0 | 100 | 36 | 3-5 |
| 3-5 36 50 180 40 45 15 16 | 1.0 12.0 | 1.0 | 1.6 | 15 | 4.5 | 4.0 | 18.0 | 50 | 36 | 3-5 |
| 3-5 36 33 119 40 30 15 14 | 1.0 10.5 | 1.0 | 1.0 | 15 | 3.0 | 4.0 | 11.9 | 33 | 36 | 3-5 |
| 3-5 36 100 360 40 90 15 22 | 1.0 10.0 | 7 | 2.2 | 15 | 9.0 | 4.0 | 36.0 | 100 | 36 | 3-5 |
| 3-5 36 50 180 40 45 15 16 | 119 | • / | 1.4 | 15 | 2.0 | 4.0 | 50.0 | 100 | 50 | 25 |
| 3-5 36 33 119 40 30 15 14 | .7 11.2 7 8.4 | 7 | 1.0 | 1.1 | 45 | 40 | 18.0 | 50 | 36 | 1-7 |

Channel Changes and Bank Erosion

Scour and fill occurs seasonally on the Tanana River. At higher flows, the sand- and silt-size material is scoured from the bed and transported in suspension as well as bedload. If the flow declines and velocities decrease in parts of the channel, the fine material may drop out and be deposited. This seasonal change may explain the bar that has formed adjacent to the right bank—high flow washes out the bar and the flow pattern changes along the right bank—causing lateral erosion. The bar re-forms as the flow declines.

Documenting long-term channel change through comparisons of surveyed cross sections was difficult because of the dynamic nature of the river and the fact that these survey data only captured pieces of the change over time. The data collected for this study and the hydraulic model represent the conditions at the time of the August 1996 field survey. Substantial changes in channel geometry have occurred in this river system and may occur regularly. Norman (1975) surveyed four cross sections in 1971-upstream and downstream sides of the bridge and a section near the 1996 cross section Exit 1. Direct comparison between cross sections used in this study and Norman (1975) are complicated further by the fact that the pipeline crossing and its associated revetment that encroaches on the channel had not been constructed in 1971. Norman's cross sections measured at the bridge at varying discharges indicated substantial changes in the bed over a few months (fig. 3). The delta formed by the Delta River probably is in a constant state of flux (note the changes in fig. 6). It is likely the channel downstream of the bridge is constantly changing shape as the flow and sedimenttransport rates change in both the Tanana and Delta Rivers. This is not unusual on rivers carrying large amounts of fine sediment and has been observed at other sites on the Tanana River with comparable channel changes occurring in as little as a week (Burrows and others, 1981).

The cause of the accelerated lateral erosion on the right bank is unknown. Two effects appear to occur at varying flows. First, as mentioned previously, as the flow decreases, the bar re-forms. Although this bar may buffer the bank from direct attack, the main channel also shifts to the left as the flow decreases, thereby lowering the velocities directed to the right bank. Second, at higher flows, an eddy forms on the right bank upstream from the bridge and reverse flow occurs on the right bank and through the bridge. This was observed during



Figure 6. Channel changes at cross section Exit 1 from 1971 to 1996, Tanana River at Big Delta, Alaska. See <u>figure 2</u> for cross-section location.

the 1971 high-flow measurement of 51,600 ft³/s and during a discharge measurement from the bridge of 49,500 ft³/s on August 19, 1967—the 100-year flood flow is 86,700 ft³/s. The bank erosion that prompted this study occurred during early spring and continued into the early part of summer, a period of intermediate flows. The morphology of the Delta River's delta at this time is unknown. Changes in its shape and extent could influence the velocities along the right bank upstream from the bridge. The bar that protects the right bank easily could be eroded if the flow of the Tanana were directed at it. There were no observations of these intermediate flows in 1996.

At the time of the August 1996 survey, velocities along the right bank were very slow. One goal of the survey was to determine what maximum velocities might be expected—a velocity of 9.5 ft/s was measured at the rock bluff downstream of the bridge. During a discharge measurement of 51,600 ft³/s made at the bridge on August 13, 1971, the highest velocity measured was 9.9 ft/s at 20 percent of the total depth near pier 3.

Conclusions

Hydraulic conditions at bridge 524 are complex because the Delta River enters immediately downstream of the bridge. The varying discharge and shape of the delta formed by the Delta River affect the flow of the Tanana River as it passes through the bridge. A water-surface profile model was developed and calibrated to the relatively low flow observed at the time of the field survey. However, given the complications and variations of the channel at different discharges, the model results should be considered an estimate.

Computed pier scour varied from 43.3 to 35.9 ft. Possible mitigating factors, such as effective pier length and bed armoring, reduced the computed pier-scour magnitude to 11.4 ft. Maximum observed pier scour during the field survey at a relatively low flow was 6.0 ft.

The cause of the accelerated lateral erosion on the right bank is unknown. At the time of the field survey, a bar had formed between the main channel and the right bank. The erosion occurred at flows higher than those observed. The circumstances at the time of active erosion are uncertain erosion may occur at an intermediate flow or higher flows. At higher flows an eddy has been observed under the right side of the bridge. The extent and shape of the delta downstream of the bridge, as well as the discharge of the Delta River, affect the flow and channel configuration of the Tanana River upstream of the bridge.

Both the pier-scour computations and the determination of the bank-erosion process would benefit from observations at higher flows. Previous work by Norman (1975) lacks detailed observations of high flow at the piers. Hydraulic data gathered at a high flow, and/or a period of active bank erosion, would be useful for understanding and attempting to predict both of these processes.

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620.1 972.9 656.5 974.8 570.9, 974.6 557.3, 976.5
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620.1 972.9 656.5 974.8 570.9, 974.6 577.3, 976.5
620.1 972.9 656.5 974.8 570.9, 974.6 577.3, 976.5
620.1 972.9 656.5 974.8 570.9, 974.6 577.3, 976.5
620.1 977.9 755.5 774.7
720.9 775.7 755.7 775.7 755.7 0 GEOLOGICAL SURVEY COMPUTATIONS X -10.0 41.3 104.8 168.4 247.8 247.8 247.8 342.1 10/96 ×O -6020. ERR-CODE m Heinrichs USGS н 982.10 975.40 977.70 968.50 950.70 961.20 979.50 Y FEDEKAL HIGHWAY ADMINISTRATION - U. 3. MODRI, FOR WATER-SURFACE PROFILE | FRUCESSING CROSS SECTION - "XIT2 " SECTION "XIT72 " WRITTEN TO DISK, RECORD NO. -612. × 1007. CK 00 Bridge No. 524, Tanana River at Big Deit Hydraulic Survey, model run by Tom Heinr WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 0 XMAX 354.5 X -79.2 25.4 89.0 152.5 231.9 235.9 336.8 11 "BRDG SRD EK 50 9 998 AT 0 1000.00 976.60 977.70 955.80 957.70 971.20 971.20 1007.50 YMIN 948,70 SECTION . 301: 2): 1.5, SECID "XIT2 21: section ą. VSLOPE u 0.000000 X 263.7 30, VSN) CROSS 11 (NGP X 0.030 -6000. 9. 73 130. 216. 226. 320. 354. (NSA č measurement COEFFICIENTS 035 0.030 SKEW **PROCESSING** FOR PAIRS K Y MAX-MIN POINTS: XMIN -6020.0 1020.00 IHFNO 0. BREAKPOINTS 1020.00 980.10 975.90 977.30 959.90 948.70 968.30 987.50 CD 0.030 035 SUMMARY 3 COORDINATE Y 0 0 BRDG FINISH CROSS S -6020.0 1 57.2 57.2 120.7 200.2 263.7 311.4 352.5 ROUGHNESS 0.0 HEINIA SKEW 0.0 START DATA WSPRO V082195 SUBAREA N SA :: X-X *** * 1 : × *** **

22 Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

8420 QCR 69604 69604 4 76300 76300 84200 84200 84200 95600 95600 95600 436.0 711.5 -280. 183.3 294.9 FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS SURVEY -280. 226.3 333.9 191.0 5.63 4.75 REW 712 193.2 5.56 1 86700 86700 115000 136900 95600 86700 103000 136900 COMPUTATIONS 11 Bridge No. 524, Tanana River at Rig Dalta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIMB: 10-23-96 11:39 CROSS-SECTION PROPERTIES: ISEQ = 4; SECID = BRDG ; SRD = FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL MODEL FOR WATER-SURFACE PROFILE COMPUTATIO Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 618.8 159.5 400.7 **VEL** 4.84 2.12.2 VELOCITY DISTRIBUTION: ISEQ = 4; SECID = BRDG ; SRD = LEW 95600 185.7 236.2 4.57 5.79 212.3 5.06 235.4 0 21500. 1.00 ALPH 86700 118.0 250.9 371.0 502.1 WETP 589 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 REW AREA K 711.5 4441.6 848643. 2 86700 3 86700 187.1 5.75 193.6 248.9 281.5 3.82 9 WHO'L 73.0 582 9.822 348.4 519.3 BRDG 76300 ROUGHNESS COEFFICIENTS (NSA = 2): 0.030 0.100 *** Q-DATA POR SEC-TD, ISEQ - XIT4 Q XIT73 25800 25800 104000 123000 XIT3 123000 86700 APP1 XIT2 189.6 252.0 5.45 5.50 HP I BRDG 980,87 * 980.87 21500 848643 848643 195.4 197.2 981.12 * 981.12 21500 ¥ *** Q-DATA FOR SEC-ID, ISEQ = Q BRDG 21500 21500 86700 *** Q-DATA FOR SEC-ID, ISEQ = Q APP1 18900 18900 76300 *** Q-DATA FOR SEC-ID, ISEQ = Q XIT2 23100 23100 93200 50.0 *** Q-DATA FOR SEC-ID, ISEO = 473.7 205.5 HP 2 BRDG 980.87 * * 21500 324.2 4442 5.71 5.19 233.5 4.24 253.6 188.3 2.07.0 AREA LEW 0.5 0.5 294.9 183.3 436.0 WSEL SA# WSEL 980.87 HP 1 APPR 980.87 V082195 V082195 STA. A(I) V(I) (I) A(I) X STA. A(I) V(I) X STA. A(T) V(I) WSPRO WSPRO X STA. × 0 0 0 -XIT4 27400 27400 110000 123000 123000 86700 122000 136900 136900 9560 973.40 973.40 973.90 974.80 973.90 977.10 977.10 977.20 981.40 XMAX 998.70 987.90 X XMAX 773.2 1000.30 981.50 0 FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS 5 675.6 0.0 59.5 125.1 190.8 256.4 332.0 337.6 453.2 518.9 518.9 518.9 514.8 X -20.1 Bridge No. 524, Tanana River at Big Delta Wydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Frediles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 = 740. ERR-CODE *** FINISH PROCESSING CROSS SECTION - "APP1 " *** CROSS SECTION "APP1 " WRITTEN TO DISK, RECORD NO. = 6 986.70 973.20 973.70 973.70 973.60 973.60 977.60 977.70 977.30 978.40 Y 996.30 666.0 981.10 773.2 1000.30 XMXX XMXX 773.2 1000.30 > CK 0.00 -9.6 43.1 108.7 174.4 371.2 371.2 436.8 502.8 502.8 502.8 502.9 XMAX 1613.9 PROCESSING CROSS SECTION - "APP1 " ---- DA'FA SUMMARY FOR SECID "APP1 " AT SRD = EK 0.50 986.70 973.40 973.60 974.30 974.30 974.00 974.00 977.00 977.50 977.50 977.50 VMIN 973.20 969.60 VMIN 968.60 (NGP = 44): ROUGHNESS COEFFICIENTS (NSA = 1): 2): VSLOPE ****** X 43.1 616.8 761.2 x 551.2 -19.6 26.7 92.3 92.3 158.0 223.6 2289.2 354.8 420.4 420.4 420.4 653.9 SUBAREA BREAKPOINTS (NSA = 604. 0.10 604 X-Y COORDINATE PAIRS X-Y MAX-MIN POINTS: X-Y MAX-MIN POINTS: ONTHI 0. 998.70 976.40 973.70 974.30 974.30 974.40 974.20 976.00 977.60 977.60 551.2 968.60 741.2 988.30 XMIN Y -52.1 998.40 0.030 Y XMIN Y -20.1 998.70 APP1 740 0:030 -20.1 10.3 75.9 141.6 207.2 272.8 3338.4 404.0 SKEW START 469.7 0.0 601.3 261280V WSPRO o *** *** 0

9560 9560 9560

| V082195 MODEL FOR WATER-SURFACE PR IICAL SURVEY Bridge No. 524, Tanana Rivor at Big Dol Hodraulic Survey: model run by Tom Hein | 0/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 SRD = 0. WATCHING DATE & TIME: 10-23-96 11:39 | SM REW OCR MSEL LEW REM AREA K 0 666 82440 981.32 -0.3 712.4 4704.1 932049. | x STA0.3 50.3 73.5 1 A(I) 274.5 50.3 73.5 1 V(I) 3.92 5.22 4.18 | X STA. 183.2 206.0 229.6 2 A(1) 211 201.3 202.9 200.7 V(1) 5.34 5.30 5.36 N (1) 5.34 5.30 5.36 X STA. 297.6 327.2 351.0 A(1) 218.9 207.4 205.6 V(1) 218.9 5.18 5.26 | 0 = 0. X STA. 440.1 478.2 531.1 5 0 × 100 × 10 247.6 282.7 282.7 282.0 V(I) 4.34 3.80 3.81 1 1 APPR 981.53 21500 | 10.9 130.7 1 214.0 WSPRO FEDERAL HIGHWAY ADMINISTRATION - WSPRO 5.02 V082195 MODEL FOR WATER-SURFACE FR | 10.3 234.8 Bridge No. 524, Tanana River at Rig Del Hydraulic Survey: model run by Tom Hein 233.9 233.9 4.60 4.60 **** RUN DATE & TTME: 10-23-96 | 57.3 544.4 CROSS-SECTION PROPERTIES: ISEO 5; SEC1 439.9 WSEL SA# AREA K TOPW WETE 2.44 1 5473 1099800 668 673 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | WSPRO FEDERAL HIGHMAY ADMINISTRATION - V082195 MODEL FOR WATER-SURFACE FR | DICAL SURVEY Bridge No. 524. Tanana River at Big Del Hydraulic Survey: model run by Tom Hein WSPRO Profiles (WSPRO ver. V082195) | <pre>x** RUN DATE & TIME: 10-23-96 11:39 10/96 SRD = -280. VELOCITY DISTRIBUTION: ISEQ = 5; SECID =</pre> | EM REM QCR WSEL LEW REM AREA K 75/69 981.53 -1.0 666.6 5473.1 1099890. | 5 173 1213 10 1 10 11 10 11 5 64 E |
|--|--|---|--|---|--|---|---|---|--|--|--|---|---|------------------------------------|
| FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGJ NODEL FOR MATER-SURFACE PROFILE COMPUN | Bridgo No. 524, Tanana River at Bid Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10 WSPRO Profiles (WSPRO Ver. V082295) SSS-SECTION PROPERTIES: 10 23 96 11:39 SSS-SECTION PROPERTIES: ISEQ = 5; SECID = APPR ; 5 | SEL SA# AREA K TOPW WETP ALPH LEN 1 5200 1011614 666 671 1.00 (| AVER 981.12 * * 21500 PERPEAL HIGHWAY ADMINISTRATION - U. S. GEOLOG | MODEL FOR WATER-SURPACE FROFILE COMPU- Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 1 WSPRO Profiles (WSPHO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | OCTTV DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD WSEL LEW REW ANKA 981.12 0.0 666.0 5199.7 1011614. 21500. 4 | 0.0 41.2 63.9 88.6 11 286.4 1.2 228.9 231.7 226.0 3.75 4.70 4.64 4.76 | 130.7 149.8 159.7 199.1 217.9 190.1 21 212.4 215.6 217.9 217.9 4.90 5.06 4.99 4.93 4.90 | 234.8 263.4 295.9 339.1 45 265.3 265.3 292.9 513.8 4.30 4.05 3.67 2.09 | 544.4 561.0 577.8 595.4 61 201.1 205.0 210.9 225.7 5.35 5.24 5.10 4.76 | BRDG 981.32 * 981.32 21500 | FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOG MODEL FOR WATER-SURFACE PROFILE COMPU | <pre>Bridge No. 524, Tanana River at Big Delta Hydraulic Survey, model run by Tom Heinrichs USGS 1 WSPRD Profiles (WSPRO ver. V082195) *** RUN DATE # TIME: 10-21-96 11:39 05S-SECTION PROPERTIES: ISSQ = 4, SECID = BRDG ;</pre> | SEL SA# AREA K TOPW WETP ALPH LE 1 4704 932049 584 590 | .32 4704 932049 584 590 L.UU |

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QCR 313438 313438 QCR 287204 287204 .0 765.5 148.3 286.9 499.6 -2.80 .0 FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY GEOLOGICAL SURVEY 614.5 730.2 3.72 REW 765 577.6 5.94 1164.6 REW 734 COMPUTATIONS COMPUTATIONS COMPUTATIONS 11 ISEQ - A_i SECID = BRDG ; SRD = Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Fuclites (WSPRO ver. V082195) SPARE ND MATE & TIME 10-23-96 11:39 SS-SECTION PROPERTIES: ISEQ = 5; SECID = APPR ; SRD = Bridge No. 524, Tanana River at Dig Delta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 MSPRO Profiles (MSPRO ver. V082195) *** RUN DATE & THME: 10-23-96 11:39 Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by rom Heinrichs USGS 10/96 Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 6.45 451.4 122.6 256.0 623.4 VEL VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD = -30 L'EW -30 LEW 570.7 603.4 693.2 67.9 735.1 5.90 O' 86700. ALPH 1.00 1.00 WETP ALPH MODEL FOR WATER-SURFACE PROFILE MODEL FOR WATER-SURFACE PROFILE FEDERAL HIGHWAY ADMINISTRATION - U. S. MODEL FOR WATER-SURFACE PROFILE 96.6 102.6 226.1 593.2 Bridge No. 524, Tanana River at Big Delta WETP 641 807 *** RUN DATE & TIME: 10-23-96 11:39 ¥ 765.5 13446.0 4355061. 700.0 6.19 7.10 7.45 610.2 581.9 647.4 6.70 V082195) T97 TOPW 627 627 67.4 199.4 359.2 565.7 AREA 6.93 62 6.50 7.00 625.4 568.9 619.3 HP 1 BRDG 993.00 * 993.00 86700 4035520 4355061 667.1 WSPRO Profiles (WSPRO ver. 4035520 4355061 REW 38.3 173.7 539.0 320.8 CROSS-SECTION PROPERTIES: HP 2 BRDG 993,00 * * 86700 992.56 * * 86700 CROSS-SECTION PROPERTIES: 676.6 AREA 11710 11710 AREA 13446 13446 857.9 5.05 566.8 7.65 635.1 6.83 LEW -31.3 9.99.6 -31.3 148.3 286.9 -SA# SA# MSEL 992.56 HP 2 APPR WSEL 993.00 MSBL 992.56 V082195 V082195 V082195 A(I) V(I) X STA. A(I) X STA. A(I) V(I) X STA. A(T) V(T) X STA. $(I)\Lambda$ WSPRO WSPRO WSPRO --269102 269102 269102 731.2 239.6 6666.6 185.6 330.8 492.2 542.7 -280. FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS -280. .6 231.1 255.4 24.65 742.8 8.55 8.28 7.93 327.0 523.6 546.3 2.46 507.2 437.4 3.29 REW 731 11 Bridge No. 524, Tauana River at Big Dolta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WEPRO Profiles (WSRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 cross-SECTION PROPERTIES: ISBQ - 4; SECID = BRDG ; SRD = Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) ... RUN DATE & TIME: 10-23 96 11:39 614.9 31.76 2.98.7 660.8 156.3 456.9 462.2 VELOCITY DISTRIBUTION: ISEQ = 4; SECID = RRDG ; SRD = VEL LEW -25 498.2 563.9 614.1 2.03 539.7 7.06 530.0 239.7 8.03 4.48 o 86700. WETP ALPH 1.00 192.6 118.1 270.3 422.4 613.1 595.1 347.4 Bridge No. 524, Tanana River at Rig Delta 634 REW AREA K 731.2 11173.4 3758631. 569.5 530.4 500.6 229.4 321.1 3.35 4.80 8.66 7.81 4.69 555.1 223.9 78.7 TOPW 620 172.0 577.0 242.3 388.8 577.8 301.1 46.5 562.3 227.0 274.6 212.9 507.8 7.30 1.71 8.77 494.3 992.14 * 992.14 86700 593.9 992.56 * 992.56 86700 × 3758631 3758631 214.0 358.9 535.4 151.7 560.2 HP 2 BRDG 992.14 * * 86700 268.4 -26.0 738.1 227.6 AREA 11173 11173 8.64 583.0 263.7 217.3 8.65 501.6 24.44 4.08 5.87 501.1 LEW -26.0 330.8 492.2 185.6 1.205 132.0 239.6 -SA# WSEL 992.14 HP 1 APPR HP 1 BRDG

MSEL 11.566

V082195

MSPRO

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A(I) V(I)

X STA.

A(I) V(I)

X STA.

X STA. A(I) V(I)

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X STA.

WSPRO V082195

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X STA. A(I) V(I)

X STA. A(I) V(I)

A(I) V(I)

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X STA.

WSPR0 V082195

| X STA. 290.6 324.9 363.9 407.8 455.5 502.8 A(1) 667.0 702.5 739.3 754.6 757.0 V(1) 6.50 6.17 5.86 5.74 5.73 | X STA. 502.8 540.9 568.0 593.4 626.9 766.3 AIX 699.2 656.3 665.9 741.3 1204.6 766.3 V(I) 6.20 6.61 6.51 5.85 3.60 | <pre>H * HP 1 BRDG 992.81 * 992.81 86700 HP 1 BRDG 992.81 * 992.81 86700 I NSPRO FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY V032195 MODEL FOR WATBR SURFACE PROFILE COMPUTATIONS V032195</pre> | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WERD Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 *** RUN DATE & TIME: 10-23-96 11:39 CROSS-SECTION PROPERTIES: ISEQ = 4; SECID = BRDG ; SRD = -280. | 922.81 11591 3973580 625 639 283 639 283164 283164 283164 11591 3973580 625 639 1.00 -29 734 283164 1 HP 2 BRDG 992.81 * 86700 | MSPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY V082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS Bridge No. 524, Tanana River at Big Delta Hadraulic Survey, model tut by Tom Heinrichs USGS 10/96 | WEPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 VELOCITY DISTRIBUTION: ISBQ = 4; SECID = BRDG ; SRD = -280. | WSEL LEW REW AREA K 0 VEL 992.81 -29.8 733.5 11590.6 3973580. 86700. 7.48 | x sra29.8 46.4 78.8 118.3 155.8 186.0 A(I) 5.57 7.45 7.31 7.56 8.03 | x gwh. 186.0 214.5 243.3 271.0 299.9 331.7 A(I) 518.4 520.1 509.1 523.0 535.5 331.7 V(I) 8.36 8.34 8.52 8.29 8.10 | x stra. 331.7 359.9 389.9 423.6 458.2 493.7 A(1) 519.6 524.0 549.9 560.0 458.1 493.7 V(I) 8.34 8.27 7.88 7.74 7.63 | x sTR. 493.7 538.0 578.5 613.7 661.3 733.5 A(I) 715.6 592.1 7.32 7.56 5.80 5.59 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | HP 1 APPR 993.20 993.20 00.00 1 WSPRO PEDERAL HIGHWAY ADMINISTRATION U. S. GEOLOCICAL SURVEY V082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRD Profiles (WSPRD Vor. V082195) |
|---|---|--|--|---|--|---|--|--|--|--|--|--|---|
| WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | VELOCITY DISTRIBUTION: ISEQ = 4; SECID = BRDG ; SRD = -280. | WSEL LEW REW AREA K 0 VEL 993.00 -30.9 734.2 11709.6 4035520. 86700. 7.40 X STA30.9 47.1 70.3 118.0 156.5 186.0 A(1) 801.1 567.4 602.4 595.2 531.9 | V(1) 524.7 515.6 243.5 271.2 300.3 332.2 X STA. 186.0 214.5 526.6 515.4 529.0 542.7 332.2 V(1) 524.7 524.0 542.7 332.2 V(1) 8.26 8.23 8.41 8.19 7.99 X STA. 332.2 8.41 8.19 7.99 X STA. 332.2 16.4 360.0 390.4 555.3 424.2 555.6 557.4 1494.3 | V(I) 8.40 8.08 7.81 7.66 7.55 x stra. 494.3 537.6 579.0 614.3 662.0 734.2 A(I) 610.0 613.2 579.4 643.9 778.7 734.2 V(I) 7.11 7.07 7.48 6.73 5.57 | 1 HF 1 APPR 993.38 * 993.38 86700 USSPRO FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY V082195 MODFL FOR WATER-SURFACE PROFILE COMPUTATIONS | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Hoinrichs USGS 10/96 WSPRO Prefiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 CROSS-SECTION PROPERTIES: ISBQ = 5; SECID - APFR ; SRD = 0. | WSEL SA# AREA K TOPW WETP ALPH LEW REW QCR 1 14101 4698050 801 812 335927 993.38 14101 4698050 801 812 1.00 -33 766 335827 | 1 HP 2 APPR 993.38 * * 86700 1 NGPRO PEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY | V082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS Bridge No. 524, Tauaua River at Big Delta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 | WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | VELOCITY DISTRIBUTION: ISEQ = 5; SECID - APPR ; SRD = 0. WSEL LEW REW AREA K Q VEL 003 38 -34.2 766.3 14100.9 4698050. 86700. 6.15 | x sra14.2 38.1 67.7 97.3 123.7 149.8 A(1) 911.5 659.3 644.4 602.0 608.2 408.2 1.13 4.76 6.58 6.73 7.20 7.13 | x sra. 149.8 175.6 201.7 228.8 259.2 290.6 A(1) 7.27 596.2 7.12 6.88.5 646.3 A(1) 7.23 7.12 6.80 6.71 |

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184.4 327.7 488.8 725.5 144.8 278.8 491.6 FEDERAL HIGHWAY ADMINISTRATION - U. S. GROLOGICAL SURVEY 0 CEOLOCICAL SURVEY -280. 472.7 657.8 504.0 503.9 8.60 7.90 6.43 476.9 9.09 8.60 6.59 REW 764 548.4 673,8 COMPUTATIONS COMPUTATIONS . Bridge No. 524, Tanana Kiver at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 MSPRO Profiles (MSPRO ver. V082195) Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 VEL 7.10 660.2 SRD 441.7 8.54 154.6 295.8 452.9 120.7 249.2 VEL VELOCITY DISTRIBUTION: ISEQ = 4; SECID = BRDG ; SRD = LEW -25 VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD -6.11.5 554.7 7.81 517.1 574.1 525.9 8.24 8.84 7.55 459.9 9.43 490.1 0 SECID = APPR 86700. 86700. ALPH 1.00 MODEL FOR WATER-SURFACE PROFILE FOR WATER-SURFACE PROFILE FEDERAL HIGHWAY ADMINISTRATION - U. S. 94.8 219.6 115.7 267.6 418.7 610.9 392.1 Bridge No. 524, Tanana River at Big Delta WETP 11:39 661. REW AREA K 725.5 10154.1 3249306. × REW AREA K 763.9 12216.5 3736266. 507.9 545.4 7.95 8.34 9.63 494.4 8.53 514.2 8.43 645.7 6.71 519.8 450.3 8.77 ŝ 66.6 *** RUN DATE & TIME: 10-23-96 CROSS-SECTION PROPERTIES: ISEQ - 5; TOPW 064 348.7 76.4 2.40.3 384.6 575.5 194.6 479.4 449.7 9.64 465.0 9.32 561.5 7.72 7.21 532.2 8.15 991.01 * 991.01 86700 520.1 8.34 6.003 3736266 3736266 38.5 212.4 311.6 46.8 355.3 532.9 169.4 HP 2 APPR 991.01 * * 86700 AREA 12217 12217 573.9 MODEL 757.4 650.1 9.64 7.94 511.3 8.48 9.49 449.9 546.1 6.67 456.9 LEW -25.8 1.EW -16.4 184.4 327.7 144.8 278.8 488.8 -25.8 16.4 SA# WSEL 991.01 ASEL. 990.48 HP 1 APPR WSEL 10.166 V082195 V082195 X STA. A(I) V(I) X STA. A(I) V(I) X STA. A(I) V(I) STA. A(I) V(I) A(I) V(I) A(I) V(I) A(I) (T)A WSPRO WEPRO X STA. STA X STA × × QCR 235526 235526 QCR 330865 330865 149.6 289.7 502.2 1.66.1 0 -280. FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY GEOLOGICAL SURVEY 0 5.69 600.6 7.22 638.5 61.9 762.1 1187.6 REW 725 REW 766 3.65 COMPUTATIONS COMPUTATIONS 81 1 Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by rum Heinrichs USGS 10/96 WSPRO Profilea (WSPRO vor. V082195) *** RUN DATE & TIME: 10-23-96 11:39 Bridge No. 524, Tanana River at Big Delta Hydraulic Survey, model run by Tom Heinrichs USGS 10/96 WERV0 Procides (WSPRO ver. V003195) *** RUN DATE & TIME: 10-23-96 11:39 Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 GRD 123.6 258.5 454.1 626.5 SECID = BRDG ; SRD VEL 6.21 VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD = -15 LEW -33 L'EW SECID - APPR ; 679.0 6.89 743.9 5.83 5.88 613.8 7.06 737.8 o 86700. ALPH ALPH 1.00 1.00 WATER-SURFACE PROFILE PROFILE ŝ 228.2 595.0 96.4 406.6 FEDERAL HIGHWAY ADMINISTRATION - U. 524, Tanana River at Big Delta WETP WETP 621 811 811 ¥ 766.1 13956.9 4621846. 601.8 617.0 7.03 730.4 16 5 6.55 662.1 WATER SURPACE ISEQ = 4; TOPW 608 608 CROSS-SECTION PROPERTIES: ISEQ = 51 TOPW 800 67.8 201.2 362.7 567.5 AREA 6.66 6.66 8 3249306 3249306 7.32 6.24 620.9 591.9 694.4 651.2 990,48 * 990.48 86700 K 4621846 4621846 540.4 38.4 FOR REW 175.3 324.0 CROSS-SECTION PROPERTIES: 990.48 * * 86700 FOR 86700 690.4 MODEL AREA 10154 10154 AREA 13957 13957 905.3 7.36 MODEL HP 2 APPR 993.20 * * 9.79 588.9 1.659 6.57 6.28 -33.6 149.6 289.7 502.2 Bridge No. -33.6 4 SAH WSEL SA# WSEL 993.20 HP I BRDG HP 2 BRDG WSEL 990.48 993.20 V082195 V082195 X STA. A(I) V(I) V082195 A(I) V(I) STA. A(I) V(I) A(I) V(I)

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|---|---|
| 6,74 7,76 7,41 6,58 4,10 | HP 2 APPR 993.28 * * 95600 |
| BRDG 992.81 * 992.81 95600 | WSPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY V082195 MODEL FOR WATER-SURFACE FROFILE CONFUTATIONS |
| FEDERAL HIGHMAX ADMINISTRATION - 11. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Frofiles (WSPRO ver. V082195) |
| Bridge No. 524, Tanaua River at Big Delta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSRRO ver. VO82195) *** RUN DATE & TIME: 10-23-96 11:39 333-5ECTION PROPERTES: ISEQ = 4; SECID = RRDG ; SRD = -280. | *** RUN DATE & TIME: 10-23-96 11:39 VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD = 0. |
| SEL SA# AREA K TOPM METP ALPH LEW REW QCR ⊥ 11591 3973580 625 639 283164 81 11591 3973580 625 639 1.00 -29 734 283164 | WSEL LIEW REW AREA K Q VEL 993.28 -33.9 766.2 14020.9 4655660. 95600. 6.82 |
| 2 BRDG 992.81 * * 95600 | X STA13.9 38.3 07.9 7.70 123.1 47.2 123.1 123 |
| FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | X STA. 149.2 175.6 201.6 228.7 259.0 290.4 A(1) 608.1 595.6 604.7 633.1 642.1 |
| Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | V(I) 7.00 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.02 1 0.02 <th0.02< th=""> <th0.02< th=""> <th0.02< th=""></th0.02<></th0.02<></th0.02<> |
| BLOCITY DISTRIBUTION: ISEQ = 4; SECID = RRDG ; SRD = -280. | X STA. 502.1 541.3 567.1 595.2 626.8 766.2 A(I) 715.2 626.7 677.9 738.7 1193.6 V(I) 6.68 7.63 7.05 6.47 4.00 |
| WSEL LEW REW AREA K Q VEL 992.81 -29.8 733.5 11590.6 3973580. 95600. 8.25 | 1 * + HP 1 BRDG 993.71 * 993.71 95600 |
| -29.8 46.4 78.8 118.3 155.8 186.0 777.8 581.8 593.0 573.3 539.6 6.15 8.22 8.06 8.34 8.86 | 1 WSPRO FEDERAL HICHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY V082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | Bridge No. 524, Tanana Kiver at Big Deita Hydraulic Survey; model run hy Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver, V082195) *** RUN DATE & TIME: 10-23-96 11:39 APPOGE-SECTION BADDERTES, TERD - 4, SECTD = BADC, SED = -280. |
| . 331.7 359.9 389.9 423.6 428.4 439.7 31.7 554.0 549.9 560.0 568.1 439.7 9.20 9.12 8.69 8.54 8.41 | WSEL SA# AREA & TOPW WETP ALPH LEW REW 30 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 993.71 12156 4280591 629 644 1.00 -31 737 30 1 HP 2 BRDG 993.71 * 95600 |
| I APPR 993.28 * 993.28 95600 | I ASPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY VOB2195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS |
| PEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURPACE PROFILE COMPUTATIONS | Bridge No. 524, Tanana River at Big Dolta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 |
| <pre>Rridge No. 524. Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) +++ RUN bATE & TIME: 10-23-96 11:39 ROSS-SECTION PROPERTIES: ISBQ = 5; SECID = APPR ; SRD = 0.</pre> | WSPRO Profiles (WSPRO ver. V082195) *** KUN DATE & TIME: 10-23-96 11:39 vertary presentation. Isso = 4. SECTD - BRDG : SRD = -280. |
| | VELOCITY DISTRIBUTION: ISEQ = 4; SECID - BRDG ; SRD = -600. |

28 Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

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QCR 298828 298828 951715 351715 332.4 494.3 185.8 736.0 .0 -280. FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS GEOLOGICAL SURVEY FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS -280. 8.50 8.27 5.90 REW 736 810.8 767 560.1 8.53 562.5 578.3 REW COMPUTATIONS 11 Bridge No. 534, Tunaua River at Biy Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082155) *** RUN DATE & TIME: 10-23-96 11:19 ccnos9-SECTION FROFERTIES: ISBQ = 4, SECID = BRDC ; SRD = Bridge No 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WERRO Profiles (WSRPO ver. V082195) CROSS-SECTION PROPERTIES: 11502 = 5; SECID = APPR ; SRD = CROSS-SECTION PROPERTIES: 11502 = 5; SECID = APPR ; SRD = Dridge No. 524. Tanana River at Big Delta Wrydraulic Survey; model run by Tom Heinrichs USGS 10/96 WFRO Profiles (MSPRO ver, V082195) ** RUN DATE & TTME: 10-23-96 11:39 155.4 VEL 7.94 459.5 661.9 300.1 1 -31 LEW -35 LEW VELOCITY DISTRIBUTION: ISEQ = 4; SECID = BRDC ; SRD 597.6 8.00 582.5 6.63.9 7.20 5.024 8.21 0 9.01 95600. ALPH 1.00 1.00 ALPH FEDERAL HIGHWAY ADMINISTRATION - U. S. MODEL FOR WATER-SURFACE PROFILE 117.6 271.6 424.7 614.3 WETP 643 WETP 815 × 736.0 12036.1 4214003. 621.5 7.69 8.78 8.36 8.05 544.3 571.7 594.1 6'LL MAOL 629 243.0 390.8 0 803 WHOT 579. AREA 8.81 9.00 * HP 1 BRDG 993.52 * 993.52 95600 581.9 8.22 531.4 542.6 616.9 7.75 K 4942749 4942749 993.95 * 993.95 95600 24 4214003 4214003 REW 46.6 214.4 HP 2 BRDG 993.52 * * 95600 360.7 538.6 HP 2 APPR 993.95 * * 95600 AREA 12036 12036 826.4 539.2 8.87 7.44 14558 8.88 AREA 642.2 538.1 -31.6 LEW 185.8 332.4 -31.6 494.3 SA# SA# WSEL. 52.566 HP 1 APPR WSEL WSEL 993.95 993.52 WSPRO V082195 V082195 V082195 A(I) V(I) A(I) V(I) X STA. A(I) V(I) A(I) V(I) X STA. WSPRO MSPRO X STA. X STA H. --293.6 767.0 505.6 185.8 332.3 494.5 736.7 151.1 0 FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MOJEL FOR WATER-SURFACE PROFILE COMPUTATIONS FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE CUMPUTATIONS 0 1238.2 3.86 8.55 8.17 635.7 667.4 8.46 7.52 7.16 8.6LL 584.8 815.2 5.86 REW 767 6.13 564.7 558.9 11 Bridge No. 524. Tanana River at Big Delta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Frofiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 Rridge No. 524. Tanana River at Big Delta Hydraulic Survey, model run by fom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO Vor. V082195) NR-RUN DATE & TIME: 10-23-96 11:39 VEL 6.50 124.7 459.6 SRD 262.2 159.2 630.2 736.7 12155.6 4280591. 95600. 7.86 300.5 155.3 VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD = 662. -36 LEW ISEQ = 5; SECID = APPR ; 788.2 6.06 588.9 26.7 543.3 8.80 8.12 671.3 7.12 630.1 792.3 03 7.59 661.1 7.23 603.2 O, 95600. 9. WETP ALPH 1.00 597.3 6.1.6 231.7 411.3 117.6 271.5 424.8 614.7 815 REW AREA K 767.0 14702.6 5021081. 698.1 548.7 565.5 7.38 754.2 6.34 7.96 675.2 7.08 1.1.29 7.61 8.71 45 600.5 647.3 8 6.7.9 8.17 203.6 569.4 368.1 242.9 391.6 5.9.4 MAOL 804 586.6 8.15 689.8 6.93 626.9 7.62 738.6 675.9 8.49 8.92 563.0 7.65 535.7 625.1 994.13 * 994.13 95600 5021081 5021081 × 38.0 46.6 328.5 542.5 214.4 360.5 538.9 CROSS-SECTION PROPERTIES: 994.13 * * 95600 177.2 838.0 AREA 14703 14703 6.83 6.67 8 81 622.9 699.8 8.81 649.6 7.36 964.3 4.96 7.67 716.8 542.5 542.3 -31.6 LEW -36.9 1.141 293.6 505.6 -31.6 185.8 332.3 494.5 -36.9

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| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS Derived MO 524 Tranana River at Big Delta | V(I) 6.99 9.31 8.92 9.08 9.75 x STA. 185.0 213.1 241.2 268.6 296.9 329.0 A(I) 473.0 466.0 466.5 474.9 494.8 |
|--|--|--|
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRD Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | X(I) 10.11 10.26 10.25 10.06 9.66 X STA. 329.0 356.6 36.0 420.2 484.5 489.7 X STA. 329.0 356.6 36.0 478.4 9.41 9.56 X STA. 329.0 356.6 36.0 9.56.7 489.7 X STA. 329.0 356.6 9.34 9.41 9.34 X (I) 10.24 9.99 9.34 9.41 9.34 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | ELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; END = 0. WSEL LEW REW AREA K Q VEL 993.95 ~36.3 766.9 14558.0 4942749. 95600. 6.57 | X STA. 489.7 533.6 576.1 611.4 660.6 727.6 A(1) 563.8 553.6 524.5 595.6 686.1 727.6 V(1) 8.48 8.64 9.11 8.03 6.97 1 HP 1 APPR 991.69 * 991.69 95600 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 36.3 38.4 682.0 68.2 97.2 124.8 150.4 150.4 150.4 150.4 13.1 150.4 1.98 7.138 7.43 7.80 | 1 WSPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY V082195 MODEL FOR WATER-SURFACE FROFILE COMPUTATIONS |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 robocs_Gerrin Menophyrity: 1:8:0 18:0 = 5: SECID = APPR : SRD = 0. |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | WSEL SA# AREA K TOPW METP ALPH LEW REW QCF 1 12755 4002940 793 803 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 991.69 12755 4002940 793 803 1.00 -27 765 29029 HP 2 APPR 991.69 * * 95600 |
| $ \begin{array}{c} FRERAL HIGHAAV ADMINISTRATION = U. S. GEDLOGICAL SURVEX MATCH = U. S. GEDLOGICAL SURVEX MATLERATION = U. S. GEDLOGICAL SURVEX MATLERATION = U. S. GEDLOGICAL SURVEX MATLES THER : 10-21-96 11:39 For Mathematical BUSS 10/96 For Match = WELLERA (WERSHOW VEL, WORDS); WALL SURVEY MATCH IS THE : 10-21-96 11:39 For Match = WELLERA (WERSHOW VEL, WORDS); WALL SURVEY MATCH IS THE : 10-21-96 11:39 FOR MATCH = WELLERA (WERSHOW VEL, WORDS); WALL SURVEY MATCH IS THE : 10-21-96 11:39 FOR MATCH = WELLERA (WELLERA (WERSHOW VEL, WORDS); WALL SURVEY MATCH IS THE : 10-21-96 11:39 FOR MATCH = WELLERA (WELLERA ($ | Т ВКИЙ 991.00 × 991.09 95600 | WSPRO FEDERAL HICHMAY ADMINISTRATION - U. S. GROLAGICAL SURVEY V082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver, V082195) |
| Were area were area the law rev area the law rev area the law reverters consurvations where area the law reverters the law reveres the law reverters the law reverters the law revere | <pre>Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WEPRO Profiles (WSFRO ver. V082195) *** RUN DATE & TMR: 10-21-96 11:39 *ROSS-SECTION PROPERTIES: ISEQ = 4; SECID = BRDG ; SRD = -280.</pre> | *** RUN DATE & TIME; 10-23-96 11:39 VELOCITY DISTRIBUTION: 18EQ = 5; SECID = AFFR ; SRD = 0. |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | WSEL SAM AREA K TOPW WETP ALPH LEW REW QCR 1 10526 3432618 612 626 | WSBL LEW REW AREA K 002940. 95600. 7.50 |
| FEDERAL HIGHMA ADMINISTRATION - U. S. GEOLOGICAL SUKVEY V(I) 0.000 | 1.09 10526 3432618 612 626 1.00 -19 728 24.00 2 DRDG 991.09 * * 95600 | x STA28.2 38.5 67.0 95.6 121.1 146.3 A(1) 802.5 588.6 572.9 536.4 244.0 A(1) 802.5 588.6 572.9 536.4 244.0 A(1) 8.75 |
| $ \begin{array}{c} \text{Bridge No. 244, Tabuar Avery model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10/96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10, 23-96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10, 23-96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10, 23-96 \\ \text{Wattic Survey; model run by Tom Heinrichs Uses 10, 23-96 \\ \text{Wattic Survey; matrix Run Dark R Run ARRA & Run Dark R Run ARRA & Run Bars & Run Run Lun Heinrichs Uses 10, 23-96 \\ \text{Wattic Liew Risk ARRA & Run ARRA & Run ARRA & VII \\ 91.09 & -10.9 & 727.6 & 105.6.3 & 3432618 \\ \text{Wattic Liew Risk ARRA & Run ARRA & Run ARRA & VII \\ 0.100 & -10.9 & 40.9 & 77.7 & 117.0 & 155.1 & 185.0 \\ \text{Wattic Liew Risk ARRA & 2000; 9.08 \\ \text{Wattic Liew Risk ARRA & 117.0 & 155.1 & 185.0 \\ \text{Wattic Survey} Discrete Contronome Control Contronome Contro$ | PEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL, FOR WATER-SURFACE FROFILE COMPUTATIONS COMPUTATIONS | X STA: 146.3 171.8 196.8 222.9 252.5 282.2 X A(1) 546.0 533.1 8.70 8.33 8.41 V(1) V(1) 171.8 1.70 10.1 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | Bridge No. 244, fandum Arter of by Yom Heinrichs USGS 10/96 Hydraulic Survey; model run by Yom Heinrichs USGS 10/96 WSFRO Profiles (WSFRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | X STA. 282.2 316.0 354.2 397.3 445.9 494.9 A(I) 7.85 637.3 665.4 692.5 697.4 94.9 V(I) 7.85 7.50 7.18 6.90 6.85 |
| WSEL LEW REN AREA K Q VEL 1. 991.09 -19.9 727.6 10526.3 3432618: 95600. 9.08 EX EX -19.9 46.9 77.7 117.0 155.1 185.0 | /ELOCITY DISTRIBUTION: ISEQ = 4; SECID = BRDG ; SRD = −280. | x STA. 494.9 536.7 563.0 590.1 620.5 764.6 A(I) 7.19 8.23 7.78 7.08 4.33 V(I) 7.19 8.23 7.78 7.08 4.33 |
| | WSEL LEM REM AREA K Q WEL 991.09 -19.9 727.6 10526.3 3432618. 95600. 9.08 A19.9 46.9 77.7 117.0 155.1 185.0 | L + EX HANNANYANA BAARTED CATCHEARTONIC 10 |

Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska
| | | | WSEI. | 16.10 | 91.58 | 92.27 | | 92.14 | 92.56 | 16.26 | | | | WSEL | 92.11 | 92.30 | 92.99 | | 00.56 | 93.38 | 93.69 | |
|---|--|---|--|--|---|---|--|---|---|---|--|--|--|-------------------------------------|---|---|---|--|---|--|---|--|
| | | | Q VEL | 000 9 01 | e 000 | 200 9 | | 9 001. | 700 9 | 300 9 | RVEY | | | VEL 0 | 6 000 | 000 9 | 000 9 | | 100 9 | 700 9 | 300 9 | RVEY |
| | 96 | | | 110 | 104 | 93 | | 86 | 86 | 76 | AL SU | 96. | | | 123 | 123 | 123 | | 86 | 86 | 76 | AL SU |
| | GS 10, | | FR | 982.13 | 0.52 | 0.35 | | 0.32 | 0.28 | 0.34 | COLOGIC | GS 10/ | | CRWS | 986.37 | | 0.41 | | | 0.26 | ****** | OLOGIC |
| | tichs US | | EGI. | 02.20 | 92.45 * | 92.70 * | . 0.66 | 93.08 | 0.00 | 93.50 | S. GE | t chs US | | EGL | 2.99 | 3.28 * | . 59 * | IMITS. | 3.86 * | 3.97 * | 4.22 * | s. GE |
| | g Delta Heinr | 11:39 | НР | 6 | .24 9 | .25 9 | ENDED I | .13 9 | .13 9 | 29 9: | ON - U | g Delta Heinri | 11:39 | HF | | .25 99 | .31 99 | ENDED I | .14 95 | .11 99 | .25 99 | . U - NC |
| | at Bi | 082195 3-96 | UHD | 89 | .88 0 | .42 0 | RECOMM | 0 00.00 | .00 0 | 0 09.0 | STRATI | at Bi | 082195 3-96 | CHU | 88 | .28 0 | .60 0 | RECOMM | .85 U | .59 0 | .53 0 | STRATIC |
| | River L run | ver. V : 10-2 | RFA K A | 950 0 | 910 0 | 431 0 | DE OF | 176 0 | 447 0 640 1 | 318 0 | ADMINI WATER- | River | ver. V :: 10-2 | REA K A | 746 0 | 452 0 024 2 | 221 0 092 2 | DE OF | 712 0 | 100 0 | 593 0 | INIMUA |
| | 'ranana' | WSPRO & TIME | A N | 1 4914 | 4 4437 | 4 26 3 5666 | OUTSI | 1 3759 | 0 13 5 4355 | 9 17 | FOR | Tanana | WSPRO & TIME | A P | 2496 | 1 4949 | 3 6274 | 1STUO C | 1 4036 | 3 14 | 1120 | CGHWAY |
| | . 524. Surve | files N DATE | LEG | -304 | -305 | -344 | E RATI | -2 | -31 | -1 | ERAL H | . 524, Surve | files N DATR | LEI | -331 | -330 | -367 | E RATIC | -3(| -3. | -161 | ERAL H |
| | dge No | RO Pro | FLEN | | 450 | 637 | NEYANC | 332 | 280 | 740 | FED | dge No | RO Pro | SRDL | ****** | 450 | 637 | NEYANC | 332 | 280 | 740 | FED |
| | Bri Hyd | MSF | D:CODE SRD | :XS -1698 | :XS 1248 | :XS -611 | 135 CON | :XS -279 | 0 SX: | :XS 740 | 195 | Bri | L WSH | SRD | :XS -1698 | :XS -1248 | :XS -611 | 135 CON | :XS -279 | o sx: | :XS | 140 |
| | 5100 | ASE | IISX | XIT4 | XIT3 | XIT2 | N III | RRIXG | APPR | APPI | 1 WSPR(V082. | 2100 | CASE | XSII | XIT4 | XIT3 | XIT2 | 11 12 11 | BRDG | APPR | APP1 | 1 WSPR(|
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | WSEL | 01.970 | 179.94 | 980.63 | 380.87 | 181.12 | | 981,53 | | | | MSEL. | 980,28 | 980.49 | 981,09 | 981.32 | 181.53 | | 181,87 |
| | SN | | | Q WSEL VEL | 27400 979.70 6.40 | 7.00 979.94 | 23100 980.63 5.28 | 21500 980.87 4.84 | 21500 981.12 | | 18900 981.53 5.13 | SURVEY | | | Q MSEL VEL | 27400 980.28 6.11 | 25800 980.49 6.67 | 23100 981.09 5.09 | 21500 981.32 | 21500 981.53 3,93 | | 18900 981,87 4.86 |
| | PUTATIONS | 10/96 | | CRWS Q WSEL FR# VEL | 1.24 27400 979.70 0.32 6.40 | **** 25800 979.94 0.37 7.00 | •••• 23100 980.63 0.27 5.28 | **** 21500 980.87 0.31 4.84 | **** 21500 981.12 0.26 4.14 | | ••••• 18900 981.53 0.36 5.13 | OGICAL SURVEY IPUTATIONS | 10/96 | | CRWS Q MSEL FR# VEL | 1.24 27400 980.28 0.30 6.11 | •••• 25800 980.49 0.35 6.67 | **** 23100 981,09 0.26 5.09 | **** 21500 981.32 0.28 4.57 | 0.24 3,93 981.53 | | **** 18900 981,87 0.14 4.86 |
| | LE COMPUTATIONS | hs uses 10/96 | | EGL CRWS Q WSEL EKR FR# VEL | .34 971.24 27400 979.70 *** 0.32 6.40 | .71 ****** 25800 979.94 .00 0.37 7.00 | .07 •••••• 23100 980.63 1.00 0.27 5.28 | .23 ****** 21500 980.87 0.00 0.31 4.84 | 38 ****** 21500 981.12 0.00 0.26 4.14 | MITS. 0.61 | .94 ****** 18900 981.53 1.00 0.36 5.13 | 3. GEOLOGICAL SURVEY LE COMPUTATIONS | the USGS 10/96 | | EGL CRWS Q MSEL | .86 971.24 27400 980.28 *** 0.30 6.11 | 19 ****** 25800 980.49 0.00 0.35 6.67 | 50 ****** 23100 981.09 0.00 0.26 5.09 | .64 ****** 21500 981.32 0.00 0.28 4.57 | | MITS, 0.61 | 24 ****** 18900 981,87 .00 0.34 4.86 |
| | PROFILE COMPUTATIONS | Delta Heinrichs USGS 10/96 | 1:39 | HF EGL CRWS Q WSEL HO EKR FRM VEL | ** 980.34 971.24 27400 979.70 ** ****** 0.32 6.40 | 31 980.71 ****** 25800 979.94 06 0.00 0.37 7.00 | 36 981.07 •••••• 23100 980.63 00 0.00 0.27 5.28 | 17 981.23 ****** 21500 980.87 00 0.00 0.31 4.84 | 15 981.38 ****** 21500 981.12 00 0.00 0.26 4.14 | NDED LIMITS. ATIO = 0.61 | 49 981.94 ****** 18900 981.53 07 0.00 0.36 5.13 | <pre>N = U. S. GEOLOGICAL SURVEY PROFILE COMPUTATIONS</pre> | Delta Heinrichs USGS 10/96 | 1:39 | HF EGL CRWS Q MSFL. HO ERR FRM VEL | ** 980.86 971.24 27400 980.28 ** ****** 0.30 6.11 | 26 981.19 ****** 25800 980.49 06 0.00 0.35 6.67 | 31 981.50 ****** 23100 981.09 00 0.00 0.26 5.09 | 14 981.64 ****** 21500 981.32 00 0.00 0.28 4.57 | 13 981.77 ****** 21500 981.53 00 0.00 0.24 3.93 | NDED LIMITS, ATIO = 0.61 | 41 982.24 ****** 18900 981.87 06 0.00 0.34 4.86 |
| THATTAN - U - UEVIDATAN - U - UNAT | URFACE PROFILE COMPUTATIONS | at Big Delta y Tom Heinrichs USGS 10/96 | 661139 -96 11:39 | HD HF EGL CRMS Q WSEL PH HO EKR FR# VEL | 64 ***** 980.34 971.24 27400 979.70 00 ***** ******* 0.32 6.40 | 76 0.31 980.71 ****** 25800 979.94 00 0.06 0.00 0.37 7.00 | 43 0.36 981.07 ****** 23100 980.63 00 0.00 0.00 0.27 5.28 | 36 0.17 981.23 ****** 21500 980.87 00 0.00 0.00 0.31 4.84 | 27 0.15 981.38 ****** 21500 981.12 00 0.00 0.00 0.26 4.14 | ECOMMENDED LIMITS. KRATIO = 0.61 | 41 0.49 981.94 ****** 18900 981.53 00 0.07 0.00 0.36 5.13 | TRATION - U. S. GEOLOGICAL SURVEY MIFACE PROFILE COMPUTATIONS | at Big Delta yy Tom Heinrichs USGS 10/96 821951 | -96 11:39 | HD NF EGL CRMS Q MSEL PH NO ERR FR# VEL | 58 ***** 980.86 971.24 27400 980.28 00 ***** ****** 0.30 6.11 | 69 0.26 981.19 ****** 25800 980.49 00 0.06 0.00 0.35 6.67 | 40 0.31 981.50 ****** 23100 981.09 01 0.00 0.00 0.26 5.09 | 33 0.14 981.64 ****** 21500 981.32 00 0.00 0.00 0.28 4.57 | 24 0.13 981.77 ****** 21500 981.53 00 0.00 0.00 0.24 3.93 | IECOMMENDED LIMITS. KRATIO = 0.61 | 37 0.41 982.24 ****** 18900 981.87 00 0.06 0.00 0.34 4.86 |
| NIMINISTRATION - U.S. GEOLOGICAL SURVEI | APPLINISTRATION = 0. 3. GEOCOLOUL SOMER | River at Big Delta 1 run by rom Heinrichs USGS 10/96 | ver. V082195) : 10-23-96 11:39 | REA VHD HF EGL CRMS Q WSEL K Alph HU EKR FR# VEL | 283 0.64 ***** 980.34 971.24 27400 979.70 965 1.00 ***** ****** 0.32 6.40 | 686 0.76 0.31 980.71 ****** 25800 979.94 351 1.00 0.06 0.00 0.37 7.00 | 372 0.43 0.36 981.07 ****** 23100 980.63 778 1.00 0.00 0.00 0.27 5.28 | 440 0.36 0.17 981.23 ****** 21500 980.87 222 1.00 0.00 0.00 0.31 4.84 | 197 0.27 0.15 981.38 ***** 21500 981.12 545 1.00 0.00 0.00 0.26 4.14 | DE OF RECOMMENDED LIMITS. APPL " KRATIO = 0.61 | 682 0 41 0 49 981.94 ****** 18900 981.53 566 1.00 0.07 0.00 0.36 5.13 | ADMINISTRATION - U. S. GEOLOGICAL JUNEY JATER-SURFACE PROFILE COMPUTATIONS | River at Big Delta I run by Tom Heinrichs USCS 10/96 Ar VOR71651 | : 10-23-96 11:39 | REA VHD HF EGL CRWS Q USEL K ALPH HO ERR FRM VEL | 483 0.58 ***** 980.86 971.24 27400 980.28 501 1.00 ***** ****** 0.30 6.11 | 867 0.69 0.26 981.19 ****** 25800 980.49 922 1.00 0.06 0.00 0.35 6.67 | 541 0.40 0.31 981.50 ****** 23100 981.09 120 1.01 0.00 0.00 0.26 5.09 | 702 0.33 0.14 981.64 ****** 21500 981.32 321 1.00 0.00 0.00 0.28 4.57 | 470 0.24 0.13 981.77 ****** 21500 981.53 322 1.00 0.00 0.00 0.24 3.93 | DE OF RECOMMENDED LIMITS. APP1 * KRATIO = 0.61 | 987 0.37 0.41 982.24 ****** 18900 981.87 143 1.00 0.06 0.00 0.34 4.86 |
| CHUAV ADMINISTRATION - U. S. DEULUDILAL SURVEI | FOR WATER-SURFACE PROFILE COMPUTATIONS | Tanana River at Big Delta : model run Prom Heinrichs USGS 10/96 | WSPHO VEY. VU82195) & TIME: 10-23-96 11:39 | I AREA VHD HF EGL CRWS Q WSEL K ALPH HU EKR FR# VEL | 1136965 1.00 ***** 980.34 971.24 27400 979.70 | 3686 0.76 0.31 980.71 ****** 25800 979.94 909351 1.00 0.06 0.00 0.37 7.00 | 1 4372 0.43 0.36 981.07 ****** 23100 980.63 1 1163778 1.00 0.00 0.00 0.27 5.28 | 4440 0.36 0.17 981.23 ****** 21500 980.87 98822 1.00 0.00 0.00 0.31 4.84 | 1 5197 0.27 0.15 981.38 ****** 21500 981.12 1010645 1.00 0.00 0.00 0.26 4.14 |) OUTSIDE OF RECOMMENDED LIMITS. "APPL " KRATIO = 0.61 | 1 3682 0 41 0.49 981.94 ****** 18900 981.53 614566 1.00 0.07 0.00 0.36 5.13 | GHMAY ADMINISTRATION - U. 3. GEOLOGICAL SURVEY FOR UATER-SURFACE PROFILE COMPUTATIONS | Tanana River at Big Delta ; model run by Tom Heinrichs USGS 10/96 My Debo ver V0871651 | & TINE: 10-23-96 11:39 | N AREA VHD NF EGL CRWS Q MSRI, K ALPH HO ERR FR# VEL | 4483 0.58 ***** 980.86 971.24 27400 980.28 1224603 1.00 **** ****** 0.30 6.11 | 1 3867 0.69 0.26 981.19 ****** 25800 980.49 981922 1.00 0.06 0.00 0.35 6.67 | 1 4541 0.40 0.31 981.50 ****** 23100 981.09 1232120 1.01 0.00 0.00 0.26 5.09 | 7 4702 0.33 0.14 981.64 ****** 21500 981.32 931321 1.00 0.00 0.00 0.28 4.57 | 1 5470 0.24 0.13 981.77 ****** 21500 981.53 1099022 1.00 0.00 0.00 0.24 3.93 |) OUTSIDE OF RECOMMENDED LIMITS. "APPI * KRATIO = 0.61 | 1 3887 0.37 0.41 982.24 ****** 18900 981.87 670143 1.00 0.06 0.00 0.34 4.86 |
| VUAL HIGHWAY ADMINISTRATION - U. S. WENLOWLOWLOW SURVEI | NODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | . 524. Tanana River at Big Delta Survey: model run.nooron Heinrichs USGS 10/96 | tiles (WSPRO Ver. VU82195) 4 DATE & TIME: 10-23-96 11:39 | LEN AREA VHD HF EGL CRMS Q WSEL REM K ALPH HU EKR FR# VEL | 0 4283 0.64 ***** 980.34 971.24 27400 979.70 341 1136965 1.00 ***** ****** 0.32 6.40 | -2 3686 0.76 0.31 980.71 ****** 25800 979.94 326 909351 1.00 0.06 0.00 0.37 7.00 | -15 4372 0.43 0.36 981.07 ****** 23100 980.63 340 1163778 1.00 0.00 0.00 0.27 5.28 | 1 4440 0.36 0.17 981.23 ****** 21500 980.87 712 848222 1.00 0.00 0.00 0.31 4.84 | 0 5197 0.27 0.15 981.38 ****** 21500 981.12 666 1010645 1.00 0.00 0.00 0.26 4.14 | E RATIO OUTSIDE OF RECOMMENDED LIMITS. "APPL " KRATIO = 0.61 | 0 3682 0.41 0.49 981.94 ****** 18900 981.53 596 614566 1.00 0.07 0.00 0.36 5.13 | ERAL HIGHHAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY NODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | . 524, Tanana River at Big Delta Survey: model run by Tom Heinrichs USCS 10/96 Filse Vietedo vor V0871051 | N DATE & TIME: 10-23-96 11:39 | LEW AREA VHD HF EGL CRWS Q BISEL REW K ALPH HO ERR FRH VEL | -2 4483 0.58 **** 980.86 971.24 27400 980.28 342 1224603 1.00 **** ****** 0.30 6.11 | -5 3867 0.69 0.26 981.19 ****** 25800 980.49 327 981922 1.00 0.06 0.00 0.35 6.67 | -35 4541 0.40 0.31 981.50 ****** 23100 981.09 341 1232120 1.01 0.00 0.00 0.26 5.09 | 0 4702 0.33 0.14 981.64 ****** 21500 981.32 712 931321 1.00 0.00 0.00 0.28 4.57 | 0 5470 0.24 0.13 981.77 ****** 21500 981.53 667 1099022 1.00 0.00 0.00 0.24 3.93 | E RATIO OUTSIDE OF RECOMMENDED LIMITS. "APP1 " KRATIO = 0.61 | 0 3887 0.37 0.41 982.24 ****** 18900 981.87 598 670143 1.00 0.06 0.00 0.14 4.86 |
| PEDEUAL HICHWAY ADMINISTRATION - U. S. NEULUNICHLAU SURVEI | FEDERAL HIGHWAY ADMINISTRATION = 0.3. GEODOLOM SOVER MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | dge No. 524. Tanana River at Big Delta raulic Survey; model run by Tom Heinrichs USGS 10/96 | RO Profiles (WSPRO Ver. VU02199) ••• RUN DATE & TIME: 10-23-96 11:39 | SRDL LEW AREA VHD HF EGL CRMS Q WSEL Flen Rew K aliph hu ekr frø vel | 0 4283 0.64 **** 980.34 971.24 27400 979.70 ***** 341 1136965 1.00 ***** ****** 0.32 6.40 | 450 -2 3686 0.76 0.31 980.71 ****** 25800 979.94 450 326 909351 1.00 0.06 0.00 0.37 7.00 | 637 -15 4372 0.43 0.36 981.07 ****** 23100 980.63 637 340 1163778 1.00 0.00 0.00 0.27 5.28 | 332 1 4440 0.36 0.17 981.23 ****** 21500 980.87 332 712 848222 1.00 0.00 0.00 0.31 4.84 | 280 0 5197 0.27 0.15 981.38 ****** 21500 981.12 280 666 1010645 1.00 0.00 0.00 0.26 4.14 | VEVANCE RATIO OUTSIDE OF RECOMMENDED LIMITS. "APPL " KRATIO = 0.61 | 740 0 3682 0 41 0.49 981.94 ****** 18900 981.53 740 596 614566 1.00 0.07 0.00 0.36 5.13 | FEDERAL HIGHMAY ADMINISTRATION - U. 3. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | dye No. 524, Tanana River at Big Delta ráulic Survey, model run by Tom Heinrichs USCS 10/96 po bocfilae (95900 vor V0871950) | *** RUN DATE & TIME: 10-23-96 11:39 | SRDL LEW AREA VHD HF EGL CRWS Q USEL. FLEN REW K ALPH HO ERR FRM VEL | | 450 -5 3867 0.69 0.26 981.19 ****** 25800 980.49 450 327 981322 1.00 0.06 0.00 0.35 6.67 | 637 -35 4541 0.40 0.31 981.50 ****** 23100 981.09 637 341 1232120 1.01 0.00 0.00 0.26 5.09 | 332 0 4702 0.33 0.14 981.64 ****** 21500 981.32 332 712 931321 1.00 0.00 0.00 0.28 4.57 | 280 0 5470 0.24 0.13 981.77 ****** 21500 981.53 280 667 1099022 1.00 0.00 0.00 0.24 3.93 | VEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS. "APPI " KRATIO = 0.61 | 740 0 3887 0.37 0.41 982.24 ****** 18900 981.87 740 598 670143 1.00 0.06 0.00 0.34 4.86 |
| PO PEDEDAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY | 10 FEDERAL HIGHMAY ADMINISTRATION - U. S. GEODOLOLD SURVEY | Bridge No. 524. Tanana River at Big Delta IT Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 | WSPRO Profiles (WSFRO Ver. VO82195) *** RUN DATE & TIME: 10-23-96 11:39 | ID:CODE SRDL LEN AREA VHD HF EGL CRMS Q WSEL SRD FLEN REM K ALPH HU EKR FR# VEL | 4 :XS ***** 0 4283 0.64 **** 980.34 971.24 27400 979.70 -1698 ***** 341 1136965 1.00 **** ****** 0.32 6.40 | 3 :XS 450 -2 3686 0.76 0.31 980.71 ****** 25800 979.94 -1248 450 326 909351 1.00 0.06 0.00 0.37 7.00 | 2 :X5 637 -15 4372 0.43 0.36 901.07 ****** 23100 980.63 -611 637 340 1163778 1.00 0.00 0.00 0.27 5.28 | G :XS 332 1 4440 0.36 0.17 981.23 ****** 21500 980.87 -279 332 712 848222 1.00 0.00 0.00 0.31 4.84 | R :XS 280 0 5197 0.27 0.15 981.38 ****** 21500 981.12 0 280 666 1010645 1.00 0.00 0.00 0.26 4.14 | =135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS. "APP1 " KRATIO = 0.61 | 1 :XS 740 0 3682 0 41 0.49 981.94 ****** 18900 981.53 740 740 596 614566 1.00 0.07 0.00 0.36 5.13 | RU FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY 2195 NODEL FOR WATER-SURFACE PROFILE COMPUTATIONS | ${\cal M}$ Bridge No. 524, Tanana River at Big Delta Hydraulic Survey, model run by Tom Heinrichs USCS 10/96 weedo postilae (MSEPO var V0821954) | *** RUN DATE & TIME: 10-23-96 11:39 | TD:CODE SRDL LEW ARRA VHD NF EGL CRWS Q USEL, SRD FLEN REW K ALPH HO ERR FRM VEL | 4 :XS ***** -2 4483 0.58 **** 980.86 971.24 27400 980.28 -1698 ***** 342 1224603 1.00 ***** ****** 0.30 6.11 | 3 :XS 450 -5 3867 0.69 0.26 981.19 ****** 25800 980.49 -1248 450 327 981922 1.00 0.06 0.00 0.35 6.67 | 2 :XS 637 -35 4541 0.40 0.31 981.50 ****** 23100 981.09 -611 637 341 1232120 1.01 0.00 0.00 0.26 5.09 | G: :XS 332 0 4702 0.33 0.14 981.64 ****** 21500 981.32 -279 332 712 931321 1.00 0.00 0.00 0.28 4.57 | In 1XS 280 0 5470 0.24 0.13 981.77 ****** 21500 981.53 0 280 667 1099022 1.00 0.00 0.24 3.93 | =115 CONVEYANCE NATIO OUTSIDE OF RECOMMENDED LIMITS. -APPI * KRATIO = 0.61 | 1 :XS 740 0 3887 0.37 0.41 982.24 ****** 18900 981.87 740 740 598 570143 1.00 0.05 0.00 0.34 4.86 |

| | WSEL | 50.266 | 992.33 | 993.00 | | 992.81 | 993.28 | 993.67 | | | | MSEL | 992.87 | 80.566 | \$7.266 | | 17.500 | EL. 966 | 74.47 | | | WSEL |
|-------|--|-------------------------------------|---|---|--|--|--|--|--|---|---|--|---|---|--|--|--|--|--|---|---|--|
| | VEL | 4.97 | 4.88 | 03000 | | 95600 8.25 | 95600 | 6.82 84200 4.54 | SURVEY | | | Q | 36900 | 36900 | 36900 | | 95600 | 00956 | 84200 | SURVEY | | 0 |
| | CRWS FR# | 0.51 | 0.51 | 0.34 | | ***** | | 0.34 | DLOGICAL | 35 10/96 | | CRMS FR# | 87.73 1 | 0.53 | 1 | | | ***** | ***** | LOGICAL | S 10/96 | CRWS |
| | EGL ERR | ***** | 93.18 | 93.42 ** | LIMITS. | 93.87 ** | * 00. 46 | 94,31 ** | FILE CO | a ichs ust | | EGL | 93.75 9 | 94.03 ** | 94.34 ** | LIMITS. | 94.67 ** | ** 64.79 | ** 50.26 | . S. GEO | a ichs USG | EGL |
| | HF | ** *** | 0.23 9 | 0.24 9 | TENDED | 0.13 9 | 9 11.0 | 00.10 | ION - U | g Delt | 11:39 | HF HO | 6 *** | .25 9 | .31 9 | RATTO | .15 9 | 9 21. | .26 9 | ON - U | g Delt Heinr | 11:39 HF |
| | UHD HALPH | 2.29 ** | 0.85 0 | 0.42 0 | RECOM | 1.06 0 | 0.72 | 0.65 0 | ISTRAT1 -SURFAC | r at Bi by Ton | V082195 | VHD AL.PH | 0.87 ** | 0.95 0 | 0.60 0 | RECOMM | 0.96.0 | 0.66 0 | 0.57 0 | ISTRATI-SURFAC | r at Bi by Tom V082195 | 23-96 VHD |
| | AREA K | 151509 | 23548 | 29262 | SIDE OF | 11589 | 14022 | 185592 18557 | NY ADMIN | na Rive del run | 00 ver. | AREA K | 27658 | 26380 | 32340 | SIDE OF | 12153 | 14702 | 19876 | Y ADMIN WATER | na Rive del run O ver. | ME: 10-3 AREA |
| | LEW REW | 347 54 | 334 49 | 683 353 62 | TIO OUT | -29 39 | -33 | -19 40 | HIGHWA | 4, Tana vev: mo | TE & TI | LEW REW | 573 51 | 575 334 55 | 928 353 69 | TIO OUT | -31 40 | -36 50 | -19 45 | HIGHWA EL FOR | 4, Tana vey; mo s (WSPR | TE & TI LEW |
| - | FLEN | | 450 -3 | 637 -3 | YANCE RA | 332 | 280 | 280 740 740 | FEDERAL | e No. 52 | Profile * RUN DA | PLEN | E | 450 -3 | 637 -3 | ANCE RA | 332 | 280 | 740 | FEDERAL | a No. 52 ilic Sur Profile | RUN DA |
| CASE | SRD I | -1698 *** | :XS -1248 | :XS -611 | 35 CONVEN | :XS | SX: | 0 740 | 56 | Bridge | WSPRO | SRD E | :XS *** | :XS -1248 | :XS -611 | 35 CONVEN | SX: | XS . | XS TAU | 56 | Bridge Hydrau WSPRO | CODE S |
| Q 500 | XSID | XIT4 | XIT3 | XIT2 | 1=== | BRDG | APPR | APP1 | 1 WSPRO V0821 | 0050 | CASE | XSID | XIT4 | XIT3 | XIT2 | 1 | BRDG | APPR | APP1 | 1 WSPRO VOB21 | | XSID |
| | dge No. 524, Tanana River at Rig Delta raulic Survey; model run by Tom Heinrichs USGS 10/96 RO Profiles (MSPRO ver, V082195) | *** RUN DATE & TIME: 10-23-96 11:39 | SRDL LEW AREA VIID HF EGL CRMS Q WSEL FLEN REW K ALPH HO EKR FK# VEL | •••••• -3312 24746 0.88 ••••• 992.99 986.37 123000 992.11 •••••• 347 5496068 2.29 ••••• •••••• 0.51 4.97 | 450 -3453 25035 0.43 0.17 993.15 ****** 86700 992.73 450 334 5274406 2.28 0.00 0.00 0.36 3.46 | 637 -3684 29272 0.30 0.14 993.30 ****** 86700 993.00 637 353 6285391 2.18 0.00 0.00 0.29 2.96 | VEVANCE RATIO OUTSIDE OF RECOMMENDED LIMITS. - PRD3 * KRATIO = 0.63 | 332 -29 11592 0.87 0.10 993.68 ****** 86700 992.81 332 734 3974415 1.00 0.29 0.00 0.31 7.48 | 280 -33 13954 0.60 0.11 993.80 ****** 86700 993.20 280 766 4620227 1.00 0.00 0.00 0.26 6.21 | 740 -19 18307 0.54 0.26 994.06 ****** 76300 993.51 740 1611 4093808 2.01 0.00 0.00 0.31 4.17 | FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL. FOR WATER-SURFACE PROFILE COMPUTATIONS | dge No. 524, Tanana River at Big Delta raulic Survey, model run by Tom Neinricha USCS 10/96 | RO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 | STAL LEW AREA VHD HF ECL CRWS Q WSFI. FLEN REW K ALPH HO ERR FR# VEL | 2470 16744 0.90 990.53 979.78 86700 989.64 347 3873708 2.15 0.55 5.18 | 450 -2430 15463 1.06 0.26 990.87 ****** 86700 989.81 450 334 3387028 2.17 0.08 0.00 0.62 5.61 | 637 -28B0 20443 0.61 0.32 991.18 ****** 86700 990.57 637 353 4415498 2.18 0.00 0.00 0.44 4.24 | 332 -15 10156 1.13 0.17 991.62 ****** 86700 990.48 332 725 3250174 1.00 0.26 0.00 0.37 8.54 | 280 -25 12213 0.78 0.17 991.79 ****** 86700 991.01 280 764 3734661 1.00 0.00 0.00 0.32 7.10 | 740 -19 14923 0.76 0.41 992.20 ****** 76300 991.44 740 1609 3235554 1.88 0.00 0.00 0.41 5.11 | FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY NODEL FOR WATER-SURFACE FROFILE COMPUTATIONS dome No. 524. Tanana River at Big Delta | raulic Survey: model run by Tom Heinrichs USGS 10/96 NO Profiles (WSPRO ver. 0023155) |
| | 2 100 Brid Hydr | - HOR | XSID:CODE SRD | XIT4 :XS -1698 | XIT3 :XS -1248 | XIT2 :XS -611 | ===135 CONV | BRDG :XS -279 | APPR :XS 0 | APP1 :XS 740 | U WSPRO V082195 | 2 100 Brid | CASEY WSPI | XSID, CODE SRD | XIT4 :XS -1698 | XIT3 :XS -1248 | XIT2 :XS -611 | BRDG :XS -279 | APPR : XS 0 | APPL :XS 740 | uspro Vo82195 Brid | рун |

Q 500 CASE 3

| 992.87 | 15.566 | 92.266 | | 993.52 | 993.95 | 994.30 | | MSEL | 690.33 | 15.066 | 991.25 | 991.09 | 991.69 | 992.16 |
|--------|-----------------------|------------------|----------------------|-------------|------------------|-------------------------------|--|-------------|---------------|--------------|------------------|-------------|---------------|---------------|
| 136900 | 95600 | 95600 2.95 | | 95600 | 95600 | 84200 4.30 SURVEY | ONS | 0 VEL | 95600 5.09 | 95600 | 95600 | 95600 | 95600 | 84200 5.23 |
| 987.73 | 0.34 | 0.28 | ·c | 0.32 | 0.27 | 0.31 BOLOGICAL | COMPUTATI SGS 10/96 | CRWS FR# | 980.64 | 0.60 | 0.43 | 0.39 | 0.33 | 0.41 |
| 393.75 | 993.91 | 994.05 | D LIMITS 0 = 0.60 | 994.50 | 994.62 | 994.89 0.00 | ROFILE (Ita nrichs U | EGL | 991.22 | 991.54 | 991.86 | 992.37 | 992.56 | 992.98 |
| | 0.17 | 0.14 | KRATT | 0.10 | 0.12 | 0.27 0.00 | ACE P Big De om Hei 95) 11:3 | HF HO | | 0.26 | 0.32 | 0.18 | 0.19 | 0.42 |
| 0.87 | 0.41 2.26 | 0.29 | F RECO | 0.98 | 0.67 | 0.59 2.05 | R-SURF. er at 1 1 by T 1 v0821 -23-96 | VHD ALPH | 0.89 2.21 | 1.03 | 0.61 2.20 | 1.28 | 0.87 | 0.82 |
| 27658 | 28079 2914379 | 32442 6993931 | UTSIDE OF | 12035 | 14559 4943306 | 19598 4445036 WAY ADMIN | COR WATE Inana Rive model ru SPRO ver. TIME: 10- | AREA K | 18783 4274985 | 17489 | 22717 4881807 | 10528 | 12751 4001385 | 16108 |
| -3573 | -3725 -3725 334 | 3935 | RATIO 0 | -31 736 | -35 | -19 1612 AL HIGH | 000EL 1 524, Ta urvey: les (WS DATE & | I.EW REW | -2707 347 | -2675 | -3105 | -19 728 | -27 765 | 19 |
| | 450 | 637 | VEYANCE | 332 | 280 | 740 740 FEDER | dge No. raulic s RO Profi | SRDI. | | 450 | 637 | 332 | 280 280 | 740 |
| SX: | -1698 :XS -1248 | :X5 -611 | 35 CUN | :XS -279 | :XS | :XS 740 | 95. Brli Hyd WSP | SRD | :X\$ -1698 | :XS -1248 | :XS -611 | :XS -279 | 0 SX: | : X5 740 |
| XIT4 | XIT3 | XIT2 | Lasa | BRDG | APPR | APP1 1 USERG | Q 500 CASE 4 | disx | XIT4 | X1T3 | XIT2 | BRDG | APPR | APP1 ER |

I NORMAL END OF WSPRO EXECUTION.

GEOLOGICAL SURVEY COMPUTATIONS GEOLOGICAL SURVEY COMPUTATIONS 10/96 VEL 4.13 10/96 VEL 4.57 USGS Bridge No. 524, Tanana River at Big Delta Hydraulic Survey: model run by Tom Heinrichs USGS WERPO Fuciles (WERPO ver. V003195) *** RUN DATE & TIME: 10-23-96 11:39 REW 712 REW 666 21500. VELOCITY VELOCITY 5.35 0 2.4 21500. 5 - U. S. (PROFILE Bridge No. 324, Tanana River at Big Delta Hydraulic Suvey: model run by Yon Heinrichs (WSPRD Proficiss (WSPRD ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 PROFILE v. LEW 0 LEW 0 - 0. -× * 932049. 1011614. ~ 8 0 12.2 12.1 HYDEPTH HYDEPTH FEDERAL HIGHWAY ADMINISTRATION MODEL FOR WATER-SURFACE FEDERAL HIGHWAY ADMINISTRATION MODEL FOR WATER-SURFACE ALPH 1.00 ALPH 1.00 AREA 4704.1 AREA 5199.7 590 590 WETP 2286.4 2228.9 2228.9 2214.0 2214.0 2215.4 2219.5 2219.5 2219.5 2219.9 2219.9 225.9 2265.0 2210.1 2265.0 308.7 308.7 671 201.1 AREA TUBE" AREA 205. REW .112.4 REW 666.0 DEPTH STREAM MJOT 666 584 TOPW 41.28 24.69 24.69 19.84 19.84 19.10 19.10 19.10 19.10 19.10 19.10 19.10 19.20 87.23 4.45 22.25 22.25 20.33 20.33 20.33 20.33 20.33 20.33 20.25 21.66 19.10 19.10 19.20 116.75 117.75 116.75 110 T'UBE" 16.57 FOR 16.75 WIDTH HIDIM PROPERTIES: " STREAM DISTRIBUTION: " к 932049 932049 MODEL DISTRIBUTION:" WSEL LEW 81.32 -0.3 K 1011614 1011614 LEW 0.0 41.2 63.9 88.6 88.9 88.7 110.9 110.9 110.1 577.8 21500 561.0 RIGHT RIGHT HYDRAULIC VELOCITY WSEL 981.32 W3EL 981.12 CROSS-SECTION 544.4 AREA 5200 5200 0.0 41.2 63.9 85.9 85.9 110.9 110.9 110.9 130.1 150.1 150.1 150.1 150.1 150.1 150.1 150.1 150.1 150.1 150.1 160.7 170.7 981.32 4704 561.0 AREA WSEL LEFT LEFT VELOCITY VELOCITY. 1 WSPRO V082195 HIGHEST LARGEST WSPRO V082195 SECID BRDG SECID APPR TOTAL SECID TOTAL TUBE# TUBE# 16 17 BRDG SA# SA# SURVEY GEOLOGICAL SURVEY COMPUTATIONS COMPUTATIONS GEOLOGICAL e No. 524. Tanana River at Big Delta ulic Survey; model run by Tom Heinrichs USGS 10/96 Profilas (MSPRO ver. V082195) PRO PARE & TIME: 10-23-96 11:39 VEL 4.84 REW 712 21500. VELOCITY 5.79 5.79 FEDERAL HIGHWAY ADMINISTRATION - U. S. (MODEL FOR WATER-SURFACE PROFILE FEDERAL HIGHWAY ADMINISTRATION - U. 3. MODEL FOR WATER-SURPACE PROFILE LEW -Tanana River at Big Delta & TIME: 10-23-96 11:39 K 848643. 8.7 8.7 4000 HYDEPTH 1.00 WETP ALPH BRIDGE SECTION: " AREA 4441.6 253.6 195.4 248.9 235.4 193.2 188.3 188.3 187.1 185.7 191.0 207.0 197.2 193.6 00000 589 185.7 185.7 TUBE" AREA 226.252.252. 236. 212 281 H STREAM 21.34 711.5 TOPW 582 1 TUBE" 21.34 49,45 22,96 441,46 41,46 41,46 22,25 22,27 22,29 46 22,29 22,29 22,29 22,29 22,29 23,29 23,29 24,23 37,71 16 27 22,29 22,20 22 HINTH "CROSS-SECTION PROPERTIES:" PROPERTIES: " NI Bridge No. 524, T Hydraulic Survey, WSPRO Profiles (W HYDRAULIC DEPTH 50.9 272.2 2 STREAM DISTRIBUTION: " K 848643 848643 524. DATE LEW 0.5 BED ELEVATION 21500 50.0 73.0 119.5 119.5 205.5 2228.6 2028.6 2029.6 2029.6 2028.6 2029.6 20 519.3 8 21500 272.2 RIGHT 618. No. VELOCITY. VIMY 969.60 *** Bridge *** WSEL 980.87 SECTION 50.5 50.0 73.0 1118.0 1159.5 1183.3 2250.9 2250.9 2228.6 2020.0 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200.0 200 WSEL 981.12 WSEL 980.87 AREA 4442 4442 250.9 LEFT 250. "VELOCITY E SECID W BRDG 980 MIMIMIM. "HIGHEST LARGEST V082195 V082195 ·CROSS-SECID X 62.3 TUBE# **MSPRO** SECID TOTAL WSPRO 5 5 BRDG SA#

34 Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

| 80 48 29 | 05 | 05 | | REW 731 | EOLOGICAL SURVI COMPUTATIONS | ISGS 10/96 | | Q VEL 0. 7.76 | 87 71 61 | 69 65 65 | 66 28 28 54 54 | 17 03 93 | 30 81 06 | .84 | 77 | .66 | | | REW |
|---|--|---|---|---|--|--|---|--|--|--|---|---|--|---|--|--|--|---|---|
| 440 | 5. | 5. | | SW SS | S. G. | ichs U | | 8670 | 55.5 | - 00 00 1 | | 1 7 2 2 2 | | 2 | 80 | 80 | | | Ma |
| 12.1 6.3 | 12.7 | 12.7 | | ALPH LE | ATION - U. | Big Delta Tom Heinri 195) | 6 11:39 | к 3758631. | 10.2 17.5 14.5 | 14.8 17.3 17.7 | 17.6 17.6 16.3 17.9 17.9 | 15.6 15.6 | 14.0 | 10.6 | 17.5 | 17.9 | | | ALPH LA |
| 23.9 | 12.9 | UBE" 12.9 | | WETP | INISTR ER-SUR | ver at un by | 0-23-9 | AREA 173.4 | 38.1 62.3 69.5 | 63.9 07.2 01.1 | 94.3 500.6 523.6 501.6 | 339.7 546.3 | 593.9 | 142.8 | 194.3 | FUBE* | | | WETP 807 |
| 18.05 2 19.79 2 51.71 3 | TUBE" 16.81 2 | STREAM T 16.81 2 | | TOPW 620 620 | GHWAY ADM FOR WAT | Tanana Ri ; model r | & TIME: 1 | 731.2 11 | 32.21 5 39.39 5 | 38.22 29.31 28.36 | 28.29 9 28.01 5 32.15 1 32.15 1 28.09 0 28.09 0 28.09 0 28.09 0 28.09 0 28.09 0 28.09 0 28.09 0 28.09 0 28.09 0 28.00 0 28.00 0 28.01 0 28.01 0 28.01 0 20 0 20 0 20 0 20 0 20 0 20 0 20 0 | 334.48 | 42.46 35.29 47 70 | 70.38 | 28.29 | 28.01 | 1.1.5 | | T97 |
| 595.1 614.9 666.6 | Y STREAM 577.0 | JC DEPTH | PROPERTIE: Q 86700 | K 3758631 3758631 | EDERAL HI | No. 524, ' ic Survey | RUN DATE | -26.0 | 46.5 78.7 118.1 | 156.3 185.6 214.0 | 242.3 270.3 298.7 330.8 358.9 | 456.9 | 577.8 577.8 613.1 660.8 | 731.2 | 242.3 | LIC DEPTH 270.3 | PROPERTIE | 86700 | K 4355061 |
| 577.0 595.1 614.9 | T VELOCIT 560.2 | T HYDRAUI 560.2 | SECTION I WSEL 992.14 | AREA 11173 11173 | H | Bridge h Hydraul: wspec pr | 1 *** | WSEL WSEL | -26.0 46.5 78.7 | 118.1 156.3 185.6 | 214.0 242.3 270.3 330.8 330.8 | 388.8 388.8 422.4 456.9 | 535.4 577.8 613.1 | 660.8 | 214.0 | ST HYDRAU 242.3 | -SECTION | 992.56 | AREA 13446 |
| 18 19 20 | T1 17 | LARGES | CROSS- SECID 3RDG | SA# 1 FOTAL | VSPRO 1082195 | | The offer | SECID | rube# 1 2 3 | 4 10 10 | 8 9 11 11 | 13 14 15 | 17 18 18 | 20 | L 1 | "LARGE: | "CROSS- | APPR | SA# |
| | | | | | | | | | | | | | | | | | | | |
| 02 22 18 | 20 24 | 30 550 550 | 23 69 | 58 34 80 81 | 35 06 | 50 | 50 | | REW 667 | BOLOGICAL SURVEY COMPUTATIONS | scs 10/96 | Q VEL 0. 3.93 | лту 54 | 41 33 56 | 81 | 74 69 65 | 21 08 91 | 35 03 | 46 95 05 |
| 3.92 5.22 4.18 | 4.31 5.20 5.34 | 5.30 5.36 5.50 | 4,91 5,18 4,69 | 4.58 4,34 3.80 3.81 | 3.06 | 5.50 | 5.50 | | JSW REW D 667 | , S. GEOLOGICAL SURVEV PTLE COMPUTATIONS | a icha USCS 10/96 | 21500. 3.93 | VELOCITY 3.54 | 4.41 4.56 4.56 | 4.81 4.72 | 4.74 4.65 4.65 | 4.21 4.08 3.91 | 3.35 2.03 | 2,46 4,95 5,05 |
| 5.4 3.92 8.9 5.22 5.9 4.18 | 6.0 4.31 8.5 5.20 8.8 5.34 | 8.6 5.30 8.8 5.36 9.1 5.50 9.1 5.50 | 7.4 4.91 8.7 5.18 8.8 4.69 7.3 4.69 | 6.8 4.58 6.5 4.34 5.3 3.80 5.2 3.81 | 6.7 4.35 3.9 3.06 | 9.1 5.50 | 9,1 5,50 | | ALPH LJSW REW 1 OD 0 667 | ANTION - U. S. GEOLOGICAL SURVEY PRACE PROPILE COMPUTATIONS | t Big Delta Trom Heinricha USCS 10/96 2195) 96 11:39 | K 0 VEL 1099890. 21500. 3.93 | HYDEPTH VELOCITY 7.2 3.54 | 10.5 4.41 9.8 4.33 10.6 4.56 | 11.2 4.81 11.5 4.72 | 11.2 4.74 11.1 4.69 11.2 4.65 | 9.7 4.21 9.1 4.08 8.4 3.91 | 6.9 3.35 4.6 2.03 | 5.4 2.46 12.4 4.95 12.7 5.05 |
| 274.5 5.4 3.92 205.8 8.9 5.22 257.0 5.9 4.18 | 249.2 6.0 4.31 260.7 8.5 5.20 201.3 8.8 5.34 | 202.9 8.6 5.30 200.7 8.8 5.36 195.6 9.1 5.50 104.5 8 7 5 50 | 218.9 7.1 4.91 2207.4 8.7 5.18 205.6 8.8 5.23 205.5 7.3 4.69 | 234.5 6.8 4.58 247.6 6.5 4.34 2282.7 5.3 3.80 3.80 | 247.2 6.7 4.35 350.8 3.9 3.06 | 195.6 9.1 5.50 | TOBE" 9.1 5.50 | | WEYP ALPH LJSW REW 673 273 1 00 0 667 | MINISTRATION - U. S. GEOLOGICAL SURVEY | tiver at Big Delta run by Tom Heinricha USCS 10/96 pr. VOB21951 10-33-96 11:39 | AREA 5473.1 1099890, 21500, 3.93 | AREA HYDEPTH VELOCITY 303.9 7.2 3.54 | 10.5 43.7 10.5 4.41 240.1 9.8 4.33 235.8 10.6 4.56 | 223.6 11.2 4.81 227.6 11.5 4.72 | 2227.0 11.2 4.74 2229.4 11.1 4.69 231.1 11.2 4.65 | 255.4 9.7 4.21 263.7 9.1 4.08 274.6 8.4 3.91 | 321.1 6.9 3.35 530.0 4.6 2.03 | 437.4 5.4 2.46 2217.3 12.4 4.95 212 12 12.4 5.05 |
| 50.62 274.5 5.4 3.92 23.18 205.8 8.9 5.22 43.72 257.0 5.9 4.18 | 41.56 249.2 6.0 4.31 24.39 206.7 8.5 5.20 22.79 201.3 8.8 5.34 | Z3.61 Z02.9 8.6 5.30 Z22.84 200.7 8.8 5.36 Z1.51 195.6 9.1 5.50 Z1.51 195.6 9.1 5.50 | 23.63 203.2 0.1 9 7.4 4.91 23.77 207.4 8.7 5.18 23.39 205.6 8.8 5.23 31.21 22.29.2 7.3 4.69 | 34,51 234.5 6.8 4.58 38,09 247.6 6.5 4.34 52,90 282.7 5.3 3.80 52,92 282.7 5.3 3.80 | 96.71 247.2 6.7 4.35 90.74 350.8 3.9 3.06 | M TUBE" 21.51 195.6 9.1 5.50 | H STREAM TUBE" 9.1 5.50 21.51 195.6 9.1 5.50 | - 1 SB | TOPW WEEP ALPH LISW REW 668 672 100 0 667 669 673 100 0 667 | LGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY DE ADMINISTRATION - U. S. GEOLOGICAL SURVEY | Tanana River at Big Delta y; model zun by Tom Heinrichs USCS 10/96 (MSPRO ver. V082195) & TINE: 10-23-96 11:39 | КЕМ АКЕА КСО К 0 VEL 666.6 5473.1 1099890. 21500. 3.93 | WIDTH AREA HYDEPTH VELOCITY 42.29 303.9 7.2 3.54 | 23.24 243.7 10.5 4.41 25.30 240.1 9.8 4.33 25.23 23.5.8 10.6 4.56 | 19.93 223.6 11.2 4.81 19.75 227.6 11.5 4.72 | 20.25 227.0 11.2 4.74 20.66 229.4 11.1 4.69 20.56 231.1 11.2 4.65 | 26.44 255.4 9.7 4.21 28.83 263.7 9.1 4.08 32.67 274.6 8.4 3.91 | 46.33 321.1 6.9 3.35 114.79 530.0 4.6 2.03 | 80.52 437.4 5.4 2.46 17.54 217.3 12.4 4.95 10.1 1.1 1.2 1.5 1.05 |
| 50.3 50.62 274.5 5.4 3.92 73.5 23.18 205.8 8.9 5.22 117 43 72 257.0 5.9 4.18 | 158.8 41.56 249.2 6.0 4.1 158.8 41.56 249.2 6.0 4.1 183.2 24.39 206.7 8.5 5.20 206.0 22.79 201.3 8.8 5.34 | 229.6 23.61 202.9 8.6 5.30 252.4 22.84 200.7 8.8 5.36 274.0 21.51 195.6 9.1 5.50 274.0 21.51 195.6 9.1 5.50 | 227.5 23.53 203.5 7.4 4.91 321.0 23.77 207.4 8.7 5.18 351.0 23.77 207.4 8.7 5.18 405.6 31.21 229.2 8.8 5.23 40.5.6 31.21 229.2 7.3 4.69 | 440.1 34.51 234.5 6.8 4.58 478.2 38.09 247.6 6.5 4.34 531.1 52.90 282.7 5.3 3.80 531.6 202.02 282.7 5.3 3.80 | 521.7 36.71 247.2 6.7 4.35 621.7 36.71 247.2 6.7 4.35 712.4 90.74 350.8 3.9 3.06 | TY STREAM TUBE" 274.0 21.51 195.6 9.1 5.50 | 1LIC DEPTH STREAM TUBE" 9.1 5.50 274.0 21.51 195.6 9.1 5.50 | PROPERTIES:" 21500 21500 | K TOPW WEYP ALPH LJEW REW 1099830 668 672 2000000 669 673 100 0 667 | <pre>LU3903U 000 012 110 110 110 110 110 110 110 110</pre> | No. 524, Tanana River at Big Delta No. 524, Tanana River at Big Delta rici survey: model zun by Tom Heinrichs USCS 10/96 rici les (MSPRO ver. V082195) sub DAVE f TIMS: 10-23-96 11:39 | LEW LEW AREA K 21500. 3.93 -1.0 666.6 5473.1 1099890. 21500. 3.93 | RIGHT WIDTH AREA HYDEPTH VELOCITY 41.3 42.29 303.9 7.2 3.54 | 64.5 23.24 243.7 10.5 4.41 89.8 25.30 240.1 9.8 4.33 112.0 22.23 23.5.8 10.6 4.56 | 132.0 19.93 223.6 11.2 4.81 151.7 19.75 227.6 11.5 4.72 | 172.0 20.25 227.0 11.2 4.74 12.6 20.60 229.4 11.1 4.69 21.1 20.56 231.1 11.2 4.65 | 239.6 26.44 255.4 9.7 4.21 268.4 28.83 263.7 9.1 4.08 301.1 32.67 274.6 8.4 3.91 | 347.4 46.33 321.1 6.9 3.35 462.2 114.79 530.0 4.6 2.03 | 542:7 80.52 437.4 5.4 2.46 560.2 17.54 217.3 12.4 4.95 550.2 17.54 217.3 12.4 5.05 |
| -0.3 50.3 50.62 274.5 5.4 3.92 50.3 73.5 23.18 205.8 8.9 5.22 73.6 117 257.0 5.9 4.18 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 206.0 229.6 23.61 202.9 8.6 5.30 229.6 252.4 22.84 200.7 8.8 5.36 252.4 274.0 21.51 195.6 9.1 5.50 262.4 204.5 195.6 9.1 5.50 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 405.6 440.1 34.51 234.5 5.8 4.58 440.1 478.2 38.09 247.6 5.5 4.34 478.2 531.1 52.90 282.7 5.3 3.80 | 531.1 205.0 23.00 247.2 5.7 4.35 585.0 621.7 36.71 247.2 6.7 4.35 621.7 712.4 90.74 350.8 3.9 3.06 | 3T VELOCITY STREAM TUBE" 252.4 274.0 21.51 195.6 9.1 5.50 | Tr HYDRAULIC DEPTH STREAM TUBE" 252.4 274.0 21.51 195.6 9.1 5.50 | SECTION PROPERTIES:" MSEL Q 981.53 21500 | AREA K TOPW WETP ALPH LJ5W REW AREA 1099830 668 672 5473 1099830 568 672 100 0 667 | FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MANNET FORD MANNET-SURVEY PROFILE COMPUTATIONS | Bridge No. 524, Tanana River at Big Delta Brydraulic Survey: model zun by Tom Heinriche USCS 10/96 WSPRD Profiles (WSPRD ver. V082195) *** RUN DATE TIME: 10-23-96 11:39 | CTY DISTRIBUTION." MSEL LEW LEW AREA K 21500, 2.93 981.51 -1.0 666.6 5473.11099890, 21500, 3.93 | LEFT RIGHT WIDTH AREA HYDEPTH VELOCITY -1.0 41.3 42.29 303.9 7.2 3.54 | 41.3 64.5 23.24 243.7 10.5 4.41 64.5 89.8 25.30 240.1 9.8 4.33 89.8 112.0 22.23 235.8 10.6 4.56 | 112.0 132.0 19.93 223.6 11.2 4.81 132.0 151.7 19.75 227.6 11.5 4.72 | 151.7 172.0 20.35 227.0 11.2 4.74 172.0 122.6 20.60 229.4 11.1 4.69 192.6 21.50.56 231.1 11.2 4.65 | 213.1 239.6 26.44 255.4 9.7 4.21 239.6 288.4 28.83 263.7 9.1 4.08 268.4 301.1 32.67 274.6 8.4 3.91 | 301.1 347.4 46.33 321.1 6.9 3.35 347.4 462.2 114.79 530.0 4.6 2.03 | 462.2 542.7 80.52 437.4 5.4 2.46 542.7 50.2 17.54 217.3 12.4 4.95 542.5 570.2 17.54 217.3 12.4 4.95 |

| "LARGEST HYDRAU 11 332.2 "CROSS-SECTION SEELD WSEL APPR 993.38 SA# AREA 1 14101 TOTAL 14101 1 WSPRO FU0032195 FU0032 | -LARGEST HYDRAUU 11 332.2 11 332.2 CR05S-SECTION 1 2.CR05S-SECTION 1 2.CR05S-SECTION 1 2.CR05S-SECTION 1 2.CR05S-SECTION 14101 2.2 14101 2.2 24.2 2.3 3.1 2.2 3.8.1 2.2 123.7 MATIONS 2.1 175.6 2.1 | "LARGEST HYDRAUU 11 332.2 CR0SS-SECTION 1 24.2.2.2 24.8.4.2.2.2 24.1.4101 1.1.07AL 14101 1.1.07AL 14100 |
|---|---|--|
| "CROS SECIT SA# TOTAL NSPRC NSPRC NO821 MSPRC NO821 APPR APPR APPR APPR APPR | "CROS SECUT APPR APPR APPR 1 TOTAL BSECU SECUT APPR TAPR TAPR TAPR TAPR TAPR TAPR TAP | "CR05 "SECII APPR SECII APPR TOTAL TOTAL APPR POSTCAL SURVEY COLCAL SURVEY POSTCAL S |
| TCDAL TCDAL WSERO WSERO WSELOCIT *VELOCIT APPR APPR TUBE# 1 2 3 3 3 | TCTAL TCTAL 1 WSERO WS2195 WELOCIT *VELOCIT *VELOCIT *VELOCIT *VELOCIT *VELOCIT *VELOCIT *VELOCIT *VELOCIT * * * * * * * * * * * * * | 1 TOTAL WSPRO WS2195 WELOCIT WSPRO V082195 VELOCIT SECID APPR TUBE# TUBE# TUBE# TUBE# TUBE# TUBE# 10/96 10/96 10/96 |
| BL Hyver WSS WSSCID SECID SECID APPR APPR 99: 1 1 -31 2 3 6 3 6 | BL Hyver WSS WSS WSS WSS WSSCID SECTD SECTD SECTD 1 -3 1 -3 2 -3 3 -5 12 2 -3 3 -5 12 2 -3 3 -5 12 2 -3 3 -5 2 -3 3 -5 5 12 -3 3 -5 5 12 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 | BL: BL: BL: BL: BL: BL: BL: BL: |
| *VELOCITY DIS SECID WES APPR 993.3 APPR 993.3 1 -34.2 2 38.1 2 36.7 4 97.3 | *VELOCITY DIS SECID WES APER 99.3.3 APER 99.3.3 1 - 34.2 3 - 34.1 2 3 - 34.1 3 - 57.7 4 - 37.3 7 - 175.6 7 - 175 | •VELOCITY DIS SECID 083 SECID 085 APPR 993.3 APPR 993.3 1 -34.2 3 67.7 6 149.8 10/96 10/96 10 259.8 10 2 |
| TUBER LAFT 1 -34.7 2 36.1 3 67.7 4 97.3 | TUBER LEFT TUBER LEFT 2 1 -34.1 3 67.7 4 97.3 4 97.3 7 123.7 TAPTIONS 7 175.6 7 175.6 | TUBE LAFT 1 -34.2 3 4 97.3 3 5.7 3 5.7 3 5.7 4 97.3 1 9.23.7 1 175.6 1 0/96 10 259.2 10 259.2 |
| | ICAL SURVEY 5 123.7 TAPIONS 6 149.8 7 175.6 | JICAL SURVEY 5 123.7 7 19.8 7 195.6 7 195.6 8 201.7 9 228.8 10/96 11 290.6 |

GEOLOGICAL SURVEY COMPUTATIONS

766 REW

96/01 SDSH

VEL 6.15

FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS - U. S. GEOLOGICAL SURVEY FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SU MODEL FOR WATER-SURFACE FROFILE COMPUTATIONS Hydraulic Survey; model run by Tom Heinrichs USGS 10/95 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 VEL 6.21 Bridge No. 524, Tanana River at Big Delta Hydraults Survey; model run by rom Heinrichs USGS 10/96 WEND Profiles (WSFRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 VEL 8.54 725 REW VELOCITY Q 86700. VELOCITY a 6.67 9.04 8.34 8.38 7.36 6.55 86700. LEW -15 Bridge No. 524, Tanana River at Big Delta 725.5 10154.1 3249306. REW AREA K 766.1 13956.9 4621846. 10.3 16.2 13.2 13.3 12.5 222.1 222.1 522.1 522.1 522.1 522.2 522.3 522.5 52.5 5 22.9 24.1 HYDEPTH HYDEPTH 1.00 WETP ALPH 621 AREA 650.1 479.4 519.8 517.1 AREA 6505.3 6505.3 6517.0 617.0 617.0 613.8 601.8 651.3 652.0 653.5 733.4 733.4 733.4 733.4 752.1 653.2 762.1 752. 9.885 "LARGEST HYDRAULIC DEPTH STREAM TUBE" 18 567.5 595.0 27.42 662.1 TOPW 608 WIDTH 63.18 29.63 39.27 38.93 'HIGHEST VELOCITY STREAM TUBE" 25.73 "CROSS-SECTION PROPERTIES: " "VELOCITY DISTRIBUTION:" SECID WSEL LEW AFFR 993.20 -33.6 K 3249306 3249306 "VELOCITY DISTRIBUTION:" LEW -16.4 RIGHT 38.4 38.4 38.4 123.6 1123.6 1125.3 175.3 175.3 175.3 201.2 201.2 201.2 201.2 201.2 201.2 201.2 201.2 202.2 256.6 567.5 567.5 595.0 626.5 766.1 Q 86700 46.8 76.4 115.7 154.6 175.3 595.0 RIGHT WSEL 990.48 LEFT -16.4 46.8 76.4 115.7 LEFT -33.6 67.8 67.8 96.4 96.4 1149.6 1149.6 1149.6 201.2 228.2 228.2 228.2 228.2 238.7 352.7 352.7 352.7 352.7 352.7 352.7 502.2 201.2 200.2 20 567.5 595.0 626.5 10154 567.5 540.4 149.6 WSEL 990.48 AREA WSPRO V082195 V082195 SECID BRDG SECID WSPRO TOTAL TUBE# BRDG TUBE# 9 18 P N N T SA# FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS 7.48 Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; andela run by Tom Heinrichs USGS 10/96 WEPRO Prolines (WSFWO ver. V082195) *** RUN DATE & THME: 10-23-96 11:39 REW 734 REW 766 Q 86700. 8.34 8.52 3.60 7.27 6.51 LEW -33 LEW 29 REW AREA K 733.5 11590.6 3973580. 24.3 10.2 115.0 115.0 115.0 117.8 117.8 118.4 118.4 16.8 117.5 117.5 116.0 113.9 116.0 113.9 114.6 16.3 18.4 18.4 8.6 23.1 HYDEPTH WETP ALPH 639 639 1.00 ALPH 1.00 811 811 TUBE" 519.6 WETP 596.2 573.8 637.9 775.6 509.1 665.9 766.3 139.36 1204.6 "LARGEST HYDRAULIC DEPTH STREAM TUBE" 18 568.0 595.4 27.38 665.9 "LARGEST HYDRAULIC DEPTH STREAM TUPW 800 800 WIDTH 32.27 32.53 39.53 39.53 39.52 39.52 31.61 31.81 31.81 31.81 31.81 31.81 31.81 31.81 31.99 31.99 31.99 31.59 33.52 33.55 35.555 TOPW 625 625 "HIGHEST VELOCITY STREAM TUBE" 6 149.8 175.6 25.85 'HIGHEST VELOCITY STREAM TUBE" 28.18 27.62 "CROSS-SECTION PROPERTIES:" SECID WSEL Q APPR 993.20 86700 "CROSS-SECTION PROPERTIES: " "VELOCITY DISTRIBUTION;" SECID WSEL LEW BRDG 992.81 -29.8 K 4621846 4621846 873580 3973580 Q 86700 46.4 178.8 155.8 155.8 155.8 186.0 2214.5 2215.5 22215.5 22215.5 22215.5 22215. 733.5 271.0 595.4 359.9 RIGHT 626.9 -29.0 46.4 46.4 1118.3 1155.8 1155.8 1186.0 2291.0 3599.9 3599.9 3599.9 3599.9 3599.9 3599.9 453.5 5538.0 6573.7 5538.0 331.7 13957 661.3 AREA 11591 11591 243.3 AREA 568.0 WSEL 992.81 LEPT V082195 TOTAL TOTAL SECID WSPRO TUBE# 8 11 SA# BRDG 20 18 SA#

| | 8.60 | | 7.41 | | | | | W REW | | 9 734 | | S. GEOLU | | chs uses | | 4 | 95600. | VELOCITY | 6.15 | 8.22 | 8.06 | 8 86 | 9.22 | 9.19 | 9.39 | 8.93 | 9.20 | 9.12 8 60 | 8.54 | 8.41 | 7.73 | 0.03 | 64.7 | 6.16 | | 00.0 | 4.34 | | 9.20 | | | | | | WER NO | | 33 766 | o reor | TLE COME |
|-----------|-------|-----------|-------|-------|----------|-------|--------|---------|---------|---------|---------|--------------------|-----------|------------|--------------------|----------|----------|-------------|----------|-------------|---------|--|---|----------|----------|-----------------|----------|--------------|----------|---------------------|----------|----------|----------------|-------|-------|------------|--------|-----------|-------|-------|---|-----------|---------|--------|--------------|--------|---------|------------|-----------|
| | 20.9 | | 22.1 | | | | | ALPH LE | | 1.00 -2 | | ATION - U. | Big Delta | Tom Heinri | 6 11:39 | d | 3973580. | HYDEPTH | 10.2 | 18.0 | 15.0 | 17.8 | 18.2 | 10.0 | 18.4 | 16.8 | 18.4 | 17.5 | 16.2 | 16.0 | 13.9 | 0.91 | 13.4 | 10.7 | | | 18.4 | | 18.4 | | | | | | ALPH LE | | 1.00 -1 | ATTON - II | FACE PROF |
| | 504.0 | TUBE" | 585.2 | | | | | WETP | 639 | 639 | | DMINISTR | River at | Yd nur | 10-23-9 | | 11590.6 | AREA | 777.8 | 581.8 | 593.0 | 530 K | 518.4 | 520.1 | 509.1 | 535.5 | 519.6 | 524.0 | 560.0 | 568.1 | 618.1 | T. 260 | 0.010 | 775.6 | | 1 00 1 | T. 606 | TUBE" | 519.6 | | | | | | WETP | 811 | 811 | UNMERTER | NATER-SUR |
| AM TUBE" | 24.09 | TH STREAM | 26.53 | | (ES: " | | | MODM 2 | 625 | 625 | | HIGHWAY A | Tanana | tabom : | E & TIME: | | 733.5 | WIDTH | 76.27 | 32.32 | 39.53 | 76-15 70 34 | 28.45 | 28.85 | 27.62 | 51.81 | 28.18 | 29.99 | 34.59 | 35.42 | 44.31 | 40.48 | 02.00 VA 64 | 72.20 | | AM TUBE" | 29.12 | TH STREAD | 28.18 | | | IES: | | | K TOPW | 0 800 | 0 800 | A VAMMATU | L FOR V |
| ITY STREP | 144.8 | ULTC DEP | 587.5 | | PROPERTI | 0 | 95600 | | 3973580 | 3973580 | | FEDERAL I MODEI | No. 524 | lic Surve | RUN DATE | NOLTUNIN | -29.8 | BICHT | 46.4 | 78.8 | 118.3 | 196.0 | 214.5 | 243.3 | 271.0 | 1.122 | 359.9 | 389.9 | 0.624 | 493.7 | 538.0 | 6.8/6 | 1.610 | 733.5 | | ITY STRE | 271.0 | ULIC DEP | 359.9 | | and the second se | PROPERT | 0095600 | nnore | | 465566 | 465566 | TANDAAT | MODE |
| ST VELOC | 120.7 | CT HVDRAI | 561.0 | | -SECTION | WSEL | 992.81 | ADPA | 11591 | 11591 | | 5 | Bridge | Hydrau | W5PH0 | TZIQ YTI | 992.81 | 1.8FT | -29.8 | 46.4 | 78.8 | 166 0 | 186.0 | 214.5 | 243.3 | b 66C | 331.7 | 359.9 | 073.6 | 458.2 | 493.7 | 538.0 | C. 812 | 661.3 | | SET VELOC | 243.3 | CST HYDRA | 331.7 | | | S-SECTION | 135M | 07.066 | AREA | 14021 | 14021 | | 35 |
| "HIGHE | ŝ | "L'ADCE | 18 | | "CROSS | SECID | BRDG | CA # | - | TOTAL | 1 | WSPRO V08215 | | | | "VELOC | BRDG | "anita | 1 | 2 | ε. | 4 | e n | L | 8 0 | 10 | 11 | 12 | 14 | 15 | 16 | 17 | 10 | 20 | | HOIH. | 8 | "L'ARGH | 11 | | | "CROS | SECID | AFFR | SA# | 1 | TOTAL | 1 | V0821 |
| 9.17 | 9.49 | 9.64 | . 43 | 9,09 | 9.32 | 8.77 | 8.84 | 8.60 | 7.94 | CT . 0 | 1 55 | 6.59 | 0 64 | 5.04 | 9.63 | | | | DPW PP | 11711 H 117 | 25 764 | and a second sec | . S. GEOLOGICAL SURVEY BILE COMPUTATIONS | | 9 | ichs USGS 10/96 | | | | Q VEL 86700 7.10 | | VELOCITY | 5.72 | 7.72 | 8.24 | 8.60 | 8.48 | 8.34 | 8.43 | 18.1 | 7.55 | 7.21 | 6,71 | 6.40 | 6.45 5 74 | 7.76 | 7.41 | 6,58 | 4,10 |
| 15.9 | 16.3 | 1.01 | 16.3 | 14.9 | 15.9 | 14.5 | 14.3 | 14.0 | 12.4 | C.21 | 3 11 | 10.1 | 1.21 | 1.01 | 16.5 | | | | AT DU T | ALEN P | 1.00 - | | ATION - U | LAUD FIN | Big Delt | Tom Heinr | 195) | | | X | | HYDEPTH | 11.8 | 19.9 | 20.3 | 20.9 | 20.8 | 20.6 | 20.6 | 18.1 | 17.5 | 16.2 | 14.9 | 13.6 | 13.5 | 1.12 | 22.1 | 21.6 | 7.2 |
| 7.274 | 456.9 | 449.7 | 459.9 | 476.9 | 449.9 | 494.4 | 490.1 | 503.9 | 546.1 | 532.2 | E . 10C | 657.8 | - | 1.600 | TUBE" 450.3 | | | | Comments | 700 | 664 | | DMINISTR | ATEK-SUK | River at | run by | er. V082 | | | AREA | C. 01991 | AREA | 757.4 | 561.5 | 9.050 | 504.0 | 511.3 | 520.1 | 514.2 | 554.7 | 573.9 | 600.9 | 645.7 | 677.5 | 673.8 | 650.3 | 585.2 | 658.8 | 1056.1 |
| 36 76 | 28.00 | 27.94 | 27.32 | 31.93 | 65.12 | 34.12 | 34.24 | 35,87 | 44.08 | 42.58 | 22.05 | 65.26 | M TUBE" | 27.94 | H STREAM 27.32 | | .ES: " | | and and | MAOL | 064 | | IIGHWAY A | N HON N | Tanana | y: model | (WSPRO V | | | REW | 6.001 | HIDTH | 64.26 | 28.17 | 26 88 | 24.09 | 24.61 | 25.22 | 25.00 | 29.61 | 32.77 | 37.14 | 43.36 | 49.63 | 49.87 | 64.25 | 26.53 | 30.47 | 145.90 |
| 184 4 | 212.4 | 240.3 | 267.6 | 327.7 | 5.665 | 418.7 | 452.9 | 488.8 | 532.9 | 575.5 | 6.019 | 725.5 | TY STREA | 240.3 | JLIC DEPT 267.6 | | PROPERTI | 86700 | | A DECERC | 3736266 | | EDERAL I | MODEL | No. 524, | Lic Surve | Profiles | TTUR NON | RUPTON: | LEW | 0.03- | RIGHT | 38.5 | 66.6 | 8.46 | 144.8 | 169.4 | 194.6 | 219.6 | 249.2 | 311.6 | 348.7 | 392.1 | 441.7 | 491.6 | 534.5 | 587.5 | 618.0 | 763.9 |
| 164 6 | 184.4 | 212.4 | 240.3 | 295.8 | 327.7 | 9 185 | 418.7 | 452.9 | 488 8 | 532.9 | 5.515 | 610.9 | ST VELOCI | 212.4 | ST HYDRAI 240.3 | | -SECTION | M3EL 991.01 | | AREA | 12217 | | - | 5 | Bridge | Hydrau | WSPRO 1 | | ASIG ALL | WSEL | 10.166 | LEFT | -25.8 | 38.5 | 66. b | 120.7 | 144.8 | 169.4 | 194.6 | 219.6 | 3. 642 | 311.6 | 348.7 | 392.1 | 441.7 | 491.6 | 0.133 | 587.5 | 618.0 |
| U | n vo | E | 8 6 | 10 | 11 | 11 | 14 | 15 | 16 | 17 | 18 | 20 | "HIGHE | 4 | * LARGE 8 | | "CROSS | APPR | | SA# | TOTAL. | 1 | WSPRO | V08219 | | | | | "VELOC | SECID | APPR. | TUBE# | 1 | 2 | m * | T 1 | 0 | L | 8 | 6 | 11 | 12 | 13 | 14 | 15 | 16 | 18 | 19 | 20 |

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OGICAL SURVEY PUTATIONS OGICAL SURVEY PUTATIONS 10/96 VEL 8.25 LUR 3 Q

| 7 214.4 242.9 28.56 535.7 18 8 242.9 271.5 28.62 548.7 19 9 271.5 28.94 543.3 13 10 200.5 332.3 31.79 558.9 17 | 11 332.3 360.5 28.25 542.3 19 12 360.5 391.6 31.03 563.0 18 | 13 391.6 424.8 41.22 505.2 1/ 14 424.8 459.6 34.82 588.9 16 15 459.6 494.5 34.85 584.8 16 16 494.5 538.9 44.38 649.6 14 | 17 538.9 579.4 40.54 625.1 15 18 579.4 614.7 35.30 600.5 17 | 19 614.7 662.4 47.71 671.3 14 20 662.4 736.7 74.24 815.2 11 | | "HIGHEST VELOCITY STREAM TUBE" 7 214.4 242.9 28.56 535.7 18 | | "LARGEST HYDRAULIC DEPTH STREAM TUBE" 11 332 3 360.5 28.25 542.3 19 | | "CBASS-SECUTAN DRODEPTIES." | SECID WSEL Q | APPR 994.13 95600 | udin amon u | SAT AKEA K TUFW WELF AUER 1 14703 5021081 804 015 | TOTAL 14703 5021081 804 815 1.00 | 1 | WSPRO FEDERAL HIGHWAY ADMINISTRATION V082195 MODEL FOR WATER-SURFACE | Bridge No. 524, Tanana River at Big Hydraultc Survey, model run by Tom H | WERKO FIGILIES (WSFRU VEL VULLIS) *** RUN DATE & TIME: 10-23-96 11 | "VELOCITY DISTRIBUTION:" | APPR 994.13 -36.9 767.0 14702.6 50210 | TUBE# LEFT RIGHT WIDTH ARKA HYDEP 1 -36.9 38.0 74.88 964.3 12 | 2 38.0 67.9 29.96 689.8 23 | a 97.9 124.7 26.76 630.1 23 | 5 124.7 151.1 26.40 635.7 24 | 7 177.2 203.6 26.37 626.9 23 | 8 203.6 231.7 28.13 647.3 23 0 231.7 262.3 30.46 661.1 21 | 10 262.2 293.6 31.43 667.4 21 | 11 293.6 328.5 34.92 699.8 20 | 13 368.1 411.3 43.22 754.2 17 | 14 411.3 459.2 47.86 792.3 16 | 16 505.6 542.5 36.94 716.8 19 | 17 542.5 569.4 26.94 675.9 25 | 18 569.4 597.3 27.88 698.1 25 ** **** 520.5 25.67 788 5 | 19 597.3 630.2 32.87 785.2 24 20 630.2 767.0 136.84 1238.2 9 | | "HIGHEST VELOCITY STREAM TOBE" 6 151.1 177.2 26.17 522.9 23 |
|---|--|--|--|--|-----------|--|-----------|--|-----------|-----------------------------|--------------|-------------------|-------------|--|----------------------------------|----------|---|---|---|--------------------------|---------------------------------------|--|----------------------------|-----------------------------|------------------------------|------------------------------|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--|---|------------|--|
| 96/01 SSS | | 0 VEL 00. 6.82 | 21TY 26 | 30 | 74 | .11 86 | 0.0 | 06 | 50 CC | .22 | . 85 | .39 | .37 | .68 | .05 | 47 | 00 | 11. | .05 | | | 0.014 | **** ** | 737 | 3EOLOGICAL SURVEY | COMPUTATIONS | | USGS 10/96 | | | Q VEL | 00. 7,86 | CITY | .70 | .15 | .92 | .46 .81 |
| Big Delta Tom Heinrichs U | 5 11:39 | K 1655660. 9560 | IYDEPTH VELOC | 22.2 | 22.7 7. | 23.2 8. | 22.9 8. | 22.4 7. | 20.5 7. | 19.3 7. | 16.7 6. | 15.7 6. | 15.9 6. | 18.2 6. | 24.2 | 23.4 6. | 8.6 4. | 23.2 8. | 24.2 7. | | | 100 | WITH NOW | 1.00 -31 | ATION - U. S. C | FACE PROFILE | Big Delta | Tom Heinrichs (| 6 11:39 | | К | 4280591. 9560 | HVDEPTH VELOC | 10.7 5 | 18.8 8 | 16.0 7 | 18.6 8 19.0 8 |
| nana River at model run by | TIME: 10-23-9 | REW AREA 66.2 14020.9 | TH AREA 1 | .54 655.1 | .26 617.8 | .38 589.4 | .99 595.6 | .03 604.7 | .37 633.1 | .28 662.5 | .85 697.5 | 57 748.4 | .14 750.2 | .21 715.2 | 9 677.9 | 54 738.7 | .40 1193.6 | UDE* 589.4 | TREAM TUBE" | | | dimitia analysis | 629 644 | 629 644 | WAY ADMINISTR | OR WATER-SUR | mana River at | model run by | TIME: 10-23-9 | | REW AREA | 36.7 12155.6 | VTH AREA | 1.17 838.0 | 1.25 586.6 | 1.76 627.7 | 1.41 564.7 1.62 542.5 |
| No. 524, Tan lic Survey; I | RUN DATE & | RIBUTION: " LEW -33.9 70 | RIGHT WID | 67.9 29 | 123.8 27 | 149.2 25 | 201.6 25 | 228.7 27 | 259.0 30 | 324.6 34 | 363.5 38 | 454.9 47 | 502.1 47 | 541.3 39 | 567.3 25 | 626.8 31 | 766.2 139 | ITY STREAM T 149.2 25 | VULIC DEPTH S 595.2 27 | | PROPERTIES: 0 95600 | | 4280591 | 4280591 | PEDERAL, HIGH | MODEL F | NO. 524, Ta | Ilic Survey; | RUN DATE & | II . INCLUIDE | LINTER LEW | -31.6 7 | DIGHT WID | 46.6 78 | 77.8 31 | 117.6 39 | 185.8 30 214.4 28 |
| 0 5 | 0* | IST SEL | - | n m e | 11. | | 5.6 | 01.6 | 28.7 | 6.06 | 24.6 | 6.1.5 | 54.9 | 02.1 | 41.3 | 95.2 | 26.8 | VEL/0C 23.8 | NYDRA 57.3 | | TI SU | | AREA 2156 | 2156 | | | Bridge | Hydrau | WSPRU *** | and and an | WSEL | 17. 566 | n'aa 1 | -31.6 | 46.6 | 117.6 | 155.3 |

USGS 10/96 REW 767 8.81 LEW -36 J. S. C DFILE ta tichs

GEOLOGICAL SURVEY COMPUTATIONS VEL 6.50 7.67

SURVEY COMPUTATIONS Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-23-96 11:39 VEL 6.57 VEL 9.08 GEOLOGICAL 10/96 USGS REW 728 95600. 7.80 7.13 VELOCITY $\begin{array}{c} 6.99\\ 9.31\\ 8.92\\ 9.08\\ 9.08\\ 9.75\\ 10.11\\ 10.26\\ 10.25\end{array}$ O 95600. PROFILE Bridge No. 524, Tanana River at Big Delta Bydrault Survey: model run by Tan Heinrichs WEPRO Profiles (WSPPO vor. UN2195) *** RUN DATE & TIME: 10-23-96 11:39 LEW -19 AREA K 10526.3 3432618. 10.2 116.6 113.7 113.8 113.8 116.6 116.6 116.6 4942749. 222.9 222.8 222.8 233.6 232.2 232.6 232.2 232.6 232.2 232.6 232.2 232.6 232.2 232.6 232.2 232.6 23.9 24.9 HYDEPTH HYDEPTH FEDERAL HIGHWAY ADMINISTRATION MODEL FOR WATER-SURFACE ALPH 1.00 AREA 14558.0 AREA 682).7 682).7 647.6 647.6 643.6 6532.2 6532.2 6532.2 6533.2 771.7 7 AREA 684.0 513.5 536.1 536.1 536.1 490.4 473.0 466.5 626 WETP 6.070 TUBE" 613.1 A STREAM 26.95 727.6 WIDTH 66.79 30.86 33.26 38.10 29.89 28.13 28.13 28.07 27.45 612 612 TOPW REW 766.9 MIDTH 74.65 74.65 28.99 25.55 25.75 26.76 26.76 26.76 33.67 33.75 33.67 33.75 33.67 33.67 33.75 35.75 STREAM TUBE" 25.65 "CROSS-SECTION PROPERTIES:" SECID WSBL Q HYDRAULIC DEPTH K 3432618 3432618 TY DISTRIBUTION: WSEL LEW 993.95 -36.3 "VELOCITY DISTRIBUTION: SECID WSEL LEW BRDG 991.09 -19.9 00956 46.9 77.7 117.0 155.1 185.0 213.1 241.2 241.2 268.6 38.4 968.2 968.2 1124.8 1150.4 1150.4 150.6 2031.5 2031.5 2031.5 2031.5 2051.5 2051.5 2051.5 5569.1 5569.1 5569.1 5569.1 7626.9 569.1 150.4 RICHT RIGHT VELOCITY LEFT -19.9 46.9 77.7 117.0 1155.1 1155.1 1185.0 213.1 241.2 -36.3 38.4 962.2 967.2 1150.4 1150.4 1150.4 1150.4 1150.4 3251.5 2230.8 2251.5 2230.8 2251.5 2255.2 2255.2 2255.2 2555.2 124.8 542.2 WSEL 991.09 AREA 10526 10526 LEPT "VELOCITY I SECID W HIGHEST LARGEST WSPRO V082195 SRC1D BRDG TOTAL TUBE TUBE# BRDG APPR ŝ 17 SA# 20022002 SEOLOGICAL SURVEY COMPUTATIONS GEOLOGICAL SURVEY COMPUTATIONS VEI. GEOLOGICAL Bridge No. 524, Tanana River at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Proiciles (WSPMO ver. V082195) *** RUN DATE & TYME: 10-23-96 11:39 REW REW 736 167 0 95600. VELOCITY 87 1.07 01 - U. S. G PROFILE 6 8 PROFILE LEW -35 -31 LEW Tanana River at Biy Delta AREA K 12036.1 4214003. 18.6 19.0 25.1 HYDEPTH FEDERAL HIGHWAY ADMINISTRATION FEDERAL HIGHWAY ADMINISTRATION MODEL FOR WATER-SURFACE WATER-SURPACE ALPH 1.00 1.00 ALPH WETP 815 815 WETP 530.3 TUBE" 539.2 643 HYDRAULTC DEPTH STREAM TUBE" 542.5 569.4 26.94 675.9 LIC DEPTH STREAM 360.7 28.31 TOPW REW 736.0 MLDTH 78.18 33.75 33.75 33.75 33.75 33.75 33.76 28.62 28.55 28.55 33.77 33.77 33.27 33.27 33.27 33.27 34.76 34.77 35.24 34.77 35.24 34.76 34.76 34.76 35.24 MAOL. 629 803 FOR STREAM TUBE 28.47 PROPERTIES: " PROPERTIES: " TY DISTRIBUTION:" WSEL LEW 993.52 -31.6 7 K 4214003 4214003 ¥ MODEL Bridge No. 524, 4942749 4942749 00956 46.6 77.9 155.4 155.8 155.8 214.4 2213.0 330.1 332.4 332.4 424.7 4294.3 459.5 459.5 614.3 614.3 736.0 95600 300.1 6.1.9 RIGHT HYDRAULIC HIGHEST VELOCITY "CROSS-SECTION SECID WEEL CROSS-SECTION 31.6 76.6 77.9 1117.6 1155.4 1155.4 1155.4 1155.4 231.0 3201.1 32 14558 661.9 WSEL 993.52 AREA 12036 12036 271.6 332.4 993.95 AREA 542.5 LEFT "VELOCITY I SECID W BRDG 993 "LARGEST * LARGEST WSPRO V082195 V082195 TOTAL SECID BRDG WSPRO. TOTAL APPR. TUBE# 6 SA# 17 SA# 11

| 18 563.0 590.1 27.05 514.2 | | | | | | | | | | RVEY | | | | | | | | | | | | | | | | | |
|----------------------------------|----------------|-------|-------|-------|-------|--------------------|--------------------|-------------------------|-------------------------|--------------------------|--|----------------------------|-----------------|-------|-------|--------|-------|-------|-------|-------|-------|--------|-------|-------|-------|----------------|--------------------|
| | | | | | | 20 | 10 | | EW 65 | DLOGICAL S DMPUTATION | 3S 10/96 | 0 VEL | ry 6 | 0.4 | | 6 5 | 1 | 0 | | 50 0 | 0 00 | 0 | r. 0 | n en | 8 0 | a c | 2 |
| 10.00 9.60 10.24 9.99 | 9.41 | 9,34 | 8.6 | 9.1 | 6.9 | 10.20 | 10.2 | | LEW RI | U. S. GE | ta richs US | 95600 | VELOCI 5.9 | 8.1 | 8.9 | 8.7 | 6.8 | 8.7 | 8.4 | 7.8 | 7.1 | 6.9 | 7.1 | 8.2 | 1.1 | 4.3 | 8.9 |
| 16.8 15.4 16.9 16.3 | 15.0 | 14.6 | 13.0 | 14.9 | 10.2 | 16.6 | 17.0 | | ALPH I 1.00 - | RATION - 1 REACE PRC | t Big Delt Tom Heini 195) 16 11:39 | K 4002940. | нурертн 12.0 | 20.6 | 21.0 | 21.6 | 21.3 | 21.1 | 1.61 | 18.0 | 15.4 | 14.3 | 15.9 | 22.1 | 22.7 | 22.22 | 21.3 |
| 474.9 494.8 466.8 478.4 | 511.6 508.2 | 512.0 | 553.6 | 524.5 | 686.1 | 466.0 | TUBE" 466.5 | | WETP 803 803 | DMINISTI ATER-SUI | River al run by er. v08: 10-23-5 | AREA 12754.6 | AREA 802.5 | 588.6 | 536.4 | 544.0 | 533.1 | 549.6 | 568.1 | 608.6 | 637.3 | 692.5 | 665 1 | 581.0 | 614.2 | 1102.9 | 533.1 |
| 28.31 32.08 27.61 | 34.20 | 35.15 | 42.47 | 35.30 | 66.95 | 1 TUBE" 28.07 | I STREAM 27.45 | . : SS | TOPW 793 793 | FOR W | Tanana /; model (WSPRO v & TIME: | . REW 764.6 | AIDTH 66.70 | 28.57 | 25.51 | 25.17 | 25.02 | 26.03 | 29.70 | 33.72 | 38.21 | 48.59 | 49.02 | 26.32 | 27.05 | 30.39 | M TUBE" 25.02 |
| 296.9 329.0 356.6 | 420.2 | 489.7 | 576.1 | 611.4 | 727.6 | TY STREAN 241.2 | LIC DEPTF 268.6 | PROPERTIE Q 95600 | K 4002940 4002940 | EDERAL HI MODEL | No. 524, ic Survey rofiles RUN DATE | IBUTION: LEW -28.2 | RIGHT 1 | 67.0 | 121.1 | 146.3 | 196.8 | 222.9 | 252.5 | 316.0 | 354.2 | 445.9 | 494.9 | 563.0 | 590.1 | 764.6 | TY STREAU 196.8 |
| 268.6 296.9 329.0 | 386.0 | 454.5 | 533.6 | 576.1 | 9.033 | vELOCIT 213.1 | PADRAUI 241.2 | SECTION 1 WSEL | AREA 12755 12755 | Ы | Bridge 1 Hydraul: WSPRO Pi *** F | PY DISTR WSEL 991.69 | LEFT 1 | 38.5 | 92.6 | 121.1 | 146.3 | 196.8 | 252.5 | 282.2 | 316.0 | 3.97.3 | 445.9 | 536.7 | 563.0 | 590.1 620.5 | T VELOCI 171.8 |
| 9 11 11 | 13 | 15 | 17 | 18 | 20 | LSHDIH. | I.ARGEST | CROSS- | SA# 1 TOTAL | WSPR0 7082195 | | "VELOCI" SECID APPR | TUBE# | 2 | m 4 | - in i | 9 | 80 | 10 | 11 | 12 | 14 | 15 | 11 | 18 | 19 20 | "HIGHES |

-110 205 11400 11400 11400 994.1 994.0 991.7 -46.6, 985.7 5 985 Bridge No. 524, Tanana River ** Slough ** at Big Delta Hydraulic Survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) 137.9, 986.2 237.9, 986.2 988 981.1 573 981 -27.7. 969.3 972.3 9.486 8 988 969. 124.7. .2, 969. 973.9 971.3 985.7 970. 976.3 975.7 267.3, 974.9 5 243 3. 971. 986.4 50 119. N 7.186 6.6 113. -6.7 973. 111. 981 137.9, 986. 10400 10400 10400 11400 993.4 993.2 991.0 993.3 52. 6 87 4 -109.6, 9 .6 19.7, . 972.6 5 7 118.1, 972.2 5 144.4, 975.9 247.3, 988.3 60. 986.1 45.9, 969.3 696 28 973 u 63 -35.3, -13.3, 972 970. 143.4, ⁴ 224, 6, 1001.4 - 309, 6, 986.4 - 10 -34.8, 983.9 0, 981 6.6, 977,6 -39.5, 972.5 361, 972,6 945.9 97 65.6, 972.6 72.2, 972,6 85.3, 97 101.7, 971.9 111,6, 971.7 118.1, 114.5, 973.9 137.8, 975.5 144.4, 205.8 986 211.2, 987.1 247.3, 9 279.3, 1000.3 0.035 1.779 9.1 106.9, 131.7, 981 -309.6, 986.4 -1 , 981 6.6, 977.6 978 -11, 974.1 113 4. 5 ŝ 986.2 -250.3, 1001.2, -235.3, 986.3 -18.2, 982.9, 0, 980.8, 8.2, 21.3, 975.7, 27.9, 975.1, 34. 47.6, 973 54.1, 972.8, 60.7, 73.8, 970.9, 80.4, 970.4, 87, 100.1, 971.1, 106.6, 971.5, 1 126.3, 976.6, 139.5, 980.8, 1 258.4, 1003.4 0.10, 0.030, 0.10 8.2. 984.7 54.80 3 204 -228.3, 999.7 -213.3, 984.7 5.2, 979.1 15, 978.1 21.6 34.7, 975.2 41.3, 973.9 56 67.5, 970.9 74.1, 970.9 80 93.7, 960.6 120.8, 979 131 173.4, 999.9 0.10 0.00 -226, 1001.1 -211, 986.1 0, 980.8 3.3, 979 29.5, 97 62.3, 972.6 78.7, 970.2 9 128, 977.1 132.6, 980.8 11 252.9, 1001.2 0.10 0.030 0.050 147 138 10400 402 -226, 1001.1 -21 -11 -35 2570 981.1 565 0 SLG3 SL/G2 SLG1 SLG4

42 Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

| ROUGHNESS COEFFICIENTS (NSA = 3): 0.100 0.030 0.035 MSPRO WSPRO WSPRO W05L FOR WATER-SURFACE PROFILE COMPUTATIONS V082195 Bridge No. 524, Tanana River **_Slough_** at Big Dolta Hydraniic survey: model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) | *** RUN DATE & TIME: 10-31-96 08:41 *** START PROCESSING CROSS SECTION - "SLG3 " XS SLG3 204 CR -228.3, 999.7 -213.3, 984.7 -13.3, 984.7 0, 901.1 CR -228.3, 999.1 15, 978.1 21.6, 977.1 28.1, 975.7 CR 34.7, 975.2 41.3 977.9 54.4, 972 00.9, 971.3 CR 34.7, 975.2 41.3 977.9 54.4, 972 00.9, 971.3 CR 34.7, 975.2 41.3 977.9 80.6, 970.3 87.2, 969.8 CR 97.7, 963.6 100.3, 969.1 106.9, 969 113.4, 969.3 CR 173.4, 999.9 N 0.10 0.030 CR 173.4, 999.9 N 0.10 0.030 CR 7.5 7 10.3 10.3 10.7, 981 137.9, 985.7 CR 173.4, 999.9 N 0.10 0.0030 CR 173.4, 999.9 N 0.10 0.0000 CR 173.4, 999.9 N 0.10 0.0000 CR 173.4, 999.9 N 0.10 0.0000 CR 173.4, 999.9 N 0.10 0.00000 | *** FINISH PROCRSSING CROSS SECTION - "SLG3 " *** CROSS SECTION "SLG3 " WRITTEN TO DISK, RECORD NO. = 2 DATA SUMMARY FOR SECID "SLG3 " AT SRD = 204. ERR-CODE = 0 SKEW IHPNO VSLOPE EK CK 0.0 0.0 0.0 | X-Y COORDINATE PAIRS (NGP = 25): X Y Y <thy< th=""><th>X-Y MAX-MIN POINTS: XMIN Y X YMAX -228.3 999.70 106.9 969.00 173.4 999.90 173.4 999.90 SUBAREA BREAKPOINTS (NSA = 2): -21.</th><th>ROUCHNESS CORFFICIENTS (NSA = 2): 0.100 0.030 1 MSFRO FEDERAL HIGHWAY ADMINISTRAFION U. S. CEOLOGICAL SURVEY WSPRO FEDERAL HIGHWAY ADMINISTRAFION U. S. CEOLOGICAL SURVEY 082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS Bridge No. 524, Tannan River **_Slough_** at Big Delta Hydraulic Survey; model run by Toom Heinrichs USGS 10/96 WSFNO Ver. V082195 WSFNO Ver. 10-31-96 08:41</th><th>*** SFART PROCESSING CROSS SECTION - "SIG2 " XS SIG2 402 GR -226, 1001.1 -211, 986.1 -11, 986.1 -6.7, 984.6 GR 0, 980.8 3.3, 979 29.5, 974.1 45.9, 973.6 GR 62.3, 972.6 78.7, 970.2 95.1, 969.3 111.6, 969.4</th></thy<> | X-Y MAX-MIN POINTS: XMIN Y X YMAX -228.3 999.70 106.9 969.00 173.4 999.90 173.4 999.90 SUBAREA BREAKPOINTS (NSA = 2): -21. | ROUCHNESS CORFFICIENTS (NSA = 2): 0.100 0.030 1 MSFRO FEDERAL HIGHWAY ADMINISTRAFION U. S. CEOLOGICAL SURVEY WSPRO FEDERAL HIGHWAY ADMINISTRAFION U. S. CEOLOGICAL SURVEY 082195 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS Bridge No. 524, Tannan River **_Slough_** at Big Delta Hydraulic Survey; model run by Toom Heinrichs USGS 10/96 WSFNO Ver. V082195 WSFNO Ver. 10-31-96 08:41 | *** SFART PROCESSING CROSS SECTION - "SIG2 " XS SIG2 402 GR -226, 1001.1 -211, 986.1 -11, 986.1 -6.7, 984.6 GR 0, 980.8 3.3, 979 29.5, 974.1 45.9, 973.6 GR 62.3, 972.6 78.7, 970.2 95.1, 969.3 111.6, 969.4 |
|---|---|--|---|--|---|--|
| WSPRO FEDERAL HICHWAY ANWINISTRATION - U. S. GEOLOGICAL SURVEY V082195 MODEL FOR WATER-SURPACE PROFILE COMPUTATIONS *** RUN DATE & TIME: 10-31-96 08:41 T1 Bridge No. 524, Tanana River **_Slough.** at Big Delta Hydraulic Survey; model run by rom Heinrichs USES 10/96 | T3 WSFRO Frofiles (WSPRD Ver. V082195) 0 2570 10400 10400 10400 1400 11400 11400 0 2570 10400 10400 10400 10400 194.0 91.7 0 2570 10400 10400 10400 194.0 91.7 0 257 91.1 92.6 93.3 94.1 94.0 91.7 0 0 93.2 991.0 993.3 94.1 94.0 91.7 0 0 93.2 991.0 993.3 94.1 94.0 91.7 0 0 93.2 991.0 993.3 94.1 94.0 91.7 0 0 0 93.2 991.0 93.3 94.1 94.0 91.7 0 0 0 93.2 991.0 993.3 94.1 94.0 91.7 0 0 0 91.0 0 93.2 91.0 91.0 91.7 </th <th><pre>*** START PROCESSING CROSS SECTION - "SLU4 " XS SLG4 0 24.6, 1001.4 -309.6, 986.4 -109.6, 986.4 -46.6, 985.7 CR -24.6, 1001.4 -309.6, 981 6.6, 977.6 19.7, 974.9 CR 29.5, 972.5 36.1, 972.9 45.9, 972.6 88.9, 972.3 CR 53.5, 972.6 772.7, 972.6 85.3, 972.5 88.6, 972.3 CR 65.972.6 113.1, 972.2 124.7, 973 CR 65.972.6 721.6 71.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.7 118.1, 972.8 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.7 118.1, 9</pre></th> <th>GR 134.5, 973.9 137.8, 975.5 144.4, 975.9 150.9, 981 GR 205.8, 986 211.2, 987.1 247.3, 988.3 267.3, 988.3 GR 205.8, 986 211.2, 987.1 247.3, 988.3 267.3, 988.3 GR 279.3 1000.1 N 0.10 0.00 SA</th> <th> DATA SUMMARY FOR SECID "SLG4 " AT SRD = 0. ERR-CODE = 0 SKEM IHFNO VISLOPE EK CK 0.0 0. ******** 0.50 0.00 X-Y COORDINATE PAIRS (NGE = 29): ***</th> <th>X X X</th> <th>X Y MAX-MIN POINTS: XMIN Y X XYAX -324.6 1001.40 111.6 971.70 279.3 1000.30 -324.6 1001.40 SUBAREA BREAKPOINTS (NSA = 3): -110. 205.</th> | <pre>*** START PROCESSING CROSS SECTION - "SLU4 " XS SLG4 0 24.6, 1001.4 -309.6, 986.4 -109.6, 986.4 -46.6, 985.7 CR -24.6, 1001.4 -309.6, 981 6.6, 977.6 19.7, 974.9 CR 29.5, 972.5 36.1, 972.9 45.9, 972.6 88.9, 972.3 CR 53.5, 972.6 772.7, 972.6 85.3, 972.5 88.6, 972.3 CR 65.972.6 113.1, 972.2 124.7, 973 CR 65.972.6 721.6 71.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 791.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.2 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.7 118.1, 972.8 124.77, 973 CR 70.1 9 111.6 701.7 118.1, 972.7 118.1, 9</pre> | GR 134.5, 973.9 137.8, 975.5 144.4, 975.9 150.9, 981 GR 205.8, 986 211.2, 987.1 247.3, 988.3 267.3, 988.3 GR 205.8, 986 211.2, 987.1 247.3, 988.3 267.3, 988.3 GR 279.3 1000.1 N 0.10 0.00 SA | DATA SUMMARY FOR SECID "SLG4 " AT SRD = 0. ERR-CODE = 0 SKEM IHFNO VISLOPE EK CK 0.0 0. ******** 0.50 0.00 X-Y COORDINATE PAIRS (NGE = 29): *** | X X X | X Y MAX-MIN POINTS: XMIN Y X XYAX -324.6 1001.40 111.6 971.70 279.3 1000.30 -324.6 1001.40 SUBAREA BREAKPOINTS (NSA = 3): -110. 205. |

19 63 WSEL. 981.10 60 58 981.12 981.17 981.20 WSEL 992. 992 992. 992. 985.50 976.30 973.90 971.60 974.50 988.40 1003.40 FEDERAL HIGHMAY ADMINISTRATION - U. S. GEOLUGICAL SUKVEY MODEL FOR MATER-SURFACE PROFILE COMPUTATIONS VEL 2.28 2570 2570 2570 SURVEY Q VEL 10400 10400 2.38 10400 10400 COMPUTATIONS X 27.7 14.8 41.0 67.3 93.5 119.8 243.4 Big Delta USGS 10/96 × F Bridge No. 524, Tanana River **_Slough_** at Big Delta Hydraulic Survey: model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (WSPRO ver. V082195) *** RUN DATE & TIME: 10-31-96 08:41 GEOLOGICAL ****** CRMS FR# 975.09 0.15 0.16 0.15 978.78 0.16 0.17 258 CRMS ******* * * * * * * * **** * * * * * * * ******* FR# 981.18 981.26 0.00 981.30 4444444 992.76 986.20 978.80 974.50 972.00 973.00 973.00 40 ERR 981.22 0.00 - 11. S. C ERR .73 992.78 Tanana River **_Slough_** at y; model run by Tom Meinrichs (WSPRO ver. V082195) 54 992. 1003. 08:41 X -35.3 8.2 34.5 60.7 87.0 87.0 1113.2 XMAX 258.4 0.03 00 03 02 00 02 HIP **** ***** HP **** **** HIGHWAY ADMINISTRATION EL FOR WATER-SURFACE 00 00 00 00 0 Bridge No. 2. J. model ... V08219-Hydraulic Survey; model ... V08219-....eko Profilas (WSPRO ver. V0821-96 6 0.09 0.10 0.16 0.08 0.10 0.07 0.152.00 0.15 ALPH ALPH 1 0 Y 986.20 975.10 975.10 972.80 971.50 980.80 VIMY 970.40 PROFILE CALCULATIONS AREA K 5784 1268698 31: AREA K 191581 1060 204910 181672 4375 4706 1040136 4700 1127 208403 956249 3): ROUGHNESS COEFFICIENTS (NSA = 0.100 0.030 0.100 X -235.3 0.0 27.9 54.1 80.4 106.6 139.5 X 80.4 = WSN) 152 132 133 -2 -315 272 -220 -217 244 LEW REW -241 MODEL PEDERAL MAX-MIN POINTS: BREAKPOINTS 1001.20 982.90 975.70 973.00 971.10 971.10 976.60 1003.40 147 SRDL PLEN SRDL 198 193 198 193 XMIN Y -250.3 1001.20 ****** 204 204 ****** ***** ***** 54 BEGINNING -35. :XS 402 : XS 595 :XS 204 0 XSID:CODE SRD CODE 0 SRD :XS 204 402 :XS :XS :XS :XS WSPRO V082195 SUBAREA V082195 XSID: WSPRO SLG4 SLG3 X-X SLG2 LU'IS SLG4 SLG3 SLG2 SLG1 +++ 984.60 973.60 969.40 986.20 YMAX 1001.20 0 - U. S. GEOLOGICAL SURVEY PROFILE COMPUTATIONS 0 5 985. 988.4 S 977.1 132.6, 980.8 137.9, 986.2 237.9, 986.2 x -6.7 45.9 111.6 237.9 Delta S 10/96 n × 6 -27.7. 974. ERR-CODE 252 250.3, 1001.2 -235.3, 986.2 -35.3, 986.2 -27. -18.2, 982.9 0, 980.8 8.2, 978.8 14.8, 976.3 21.3, 975.7 27.9, 975.1 34.5, 974.5 41.9, 973.9 41.6, 973 54.1, 972.4 67, 972.67.3, 971.6 73.8, 970.9 80.4, 970.4 87, 970.4 93.5, 970.4 100.1, 971.1 106.6, 971.5 113.2, 973 119.8 97 126.3, 970.6 119.5, 980.8 143.4, 988.4 243.4, 256.4, 1003.4 ERR-CODE 4 m Bridge No. 524. Tanana River **_Slough ** at Big D Hydraulic Survey; model run by Tom Heinrichs USGS MSPRO Profiles (MSPRO ver. V082195) *** RUN DATE & TIME: 10-31-96 08:41 RECORD NO. = ij. 986.10 974.10 969.30 986.20 1001.20 NO. 595. 402. PROCESSING CROSS SECTION - "SLG2 " SECTION "SLG2 " WRITTEN TO DISK, RECORD CK CK 0.00 0 XMAX 252.9 X 11.0 29.5 95.1 137.9 e HIGHWAY ADMINISTRATION SL FOR WATER-SURFACE - "SLG1 " 11 "SLG1 ũ. ROSS SECTION - "5LG1 " WRITTEN TO DISK, SRD SRD EK 50 EK 50 AT TA " 0.10 0 0 050 986.10 979.00 970.20 980.80 NIMY 05.30 ART PROCESSING CROSS SECTION SLG1 595 . 17): Y 3): 29) 0 SECID "SLG1 " SLO2 147 3): (NSA = 0.050 VSLOPE ****** 138 ASLOPE 11 11 -211.0 3.3 78.7 132.6 X 95.1 0.030 CROSS H (NGP SECID (NGP 0.030 252.9, 1001.2 0.10 0.030 (NSA MODEL "SLG1 COEFFICIENTS .100 0.030 FEDERAL PROCESSING Y MAX-MIN POINTS: XMIN 226.0 1001.10 COORDINATE PAIRS -35 FOR DATA SUMMARY FOR COORDINATE PAIRS ****** ONHHI 0. -11 IHFNO 0. SUBAREA BREAKPOINTS -11. 138. 1001.10 980.80 972.60 977.10 1001.20 SECTION SECTION 0.10 SUMMARY 128. HSTNTA ROUGHNESS C SKEW 0.0 HSINIA -226.0 0.0 62.3 128.0 252.9 START CROSS SKEW 0.0 CROSS DATA × WSPRO V082195 X-X EX *** XX GR GR N N N SA * * * 1 X-X * * * *** **

4

44 Hydraulic Survey and Scour Assessment of Bridge 524, Tanana River at Big Delta, Alaska

| | 50'166 | | | MSEL | 993.30 | 993.27 | 993.30 | FF. F99 | v | | WSEL | 994.10 | 994.07 | 994.10 | 994.12 | ĸ | | | WSEL | 994.00 | 10.500 |
|----------------------------|---|---|--|-------------------------------|-------------------------|-------------------|--------------------|---------------------|--|-----------------------|------------------------|--------------------|------------------|------------------|---------------------|------------------------|------------------------|-----------------------|------------------------|--------------------|-----------|
| 70.7 | 10400 | , SURVE | 10 | Q | 11400 | 11400 2.46 | 11400 2.27 | 11400 2.26 | L SURVE | | VEL | 11400 | 11400 2.31 | 11400 2.11 | 11400 2.10 | L SURVE | 10 | | VEL | 11400 | 11400 |
| 0.22 | ****** | OLOGICAL UMPUTATI | GS 10/96 | CRWS FR# | 979.14 0.12 | ****** | ****** | ****** | OMPUTAT OMPUTAT g Delta GG 10/9 | | FRWS | 979,14 0.11 | 0.15 | 0.16 | ****** | OILOGICA OMPUTAT | g Delta GS 10/9 | | CRMS FR# | 979.14 0.11 | ***** |
| 000 | * 527.166 | U. S. GE OFILE C | richs US | EGL | 993,38 | 993.44 | 993.47 * | \$ 40°.0 | U. S. GP OFTLR C ** at Bi richs US | | EGL ERR | 994.17 | 994.23 | 994.24 | 994.26 | U. S. GE OFILE C | ** at Bi richs US | | EGL | ****** | * 21.12 |
| 0.00 | 0.03 | CE PR | m Hein 5) 08:41 | HF | | 0.02 | 0.02 | 0.00 | CR PR CR PR lough_ | 5) 08:41 | HF | * **** | 0.02 | 0.02 | 0.02 | CE PR | lough_m | 5) 08:41 | HF | * * * * * | 0.02 |
| 1.90 | 0.19 | II STRAT | u by To v08219 31-96 | UHD ALPH | 0.08 * | 0.17 | 0.16 2.03 | 0.16 | IISTRAT C-SURFA | V08219 | VHD. ALPH | 0.07 * | 0.15 | 0.14 2.06 | 0.14 2.04 | HI STRAT | by To | V08219 | UHD ALPH | 0.07 * 1.52 * | 0,15 |
| C45.24X | 3930 830640 | WAY ADMIN OR WATER | nana kive model run PRO ver. TIME: 10- | AREA K | 6195 1393681 | 4637 | 5029 1123427 | 5043 1092220 | WAY ADMIN OR WATEF OR WATEF nana Rive | PRO Ver. TIME: 10- | AREA K | 6667 1542799 | 4942 | 5399 1222368 | 5433 1191313 | WAY ADMIN OR WATEF | mana Rive model run | PRO Ver. TIME: 10- | AREA K | 6608 1523803 | 4904 |
| 243 | -239 246 | AL HIGH ODEL F | urvey; Ta urvey; les (WS DATE & | LEW REW | -315-272 | -221 157 | -217 245 | -241 248 | AL HIGH ODEL F 524, Ta | les (WS DATE & | LEW REW | -316 273 | -222 159 | -218 246 | -242 249 | AL HIGH | 524, Ta urvey; | les (WS DATE & | LEW REW | -316 273 | -222 |
| 198 | 193 | FEDER M | Ige No. caulic S KU Profi *** RUN | SRDL | ***** | 204 | 198 | 193 | FEDER M dge No. | RO Profi | SRDL | ****** | 204 | 198 | 193 193 | FEDER | dge No. | RO Profi *** RUN | SRDL | ***** | 204 |
| 402 | SLG1 :XS 595 | WSPRO V082195 | Brid Hydi WSP | XSID:CODE SRD | SIG4 :XS | SLG3 : XS 204 | sLG2 :XS 402 | SLG1 : X5 595 | WSPRO V082195 Brid | Id SM | X51D:CODE SRD | SLG4 :XS | SLG3 :XS 204 | SLG2 :XS 402 | sug1 :xs 595 | WSPRO V082195 | Brid | MSPI | XSID: CODE SRD | SLG4 : XS | SIG3 ; XS |
| | | | WSEL | 993.40 | 993.38 | 993.40 | 993.42 | | | WSEL | 993.20 | 993.18 | 993.20 | 993.23 | | | | WSEL | 991.00 | 990.98 | 10 199 |
| 2.21 | SURVEY | | 0 VEL | 10400 | 10400 2.22 | 10400 2.05 | 10400 2.04 | , SURVEY ONS | | 0 VEL | 10400 | 10400 2.26 | 10400 2.09 | 10400 2.08 | , SURVEY IONS | | | VEL | 10400 2.15 | 10400 2.75 | 10400 |
| 0.18 | OMPUTATI | g Delta GS 10/96 | CRWS FR# | 978.78 | ****** | 0.16 | 0.16 | COLUGICAL | g Delta 665 10/96 | CRWS FR# | 978.78 0.11 | 0.15 | 0.16 | 0.16 | COMPUTATI | lg Delta SGS 10/96 | | CRWS FR# | 978.78 0.16 | 0.20 | ****** |
| 0.00 | U. S. GE OFILE C | ** at Bi richs US | EGL ERR | 993.46 | 993.52 * | \$ 757.54 * | 993.55 * | U. S. GE | ** at Bi richs us | EGL | 993.27 | 993.32 * | 993.34 * | 993.36 • | U. S. GP OFILE C | ** at Bi richs US | | EGL | 991.10 | 00.00 | 10 100 |
| 00.0 | ACE PR | slough_ om Hein 95) | 08:41 HF H0 | * ***** | 0.02 | 0.02 | 0.02 | TION - | Slough_ om Hein 95) 08:41 | HF HO | * ***** | 0.02 | 0.02 | 0.02 | TION - | Slough om Hein | 166 | HF | * * * * * * | 0.03 | 0 03 |
| ~ | STRA7 SURP1 | n by To V08219 | -31 96 VHD | 0.06 | 0.14 | 0.13 2.03 | 0.13 | NI STRA | er ** n by T v0821 -31-96 | VHD ALPH | 0.07 | 0.14 | 0.14 2.03 | 0.13 | NI STRA | er **_ | -31-96 | ИНД АЦРН | 0.10 | 0.20 | 06 0 |
| 1.94 (| NI -N | kiv l ru ver. | AREA AREA K | 6254 1411964 | 4677 1038230 | 5075 1135506 | 5089 1103786 | WAY ADMI OR WATE | nana Riv model ru PRO ver. TIME: 10 | AREA K | 6137 1375513 | 4601 | 4982 1111263 | 4992 | WAY ADMI OR WATE | nana Riv model ru | TIME: 10 | AREA K | 4847 | 37777 802193 | CLUC |
| 1008270 1.94 (| WAY ADMINI OR WATER- | mana mode PRO | 8 | | 21 | 245 | -242 248 | NAL HIGH | 524, Ta urvey; les (WS DATE & | LEW REW | -315 272 | -221 157 | -217 245 | -241 248 | AL HICH | 524, Ta | DATE & | I,EW REW | -313 270 | -219 | 144 |
| 248 1008270 1.94 (| AL HIGHWAY ADMINI ODEL FOR WATER- | 524, Tanana urvey; mode les (WSPRO | DATE & T LEW REW | -316 272 | 1-2- | | | mΣ | 5 H 2 | | | - | 80 00 | m m | DEF | | N | | | | |
| 193 248 1008270 1.94 (| FEDERAL HIGHWAY ADMINI MODEL FOR WATER- | lge No. 524, Tanana aulic Survey: mode O Profiles (WSPRO | SRDL LEW | | 204 -2 204 1 | 198 | 193 | FEDE | dge No raulic to Prof | SRDL | ***** | 204 | 19 | 19 | FE | dge No | RO Pro | FLEN | | 204 | 00.0 |
| 595 193 248 1008270 1.94 (| FEDERAL HIGHWAY ADMINI 95 MODEL FOR WATER- | Bridge No. 524, Tanana Hydraulic Survey; mode WSPRO Profiles (WSPRO | *** RUN DATE & T :CODE SRDL LEW SUD FIEN REW | XS ***** -316 0 ****** 272 | :XS 204 -2 204 204 1 | :XS 198 - 402 198 | :XS 193 595 193 | 95 FEDE | Bridge No Hydraulic WSPRO Pro | CODE SRDL SRD FLEN | ****** 0 ****** SX: | :XS 204 204 204 | :XS 19 402 19 | :XS 19 595 19 | 95 FE | Bridge No Hydraulie | WSPRO Pro | SRD FLEN | ****** 0 ****** SX: | :XS 204 204 204 | |

991.70 991.75 MSEL 991.67 17.199 02 994.00 994. 11400 2.13 GEOLOGICAL SURVEY COMPUTATIONS 11400 2.12 11400 2.17 11400 2.82 11400 2.66 11400 2.67 2.32 VEL Bridge No. 524. Tanana River **_Slough_** at Big Delta Hydraulic survey; model run by Tom Heinrichs USGS 10/96 WSPRO Profiles (MSPRO ver. V082195) *** RUN DATE & TIME: 10-31 96 08:41 ******* ******* 979.14 0.15 ******* 0.15 CRWS FR# 0.22 0.21 ****** **** 991.96 0.00 994.17 991.89 0.00 991.92 0.00 994.15 991.81 0.00 PROFILE EGL 0.02 0.02 ***** 0.03 0.03 06 0.04 HF FEDERAL HIGHWAY ADMINISTRATION MODEL FOR WATER-SURFACE 00 0.15 2.06 0.14 2.04 ALPH 0.11 0.22 0.21 0.21 1.82 5384 1178694 5256 1115773 4035 867482 4293 5353 1209776 AREA K 4270 907066 1101346 -218 246 -242 249 LEW REW -314 271 219 -216 243 -240 247 159 198 193 SRDL ****** 204 198 193 204 :XS 204 XSID:CODE SRD SLG2 :XS 402 0 :XS 595 :XS 402 :XS 595 204 sx: 1 WSPRO V082195 SLG1 SLG2 SLG4 SLG3 SLG1 FR

EXECUTION WSPRO OF END NORMAL - This page is intentionally left blank.

Table B1.Cross section Approach 1 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -20.1 | 998.7 | extended up |
| _ | - | -19.6 | 986.7 | estimated overbank |
| 10,753.1 | 9,894.0 | -9.6 | 986.7 | rebar |
| 10,751.3 | 9,903.4 | 0.0 | 981.5 | left edge of water |
| 10,753.6 | 9,913.5 | 10.3 | 976.4 | channel sounding |
| 10,757.3 | 9,929.5 | 26.7 | 973.4 | channel sounding |
| 10,761.0 | 9,945.5 | 43.1 | 973.2 | channel sounding |
| 10,764.6 | 9,961.5 | 59.5 | 973.4 | channel sounding |
| 10,768.3 | 9,977.5 | 75.9 | 973.7 | channel sounding |
| 10,772.0 | 9,993.4 | 92.3 | 973.6 | channel sounding |
| 10,775.7 | 10,009.4 | 108.7 | 973.7 | channel sounding |
| 10,779.3 | 10,025.4 | 125.1 | 973.7 | channel sounding |
| 10,783.0 | 10,041.4 | 141.6 | 974.3 | channel sounding |
| 10,786.7 | 10,057.4 | 158.0 | 974.3 | channel sounding |
| 10,790.4 | 10,073.4 | 174.4 | 974.2 | channel sounding |
| 10,794.0 | 10,089.4 | 190.8 | 973.9 | channel sounding |
| 10,797.7 | 10,105.4 | 207.2 | 973.5 | channel sounding |
| 10,801.4 | 10,121.3 | 223.6 | 973.5 | channel sounding |
| 10,805.1 | 10,137.3 | 240.0 | 973.6 | channel sounding |
| 10,808.7 | 10,153.3 | 256.4 | 974.8 | channel sounding |
| 10,812.4 | 10,169.3 | 272.8 | 974.4 | channel sounding |
| 10,816.1 | 10,185.3 | 289.2 | 974.0 | channel sounding |
| 10,819.8 | 10,201.3 | 305.6 | 973.8 | channel sounding |
| 10,823.4 | 10,217.3 | 322.0 | 973.9 | channel sounding |
| 10,827.1 | 10,233.3 | 338.4 | 974.2 | channel sounding |
| 10,830.8 | 10,249.3 | 354.8 | 974.8 | channel sounding |
| 10,834.5 | 10,265.2 | 371.2 | 975.6 | channel sounding |
| 10,838.1 | 10,281.2 | 387.6 | 975.8 | channel sounding |
| 10,841.8 | 10,297.2 | 404.0 | 976.0 | channel sounding |
| 10,845.5 | 10,313.2 | 420.4 | 976.4 | channel sounding |
| 10,849.2 | 10,329.2 | 436.8 | 976.7 | channel sounding |
| 10,852.8 | 10,345.2 | 453.2 | 977.1 | channel sounding |
| 10,856.5 | 10,361.2 | 469.7 | 977.6 | channel sounding |
| 10,860.2 | 10,377.2 | 486.1 | 977.0 | channel sounding |
| 10,863.8 | 10,393.1 | 502.5 | 977.3 | channel sounding |
| 10,867.5 | 10,409.1 | 518.9 | 977.2 | channel sounding |
| 10,871.2 | 10,425.1 | 535.3 | 977.6 | channel sounding |
| 10,874.9 | 10,441.1 | 551.7 | 977.5 | channel sounding |
| 10,877.1 | 10,450.7 | 561.5 | 978.4 | channel sounding |
| 10,888.3 | 10,482.3 | 594.8 | 981.4 | right edge of water |
| 10,889.4 | 10,488.7 | 601.3 | 982.3 | toe of bank |
| 10,890.3 | 10,491.1 | 603.9 | 986.3 | rebar |
| - | - | 1,603.9 | 986.3 | estimated overbank |
| — | _ | 1,613.9 | 996.3 | extended up |



Table B2.Cross section Approach 2 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| 10,753.1 | 9,894.0 | -9.1 | 987.2 | bank |
| 10,751.3 | 9,903.4 | .0 | 981.5 | left edge of water |
| 10,747.6 | 9,909.9 | 7.4 | 976.2 | channel sounding |
| 10,739.5 | 9,924.1 | 23.8 | 974.5 | channel sounding |
| 10,731.3 | 9,938.4 | 40.2 | 973.4 | channel sounding |
| 10,723.2 | 9,952.6 | 56.7 | 973.3 | channel sounding |
| 10,715.0 | 9,966.8 | 73.1 | 973.4 | channel sounding |
| 10,706.9 | 9,981.1 | 89.5 | 973.5 | channel sounding |
| 10,698.7 | 9,995.3 | 105.9 | 973.6 | channel sounding |
| 10,690.6 | 10,009.6 | 122.3 | 973.5 | channel sounding |
| 10,682.4 | 10,023.8 | 138.7 | 973.4 | channel sounding |
| 10,674.3 | 10,038.0 | 155.1 | 973.4 | channel sounding |
| 10,666.1 | 10,052.3 | 171.5 | 973.4 | channel sounding |
| 10,658.0 | 10,066.5 | 187.9 | 973.3 | channel sounding |
| 10,649.8 | 10,080.7 | 204.3 | 972.9 | channel sounding |
| 10,641.6 | 10,095.0 | 220.7 | 972.9 | channel sounding |
| 10,633.5 | 10,109.2 | 237.1 | 972.9 | channel sounding |
| 10,625.3 | 10,123.4 | 253.5 | 973.3 | channel sounding |
| 10,617.2 | 10,137.7 | 269.9 | 973.9 | channel sounding |
| 10,609.0 | 10,151.9 | 286.3 | 974.1 | channel sounding |
| 10,600.9 | 10,166.2 | 302.7 | 974.1 | channel sounding |
| 10,592.7 | 10,180.4 | 319.1 | 973.5 | channel sounding |
| 10,584.6 | 10,194.6 | 335.5 | 972.9 | channel sounding |
| 10,576.4 | 10,208.9 | 351.9 | 972.6 | channel sounding |
| 10,568.3 | 10,223.1 | 368.3 | 972.8 | channel sounding |
| 10,560.1 | 10,237.3 | 384.8 | 973.3 | channel sounding |
| 10,552.0 | 10,251.6 | 401.2 | 973.1 | channel sounding |
| 10,543.8 | 10,265.8 | 417.6 | 973.4 | channel sounding |
| 10,535.7 | 10,280.1 | 434.0 | 974.7 | channel sounding |
| 10,527.5 | 10,294.3 | 450.4 | 975.5 | channel sounding |
| 10,519.4 | 10,308.5 | 466.8 | 975.8 | channel sounding |
| 10,511.2 | 10,322.8 | 483.2 | 976.0 | channel sounding |
| 10,503.1 | 10,337.0 | 499.6 | 976.5 | channel sounding |
| 10,494.9 | 10,351.2 | 516.0 | 976.7 | channel sounding |
| 10,486.8 | 10,365.5 | 532.4 | 977.1 | channel sounding |
| 10,478.6 | 10,379.7 | 548.8 | 977.2 | channel sounding |
| 10,470.5 | 10,393.9 | 565.2 | 977.7 | channel sounding |
| 10,462.3 | 10,408.2 | 581.6 | 977.8 | channel sounding |
| 10,454.2 | 10,422.4 | 598.0 | 978.2 | channel sounding |
| 10,446.0 | 10,436.7 | 614.4 | 978.7 | channel sounding |
| 10,437.9 | 10,450.9 | 630.8 | 978.0 | channel sounding |
| 10,429.7 | 10,465.1 | 647.2 | 978.4 | channel sounding |
| 10,421.6 | 10,479.4 | 663.6 | 978.0 | channel sounding |
| 10,413.4 | 10,493.6 | 680.0 | 978.5 | channel sounding |
| 10,405.3 | 10,507.8 | 696.4 | 978.9 | channel sounding |
| 10,397.1 | 10,522.1 | 712.9 | 978.4 | channel sounding |
| 10,393.8 | 10,527.8 | 719.4 | 978.4 | channel sounding |
| 10,372.6 | 10,584.6 | 779.3 | 981.0 | right edge of water |
| 10,357.8 | 10,615.9 | 813.7 | 982.0 | bank |
| 10,346.9 | 10,643.1 | 842.8 | 980.9 | bank |
| 10,325.4 | 10,675.3 | 881.5 | 980.9 | bank |
| 10,319.2 | 10,701.7 | 907.5 | 983.9 | bank |



Table B3.Cross section Approach 3 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| 10.499.7 | 9.929.0 | -63.6 | 987.1 | bank |
| 10 480 6 | 9 964 6 | -23.2 | 986.8 | rehar |
| 10 477 3 | 9 989 5 | 0 | 981.1 | left edge of water |
| 10,467,5 | 10,006,6 | 19.7 | 978.4 | channel sounding |
| 10,467.5 | 10,000.0 | 36.1 | 976.2 | channel sounding |
| 10,451.2 | 10,025.0 | 52.5 | 974.9 | channel sounding |
| 10,431.2 | 10,039.0 | 68.9 | 973.9 | channel sounding |
| 10,443.1 | 10,049.5 | 85.3 | 972.9 | channel sounding |
| 10,434.7 | 10,003.5 | 101.7 | 972.5 | channel sounding |
| 10,420.0 | 10,077.7 | 118.1 | 971.7 | channel sounding |
| 10,410.5 | 10,092.0 | 134.5 | 971.7 | channel sounding |
| 10,410.3 | 10,100.2 | 150.0 | 970.3 | channel sounding |
| 10,402.5 | 10,120.4 | 167.3 | 970.3 | channel sounding |
| 10,394.2 | 10,134.7 | 107.5 | 970.3 | channel sounding |
| 10,380.0 | 10,146.9 | 200.1 | 970.3 | channel sounding |
| 10,377.9 | 10,103.2 | 200.1 | 970.8 | channel sounding |
| 10,309.7 | 10,177.4 | 210.5 | 970.9 | channel sounding |
| 10,555.4 | 10,203.9 | 249.4 | 970.9 | channel sounding |
| 10,345.2 | 10,220.1 | 203.8 | 971.0 | channel sounding |
| 10,337.1 | 10,234.5 | 282.2 | 971.0 | channel sounding |
| 10,328.9 | 10,248.0 | 298.0 | 971.5 | channel sounding |
| 10,320.8 | 10,262.8 | 315.0 | 9/1.5 | channel sounding |
| 10,312.0 | 10,277.0 | 331.4 247.9 | 972.0 | channel sounding |
| 10,304.5 | 10,291.3 | 347.8 | 973.1 | channel sounding |
| 10,290.3 | 10,305.5 | 304.2 200.6 | 974.0 | channel sounding |
| 10,288.2 | 10,319.8 | 380.0 | 975.0 | channel sounding |
| 10,280.0 | 10,334.0 | 397.0 | 975.4 | channel sounding |
| 10,271.9 | 10,348.2 | 413.4 | 976.1 | channel sounding |
| 10,203.7 | 10,302.5 | 429.8 | 976.9 | channel sounding |
| 10,255.6 | 10,376.7 | 446.2 | 977.1 | channel sounding |
| 10,247.4 | 10,390.9 | 402.0 | 970.9 | channel sounding |
| 10,239.3 | 10,405.2 | 4/9.0 | 977.5 | channel sounding |
| 10,231.1 | 10,419.4 | 495.4 511.0 | 978.0 | channel sounding |
| 10,225.0 | 10,433.7 | 511.8 | 978.2 | channel sounding |
| 10,214.8 | 10,447.9 | 528.2 544.6 | 978.0 | channel sounding |
| 10,206.7 | 10,462.1 | 544.6 | 979.1 | channel sounding |
| 10,182.2 | 10,504.8 | 593.9 | 978.3 | channel sounding |
| 10,174.1 | 10,519.1 | 610.3 | 978.8 | channel sounding |
| 10,105.9 | 10,555.5 | 020.7 | 978.8 | channel sounding |
| 10,157.8 | 10,547.5 | 643.1 | 978.0 | channel sounding |
| 10,149.6 | 10,561.8 | 639.3 | 978.7 | channel sounding |
| 10,141.5 | 10,576.0 | 6/5.9 | 979.1 | channel sounding |
| 10,133.3 | 10,590.3 | 692.3 | 978.9 | channel sounding |
| 10,125.2 | 10,604.5 | /08./ | 978.0 | channel sounding |
| 10,117.0 | 10,618.7 | 725.1 | 972.7 | channel sounding |
| 10,108.9 | 10,633.0 | /41.5 | 969.1 | channel sounding |
| 10,100.7 | 10,647.2 | 151.9 | 969.0 | channel sounding |
| 10,092.6 | 10,661.4 | 774.3 | 972.0 | channel sounding |
| 10,084.4 | 10,6/5.7 | /90.7 | 976.3 | channel sounding |
| 10,079.5 | 10,684.2 | 800.6 | 980.1 | channel sounding |
| 10,048.5 | 10,714.5 | 842.3 | 980.9 | right edge of water |
| 10,047.4 | 10,720.0 | 847.6 | 982.1 | toe of bank |
| 10,047.0 | 10,721.8 | 849.4 | 986.5 | rebar |
| 10,044.6 | 10,726.7 | 854.8 | 987.1 | Dank |
| 10,026.5 | 10,738.0 | 890.9 | 988.5 | Uank |



Table B4.Cross section Approach 4 at the Tanana River at BigDelta.

[Points surveyed August 27, 1996. See figure 2 for location. See text for coordinate information; ft, foot]

-

| (ft)(ft)(ft)Notes10,171.19,803.9-2,15.9995.5road shoulder10,190.39,815.9-1,10.2989.4parking lot10,206.19,952.5-49.0989.7bank10,205.99,955.3-46.5986.8bank10,206.79,957.2-45.3987.5rebar10,207.49,959.9-43.3984.4toe of bank10,207.49,959.9-43.3984.4toe of bank10,207.49,959.9-43.3984.4toe of bank10,207.49,959.9-43.3976.6channel sounding10,159.010,035.446.3976.6channel sounding10,158.010,049.562.7975.5channel sounding10,142.510,063.779.1973.9channel sounding10,124.210,077.995.5972.7channel sounding10,125.010,092.1111.9972.1channel sounding10,104.210,077.995.5971.3channel sounding10,104.210,177.1210.3970.7channel sounding10,084.710,120.4144.7971.5channel sounding10,059.910,254.8970.5channel sounding10,054.110,177.1210.3970.7channel sounding10,054.110,219.6259.6971.1channel sounding10,054.810,262.1308.8971.2channel sounding10,045.410,276.3 <td< th=""><th>Easting</th><th>Northing</th><th>Station</th><th>Elevation</th><th>N1 /</th></td<> | Easting | Northing | Station | Elevation | N 1 / |
|--|----------|----------|----------------|-----------|---------------------|
| 10,171.1 $9,803.9$ $-2,15.9$ 995.5 road shoulder $10,190.3$ $9,815.9$ $-1,10.2$ 988.6 base road embank $10,221.0$ $9,952.5$ -49.0 989.7 bank $10,206.1$ $9,957.2$ -45.3 987.5 bank $10,206.7$ $9,957.2$ -45.3 987.5 rebar $10,207.4$ $9,959.9$ -43.3 984.4 toe of bank $10,202.3$ $10,007.0$ 0 980.9 left edge of water $10,167.3$ $10,021.2$ 29.9 978.4 channel sounding $10,150.8$ $10,049.5$ 62.7 975.5 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,062.1$ 111.9 972.1 channel sounding $10,112.6$ $10,092.1$ 111.9 971.3 channel sounding $10,012.1$ $10,120.4$ 144.7 971.6 channel sounding $10,061.1$ $10,120.4$ 144.7 971.5 channel sounding $10,062.1$ $10,33.9$ 971.3 channel sounding $10,064.1$ $10,17.1$ 210.3 970.7 channel sounding $10,065.1$ $10,219.6$ 295.6 971.1 channel sounding $10,064.3$ $10,223.8$ 276.0 971.3 channel sounding $10,051.6$ $10,220.6$ 971.2 channel sounding $10,043.3$ $10,233.8$ | (ft) | (ft) | (ft) | (ft) | Notes |
| 10,190.3 $9,815.9$ $-1,93.3$ 988.6 base road embank $10,221.0$ $9,982.1$ $-1,10.2$ 989.4 parking lot $10,206.1$ $9,952.5$ -40.0 989.7 bank $10,205.9$ $9,957.2$ -45.3 987.5 rebar $10,206.7$ $9,957.2$ -45.3 987.5 rebar $10,202.3$ $10,007.0$ 0 980.9 left edge of water $10,167.3$ $10,021.2$ 29.9 978.4 channel sounding $10,150.8$ $10,049.5$ 62.7 975.5 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 977.9 channel sounding $10,142.5$ $10,067.7$ 95.5 972.7 channel sounding $10,112.0$ $10,02.1$ 111.9 972.1 channel sounding $10,112.7$ $10,106.2$ 128.3 971.9 channel sounding $10,012.1$ $10,120.4$ 144.7 971.5 channel sounding $10,002.9$ $10,148.8$ 177.5 971.5 channel sounding $10,007.4$ $10,177.1$ 210.3 970.7 channel sounding $10,076.4$ $10,171.1$ 220.8 970.7 channel sounding $10,043.1$ $10,248.0$ 292.4 971.1 channel sounding $10,045.1$ $10,248.0$ 292.4 971.1 channel sounding $10,045.1$ $10,248.0$ 292.4 971.1 channel sounding< | 10,171.1 | 9,803.9 | -2,15.9 | 995.5 | road shoulder |
| 10,221.0 $9,893.1$ $-1,10.2$ 989.4 parking lot $10,205.9$ $9,955.3$ -46.5 986.8 bank $10,207.4$ $9,957.2$ -45.3 987.5 rebar $10,207.4$ $9,957.2$ -45.3 984.4 toe of bank $10,207.4$ $9,959.9$ -43.3 984.4 toe of bank $10,207.4$ $9,959.9$ -43.3 984.4 toe of bank $10,207.4$ $9,959.9$ -43.3 984.4 toe of bank $10,167.3$ $10,021.2$ 29.9 978.4 channel sounding $10,150.8$ $10,049.5$ 62.7 975.5 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 971.9 channel sounding $10,117.7$ $10,106.2$ 128.3 971.7 channel sounding $10,117.7$ $10,162.9$ 193.9 971.3 channel sounding $10,084.1$ $10,177.1$ 210.3 970.7 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,026.8$ $10,276.3$ 325.2 971.1 channel sounding $10,025.9$ $10,248.0$ 292.4 971.2 channel sounding $10,020$ | 10,190.3 | 9,815.9 | -1,93.3 | 988.6 | base road embank |
| 10,206.1 9,952.5 -49.0 989.7 bank 10,205.9 9,955.3 -46.5 986.8 bank 10,207.4 9,959.9 -43.3 984.4 toe of bank 10,207.4 9,059.9 -975.5 channel sounding 10,159.0 10,035.7 79.1 973.9 channel sounding 10,142.5 10,063.7 79.1 973.9 channel sounding 10,142.5 10,063.7 79.1 971.9 channel sounding 10,142.5 10,062.1 128.3 971.9 channel sounding 10,112.1 10,134.2 161.1 971.3 channel sounding 10,024.1 10,124.7 144.7 971.5 channel sounding 10,076.4 10,177.1 210.3 970.7 channel sounding 10,076.4 10,171.1 210.3 970.7 channel sounding | 10,221.0 | 9,893.1 | -1,10.2 | 989.4 | parking lot |
| 10,205.9 9,955.3 -46.5 986.8 bank 10,207.4 9,959.9 -43.3 987.5 rebar 10,207.4 9,959.9 -43.3 984.4 toe of bank 10,202.3 10,007.0 .0 980.9 left edge of water 10,157.3 10,021.2 29.9 978.4 channel sounding 10,150.8 10,049.5 62.7 975.5 channel sounding 10,142.5 10,063.7 79.1 973.9 channel sounding 10,124.2 10,077.9 955.5 972.7 channel sounding 10,126.0 10,092.1 111.9 972.1 channel sounding 10,127.0 10,162.2 128.3 971.9 channel sounding 10,012.1 10,134.6 161.1 971.3 channel sounding 10,084.7 10,162.9 193.9 971.3 channel sounding 10,076.4 10,177.1 210.3 970.7 channel sounding 10,068.1 10,276.3 325.2 971.1 channel sounding 10,026.8 10,262.1 308.8 971.2 </td <td>10,206.1</td> <td>9,952.5</td> <td>-49.0</td> <td>989.7</td> <td>bank</td> | 10,206.1 | 9,952.5 | -49.0 | 989.7 | bank |
| 10,206.7 9,957.2 -45.3 987.5 rebar 10,207.4 9,959.9 -43.3 984.4 toe of bank 10,202.3 10,007.0 .0 980.9 left edge of water 10,167.3 10,021.2 29.9 978.4 channel sounding 10,159.0 10,035.4 46.3 976.6 channel sounding 10,142.5 10,063.7 79.1 973.9 channel sounding 10,142.5 10,063.7 79.1 973.9 channel sounding 10,142.5 10,063.7 79.1 973.9 channel sounding 10,142.5 10,063.7 79.1 971.3 channel sounding 10,17.7 10,162.1 128.3 971.9 channel sounding 10,104.4 144.7 971.6 channel sounding 10,092.9 10,148.8 177.5 971.5 channel sounding 10,084.7 10,171 210.3 970.7 channel sounding 10,051.6 10,219.6 259.6 971.1 channel sounding 10,053.1 10,248.0 292.4 971.1 cha | 10,205.9 | 9,955.3 | -46.5 | 986.8 | bank |
| 10,207.4 $9,959.9$ -43.3 984.4 toe of bank $10,202.3$ $10,007.0$.0 980.9 left edge of water $10,167.3$ $10,021.2$ 29.9 978.4 channel sounding $10,150.8$ $10,049.5$ 62.7 975.5 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,126.0$ $10,092.1$ 111.9 972.1 channel sounding $10,126.0$ $10,092.1$ 111.9 972.1 channel sounding $10,102.4$ 104.7 971.6 channel sounding $10,092.9$ $10,148.8$ 177.5 971.5 channel sounding $10,092.9$ $10,148.8$ 177.5 971.7 channel sounding $10,068.1$ $10,17.1$ 210.3 970.7 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,026.8$ $10,262.1$ 308.8 971.2 channel sounding $10,026.8$ $10,262.1$ 308.8 971.2 channel sounding $10,026.8$ $10,276.3$ 325.2 971.1 channel sounding $10,013.3$ $10,231.4$ 374.4 972.6 channel sounding $9,993.5$ $10,331.8$ 374.4 972.6 channel sounding </td <td>10,206.7</td> <td>9,957.2</td> <td>-45.3</td> <td>987.5</td> <td>rebar</td> | 10,206.7 | 9,957.2 | -45.3 | 987.5 | rebar |
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| 10,159.0 $10,035.4$ 46.3 976.6 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,124.2$ $10,077.9$ 95.5 972.7 channel sounding $10,126.0$ $10,092.1$ 111.9 971.3 channel sounding $10,102.1$ $10,120.4$ 144.7 971.6 channel sounding $10,092.9$ $10,148.8$ 177.5 971.3 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,026.8$ $10,276.3$ 325.2 971.1 channel sounding $10,026.8$ $10,262.1$ 308.8 971.2 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $10,020.0$ $10,304.6$ 358.0 971.6 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,990.7$ $10,347.2$ 407.2 974.2 channel sounding $9,990.7$ $10,347.2$ 407.2 974.2 channel sounding $9,990.7$ $10,347.2$ 407.2 975.5 < | 10,167.3 | 10,021.2 | 29.9 | 978.4 | channel sounding |
| 10,150.8 $10,049.5$ 62.7 975.5 channel sounding $10,142.5$ $10,063.7$ 79.1 973.9 channel sounding $10,134.2$ $10,077.9$ 95.5 972.7 channel sounding $10,126.0$ $10,092.1$ 111.9 972.1 channel sounding $10,117.7$ $10,106.2$ 128.3 971.9 channel sounding $10,010.4$ $10,120.4$ 144.7 971.6 channel sounding $10,012.0$ $10,134.6$ 161.1 971.3 channel sounding $10,029.9$ $10,148.8$ 177.5 971.5 channel sounding $10,084.7$ $10,162.9$ 193.9 971.3 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,043.3$ $10,233.8$ 276.0 971.3 channel sounding $10,016.6$ $10,276.3$ 325.2 971.1 channel sounding $10,016.8$ $10,276.3$ 325.2 971.1 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,997.2$ $10,347.2$ 407.2 974.2 channel sounding $9,997.2$ $10,347.2$ 407.2 $974.$ | 10,159.0 | 10,035.4 | 46.3 | 976.6 | channel sounding |
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| 10,142.5 $10,063.7$ 79.1 973.9 channel sounding $10,124.2$ $10,077.9$ 95.5 972.7 channel sounding $10,126.0$ $10,092.1$ 111.9 972.1 channel sounding $10,117.7$ $10,106.2$ 128.3 971.9 channel sounding $10,109.4$ $10,120.4$ 144.7 971.6 channel sounding $10,002.9$ $10,148.8$ 177.5 971.5 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,075.4$ $10,219.6$ 259.6 971.1 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,035.1$ $10,248.0$ 292.4 971.1 channel sounding $10,035.1$ $10,248.0$ 292.4 971.1 channel sounding $10,018.6$ $10,276.3$ 325.2 971.1 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,997.2$ $10,347.2$ 407.2 974.2 channel sounding $9,997.2$ $10,347.2$ 407.2 974.2 channel sounding $9,997.7$ $10,347.2$ 407.2 974.2 channel sounding $9,997.7$ $10,347.2$ 407.2 974.2 | 10,142.5 | 10,063.7 | 79.1 | 973.9 | channel sounding |
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| 10,084.7 $10,162.9$ 193.9 971.3 channel sounding $10,076.4$ $10,177.1$ 210.3 970.7 channel sounding $10,068.1$ $10,191.3$ 226.8 970.7 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,043.3$ $10,233.8$ 276.0 971.3 channel sounding $10,055.1$ $10,248.0$ 292.4 971.1 channel sounding $10,026.8$ $10,262.1$ 308.8 971.2 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $10,002.0$ $10,304.6$ 358.0 971.6 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,997.2$ $10,347.2$ 407.2 974.2 channel sounding $9,967.0$ $10,375.5$ 440.0 973.5 channel sounding $9,960.7$ $10,375.5$ 440.0 973.5 channel sounding $9,952.5$ $10,389.7$ 456.4 974.9 channel sounding $9,952.5$ $10,430.9$ 472.8 975.2 channel sounding $9,992.7$ $10,445.4$ 522.0 977.0 channel sounding $9,992.9$ $10,418.0$ 489.2 975.5 channel sounding $9,992.9$ $10,474.7$ 554.9 976.8 channel sounding $9,992.9$ $10,474.7$ 554.9 975.9 </td <td>10,092.9</td> <td>10,148.8</td> <td>177.5</td> <td>971.5</td> <td>channel sounding</td> | 10,092.9 | 10,148.8 | 177.5 | 971.5 | channel sounding |
| 10,076.4 $10,177.1$ 210.3 970.7 channel sounding $10,068.1$ $10,191.3$ 226.8 970.5 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,043.3$ $10,233.8$ 276.0 971.3 channel sounding $10,043.3$ $10,233.8$ 276.0 971.3 channel sounding $10,026.8$ $10,262.1$ 308.8 971.2 channel sounding $10,026.8$ $10,226.3$ 325.2 971.1 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $10,002.0$ $10,304.6$ 358.0 971.6 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,995.5$ $10,33.0$ 390.8 973.3 channel sounding $9,967.2$ $10,347.2$ 407.2 974.2 channel sounding $9,967.7$ $10,375.5$ 440.0 973.5 channel sounding $9,962.5$ $10,389.7$ 456.4 974.9 channel sounding $9,952.5$ $10,389.7$ 456.4 974.9 channel sounding $9,944.2$ $10,403.9$ 472.8 975.2 channel sounding $9,927.7$ $10,432.2$ 505.6 976.2 channel sounding $9,927.7$ $10,432.2$ 505.6 976.2 channel sounding $9,927.9$ $10,474.7$ 554.9 975.9 channel sounding $9,984.6$ $10,488.9$ 571.3 975.9 <td>10,084.7</td> <td>10,162.9</td> <td>193.9</td> <td>971.3</td> <td>channel sounding</td> | 10,084.7 | 10,162.9 | 193.9 | 971.3 | channel sounding |
| 10,068.1 $10,191.3$ 226.8 970.5 channel sounding $10,059.9$ $10,205.4$ 243.2 970.7 channel sounding $10,051.6$ $10,219.6$ 259.6 971.1 channel sounding $10,043.3$ $10,233.8$ 276.0 971.3 channel sounding $10,035.1$ $10,248.0$ 292.4 971.1 channel sounding $10,016.8$ $10,276.3$ 325.2 971.1 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $10,010.3$ $10,290.5$ 341.6 971.2 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,993.8$ $10,318.8$ 374.4 972.6 channel sounding $9,997.2$ $10,347.2$ 407.2 974.2 channel sounding $9,967.1$ $10,375.5$ 440.0 973.5 channel sounding $9,967.1$ $10,375.5$ 440.0 973.5 channel sounding $9,962.5$ $10,389.7$ 456.4 974.9 channel sounding $9,944.2$ $10,403.9$ 472.8 975.5 channel sounding $9,927.7$ $10,432.2$ 505.6 976.2 channel sounding $9,911.1$ $10,446.4$ 522.0 977.0 channel sounding $9,929.9$ $10,474.7$ 554.9 976.8 channel sounding $9,886.4$ $10,503.1$ 587.7 975.9 channel sounding $9,886.8$ $10,531.4$ 620.5 974.9 <td>10,076.4</td> <td>10,177.1</td> <td>210.3</td> <td>970.7</td> <td>channel sounding</td> | 10,076.4 | 10,177.1 | 210.3 | 970.7 | channel sounding |
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| 10,051.6 $10,219.6$ 259.6 971.1 $channel sounding$ $10,043.3$ $10,233.8$ 276.0 971.3 $channel sounding$ $10,035.1$ $10,248.0$ 292.4 971.1 $channel sounding$ $10,026.8$ $10,226.1$ 308.8 971.2 $channel sounding$ $10,018.6$ $10,276.3$ 325.2 971.1 $channel sounding$ $10,010.3$ $10,290.5$ 341.6 971.2 $channel sounding$ $10,002.0$ $10,304.6$ 358.0 971.6 $channel sounding$ $9,993.8$ $10,318.8$ 374.4 972.6 $channel sounding$ $9,995.5$ $10,333.0$ 390.8 973.3 $channel sounding$ $9,997.2$ $10,347.2$ 407.2 974.2 $channel sounding$ $9,960.7$ $10,375.5$ 440.0 973.5 $channel sounding$ $9,960.7$ $10,375.5$ 440.0 973.5 $channel sounding$ $9,944.2$ $10,403.9$ 472.8 975.2 $channel sounding$ $9,927.7$ $10,432.2$ 505.6 976.2 $channel sounding$ $9,927.7$ $10,446.4$ 522.0 977.0 $channel sounding$ $9,911.1$ $10,460.5$ 538.4 977.2 $channel sounding$ $9,929.9$ $10,474.7$ 554.9 976.8 $channel sounding$ $9,84.6$ $10,488.9$ 571.3 975.9 $channel sounding$ $9,885.3$ $10,531.4$ 620.5 974.9 $channel sounding$ $9,886.4$ $10,531.4$ | 10,059.9 | 10,205.4 | 243.2 | 970.7 | channel sounding |
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| 10,035.1 $10,248.0$ 292.4 971.1 $channel sounding$ $10,026.8$ $10,262.1$ 308.8 971.2 $channel sounding$ $10,018.6$ $10,276.3$ 325.2 971.1 $channel sounding$ $10,010.3$ $10,290.5$ 341.6 971.2 $channel sounding$ $10,002.0$ $10,304.6$ 358.0 971.6 $channel sounding$ $9,993.8$ $10,318.8$ 374.4 972.6 $channel sounding$ $9,993.8$ $10,318.8$ 374.4 972.6 $channel sounding$ $9,995.5$ $10,333.0$ 390.8 973.3 $channel sounding$ $9,977.2$ $10,347.2$ 407.2 974.2 $channel sounding$ $9,960.7$ $10,375.5$ 440.0 973.5 $channel sounding$ $9,960.7$ $10,375.5$ 440.0 973.5 $channel sounding$ $9,952.5$ $10,389.7$ 456.4 974.9 $channel sounding$ $9,944.2$ $10,403.9$ 472.8 975.2 $channel sounding$ $9,927.7$ $10,432.2$ 505.6 976.2 $channel sounding$ $9,914.1$ $10,446.4$ 522.0 977.0 $channel sounding$ $9,92.9$ $10,474.7$ 554.9 976.8 $channel sounding$ $9,886.4$ $10,503.1$ 587.7 975.1 $channel sounding$ $9,886.4$ $10,559.7$ 653.3 973.9 $channel sounding$ $9,886.8$ $10,573.9$ 669.7 973.7 $channel sounding$ $9,886.8$ $10,573.9$ </td <td>10,043.3</td> <td>10,233.8</td> <td>276.0</td> <td>971.3</td> <td>channel sounding</td> | 10,043.3 | 10,233.8 | 276.0 | 971.3 | channel sounding |
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| 9,993.810,318.8 $3/4.4$ 972.6channel sounding9,985.510,333.0390.8973.3channel sounding9,977.210,347.2407.2974.2channel sounding9,960.710,361.3423.6974.8channel sounding9,960.710,375.5440.0973.5channel sounding9,952.510,389.7456.4974.9channel sounding9,944.210,403.9472.8975.2channel sounding9,935.910,418.0489.2975.5channel sounding9,927.710,432.2505.6976.2channel sounding9,914.110,446.4522.0977.0channel sounding9,914.110,446.5538.4977.2channel sounding9,92.910,474.7554.9976.8channel sounding9,84.610,488.9571.3975.9channel sounding9,84.610,531.4620.5974.9channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,828.510,602.3702.5975.5channel sounding9,828.510,602.3702.5975.5channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,774.010,695.8810.8979.9channel sounding9,768.510,706.382 | 10,002.0 | 10,304.6 | 358.0 | 9/1.6 | channel sounding |
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| 9,977.210,347.2407.2974.2channel sounding9,969.010,361.3423.6974.8channel sounding9,960.710,375.5440.0973.5channel sounding9,952.510,389.7456.4974.9channel sounding9,944.210,403.9472.8975.2channel sounding9,935.910,418.0489.2975.5channel sounding9,927.710,432.2505.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,84.610,488.9571.3975.9channel sounding9,886.410,503.1587.7975.1channel sounding9,886.410,531.4620.5974.9channel sounding9,885.010,573.9669.7973.7channel sounding9,885.110,559.7653.3973.9channel sounding9,882.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,874.010,695.8810.8979.9channel sounding9,774.010,695.8810.8979.9channel sounding9,774.010,695.8810.8979.9channel sounding9,768.510,706.3822.6982.9bank9,767.810,707.0823.6 | 9,985.5 | 10,333.0 | 390.8 | 973.3 | channel sounding |
| 9,969.010,361.3 423.6 974.8 channel sounding9,960.710,375.5440.0973.5channel sounding9,952.510,389.7456.4974.9channel sounding9,944.210,403.9472.8975.2channel sounding9,935.910,418.0489.2975.5channel sounding9,927.710,432.2505.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,846.410,503.1587.7975.9channel sounding9,864.810,531.4620.5974.9channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,673.9669.7975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,774.010,695.8810.8979.9channel sounding9,768.510,706.3822.6982.9bank9,767.810,707.0823.6 <td>9,977.2</td> <td>10,347.2</td> <td>407.2</td> <td>974.2</td> <td>channel sounding</td> | 9,977.2 | 10,347.2 | 407.2 | 974.2 | channel sounding |
| 9,960.710,375.5440.0973.5channel sounding9,952.510,389.7456.4974.9channel sounding9,944.210,403.9472.8975.2channel sounding9,935.910,418.0489.2975.5channel sounding9,927.710,432.2505.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,846.410,503.1587.7975.9channel sounding9,864.810,531.4620.5974.9channel sounding9,853.310,559.7653.3973.9channel sounding9,845.010,573.9669.7973.7channel sounding9,845.110,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,774.010,695.8810.8979.9channel sounding9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,969.0 | 10,361.3 | 423.0 | 974.8 | channel sounding |
| 9,952.510,389.7456.4974.9channel sounding9,942.210,403.9472.8975.2channel sounding9,935.910,418.0489.2975.5channel sounding9,927.710,432.2505.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,84.610,488.9571.3975.9channel sounding9,864.410,503.1587.7975.1channel sounding9,865.810,531.4620.5974.9channel sounding9,865.810,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,845.810,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,709.9826.1985.3bank | 9,960.7 | 10,375.5 | 440.0 | 973.5 | channel sounding |
| 9,944.210,405.9472.8973.2channel sounding9,935.910,418.0489.2975.5channel sounding9,927.710,432.2505.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,919.410,446.4522.0977.2channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,886.410,503.1587.7975.9channel sounding9,866.810,531.4620.5974.9channel sounding9,853.310,559.7653.3973.9channel sounding9,845.010,573.9669.7973.7channel sounding9,845.110,588.1686.1974.9channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,776.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,952.5 | 10,389.7 | 456.4 | 974.9 | channel sounding |
| 9,953.910,418.0489.2973.5channel sounding9,927.710,432.2505.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,894.610,488.9571.3975.9channel sounding9,864.410,503.1587.7975.1channel sounding9,865.810,531.4620.5974.9channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,820.310,616.4718.9975.9channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,944.2 | 10,405.9 | 472.8 | 975.2 | channel sounding |
| 9,927.710,432.2503.6976.2channel sounding9,919.410,446.4522.0977.0channel sounding9,911.110,460.5538.4977.2channel sounding9,902.910,474.7554.9976.8channel sounding9,894.610,488.9571.3975.9channel sounding9,886.410,503.1587.7975.1channel sounding9,865.810,531.4620.5974.9channel sounding9,853.310,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,845.810,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,776.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,955.9 | 10,418.0 | 409.2 505.6 | 975.5 | channel sounding |
| 9,919.410,440.4 522.0 977.0 channel sounding9,911.110,460.5 538.4 977.2 channel sounding9,902.910,474.7 554.9 976.8 channel sounding9,894.610,488.9 571.3 975.9 channel sounding9,886.410,503.1 587.7 975.1 channel sounding9,869.810,531.4620.5 974.9 channel sounding9,853.310,573.9669.7 973.7 channel sounding9,845.010,573.9669.7 973.7 channel sounding9,845.810,602.3 702.5 975.5 channel sounding9,820.310,616.4 718.9 975.9 channel sounding9,807.010,639.1 745.1 980.1 channel sounding9,774.010,695.8 810.8 979.9 channel sounding9,776.310,702.1 818.0 980.9 right edge of water9,767.810,707.0 823.6 985.3 bank9,767.810,709.9 826.1 985.9 rebar | 9,927.7 | 10,452.2 | 505.0 | 970.2 | channel sounding |
| 9,911.110,400.3538.4971.2channel sounding9,902.910,474.7554.9976.8channel sounding9,894.610,488.9571.3975.9channel sounding9,886.410,503.1587.7975.1channel sounding9,869.810,531.4620.5974.9channel sounding9,853.310,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,826.810,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,776.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,919.4 | 10,440.4 | 522.0 538.4 | 977.0 | channel sounding |
| 9,892.910,474.7534.9970.8channel sounding9,894.610,488.9571.3975.9channel sounding9,886.410,503.1587.7975.1channel sounding9,869.810,531.4620.5974.9channel sounding9,853.310,573.9663.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,826.810,588.1686.1974.9channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,776.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 0,002,0 | 10,400.3 | 554.0 | 977.2 | channel sounding |
| 9,894.010,486.9571.3973.9channel sounding9,886.410,503.1587.7975.1channel sounding9,869.810,531.4620.5974.9channel sounding9,853.310,573.9653.3973.9channel sounding9,845.010,573.9669.7973.7channel sounding9,836.810,588.1686.1974.9channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,870.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,902.9 | 10,474.7 | 571.3 | 970.0 | channel sounding |
| 9,880.410,505.1567.7973.1Channel sounding9,869.810,531.4620.5974.9channel sounding9,853.310,559.7653.3973.9channel sounding9,845.010,573.9669.7973.7channel sounding9,836.810,588.1686.1974.9channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,776.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,094.0 | 10,400.9 | 5977 | 975.9 | channel sounding |
| 9,853.310,531.4020.3974.9channel sounding9,853.310,559.7653.3973.9channel sounding9,845.010,573.9669.7973.7channel sounding9,836.810,588.1686.1974.9channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,776.310,702.1818.0980.9right edge of water9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,000.4 | 10,505.1 | 620.5 | 975.1 | channel sounding |
| 9,845.010,573.9669.7973.7channel sounding9,845.010,573.9669.7973.7channel sounding9,836.810,588.1686.1974.9channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,809.8 | 10,551.4 | 653.3 | 073.0 | channel sounding |
| 9,836.810,515.7605.7975.7channel sounding9,836.810,588.1686.1974.9channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,855.5 | 10,555.7 | 660 7 | 973.7 | channel sounding |
| 9,850.610,560.1574.5Channel sounding9,828.510,602.3702.5975.5channel sounding9,820.310,616.4718.9975.9channel sounding9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 0 836 8 | 10,575.7 | 686.1 | 974.9 | channel sounding |
| 9,820.310,616.4718.9975.9channel sounding9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,830.8 | 10,588.1 | 702.5 | 975.5 | channel sounding |
| 9,807.010,639.1745.1980.1channel sounding9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9 820 3 | 10,002.5 | 718.9 | 975.9 | channel sounding |
| 9,774.010,695.8810.8979.9channel sounding9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9,807.0 | 10,639 1 | 745.1 | 980.1 | channel sounding |
| 9,770.310,702.1818.0980.9right edge of water9,768.510,706.3822.6982.9bank9,767.810,707.0823.6985.3bank9,767.810,709.9826.1985.9rebar | 9 774 0 | 10,695.8 | 810.8 | 979.9 | channel sounding |
| 9,768.5 10,706.3 822.6 982.9 bank 9,767.8 10,707.0 823.6 985.3 bank 9,767.8 10,709.9 826.1 985.9 rebar | 9 770 3 | 10,093.0 | 818.0 | 980.9 | right edge of water |
| 9,767.8 10,707.0 823.6 985.3 bank 9,767.8 10,709.9 826.1 985.9 rebar | 9 768 5 | 10,706.3 | 822.6 | 982.9 | hank |
| 9,767.8 10,709.9 826.1 985.9 rebar | 9.767.8 | 10,707.0 | 823.6 | 985 3 | bank |
| 2,101.0 10,102.2 020.1 903.9 100ai | 97678 | 10,709.9 | 826.1 | 985.9 | rehar |
| 9,735.5 10,773.9 897.6 988.0 on gravel pad | 9,735.5 | 10,773.9 | 897.6 | 988.0 | on gravel pad |



Table B5.Cross section Approach 5 at the Tanana River at BigDelta.

| Easting | Northing | Station | Elevation | Notes |
|----------|----------|---------|-----------|---------------------|
| (11) | (11) | (11) | (11) | |
| 10,136.9 | 9,963.9 | -39.8 | 984.7 | toe of bank |
| 10,137.1 | 9,968.8 | -35.9 | 984.6 | rebar |
| 10,134.3 | 10,010.1 | .0 | 980.9 | left edge of water |
| 10,110.6 | 10,011.2 | 14.1 | 978.6 | channel sounding |
| 10,097.9 | 10,030.3 | 37.0 | 975.4 | channel sounding |
| 10,088.8 | 10,044.0 | 53.4 | 974.0 | channel sounding |
| 10,070.7 | 10,071.4 | 86.2 | 972.0 | channel sounding |
| 10,052.6 | 10,098.7 | 119.0 | 971.3 | channel sounding |
| 10,043.5 | 10,112.4 | 135.5 | 973.3 | channel sounding |
| 10,034.5 | 10,126.1 | 151.9 | 973.6 | channel sounding |
| 10,016.3 | 10,153.4 | 184.7 | 973.3 | channel sounding |
| 10,007.3 | 10,167.1 | 201.1 | 971.8 | channel sounding |
| 9,998.2 | 10,180.8 | 217.5 | 970.6 | channel sounding |
| 9,989.2 | 10,194.4 | 233.9 | 970.6 | channel sounding |
| 9,980.1 | 10,208.1 | 250.3 | 970.9 | channel sounding |
| 9,971.0 | 10,221.8 | 266.7 | 971.1 | channel sounding |
| 9,962.0 | 10,235.5 | 283.1 | 970.9 | channel sounding |
| 9,952.9 | 10,249.1 | 299.5 | 971.3 | channel sounding |
| 9,943.8 | 10,262.8 | 315.9 | 971.0 | channel sounding |
| 9,934.8 | 10,276.5 | 332.3 | 971.1 | channel sounding |
| 9,916.7 | 10,303.8 | 365.1 | 972.5 | channel sounding |
| 9,907.6 | 10,317.5 | 381.5 | 974.8 | channel sounding |
| 9,898.5 | 10,331.2 | 397.9 | 973.7 | channel sounding |
| 9,889.5 | 10,344.9 | 414.3 | 974.4 | channel sounding |
| 9,880.4 | 10,358.5 | 430.7 | 974.9 | channel sounding |
| 9,871.3 | 10,372.2 | 447.1 | 975.2 | channel sounding |
| 9,862.3 | 10,385.9 | 463.6 | 972.6 | channel sounding |
| 9,853.2 | 10,399.6 | 480.0 | 974.4 | channel sounding |
| 9,844.2 | 10,413.2 | 496.4 | 974.9 | channel sounding |
| 9,835.1 | 10,426.9 | 512.8 | 975.7 | channel sounding |
| 9,826.0 | 10,440.6 | 529.2 | 975.9 | channel sounding |
| 9,817.0 | 10,454.3 | 545.6 | 976.2 | channel sounding |
| 9,807.9 | 10,467.9 | 562.0 | 974.9 | channel sounding |
| 9,798.8 | 10,481.6 | 578.4 | 975.7 | channel sounding |
| 9.789.8 | 10.495.3 | 594.8 | 977.6 | channel sounding |
| 9.780.7 | 10.509.0 | 611.2 | 975.6 | channel sounding |
| 9.771.7 | 10.522.6 | 627.6 | 974.3 | channel sounding |
| 9.762.6 | 10.536.3 | 644.0 | 973.6 | channel sounding |
| 9.753.5 | 10,550.0 | 660.4 | 973.3 | channel sounding |
| 9 744 5 | 10,563.7 | 676.8 | 974.9 | channel sounding |
| 97354 | 10,505.7 | 693.2 | 975.5 | channel sounding |
| 9 726 3 | 10,591.0 | 709.6 | 975.7 | channel sounding |
| 97173 | 10,591.0 | 726.0 | 978.1 | channel sounding |
| 9,699,7 | 10,632.0 | 758.8 | 975.1 | channel sounding |
| 9 681 0 | 10,052.0 | 791 7 | 975 1 | channel sounding |
| 9 669 5 | 10,057.4 | 812.5 | 981.0 | right edge of water |
| 9,664.3 | 10,670.0 | 810.7 | 983 / | toe of hank |
| 9 664 2 | 10,001.9 | 820.5 | 985 / | hank |
| 9 657 9 | 10,002.9 | 831.6 | 985 5 | hank |
| ,051.) | 10,071.7 | 0.110 | 105.5 | Julin |



Table B6.Cross section Discharge Measurement at the TananaRiver at Big Delta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -52.1 | 998.4 | bank |
| 10,029.6 | 10,038.301 | -19.0 | 989.6 | rebar |
| 10,031.1 | 10,057.3 | .0 | 981.1 | left edge of water |
| 10,031.9 | 10,067.1 | 9.8 | 975.1 | channel sounding |
| 10,034.6 | 10,099.8 | 42.7 | 970.6 | channel sounding |
| 10,037.3 | 10,132.5 | 75.5 | 972.0 | channel sounding |
| 10,039.9 | 10,165.2 | 108.3 | 970.6 | channel sounding |
| 10,042.6 | 10,197.9 | 141.1 | 969.9 | channel sounding |
| 10,044.5 | 10,220.8 | 164.0 | 970.4 | channel sounding |
| 10,046.4 | 10,243.7 | 187.0 | 970.4 | channel sounding |
| 10,048.2 | 10,266.5 | 210.0 | 970.2 | channel sounding |
| 10,050.1 | 10,289.4 | 233.0 | 972.7 | channel sounding |
| 10,052.0 | 10,312.3 | 255.9 | 972.2 | channel sounding |
| 10,053.8 | 10,335.2 | 278.9 | 972.9 | channel sounding |
| 10,056.5 | 10,367.9 | 311.7 | 974.1 | channel sounding |
| 10,059.2 | 10,400.6 | 344.5 | 975.4 | channel sounding |
| 10,061.9 | 10,433.3 | 377.3 | 976.3 | channel sounding |
| 10,065.3 | 10,475.8 | 420.0 | 977.6 | channel sounding |
| 10,069.3 | 10,524.9 | 469.2 | 977.6 | channel sounding |
| 10,073.4 | 10,573.9 | 518.4 | 976.6 | channel sounding |
| 10,076.0 | 10,606.6 | 551.2 | 968.6 | channel sounding |
| 10,081.4 | 10,672.0 | 616.8 | 969.6 | channel sounding |
| 10,085.4 | 10,721.1 | 666.0 | 981.1 | right edge of water |
| 10,086.2 | 10,730.6 | 675.6 | 988.4 | rebar |
| _ | _ | 741.2 | 988.3 | estimated overbank |
| _ | _ | 761.2 | 988.3 | estimated overbank |
| _ | _ | 773.2 | 999 | extended up |



Table B7.Cross section Upstream Side Bridge at the TananaRiver at Big Delta.

| Easting | Northing | Station | Elevation | Notes |
|----------|----------|---------|-----------|---------------------|
| (ft) | (ft) | (ft) | (ft) | |
| _ | _ | -31.6 | 993.9 | low steel |
| 10,016.7 | 10,014.7 | -31.5 | 993.1 | bank |
| 10,006.2 | 10,030.6 | -12.5 | 989.8 | bank |
| 9,997.3 | 10,039.5 | .0 | 981.1 | left edge of water |
| 9,989.5 | 10,050.1 | 13.1 | 975.6 | channel sounding |
| 9,979.7 | 10,063.3 | 29.5 | 973.3 | channel sounding |
| 9,970.0 | 10,076.5 | 45.9 | 972.1 | channel sounding |
| 9,960.2 | 10,089.7 | 62.3 | 969.6 | channel sounding |
| 9,950.5 | 10,102.9 | 78.7 | 972.1 | channel sounding |
| 9,940.7 | 10,116.1 | 95.1 | 975.4 | channel sounding |
| 9,931.0 | 10,129.3 | 111.6 | 974.8 | channel sounding |
| 9,921.3 | 10,142.5 | 128.0 | 974.9 | channel sounding |
| 9,911.5 | 10,155.7 | 144.4 | 974.1 | channel sounding |
| 9,901.8 | 10,168.9 | 160.8 | 971.1 | channel sounding |
| 9,892.0 | 10,182.1 | 177.2 | 970.9 | channel sounding |
| 9,882.3 | 10,195.2 | 193.6 | 970.4 | channel sounding |
| 9,872.5 | 10,208.4 | 210.0 | 970.7 | channel sounding |
| 9,862.8 | 10,221.6 | 226.4 | 971.0 | channel sounding |
| 9,853.0 | 10,234.8 | 242.8 | 970.5 | channel sounding |
| 9,843.3 | 10,248.0 | 259.2 | 970.3 | channel sounding |
| 9,833.5 | 10,261.2 | 275.6 | 970.0 | channel sounding |
| 9,823.8 | 10,274.4 | 292.0 | 971.2 | channel sounding |
| 9,814.0 | 10,287.6 | 308.4 | 972.5 | channel sounding |
| 9,804.3 | 10,300.8 | 324.8 | 972.4 | channel sounding |
| 9,794.6 | 10,314.0 | 341.2 | 970.1 | channel sounding |
| 9,784.8 | 10,327.2 | 357.6 | 970.0 | channel sounding |
| 9,775.1 | 10,340.4 | 374.0 | 971.6 | channel sounding |
| 9,765.3 | 10,353.6 | 390.4 | 972.4 | channel sounding |
| 9,755.6 | 10,366.8 | 406.8 | 973.1 | channel sounding |
| 9,745.8 | 10,380.0 | 423.2 | 973.1 | channel sounding |
| 9,736.1 | 10,393.2 | 439.7 | 972.8 | channel sounding |
| 9,726.3 | 10,406.4 | 456.1 | 973.4 | channel sounding |
| 9,716.6 | 10,419.6 | 472.5 | 973.8 | channel sounding |
| 9,706.8 | 10,432.8 | 488.9 | 972.3 | channel sounding |
| 9,697.1 | 10,446.0 | 505.3 | 975.0 | channel sounding |
| 9,687.4 | 10,459.2 | 521.7 | 977.1 | channel sounding |
| 9,677.6 | 10,472.4 | 538.1 | 976.4 | channel sounding |
| 9,667.9 | 10,485.6 | 554.5 | 974.8 | channel sounding |
| 9,658.1 | 10,498.8 | 570.9 | 974.6 | channel sounding |
| 9,648.4 | 10,512.0 | 587.3 | 972.3 | channel sounding |
| 9,628.9 | 10,538.3 | 620.1 | 973.9 | channel sounding |
| 9,619.1 | 10,551.5 | 636.5 | 977.8 | channel sounding |
| 9,609.4 | 10,564.7 | 652.9 | 977.6 | channel sounding |
| 9,599.6 | 10,577.9 | 669.3 | 976.5 | channel sounding |
| 9,589.9 | 10,591.1 | 685.7 | 974.3 | channel sounding |
| 9,580.1 | 10,604.3 | 702.1 | 976.4 | channel sounding |
| 9,574.3 | 10,612.2 | 712.0 | 981.1 | right edge of water |
| 9,571.3 | 10,615.4 | 716.3 | 983.4 | bank |
| 9,563.7 | 10,620.9 | 725.2 | 990.4 | bank |
| 9,554.2 | 10,636.2 | 743.2 | 995.6 | bank |
| 9,553.6 | 10,637.0 | 744.2 | 1,001.2 | low steel |



Table B8.Cross section Downstream Side Bridge at the TananaRiver at Big Delta.

[Points surveyed August 27, 1996. See figure 2 for location. See text for coordinate information; ft, foot]

_

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| 9,979.7 | 10,001.4 | _ | 993.9 | low steel |
| 9,984.5 | 9,990.9 | -33.1 | 993.1 | bank |
| 9,974.1 | 10,006.9 | -14.1 | 989.8 | bank |
| 9,965.4 | 10,018.0 | .0 | 980.8 | left edge of water |
| 9,942.7 | 10,049.8 | 39.1 | 972.8 | channel sounding |
| 9,931.0 | 10,065.6 | 58.8 | 967.1 | channel sounding |
| 9,927.1 | 10,070.9 | 65.3 | 968.2 | channel sounding |
| 9,913.4 | 10,089.4 | 88.3 | 971.8 | channel sounding |
| 9,903.7 | 10,102.6 | 104.7 | 973.5 | channel sounding |
| 9,893.9 | 10,115.7 | 121.1 | 975.4 | channel sounding |
| 9,884.2 | 10,128.9 | 137.5 | 973.2 | channel sounding |
| 9,878.3 | 10,136.9 | 147.3 | 971.8 | channel sounding |
| 9,872.5 | 10,144.8 | 157.2 | 968.7 | channel sounding |
| 9,858.8 | 10,163.3 | 180.1 | 968.9 | channel sounding |
| 9,845.2 | 10,181.7 | 203.1 | 963.6 | channel sounding |
| 9,835.4 | 10,194.9 | 219.5 | 964.3 | channel sounding |
| 9,825.7 | 10,208.1 | 235.9 | 965.8 | channel sounding |
| 9,821.8 | 10,213.4 | 242.5 | 965.0 | channel sounding |
| 9,810.1 | 10,229.2 | 262.2 | 964.4 | channel sounding |
| 9,806.2 | 10,234.5 | 268.7 | 966.8 | channel sounding |
| 9,796.5 | 10,247.7 | 285.1 | 971.9 | channel sounding |
| 9,786.7 | 10,260.9 | 301.5 | 972.6 | channel sounding |
| 9,777.0 | 10,274.1 | 318.0 | 973.9 | channel sounding |
| 9,755.5 | 10,303.1 | 354.0 | 963.3 | channel sounding |
| 9,753.6 | 10,305.8 | 357.3 | 973.6 | channel sounding |
| 9,738.0 | 10,326.9 | 383.6 | 974.8 | channel sounding |
| 9,728.2 | 10,340.1 | 400.0 | 972.5 | channel sounding |
| 9,718.5 | 10,353.3 | 416.4 | 972.2 | channel sounding |
| 9,708.8 | 10,366.5 | 432.8 | 971.1 | channel sounding |
| 9,699.0 | 10,379.7 | 449.2 | 971.3 | channel sounding |
| 9,689.3 | 10,392.9 | 465.6 | 971.3 | channel sounding |
| 9,679.5 | 10,406.1 | 482.0 | 972.1 | channel sounding |
| 9,669.8 | 10,419.3 | 498.4 | 972.7 | channel sounding |
| 9,660.0 | 10,432.5 | 514.8 | 971.0 | channel sounding |
| 9,650.3 | 10,445.7 | 531.2 | 974.3 | channel sounding |
| 9,640.5 | 10,458.8 | 547.6 | 973.8 | channel sounding |
| 9,630.8 | 10,472.0 | 564.0 | 972.7 | channel sounding |
| 9,621.0 | 10,485.2 | 580.4 | 969.5 | channel sounding |
| 9,611.3 | 10,498.4 | 596.8 | 964.8 | channel sounding |
| 9,601.5 | 10,511.6 | 613.2 | 964.4 | channel sounding |
| 9,591.8 | 10,524.8 | 629.6 | 964.8 | channel sounding |
| 9,582.1 | 10,538.0 | 646.1 | 971.9 | channel sounding |
| 9,574.4 | 10,548.3 | 658.9 | 981.1 | right edge of water |
| 9,563.8 | 10,557.4 | 672.4 | 988.3 | bank |
| 9,554.3 | 10,570.8 | 688.9 | 993.0 | bank |
| 9,522.1 | 10,613.6 | 742.5 | 998.9 | bank |



Table B9. Cross section Exit 1 at the Tanana River at Big Delta.

[Points surveyed August 27, 1996. See <u>figure 2</u> for location. See text for coordinate information; ft, foot]

_

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -6,020.0 | 1,020.0 | extended up |
| _ | _ | -6,000.0 | 1,000.0 | estimated delta |
| _ | _ | -84.0 | 982.8 | estimated delta |
| 9,725.6 | 9,963.9 | -14.8 | 981.2 | rebar |
| 9,722.8 | 9,980.8 | .0 | 980.3 | left edge of water |
| 9,696.0 | 9,999.7 | 31.6 | 980.1 | channel sounding |
| 9,683.5 | 10,014.8 | 51.3 | 976.5 | channel sounding |
| 9,673.1 | 10,027.5 | 67.7 | 975.7 | channel sounding |
| 9,662.6 | 10,040.1 | 84.1 | 973.8 | channel sounding |
| 9,652.2 | 10,052.8 | 100.5 | 973.5 | channel sounding |
| 9,641.7 | 10,065.4 | 116.9 | 973.9 | channel sounding |
| 9,631.3 | 10,078.1 | 133.3 | 974.6 | channel sounding |
| 9,620.8 | 10,090.7 | 149.7 | 971.9 | channel sounding |
| 9,610.4 | 10,103.3 | 166.1 | 965.7 | channel sounding |
| 9,599.9 | 10,116.0 | 182.5 | 963.2 | channel sounding |
| 9,589.5 | 10,128.6 | 198.9 | 960.2 | channel sounding |
| 9,579.0 | 10,141.3 | 215.3 | 957.8 | channel sounding |
| 9,558.1 | 10,166.6 | 248.1 | 955.8 | channel sounding |
| 9,547.7 | 10,179.2 | 264.5 | 957.8 | channel sounding |
| 9,537.2 | 10,191.9 | 280.9 | 958.2 | channel sounding |
| 9,526.8 | 10,204.5 | 297.3 | 964.2 | channel sounding |
| 9,516.3 | 10,217.2 | 313.7 | 967.3 | channel sounding |
| 9,505.9 | 10,229.8 | 330.2 | 970.9 | channel sounding |
| 9,495.4 | 10,242.5 | 346.6 | 973.8 | channel sounding |
| 9,485.0 | 10,255.1 | 363.0 | 976.8 | channel sounding |
| 9,478.7 | 10,262.7 | 372.8 | 976.6 | channel sounding |
| 9,467.9 | 10,280.6 | 393.4 | 980.6 | right edge of water |
| 9,463.8 | 10,280.6 | 396.1 | 982.5 | rebar |
| 9,449.4 | 10,285.2 | 408.8 | 994.4 | bank |
| - | - | 410.8 | 1,014.4 | cliff face |



Table B10. Cross section Exit 2 at the Tanana River at Big Delta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -6,020.0 | 1,020.0 | extended up |
| - | _ | -6,000.0 | 1,000.0 | estimated delta |
| - | _ | -84.0 | 982.8 | estimated delta |
| 9,474.6 | 9,803.0 | -10.0 | 980.5 | rebar |
| 9,470.5 | 9,812.4 | .0 | 980.1 | left edge of water |
| 9,470.2 | 9,822.1 | 9.5 | 976.6 | channel sounding |
| 9,466.6 | 9,837.5 | 25.4 | 975.4 | channel sounding |
| 9,463.0 | 9,853.0 | 41.3 | 975.7 | channel sounding |
| 9,459.4 | 9,868.5 | 57.2 | 975.9 | channel sounding |
| 9,455.8 | 9,884.0 | 73.1 | 976.1 | channel sounding |
| 9,452.2 | 9,899.4 | 89.0 | 977.7 | channel sounding |
| 9,448.6 | 9,914.9 | 104.8 | 977.2 | channel sounding |
| 9,445.0 | 9,930.4 | 120.7 | 977.3 | channel sounding |
| 9,442.9 | 9,939.7 | 130.3 | 977.7 | channel sounding |
| 9,437.8 | 9,961.3 | 152.5 | 968.5 | channel sounding |
| 9,434.2 | 9,976.8 | 168.4 | 967.2 | channel sounding |
| 9,427.0 | 10,007.7 | 200.2 | 959.9 | channel sounding |
| 9,423.4 | 10,023.2 | 216.0 | 955.8 | channel sounding |
| 9,419.8 | 10,038.7 | 231.9 | 950.7 | channel sounding |
| 9,416.2 | 10,054.2 | 247.8 | 948.9 | channel sounding |
| 9,412.7 | 10,069.6 | 263.7 | 948.7 | channel sounding |
| 9,409.1 | 10,085.1 | 279.6 | 957.7 | channel sounding |
| 9,407.6 | 10,091.3 | 285.9 | 961.2 | channel sounding |
| 9,405.5 | 10,100.6 | 295.5 | 965.5 | channel sounding |
| 9,401.9 | 10,116.1 | 311.4 | 968.3 | channel sounding |
| 9,399.7 | 10,125.3 | 320.9 | 971.2 | channel sounding |
| 9,396.1 | 10,140.8 | 336.8 | 979.5 | right edge of water |
| 9,394.9 | 10,146.0 | 342.1 | 981.7 | rebar |
| 9,386.5 | 10,154.7 | 352.5 | 987.5 | bank |
| _ | _ | 354.5 | 1,007.5 | cliff face |



Table B11. Cross section Exit 3 at the Tanana River at Big Delta.

[Points surveyed August 27, 1996. See <u>figure 2</u> for location. See text for coordinate information; ft, foot]

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -6,020.0 | 1,020.0 | extended up |
| _ | _ | -6,000.0 | 1,000.0 | estimated delta |
| _ | _ | -81.8 | 983.1 | estimated delta |
| 9,474.6 | 9,803.0 | -12.6 | 981.5 | rebar |
| 9,470.5 | 9,812.4 | -3.1 | 980.1 | toe of bank |
| 9,470.2 | 9,822.1 | .0 | 979.2 | left edge of water |
| 9,466.6 | 9,837.5 | 22.7 | 979.0 | channel sounding |
| 9,463.0 | 9,853.0 | 39.1 | 972.6 | channel sounding |
| 9,459.4 | 9,868.5 | 55.5 | 969.4 | channel sounding |
| 9,455.8 | 9,884.0 | 71.9 | 968.2 | channel sounding |
| 9,452.2 | 9,899.4 | 88.4 | 967.7 | channel sounding |
| 9,448.6 | 9,914.9 | 104.8 | 967.9 | channel sounding |
| 9,445.0 | 9,930.4 | 121.2 | 969.1 | channel sounding |
| 9,442.9 | 9,939.7 | 137.6 | 968.8 | channel sounding |
| 9,437.8 | 9,961.3 | 154.0 | 968.2 | channel sounding |
| 9,434.2 | 9,976.8 | 170.4 | 967.3 | channel sounding |
| 9,427.0 | 10,007.7 | 186.8 | 966.5 | channel sounding |
| 9,423.4 | 10,023.2 | 203.2 | 965.5 | channel sounding |
| 9,419.8 | 10,038.7 | 219.6 | 964.3 | channel sounding |
| 9,416.2 | 10,054.2 | 236.0 | 962.5 | channel sounding |
| 9,412.7 | 10,069.6 | 252.4 | 959.3 | channel sounding |
| 9,409.1 | 10,085.1 | 268.8 | 958.6 | channel sounding |
| 9,407.6 | 10,091.3 | 285.2 | 966.5 | channel sounding |
| 9,405.5 | 10,100.6 | 301.6 | 975.1 | channel sounding |
| 9,401.9 | 10,116.1 | 324.3 | 979.3 | right edge of water |
| 9,399.7 | 10,125.3 | 326.8 | 980.2 | toe of bank |
| 9,396.1 | 10,140.8 | 330.5 | 984.3 | rebar |
| 9,394.9 | 10,146.0 | 333.5 | 987.3 | estimated bank |
| - | - | 335.5 | 1,007.3 | cliff face |

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Table B12. Cross section Exit 4 at the Tanana River at Big Delta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -6,020.0 | 1,020.0 | extended up |
| _ | _ | -6,000.0 | 1,000.0 | estimated delta |
| 8,391.010 | 9,525.970 | -76.1 | 982.6 | delta |
| 8,405.1 | 9,593.7 | -6.9 | 981.0 | rebar |
| 8,406.4 | 9,600.5 | .0 | 979.7 | left edge of water |
| 8,409.1 | 9,613.3 | 13.1 | 978.3 | channel sounding |
| 8,415.1 | 9,642.2 | 42.7 | 977.6 | channel sounding |
| 8,421.8 | 9,674.4 | 75.5 | 965.7 | channel sounding |
| 8,428.5 | 9,706.5 | 108.3 | 962.2 | channel sounding |
| 8,435.1 | 9,738.6 | 141.1 | 962.7 | channel sounding |
| 8,441.8 | 9,770.7 | 173.9 | 962.7 | channel sounding |
| 8,448.5 | 9,802.8 | 206.7 | 962.9 | channel sounding |
| 8,455.2 | 9,835.0 | 239.5 | 963.8 | channel sounding |
| 8,461.8 | 9,867.1 | 272.3 | 965.9 | channel sounding |
| 8,469.8 | 9,905.6 | 311.7 | 966.1 | channel sounding |
| 8,475.8 | 9,934.6 | 341.2 | 979.7 | right edge of water |
| _ | _ | 346.2 | 984.7 | estimated bank |
| _ | _ | 348.2 | 1,004.7 | cliff face |



Table B13.Cross section Slough 1 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -2,50.3 | 1,001.2 | estimated overbank |
| _ | _ | -2,35.3 | 986.2 | estimated overbank |
| 10,376.434 | 11,291.563 | -35.3 | 986.2 | bank |
| 10,370.0 | 11,296.0 | -27.7 | 985.5 | rebar |
| 10,361.8 | 11,301.0 | -18.2 | 982.9 | toe of bank |
| 10,344.7 | 11,307.1 | .0 | 980.8 | left edge of water |
| 10,337.1 | 11,310.4 | 8.2 | 978.8 | channel sounding |
| 10,331.1 | 11,313.0 | 14.8 | 976.3 | channel sounding |
| 10,325.1 | 11,315.6 | 21.3 | 975.7 | channel sounding |
| 10,319.0 | 11,318.2 | 27.9 | 975.1 | channel sounding |
| 10,313.0 | 11,320.7 | 34.5 | 974.5 | channel sounding |
| 10,307.0 | 11,323.3 | 41.0 | 973.9 | channel sounding |
| 10,301.0 | 11,325.9 | 47.6 | 973.0 | channel sounding |
| 10,294.9 | 11,328.5 | 54.1 | 972.8 | channel sounding |
| 10,288.9 | 11,331.1 | 60.7 | 972.0 | channel sounding |
| 10,282.9 | 11,333.7 | 67.3 | 971.6 | channel sounding |
| 10,276.8 | 11,336.3 | 73.8 | 970.9 | channel sounding |
| 10,270.8 | 11,338.9 | 80.4 | 970.4 | channel sounding |
| 10,264.8 | 11,341.5 | 87.0 | 970.4 | channel sounding |
| 10,258.8 | 11,344.1 | 93.5 | 970.4 | channel sounding |
| 10,252.7 | 11,346.7 | 100.1 | 971.1 | channel sounding |
| 10,246.7 | 11,349.2 | 106.6 | 971.5 | channel sounding |
| 10,240.7 | 11,351.8 | 113.2 | 973.0 | channel sounding |
| 10,234.6 | 11,354.4 | 119.8 | 974.5 | channel sounding |
| 10,228.6 | 11,357.0 | 126.3 | 976.6 | channel sounding |
| 10,216.6 | 11,362.2 | 139.5 | 980.8 | right edge of water |
| 10,212.8 | 11,363.5 | 143.4 | 988.4 | rebar |
| _ | _ | 243.4 | 988.4 | estimated overbank |
| | _ | 258.4 | 1,003.4 | estimated overbank |



Table B14.Cross section Slough 2 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -2,26.0 | 1,001.1 | estimated overbank |
| _ | _ | -2,11.0 | 986.1 | estimated overbank |
| 10,302.530 | 11,121.440 | -11.0 | 986.1 | bank |
| 10,298.1 | 11,121.7 | -6.7 | 984.6 | rebar |
| 10,291.5 | 11,121.9 | .0 | 980.8 | left edge of water |
| 10,288.2 | 11,122.1 | 3.3 | 979.0 | channel sounding |
| 10,262.0 | 11,123.6 | 29.5 | 974.1 | channel sounding |
| 10,245.6 | 11,124.5 | 45.9 | 973.6 | channel sounding |
| 10,229.3 | 11,125.4 | 62.3 | 972.6 | channel sounding |
| 10,212.9 | 11,126.3 | 78.7 | 970.2 | channel sounding |
| 10,196.5 | 11,127.3 | 95.1 | 969.3 | channel sounding |
| 10,180.1 | 11,128.2 | 111.6 | 969.4 | channel sounding |
| 10,163.7 | 11,129.1 | 128.0 | 977.1 | channel sounding |
| 10,159.1 | 11,128.8 | 132.6 | 980.8 | right edge of water |
| 10,153.8 | 11,129.7 | 137.9 | 986.2 | rebar |
| _ | _ | 237.9 | 986.2 | estimated overbank |
| - | - | 252.9 | 1,001.2 | estimated overbank |



Table B15.Cross section Slough 3 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -2,28.3 | 999.7 | estimated overbank |
| _ | _ | -2,13.3 | 984.7 | estimated overbank |
| 10,278.7 | 10,925.2 | -13.3 | 984.7 | rebar |
| 10,265.4 | 10,925.3 | .0 | 981.1 | left edge of water |
| 10,260.3 | 10,924.4 | 5.2 | 979.1 | channel sounding |
| 10,250.5 | 10,923.9 | 15.0 | 978.1 | channel sounding |
| 10,243.9 | 10,923.6 | 21.6 | 977.1 | channel sounding |
| 10,237.4 | 10,923.2 | 28.1 | 975.7 | channel sounding |
| 10,230.8 | 10,922.9 | 34.7 | 975.2 | channel sounding |
| 10,224.2 | 10,922.5 | 41.3 | 973.9 | channel sounding |
| 10,211.1 | 10,921.8 | 54.4 | 972.0 | channel sounding |
| 10,204.6 | 10,921.5 | 60.9 | 971.3 | channel sounding |
| 10,198.0 | 10,921.2 | 67.5 | 970.9 | channel sounding |
| 10,191.5 | 10,920.8 | 74.1 | 970.9 | channel sounding |
| 10,184.9 | 10,920.5 | 80.6 | 970.3 | channel sounding |
| 10,178.4 | 10,920.1 | 87.2 | 969.8 | channel sounding |
| 10,171.8 | 10,919.8 | 93.7 | 969.6 | channel sounding |
| 10,165.3 | 10,919.4 | 100.3 | 969.1 | channel sounding |
| 10,158.7 | 10,919.1 | 106.9 | 969.0 | channel sounding |
| 10,152.2 | 10,918.8 | 113.4 | 969.3 | channel sounding |
| 10,145.6 | 10,918.4 | 120.0 | 975.6 | channel sounding |
| 10,135.8 | 10,917.9 | 129.8 | 979.0 | channel sounding |
| 10,133.9 | 10,917.8 | 131.7 | 981.0 | right edge of water |
| 10,127.8 | 10,917.3 | 137.9 | 985.7 | rebar |
| 10,093.1 | 10,925.1 | 173.4 | 999.9 | bank |



Table B16.Cross section Slough 4 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -324.6 | 1,001.4 | estimated overbank |
| _ | _ | -309.6 | 986.4 | estimated overbank |
| 10,361.7 | 10,730.1 | -109.6 | 986.4 | bank |
| 10,299.3 | 10,721.3 | -46.6 | 985.7 | rebar |
| 10,287.5 | 10,721.8 | -34.8 | 983.9 | toe of bank |
| 10,252.7 | 10,722.1 | .0 | 981.0 | left edge of water |
| 10,246.2 | 10,722.2 | 6.6 | 977.6 | channel sounding |
| 10,233.1 | 10,722.2 | 19.7 | 974.9 | channel sounding |
| 10,223.2 | 10,722.2 | 29.5 | 972.5 | channel sounding |
| 10,216.7 | 10,722.2 | 36.1 | 972.9 | channel sounding |
| 10,206.8 | 10,722.2 | 45.9 | 972.6 | channel sounding |
| 10,200.2 | 10,722.3 | 52.5 | 972.3 | channel sounding |
| 10,187.1 | 10,722.3 | 65.6 | 972.6 | channel sounding |
| 10,180.6 | 10,722.3 | 72.2 | 972.6 | channel sounding |
| 10,167.4 | 10,722.3 | 85.3 | 972.5 | channel sounding |
| 10,164.2 | 10,722.3 | 88.6 | 972.3 | channel sounding |
| 10,151.0 | 10,722.4 | 101.7 | 971.9 | channel sounding |
| 10,141.2 | 10,722.4 | 111.6 | 971.7 | channel sounding |
| 10,134.6 | 10,722.4 | 118.1 | 972.2 | channel sounding |
| 10,128.1 | 10,722.4 | 124.7 | 973.0 | channel sounding |
| 10,118.2 | 10,722.4 | 134.5 | 973.9 | channel sounding |
| 10,114.9 | 10,722.4 | 137.8 | 975.5 | channel sounding |
| 10,108.4 | 10,722.5 | 144.4 | 975.9 | right edge of water |
| 10,101.8 | 10,722.5 | 150.9 | 981.0 | right edge of water |
| 10,047.0 | 10,721.8 | 205.8 | 986.0 | rebar |
| 10,044.6 | 10,726.7 | 211.2 | 987.1 | bank |
| 10,026.5 | 10,758.0 | 247.3 | 988.3 | bank |
| - | _ | 267.3 | 988.3 | estimated overbank |
| _ | _ | 279.3 | 1,000.3 | estimated overbank |



Table B17.Cross section Approach 8000 at the Tanana River atBig Delta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|--------------------|
| _ | _ | -32.8 | 45.8 | bank |
| _ | _ | 0.0 | 40.3 | left edge of water |
| _ | _ | 16.4 | 37.3 | channel sounding |
| - | _ | 32.8 | 32.8 | channel sounding |
| _ | _ | 49.2 | 34.0 | channel sounding |
| _ | _ | 65.6 | 34.2 | channel sounding |
| _ | _ | 82.0 | 37.6 | channel sounding |
| - | _ | 98.4 | 36.8 | channel sounding |
| _ | _ | 114.8 | 35.7 | channel sounding |
| - | _ | 131.2 | 34.6 | channel sounding |
| _ | _ | 147.6 | 31.6 | channel sounding |
| - | _ | 164.0 | 32.5 | channel sounding |
| - | _ | 180.4 | 29.6 | channel sounding |
| _ | _ | 196.8 | 30.0 | channel sounding |
| - | _ | 213.2 | 31.7 | channel sounding |
| - | _ | 229.6 | 31.5 | channel sounding |
| _ | _ | 246.0 | 31.9 | channel sounding |
| _ | _ | 262.4 | 31.8 | channel sounding |
| - | _ | 278.8 | 31.5 | channel sounding |
| _ | _ | 295.2 | 31.4 | channel sounding |
| _ | _ | 311.6 | 31.7 | channel sounding |
| - | _ | 328.0 | 31.7 | channel sounding |
| - | _ | 344.4 | 31.7 | channel sounding |
| _ | _ | 360.8 | 31.5 | channel sounding |
| - | _ | 377.2 | 31.6 | channel sounding |
| - | _ | 393.6 | 31.5 | channel sounding |
| - | _ | 410.0 | 31.4 | channel sounding |
| _ | _ | 426.4 | 31.1 | channel sounding |
| - | _ | 442.8 | 31.2 | channel sounding |
| _ | _ | 459.2 | 31.1 | channel sounding |
| _ | _ | 475.6 | 31.5 | channel sounding |
| - | _ | 492.0 | 32.3 | channel sounding |
| _ | _ | 508.4 | 33.1 | channel sounding |
| - | _ | 524.8 | 33.7 | channel sounding |
| _ | - | 541.2 | 34.1 | channel sounding |
| - | _ | 557.6 | 34.6 | channel sounding |
| - | - | 574.0 | 35.0 | channel sounding |
| _ | - | 590.4 | 35.3 | channel sounding |
| _ | _ | 606.8 | 34.2 | channel sounding |



Table B18.Cross section Slough 8000 at the Tanana River at BigDelta.

| Easting (ft) | Northing (ft) | Station (ft) | Elevation (ft) | Notes |
|-----------------|------------------|-----------------|-------------------|---------------------|
| _ | _ | -85.3 | 44.1 | bank |
| _ | _ | -36.1 | 43.1 | bank |
| _ | _ | -34.5 | 41.6 | bank |
| _ | _ | .0 | 39.4 | left edge of water |
| _ | _ | 29.5 | 34.8 | channel sounding |
| _ | _ | 39.4 | 34.4 | channel sounding |
| _ | _ | 45.9 | 34.1 | channel sounding |
| _ | _ | 52.5 | 34.3 | channel sounding |
| _ | _ | 59.1 | 34.0 | channel sounding |
| _ | _ | 65.6 | 34.2 | channel sounding |
| _ | _ | 72.2 | 34.2 | channel sounding |
| _ | _ | 78.7 | 34.3 | channel sounding |
| _ | _ | 85.3 | 34.3 | channel sounding |
| — | — | 91.9 | 34.0 | channel sounding |
| _ | _ | 98.4 | 33.9 | channel sounding |
| _ | _ | 105.0 | 34.1 | channel sounding |
| _ | _ | 111.6 | 34.0 | channel sounding |
| _ | _ | 118.1 | 34.2 | channel sounding |
| _ | _ | 124.7 | 33.9 | channel sounding |
| — | — | 137.8 | 34.3 | channel sounding |
| — | — | 144.4 | 34.5 | channel sounding |
| — | — | 150.9 | 34.2 | channel sounding |
| — | — | 157.5 | 34.3 | channel sounding |
| _ | — | 170.6 | 39.2 | right edge of water |
| _ | — | 177.2 | 41.5 | bank |
| _ | _ | 180.5 | 46.8 | bank |
| _ | _ | 242.8 | 47.5 | bank |


Manuscript approved for publication, October 26, 2006 Prepared by the USGS Publishing Network, Publishing Service Center, Tacoma, Washington Robert Crist Christine Severtson Sharon Wahlstrom Bobbie Jo Richey Publishing Service Center, Sacramento, California Virginia Wenslaff For more information concerning the research in this report, contact the Alaska Science Center U.S. Geological Survey 4230 University Drive, Suite 201 Anchorage, Alaska 99508-4664 http://alaska.usgs.gov

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